



Ethiopia's Nationally Determined Contribution Update



TECHNICAL REPORT
JULY, 2021



*Empowered lives.
Resilient nations.*

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EXECUTIVE SUMMARY

Introduction

The Government of Ethiopia has undertaken economy-wide analysis and comprehensive stakeholder engagement to update its Nationally Determined Contribution (NDC). Ethiopia originally submitted its Intended Nationally Determined Contribution (INDC) to the United Nations Framework Convention of Climate Change (UNFCCC) on 10th June 2015 which later converted to Ethiopia's 1st NDC after it ratified the Paris Agreement (PA) on 9th March 2017. A preliminary update of the first NDC has already been submitted to UNFCCC at the end of 2020. The final update of Ethiopia's NDC is submitted in July 2021, to allow the international community to consider Ethiopia's new targets well ahead of COP 26 which has been re-scheduled to take place in November 2021 in Glasgow.

This report builds on Ethiopia's first NDC and provides a robust evidence base for prioritising the updated NDC's mitigation and adaptation contributions, establishing intermediate indicators to measure progress towards the new NDC targets, and develop recommendations for strengthening the Monitoring Reporting and Verification (MRV) and Monitoring and Evaluation (M&E) systems.¹ This technical report also provides a suite of sectoral priority interventions that have informed the enhanced NDC that can guide sector ministries, development partners, development financing institutions, the private sector, and other stakeholders in designing and implementing the enhanced NDC's activities.

In determining the mitigation contributions, the following activities were undertaken: (i) updating the Business-as-usual (BAU) scenario, (ii) preparing greenhouse gas (GHG) emission pathways to 2030 (national and sectoral), (iii) setting 2025 and 2030 targets consistent with Ethiopia's strong commitment and readiness to act on climate change, (iv) assessing and prioritizing mitigation interventions and indicator selection through a consultative process, (v) disaggregating conditional and unconditional contributions, and (vi) reviewing the role of carbon markets in the enhanced NDC.

In determining the adaptation contributions, the following activities were undertaken: (i) a review of Ethiopia's adaptation policy, institutional landscape and their respective challenges, (ii) setting

¹ Monitoring, Reporting and Verification (MRV) refers to mitigation, Monitoring and Evaluation refers to adaptation actions as they do not require verification In the same way that emission reductions do.

a 2018 baseline and 2030 targets, (iii) prioritization of 40 adaptation interventions, and (iv) the selection of accompanying indicators.

A review of Ethiopia's current MRV and M&E systems, and engagement in carbon market were also conducted, and recommendations made for improvements.

Mitigation contributions

The preparation of an updated BAU, GHG emission pathways as well as both conditional and unconditional mitigation pathways until 2030 was undertaken using the Green Economy Model (GEM) developed by the World Resources Institute (WRI). The GEM was originally applied to support initiatives led by Ethiopia's Environment Forest and Climate Change Commission (EFCCC) and the Planning and Development Commission (PDC), Ethiopia's Low Emission Development Strategy 2050 (LEDS) and the 10 Year Development Plan (2021-2030), respectively. These efforts have predated the NDC update process and are being used to develop greenhouse gas (GHG) emission projections.

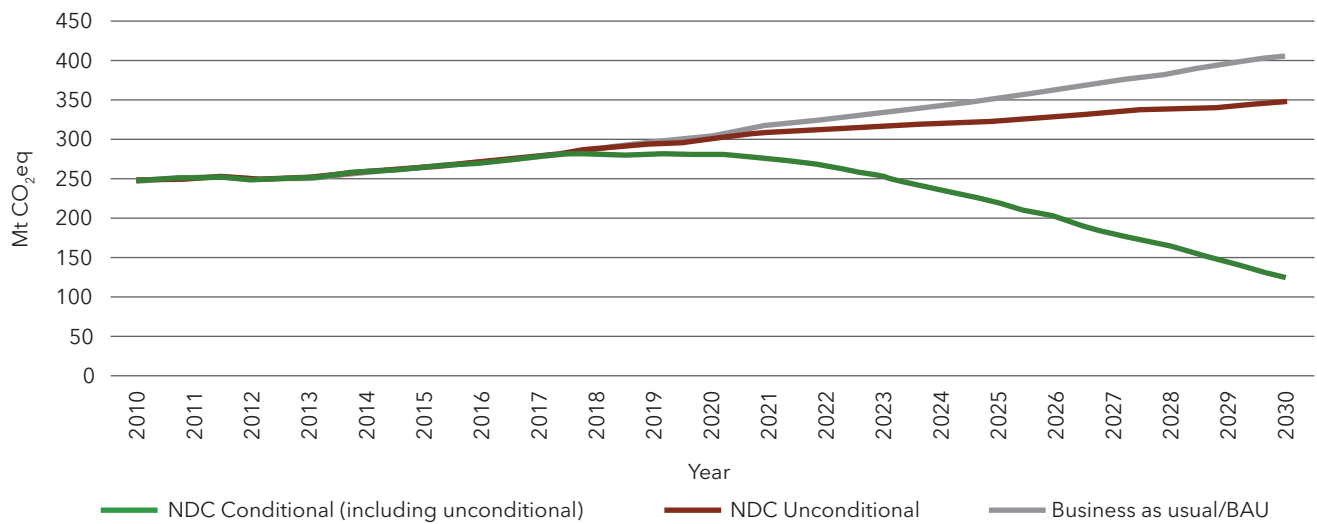
The GEM is an Integrated Assessment Model that goes beyond a linear representation of changes in emissions, to incorporate socio-economic and environmental trends, based on system-dynamics modelling to provide a simulation of the whole Ethiopian economy and its interactions regarding emissions. This means that the GEM considers feedback mechanisms between the Ethiopian economy and the various social and ecological subsystems in which it is embedded. The GEM is a representation of Ethiopia's economy as a complex adaptive system, including demographics, labour supply, fiscal space, domestic and external sectors, as well as biophysical modules, such as carbon stock and land cover. Improvement of the GEM over the original modelling is that it includes emissions from land use change in accordance with the Intergovernmental Panel on Climate Change (IPCC) 2006 inventory guidance.

Updated BAU, unconditional and conditional GHG emission pathways, including 2025 and 2030 targets²

BAU emission projections of the updated NDC differ from the 1st NDC because of differences in the methods of estimation and the updated data used compared to the first NDC. In this regard, the updated emission level in 2010 are estimated at 247 million metric tonnes of carbon dioxide equivalents (Mt CO₂eq) which are projected to increase to a level of 403.5 Mt CO₂eq in the BAU scenario in 2030. The projections are further divided into three pathways notably unconditional, conditional and BAU. The unconditional pathway will result in absolute emission levels of 347.3 Mt CO₂eq in 2030, which represents a reduction against the revised BAU of 14% (-56 Mt CO₂eq) in 2030. The impact of further policy interventions proposed under the conditional pathway decreases absolute emission levels to 125.8 Mt CO₂eq such that the combined impact of unconditional and conditional contributions represents a reduction of 68.8% (-277.7 Mt CO₂eq) in comparison with the revised BAU emissions in 2030 (Figure E-1). This ambitious pathway is conditional on international support and includes Ethiopia's unconditional efforts.

² Figures may not add up due to rounding.

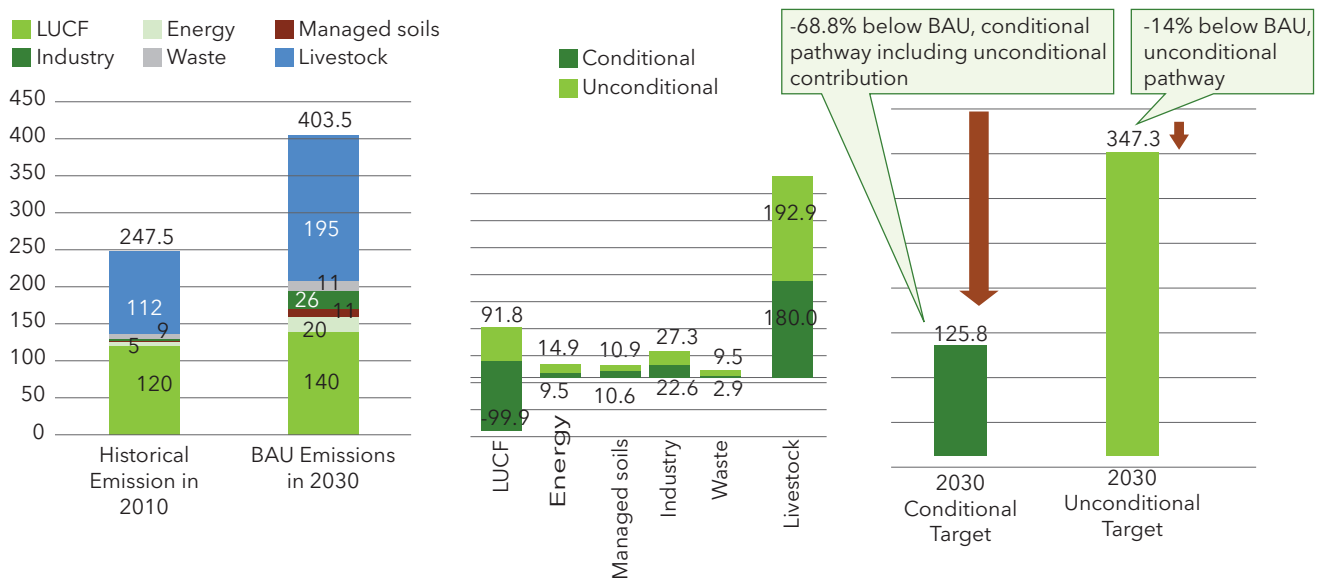
FIGURE E-1: ETHIOPIA'S BUSINESS-AS-USUAL, UNCONDITIONAL AND CONDITIONAL EMISSION PATHWAYS



Note: The line "NDC Conditional" represents the combined impact of unconditional and conditional elements.

Figure E-2 below provides an overview of how each of the different sectors will contribute to this overall reduction.

FIGURE E-2: ETHIOPIA'S BUSINESS-AS-USUAL, UNCONDITIONAL AND CONDITIONAL EMISSION PATHWAYS WITH CONTRIBUTIONS BY SECTOR



It is crystal clear that the Ethiopian economy will undergo structural change in the coming years. The 10YDP signifies that the base of the economy will be anchored on the manufacturing sector. In addition to this, there will be high pace of urbanization. These emerging realities will have their own cumulative repercussion on the pattern of emission. Thus, emissions from industry and energy are expected to increase by a larger percentage compared to other sectors (Table 1). Nevertheless, the agricultural sector, particularly livestock will remain as the main contributor to the GHG emission in the coming years followed by the Land Use and Forestry sector. Both sectors together represent 83% (LUCF 35% and livestock 48%) of total BAU emissions in 2030. Important to note is that LUCF accounts for emissions from biomass use e.g., for cooking and baking, which is the single largest driver of LUCF-related emissions. The following table describes the contributions of each sector to aggregate unconditional and conditional emission reduction targets, ordered by mitigation potential in each of the respective sector categories.

TABLE E-1: GHG EMISSION PROJECTIONS IN BAU, UNCONDITIONAL AND CONDITIONAL PATHWAYS

Sector	BAU emission projection (Mt CO ₂ eq)			Unconditional emission projection (Mt CO ₂ eq)		Conditional emission projection (incl. unconditional) (Mt CO ₂ eq)	
	2020	2025	2030	2025	2030	2025	2030
Industry	5.9	12.7	26.1	12.9	27.3	10.2	22.6
Energy	10.7	14.4	20.0	12.7	14.9	10.4	9.5
LUCF	125.0	133.8	140.2	112.6	91.8	21.4	-99.9
Livestock	146.4	169.5	194.8	168.7	192.9	162.8	180.0
Managed Soils	5.8	8.1	11.0	8.0	10.9	8.0	10.6
Waste	9.1	10.3	11.5	9.4	9.5	6.0	2.9
TOTAL (Mt CO₂eq)	302.9	348.8	403.5	324.3	347.3	218.8	125.8

Whereas the mitigation potentials are represented at sector level considering all sector-relevant policies and variables as underlying interlinked drivers of emissions, activity level emission reductions are monitored and verified through sectoral MRV systems upon implementation of each activity in the context of the 10YDP. The updated NDC represents a clear progression in ambition for the following reasons:

1

Higher robustness of GHG emissions pathways and targets through improvements in methodology, thereby more accurately and completely capturing historical emissions and emissions pathways through greater alignment with national GHG inventories, revised emission factors and improved consistency with the IPCC's 2006 guidelines.

2

Ethiopia proposes an emission reduction target of 68.8% which is more ambitious compared to its first NDC (64%).

3

Inclusion of a detailed adaptation baseline and 2030 targets and additional adaptation interventions per sector. The first NDC did not have a quantified baseline and targets.

4

Clear demarcation between unconditional and conditional mitigation and adaptation interventions, with a meaningful domestic contribution, unlike the first NDC.

5

Commitment to explore further ambition increases during the NDC commitment period. This includes potentially enhancing Ethiopia's NDC ambition by reducing emissions currently outside the scope of this NDC update, for instance for GHGs not covered by the current NDC (e.g., Hydrofluorocarbons (HFCs) in the context of the Kigali Amendment to the Montreal Protocol) where GoE initiatives on sustainable cooling are already underway and further mitigation potential exists.

6

Better adaptability and flexibility of the methodology to potential future changes of policies or external shocks.

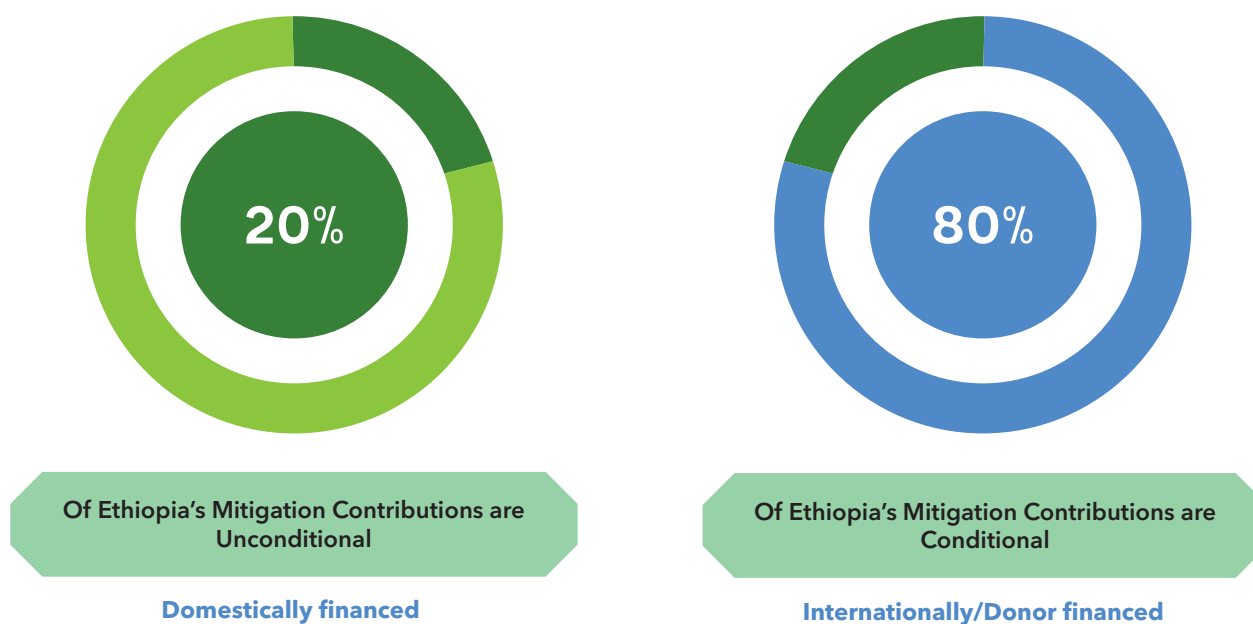
7

An enhanced ability to track progress on mitigation and adaptation actions with improved MRV/M&E.

Conditionality of action

The level of ambition that can be achieved unconditionally, and the level of international support required to achieve conditional targets, indicates noteworthy progress for the updated NDC. The proposed NDC's policy interventions are sector-wide actions, comprising many different activities requiring both domestic and international investment. Based on the experience of other countries and the economic realities of Ethiopia, it is proposed that 20% of the total reduction will be domestically financed while the remaining 80% shall be financed by international support. Although exceptions have been applied where mitigation interventions rely fully on international support, this guide is regarded as appropriate when considering Ethiopia's marginal historical responsibility and least developed country (LDC) status, domestic resource availability and sustainable development priorities. This split assumes that Ethiopia will implement the least-cost mitigation actions first to achieve its unconditional targets.

FIGURE E-3: CONDITIONAL AND UNCONDITIONAL CONTRIBUTION



Adaptation contributions

In line with global best practice and widely adopted guidance on NDC enhancement (WRI and UNDP, 2019), twelve discrete steps were undertaken for the preparation of the adaptation actions:

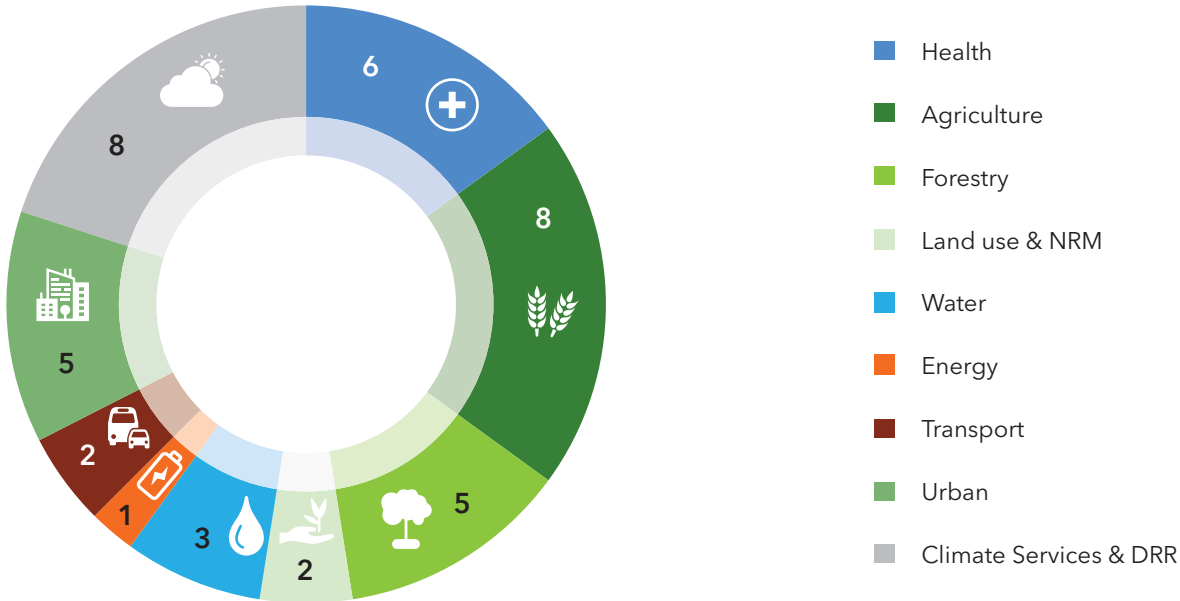
- ▶ Updating or adding information on adaptation indicators, targets, impacts, and vulnerabilities.
- ▶ Updating or adding information on national, sub-national (woredas), and sectoral long-term planning and goals.
- ▶ Updating or adding current and near-term planning and action.
- ▶ Updating or adding monitoring, evaluation, and learning systems and plans.
- ▶ Updating or adding information on gaps and barriers (policy, institutional arrangements, resource mobilization, training, and capacity building).
- ▶ Updating or adding information on progress and achieved results.
- ▶ Adding actions or measures to strengthen implementation (policy, institutional arrangements, resource mobilization, training and capacity building, technology).
- ▶ Ensuring alignment with the UNFCCC Adaptation Communication.
- ▶ Providing accurate information to enhance clarity, transparency and understanding.
- ▶ Establishing linkages with mitigation through mitigation co-benefits.
- ▶ Establishing linkages with other frameworks e.g., Sustainable Development Goals (SDGs), Sendai Framework for Disaster Risk Reduction etc.
- ▶ Increasing stakeholder ownership through wide stakeholder consultations.

This was followed by prioritization of adaptation interventions and setting 2018 baselines and 2030 targets. The results of these combined processes and approaches are presented in the report.

Ethiopia’s major climate change adaptation commitments are in the sectors of agriculture, and land use and forestry, with additional adaptation contributions in water, health, energy, transport and urban settlements. Agriculture, Forestry and Other Land Use (AFOLU) adaptation actions represent the bulk of the updated NDC’s commitments to strengthening Ethiopia’s resilience to climate change. Ethiopia has already undertaken important adaptation efforts in these sectors, and will further expand and prioritize measures such as climate-smart agriculture, livestock diversification, improved (drought-resistant) animal breeding, rangeland management, improved (drought-resistant) crop varieties, crop and livestock insurance, watershed management and rehabilitation, ecosystem-based adaptation, sustainable forest management, community-based forest management and conservation, and afforestation and reforestation programs. Across all of these activities, a gender-responsive approach will be taken and vulnerable groups and communities will be considered, to ensure equity in benefits that arise thereof the efforts. Together with these initiatives, efforts will be made to diversify adaptive livelihood alternatives that enhance households’ resilience to climate shocks in a manner that the livelihood options are friendly co-exist with the natural ecosystem.

The updated NDC has identified 40 adaptation interventions with a clear demarcation between unconditional and conditional, covering sectors such as Agriculture, Forestry, Water, Transport, Urban, Health, Land Use and Natural Resource Management, and Climate services and disaster risk reduction sectors (Figure E-4). This includes mitigation interventions that have adaptation co-benefits and vice versa. Besides, a quantified baseline (2018) and 2030 target for each adaptation intervention has been identified for guidance on implementation and monitoring of the updated NDC. To enhance inclusiveness of the adaptation interventions, gender considerations and other cross-cutting issues have been sufficiently entertained in this NDC.

FIGURE E-4: ADAPTATION INTERVENTIONS



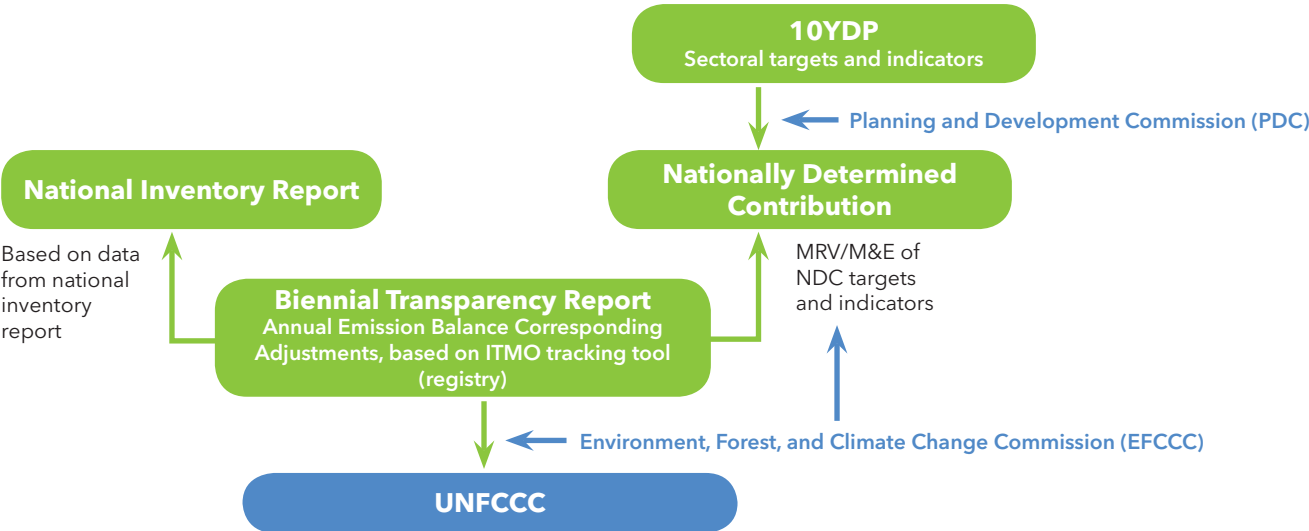
Adaptation interventions in the AFOLU sector will be complemented with strategic adaptation actions in other economic sectors such as water (improving access to potable water), energy (energy diversity through alternatives and renewables), transport (climate resilient design of sustainable transportation systems, integrating climate change into transportation planning and development), urban settlements (urban greenery, adaptive urban planning), health (integrated environment and health surveillance protocols, improvement in basic health services and emergency medical services), and disaster risk reduction (improvement in early warning systems, improvement in disaster risk planning and preparedness).

Mitigation MRV and adaptation M&E

The MRV and M&E framework for Ethiopia’s updated NDC will work towards full alignment with Articles 4 (Mitigation), 6 (Cooperative Approaches), Article 7 (Adaptation) and 13 (Enhanced Transparency Framework) under the PA. Article 13 specifies elements of reporting via biennial transparency reports (BTRs), with further flexibility for LDCs (‘trifurcation’). Ethiopia will therefore also comply with anticipated multilateral reporting and accounting provisions for participation in market mechanisms, as well as information on sustainable development promotion, environmental integrity, and transparency.

To this end, the NDC MRV and M&E framework will eventually be fully integrated with 10YDP targets and indicators for each sector as shown in Figure E-5 below. Therefore, the international support is critical in building capacity for stakeholders who will undertake the tracking, collection, and reporting of data, as MRV and M&E systems are prerequisite for successful implementation of this NDC including reporting to the global community (including UNFCCC and other key partners).

FIGURE E-5: NDC-SPECIFIC MRV AND M&E FRAMEWORK



Engaging in carbon markets to achieve NDC goals and increase ambition

Ethiopia has expressed a strong desire to participate in carbon market opportunities offered through the PA. Ethiopia's first NDC included an indication of interest to participate in PA-backed carbon markets based on environmental integrity, robust accounting and the promotion of sustainable development. Ethiopia has gained experience in participating in relevant carbon market initiatives (such as the Kyoto Protocol's (KP's) Clean Development Mechanism (CDM), voluntary carbon standards, as well as emerging multilateral and bilateral approaches and is looking to develop its own domestic carbon market. However, the country has not been effective in hosting carbon market mechanisms relative to the mitigation potential and ambition set by CRGE and the NDC.

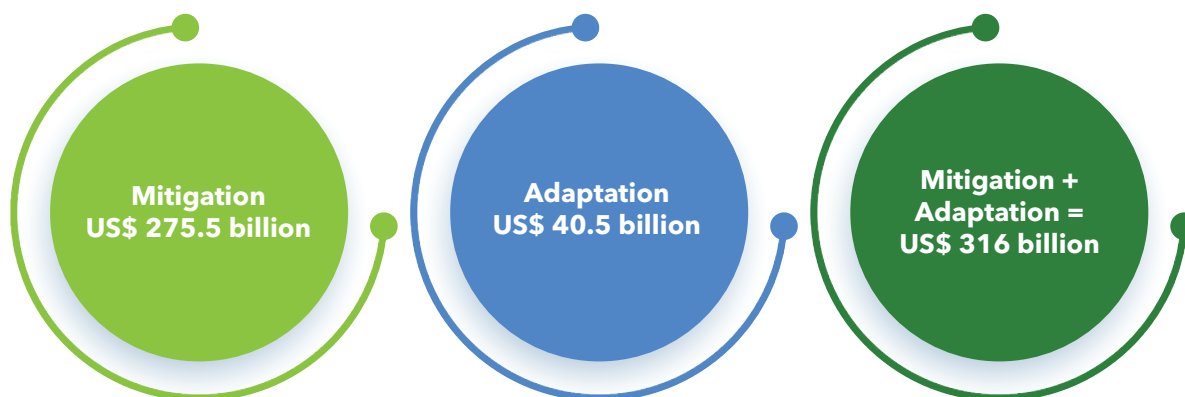
Ethiopia intends to address this prevailing gap by engaging in emerging international carbon markets governed by Article 6 of the PA. Ethiopia sees carbon markets as instruments to increase mitigation ambition and places high importance on environmental integrity through robust accounting as well as the promotion of sustainable development. To this end, the following activities will be undertaken as part of developing Ethiopia's carbon market opportunities:

- ▶ Identifying additional mitigation potential that is eligible to receive domestic and international support through carbon markets for updated NDC priority sectors and interventions.
- ▶ Cooperating with interested Parties and proactively working towards bilateral agreements as well as engaging in new multilateral mechanisms.
- ▶ Development of institutional capacity, procedures and required support tools to comply with all PA rulebook participation, accounting and reporting requirements. This includes developing a registry database based on registry requirements in bilateral Article 6 cooperation as well as development of procedures to effectively approve activities, authorize ITMO transfers, implement carbon accounting and perform Article 6 reporting responsibilities
- ▶ Further carbon market instruments beyond the PA, including the International Civil Aviation Organization's (ICAO's) CORSIA, will be explored for their potential to support implementation of the NDC.
- ▶ Participation in experience-sharing and exchanges among peers to draw lessons and insights from each other while building readiness for mobilizing carbon and climate finance.

Conditional and unconditional financing need

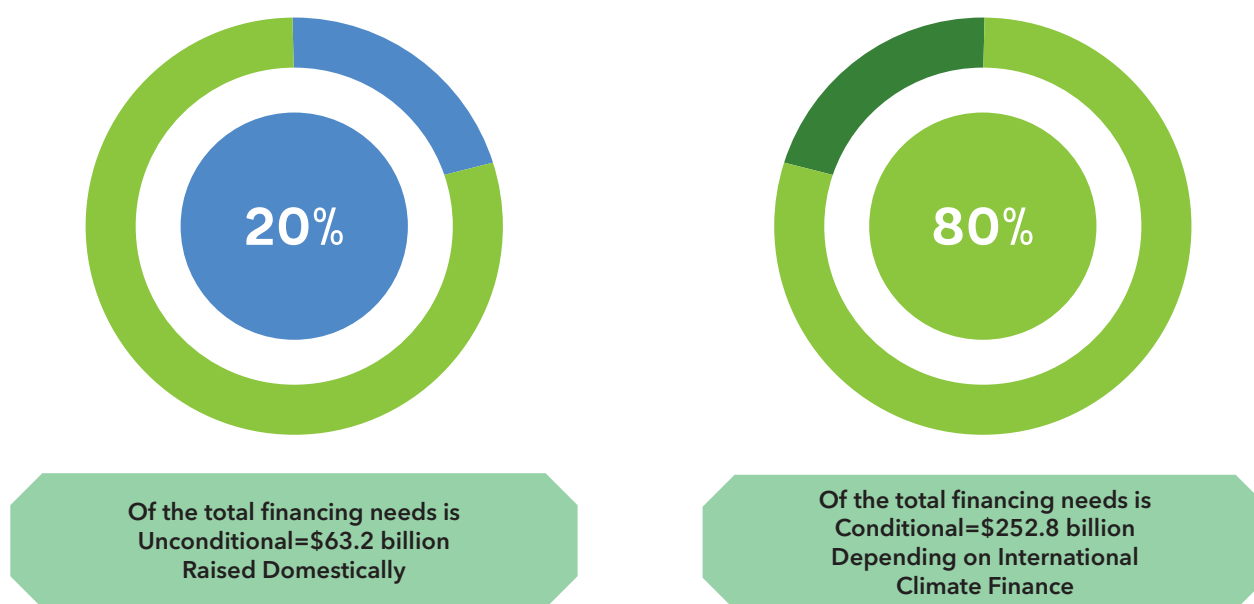
The financial resources required to implement the updated NDC in the next 10 years is estimated as US\$ 316 billion. The mitigation interventions identified in the updated NDC require US\$ 275.5 billion and adaptation actions require US\$ 40.5 billion (Figure E-6). The financial estimates are derived from climate resilience plans of sectors and Ethiopia's Ten Years Development Plan, which aims to build a climate resilient green economy by 2030.

FIGURE E-6: FINANCING NEEDS TO IMPLEMENT THIS NDC



Alike the GHG emission reduction targeting, 20% of the total estimated finance is unconditional while 80% is conditional. Ethiopia is committed to invest US\$ 63.2 billion on climate change mitigation and adaptation actions from domestic sources, which is equivalent to an average annual investment of US\$ 6.32 billion by 2030. The conditional finance, which is equivalent to US\$ 252.8 billion, should be received from international climate finance sources (Figure E-7).

FIGURE E-7: BREAKDOWN OF CONDITIONAL AND UNCONDITIONAL FINANCING



Recommendations

Recommendations for implementation and improvement of this NDC have been prepared. The following recommendations provide a suite of immediate and long-term enabling measures that will result in strengthened action across all sectors and planning levels, with economy-wide benefits.

TABLE E-2: RECOMMENDATIONS FOR IMPLEMENTATION AND IMPROVEMENT OF THE ENHANCED NDC

Category	Recommendations on Enabling Measures
Political commitment	In addition to the NDC, the newly launched 10YDP and Ethiopia’s 2050 Low Emission Development Strategy (currently under development) as well as Ethiopia’s Green Legacy Initiative (GLI) are clear indicators of Ethiopia’s commitment to both adaptation and mitigation measures. Support should be replicated across sectoral strategies and at regional and Woreda levels, contributing to the implementation of this enhanced NDC.
Policy processes	<p>Streamline NDC implementation with current and future national and sectoral strategies and policies to derive maximum benefits and for effective utilisation of limited resources.</p> <p>Build on early successes such as CRGE and 1st NDC implementation.</p> <p>Enhance the current and comprehensive national vulnerability and risk assessment to develop a baseline for measuring adaptation progress and impact of interventions.</p>
Institutional framework	Improve Ethiopia’s climate change institutional architecture to unlock maximum beneficiation of current investments in climate change, including for climate change adaptation.
Monitoring and evaluation	<p>Due attention should be given to continually develop a robust MRV and M&E framework for adaptation and mitigation, at national and sub-national levels.</p> <p>Strengthen adaptation finance tracking.</p> <p>Indicators should be updated periodically as needed and communicated widely to stakeholders.</p> <p>Increasing accessibility to climate adaptation data at national, regional and Woreda levels.</p> <p>Strengthening an information portal or database for adaptation information and data to support policy development and implementation efforts.</p> <p>Continuing to develop and strengthen the transparency framework, with a focus on tracking progress on adaptation measures.</p>
Resource mobilisation	<p>Detailed budgets with a clear demarcation between climate and development needs should be prepared for climate finance projects.</p> <p>Capacity building training should be provided to project developers and government project sponsors on the difference between climate and economic development actions.</p> <p>On the resource requirement figures, it should be continually refined as more detailed data and information becomes available.</p> <p>Adopt a blended financing approach to resource mobilisation to tap into all appropriate financing sourcing such as climate finance, private sector, development partners, internal resources etc.</p>
Carbon markets	Build on existing experiences and use bilateral cooperation to establish the institutional framework and capacity to participate in Article 6 mechanisms.
Integrate NDC into regional plans	Operationalize the NDC by integrating national goals into regional plans and harmonizing the national target with regional interventions.

Category	Recommendations on Enabling Measures
Stakeholder engagement	Improve coordination of all actors (development partners, development finance institutions, private sector, academia etc.) to identify synergies and avoid duplication of efforts.
	Continue to strengthen efforts to engage stakeholders and public awareness in climate adaptation policy development.
	Establish structured stakeholder engagement platforms for information exchange of information and lessons learnt.
Capacity building	Improve the capacity (human resource, technology, financing, training) for institutions directly involved in NDC implementation.
	Promote embedding of capacity in institutions.

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LIST OF ABBREVIATIONS

10YDP	Ten Years Development Plan
AFOLU	Agriculture, Forestry, and other Land Use
BAU	Business-as-Usual
BTR	Biennial Transparency Report
CAPEX	Capital Expenditure
CARP	Centralized Accounting and Reporting Platform
CBA	Cost Benefit Analysis
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
CMA	Conference of the Parties Serving as the Meeting of the Parties to the Paris Agreement
CO ₂ eq	Carbon dioxide equivalent
COP	Conference of Parties
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation
COVID-19	Novel Corona Virus 2019
CRGE	Climate Resilience and Green Economy Strategy
DNA	Designated National Authority
ECRC	Environment and Climate Research Centre
EFCCC	Environment, Forest, and Climate Change Commission
EPACC	Ethiopia Program of Adaptation on Climate Change
ETF	Enhanced Transparency Framework
FNRB	Fraction of Non-Renewable Biomass
GCF	Green Climate Fund
GEM	Green Economy Model
GHG	Greenhouse Gases
GoE	Government of Ethiopia
GTPII	Second Growth and Transformation Plan
GWPs	Global Warming Potentials
HFCs	Hydrofluorocarbons
H-NAP	National Health Adaptation Plan to Climate Change
ICAO	International Civil Aviation Organisation
ICS	Improved Cook Stove

INDC	Intended Nationally Determined Contributions
IPCC	Intergovernmental Panel on Climate Change
ITMO	Internationally Transferred Mitigation Outcomes
JCM	Joint Crediting Mechanism
KP	Kyoto Protocol
LDC	Least Developed Country
LMP	Livestock Master's Plan
LT-LEDS	Long-Term Low Emission Development Strategy
LULUCF	Land Use, Land Use Change and Forestry
M&E	Monitoring and Evaluation
MAC	Marginal Abatement Cost curve
MEFCC	Ministry of Environment, Forest and Climate Change
MoF	Ministry of Finance
MRV	Measuring, Reporting, and Verification
MSW	Municipal Solid Waste
Mt CO ₂ eq	Million metric tonnes of carbon dioxide equivalent
Mt	Megatons
NAMA	Nationally Appropriate Mitigation Actions
NAP	National Adaptation Plan
NAP-ETH	Ethiopia's National Adaptation Plan 2019
NDC	Nationally Determined Contributions
NEP	National Electrification Plan
NMA	National Meteorological Agency
NMT	Non-Motorised Transport
NPV	Net Present Value
OPEX	Operating Expenditure
PA	Paris Agreement
PoA	Programme of Activity
PDC	Planning and Development Commission
PSI	Policy Studies Institute
PV	Photo Voltaic
REDD+	Reducing emissions from deforestation and forest degradation
SCF	Standardized Crediting Framework
SDGs	Sustainable Development Goals
SIDS	Small Island Developing States
SLMP	Sustainable Land Management Program
SNNP	Southern Nations Nationalities and People
UNDP	United Nations Development Programme
UNECA	United Nations Economic Commission for Africa
UNFCCC	United Nations Framework Convention on Climate Change
VCM	Voluntary Carbon Markets
VER	Verified Emission Reduction
WRI	World Resource Institute

INTRODUCTION

This section provides background information on national circumstances; geography, climate, socioeconomic, climate change impacts and vulnerability, climate change policy and institutional framework in Ethiopia; Ethiopia's 1st NDC and the processes and requirements for Nationally Determined Contributions (NDCs), including updating of NDCs. An overview of the purpose and structure of the report is also presented as guidance on using this report.

1.1 Purpose and structure of report

The objective of this report is to provide a robust and transparent evidence base informed by technical and economic analysis to support the Government of Ethiopia to update its first NDC ahead of the twenty-sixth Conference of the Parties to the UNFCCC (COP) which has been rescheduled to November 2021. The report also provides a suite of sectoral priority interventions that have informed components of the enhanced NDC that can guide sector ministries, development partners, development financing institutions, private sector and a wider range of stakeholders in designing and implementing programmes and projects as part of implementation support of the enhanced NDC. Specifically, the report presents the approach used to determine mitigation and adaptation contributions, outlines costing estimates and identifies resources required for implementation of the enhanced NDC, as well as measures to track implementation.

This report has been structured as follows:

- ▶ **National circumstances:** Provides an overview of Ethiopia's climate, geography, socioeconomics, climate vulnerability and climate change impacts. A high-level summary of the initial version of Ethiopia's 1st NDC is presented with analysis of status of implementation to date. Lastly, an overview of Ethiopia's climate change policy and institutional landscape is presented.
- ▶ **Ethiopia's NDC enhancement process:** Presents the preparatory activities undertaken by the Government of Ethiopia to update its NDC including process, and approach.
- ▶ **Determining mitigation contributions:** Provides the methodology and results for updating the BAU scenario, GHG emission pathways to 2030 (national and sectoral), setting 2025 and 2030 targets, prioritization of mitigation interventions and indicator selection, and disaggregation of conditional and unconditional contributions.

- ▶ **Determining adaptation contributions:** Provides the methodology and results for setting a baseline and 2030 targets, prioritization of adaptation interventions and indicator selection. An overview of adaptation policy and institutional landscape with respective successes and challenges is also presented.
- ▶ **Resources required for NDC implementation:** provides an initial list of mitigation and adaptation interventions and preliminary estimates of funding requirements based on government reports for implementing the enhanced NDC. The role of carbon markets as a potential avenue for resource mobilisation for the enhanced NDC is presented.
- ▶ **MRV and M&E:** Provides recommendations for strengthening Ethiopia's MRV and M&E systems for mitigation, adaptation, and finance based on existing systems.
- ▶ **Conclusions and recommendations:** provide a summary of key findings of this technical assistance assignment that will be captured in Ethiopia's enhanced NDC. Recommendations on implementation arrangements, capacity building and technology transfer, and financial support are also provided for Government of Ethiopia's consideration.
- ▶ **Appendices:** Provides data sources, assumptions, and limitations to the assignment as well as guiding notes for better interpretation of results.

1.2 Background

Parties to the UNFCCC adopted the Paris Agreement at COP 21 in 2015. Subsequently, the Paris Agreement entered into force on 4th November 2016 ahead of the twenty-second Conference to the Parties that called for Intended Nationally Determined Contributions (INDCs) to be transitioned to Nationally Determined Contributions (NDCs)³. Ethiopia submitted its INDC to the UNFCCC on 10 June 2015 which was later converted to Ethiopia's 1st NDC after Ethiopia ratified the Paris Agreement on 9th March 2017⁴. Under the agreement, 188 Parties, including Ethiopia, committed to transform their development trajectories and limit dangerous anthropogenic climate change to 1.5°C - 2°C. Parties also agreed to adapt to the adverse impacts of climate change, foster climate resilience, and low greenhouse gas (GHG) emissions development in a manner that does not threaten food production.

Under the Paris Agreement, parties must prepare, communicate, and maintain successive Nationally Determined Contributions (NDCs) that they intend to achieve through domestic mitigation and adaptation measures (Article 4.2). Each Party's successive NDC is expected to represent a progression beyond the Party's current NDC, and reflect its highest ambition, reflecting its common but differentiated responsibilities and respective capabilities, in the light of different national circumstances (Article 4.3). Further, all Parties are required to provide information necessary for clarity, transparency and understanding (Article 4.8) and should communicate an NDC every five years (Article 4.9) for recording in a public registry maintained by the UNFCCC secretariat (Article 4.12).

³ AFDB, CIF, Transitioning INDCs to NDCs in Africa (2015).

⁴ Wuppertal Institute for Climate, Environment and Energy, Wuppertal, Implementation of Nationally Determined Contributions, Ethiopia Country Report (2018).

In accounting for their anthropogenic emissions and removals corresponding to their NDCs, Parties should promote environmental integrity, transparency, accuracy, completeness, comparability, and consistency, and ensure the avoidance of double counting (Article 4.13). It is important to emphasize that these key elements of the Paris Agreement rulebook accounts for the high degree of climate vulnerability and marginal historical emissions of least developed countries (LDC), including Ethiopia. This allows for more flexibility and longer timeframes for ambition increases compared to industrialized countries and emerging economies.

Existing NDCs under the Paris Agreement are applicable for 5 to 10 years until either 2025 or 2030, with the intent for all countries to prepare NDCs covering the timeframe until 2030. Second generation NDCs are to be submitted by 2020, and thereafter updated every five years (with the submissions either maintaining the existing NDC without modification or revising the NDC and submitting an enhanced NDC as needed).

To facilitate clarity, transparency, and understanding of the NDCs, the UNFCCC requires that Parties *shall* submit their NDCs 9-12 months prior to the relevant CMA session (Conference of the Parties serving as the meeting of the Parties to the Paris Agreement). The 2020 CMA (COP 26) which was scheduled to take place in November 2020 (in Glasgow) has since been rescheduled to November 2021 due to the COVID-19 pandemic (UNFCCC, 2020). Despite this setback, it is anticipated that this rescheduling will ensure all parties can focus on the issues to be discussed at this vital conference and allow more time for the necessary preparations to take place. This extension in time for preparation presents an opportunity for Ethiopia to undertake the necessary processes and analytical studies to update its NDC. Once the NDC submissions are received, the UNFCCC Secretariat will prepare a synthesis report of all countries' NDCs, for circulation to Parties prior to the CMA (COP 26).

The UNFCCC intends for NDCs to stay current, relevant, and consistent with changing national circumstances and emissions profiles. To this end, the NDC cycle has two built-in stage-gates for revisions and updates between 2020 and 2030 - one in 2024-2025 (9-12 months prior to the CMA in 2025, or COP 31), and another in 2029-2030 (9-12 months prior to the CMA in 2030, or COP 36).

1.3 Geography, climate, and socioeconomics

Ethiopia is a land-locked country located in the Horn of Africa and shares borders with Eritrea to the north, Djibouti and Somalia to the east, Sudan and South Sudan to the west, and Kenya to the south. Ethiopia's topography is characterized by large regional differences, which are reflected in its climate. The lowlands in the southeast, covering approximately 55% of the country's land area and northeast are tropical with average temperatures of 25-30°C, while the central highlands (over 1500 meters in elevation, covering about 45% of the country's surface) are much cooler with average temperatures around 15-20°C. The highland plateau is divided by the East African Rift Valley. Mean annual rainfall ranges from less than 300 mm in the south-eastern and north-western lowlands to over 2,000 mm in the south-western highlands⁵. Because of this latitudinal and altitudinal contrasts, the climate system is equally extraordinarily complex.

5 Ministry of Foreign Affairs of the Netherlands, Climate Change Profile Ethiopia (2018).

Ethiopia is also one of the least developed countries in the world and is the second-most populous country in Africa with a population of more than 100 million (CSA, 2013). The country has endorsed a climate resilient green economic path since 2011 and has registered dramatic economic growth, with a growth rate averaging 9.2% a year from 2010/11 to 2019/20. This growth rate is high when compared to a regional average of 5.4% (PDC, 2021). The high growth rates have been also accompanied by structural transformation. This is evidenced by the fact the share of the agricultural sector to GDP decreased to 32.7% in 2019/20 from 45.7 in 2010/11 while the construction, and services sector made up most of the growth. The share of the constructions and the service sectors from the total GDP reached as high as 21.1 and 39.5, respectively, in 2019/20. All the while, the rate of poverty has declined from 29.6% in 2010/11 to 23.5% in 2019/20 (PDC, 2021).

Ethiopia has heavily invested in road and railway infrastructure, industrial parks universities, and the energy sector over the last decades. The 10YDP aims to build on the enhanced physical infrastructure to promote the industrial sector and achieve successful economic transformation. It envisions increasing the share of the manufacturing from the total GDP from the current level of 6.9% to 17.2% by 2030 (PDC, 2021). The plan also aims to achieve an average economic growth of 10% in the coming ten years. Agriculture, manufacturing, tourism, urban development and the mining sectors are going to be the priority sectors. The plan has also mainstreamed Sustainable Development Goals (SDGs) and climate resilient green economy in different sectors. This ensures that the legacy of green economic development path will extend into the future.

The Ethiopian economy is vulnerable to climate change. This is because the agriculture sector, which employed 78% of the country's labour force in 2013, heavily relies on rainfall. Apart from this, nearly 80% of the population of Ethiopia lives in the rural area where most of them are smallholders who practice low input and low output farming in a very fragmented land (CSA, 2015). The vulnerability of the sector to climate change has urged the Ethiopian government to design strategies to mitigate the possible impacts of climate change. Hence, mitigation and adaptation activities have been already included in the sectoral plans and various initiatives. For example, the Agriculture Growth Program (AGP), the Livestock Master Plan (LMP), Livestock & Fisheries Sector Plan (LFSP) and the Sustainable Land Management Programme (SLMP) are critical programs in the agriculture sector and are also included in the NAP. The AGP enables improving agricultural productivity and commercialization of targeted smallholder farmers. The SLMP has been a way for mainstreaming green economy needs into sectoral programmes at all levels and it has been configured to the safety net programmes. NAP is a critical part of the CRGE that focuses on adaptation programs taken by each sector to build climate resilient economy. The ten years' development plan inculcated the CRGE and the NAP to build climate resilient green economy in the coming years.

COVID-19 pandemic has exacerbated the vulnerability of Ethiopia and resulted in enormous disruption to lives and livelihoods. Alarmingly, Ethiopia is currently facing a double threat from climate change and the COVID-19 pandemic. According to official figures, Ethiopia's economy grew at 6.1 percent in the fiscal year 2020, compared to 9 percent in 2019. Remittance declined by 10 percent in 2020, and Foreign Direct Investment inflows were 20 percent lower, affecting already thin financially reserve levels and increasing external financing needs. An economic rebound is expected in 2021 to achieve a modest rate of 6% growth. However, other crises, although of smaller magnitude but serious nevertheless, have contributed to Ethiopia's vulnerability. These include

a desert locust invasion that affected at least one million people; erratic rainfall that disrupted the country's dominant rain-fed agricultural sector as well as cholera, measles, and yellow fever outbreaks. Combined, these factors have a significant systemic shock that has profound implications for Ethiopia, both for short- and medium- to long-term which now require to be considered in all developmental planning processes, including updating of Ethiopia's NDC. Nevertheless, the disruptions caused by the Covid -19 Pandemic also offer an opportunity to build forward greener'. This NDC, mainstreamed in to the ten years development plan, sets out Ethiopia's priorities in building its low carbon climate resilient future.

1.4 Climate change impacts and vulnerability

Despite an almost negligible contribution to global greenhouse gas (GHG) emissions, currently estimated at 0.04% of global emissions⁶, Ethiopia is highly vulnerable to the impacts of climate change. This is due to Ethiopia's high dependence on rain-fed agriculture and natural resources, and relatively low adaptive capacity to deal with climate impacts. There is compelling evidence of climate change in Ethiopia over the last 50 years. At the national level, temperatures have increased by an average of around 1°C since the 1960s. This increase has also been felt across all regions. Rainfall nationally is subject to high variability between years, seasons, and regions. Yearly variation around mean rainfall levels is 25% and can increase to 50% in some regions. Despite this complexity, there is evidence of a 20% decrease in rainfall in the south-central region of the country. Extreme weather events are common, especially droughts and floods with indication that the incidence of droughts and floods may have increased in the last 10 years relative to the decade before⁷.

There is a plethora of impacts of climate change already being experienced in Ethiopia's water, agriculture, infrastructure, forestry, and public health sectors. Water scarcity and drought conditions are expected to increase risks of food insecurity and may exacerbate conflict situations over scarce resources and population movements. Heavy rains, flooding, and soil erosion puts both urban and rural infrastructure at risk, particularly for poor and vulnerable groups. Increased occurrences of drought conditions and reduced rainfall across much of the country will further impact agriculture, livestock, food security, and human health. Environmental degradation impacted water resources, and loss of biodiversity and ecosystem services constitute serious obstacles to the country's continued development and poverty reduction efforts, increasing vulnerability to risks and hazards, increasing the importance for sustainable adaptation and resilience measures⁸.

Data from the Emergency Event Database: EM-Dat database⁹ presented in Table 1, shows the varying magnitude of natural hazards, including floods, landslides, epidemic diseases, and storms Ethiopia has faced for the 1900 - 2020 period.

6 European Commission, EDGAR, Fossil CO₂ and GHG emissions of all world countries (2019). Available at <https://edgar.jrc.ec.europa.eu/overview.php?v=booklet2019&sort=des8>

7 Federal Democratic Republic of Ethiopia, Climate Resilience Strategy Agriculture and Forestry (2015).

8 World Bank Group, Climate Risk Country Profile - Ethiopia (2020).

9 EM-DAT: The Emergency Events Database - Universite catholique de Louvain (UCL) - CRED, D. Guha-Sapir, Brussels, Belgium. [http://emdat.be/emdat_db/\(2020\)](http://emdat.be/emdat_db/(2020)).

TABLE 1: NATURAL DISASTERS IN ETHIOPIA, 1900-2020

Natural Hazard 1900-2020	Subtype	Events Count	Total Deaths	Total Affected	Total damage ('000 US\$)
Drought	Drought	16	402,367	77,141,879	1,492,600
Earthquake	Ground Movement	2	24	585	320
Epidemic	Bacterial Disease	16	10,999	134,551	0
	Viral Disease	6	156	4,819	0
	Parasitic Disease	1	157	25,000	0
Flood	Flash Flood	9	863	1,129,358	9,400
	Riverine Flood	32	1,105	1,809,978	8,900
Insect Infestation	Locust	4	0	0	0
Landslide	Landslide	5	93	215	36
Mass Movement (dry)	Landslide	1	13	0	0
Volcanic Activity	Ash Fall	3	69	11,000	0
Wildfire	Forest Fire	1	0	5	0



At sectoral level, for the agriculture and forestry sector, floods and droughts have resulted in severe loss to agricultural crops and livestock resulting in food security implications. The economic impact depends on the extent of the variability and extreme events, but droughts alone can reduce total GDP by 1% to 4% while soil erosion has been estimated to reduce agricultural GDP by 2% to 3% (around 1% of total GDP)¹⁰. Even excluding these major extremes, the sensitivity of agricultural output to weather variability means significant negative impacts.

A recent climate risk analysis for Ethiopia's agriculture sector conducted by GIZ in 2020 indicates that both temperature and precipitation extremes are projected to increase, with the diverse regions and agro-ecologies of Ethiopia being affected differently. There is unambiguous evidence that climatic conditions affect crop production in Ethiopia. The projected changes translate into modelled shifts in suitability patterns for different crops, with net suitability for maize, wheat and teff decreasing, while the overall suitability to grow sorghum will increase. Further, crop models predict maize yield increases at national level by mid-century, although some zones are projected to experience losses. The vulnerability assessment showed that zones with very high vulnerability to climate change are located mainly in Dire Dawa, Gambela, Somali, Oromia and the Southern Nations, Nationalities and People's (SNNP) regions, which is driven by factors, such as lack of input use and exposure to heat extremes, particularly in the pastoralist regions.¹¹ For coffee, the greatest losses in suitability are projected to occur in the SNNP region followed by Oromia, with increased suitability projected mostly in the southern and central parts of Oromia and patches of Amhara region. However, new coffee areas will emerge in the Amhara region under climate change, which provides opportunities for development of the crop in these areas.¹²

¹⁰ Federal Democratic Republic of Ethiopia, Climate Resilience Strategy Agriculture and Forestry (2015).

¹¹ GIZ, Climate Risk Analysis for Identifying and Weighing Adaptation Strategies in Ethiopia's Agricultural Sector (2020).

¹² *Ibid.*

The major effects of climate change on livestock production include feed shortage, shortage of water, livestock genetic resources loss, reduced productivity, and decreased mature weight and/or longer time to reach mature weight in their order of importance. Higher temperatures resulting from climate change may increase the rate of development of certain pathogens or parasites that have one or more life cycle stages outside their animal host. Furthermore, the spatial distribution and availability of pasture and water are highly dependent on the pattern and availability of rainfall. Shortage of feed and water contribute to reduced productivity and reproductive performance of livestock. This includes slow growth rate of animals, loss of body condition, reduced milk production and poor reproductive performance in mature animals. These climate change impacts are being felt by all pastoral regions in Ethiopia which are highly prone to the adverse impacts of climate change, but the impacts are more prevalent in the North-eastern lowlands of Ethiopia.¹³



For the water sector, projected trends of increased temperatures and precipitation patterns and intensity is expected to not only increase water stress and freshwater vulnerability, but also exacerbate existing non-climatic stressors and will challenge the country's existing weak water governance regime. Furthermore, projected increases in the frequency of droughts, increased evaporation, and evapotranspiration, along with changes in rainfall patterns and runoff, may further reduce availability in water-scarce regions i.e., southern, eastern, and central regions.¹⁴



Ethiopia's power sector is heavily reliant on hydropower and extremely sensitive to climate change with worsening droughts, more frequent floods, and landslides in some areas. A reduction in water availability and river flow threatens potential hydropower generation for Ethiopia. Projected trends are expected to increase costs of maintenance and repairing of power and energy infrastructure as well as disrupt power supply.¹⁵

On a positive note, the Climate Resilience Strategy for Water and Energy provides planning assumptions (Table 2) that have been mapped for the water and energy sector with their subsequent implications for economic growth and poverty reduction which can guide climate resilient planning for these sectors.



For the transport sector, climate change is expected to have a significant impact on transportation (roads, rail, air), affecting the way transportation systems are planned, designed, constructed, operated, and maintained. While the expected risks to Ethiopia's transport infrastructure are known, they have not been quantified, and a detailed vulnerability assessment has not been carried out for the sector as a whole or for any of its individual modes. However, the Climate Resilient Transport Sector Strategy provides a qualitative analysis focused primarily on identification of impacts that will require an adjustment of current practices, to ensure that the existing service levels of the Ethiopian transport network and its assets are not compromised. Further work is required to investigate critical tipping points for infrastructure.¹⁶

13 Solomon Tiruneh, Firew Tegene, Impacts of climate change on livestock production and productivity and different adaptation strategies in Ethiopia (2018).


14 Ministry of Environment and Forest, Ethiopia's Second National Communication to the UNFCCC (2015). The Federal Democratic Republic of Ethiopia.

15 The World Bank (2017). Ethiopia - Country Environmental Analysis. Realizing Green Transformation. URL: https://docs.google.com/viewer?url=http://www.efdiinitiative.org/sites/default/files/publications/ethiopia_cea_0.pdf

16 Ministry of Transport, Climate Resilient Transport Sector Strategy (2017).

TABLE 2: KEY WATER AND ENERGY VULNERABILITIES TO CLIMATE CHANGE AND POTENTIAL IMPACTS

Impact ↓ Negative Impact ☑ Positive Impact			
Climate Stressor	Impacts related to water and energy on...	Economic Growth	Poverty Reduction
Increase in temperature	Higher evaporation of dams and rivers, potentially reducing supply	↓	
	Increased demand for power for cooling	↓	
	Increased human, animal and crop water demand		↓
Increased rainfall variability	Less certainty of the productivity of hydropower assets	↓	
	Less certainty of the productivity of thermal generation assets	↓	
	Less certainty of irrigation volumes available for use	↓	↓
	Less certainty for rural livelihoods and income		↓
Increase in rainfall extremes (floods and droughts)	Floods can damage water and energy assets and increase soil erosion	↓	
	Droughts impede the productivity of energy assets	↓	
	Droughts reduce irrigation volumes	↓	↓
	Droughts increase water stress for people and their livestock		↓
Increase in rainfall in West	Allows increased production from hydropower	☑	
	Depending on rainfall pattern, can lead to increased agricultural productivity and more secure livelihoods	☑	☑↓
Decrease in rainfall	Reduced productivity of hydropower energy assets	↓	
	Significantly reduced harvest and food security		↓
	Increased water stress for people and their livestock		↓

 Ethiopia is expected to have significant health effects caused by climate change, primarily related to rising temperatures, heat waves, floods, droughts and changing disease patterns. Effects will be manifested through the increase in vector-borne and water-borne diseases, severe malnutrition, and increases in flood incidence and displacement of people. Ethiopia has a high incidence of climate-sensitive diseases and the risk of vector-borne diseases such as malaria and dengue fever are likely to increase towards the 2070s. Four to five million people in Ethiopia are infected with malaria and over ten thousand people die of malaria every year.¹⁷ Approximately 70% of the population lives in malaria-endemic areas and outbreaks account for up to 20% of deaths for children under the age of 5. Increased temperatures will likely expand the range of malaria to highland areas and increased flooding will facilitate the spread of waterborne diseases like diarrhoea. Additionally, more than 70,000 deaths annually are tied to indoor and outdoor air pollutants, which a hotter, more drought-prone climate will.¹⁸

17 Federal Ministry of Health, National health Adaptation Plan to Climate Change (2017).

18 WHO (2015). Climate and Health Country Profile - Ethiopia. URL: https://apps.who.int/iris/bitstream/handle/10665/208861/WHO_FWC_PHE_EPE_15.07_eng.pdf?sequence=1

1.5 Ethiopia's 1st NDC

Ethiopia submitted its INDC to the UNFCCC on 10, June 2015 which later converted to Ethiopia's 1st NDC after Ethiopia ratified the Paris Agreement in March 2017. Developed through an inclusive and participatory process, the current NDC depicts domestic climate change mitigation and adaptation commitments which are aligned with the second national Growth and Transformation Plan and anchored on the Climate Resilient Green Economy Strategy of Ethiopia (Federal Democratic Republic of Ethiopia, 2015). As expected of Parties to periodically update their NDCs after every 5-year cycle, this technical analysis informs updating of Ethiopia's NDC.

The mitigation component of the 1st NDC aimed to reduce greenhouse gas emissions (GHG) and committed to reducing 255 Mt CO₂eq by 2030, compared to a Business-as-Usual (BAU) trajectory in the same year. Ethiopia estimated that its emissions were approximately 150 Mt CO₂eq in 2010 (baseline year) and projected that they would reach 400 Mt CO₂eq by 2030. This would amount to an increase of 250 Mt CO₂eq by 2030. The NDC commitment of reducing emissions by 255 Mt CO₂eq by 2030 would amount to emissions of only 145 Mt CO₂eq by 2030 which is less than the 2010 baseline year. This commitment translates into a 64% net reduction from the 2030 BAU projections, and a 3.33% absolute reduction from the 2010 baseline. Of the 255 Mt CO₂eq GHG reduction by 2030 commitment, 90 Mt CO₂eq is from agriculture; 130 Mt CO₂eq is from forestry; 20 Mt CO₂eq is from industry; 10 Mt CO₂eq is from transport; and 5 Mt CO₂eq is from buildings. This excludes the reduction of 19 Mt CO₂eq in neighbouring countries due to the export of electric power to them from Ethiopia (Federal Democratic Republic of Ethiopia, 2015).

The adaptation component, which was only briefly presented, aimed to reduce the vulnerability of the Ethiopian population, environment and economy to the adverse effects of climate change whilst mainstreaming climate resilience into development activities. The short-term actions for adaptation in the 1st NDC were strengthening the adaptation policy and regulatory framework through the development and implementation of various adaptation strategies and plans at national, regional, sub-national and sectoral levels. The medium and long-term actions aimed to increase resilience and reduce vulnerability of livelihoods and landscapes in three areas namely drought, floods, and other cross-cutting interventions.

Ethiopia has made progress in implementing its NDC which has been recognised globally as one of the most ambitious initiative. A recent study assessing progress on the implementation of the CRGE strategy (2011-2019) was also intended to inform updating of the progress of Ethiopia's NDC on adaptation, mitigation, climate finance, institutional arrangements, policy and the role of the private sector. This assessment revealed certain gaps in the design and implementation of Ethiopia's 1st NDC (see below). The main findings of the assessment include the following:

- ▶ Difficulty to compare subsequent emissions inventories and the GEM with the 2010 CRGE base year emission estimate because of methodological differences in the calculations of the underlying model of the CRGE strategy, including the following:
 - Granularity of CRGE calculations by sector not congruent with IPCC sector classification.
 - Lack of updated and consistent data availability (GWP, livestock, etc)

- Methodological differences (model specifications, omitted structures such as omitted land use categories in the CRGE model)
- ▶ Mitigation contributions were relatively given priority compared to adaptation contributions.

Recommendations from the assessment that are relevant to this cycle of the NDC update include the following:

- ▶ Conduct a new national and sectoral GHG inventory, adhering to 2006 IPCC guidelines, to establish accurate baselines for the years 2010 and 2020.
- ▶ Undertake new GHG growth projections (nationally and by sector) and pathways between 2020 and 2030, to establish a more accurate trajectory and recalibrate the level of ambition.
- ▶ Setting new GHG reduction targets based on the updated calculations and opt for relevant best practice in terms of mitigation interventions recognized (globally and regionally) as having climate change mitigation outcomes.
- ▶ Conduct detailed sectoral climate change risk and vulnerability assessments to establish accurate baselines for vulnerability, and to identify high-priority areas for intervention to build adaptive capacity and reduce vulnerability.
- ▶ Rapidly operationalize Ethiopia's existing MRV frameworks (developed in 2016 for major sectors) by translating theoretical guidance into operational systems, investments, staffing, and other resources.
- ▶ Ensure the use of a consistent sets of indicators related to climate change, with a final selection and official notification of indicators (sector level, programme level, project level, and activity level – both output indicators and outcome indices).
- ▶ Design and put in place a public expenditure review framework at the Ministry of Finance, the Planning and Development Commission, and across all government institutions (at the Federal, Regional, and Woreda level) that enables disaggregation of distinct budgetary flows and allocations.
- ▶ Establish a user-friendly, reliable, well-designed, and organized centralised information and knowledge management system (dual platform – server based, and cloud based) at the CRGE Facility (including the financial wing at MoF and technical wing at EFCCC). This information and knowledge management system will also consider the governance structure of the CRGE Facility (and will be usable by all components), including the two governance bodies (1) the inter-ministerial steering committee (representative ministers); and the (2) management committee (co-chaired by state ministers).

These recommendations have been considered in the current NDC update process as well.

1.6 Climate change policy and institutional framework

Ethiopia's policy framework for climate change mitigation and adaptation has undergone progressive development over the last decade. Ethiopia's Climate Resilient and Green Economy Strategy (CRGE) developed in 2011 sets out a vision for Ethiopia becoming a lower-middle-income country by 2025

through implementing a transition to a green economy. The CRGE was later mainstreamed into the second Growth and Transformation Plan (GTPII) for the 2015-2020 period for continuity, as well as into the 10-year Development Plan (2021-2030).

Ethiopia submitted its **Initial National Communication (INC)** to the UNFCCC in 2001 while the **Second National Communication (SNC)** was submitted in 2015. The National Greenhouse Gas (GHG) Inventory included in the SNC reports GHG emissions for the years 1994 to 2013 and provides projections until 2030. The inventory was prepared using methodology and procedures from the Intergovernmental Panel on Climate Change's (IPCC's) 1996 Guidelines for National Greenhouse Gas Inventories. Currently the process of preparing Biennial Update Report is undergoing.¹⁹ Ethiopia's **Nationally Appropriate Mitigation Actions (NAMA)** are further vehicles for mitigation action that describes some of the Government of Ethiopia's prioritized actions aimed at reducing or limiting GHG emissions.

Launched in 2010, the **Ethiopia Program of Adaptation on Climate Change (EPACC)** calls for the mainstreaming of climate change into decision-making at a national level and emphasises planning and implementation monitoring. It identified 20 climate change risks, mainly in health risks (human and animal); agriculture production decline; land degradation; water shortages; biodiversity; waste; displacement; and distributive justice. The EPACC also identified institutions responsible for mitigating these risks.

The NAP process provided an opportunity to further elaborate the climate resilience elements of the CRGE strategy. This process culminated in the launch of **Ethiopia's National Adaptation Plan 2017 (NAP-ETH)** to provide an overarching framework for its response to the impacts of climate change by building adaptive capacity and resilience. **The National Adaptation Plan (NAP) Implementation Roadmap**, also developed in 2019, elaborates implementation strategies for the different adaptation options and strategic priorities identified in the plan. The objective of the roadmap is to identify key enabling actions that are pivotal to actualising Ethiopia's NAP within the set-out timelines.

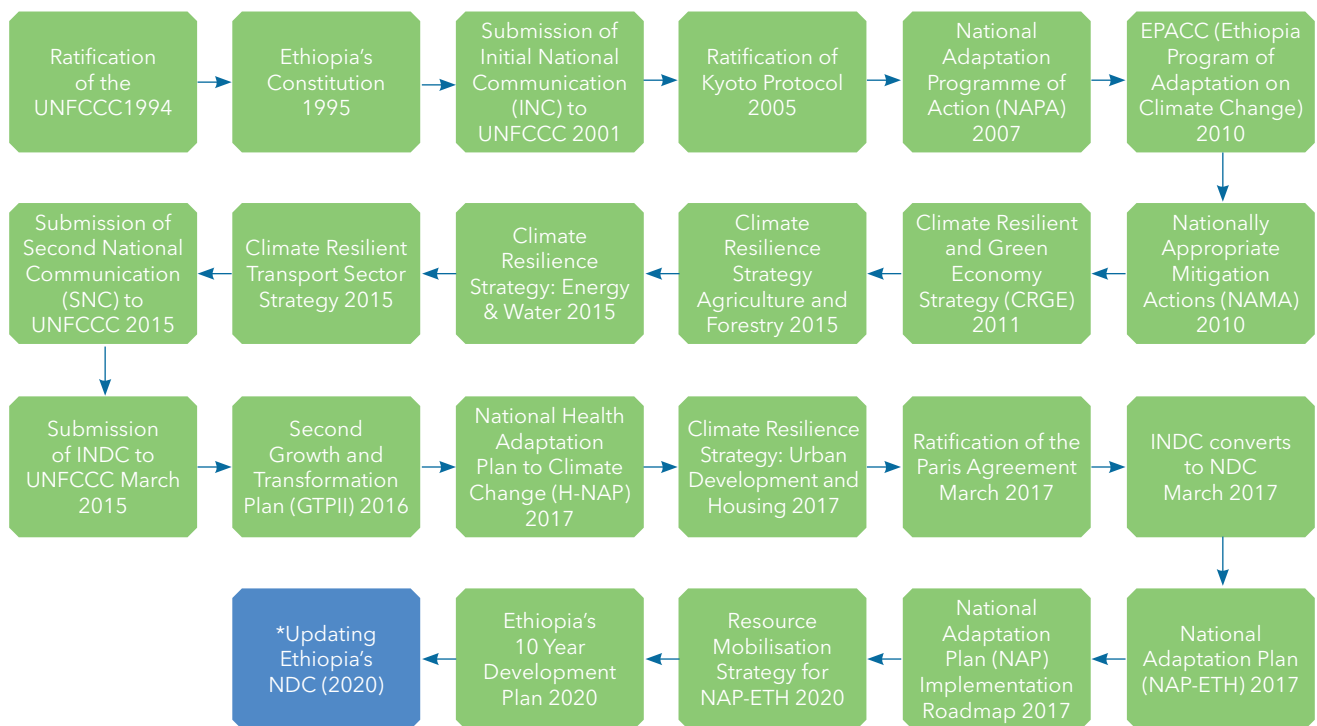
A **Resource Mobilisation Strategy for NAP-ETH** was developed in June 2020 as part of implementation of the CRGE Strategy. This resource mobilisation strategy aims to help the government to identify and scale up financing for adaptation. Specific objectives of the strategy are to identify adaptation financing needs and gaps; explore financing options and set out next steps for the short and medium term.

Ethiopia submitted its Intended Nationally Determined Contribution (INDC) in 2015, and ratified the Paris Agreement in 2017, turning its INDC into its **Nationally Determined Contribution (NDC)**. Ethiopia's 1st NDC is founded on its CRGE Strategy. The implementation of the NDC is conditioned upon an ambitious multilateral agreement among Parties enabling Ethiopia access to international support in the form of finance, capacity building and technology transfer.²⁰

19 Wuppertal Institute for Climate, Environment and Energy, Wuppertal, Implementation of Nationally Determined Contributions, Ethiopia Country Report (2018).

20 Federal Democratic Republic of Ethiopia, Intended Nationally Determined Contribution (INDC) of the Federal Democratic Republic of Ethiopia (2017a).

FIGURE 1: ETHIOPIA'S CLIMATE CHANGE POLICY ROADMAP



(Source: Pegasys, 2020)

At the sectoral level, five climate resilience strategies have been developed to provide tailored and sector-specific frameworks to build climate resilience and reduce the impact of current weather variability and future climate change. The strategies build on the CRGE Strategy as well as sectoral policies. The strategies also estimate the cost of responses including identification of the steps required to finance and implement efforts to build climate resilience. These strategies are the Climate Resilient Strategy for Agriculture and Forestry (2015), the Climate Resilience Strategy: Energy and Water (2015); the Climate Resilient Transport Sector Strategy (2015); the National Health Adaptation Plan to Climate Change (H-NAP, 2017) and the Climate Resilience Strategy: Urban Development and Housing (2017). A summary of Ethiopia's climate change policy roadmap is provided in Figure 1.

Ethiopia has progressively put in place a multi-faceted institutional architecture for the implementation of climate change interventions. Environment, Forest, and Climate Change Commission (EFCCC) - is the lead agency for the coordination of Ethiopia's response to climate change and is the National Focal Point to the UNFCCC. The EFCCC coordinates the country's reporting to the UNFCCC, formulates environmental laws and standards, and develops, coordinates, and guarantees the implementation of sectoral programmes and plans including the CRGE Strategy. The CRGE Facility comprising of the Ministry of Finance, responsible for financial aspects of CRGE implementation and M&E, and the EFCCC, responsible for technical elements, developing guidance and rules for CRGE implementation, together play a pivotal role in implementation of climate change interventions, resource mobilisation as well as monitoring and evaluation.

The Planning and Development Commission (PDC) is also one of the coordinating entities of the CRGE initiative. The institutional arrangements reflect a cross-sectoral, multi-disciplinary approach organized through bodies like the inter-ministerial and management committee and allows for regional engagement. Most relevant line ministries have in-house CRGE directorates, units or bureaus that focus on climate change policy implementation. The National Meteorological Agency (NMA) collects, exchanges, and disseminates information and advice on meteorological data as well as adverse effects of weather and climate in Ethiopia.

ETHIOPIA'S NDC ENHANCEMENT PROCESS

2.1 Process

The aim of this section is to provide clear guidance on adequate mitigation actions, both unconditional and conditional on international support, and identify feasible emission reduction targets by 2025 and 2030. The approach has included document review, stakeholder consultation and facilitation processes, with the aim of addressing the following questions:

- ▶ Which business-as-usual (BAU) modelling strategy is most compatible with the IPCC 2006 guidelines and most complete vis-à-vis the key categories of emission sources identified in recent GHG-emission inventories?
- ▶ What are the most probable and feasible mitigation pathways for Ethiopia until 2025 and 2030?
- ▶ How can Ethiopia be better positioned to participate in the carbon markets under the Paris Agreement?
- ▶ How can mitigation pathways contingent on international technical and financial support be best designed, particularly in the context of evolving global carbon markets?
- ▶ How can the updated NDC best complement the actions identified under the first NDC and enhance its ambition?
- ▶ Which important developments - both at national and international level - impact on the NDC process which was initially based on the CRGE-strategy?
- ▶ How can an effective MRV and Monitoring & Evaluation system be set up to reliably track progress on all mitigation and adaptation actions in Ethiopia?

Answering these questions required robust analysis and close collaboration with all stakeholders. This technical report provides the data, information and process description to describe how the results were generated and fed into Ethiopia's updated NDC-submission to the UNFCCC.

To align with Ethiopia's 10 Year Development Plan (2021-2030, 10YDP) and the 2050 long term low emission development strategy (LT-LEDS), this technical report relied on the analytical work carried out by the World Resource Institute (WRI) and utilized the "Green Economy Model" (GEM) that they have been developed considering Ethiopia's context with active participation of sectoral

ministries. Apart from this, recent data sets notable updated global warming potentials (GWPs) and inventory data for livestock sector (Tier 2) and additional policy interventions have been used and considered.

The technical analysis of the mitigation component comprises of concisely defined methodological steps which form the headers of the subchapters of section 2.2, namely: preparing an updated BAU pathway (Step 1), preparing updated GHG abatement pathways for 2030 (Step 2), the setting of 2025 interim and 2030 final NDC targets (Step 3), the prioritization of mitigation interventions and indicator selection (Step 4), the role of carbon markets in the NDC is well discussed as one step (Step 5) as well as the determination of conditional and unconditional policy actions (Step 6). Moreover, data sources are provided by line ministries and other stakeholders and include data from Ethiopia's first NDC and the underlying modelling framework of the CRGE-strategy, as well as new data sources fed into the GEM, the LEDS and the updated NDC (see **Appendix A** for more details).

2.2 Methodology

Mitigation

In order to update the mitigation contributions, extensive document review has been conducted and deployed a participatory GEM. The sector level and national development plans and other strategies have been thoroughly reviewed such that mitigation options have been fairly captured and aligned with the ten years development plan.

Economic wide models are the most widely applied as assessment tools to link the economy, climate, the environment and people which the NDC updating requires. Particularly, recently, Green Economy Model (GEM) based on system thinking is extensively used to capture the key drivers of change triggered by green economy interventions. The key foundations of System Dynamics model that enable to produce robust results are feedback loops, delays and non-linearity. Causality makes SD models transparent and allows the possibility of co-creating the models with the participation of local stakeholders. As a result, the GEM has been developed for Ethiopia with the participation of CRGE sectors.

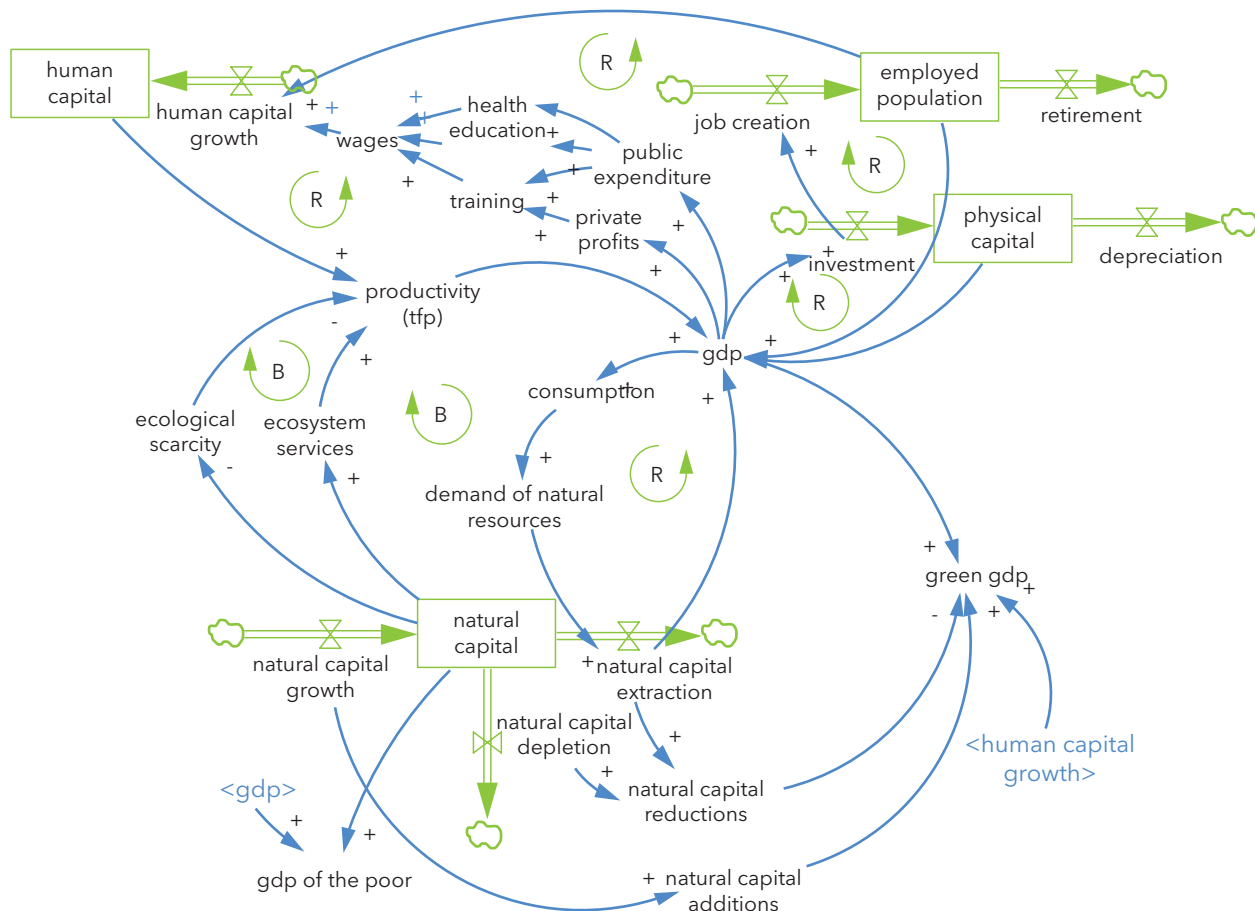
The Green Economy Model (GEM)

The GEM model developed for Ethiopia includes several sectors across social, economic and environmental dimensions. The model illustrates how population growth can both (i) support economic development and (ii) lead to resource exploitation and ultimately constrain economic growth. With the introduction of resource efficiency interventions (e.g., energy efficiency, fuel switching; or improved land and livestock management practices) negative impacts can be avoided while preserving positive ones. The core sectors of GEM are population, land use, GDP (agriculture, industry and services), household and government accounts, public infrastructure and related services (e.g., health, education, and roads), energy demand and power generation, as well as sector level and total GHG emissions. The effective integration of these sectors has been made

possible using stocks and flows, as well as by explicitly including in the model feedback loops, delays and non-linear dynamics.

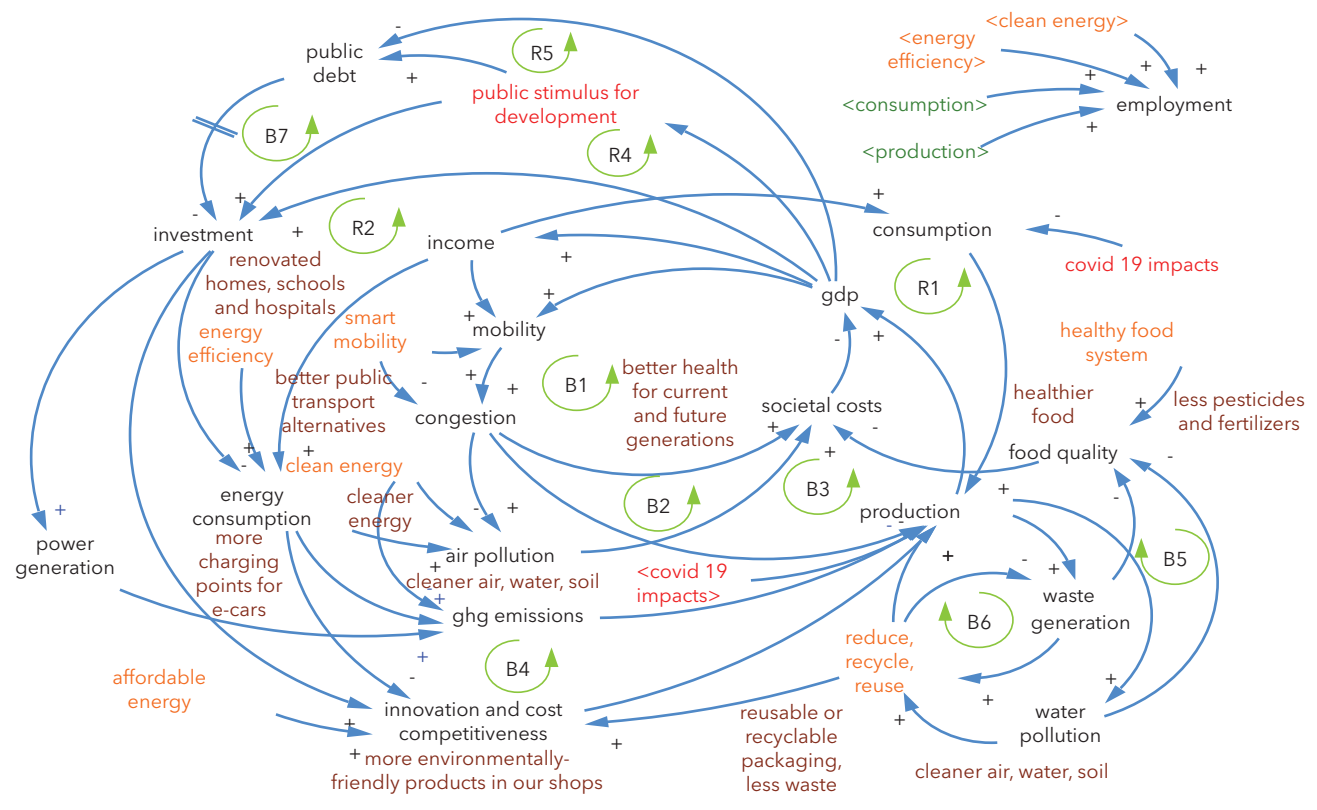
Figure 2 presents the generalized underlying structure of GEM. The diagram shows how the key capitals (built, social, human and natural) are interconnected, and contribute to shaping future trends across social, economic and environmental indicators. Specifically, feedback loops can be identified that are reinforcing (R) in all areas, pertaining economic growth and social development. These are enabled by the availability of natural capital, which, if not properly managed, can constrain economic growth (hence the balancing loops -(B)- identified in the diagram). Balancing loops include energy spending (the more we spend on energy, the less is available for other consumption and investment, curbing GDP growth) or GHG emissions (the higher the emission and air pollution, the lower labour productivity, curbing GDP growth). Policies can be implemented to promote sustainable consumption and production, decoupling economic growth from resource use (also through education and behavioural change), to mitigate the exploitation of natural capital and generate a stronger and more resilient green growth. In general, the models include key sectors notably the industrial sectors, natural and physical capitals, population and human capital (Figure 2).

FIGURE 2: CAUSAL LOOP DIAGRAM (CLD) REPRESENTING THE MAIN VARIABLES AND FEEDBACK LOOPS OF GEM APPLICATIONS



The model ensures a clear linkage across different structures and plainly depicts the paths through which mitigation options and other interventions impacts different parts of the economy, society, environment and GHG emission. For instance, when GDP increases, as historical data show, (a) income and consumption increase, leading to higher GDP via production (reinforcing loop R1) and (b) investments increase, triggering more innovation and improved cost competitiveness, which increases production and GDP (reinforcing loop R2). These two reinforcing Loops (R) generate a virtuous cycle that results in continued economic growth, via production and consumption, which also lead to employment creation. On the other hand, economic growth, in addition to creating a virtuous cycle, has given rise to various balancing factors (or Balancing Loops) that, over time, constrain growth. With economic development and income creation comes the need for mobility, resulting in more traffic and hence congestion which urges people spend more time in traffic than in performing other activities (B1 and B3). Further, congestion and energy consumption, stimulated by growing income and investments, lead to air pollution (B2), causing health problems and reducing labour productivity. Finally, as energy use increases through higher investment and income, the vulnerability to market dynamics and price volatility and extreme weather events impacting the supply of energy increases as well (B4), with negative impacts on production. The impact of COVID-19 has also been captured by the model. As we know, COVID-19 directly affects consumption (due to limitations to the movement of people) and then indirectly affects production. The structure of the model that comprises the impact of COVID-19 and the combination intervention of these dynamics and other mitigation interventions in many sectors (e.g., energy, livestock, and agriculture) is presented in Figure 3.

FIGURE 3: CAUSAL LOOP DIAGRAM MACROECONOMY



Data source and mitigation strategies

The data including sectoral and national growth rates, population dynamics, and material and energy throughput of the Ethiopian economy has been provided by the respective line ministries. Other key parameters of the model have been aligned with the 10YDP and were validated by the PDC and EFCCC. Apart from these, the most recent data on livestock inventory which used Tier 2 methodology of the IPCC has been obtained from the Ministry of Agriculture.

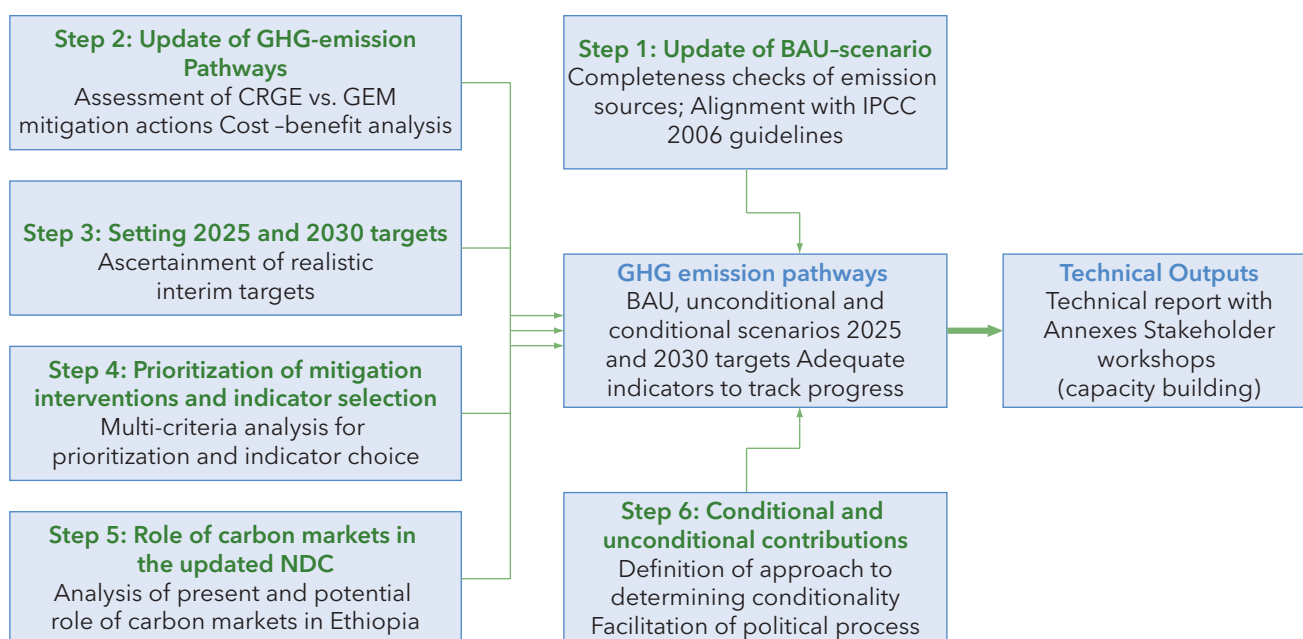
Methodological steps

An overview of the core methodological steps to develop this report is provided by Figure 2. The completion of these steps was achieved through an iterative process, requiring consultations and backstopping with all stakeholders on a continuous basis.

I. Methodological steps

An overview of the core methodological steps is provided by Figure 4. The completion of these steps was achieved through an iterative process, requiring consultations and backstopping with all stakeholders on a continuous basis.

FIGURE 4: METHODOLOGICAL STEPS TOWARDS DETERMINING UPDATED MITIGATION CONTRIBUTIONS



Source: Authors.

Step 1: Preparing an updated BAU-scenario

This step includes **reviewing** the scope of the sectoral GHG emissions for each CRGE priority sector, potential adjustments to the modelling tools, **defining** of updated projected production quantities and their GHG emissions intensities, as well as the overall sector's GHG emissions.

Initially, proposed BAU scenarios as an underpinning of the 2050 LEDS. In the context of updating Ethiopia's NDC and harmonizing national policy plans (in particular, the 10YDP) and ongoing modelling efforts, new reference scenarios have been elaborated. Concretely, this means the fusion and disaggregation of policy interventions and scenarios of the 2050 horizon into 2030 conditional, unconditional and BAU pathways. For more information see Annex D2.

Steps 2-4: Update of GHG-emission pathways including 2030 and 2025 interim targets, mitigation actions and indicator selection

These steps include as certaining alternative emission pathways for 2030 and determining national and sectoral GHG-targets, including interim targets for 2025. As the precondition for the definition of climate policy scenarios require a robust baseline, these steps rely on Step 1. The 2025 and 2030 targets can readily be extracted from the model by indicating the desired scenario, i.e., by choosing: the NDC reference or "BAU"-scenario (no low-carbon policy interventions until 2030); the unconditional scenario that implies policy choices Ethiopia would adopt in the absence of international support, or the conditional scenario that implies policy choices Ethiopia would adopt contingent on international support. Based on these choices, emission targets per scenario are readily extractable from the model.

Using the GEM as the central modelling tool for the NDC update requires that sufficient compatibility with ongoing efforts under the CRGE is still ensured. To achieve this, the 43 abatement levers suggested under the CRGE have been attributed to the more aggregated policy interventions proposed under the GEM, to the extent possible. Consecutive consultation meetings with the WRI have led to an update of previous policy interventions under the 2050 LEDS, including modifications and new additions (documented in detail in Appendix D1). Many former levers proposed under the CRGE are not directly attributable to the policy interventions proposed under the GEM. This does not mean, that individual levers are not addressed by the GEM as they are typically contained in the more aggregated policy interventions assumed by the GEM.

Indicator selection for comprehensive tracking of progress has been recommended in line with the overarching M&E efforts and the prospect of the Enhanced Transparency Framework (ETF) that will become operational during the second NDC period. Importantly, considering the ongoing COVID-19 crisis, the modular set-up of the GEM will make it easy to amend input parameters in the case of sudden economic slowdown, sectoral contraction or exacerbated debt crisis, as well as potential dynamic recoveries, with feedback on biophysical and social parameters.

Step 5: Role of carbon markets in the updated NDC

This includes identifying existing and new initiatives that can increase Ethiopia's ability to participate in future carbon markets, a summary of Ethiopia's participation in existing mechanisms such as the Clean Development Mechanism (CDM) and voluntary carbon market standards; a description of the rapidly evolving carbon market and policy environment in the context of the Paris Agreement; an identification and prioritization of sources of future credit demand in the Ethiopian context; and efforts to enable Ethiopia to meaningfully participate in the new carbon market landscape by the provision of support tools and procedures, including for instance a registry mechanism, guidelines

or manuals. This technical analysis builds on Ethiopia's engagement in the Eastern African Alliance on Carbon Markets and Climate Finance. Yet, due to the pending decisions of the international community on the rules and modalities of the CDM transition and the implementation of Article 6, the identified role of carbon markets remain tentative until multilateral Article 6 rules have been finalized, which is scheduled for COP26 in 2021.

Step 6: Conditional and unconditional contributions

The high degree of uncertainty regarding the costs and feasibility of actions guided the establishment of an approximate guide for conditionality of action under this step. The possibility to carry out comprehensive Cost Benefit Analyses (CBA) continues to exist, using the GEM's functionality. The key objective of this approach was to demonstrate a meaningful domestic contribution by Ethiopia while ensuring that all interventions that require international support will remain eligible to do so.

Adaptation

Unlike climate change mitigation, where IPCC methodologies provide a clear, universal approach to GHG calculations, climate change adaptation does not have a corresponding singular methodological reference point. Nevertheless, international best practice and UNFCCC decisions do offer guidance on the recommended approach to NDC enhancement. Specifically, this guidance is captured in UNFCCC Decision 9/CMA.1 from its 26th plenary meeting (UNFCCC, 2018). Furthermore, these directions are elaborated on and translated into a clear approach with discrete steps, by a guidance document developed by - the United Nations Development Programme (UNDP) and the World Resources Institute (WRI) (WRI and UNDP, 2019).

Based on this guidance, and in consultation with the Government of Ethiopia (through engagement with the Technical Working Group, who provided four rounds of direction and feedback on the proposed approach), the process adopted for NDC enhancement for the adaptation section was as follows:

I. Document review

The main purpose of the document review was to acquire data and information necessary for NDC enhancement. Comprehensive document review and data collection was crucial especially given the rigorous demands of the UNFCCC in terms of reporting on and revising an NDC, aimed at enhancing clarity, transparency, and understanding of a country's submission. A detailed reading and analysis of all available relevant information allowed for a strong and multi-layered understanding of completed and ongoing climate change adaptation activities in Ethiopia as well as a better understanding of national and sectoral adaptation contributions.

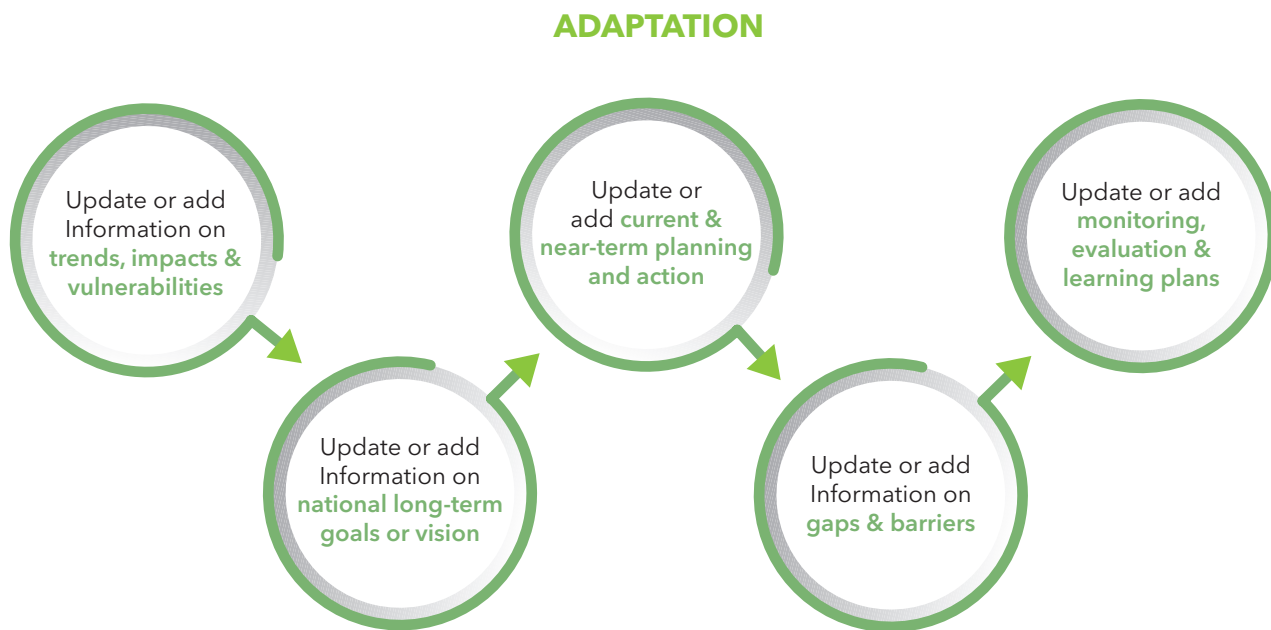
II. Determining adaptation contributions

A key preliminary step was to arrive at an understanding about what enhanced ambition could look like for Ethiopia's updated NDC. In line with global best practice and widely adopted guidance on

NDC enhancement (WRI and UNDP, 2019), the adaptation component of a country can be enhanced (as depicted in Figure) in several ways, such as the following:

- a) Updating or adding information on trends, impacts, and vulnerabilities.
- b) Updating or adding information on national long-term goals and vision.
- c) Updating or adding current and near-term planning and action.
- d) Updating or adding information on gaps and barriers; and
- e) Updating or adding monitoring, learning, and evaluation plans.

FIGURE 5: HOW TO ENHANCE ADAPTATION COMPONENT OF AN NDC



Source: WRI and UNDP, 2019.

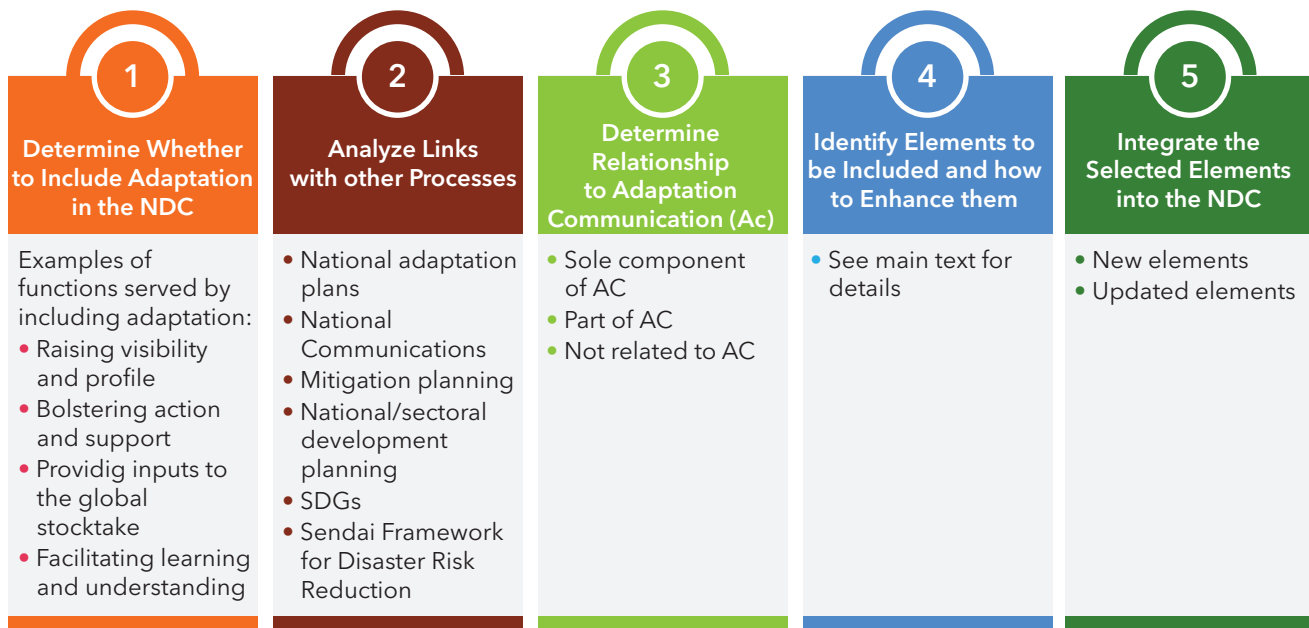
Updating Ethiopia’s NDC provides a mechanism for reflecting Ethiopia’s highest ambition that considers Ethiopia’s capabilities and national circumstances. In the context of adaptation, “enhanced ambition” could take various forms including making targets more rigorous, making indicators more specific, including additional sectors or planning levels i.e., national, regional, woredas, or including additional adaptation activities. Given that Ethiopia’s 2015 NDC leaned strongly towards mitigation, there was significant scope to raise adaptation ambition during the update.

The need to enhance ambition even on adaptation has taken on renewed urgency in light of the IPCC special report on 1.5°C, which underscored a marked increase in negative impacts from climate change between the lower 1.5°C temperature rise threshold and the higher 2.0°C temperature rise threshold (IPCC 2018). Recognizing that even half a degree of warming in the global average would require a dramatically different level of adaptive capacity to respond to climate change impacts, means that a paradigm shift in adaptation planning and implementation is necessary.

Furthermore, given the mitigation focus of Ethiopia on the agriculture, forest, and other land use (AFOLU) sectors, a strategically oriented NDC update could identify and prioritize potential adaptation co-benefits in terms of increased resilience through nature-based solutions.

Whilst implementation of an NDC is prone to several challenges such as funding, capacity, enabling environment etc - the increased ambition in an updated NDC provides a wide range of opportunities for adaptation actions across multiple sectors that can also be an impetus for economic development and can drive the co-benefits. In Ethiopia’s case, this opportunity should be maximised to ensure robust adaptation planning that will strengthen Ethiopia’s positioning to receive the much-needed implementation support in terms of funding, skills transfer, and other forms of support. At a high level, the methodological steps involved in *determining adaptation contributions* to capture in the updated NDC included the following (albeit not necessarily in this precise sequence) (Figure 6):

FIGURE 6: STEPS TO ENHANCE ADAPTATION IN THE NDC



Source: WRI and UNDP, 2019.

For clarity, the process undertaken to update the adaptation section of Ethiopia’s NDC included the following elements:

Updating or adding information on adaptation indicators, targets, impacts, and vulnerabilities

Resources and information from the adaptation planning processes in Ethiopia to date to identify adaptation gaps in Ethiopia’s 1st NDC that need updating/strengthening. It is important to note that the 1st NDC was mitigation focused and the NDC update offers opportunity to elevate the adaptation component in the enhanced NDC.

This sub-activity incorporated Ethiopia's recent work to finalize clear and feasible national and sectoral adaptation indicators and drew on goals and targets identified in Ethiopia's National Adaptation Plan (NAP) as well as sectoral climate resilience strategies. Using a bespoke screening matrix, with 24 prioritization criteria,²¹ the adaptation options identified in the NAP (inclusive of the 18 main strategies as well as long-term actions identified in the NAP) were filtered to a more focused list of priority adaptation commitments. The prioritization criteria and approach are further elaborated in Table in this report.

The recently finalized CRGE M&E system and indicators assessment, were studied and analysed, and - after cross-referencing them with the selected priority adaptation commitments - a sub-set of priority indicators that would be apt for the adaptation interventions prioritized in the revised NDC were shortlisted. Baseline data for the selected NDC indicators has been drawn from the data collected for CRGE M&E system development and indicators assessment by the Environment and Climate Research Centre (ECRC), at the Policy Studies Institute (PSI), which has recently been updated and supplemented by fresh data-collection by various line Ministries and finalised by the EFCCC.

This prioritization and selection were further informed and refined by convening and facilitating a consultative process with key stakeholders to arrive at a consensus on the action and indicator selection (through an interactive workshop designed to produce a discrete outcome). This allowed a final set of actions and indicators, to be adopted by all major sectors, in support of NDC implementation, tracking, and reporting. The process of prioritization and adoption of NDC indicators (a sub-set of the nationally finalized CRGE indicators) was finalized through a validation workshop.

Ensuring alignment with the UNFCCC adaptation communication

The Paris Agreement requires that the NDC's adaptation component be as aligned as possible with guidance on a country's periodic Adaptation Communication. Thus, the updated NDC touches on the same elements covered in an Adaptation Communication:

- ▶ National circumstances, institutional arrangements, and legal frameworks.
- ▶ Impacts, risks, and.
- ▶ National adaptation priorities, strategies, policies, plans, goals, and actions.
- ▶ Implementation and support need of developing country Parties.
- ▶ Implementation of adaptation actions and plans.
- ▶ Adaptation actions and/or economic diversification plans, including those that result in mitigation co-benefits.

²¹ 24 prioritization criteria refer to the framework (see annex B) that have been followed to weight and prioritise AOs. Note that the prioritization criteria framework has been designed to be easy to modify as needed and can be refined based on the preferences of stakeholders or key decision-makers. At present all 24 criteria have been assigned equal weight but based on stakeholder inputs and guidance from relevant government representatives, weights can be modified to allow for certain criteria to play a more significant role in determining prioritization.

- ▶ An assessment of how adaptation actions contribute to other international frameworks and/or conventions.
- ▶ Gender-responsive adaptation action and traditional knowledge, knowledge of indigenous peoples, and local knowledge systems related to adaptation.

Establishing linkages with mitigation through mitigation co-benefits

The aim of this sub-activity was to establish linkages with the mitigation component, particularly regarding targets, indicators and implementation arrangements and how monitoring and reporting for both adaptation and mitigation can be streamlined at national, regional, sub-national (woredas) and sectoral levels. One of the screening/prioritization criteria for adaptation actions in the NDC was mitigation co-benefits.

Establishing linkages with other frameworks e.g., SDGs, Sendai framework for disaster risk reduction etc.

The aim of this sub-activity was to establish linkages to other development frameworks and protocols such as the SDGs, the Sendai Framework for Disaster Risk Reduction etc. which enabled identification of synergies and trade-offs. Specifically, synergies between international and national development goals and related indicators and climate change adaptation were found. Two of the screening/prioritization criteria for adaptation actions in the NDC were alignment with SDGs and alignment with the Sendai framework.

DETERMINING MITIGATION CONTRIBUTIONS

KEY MESSAGES ON MITIGATION CONTRIBUTIONS

- ▶ Ethiopia's updated BAU, unconditional and conditional GHG emission pathways are based on substantially revised, more robust modelling methodology and GHG inventory data. As a result, both base and GHG emission 2030 pathway projections differ from those presented in the 1st NDC:
 - Updated 2010 base year emissions have been revised to **247 megatons of carbon dioxide equivalents** (Mt CO₂eq)
 - Updated BAU GHG emission pathways lead to a projected increase to **403.5 Mt CO₂eq** by 2030
 - Policy interventions in the **unconditional pathway** reduce emissions to **347.3 Mt CO₂eq in 2030**, which represents a reduction against the revised BAU of **14% (-56 Mt CO₂eq)**
 - Policy interventions in the conditional pathway reduce emissions to **125.8 Mt CO₂eq**, which represents a reduction against the revised BAU of **68.8% (-277.7 Mt CO₂eq)**
- ▶ The **updated NDC represents a substantive ambition increase** since:
 - Higher robustness of GHG emissions pathways and targets through improvements in methodology, thereby more accurately and completely capturing historical emissions and emissions pathways through greater alignment with national GHG inventories, revised emission factors and improved consistency with the IPCC's 2006 guidelines.
 - Ethiopia proposes an emission reduction target of 68.8% which is more ambitious compared to its first NDC (64%).
 - Inclusion of a detailed adaptation baseline and 2030 targets and additional adaptation interventions per sector.
 - The first NDC did not have a quantified baseline and targets.
 - Clear demarcation between unconditional and conditional mitigation and adaptation interventions, with a meaningful domestic contribution, unlike the first NDC.
 - Better adaptability and flexibility of the methodology to potential future changes of policies and external shocks.
 - An enhanced ability to track progress on mitigation and adaptation actions with improved MRV/M&E commitment to explore further ambition increases during the NDC commitment period.
 - This includes potentially enhancing Ethiopia's NDC ambition by reducing emissions currently outside the scope of this NDC update, for instance for GHGs not covered by the current NDC (e.g., Hydrofluorocarbons (HFCs) in the context of the Kigali Amendment to the Montreal Protocol) where GoE initiatives on sustainable cooling are already underway and further mitigation potential exists.

In 2015, Ethiopia formulated an NDC internationally recognized to be among the most ambitious. Despite its special circumstances as an LDC with marginal contributions to historic GHG emissions, Ethiopia pledged to limit its net emissions in 2030 to 145 Mt CO₂eq or lower, which would constitute a 255 Mt CO₂eq (or 64%) reduction from the BAU scenario developed under the country's CRGE-strategy, itself integrated into the Second Growth and Transformation Plan. For the second NDC, Ethiopia committed to update both targets and methodologies to ensure a robust methodological basis in line with all agreed UNFCCC requirements and international best practices. As a result of a review of the methodological basis of CRGE and the first NDC, as well as key ongoing efforts, it is proposed to build Ethiopia's updated NDC on modelling work undertaken by WRI in support of the GoE's preparation of the 10YDP and 2050 Long-Term Low Emission Development Strategy (LT-LEDS).

The ambition of the NDC is enhanced due to significantly more robust business-as-usual (BAU) projections. Furthermore, this approach for the first time allows a demarcation of actions into unconditional and conditional on international support. Furthermore, with a view to subsequent NDC updates, we recommend continuously exploring further **conditional** ambition increases outside the current scope of the NDC. For example, GHGs not covered by the current NDC (e.g., HFCs in the context of the Kigali Amendment to the Montreal Protocol) where GoE initiatives on sustainable cooling are already underway and further mitigation potential may become available outside the current NDC scope as a result of economic and technology development. Further examples may include negative emission technologies, green hydrogen, or others. Referring to the possibility of future mitigation increases in this current update of the NDC demonstrates Ethiopia's commitment to the PA. Such increases in ambition can then be formally included within future NDC updates based on actual developments accompanied by thorough technical analysis and validation by responsible ministries.

The first NDC relied on some 43 abatement levers formulated under the CRGE, the implementation of some of which are still pending.

Moving forward with the GEM as a modelling tool for the 10YDP, the LEDS as well as the updated NDC, the focus of this technical analysis included the following:

- ▶ Ensure sector participation in the process of updating the overarching climate policy framework.
- ▶ Ensure full alignment of the updated NDC with the 10YDP and the LEDS.
- ▶ Ensure compatibility of the GEM with UNFCCC requirements and international best practice.
- ▶ Ensure the completeness of emission sources used to simulate an updated BAU pathway as well as ensure the smooth transition of policy scenarios assumed under CRGE ("abatement levers") to those identified under the GEM.

From this assessment, the decision was taken to base the updated NDC on the GEM. Projections in the GEM are based on assumptions far closer to actual GHG data compiled in Ethiopia's GHG inventories and sectoral data for available data vintages compared to original CRGE assumptions. Therefore, the raised ambition of the updated NDC for the mitigation part largely consists of the following:

- ▶ Higher robustness of GHG emissions pathways and targets through methodological improvements relating to more accurately capturing historical emissions through alignment with national GHG inventories and consistency with IPCC-2006 guidelines.
- ▶ An absolute emission reduction in the conditional scenario compared to historical base year emissions (2010).
- ▶ Clear demarcation between unconditional and conditional mitigation interventions, with a meaningful domestic contribution.
- ▶ Commitment to explore further ambition increases for subsequent NDC updates during the ongoing NDC commitment period.
- ▶ An enhanced ability to track progress on mitigation actions with improved M&E.
- ▶ Better adaptability of the model to potential future changes of emission sources or mitigation actions.

3.1 Approach

General approach to updating BAU and GHG reduction scenarios

Principally, **three aspects** are of primary concern when updating a BAU scenario.

The **first aspect** concerns the choice of the base year in which emission projections into the future are rooted. Ideally, the base year is chosen in line with reference values from, for instance, a comprehensive GHG inventory conducted in accordance with the IPCC 2006 guidelines. In the case of the GEM, all simulations are rooted in the year 2000 which represents the year in which the second comprehensive GHG inventory was undertaken for the first National Communication in Ethiopia and build on available data vintages – usually up until 2016. Since GEM is flexible, it is possible to continue to use the base year 2010 – used in the first NDC – and project BAU emissions onwards from there.

The **second aspect** concerns the completeness of emission sources contained in the future projections. The completeness of emission sources was verified, by comparing the key categories identified from the GHG inventory conducted for the most recent (second) National Communication and the 3-year inventory for 2014-2016. Unlike the underlying model of the CRGE strategy, the GEM fully accounts for emissions from Land Use and Land Use Change and Forestry (LULUCF). Given the importance of agriculture, in the sectoral aggregation the category “land use” (managed soils and livestock) was separated from “land use change and forestry” (LUCF, which includes net changes in carbon stock from land conversion and forestry). The sectoral aggregation of the GEM follows the key categories of recent inventories which are used as input data for emission projections. Some categories for which no stock-flow data is available needed to be dropped in the GEM. This is the case, for instance, for the subcategory waste incineration.

Emissions in LUCF originate from net changes in the stock of carbon in the country, largely driven from by land conversion and emissions from biomass energy use. Unlike the CRGE, which only considered forest land as a land category, this stock of carbon is determined by all relevant types of

land classes and their transitions from one to another, depending on a variety of interrelated variables, such as population growth and economic transformation goals. The land and managed soils sector include non-livestock agricultural activities as well as forestry. Like industry, real agricultural GDP and emission data from the inventories constitute the GHG-intensity of agricultural GDP and are driven by simulated growth rates, both of agricultural GDP and emission trends. The types of land classes considered in the GEM are the following each of which has proper specifications of carbon factors that determine the above ground and below ground stocks and flows of carbon:

- ▶ Human settlements
- ▶ Forest lands
- ▶ Agricultural land
- ▶ Fallow land
- ▶ Grasslands
- ▶ Wetlands

The cement and fertilizer utilization sectors have been also treated separately. For other industrial sectors, the GEM does not disaggregate the sector into subsectors with different emission intensities. The approach used in the GEM relies on emission data sourced from inventories and determines GHG intensity of real industrial GDP with industry-wide inventory data. Concurrently, energy emissions are calculated by type of fuel used for combustion, and total energy emissions depend, in turn, on growth rates for those sectors which present non-zero mobile or stationary emissions from fossil fuel combustion. Data used comes from the International Energy Agency and includes coal, petroleum, natural gas, electricity and biofuels.

On the one hand, this approach is in line with the 2006 IPCC guidelines and recognized as international best practice for GHG inventories, on the other hand, the output produced does not distinguish between the emission-intensity of subsectors using energy, e.g., the respective contributions of transport emissions vis-à-vis emissions from the combustion of fossil fuels for power generation.

The GEM had initially been calibrated to inform Ethiopia's draft LEDS. The following key modifications and additions regarding parametrization of the model have since been adopted for the purposes of the NDC update:²²

- ▶ Simulation of BAU, unconditional and conditional pathways.
- ▶ Integration of additional policies per sector divided by conditionality of action (e.g., grassland improvement, clinker substitution, household biomass energy use, livestock sector interventions etc.).
- ▶ Use of updated Global Warming Potentials according to the 5th Assessment Report by IPCC, e.g., for methane and nitrogen emissions.
- ▶ Use of updated emission factors from biomass energy use estimated based on UNFCCC approved baseline values and forecasted based on forest sector developments.

22 For all additions and modifications regarding policies, see description for each sector as well as Annex D5.

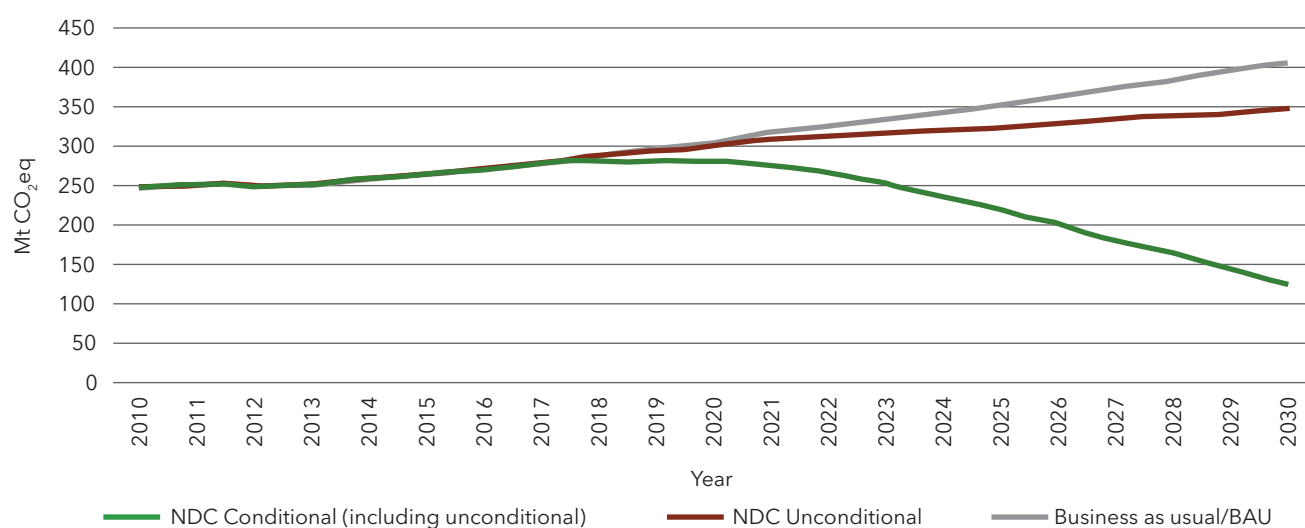
These choices significantly impact the BAU and GHG reduction pathways, which explains, *inter alia*, the significant differences to the first NDC. Compared to the emission estimate in the base year 2010 in the first NDC (150 Mt CO₂eq), the new emission level is estimated at nearly 247 Mt CO₂eq. This important difference is explained by the modifications and additions listed above. The collaborative effort has been documented and can be accessed in Appendix D 2.

3.2 BAU, conditional and unconditional GHG emission pathways

Business-as-usual projection

BAU emission projections of the updated NDC differ from the 1st NDC because of differences in the methods of estimation and the updated data used compared to the first NDC. In this regard, the updated base year emissions in 2010 are estimated at 247 million metric tonnes of carbon dioxide equivalent (Mt CO₂eq) which are projected to increase to a level of 403.5 Mt CO₂eq in the BAU scenario in 2030. The projections are further divided into three pathways notably unconditional, conditional and BAU. The unconditional pathway will result in absolute emission levels of 347.3 Mt CO₂eq in 2030, which represents a reduction against the revised BAU of 14% (-56 Mt CO₂eq) in 2030. The impact of further policy interventions proposed under the conditional pathway decreases absolute emission levels to 125.8 Mt CO₂eq such that the combined impact of unconditional and conditional contributions represents a reduction of 68.8% (-277.7 Mt CO₂eq) in comparison with the revised BAU emissions in 2030 (Figure 7). This ambitious pathway is conditional on international support and includes Ethiopia’s unconditional efforts.

FIGURE 7: NDC CONDITIONAL, UNCONDITIONAL AND BAU PATHWAYS.



Note: The line “NDC Conditional” represents the combined impact of unconditional and conditional elements.

It is crystal clear that the Ethiopian economy will undergo structural change in the coming years. The 10YDP signifies that the base of the economy will be anchored on the manufacturing sector.

In addition to this, there will be high pace of urbanization. These emerging realities will have their own cumulative repercussion on the pattern of emission. Thus, emissions from industry and energy are expected to increase by a larger percentage compared to other sectors (Table 3). Nevertheless, the agricultural sector, particularly livestock will remain as the main contributor to the GHG emission in the coming years followed by the Land Use and Forestry sector. Both sectors together represent 83% (LUCF 35% and livestock 48%) of total BAU emissions in 2030. Important to note is that LUCF accounts for emissions from biomass use e.g., for cooking and baking, which is the single largest driver of LUCF-related emissions. The contribution of each sector and sub-sector to aggregate unconditional and conditional emission reduction targets, ordered by mitigation potential in each of the respective sector categories are presented in Table 3.

TABLE 3: GHG EMISSION PROJECTIONS IN BAU, UNCONDITIONAL AND CONDITIONAL PATHWAYS

Sector	BAU emission projection (Mt CO ₂ eq)			Unconditional emission projection (Mt CO ₂ eq)		Conditional emission projection (incl. unconditional) (Mt CO ₂ eq)	
	2020	2025	2030	2025	2030	2025	2030
Industry	5.9	12.7	26.1	12.9	27.3	10.2	22.6
Energy	10.7	14.4	20.0	12.7	14.9	10.4	9.5
LUCF	125.0	133.8	140.2	112.6	91.8	21.4	-99.9
Livestock	146.4	169.5	194.8	168.7	192.9	162.8	180.0
Managed Soils	5.8	8.1	11.0	8.0	10.9	8.0	10.6
Waste	9.1	10.3	11.5	9.4	9.5	6.0	2.9
TOTAL (Mt CO₂eq)	302.9	348.8	403.5	324.3	347.3	218.8	125.8

TABLE 4: SECTORAL EMISSIONS IN THE BUSINESS-AS-USUAL/BAU AND MITIGATION POTENTIALS BY SECTOR AND CONDITIONALITY IN 2025 AND 2030

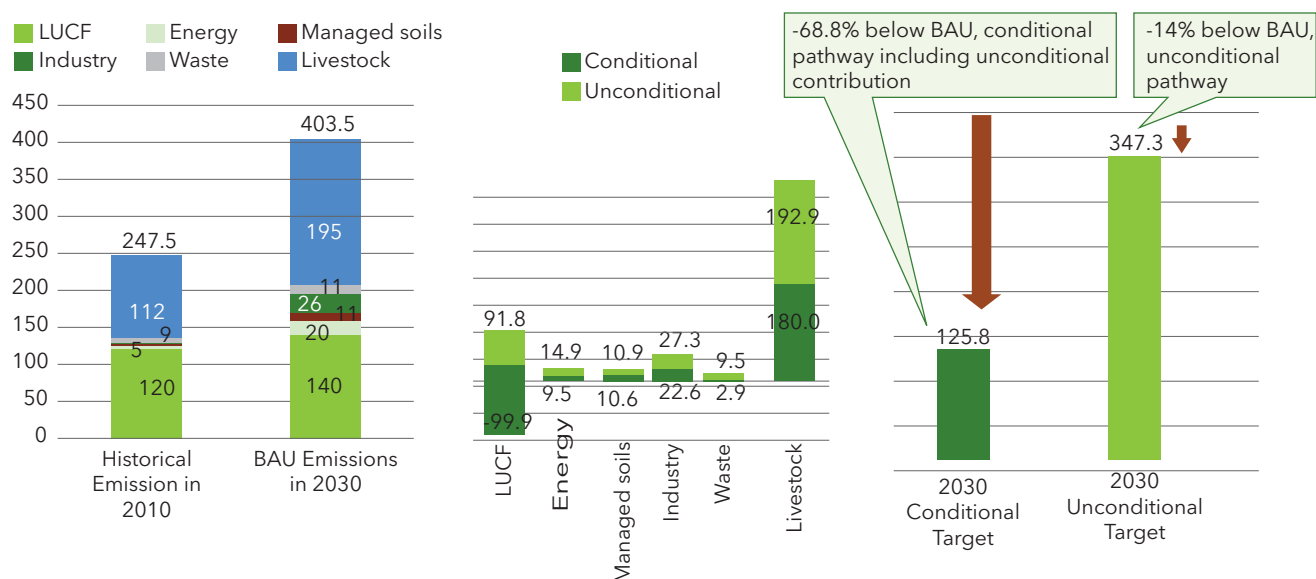
Sector	BAU emission projection (Mt CO ₂ eq)		Unconditional mitigation potential (Mt CO ₂ eq)		Conditional mitigation potential (incl. unconditional) (Mt CO ₂ eq)	
	2025	2030	2025	2030	2025	2030
Industry	12.7	26.1	-0.2	-1.2	2.5	3.5
Energy	14.4	20.0	1.7	5.1	4.0	10.5
LUCF	133.8	140.2	21.2	48.4	112.3	240.1
Livestock	169.5	194.8	0.8	1.8	6.7	14.8
Managed Soils	8.1	11.0	0.0	0.1	0.1	0.3
Waste	10.3	11.5	0.9	2.0	4.3	8.6
TOTAL (Mt CO₂eq)	348.8	403.5	24.5	56.2	129.9	277.7

Note: The column "Conditional scenario" represents the combined impact of unconditional and conditional elements on emission levels.

Whereas the mitigation potentials are represented at sector level considering all sector-relevant policies and variables as underlying interlinked drivers of emissions, activity level emission reductions are monitored and verified through sectoral MRV systems upon implementation of each activity in the context of the 10YDP. The projected emission reduction potential estimates by sector and pathways are described in Table 4.

The impact of these mitigation policies against the overall GHG pathway leads to the outcome illustrated in Figure 8.

FIGURE 8: OVERVIEW OF SECTORAL CONTRIBUTIONS TO ETHIOPIA'S MITIGATION TARGETS



3.3 Mitigation interventions and indicator selection

The unconditional and conditional scenarios in the GEM build on a set of policy interventions that have been chosen based on criteria including technical feasibility, alignment with existing plans and strategies, as well as availability of necessary data. Based on an assessment of specific interventions and continuous consultation, the final set of policy interventions have eventually been chosen from those included in the underlying model of the CRGE as well as those proposed in the initial version of the GEM.²³ It is important to note the importance of defining clear responsibilities for individual mitigation actions for both line ministries and sector focal points, in order to enhance the ambition of the updated NDC.

Table 5 provides an overview of the policies included in the unconditional and conditional scenarios. For a more detailed overview of technology adoption rates and differences in ambition between unconditional and conditional scenarios, please compare Appendix D 4. The context of the interventions is described in the subsequent sections for each sector.

²³ See Annex D1 for further details.

TABLE 5: POLICY INTERVENTIONS, INDICATORS AND POLITICAL RESPONSIBILITIES APPLIED IN BOTH SCENARIOS

Policy intervention	GEM sector	Indicator (Unit)	Political Responsibilities
Sustainable agriculture <ul style="list-style-type: none"> Increasing the share of agricultural land under sustainable management practices Reducing pre-harvest losses and land converted for agricultural infrastructure. 	LUCF	Hectares of agricultural land under sustainable management practices (ha)	Ministry of Agriculture
Grassland improvement <ul style="list-style-type: none"> Additional carbon sequestration through grassland improvement Lowlands Livelihoods Resilience Project 	LUCF	Hectares of grassland improved (ha)	Ministry of Agriculture
Household energy use <ul style="list-style-type: none"> Fuel switch: shift from residential biomass energy demand to electricity Biomass efficiency: Improved cookstoves 	LUCF	Energy demand shifted (TJ) # of improved cookstoves ²⁴ distributed and used Biomass use per household (t)	EFCCC
Reforestation <ul style="list-style-type: none"> Reforestation 3 million ha of land (conditional pathway) by 2030 20% moist Afromontane, 60% dry Afromontane, 10% acacia-commiphora, 10% combretum-Terminalia) 	LUCF	Area reforested/afforested (ha) Share of forest area of total land area (%)	EFCCC
Restoration <ul style="list-style-type: none"> Restoration of 5 million ha of land (conditional pathway) by 2030 and 9 million ha by 2050 10% moist Afromontane, 60% dry Afromontane, 10% acacia-commiphora, 20% combretum-Terminalia) 	LUCF	Area restored (ha) Share of forest area of total land area (%) GHG-intensity of agricultural GDP	EFCCC; Ministry of Water Irrigation and Energy and Ministry of Agriculture
Dairy, red meat and poultry intervention packages <ul style="list-style-type: none"> Enhancing efficiency and productivity in livestock subsectors 	Livestock	Number of improved cows ²⁵ GHG-intensity of agricultural GDP	Ministry of Agriculture
Agricultural mechanization <ul style="list-style-type: none"> Replacing cattle/oxen by tractors for farmers and smallholders 	Livestock	Number of heads of livestock reduced Number of tractors distributed	Ministry of Agriculture

24 In order to access international carbon and climate finance, it is important that cook stoves meet minimum energy efficiency standards, e.g., defined by UNFCCC or voluntary carbon standards as well as the International Organization for Standardization (ISO) which is supported by the Clean Cooking Alliance (e.g. on performance, safety, and durability see ISO 19867-1).

25 Improved cows refer to cows whose lifetime output or emission intensity is increased through the adoption of better feed or technology (e.g., milk yield). See Appendices D7 and D8 and LMP (2015).

Policy intervention	GEM sector	Indicator (Unit)	Political Responsibilities
Increase in the share of poultry <ul style="list-style-type: none"> Replacing non-dairy cattle stock by chicken (supply side) and inducing a demand shift from beef to chicken 	Livestock	Number of non-dairy cattle replaced	Ministry of Agriculture
Oilseed feeding <ul style="list-style-type: none"> Improved feeding to reduce emissions from enteric fermentation. 	Livestock	Improved feeding deployed (tons)	Ministry of Agriculture
Energy efficiency <ul style="list-style-type: none"> Economy-wide improvements of energy efficiency of appliances, machinery and other capital assets 	Energy	Efficiency parameters, e.g., efficiency of appliances and buildings (in %)	Ministry of Water Irrigation and Energy
Transport electrification <ul style="list-style-type: none"> Shifting transport energy demand from petroleum to electricity Increasing the share of electric vehicles 	Energy	Energy demand shifted (TJ) Share of electric vehicles over total fleet (%)	Ministry of Transport
Public transport <ul style="list-style-type: none"> Shifting transport energy demand from petroleum to electricity Increasing the share of public transport 	Energy	Energy demand shifted (TJ) Passenger kilometres travelled in public transport (km) Share of passenger kilometres travelled in public transport over total passenger kilometres travelled (%)	Ministry on Transport
Industry fuel switches <ul style="list-style-type: none"> Fuel switch 1: shift from industrial petroleum demand to electricity Fuel switch 2: shift from industrial petroleum demand to sustainable biomass 	Energy	Energy demand shifted (TJ) by type of fuel switch.	Ministry of Trade and Industry; Ministry of Water Irrigation and Energy
Clinker substitution <ul style="list-style-type: none"> Replacing clinker in cement with adequate and available materials without compromising cement properties 	Industry	Share of clinker in cement (%)	Ministry of trade and Industry
Waste management <ul style="list-style-type: none"> Reducing emissions from reduced waste generation rate per capita Reducing emissions from introducing ban on organic materials on landfills, i.e., waste separation and composting Reducing emissions from wastewater 	Waste	Rate of waste generation (tons p/c) Share of organic material per ton of waste on landfills (%) # of wastewater treatment plants constructed	EFCCC; Ministry of Urban Development and Construction; Ministry of Water, Irrigation and Energy

Land Use Change and Forestry (LUCF)

Emissions in LUCF originate from net changes in the stock of carbon in the country, largely emanated from land conversion and emissions from biomass energy use. Unlike the first NDC, which only considered forest land as a land category, this stock of carbon is determined by the dynamics among all types of land classes namely wetland, forest land, grass land, crop land, settlement, and other land. The result has shown that Land Use Change and Forestry (LUCF) have the largest mitigation potential as a result of highly ambitious reforestation and forest restoration targets. At the same time, LUCF is the second most important driver of emissions under BAU assumptions (Table 3). Policy interventions reduce the emission level in 2030 to -99,9 Mt CO₂eq (under the conditional pathway) which turns the entire sector into a significant GHG sink (Table 3 & Table 4). This equals a relative reduction of emissions of 171% (-240.1 Mt CO₂eq) compared to BAU emissions in LUCF by 2030. The unconditional pathway foresees a reduction of emission levels to 91.8 Mt CO₂eq, which represents a relative reduction of 34.6% of sectoral BAU emissions in 2030 (-48.4 Mt CO₂eq) (Table 6).

The potential for net emission removals in LUCF can be realized through massive reforestation and restoration of a total of up to 15 million hectares (ha) as a long-term forestry sector goal, based on Ethiopia's Forest Sector Development Plan, the Green Legacy Initiative and Reducing Emissions from Deforestation and Forest Degradation (REDD+) strategic actions. Realizing this ambitious plan will increase forest cover to 30% of the national territory by 2030. The other most important driver of LUCF emissions is biomass energy use for cooking and baking which according to international inventory guidelines are accounted under LUCF. Thus, replacing or improving household biomass energy use for cooking and baking leads to substantively reduced pressure on forestry resources. All in all, portrays the policy options of the sector in coming ten years presented in Table 5.

TABLE 6: EMISSION PROJECTIONS AND MITIGATION POTENTIALS BY CONDITIONALITY IN LUCF

Baseline/NDC Reference emission projection (Mt CO ₂ eq)		Unconditional mitigation potential (Mt CO ₂ eq)		Conditional mitigation potential (incl. unconditional) (Mt CO ₂ eq)	
2025	2030	2025	2030	2025	2030
133.8	140.2	21.2	48.4	112.3	240.1

Note: The column "Conditional scenario" represents the combined impact of unconditional and conditional elements on emission levels.

TABLE 7: POLICY INTERVENTIONS IN LUCF

Policy intervention	Indicator (Unit)	Political Responsibilities
Sustainable agriculture <ul style="list-style-type: none"> Increasing the share of agricultural land under sustainable management practices Reducing pre-harvest losses and land converted for agricultural infrastructure. 	Hectares of agricultural land under sustainable management practices (ha)	Ministry of Agriculture
Grassland improvement <ul style="list-style-type: none"> Additional carbon sequestration through grassland improvement Lowlands Livelihoods Resilience Project 	Hectares of grassland improved (ha)	Ministry of Agriculture
Reducing residential biomass use <ul style="list-style-type: none"> Fuel switch: shift from unsustainable biomass energy demand to electric stoves, renewable biofuels (e.g., residues) Biomass efficiency: Improved cookstoves 	Energy demand shifted (TJ) Number of improved cookstoves ²⁶ distributed and used Biomass use per household (t)	EFCCC, MoWIE
Reforestation <ul style="list-style-type: none"> Reforestation 3 million ha of land by 2030 (conditional pathway) 20% moist Afromontane, 60% dry Afromontane, 10% acacia-commiphora, 10% combretum-Terminalia) 	Area reforested (ha) Share of forest area of total land area (%)	EFCCC
Restoration <ul style="list-style-type: none"> Restoration of 5 million ha of land by 2030 and 9 million ha by 2050 (conditional pathway) 10% moist Afromontane, 60% dry Afromontane, 10% acacia-commiphora, 20% combretum-Terminalia) 	Area restored (ha) Share of forest area of total land area (%)	EFCCC

From the above LULC categories, forest land has been further disaggregated into the four main forest categories present in Ethiopia. Moreover, under guidance received from EFCCC, a distribution of effort among forest types of reforestation and restoration policies has been conducted (Table 8). This has substantively improved the representation of reforestation and restoration policies in the GEM.

This leads to a mean carbon factor for reforestation of 285.04 t CO₂ per hectare, and for restoration of 254.91 t CO₂ per hectare.

²⁶ In order to access international carbon and climate finance, it is important that cook stoves meet minimum energy efficiency standards, e.g., defined by UNFCCC or voluntary carbon standards as well as the International Organization for Standardization (ISO) which is supported by the Clean Cooking Alliance (e.g., on performance, safety, and durability see ISO 19867-1).

TABLE 8: TYPE OF FOREST CATEGORIES, RELATED CARBON STOCK FACTORS AND REFORESTATION AND RESTORATION EFFORT SHARES

FSR Type of forest	FSR Carbon stock factor 2013 (tons C/ha) both AGC and BGC	FSR Carbon stock factor 2013 (tons CO ₂ /ha) both AGC and BGC	Type of forest NFMS	Carbon stock factors NFI (t C/ha)	Carbon stock factors NFI (t CO ₂ /ha)	Delay time (years)	Share of reforestation target, in %	Share of restoration target, in %
High forest	107.24	393.1	Moist afro-montane	128.4	470.66	30	20	10
			Dry afro-montane	72.7	266.49	30	60	60
Woodlands	36.74	134.74	Acacia-Commiphora	38.4	140.76	30	10	10
			Combretum-Terminalia	46.2	169.35	30	10	20

Under the current BAU assumptions, the baseline deforestation until 2030 is net negative, projecting future annual forest loss of 26,868.31 ha/year, extrapolating most recent available data on tree cover loss from Global Forest Watch²⁷ between 2012 and 2019 (215,000 ha of forest loss divided by eight). Alternative baseline pathways have been simulated, including an optimistic scenario (110,000 ha of forest increase between 2013 and 2020) as well as pessimistic FREL extrapolations of 73,000 ha/year of net deforestation until 2030. Extrapolating the current trend was deemed most realistic while being conservative, as it represents the most recently available data and actual development. Moreover, baseline reforestation of 3.32 million hectares pre-2020 is assumed, through annual efforts achieved in (Ethiopian Calendar, EC): 2008 - 0.734 million ha; 2009 - 0.782 million ha; 2010 - 0.677 million ha; 2011 - 0.505 million ha; 2012 - 0.634 million ha. This accumulated area of baseline reforestation feeds into the BAU, unconditional and conditional pathways alike.

Under the conditional policy pathway, three million hectares of reforestation and 5 million hectares of restoration will be achieved by the end of the year 2030. The full target of 9 million additional hectares will be restored after 2030. Based on how the annual restoration effort breaks down after the NDC period, the 30% target could be reached sometime between 2036 and 2045. Over the NDC implementation period, the conditional pathway could achieve an increase in total forest cover of 25.6% (or 28,2 million ha). This is based on: a baseline forest cover of 17.2 million hectares in 2018; an annual baseline deforestation rate of 26,868.31 ha/year; an additional reforestation of

²⁷ <https://www.globalforestwatch.org/>

3 million ha; a baseline of 3.32 million ha of reforestation, and 5 million ha of additional restoration. The suggested distribution of efforts over the NDC period is to achieve 25% of reforestation and restoration targets over pre-2025 period and 75% in the period between 2025 and 2030. The actual distribution of effort in the GEM simulation could vary depending on political objectives of when to achieve the 30% forest cover target.²⁸ The unconditional policy pathway foresees 20% of the ambition of the hectare targets formulated under the conditional policy pathway.

It is important to note the assumption that the full carbon stock (and therefore contribution to sequestering CO₂ emissions) of reforested/afforested land is only assumed to be reached after 30 years of land changed to forest. Thus, a substantial share of the mitigation contributions from reforestation efforts undertaken during the NDC period (2021-2030) in the land sector will only be fully realized over the longer-term.

Livestock sector

The livestock sector exhibits the second most important mitigation abatements. It is also one of the most significant contributors to emission source under BAU assumptions contributing nearly 45% of total base year emissions in 2010 and almost half of the total BAU emissions in 2030. Given the economic importance and plans for a strong expansion of the sector, emission reductions are most visible in improved emission intensities of livestock production.

Policy interventions in this sector will reduce the emission level in 2030 to 180 Mt CO₂eq in the conditional pathway. This new estimate of current and projected heads of livestock in the country as well as other key parameters (e.g., revised emission factors) significantly elevate BAU emissions of this sector compared to the first NDC. The sector has relative reduction of emissions of 7.6% (-14.8 Mt CO₂eq) compared to BAU emissions in 2030. The unconditional pathway foresees a reduction of emission levels to 193 Mt CO₂eq, which represents a relative reduction of 0.92% of sectoral BAU emissions in 2030 (-1.8 Mt CO₂eq) (Table 9).

TABLE 9: EMISSION PROJECTIONS AND MITIGATION POTENTIALS BY CONDITIONALITY IN THE LIVESTOCK SECTOR

Baseline/NDC Reference emission projection (Mt CO ₂ eq)		Unconditional mitigation potential (Mt CO ₂ eq)		Conditional mitigation potential (incl. unconditional) (Mt CO ₂ eq)	
2025	2030	2025	2030	2025	2030
169.51	194.8	0.81	1.83	6.7	14.8

Note: The column "Conditional scenario" represents the combined impact of unconditional and conditional elements on emission levels.

It is a vivid fact that the emission reductions in the livestock sector are to be achieved through packages of policy interventions combining mitigation, efficiency gains and output growth in the

²⁸ The exact number of hectares reforested and restored per year can be amended in the GEM, depending on actual progress made during the NDC implementation period, taking into account 2050 long term targets.

sector. In this regard, sector specific strategy as well as national development plans have levied huge weight to the sector in a bid to reduce emission in the country. Thus, Livestock Master Plan (LMP), the 10YDP, and the CRGE strategy, have identified optimal policy interventions in the sector. Table 10 depicts the envisioned policies of the sector in the coming years emanating from these policy documents.

TABLE 10: POLICY INTERVENTIONS IN THE LIVESTOCK SECTOR

Policy intervention	Indicator (Unit)	Political Responsibilities
Dairy, red meat and poultry intervention packages <ul style="list-style-type: none"> Enhancing efficiency and productivity in livestock subsectors 	# of improved cows GHG-intensity of agricultural GDP	Ministry of Agriculture
Agricultural mechanization <ul style="list-style-type: none"> Replacing cattle/oxen by tractors for farmers and smallholders 	# of heads of livestock reduced # of tractors distributed	Ministry of Agriculture
Increase in the share of poultry. <ul style="list-style-type: none"> Replacing non-dairy cattle stock by chicken (supply side) and inducing a demand shift from beef to chicken 	# of non-dairy cattle replaced	Ministry of Agriculture
Oilseed feeding <ul style="list-style-type: none"> Improved feeding to reduce emissions from enteric fermentation. 	Improved feeding deployed (tons)	Ministry of Agriculture

Given its economic importance, this sector is expected to increase output of livestock product substantially over the next decade whilst concurrently decreasing emission intensity of agricultural GDP. This is notably due to efficiency and productivity gains in dairy, red meat and poultry sectors as proposed under the Livestock Master’s Plan (LMP 2015). All calculations of livestock emissions (feedbacks on agricultural GDP, BAU emissions, mitigation potentials) benefit from the updated livestock inventory that was conducted in 2020 according to Tier-2 IPCC methodology.

Further ambition increases can be achieved by reducing the number of livestock heads through additional policy interventions. For more details regarding the policy configuration, please refer to Appendices D4 and D7. Moreover, Appendix D8 provides new emission factors used in the current simulation for dairy cattle and dairy cow emission factors as well as new milk yield targets of the 10YDP. For further alignment between the 2030 NDC targets and 2050 LT-LEDS goals, it may be important to undertake further analysis of options to achieve development objectives such as food security and economic growth that represent alternatives to increasing livestock production since further decreasing GHG emissions, potentially to net zero by 2050 or beyond, may require adjusting sectoral output targets.

Energy sector

The energy sector has huge mitigation potential in the updated NDC next to livestock and LUCF. The lion's share of the grid-connected electricity generation comes from renewable sources. Moreover, the contribution from reducing biomass energy emissions has been already accounted for under the LUCF sector. The energy sector contributes 5% of total BAU emissions in 2030. Policy interventions in this sector will also reduce the emission level in 2030 to 9.5 Mt CO₂eq in the conditional pathway. This equals a relative reduction of emissions of 52.5% (-10.5 Mt CO₂eq) compared to BAU emissions in the energy sector (Table 2). The unconditional pathway foresees a reduction of emission levels to 15 Mt CO₂eq, which represents a relative reduction of 25.5% of sectoral BAU emissions in 2030 (-5.1 Mt CO₂eq) (Table 11).

TABLE 11: EMISSION PROJECTIONS AND MITIGATION POTENTIALS BY CONDITIONALITY IN THE ENERGY SECTOR

Baseline/NDC Reference emission projection (Mt CO ₂ eq)		Unconditional mitigation potential (Mt CO ₂ eq)		Conditional mitigation potential (incl. unconditional) (Mt CO ₂ eq)	
2025	2030	2025	2030	2025	2030
14.4	20.0	1.7	5.1	4.0	10.5

Note: The column "Conditional scenario" represents the combined impact of unconditional and conditional elements on emission levels.

Policy interventions in the energy sector target energy consumed by all sectors (Table 12). Investments in the transport sector can contribute to reducing the demand for petroleum through leapfrogging to green mobility solutions, including e-mobility, railways and non-motorized transport. This mitigation contribution does not yet include clean energy exports to neighboring countries, which are projected to reach more than 5,000 MW/year once the Great Ethiopian Renaissance Dam is connected to the grid. This could represent an additional significant mitigation potential of several Mt CO₂eq per year.

TABLE 12: POLICY INTERVENTIONS IN THE ENERGY SECTOR

Policy intervention	Indicator (unit)	Political responsibilities
Energy efficiency <ul style="list-style-type: none"> Economy-wide improvements of energy efficiency of appliances, machinery and other capital assets 	Efficiency parameters	Ministry of Water Irrigation and Energy
Transport electrification <ul style="list-style-type: none"> Shifting transport energy demand from petroleum to electricity Increasing the share of electric vehicles 	Energy demand shifted (TJ) Share of electric vehicles over total fleet (%)	Ministry of Transport

Policy intervention	Indicator (unit)	Political responsibilities
Public transport <ul style="list-style-type: none"> Shifting transport energy demand from petroleum to electricity Increasing the share of public transport, including railways 	Energy demand shifted (TJ) Passenger kilometres travelled in public transport (km) Share of passenger kilometres travelled in public transport over total passenger kilometres travelled (%)	Ministry on Transport
Industry fuel switches <ul style="list-style-type: none"> Fuel switch 1: shift from industrial petroleum demand to electricity Fuel switch 2: shift from industrial petroleum demand to sustainable biomass 	Energy demand shifted (TJ) by type of fuel switch.	Ministry of Trade and Industry

BOX 1: ACCOUNTING FOR EMISSIONS FROM BIOMASS ENERGY IN THE UPDATED NDC. FOR A DETAILED DISCUSSION OF THIS ASPECT SEE DEDICATED SECTION IN THIS CHAPTER

Emissions from biomass use for energy purposes (cooking and baking) are the second largest source of emissions in Ethiopia after livestock. According to international inventory guidelines emissions from biomass use are accounted under LUCF. Note that there is an ongoing debate about how to account for emissions from biomass energy use, as renewable biomass is considered to be emissions-free, whereas unsustainable use of biomass that is non-renewable leads to emissions. Given the continued importance of biomass energy in Ethiopia and other low-income countries for the foreseeable future, it will be important to work towards more appropriate evidence for how to account for these biomass related emissions at the inventory and NDC level. Not only is the robust and transparent accounting for emissions from biomass energy important for GHG inventories, but also for targeted policy making and Ethiopia’s participation in international carbon markets under Article 6 of the Paris Agreement, e.g., through clean cooking interventions.

The policy interventions in the energy sector predominantly consist of fuel switches or the adoption of low-carbon technologies, e.g., improved cookstoves or electric vehicles in individual and collective transport. The widespread use of biomass for energy services in Ethiopia’s socioeconomic context in which most of the population relies on biomass for basic energy services, particularly for cooking, is an important source of emissions for which international GHG accounting rules lack clear direction and potentially lead to under representing related emissions (Brack 2017).

Waste sector

The waste sector accounts for relevant emission sources with emissions emanating from municipal solid waste (MSW) generation, decomposition of organic components of waste on landfills, wastewater as well as from solid waste incineration. Mitigation action in the waste sector has a significant potential to reduce emissions. The sector contributes 3% of total BAU emissions in 2030. Despite small contributions to total BAU emissions, policy interventions in the sector can be

highly effective. Conditional interventions can reduce the emission level in 2030 to 2.9 Mt CO₂eq. This equals a relative reduction of emissions of 74.7% (-8.6 Mt CO₂eq) compared to BAU emissions in the waste sector. The unconditional pathway projects a reduction of emission levels to 9.5 Mt CO₂eq, which represents a relative reduction of 17.1% of sectoral BAU emissions in 2030 (-2.0 Mt CO₂eq) (Table 13). The envisioned policy interventions are depicted in Table 14.

TABLE 13: EMISSION PROJECTIONS AND MITIGATION POTENTIALS BY CONDITIONALITY IN THE WASTE SECTOR

Baseline/NDC reference emission projection (Mt CO ₂ eq)		Unconditional mitigation potential (Mt CO ₂ eq)		Conditional mitigation potential (incl. unconditional) (Mt CO ₂ eq)	
2025	2030	2025	2030	2025	2030
10.33	11.5	0.90	2.0	4.3	8.6

Note: The column "Conditional scenario" represents the combined impact of unconditional and conditional elements on emission levels.

TABLE 14: POLICY INTERVENTION IN THE WASTE SECTOR

Policy intervention	Indicator (unit)	Political responsibilities
Waste management	Rate of waste generation (tons p/c)	EFCCC; Ministry of Urban Development and Construction; Ministry of Water, Irrigation and Energy
<ul style="list-style-type: none"> Reducing emissions from reduced waste generation rate per capita 	Share of organic material per ton of waste on landfills (%)	
<ul style="list-style-type: none"> Reducing emissions from introducing a restriction on organic materials on landfills, i.e., waste separation and composting 	Number of wastewater treatment plants constructed	
<ul style="list-style-type: none"> Reducing emissions from wastewater 		

Note that updated waste collection rates have been included in the modelling. However, simulations could be improved if data regarding the use of collected waste were available.

Industry sector

The share of manufacturing industry has been increasing over the recent past years and the 10YDP portrayed that its share will reach as high as 17.2% of GDP by 2030. This in turn increases the emission from the sector in the coming years. Cognizant to this, commensurate interventions have been proposed to reduce emission coming from the sector in the coming years. These interventions will reduce emission levels to 22.6 Mt CO₂eq in 2030 in the conditional pathway. This equals to a relative reduction of emissions of 13.4% (-3.5 Mt CO₂eq) compared to BAU emissions. The unconditional pathway projects a reduction of emission levels to 27.3 Mt CO₂eq. Interventions will reduce emission levels to 22.6 Mt CO₂eq in 2030 in the conditional pathway (Table 15). This equals a relative reduction of emissions of 13.4% (-3.5 Mt CO₂eq) compared to BAU emissions. Unlike the underlying model of the CRGE, an important difference in accounting for emissions from industry in the GEM is that energy-related emissions in the industry sector, e.g., resulting from the combustion of fossil fuels, are included in the energy sector. This is in line with IPCC guidance on

sector classification for emissions accounting. Thus, industry emissions only refer to process-related emissions from industry.

The overview of projected BAU emissions in the industry sector as well as respective mitigation potentials for the unconditional and conditional scenarios presented in Table 15.

TABLE 15: EMISSION PROJECTIONS AND MITIGATION POTENTIALS BY CONDITIONALITY IN THE INDUSTRY SECTOR

Baseline/NDC reference emission projection (Mt CO ₂ eq)		Unconditional mitigation potential (Mt CO ₂ eq)		Conditional mitigation potential (incl. unconditional) (Mt CO ₂ eq)	
2025	2030	2025	2030	2025	2030
8.20	12.68	-0.12	-0.63	1.67	1.54

Note: The column "Conditional scenario" represents the combined impact of unconditional and conditional elements on emission levels.

The cement industry in Ethiopia is among the major sources of process-related emissions in the Ethiopian industry. Thus, the principal mitigation policy to mitigate process-related emissions in the sector is clinker substitution (Table 16).

TABLE 16: POLICY INTERVENTION IN THE INDUSTRY SECTOR

Policy intervention	Indicator (unit)	Political responsibilities
Clinker substitution* <ul style="list-style-type: none"> Replacing clinker in cement with adequate and available materials without compromising cement properties 	Share of clinker in cement (%)	Ministry of trade and Industry

* Dependent on the availability of adequate substitution materials in the domestic clinker production.

Most of industries in Ethiopia are small and micro such that they don't emit much GHG. The cement sub sector is the major source of process-related emissions in the sector. Apart from, Ethiopia plans in producing fertilizer which will increase GHG emission in the coming ten years. Cognizant to this, the principal policy to mitigate process-related emissions in the cement sector is clinker substitution while saving from increased Nitrogen use efficiency and shift away from synthetic fertilizer will be the prime mitigation strategy for the fertilizer sector.

Following recent inventory data, the cement industry in Ethiopia is a major source of process-related emissions. To mitigate process-related emissions introduction of clinker substitution has suggested as primary policy to mitigate IPPU emissions.

Unlike the CRGE, the clinker substitution policy does not foresee a decrease in the share of clinker in cement below 50% in order to maintain the desired properties of cement (IEA n.d., p. 33).²⁹

²⁹ The CRGE assumed a constant share of 45% of clinker to cement which has not been achieved to date and literature suggests may not be technically feasible.

To project emissions from clinkerization, i.e., emissions emanating from the decomposition of limestone in the clinker production process, the current and projected production data from the National Cement Development Strategy (2015-2025), as well as growth rates of construction GDP endogenously calculated by GEM. No imports of clinker have been assumed to update both the BAU emission projection of emissions from clinkerization, as well as for the estimates of mitigation potentials following Tier-1 IPCC methodologies (for more details regarding methodology, refer to Annex D5). Since the feasibility of this policy is strongly dependent on the availability of adequate additives to clinker, such as pumice, volcanic ash or slag, the action has been specified as fully conditional. Indicators that are appropriate to track progress on this policy intervention are listed in Table.

Note that despite mitigation efforts in the cement sector, given the high industrial growth rates and feedback structure of the model, the effect is visible only in a relative reduction of the GHG intensity of industrial GDP. Thus, the mitigation potential in Table in the unconditional pathway has a negative sign since absolute emissions in this pathway increase collinear to industrial output growth. This means that other variables in the unconditional and conditional scenarios of the GEM drive demand for industrial products to the extent that increased output compensates for the emission reduction efforts and leads to overall higher industry-related emissions even with the policy scenarios. Positive feedbacks include, among others, value addition, employment and export growth.

Managed soil sector

The main drivers of emissions from managed soils are linked to fertilizers, crop residues, as well as urine and dung. Thus, the sector is directly linked to the livestock sector which comprises all emission-relevant policy interventions. Managed soils are represented as a separate sector to distinguish between livestock and crop production, and to align with IPCC guidance. While livestock-related agriculture represents 48% of BAU emissions in 2030, GHG emissions from crop production on managed soils contribute 3% (Table 17).

Note that non-livestock agricultural practices have important feedbacks on labour productivity, employment and agricultural GDP in the GEM. Further work on the potential of soils to sequester GHGs may allow an increased mitigation potential in the future.

TABLE 17: EMISSION PROJECTIONS AND MITIGATION POTENTIALS BY CONDITIONALITY IN THE MANAGED SOILS SECTOR

Baseline/NDC reference emission projection (Mt CO ₂ eq)		Unconditional mitigation potential (Mt CO ₂ eq)		Conditional mitigation potential (incl. unconditional) (Mt CO ₂ eq)	
2025	2030	2025	2030	2025	2030
8.1	11.0	0.02	0.01	0.01	0.3

Note: The column "Conditional scenario" represents the combined impact of unconditional and conditional elements on emission levels.

Accounting for biomass energy under the updated NDC

Considering the uncertainty revolving around accounting for biomass energy emissions, this section elaborates on the assumptions and rationale to calibrate the emission factor for biomass energy according to forest sector developments. Adjusting forest sector targets results in significant impacts on emissions in LUCF not only because of sequestration, but also due to the availability of renewable biomass that households use for cooking and baking. The need for reforms of relevant accounting guidelines has recently also sparked debate internationally (e.g., Brack 2017). Given the paramount importance of fuelwood, charcoal and other sources of biomass energy for household use, this specific emission source due to its relevance as Ethiopia predominantly relies on biomass energy for cooking and baking are considered. This is supported by the fact that for 2020, the updated Ethiopian National Electrification Plan (NEP) estimates grid access rates of households to be around 38%. At the same time, despite growing population and energy demand, the NC2 reports a significant decrease of net emissions from the land use change and forestry sector from 102 Mt CO₂eq to in 2011 to 25.5 Mt CO₂eq in 2013. This may indicate a systematic underestimation of biomass-related energy emissions. This indication is further supported by UNFCCC-approved baseline approach used to calculate emission reductions for improved cookstoves, which relies on a more specific analysis of which share of biomass used for energy purposes can be considered renewable and therefore leading to zero emissions. Biomass used for energy purposes that is non-renewable because it has been extracted at unsustainable levels from unprotected areas, on the other hand, leads to significant emissions (CDM 2019). Thus an additional policy intervention on biomass energy use from households was included with due consideration to avoid potential double counting of emission resulting from deforestation.

Demand for biomass energy comes from households, given in TJ/year, based on IEA energy data for residential biofuel and waste energy demand. Emissions from using one TJ of energy from biomass are calculated by multiplying the amount of TJ/year with an emission factor for biomass energy use, e.g., for wood or charcoal. However, emission factors for biomass use are dependent on the fraction of non-renewable biomass (FNRB) that determines the share of biomass used from renewable sources, i.e., sustainably managed forests and grasslands, and that of biomass used that comes from non-renewable sources. An FNRB value for Ethiopia of 0.76 has been approved by UNFCCC (CDM 2019). This means that in 2017, 76% of the biomass used for household energy purposes come from non-renewable sources and need therefore be associated with an emission factor. The FNRB in turn, is dependent on forest sector developments, i.e., trends of deforestation, reforestation, restoration, protected areas or any other intervention with an impact on the biomass stock in the country. Given current trends in LUCF and the simulated projections of when LUCF may turn into a net sink, projected emission factors derived from the FNRB have been used in the GEM to simulate resulting GHG emissions (see Appendix D9):

Another adjustment to previous simulations resulted from closer examination of the IEA data source used in the GEM, it was possible to disaggregate the category of "biofuel and waste" (Hagauer et al. 2013; IEA 2020). This showed that the IEA category of "biofuels and waste" goes beyond woody biomass (to which the above mentioned FNRB factor applies) and includes categories like "residues" and "dung" which make about 1/3 of total residential biofuel demand in 2013. An emission factors

derived for woody biomass cannot be applied to these categories, but is zero since both “dung” and “residues” (e.g., coffee husks, sesame straw) are considered to be renewable sources of biomass. Hence, the suggestion to apply emission factors for biomass to only 66.1% of the total residential biofuel and waste demand (to exclude the waste/residue and dung elements (33.9% of the total). This significantly lowers emissions in all three scenarios and is one important reason of why the BAU emission levels decreased substantively compared to the projection submitted to UNFCCC on December 31st. For more details, see Appendix D9.

The significant differences that result from modifying these parameters clearly demonstrates the need to further improve accounting guidance for biomass energy emissions. This also implies further reconciling land sector and energy sector emissions sources and mitigation potentials as well as related parameters. This is crucial since previous international frameworks have been focused on reporting, but not differed regarding accounting for land use, land use change and forestry (LULUCF) related emissions reductions (compare Brack 2017). UNFCCC (2021) stresses that under the UNFCCC all emissions and removals from LULUCF are to be considered under a Party’s total emissions while the Kyoto Protocol restricts the accounting of LULUCF to emissions and removals from specific activities that are defined under its Article 3.3 and 3.4. The former, which is mandatory for Annex I Parties includes direct, human-induced deforestation, the latter, which is voluntary, includes forest land, cropland and grazing land management.

Under voluntary international carbon markets and sectoral schemes outside the UNFCCC like CORSIA, various interventions in both the forest (e.g., REDD+) and energy sectors (e.g., improved cook stoves) that claim mitigation impacts from reducing the biomass use; including the possibility to transfer such emission reductions internationally through carbon markets is currently being negotiated in the context of Article 6 of the Paris Agreement. Many countries have previously excluded LULUCF from mitigation targets, especially Annex I during the Kyoto Protocol era, but also a remaining number of countries in their NDCs; only less than a dozen provide a fully quantified LULUCF target (Fyson and Jeffery 2019). The Enhanced Transparency Framework (ETF) under the Paris Agreement as per decision 18/CMA. 1 requires countries to apply the IPCC 2006 inventory guidelines, even though there is flexibility for LDCs. We also note that LDCs like Ethiopia which can apply the ETF rules ‘at their discretion’. While explanatory notes to the guidelines (Task Force on National Greenhouse Gas Inventories, 2021) state that ‘CO₂ emissions from biomass combustion used for energy are only recorded as a memo item in the Energy sector; these emissions are not included in the Energy sector total to avoid double counting’, they also clearly argue that ‘the approach of not including these emissions in the Energy Sector total should not be interpreted as a conclusion about the sustainability, or carbon neutrality of bioenergy’. Given the ambition for all NDCs to eventually become economy-wide, further research and potentially improvements in international accounting frameworks for LULUCF biomass energy use may will be required in order to improve clarity, transparency and consistency around the approaches to determine GHG emissions and mitigation potentials from using biomass for energy purposes, in particular in the context of low-income countries in which large segments of the population continue to rely on biomass for basic energy services.

Setting 2025 & 2030 targets

The 10YDP defines sectoral targets for each sector and technology. Therefore, the proposed approach is to translate those politically defined goals into GHG emission pathways and mitigation targets, based on the modelling work described above.

Since the GEM works with semi-continuous time, i.e., providing the possibility to generate results on a monthly (or yearly) basis, both retrospectively (“backward projection”) and prospectively (“forward projection”), the GHG mitigation targets as resulting from sectoral output targets defined by 10YDP and other appropriate sectoral policy or strategy documents. The 2025 and 2030 target levels of emissions in the unconditional and conditional mitigation pathways have been extracted from the yearly emission projections provided by GEM. More information on target levels of emissions by year (e.g., in other years than 2025 or 2030) can be found in the Appendix D6.

The results provided by the GEM have been subject to significant variations because of substantial variations made in assumptions and data inputs to the GEM compared to the CRGE methodology. As a result, the absolute values of all GHG emission pathways are substantially different compared to those used by CRGE and the 1st NDC. The BAU pathway generated by GEM is higher than the original CRGE BAU, due to the difference in modelling methodologies, updated GHG inventories and GWPs. This represents a significant improvement and increase in ambition in terms of transparency and the relative emission reduction stays constant. Although the absolute GHG emission reduction in the conditional pathway by 2030 is lower than in the first NDC, the resulting emission level of 125.8 Mt CO₂ is significantly lower than in the first NDC, potentially eliminating “hot air”.³⁰

3.4 Conditional and unconditional contributions

Demarcating conditional and unconditional actions represents a considerable increase in ambition in comparison to Ethiopia’s first NDC which left the question whether an action is contingent upon international support unresolved. The most important aspect in supporting Ethiopia to determine this conditionality of action are strategic considerations guided by evidence-based decision-making, considering costs and benefits of the respective actions on emission levels, national accounts, health, integrity of ecosystem services etc, as well as an inclusive consultative process with stakeholders to agree on this demarcation. Key proposed decision parameters include mitigation cost over time, likelihood of available domestic finance, political barriers as well as potentially other factors (e.g., SDG contributions, non-monetary barriers).

Abatement costs describe the costs for the reduction of one t CO₂eq by a certain mitigation activity, which represent the net present value (NPV) of the mitigation costs (investment, operation and maintenance) minus potential revenues/savings (e.g., income from electricity or compost sales), divided by the amount of GHG emission reductions expected over the assessed period. The marginal abatement costs (i.e., costs minus revenues) are the cost of each mitigation option subtracting their reference case alternatives.

³⁰ This term is commonly used to refer to unrealistic GHG emission projections that artificially inflate a baseline scenario in order to increase mitigation outcomes in order to mobilize political capital of finance.

Domestic sources of finance, political barriers and potential contributions of mitigation actions to the SDGs are suggested to complement the decision-making process as “soft” factors.

Applying abatement cost analyses to 2030 faces the considerable challenge of uncertainties in costs and resource availability. An important strategic consideration is that almost all types of actions are not single investments (e.g., a power plant or landfill) but sector-wide and therefore programmatic, comprising many different individual activities to be implemented. Therefore, **demarkating conditional and unconditional contributions** demonstrates a meaningful domestic contribution that represents an increase in ambition to the previously submitted version of the first NDC without excluding actions from international support.

The recommended solution to the uncertainty on costs and domestic resource availability as well as technical and political feasibility is the definition of an **approximate guide** to establishing the conditionality of implementing the mitigation interventions presented in the updated NDC. Considering Ethiopia’s marginal historical responsibility, LDC status, domestic resource availability and sustainable development priorities, the following general approach is recommended:

- ▶ 20% unconditional mitigation contributions
- ▶ 80% conditional mitigation contributions

This demarcation will be assessed for its applicability for each intervention, with exceptions for those interventions with a low probability of implementation without international support because of high costs or marginal mitigation co-benefits including non-monetary barriers. These exemptions result in an overall level of conditionality that is lower than the general benchmark of 20%. The results of applying this strategic guide for conditionality, together with the exceptions, to each type of intervention leads to an overall result of 14% reduction from the BAU due to the unconditional contribution and 68.8% reduction from the BAU for the conditional contribution.

While there are no established and clearly defined standards or benchmarks for establishing conditionality provided by UNFCCC, our assessment is that these levels of conditionality are in Ethiopia’s best strategic interest since they do represent a meaningful contribution that is progression in ambition beyond the previous version of the NDC. What is clear, however, is that LDCs are formally granted a higher degree of flexibility regarding domestic contributions considering their marginal historical responsibility for GHG emissions and reporting requirements. Moreover, they are comparable to precedents established by neighbouring countries, in light of international expectations and regional comparisons.

Importantly, no intervention type will be categorized as fully unconditional as almost all interventions are typically implemented through a combination of domestic and international resources. It also helps preserve eligibility for international support from international climate finance and other means of implementation. Finally, it is important to clarify that this domestic contribution does not need to be achieved prior to drawing on international support but as an overall goal to be achieved by 2030.

RECOMMENDATIONS FOR MITIGATION

Ethiopia has put forward ambitious mitigation pathways in its NDC update. Achieving these will depend on successful mobilisation of both domestic (for unconditional targets) and international (for conditional targets) means of implementation the immediate actions for NDC implementation. To achieve this, the following recommendations are put forward:

- ▶ Streamline NDC implementation with national and sectoral strategies and policies, focusing on mainstreaming sectoral NDC targets with the 10YDP implementation strategy.
- ▶ Development of 2050 LEDES can build on NDC GHG emission pathways, taking into account the need for further analysis, policy development and resulting modelling assumptions for the period after 2030.
- ▶ Considering the anticipated composition of Ethiopia's emission sources, long term ambition increases to a potential net zero target by mid-century may require further policy alternatives in particular for livestock outputs targets and to a lesser extent industrial subsector (cement).
- ▶ Establish capacity to continue to update the methodology to model GHG emission pathways as data becomes available during the NDC implementation period in preparation for subsequent NDC updates.
- ▶ Improve institutional capacity for establishing the accounting and reporting processes on progress made towards implementing mitigation interventions of the NDC.
- ▶ Prepare a comprehensive and consolidated GHG inventory covering all emission sources that can serve as a basis for future Biennial Transparency Reports and subsequent NDC updates.
- ▶ Establish structured stakeholder engagement platforms (including academia, civil society and the private sector) to exchange information, policy development and emerging opportunities.

Further integrate monitoring, reporting and verification frameworks for mitigation interventions to achieve NDC targets, including at sectoral levels, with the MRV and M&E framework of the 10YDP.

DETERMINING ADAPTATION CONTRIBUTIONS

KEY MESSAGES ON ADAPTATION CONTRIBUTIONS

- ▶ Adaptation is a priority for the Government of Ethiopia given the devastating impacts of climate change in Ethiopia which are projected to magnify in future.
- ▶ 40 adaptation interventions covering Agriculture, Forestry, Water, Transport, Urban, Health, Land use and natural resource management, and Climate services and disaster risk reduction sectors have been prioritised. This includes mitigation interventions that have adaptation co-benefits.
- ▶ A quantified baseline and 2030 target for each adaptation intervention has been identified for guidance on implementation and monitoring of the updated NDC.
- ▶ Gender considerations are cross-cutting in the prioritised adaptation interventions.
- ▶ There is clear demarcation between unconditional and conditional adaptation interventions.
- ▶ Prioritised adaptation interventions are aligned with Ethiopia's current policy and institutional framework for easy and integrated implementation.
- ▶ There is a growing evidence base and quantification of impacts of climate change and vulnerability in Ethiopia across different scales, and sectors. Continued effort to update and quantify climate vulnerability is still needed.
- ▶ Adaptation interventions and official development interventions are closely linked and almost inseparable. A common and agreeable distinction criterion is needed in close consultation with stakeholders and in alignment with international best practices to distinguish adaptation interventions from official development interventions.

4.1 Adaptation policy and institutional arrangements

The Government of Ethiopia continues to make progress in adaptation policy, strategy development and implementation, as well as related institutional arrangements. This has contributed to an improved enabling environment for climate change adaptation through resource mobilisation and capacity building initiatives. The Climate Resilient and Green Economy Strategy (CRGE), developed in 2011, sets out a vision for Ethiopia to become a lower-middle-income country by 2025. The Climate Resilience component of the strategy is predicated on sustainable economic development, highlighting both the country's prospects for growth and its vulnerability to climate, as well as the changes required to achieve greater resilience. However, the focus of the CRGE is on mitigation, leaving a gap in the adaptation landscape. This is a striking gap as Ethiopia is a Least Developed

Country (LDC), highly vulnerable to climate impacts and contributes almost negligible GHG emissions compared to global emissions.

In response to the gap in adaptation planning at the national, sub national and sectoral levels, the Government of Ethiopia has developed five sectoral climate resilience strategies. This is a clear affirmation of Ethiopia's commitment to contributing to the goals of the Paris Agreement considering Ethiopia's national circumstances. These sectoral climate resilience strategies were developed in line with the latest guidelines.³¹ They are designed to support relevant ministries and regional offices, within the Government of Ethiopia, to integrate the CRGE strategy into annual and medium-term sectoral plans. These climate resilience strategies cover: agriculture and forestry, transport, health, water and energy, and urban development and housing sectors.

In the 2015 Paris Agreement, the National Adaptation Plan (NAP) process was highlighted as a key mechanism for achieving the global goal on adaptation based on an iterative and country-driven process that draws on existing adaptation planning initiatives where possible. Ethiopia developed its **National Adaptation Plan 2017 (NAP-ETH)** to provide a framework for its response to climate change by building adaptive capacity and enhancing the country's resilience. The Plan included 18 adaptation options and 5 strategic priorities, to be implemented between 2017 and 2030. These options and priorities serve as guidance for preparing Ethiopia's priority adaptation actions during this NDC update period. The NAP-ETH also strengthens the integration of adaptation planning processes, through effective institutions and governance structures; sourcing finance for implementation and capacity development; strengthened systems for disaster risk management, and integration among both sectors and levels.

The **National Adaptation Plan (NAP) Implementation Roadmap** (2019) elaborates implementation strategies for the adaptation options and strategic priorities identified in the NAP-ETH. The aim of the roadmap is to highlight key enabling actions that are crucial to actualising Ethiopia's NAP within the agreed timelines. The roadmap also highlights the role of key actors whose collective response will contribute to successful implementation of the NAP-ETH, as suggested by the UNFCCC guidelines. The roadmap provides guidance on implementation of actions identified through the NAP process as well as unearthing adaptation finance gaps and needs.

The government of Ethiopia has made progress in setting up a robust M&E system for adaptation monitoring and evaluation that will require continuous strengthening over time. Accompanying the system, an adaptation M&E technical paper that identifies indicators and entities responsible for delivering each of the 18 NAP adaptation options is a useful and practical tool. The technical paper also makes linkages to Ethiopia's long-term priorities, thus providing a sound foundation for designing and setting up the adaptation M&E system for the enhanced NDC.

Most recently, a **Resource Mobilisation Strategy for NAP-ETH** was developed in June 2020 in response to the strategic priority in the CRGE Strategy to "establish effective and sustainable funding mechanisms". Additionally, the NAP-ETH implementation roadmap identifies the development of a resource mobilization strategy as a short-term priority for the 2020-2021 period. This resource mobilisation strategy helps the Government of Ethiopia to identify and scale up financing

31 Federal Democratic Republic of Ethiopia, Environment, Forest and Climate Change Commission, Integrating the Climate-Resilient Green Economy (CRGE) Strategy in Sector Development Plans: Guideline for Ministries and Regional CRGE Implementing Entities.

for adaptation. The objectives of the strategy are to identify adaptation financing needs and gaps, explore financing options, and to set out next steps for the short and medium term.

SECTORAL CLIMATE RESILIENCE STRATEGIES

The **Climate Resilience Strategy for Agriculture and Forestry** focuses on crops, livestock, and forestry sectors. Its main objectives are to identify the impacts of current weather variability and projected future climate change on Ethiopia; identify ways to build climate resilience and estimate the cost of required responses, including identification of the steps necessary to finance and implement efforts to build climate resilience.

The **Climate Resilient Transport Sector Strategy** sets a framework for the Government of Ethiopia to deliver an integrated, modern transport system with a strong focus on multi modal transportation links and customer service. The vision of this Strategy is to ensure that Ethiopia's national development, poverty reduction and climate resilience goals are promoted by the transport sector.

The **Climate Resilience Strategy for Water and Energy** mirrors the vision and targets of the CRGE strategy. It identifies climate change challenges for the water and energy sectors, identifies responses as well as laying out implementation plans. The strategy had identified 11 strategic priorities which are broadly within electric power, irrigated agriculture, access to energy, and access to WASH focus areas. The Strategy estimates that implementation of the strategic priorities will initially require at least \$895m up to 2030. However, further analysis is needed to identify the optimal means of implementing these priorities and for more comprehensive costing and development of credible implementation plans. This sum does not include the significant capital investment needed to deliver energy and water infrastructure. The Energy Sector Masterplan Study indicates that around \$48 billion of investment in the energy sector alone will be required over a 20-year period.³²

The **National Health Adaptation Plan to Climate Change (H-NAP) 2017-2020** was developed with inputs from the National Framework and Health Vulnerability and Adaptation Assessment report. The H-NAP outlines observed and anticipated climate change impacts to the health sector, presents strategic approaches and key intervention areas as well as implementation arrangements. The plan gives guidance on indicators that will be used for monitoring and evaluation and recommends conducting a baseline survey as the first step. The Federal Ministry of Health (FMOH) will implement the H-NAP by mainstreaming it to various programmes and by strengthening its partnership with relevant line ministries and development partners.

The **Climate Resilience Strategy for Urban Development and Housing** has identified three strategic priorities in the areas of urban planning and risk management, local/community economic development and urban infrastructure and services. Together, the strategic priorities ensure the development of urban climate resilience with communities as the centre of what Ethiopia is seeking to achieve. The strategy indicates that \$3 billion is needed to implement the identified strategic actions up to 2030. This budget will be needed to develop climate resilience in the 80 cities and towns identified as being of tertiary level and above³³. The strategy also cautions that further analysis is needed to identify the optimal way of implementing these priorities and for detailed costing and credible implementation plans to be developed.

Ethiopia continues to be a leader in establishing a robust policy framework for climate resilience at both the national and sectoral levels. These national and sectoral climate resilient strategies need to be implemented with continued capacity enhancement, resource mobilisation and practicable institutional arrangements.

32 Federal Democratic Republic of Ethiopia, Climate Resilience Strategy: Energy and Water (2015).

33 Federal Democratic Republic of Ethiopia, Climate Resilience Strategy: Urban Development and Housing (2017).

The Government of Ethiopia recently commissioned a comprehensive review of their Flagship Climate Resilient Green Economy Strategy. The review appraised the experience of 10 years of implementation and found that there were strong systems and process accompanied by comprehensive guidance. Nevertheless, the review also found that there was less experience in actual implementation of the systems, processes and guidelines. Recommendations included shifting support from developing guidance to implementation of guidance.

In terms of policy, the CRGE review found that there was insufficient account taken by sectors in the preparation of their own sector strategies and as a result, opportunities were missed to help implement the CRGE strategy. To ensure that sector strategies take the NDC into account in their preparation and implementation, it is important that a national climate change vulnerability and risk assessment be undertaken (see box below). This would provide a standard evidence base to underpin the preparation of all sectoral initiatives. The evidence from the national assessment could be used at the beginning of the scoping of a new sectoral initiative. This would ensure early discussions consider climate change resilience and adaptation needs. Furthermore, this evidence base could also be used to create an NDC alignment assessment where the NDC actions could be used as checklist criteria, which all new sectoral strategies and policies will be compared against to check whether the following are applicable.

- ▶ The new initiative is consistent with and does not undermine the NDC actions, and
- ▶ All opportunities to implement NDC actions are maximised in the implementation of the new initiative.

A NATIONAL VULNERABILITY AND RISK ASSESSMENT FOR ETHIOPIA

A national vulnerability and risk assessment would provide an important evidence base for underpinning the preparation of national sectoral policies, plans, strategies and programmes. Vulnerability and risk assessments can be an important means of mainstreaming critical climate resilience thinking into the development of national initiatives. However, on their own they do not guarantee that new initiatives will automatically consider climate resilience. Sectors must lead on the execution of the assessment as well as understand and agree with the evidence presented. Consequently, such assessments should be widely and deeply consulted on as they are undertaken. Furthermore, sectors should be required in one way or another to consider its contents at the earliest possible stage in the creation of a new initiative in their sector. Early consideration of the evidence provided by a national vulnerability and risk assessment can influence key early decisions on the scope and direction of that initiative. If an assessment is only considered after the policy is drafted, the scope to influence is limited, as many critical decisions have already been taken and potentially more resilient options already discarded.

Typically, a national climate change vulnerability and risk assessment would consider the following:

1. An assessment of current vulnerability by sector - **including a review of past extreme events (frequency and magnitude), the impacts of the events and the capacity of institutions to manage the impacts. This current vulnerability can pick up any change that is already happening and the current state of adaptive capacity.**
2. Projections of future climate change - **Typically, this is given in 30-year time periods and can usefully be presented as scenarios as there is still substantial uncertainty over the extent of climate change to be expected. Presenting climate scenarios can supply a range of the likely change. It should be possible to communicate these scenarios to non-experts clearly and concisely, so that the implications can easily be understood. A mixture of figures, diagrams and narrative text can be used.**

A NATIONAL VULNERABILITY AND RISK ASSESSMENT FOR ETHIOPIA (CONTD...)

3. An assessment of future vulnerability - **based on an understanding of current vulnerability and future likely change, a review of the scientific literature can help provide useful evidence of future vulnerability as well as consultation with sectoral stakeholders.**
4. An assessment of the risks/impacts by sector - **based on the future vulnerability together with a combination of literature review and sectoral consultations.**
5. Conclusions and recommendations - **Provide guidance on required immediate actions.**

Finally, it is important that the private sector is one of the critical stakeholders to engage with on all climate change adaptation interventions. Consultation with the private sector typically must include the following principles:

- ▶ Awareness - the private sector must be made aware that climate change is an increasing concern.
- ▶ Understanding - the private sector must not only be made aware of the issues but also understand that the government intends to act but wants to do so in collaboration with the private sector.
- ▶ Flexibility - the private sector tends to be busy and can find it difficult to always engage at times that are convenient for government. Working around private sector availability is important.
- ▶ Consistency - It may be helpful to set up a standing forum to engage representatives of critical private sector actors on a regular basis. This forum can then be used to push the message out more widely.
- ▶ Accountability - The forum can be used to consult on proposed new legislation and regulations. It will be important to be transparent and inclusive in the membership of the forum. Consultations and agreed outputs of meetings should be published and made publicly available.
- ▶ Agreement - joint actions and strategies could be developed between the government and the private sector in areas of mutual critical importance.

4.2 Challenges in adaptation and resilience

Despite Ethiopia's many achievements in policy development and implementation, institutional re-alignments, capacity building, resource mobilisation, and stakeholder coordination, there are areas in these spheres that still require strengthening, as is expected of any development processes. One of the most pressing areas that needs improvement is streamlining the climate change institutional architecture to unlock the maximum benefits from current investments in climate change adaptation. Moreover, although the CRGE structures are working well at the national level, the capacity of the regional and local institutions to discharge the national climate policy or climate finance delivery mandates still demands additional capacity, planning and funding.³⁴

³⁴ Irish Aid, Ethiopia Country Climate Risk Assessment Report (2018).

While the NAP had another key companion document – the M&E technical paper, which identifies indicators and the responsible entities for delivering each of the 18 NAP adaptation options, – there is still a need to develop a robust monitoring and evaluation framework for adaptation. The lack of a current national vulnerability and risk assessment – to serve as a baseline for measuring adaptation progress and impact of interventions (to reduce vulnerability and increase climate resilience) – is another area of potential improvement. This also applies to regional and Woreda level risk and vulnerability assessments that are either lacking, or limited link with the CRGE Facility and national counterparts. Compared to the mitigation component which has received significant attention in setting and revising GHG baselines and targets, adaptation planning has been based on anecdotal evidence from programme, sectoral and regional vulnerability assessments, that do not provide a comprehensive and integrated representation of national, regional and Woreda level circumstances. This is also reflected in Ethiopia’s first NDC that has a clear baseline with specific targets for mitigation but no quantitative baseline for the adaptation component.

4.3 Prioritisation of adaptation interventions

There is a pressing need for climate change adaptation across all sectors in Ethiopia, given the nation’s vulnerability to climate change impacts, including hazards such as drought and (increasingly, in some locations) floods. Within this context, prioritization of adaptation interventions becomes a powerful approach to ensuring the effective and efficient utilisation of the scarce resources available. Most recently, in 2019, the formulation of Ethiopia’s National Adaptation Plan (NAP), spanning the agriculture, forestry, health, transport, energy (power), industry, water, and urban sectors re-affirmed this importance.

Furthermore, the NAP Implementation Roadmap of 2019 expanded the options outlined in the NAP with actions, categorised into short term priorities (such as capacity building, strengthening the enabling environment, and promoting research) for the 2020-2022 period, and long-term priorities (with sector-specific activities) for the 2025-2030 period. Given that most of the short-term priorities were targeted for 2020, and the NDC’s timeframe is through 2030, the long-term priorities are more relevant for consideration for the NDC.

With the addition of the long-term priorities from the NAP Implementation Roadmap, the number of potential adaptation commitments to consider for inclusion in the NDC totals 52. While the selection of 18 adaptation options under the NAP and the numerous adaptation actions under the Implementation Roadmap already reflects a lengthy, rigorous, and officially endorsed prioritization process that entailed in-depth stakeholder participation (as detailed in the NAP’s methodology), and was informed by an extremely broad range of national, sectoral, and technical studies (as noted in the NAP Implementation Roadmap methodology), there is still a need, in the context of NDC development, to focus on a further prioritised sub-set of interventions. This is because the NDC represents the core of a nation’s international commitments on climate change and becomes part of the multilateral UNFCCC process. Therefore, elevating a focused list of the most strategic adaptation priorities into the NDC will help, in turn, focus domestic and international resources on the items that Ethiopia will be most accountable for to the international community.

Prioritization criteria were developed to select the optimal interventions (from within the NAP's adaptation options and the NAP Implementation Roadmap's supplementary adaptation actions). The internationally recognized and widely used PESTLE framework (an analytical framework for multi criteria decision-making) was applied, with each of the PESTLE categories - Political, Economic (and Financial), Social, Technological, Legal (and Institutional), and Environmental - defined with four relevant criteria. This criteria framework is captured in Table. ³⁵

In using the prioritization criteria to evaluate each adaptation option (from the NAP) and each long-term adaptation action (from the NAP Implementation Roadmap), the following steps were taken for each of the 52 interventions screened (i.e., *screening steps for prioritization of adaptation actions*):³⁶

1. Cross-referencing with the Ten Years Development Plan
2. Cross-referencing with the National Adaptation Plan (since all interventions were drawn either from the NAP's adaptation options or the NAP Implementation Roadmap's long-term adaptation actions, the interventions scored high, across the board).
3. Cross-referencing with the relevant sectoral climate resilience or adaptation strategy, where such strategies exist (i.e., the agriculture and forestry climate resilience strategy; the water and energy climate resilience strategy; the transportation climate resilience strategy; the health adaptation plan; and the urban climate resilience strategy), to check for alignment.
4. Scanning global literature to find broad signals regarding the relative cost-effectiveness of the adaptation option (i.e., level of investment of typical projects).
5. Scanning global climate finance institutions' approved projects to find broad trends regarding the relative prevalence of similar interventions amongst funded projects (e.g., from the Global Climate Fund, the Adaptation Fund, the Climate Investment Funds, and the Africa Climate Change Fund).
6. Scanning online literature on privately funded climate change adaptation initiatives to find broad trends regarding the relative prevalence of similar interventions.
7. Scanning online literature on economic benefits of climate change adaptation to find broad signals regarding the economic growth and development ramifications of similar interventions.
8. Cross-referencing with the 169 targets linked to the 17 Sustainable Development Goals to check for alignment.
9. Cross-referencing with the Sendai Framework for Disaster Risk Reduction to check for alignment.

35 Note that the prioritization criteria framework has been designed to be easy to modify as needed and can be refined based on the preferences of stakeholders or key decision-makers. At present all 24 criteria have been assigned equal weight but based on stakeholder inputs and guidance from relevant government representatives, weights can be modified to allow for certain criteria to play a more significant role in determining prioritization.

36 Note that this screening or evaluation can be undertaken by stakeholders, who may arrive at divergent assessments.

10. Scanning online literature on gender-responsive adaptation interventions to find broad signals regarding the types of adaptation activities that appear to allow for more gender-sensitive and gender-mainstreamed approaches (this yielded no clarity or discernible trend; the insight derived was that any activity or intervention has the potential to be designed and implemented in a gender-responsive manner, if the project proponent explicitly intends to do so and take affirmative steps to build in gender-specific aspects; since all 52 screened interventions had such potential, but since there is no reliable evidence yet that they will in fact demonstrate such elements when operationalised, they all were scored at a moderate level). In addition to this, specific gender responsive actions and indicators have been included in Table as a starting point for mainstreaming gender considerations. However, further gender mainstreaming is needed at national and sectoral level planning.
11. Scanning online literature on livelihoods and job-creation benefits of climate change adaptation to find broad signals regarding the livelihoods and job-creation ramifications of similar interventions.
12. Scanning online literature on technological investments required for climate change adaptation to find broad signals regarding; the technology-intensive nature of similar interventions; the technological trade-offs identified or described for similar interventions (i.e., alternate uses of such technology); risks identified or described for similar interventions; and opportunities for technological leapfrogging or advancement identified or described for similar interventions.
13. Cross-referencing with the 88 recently revised CRGE indicators (and the baseline data for the 88 indicators) to check for availability of a suitable indicator, which will strengthen M&E.
14. Cross-referencing with the NAP Implementation Roadmap, to verify the identification of a responsible institution, to check whether suitable institutional arrangements exist to implement the intervention.
15. Cross-referencing with the recently concluded CRGE Implementation Assessment, and the NAP Implementation Roadmap, to verify the existence of appropriate sectoral policies, strategies, and plans, to check whether suitable legal and regulatory frameworks exist to support implementation of the intervention.
16. Cross-referencing with the African Union's Agenda 2063, and the AU's draft strategy on climate change 2015 (noted in Decision 15/5 of the African Ministerial Conference on the Environment), to check for alignment.
17. Scanning online literature (principally the IPCC's Fifth Assessment Report, Working Group II's contribution on impacts, adaptation, and vulnerabilities, 2014, and the OECD's DAC's Rio Markers handbook on climate change finance) to find broad signals on the degree to which an intervention is regarded as effective in reducing vulnerability and building adaptive capacity.
18. Scanning online literature on environmental co-benefits of climate change adaptation to find broad signals regarding the co-benefits identified or described for similar interventions.

19. Scanning online literature on mitigation co-benefits of climate change adaptation to find broad signals regarding the mitigation co-benefits identified or described for similar interventions; and
20. Scanning online literature on environmental risks of climate change adaptation to find broad signals regarding the risks identified or described for similar interventions.

The results of our screening, for each sector, are available in Appendix B.

TABLE 18: PRIORITIZATION CRITERIA FOR SELECTION OF ADAPTATION COMMITMENTS FOR ETHIOPIA'S UPDATED NDC, BASED ON THE PESTLE FRAMEWORK

Criteria Category	Criteria (in PESTLE Framework)	Explanation of Criteria	
PRIORITIZATION CRITERIA	Political	Alignment with the Ten Years Development Plan	To what extent is the adaptation intervention in alignment with Ethiopia's development vision, in terms of aims and objectives?
		Alignment with the National Adaptation Plan (NAP)	To what extent is the adaptation intervention in alignment with or reflective of Ethiopia's National Adaptation Plan (NAP-ETH)?
		Alignment with relevant sectoral climate resilience strategy	To what extent is the adaptation intervention in alignment with the relevant sector's own climate resilience strategy?
	Economic (and Financial)	Cost-effectiveness	How cost-effective is the adaptation intervention, relative to other potential options to reduce the same vulnerability?
		Suitability for resource mobilization	How strong a candidate is the adaptation intervention, in terms of attracting funding from climate adaptation finance sources?
		Suitability for private sector investment	To what extent can the adaptation intervention attract or leverage private sector finance (including commercial lending)?
		Economic development co-benefits	To what extent does the adaptation intervention bring co-benefits for economic growth and development?
	Social	Alignment with Sustainable Development Goals (SDGs)	To what extent is the adaptation intervention in alignment with or reflective of the Sustainable Development Goals and Agenda 2030?
		Alignment with the Sendai Framework for Disaster Risk Reduction	To what extent is the adaptation intervention in alignment with or reflective of the Sendai Framework for DRR (2015-2030)?
		Gender-responsiveness and equity	To what extent is the adaptation intervention suitable for gender responsiveness and gender mainstreaming in implementation?
		Ability to support sustainable livelihoods and job-creation	To what extent is the adaptation intervention likely to generate and maintain sustainable livelihoods, and to create new jobs?

Technological	Technological ease, trade-offs, risks, opportunity to leapfrog	How easy is the adaptation intervention to implement, in terms of technological tools and investment needed? How minimal are the trade-offs of deploying technology for the purpose of the adaptation intervention, versus other purposes? How minimal are the risks of deploying technology for the purpose of the adaptation intervention, in terms of unintended consequences? To what extent does the adaptation intervention enable the sector or nation to advance technologically, leapfrogging to more mature technologies?
Legal (and Institutional)	Availability of CRGE indicator and baseline data	To what extent does the adaptation intervention lend itself to effective M&E within the current M&E system, with an indicator and baseline value?
	Suitability for existing institutional arrangements	To what extent is the adaptation intervention implementable effectively within existing institutional architecture, mandates, and mechanisms?
	Feasibility within existing legal and regulatory frameworks	How feasible is the adaptation intervention within the current legal and regulatory set-up, without requiring legal or regulatory changes?
	Alignment with regional and continental obligations	How aligned is the adaptation intervention with regional and continental agreements, policies, and other commitments that impose obligations?
Environmental	Ability to reduce vulnerability and build adaptive capacity	How effective is the adaptation intervention in terms of targeting the major vulnerabilities of the sector, and building adaptive capacity in the sector?
	Environmental co-benefits	To what extent does the adaptation intervention bring co-benefits for environmental protection, management, resource-efficiency, and conservation?
	Mitigation co-benefits	To what extent does the adaptation intervention bring co-benefits in terms of reduced greenhouse gas emissions, or carbon sequestration and abatement?
	Environmental risks	How minimal are the environmental risks of implementing the adaptation intervention, in terms of unintended consequences?

Scoring Scale: High (3), Medium (2), Low (1), Unknown (0)

Note: the final selection of actions was guided less by the scoring than by recommendations and inclusions by the Govt. of Ethiopia.

In the first instance these criteria were applied to the 52 interventions. The idea of the first shortlisting was to provide greater focus to the NDC in terms of adaptation but still supply the breadth of coverage required. Consequently, any intervention that scored less than 2 for its composite (total) average score has been excluded from the NDC. With 16 interventions scoring less than 2, that left 36 adaptation commitments for inclusion in the NDC. These 36 actions were presented to the GoE and then widely discussed and amended at a three-day workshop (23-25th of December 2020) by representatives of the relevant government sectors. The outcome of that consultation left 45 Actions which are elaborated on in the tables in section 4.4, below. Further consultations with sectors and the GoE between February and March 2021 finetuned the adaptation actions to 40 adaptation contributions.

4.4 Indicator selection, setting a baseline and 2030 targets

The targets suggested in Table are drawn from the Roadmap and Ethiopia's 10YDP. Furthermore, the NAP had another key companion document - the M&E technical paper, which identifies indicators and the responsible entities for delivering each of the 18 NAP adaptation options, with linkages to the long-term priorities. These two key documents have been supplemented by the final (revised) CRGE indicators, co-developed by the EFCCC and Environment and Climate Research Centre (ECRC) at Policy Studies Institute (PSI). These indicators are matched with baseline data from past years (2015-2018). Some indicators and some baseline values reflected in the table below are drawn from the CRGE indicator reference sheets (the most recent, i.e., 2018, values). Additional relevant indicators, baselines and targets were obtained from the relevant sections of the 10YDP which have a baseline year of 2020/21 with targets running up to 2029/30.

Note: The phrasing of some of the interventions has been modified slightly from the language used in the NAP and NAP Implementation Roadmap. The interventions themselves are the same, and the content of each has not been modified. However, to strengthen the climate resilience linkage and to differentiate the interventions from more general socio-economic development and sectoral development activities - and to demonstrate the climate change motivation for climate finance eligibility - the wording for several interventions has been adjusted. Many of the adaptation actions such as agriculture and forestry protection and enhancement offer significant mitigation co-benefits as well, thus further enhancing their importance and benefits.

An attempt has been made to demarcate conditionality of the actions between conditional and unconditional using the 80/20 guide. This approach reflects Ethiopia's commitment to develop its economy in a climate resilient and low carbon trajectory. It acknowledges that there is a general development benefit to enhanced climate resilience even though the need to adapt is vastly driven by emissions generated outside Ethiopia.

TABLE 19: ADAPTATION INTERVENTIONS, INDICATORS, 2018 BASELINE AND 2030 TARGETS AS WELL AS CONDITIONALITY OF REQUIRED RESOURCES

Adaptation Intervention (Commitment)	Indicator(s) ³⁷	Baseline (2018)	2030 Target
Sector: Agriculture			
Enhance food security by improving agricultural productivity in a climate-smart manner (promote yield increasing techniques)	Productivity of rain fed crop land (based on average for teff, wheat, barley and corn)	28.9 quintals ³⁸ /Ha	45.9 quintals/Ha
	Area under irrigation (based on corn, wheat, tomatoes and onions) ³⁹	62,050 Ha*	225,913 Ha*
	Crop production through irrigation*	8 million quintals*	38 million quintals*
Diversify livestock and animal mix, including promotion of poultry and small ruminants	Productivity of poultry and small ruminants (Tons)	Specialised poultry commercial - 33,100 Tons Household - 13,200 Tons	Specialised poultry commercial - 80,900 Tons Household - 16,200 Tons
		Sheep - 66,000 Tons Goat - 44,000 Tons	Sheep - 324,000 Tons Goat - 282,000 Tons
	Percentage of improved livestock number (dairy)	Dairy - 2.7%*	Dairy 17%*
Enhanced climate resilience in livestock	Percentage of coverage of animal health services	Dairy - 11% Beef - 7%, Small ruminants - 7%	Dairy - 42% Beef - 28% Small ruminants - 28%
Prevent and control the spread of climate-driven vector-borne diseases	Percentage reduction of crop and animal disease cases	To be established	30% reduction from 2022/2023 baseline (to be established)
Improve rangeland and pasture-land management diversification, including selection of drought-resistant animal breeds	Percentage of improved content in dry feed	Local dairy - 77% Cross-breed - 41% Exotic - 33%	Local Dairy - 100% Cross-breed - 100% Exotic - 100%
Expand the use of improved crop varieties with climate resilient characteristics	Improved seed coverage (Ha)	Teff - 31,000 Ha Barley - 70,000 Ha Wheat - 413,000 Ha Corn - 438,000 Ha	Teff - 100,000 Ha Barley - 193,000 Ha Wheat - 673,000 Ha Corn - 823,000 Ha
Strengthen crop disease and pest monitoring systems in vulnerable areas	Vulnerable districts covered by such monitoring systems	Indeterminate	All districts nationally

37 There is a need to refine definitions of climate indicators vs. development indicators in the next 5 years for clearer distinction of climate and development actions.

38 Quintal = a unit of weight equal to 100 kg.

39 Represents indicator, baseline (2020) and target (2030) figures obtained from Ethiopia's 10YDP; other targets and baseline are from sectors.

Adaptation Intervention (Commitment)	Indicator(s)	Baseline (2018)	2030 Target
Strengthen drought and crop insurance mechanisms for climate risk management	Number of farmers (gender disaggregated) covered by drought and crop insurance	Indeterminate	30% increase from 2022/2023 baseline (to be established)
Sector: Forestry			
Restoration and reforestation through tree planting	Hectares reforested/restored (Ha)	2.6 million Ha	9 million Ha
Increase national forest coverage	National forest coverage	15.5%	25-30%
Enhance sustainable forest management	Area of natural forest under sustainable forest management	2 million Ha	4 million Ha
Improve sustainable utilisation of forest resources	Number of green jobs created	0.2 million	5 million
	Export earnings from sustainable forest products	41.4 million US\$	221 million US\$
Implement forest protection and health enhancement measures in natural forest ecosystems	Area of forest protected from diseases, pests and fire	-	17.2 million Ha
	Degree of federal and regional institutions' capacity for forest protection	To be established	To be established
Sector: Land Use, and Natural Resources Management			
Enhance climate resilient livelihoods of wildlife resource dependent communities in protected areas	Number of dependent communities benefiting from climate resilient wildlife resources	30,000 people	1.5 million people
Enhance sustainable natural resources development, management, and watershed protection	Number of associations vested with legal personality*	-	To cover 10,000 catchment areas*
Sector: Water			
Integrated watershed development in million Ha	Area under integrated watershed development	2.24 million Ha	10 million Ha
Improve access to potable water to strengthen community climate resilience	Potable water supply	19.36 litres/capita/day	Rural - 25 litres/capita/day by 2025/within 1 km Urban - 50-100 litres/capita/day by 2025

Adaptation Intervention (Commitment)	Indicator(s)	Baseline (2018)	2030 Target
	Decreasing non-functionality rate of water schemes	19%	7%
	Percentage of decreasing water waste	39%	20%
	Supply of drinking water for humans and animals in 100 isolated and drought-affected woredas	Indeterminate	100 woredas
	Reduce the number of residents using fluoride contaminated water	3.5 million people	0*
Expand the construction of medium and large-scale irrigation systems to enhance food security	Construction of medium and large-scale irrigation schemes	0.49 million Ha	1.2 million Ha
	Percentage of improved irrigation technologies for medium and large-scale irrigation	2%	20%
	Percentage of water use efficiency in medium and large-scale irrigations	30%	50%
	Number of gender balanced Irrigation Water User Associations (IWUAS)	none	35.5
	Job creation through irrigation network expansion*	-	930,000*
	Capacity building activities	To be established	To be established
	Enhancing women's participation in irrigation development and utilisation	To be established	To be established
Sector: Energy			
Percent of households using renewable off-grid energy sources for lighting	Percentage of households using renewable off-grid energy sources for lighting (i.e. those not served by the grid)	39.91%	100%
	Percentage of population with stable access to electricity from alternative off-grid Renewable Energy (RE) technologies	11%	35%

Adaptation Intervention (Commitment)	Indicator(s)	Baseline (2018)	2030 Target
	Decreasing number of unstable and unreliable diesel-based standalone generator systems	36 systems	0
	Percentage of increasing contribution of RE (geothermal, solar and wind) in the grid-based energy generation	9%	27%
	Percentage of reduced total electricity waste in transmission and distribution systems	19.60%	12.50%
	Percentage improvement in private sector contribution in energy generation and distribution	none	36.10%
	Energy sector job creation	To be established	To be established
	Increasing capacity building programs for modern energy systems management	To be established	To be established
	Enhancing women's and youth participation in RE development and utilisation	To be established	To be established
Sector: Transport			
Build sustainable transport systems for resilience through enhanced access to mobility	Length of non-motorised transport infrastructure constructed	26.5 Km	506 Km
	Number of cities/towns (above 50 k residents) with dedicated non-motorised transport lanes (for bicycles)	2	69
Increase climate resilient designs and safety standards for transport systems	Number of major transport infrastructures that take climate change into consideration	1	9
Sector: Urban			
Construct new sanitary landfill sites in cities/towns in climate resilient locations	Number of constructed landfill sites in climate resilient locations	6 constructed sanitary landfills	200 sanitary landfills

Adaptation Intervention (Commitment)	Indicator(s)	Baseline (2018)	2030 Target
Increase the climate resilience of urban systems	Area of land covered by green infrastructure and recreational areas (Ha)	159,263.16 Ha	30% of the land in 200 cities/towns, equal to 5,308,772 Ha
Improve provision and condition of housing for enhanced human safety against climatic stressors	Percentage of urban dwellers residing in safe and adequate housing* (gender disaggregated)	Indeterminate	70%
Enhance urban greenery for improved climate resilience	Urban green area per capita	0.41 m ² per urban inhabitant	Indeterminate
Undertake climate-adaptive urban planning	Area of land covered by green infrastructure and recreational areas (Ha)	159,263.16 Ha	-
	Number of land use plans addressing adaptation mechanisms	Not available	4,000
Sector: Climate Services and Disaster Risk Reduction			
Number of climate and early warning data produced and disseminated/year	Number of climate and early warning data produced and disseminated/year	15	59
Number of modern weather condition monitoring stations	Number of modern weather condition monitoring stations	325	806
Enhancing climate service data reliability	Enhancing climate service data reliability	0.75	0.85
Number of Eco-Hydrology Demonstration Sites in all basins	Number of Eco-Hydrology Demonstration Sites in all basins*	10*	55*
Modernise and update the basin information system coverage	Modernise and update the basin information system coverage	16.66	99.7
Surface water resource assessment coverage	Percentage of surface water resource assessment coverage	78%	100%
Ground water resource assessment coverage	Percentage of ground water resource assessment coverage	17.95%	35%
Enhancing water quality monitoring coverage	Enhancing water quality monitoring coverage percentage	Indeterminate	80%

Adaptation Intervention (Commitment)	Indicator(s)	Baseline (2018)	2030 Target
Sector: Health			
Reduce Malaria case incidence	Malaria case incidence	26/1000 in 2020	8/1000
Reduce cholera case incidence	Cholera case incidence	Baseline in 2020	0
Increase proportion of households with improved toilet	Households with improved toilet	20% in 2020	60%
Increase proportion of households with safe water supply	Proportion of households with safe water supply	70% in 2020	100%
Increase proportion of health care facilities safely managing health care waste	Safe management of health care waste	16% in 2020	50%
Increase proportion of health facilities with safe energy sources (electricity, solar)	Proportion of health facilities with safe energy sources	76% in 2020	100%

For some indicators, quantified baselines and targets are missing and will need to be developed as the NDC is implemented. Nevertheless, adaptation interventions linked to these indicators are integral to Ethiopia’s adaptation efforts and are included in the country’s adaptation commitments. As part of further analysis in future NDC M&E and updates, these baselines and proposed targets will be established by the GoE. The interventions and indicators for which this further analysis will be undertaken are as follows:

Adaptation Intervention (Commitment) ⁴⁰	Indicator
Education	
Promotion of environmental education	Number and type of educational materials (print) produced and disseminated.
	Number of formal, informal and non-formal education programs on climate change.
	Number of people (women/men) trained on climate change adaptation at different administrative levels across sectors.
	Number of people (women/men) with awareness of climate change from community awareness programs.
Industry	
Vulnerable industries take climate change adaptation considerations into account in management and planning.	Number of industries adopting climate change adaptation strategies/considerations.
Efficient and environmentally sound production systems developed.	No. of efficient and environmentally sound production systems developed.

40 Certain sectors do not yet have reliable adaptation indicators or baseline data. This is particularly true for sectors that were not included in the original 2011 CRGE Strategy (such as education), and sectors where climate change efforts thus far have focused predominantly on mitigation and not adaptation (such as industry). None of the indicators selected in the final CRGE indicators were applicable to these sectors. Nevertheless, given the importance of such sectors to climate change adaptation in Ethiopia, the NDC has included interventions for such sectors. Further work will need to be done to select indicators and establish baselines where the values are missing at present, to ensure effective M&E, and to include them in future NDC updates.

RECOMMENDATIONS ON ADAPTATION CONTRIBUTIONS

- ▶ Demarcation of implementation and monitoring and evaluation responsibilities amongst sectors and stakeholders is needed as part of the immediate actions for NDC implementation.
- ▶ Quantify missing baseline information and 2030 targets for indicators where this information has not been obtained during the NDC update process.
- ▶ Streamline NDC implementation with current and future national and sectoral strategies and policies to derive maximum benefits and for effective utilisation of limited resources.
- ▶ Build on early successes such as CRGE and 1st NDC implementation i.e., institutional arrangements, resource mobilisation, stakeholder engagement forums etc.
- ▶ Continue to strengthen efforts to engage stakeholders in climate adaptation policy development and implementation.
- ▶ Establish structured stakeholder engagement platforms for exchange of information and lessons learnt.
- ▶ Strengthen public awareness around climate adaptation efforts.
- ▶ Improve the capacity (human resource, technology, financing, training) for institutions directly involved in implementation of adaptation interventions of the NDC.
- ▶ A current and comprehensive national vulnerability and risk assessment, with regional differentiation and resolution, should be prepared.
- ▶ Continually develop a robust monitoring and evaluation framework for adaptation and mitigation, at national and sub-national levels.

CHAPTER 5

RESOURCES REQUIRED FOR ENHANCED NDC IMPLEMENTATION

KEY MESSAGES ON RESOURCES REQUIRED FOR ENHANCED NDC IMPLEMENTATION

- ▶ The required resources have been calculated based on sector plans from key ministries
- ▶ The total amount required is consistent with the 10YDP
- ▶ Figures received from the government were adjusted according to their relevance to climate or green development
- ▶ Figures were categorized as either mitigation or adaptation
- ▶ Figures were then further categorized so that 20% of the resources required will be met through domestic sources whilst 80% will be conditional on receiving international climate finance
- ▶ Total resources required is US 316 billion over the 10-year implementation period covered by this NDC update of which:
 - **Unconditional US\$ 63.2 billion**
 - **Conditional US\$ 252.8 billion**

Ethiopia's NDC is founded on its CRGE strategy. Full implementation of its NDC is conditional upon an ambitious multilateral agreement among Parties enabling Ethiopia to secure⁴¹ international support in the form of finance, capacity building and technology transfer. Whilst the NDC provides detailed mitigation responses including a GHG baseline and specific targets, the adaptation component did not receive equal attention. Consequently, emphasis has been placed on the need to raise and prioritise adaptation in the updated NDC, given Ethiopia's national circumstances, i.e., an LDC with high vulnerability to climate change and low adaptive capacity.

The CRGE strategy requires an annual spending commitment of US\$ 7.5 billion. However, federal budgetary resources for climate relevant actions are estimated at US\$ 440 million annually, while international sources add an uncertain amount.⁴² Even with these combined funding streams, there appears to be a major financing gap that needs structured and diverse resource mobilisation strategies. As an example, the development of a resource mobilisation strategy for the NAP-ETH

41 Federal Democratic Republic of Ethiopia, Intended Nationally Determined Contribution (INDC) of the Federal Democratic Republic of Ethiopia (2017a).

42 *Ibid.*

is a step in the right direction to mobilise financing for implementation activities. However, more effort is needed to develop a harmonised resource mobilisation strategy including more accurate costings (national, regional, sub national, sectoral, as well as per intervention or programme/project/activity) and implementing actual resource mobilisation activities including increasing transparency in climate change budget tracking at all levels.

While development partners, donors, the CRGE and other key stakeholders play an integral role in shaping the climate change adaptation and mitigation landscape in Ethiopia, there is need for efforts to improve coordination of all these actors to identify synergies and avoid duplication of efforts. In the future it will be critical for Ethiopia to be able to mobilise sufficient resources to implement the NDC, particularly for unconditional interventions. A framework for resource mobilisation must be developed which makes it clear what is expected by the key stakeholders. The framework will need to embrace at least the following three principles:

1. **Maximise efficiency and effectiveness of current resources** – this will include principles around benchmarking efficiency, setting targets to be achieved that are regularly reviewed to ensure they maintain their relevance and then reporting on progress and holding stakeholders accountable for that progress. Effective measurement reporting and verification process as discussed elsewhere in this report is critical and development partners are likely to respond well to such an open and accountable system.
2. **Cut harmful or counterproductive initiatives** that lead to wasteful investments. All new initiatives should be assessed to ensure they are consistent with the NDC and do not undermine resources spent on the NDC. Existing and emerging initiatives from different sectors can be co-opted and influenced so that they help implement the NDC using their existing resources.
3. **Identify and secure additional resources** from a variety of domestic and international sources. A resource mobilisation strategy and implementation plan should be prepared, that clearly identifies the resource gap, identifies potential sources and matches them with appropriate NDC actions. New and innovative sources of finance need to be identified, as well as barriers to private sector investment including a review of current legislation and regulations, and the need for new ones that promote investment.

Clearly, climate finance will be one of the most critical sources of finance. The following principles will need to guide a climate finance strategy for Ethiopia.

- ▶ Ethiopia's ability to track climate finance, measure progress, and report on it as well as allow independent verification will be critical to unlocking these sources of climate finance.
- ▶ The ability to understand the current climate vulnerability and have a consistent set of internationally recognised climate projections to inform the preparation of national and regional initiatives across all sectors will be critical to accessing climate finance. This will underpin the climate rationale for any application for climate finance.
- ▶ The ability to prepare clear and robust climate rationales for all applications for climate finance that distinguish between the economic development needs of the country and the additional resources required to make that economic development climate resilient.

- ▶ To show ambition and demonstrate commitment to transform entire sectors to become climate resilient.
- ▶ To provide a conducive legislative regulatory environment for investment and to prove to be a strong competent partner for the private sector to attract a variety of sources of finance.
- ▶ To build capacity of government to understand climate threats and support the preparation of low carbon climate resilient interventions that address those threats and improve resilience.

5.1 Costing mitigation and adaptation interventions

The resource figures for this NDC have been updated based on the sectors roadmap for implementation of climate resilience and green economy actions and the 10-Year Development Plan and its sectors breakdown. The climate resilience and green economy plans consulted during the preparation of the costings included:

Mitigation

- ▶ Agriculture Sector Roadmap for implementation of Green Economy Mitigation Actions, Ministry of Agriculture, March 2019
- ▶ Forest Sector Roadmap for Implementation of NDC/CRGE Mitigation Actions, Environment, Forest and Climate Change Commission, March 2019
- ▶ Biofuel Sector Roadmap for implementation of Green Economy Mitigation Actions, Ministry of Mines, Petroleum and Natural Gas, March 2019
- ▶ Sectoral Roadmap for implementation of Green Economy Mitigation Actions Ministry of Urban Development and Housing (MOUDH), March 2019
- ▶ Sectoral Roadmap for implementation of Green Economy Mitigation Actions, Ministry of Transport, March 2019
- ▶ Sectoral Roadmap for implementation of CRGE - Mitigation Actions, Ministry of Water Irrigation and Electricity, March 2019
- ▶ Sectoral Roadmap for Implementation of NDC/CRGE- Mitigation Actions, Ministry of Industry (MOI), March 2019

Adaptation

The NAP-ETH estimated that US\$ 90 billion would be required between 2016/17 and 2030 to implement its actions. This estimation was based on an a spend figure of US\$ 330 million per annum for each of its 18 adaptation priorities. The NAP-ETH was based on the previous national development plan (expired in 2020) and did not include a sector breakdown.

- ▶ Ethiopia's Climate Resilient Green Economy, Climate Resilience Strategy, Agriculture & Forest
- ▶ Ethiopia's Climate Resilient Transport Sector Strategy, Ministry of Transport of Ethiopia
- ▶ Climate Resilience Strategy: Urban Development and Housing, August 2017

Financial resource requirements stated in those documents were summarized and were used as the basis for calculating the NDC resource requirement figures highlighted below.

Financial requirement data for adaptation and mitigation projects by each sector was added to arrive at the total adaptation and mitigation costs for each sector and the total of the sector figures is taken as the aggregate NDC resource requirement figure for adaptation and mitigation. Project costs in the agriculture sector were seen as too high and consequently were adjusted down in consultation with the sector to a balance considered to be more reasonable.

As the resource requirement figures were taken from sector plans that had broader objectives than just climate, a high-level filter was applied to all figures. Accordingly, 80%, 50% and 20% of the estimated project costs are considered as climate relevant for each project depending upon the perceived degree of climate relevance. Furthermore, an 80/20 conditionality approximate guide was applied to the relevant resource requirements as it has been to the mitigation and adaptation actions to demonstrate the scale of international funding vis a vis nation funding required.

Ethiopia's CRGE makes it clear that it intends to develop along a low carbon climate resilient pathway. This is evident through both the CRGE strategy, which has seen 10 years of implementation and the 10YDP. Consequently, these figures reflect the costs required to ensure Ethiopia reaches lower-middle-income status through a climate resilient and green economy pathway. Nevertheless, an additional high-level analysis has been conducted to further refine these figures in terms of what can be defined more strictly as the climate proportion of the action and what proportion can be more accurately claimed to be wider green development. This analysis suggests that the climate resource requirements are US\$ 316 billion in total, which breaks down over 10 years into:

- ▶ Adaptation US\$ 40.5 billion
- ▶ Mitigation US\$ 275.5 billion

In terms of conditionality, whilst the 80/20 guide was developed for mitigation and refer to the mitigation of CO₂eq, they have also been applied to the resource mobilisation to help determine a potentially reasonable breakdown in conditionality for the whole NDC. Consequently, the breakdown of the total resources required for both Mitigation and Adaptation (US\$ 316 billion) the Ethiopian government is committed to finance approximately 20% as **unconditional (US\$ 63.2 billion)**, whilst 80% (**US\$ 252.8 billion**) will be **conditional** on receiving international climate finance. Below the breakdown by sector of these costings for adaptation and mitigation are presented.

5.2 Estimated funding requirements - Adaptation

TABLE 20: ADAPTATION RESOURCE REQUIREMENT, PERIOD: 2021 -2030

Sector	Intervention	Resource requirement (US\$ '000,000)	Climate additionality (US\$ '000,000)	Remarks	Source of information
Agriculture and forest	Micro level, household level and biodiversity responses	9,500	7,600	The resource requirement is for ten years from 2021 to 2030, taken by adding the annual requirement of 600ml and the base and investments expected under baseline of US\$ 3.5 bn. Resource requirement is set in lump sum The climate change component is assumed to be significant (80%) as these are micro level community-based interventions with clear direct adaptation benefits.	Ethiopia's Climate Resilient Green Economy, Climate Resilience Strategy, Agriculture & Forest, p 63
Total (agriculture and forest)		9,500	7,600		
Urban Development	Establish a National Urban Development & Infrastructure Fund	38,365	7,673	Such a fund would take 2% of GDP and have significant economic development benefits as well as Climate it is assumed around 20% would be climate finance relevant.	Climate Resilience Strategy: Urban Development and Housing, August 2017, pp 66-67
	Urban planning and risk management	530	106		
	Local (community) economic development	492	98.4		
	Urban infrastructure and services	1,600	320		
	Cross cutting	344	68.8		
Total (Urban Development)		41,331	8,266.2		-
Industry	No intervention specified	-		-	-
Total (Industry)		-		-	-

Sector	Intervention	Resource requirement (US\$ '000,000)	Climate additionality (US\$ '000,000)	Remarks	Source of information
Mine, petroleum and Natural Gas	No intervention specified.	-		-	-
Total (Mines, Petroleum and Natural Gas)		-		-	-
Water, Irrigation and Energy	Power generation	304	60.8	Power generation and access to energy has significant economic development benefits approximately 20% can be regarded as climate.	Ethiopia's Climate-Resilient Green Economy, Climate Resilience Strategy: Water and Energy, page 48
	Access to energy	246	49.2		
	Irrigated agriculture	71	56.8	Irrigation for agriculture and access to WASH are potentially significantly influenced by Climate Change.	
	Access to WASH	220	176		
	Cross cutting	54	43.2		
	Capital investment	48,000	24,000	Capital investment is for 20 years while other interventions are costed up to 2030 Source of finance: CRGE facility, domestic treasury and external assistance Includes energy (20% climate) WASH and Irrigation (80%) consequently it is assumed 50% of the capital investment required needs climate finance.	
Total (Water, Irrigation and Energy)		48,895	24,386		
Health	Reduce Cholera case incidence	121	96.8		
	Reduce Malaria case incidence	93	74.4		
	Increase proportion of households with improved toilet	20	16		
	Increase proportion of households with safe water supply	31	24.8		

Sector	Intervention	Resource requirement (US\$ '000,000)	Climate additionality (US\$ '000,000)	Remarks	Source of information
	Increase proportion of health care facilities safely managing health care waste	17	13.6		
	Increase proportion of health facilities with safe energy sources (electricity, solar)	11	8.8		
Health Total		293	234.4		-
Adaptation Total		100,019	40,486.6		

5.3 Estimated funding requirements - Mitigation

TABLE 21: MITIGATION RESOURCE REQUIREMENT, PERIOD: 2021-2030

Sector	Intervention	Resource requirement (US\$ '000,000)	Climate additionality (US\$ '000,000)	Remark	Source of information
Agriculture	Agricultural Mechanization (Utilization of pre and post-harvest technologies)	2,000	400	This includes significant economic development potential. Consequently only 20% can be classified as climate relevant.	Agriculture Sector Roadmap for implementation of Green Economy Mitigation Actions, Ministry of Agriculture, March 2019 (page 29-33).
	Mechanical source of power (tractor, combiner, engines etc.)	No cost assigned	10000	.	
	Value chain efficiency improvement - farmers (Provide high quality feed)	1,531.56	306	This includes significant economic development potential. Consequently only 20% can be classified as climate relevant.	
	Value chain efficiency improvement - farmers (Reduce Shoat & Calf Mortality Rate)	1,255.39	251.08		

Sector	Intervention	Resource requirement (US\$'000,000)	Climate additionality (US\$'000,000)	Remark	Source of information
	Value chain efficiency improvement - farmers (Increase number of productive cattle breed)	1,405.16	281.03		
	Value chain efficiency improvement - farmers (Increase Offtake Rate)	449.60	89.92		
	Value chain efficiency improvement - pastoralists (Provide high quality feed)	394.20	578.84		
	Value chain efficiency improvement - pastoralists (Reduce Shoat & Calf Mortality Rate)	759.60	151.92		
	Value chain efficiency improvement - pastoralists (Increase number of productive cattle breed)	953.44	190.69		
	Enhancing and intensification of diversifying animal mix (Increase number of productive poultry)	657	131.4		
	Enhancing and intensification of diversifying animal mix (Increase number of productive small ruminants (Shoats))	945	189		

Sector	Intervention	Resource requirement (US\$'000,000)	Climate additionality (US\$'000,000)	Remark	Source of information
	Rangeland and pastureland management (Increase pasture & rangeland productivity)	28,850.06	23,080.05		
	Rangeland and pastureland management (Fodder bank development)	650.5	520.4		
	Rangeland and pastureland management (Rehabilitation of range & pastureland)	1,670.4	1,336.32		
	Rangeland and pastureland management (Improved forage development)	21,614.04	17,291.23		
	Enhance lower-emitting techniques for agriculture (Soil nutrient and crop management)	13,000	10,400	The specific purpose of these measures is to lower emissions. Consequently, it is assumed that 80% of the costs are climate related.	
	Enhance lower-emitting techniques for agriculture (Tillage/residue management)	9,120	7,296		
	Enhance lower-emitting techniques for agriculture (water management)	13,500	10,800		
	Enhance lower-emitting techniques for agriculture (Agroforestry practices)	1,200	960		

Sector	Intervention	Resource requirement (US\$'000,000)	Climate additionality (US\$'000,000)	Remark	Source of information
	Enhance lower-emitting techniques for agriculture (Integrated watershed development practice)	8,500	6,800		
	Small scale irrigation (Efficient utilization of water)	3,800	760	It is assumed that there is a significant development benefit associated with cost reduction with these measures. Consequently only 20% of the costa are considered climate related.	
	Small scale irrigation (Agricultural input supply and utilization)	9,600	1,920		
	Large scale irrigation (Efficient utilization water)	5,900	1,180		
	Large scale irrigation (Agricultural input supply and utilization)	4,800	960		
Total Resource required (Agriculture)		132,555.95	95,873.88		
Forestry	Reduced deforestation: Fuel efficient stoves (baking & cooking) - R&D + Capacity building	5.27	4.2	3,060,000 US\$ for Workshop and laboratory equipment/technology procurement, 900,000 US\$ for R&D including consultancy service and exposure visit. 300,000 US\$ for gap assessment running cost. 150,000 US\$ for training (based on identified gap). Expert salary 857,142 US\$ for 10 years 80% of these costs are considered climate related.	Forest Sector Roadmap for Implementation of NDC/CRGE Mitigation Actions, Environment, Forest and Climate Change Commission, March 2019 (page 26-28)

Sector	Intervention	Resource requirement (US\$'000,000)	Climate additionality (US\$'000,000)	Remark	Source of information
	Reduced deforestation: Fuel efficient stoves (baking & cooking) - Enterprise development/ support	41.22	32.97	A total of 40,015,000 US\$ for Federal, Regional Zonal and woreda level follow up, ICST producer enterprises support, gap assessment and Finance credit - for stove producer enterprises. 1,200,000 for purchasing 12 Vehicle (regional and federal. 80% of these costs are considered climate related.	
	Reduced deforestation: Fuel efficient stoves (baking & cooking) - QC & QA	3.5	2.80	2,750,000 US\$ running cost regional level. 500,000 for federal level. 250,000 US\$ for testing equipment calibration and consumable purchasing 80% of these costs are considered climate related.	
	Reduced deforestation: LPG	No cost assigned		Financial need not indicated	
	Large- and small-scale afforestation/ reforestation and area closure (Afforestation)	655.11	524.09	80% of these costs are considered climate related	
	Large- and small-scale afforestation/ reforestation and area closure (Re-afforestation)	100.63	80.5		
	Large- and small-scale afforestation/ reforestation and area closure (Degraded forest land restoration and assisted natural regeneration)	121.19	96.95		

Sector	Intervention	Resource requirement (US\$'000,000)	Climate additionality (US\$'000,000)	Remark	Source of information
	Forest management: Forest (Improving forest management)	29.13	23.30		
	Forest management: Forest (Institutional forest management)	0.6	0.48		
	Forest management: Wood land (Improving wood lands management)	50	0.40		
Total Resource required (Forest)		1,006.65	765.69	Estimation includes human resource and technologies required. Local and international financial sources are not differentiated. The full implementation of the National Forest Sector Development Program (NFSDP) requires US\$ 15.7 billion.	
Mines	Biodiesel in fuel mixture	6.32	5.06	80% of these actions are considered climate related as they are specifically reducing emissions.	Ministry of Mines, Petroleum and Natural Gas, Environment Forest and Climate Change Commission, Plan Commission, Echnoserve and World Resources Institute, Biofuel Sector Roadmap for implementation of Green Economy Mitigation Actions, March 2019, pp 24-26

Sector	Intervention	Resource requirement (US\$'000,000)	Climate additionality (US\$'000,000)	Remark	Source of information
	Ethanol in fuel mixture	14.92	11.94		
	Ethanol for cook stove	12.77	10.22		
	Plantation	19.23	15.38		
	LPG	3.86	3.09		
Total (Mines)		57.1	45.69	-	-
Urban Development	Landfill gas management	86.09	68.87	80% of these actions are considered climate related as they are specifically reducing emissions.	Ministry of MOUDH, Environment Forest and Climate Change Commission, Plan Commission, Echnoserve and World Resources Institute, Ministry of Urban Development and Housing (MOUDH) Sectoral Roadmap for implementation of CRGE - Mitigation Actions, March 2019, pp 26-28
	Reuse, reduce and recycling of solid waste	68.44	54.75		
	Urban greenery and integrated infrastructure planning	143.08	114.46		
	Implementation of energy efficient buildings	489.36	391.49		
Urban Development (Total)		786.97	629.57	-	-
Transport	Improved public transit in Addis Ababa Light Rail Transit and other (for passengers & freight)	3,000	8,507.62	The opinion that resources are already assigned for these actions by MoT and other implementers. 80% of these actions are considered climate related as they are specifically reducing emissions.	Ministry of Transport: Transport Sector Roadmap for implementation of Green Economy Mitigation Actions has been prepared by MOT, Plan Commission, Echnoserve and World Resources Institute, March 2019

Sector	Intervention	Resource requirement (US\$'000,000)	Climate additionality (US\$'000,000)	Remark	Source of information
	Improving Public Transport (PT) Infrastructure	1,610	4,565.75		
	Improving NMT environment	650	1843.35		
	Encouraging the use of Hybrid and electric vehicles	280	794.04		
	Setting emission standards for all vehicle types	57	161.64		
	Para transit/ informal transport, like taxi system, etc.	20	56.71		
	Integrating Land use and Transportation Planning & Development	25	70.89		
Total (transport)		5,642	16,000	-	-
Water and energy	Generating energy from renewable sources	116.92	93.54	80% of these actions are considered climate related as they are specifically reducing emissions.	Ministry of Water Irrigation and Electricity, Environment Forest and Climate Change Commission, Plan Commission, Echnoserve and World Resources Institute, Sectoral Roadmap for implementation of CRGE - Mitigation Actions, March 2019, pp 24-26
	Climate resilience water land management	86,000	68,800		
	Climate resilience water shade (basin) management	No cost	10,000		
	Reducing electricity demand through efficient light	44.64	35.71		
	Shift to high efficiency appliance	1,780	1,424		
	Irrigation	No cost assigned			
Total (Water, Irrigation and Energy)		87,941.56	80,353.25	Excluded items not costed above	-

Sector	Intervention	Resource requirement (US\$'000,000)	Climate additionality (US\$'000,000)	Remark	Source of information
Industry	Clinker substitution	7.5	30,000	80% of these actions are considered climate related as they are specifically reducing emissions.	Ministry of Industry (MOI), Environment Forest and Climate Change Commission, Plan Commission, Echnoserve and World Resources Institute Sectoral Roadmap for Implementation of NDC/CRGE-Mitigation Actions, March 2019, pp 23-25
	Waste heat recovery	1.3	1.04		
	Energy efficiency	0.65	9520		
	Fuel switch	57,441.5	45,953.2		
	Alternative production processes	1.07	0.86		
	Improving industrial waste management system	3,529.63	2,823.7		
Total (Industry)		60,981.65	81,785.32		
Mitigation Total		283,329.88	275,453.70		
Grand Total (Mitigation and Adaptation)		383,348.00	315,940.30		

RECOMMENDATIONS ON RESOURCES REQUIRED FOR ENHANCED NDC IMPLEMENTATION

- ▶ All projects requiring climate finance will require detailed budgets with a clear demarcation between climate and development needs
- ▶ The resource requirement figures should be continually refined as more detailed data and information becomes available

5.4 Role of carbon markets in the enhanced NDC

Ethiopia's first NDC had already stressed Ethiopia's interest in participating in international carbon markets while highlighting the importance of effective accounting rules to ensure the environmental integrity of market mechanisms (GoE, 2015). Ethiopia's updated NDC continue to state its interest in participating in global carbon markets. The objective of this section is to provide an improved understanding regarding key developments concerning PA-backed global markets. This serves to fully understand participation requirements and potential implications of updating Ethiopia's NDC for harnessing resource mobilization potentials from carbon market instruments while preserving the environmental integrity of Ethiopia's NDC.

Lessons learned from existing and new carbon market initiatives

Ethiopia has engaged in several types of international carbon markets including the Kyoto Protocol's Clean Development Mechanism (CDM), voluntary carbon standards (e.g., Gold Standard, Verra standards), and bilateral cooperation, e.g., under the Joint Crediting Mechanism (JCM) with Japan. Regarding UNFCCC mechanisms, Ethiopia has built a small, but relevant CDM portfolio, with two registered CDM single projects in landfill gas flaring and methane collection from wastewater treatment. Both projects have not yet issued certified emission reductions (CERs).

In addition to single CDM projects, Ethiopia hosts seven CDM Programme of Activities (PoAs), which include five improved cook stoves (ICS), one biomass, and one-off-grid electrification activity. These PoAs together host 16 component project activities (CPAs) including 11 for stoves, three for solar lamps, and two for biomass. These CPAs have around 9.9 million t CO₂eq mitigation potential by 2030 and have so far issued 754,180 CERs. It is worth noting that the Ethiopia Clean Cooking and the Ethiopia Off grid Electrification with Renewable Energy Programme CDM programmes managed by Development Bank of Ethiopia with support from the World Bank's Carbon Initiative For Development (Ci-Dev), have signed contracts for CERs from biogas and solar PV household appliances until 2024 (CDM 2021a, b; Ci-Dev 2021a, b).

Ethiopia has also registered voluntary carbon market projects which are operated outside the UNFCCC (UNDP 2019a, b). The country hosts 29 Gold Standard activities covering three sectors including: the forestry sector (two projects); the energy efficiency sector (26 projects), and the solar thermal sector (one project). These projects have issued more than 795,800 emissions reduction units as of March 2021. In addition, Ethiopia has one Plan Vivo project in the woodland restoration sector, the project has issued 36,800 VERs as of November 2020 (Hoch et al., *forthcoming*). Furthermore, Ethiopia is in the process of registering one JCM project.

Despite significant efforts, Ethiopia has not been effective in hosting carbon market projects relative to the mitigation potential and ambition set by CRGE and the NDC. Even though CDM single projects have piloted innovative technologies in afforestation, waste management and industry (leather), these have not generated significant volumes of finance and have not been replicated. The afforestation project, (the Humbo Ethiopia assisted natural regeneration project) is the only CDM project that issued CERs (255 kCERs as of April 2020). It was registered in 2012 as Africa's first forestry carbon project under the CDM implemented by World Vision, with support from the World

Bank Biocarbon Fund (World Bank 2012). However, the project was deregistered in order to operate under voluntary carbon standards due to higher prices for VERs compared to the temporary CERs for forestry CDM projects.

A key observation is that access to the carbon market has been largely restricted to improved cook stoves and off grid electrification but has barely covered other key sectors. Many sectors with mitigation potential have not managed to access CDM nor voluntary carbon standards. CDM baseline methodologies do not always reflect Ethiopian circumstances and therefore need to be improved under Article 6: grid-connected renewable energy (globally one of the most important CDM project type) has not been able to access the CDM in Ethiopia because the baseline is very low due to Ethiopia's large share of hydropower in the electricity grid. The CDM baseline rules do not reflect the fact that electricity supply in Ethiopia is insufficient and unreliable, leading to high usage of diesel generators even in urban areas which is not accounted for. If future efforts aimed at improving data availability and quality would succeed in demonstrating that a considerable share of electricity used in Ethiopia was generated through off-grid and back-up electricity generation with diesel generators, this could be an important factor in making grid-connected renewable energy projects more attractive for accessing the carbon market as it would more accurately reflect the emissions intensity of power generation in the country.

There are several domestic and international challenges which hinder Ethiopia from expanding its carbon market portfolio. CDM approval procedures are considered as 'complex' for both domestic private and public project developers. Project developers in Ethiopia have limited capacity to effectively go through the CDM's approval cycle and collect data as per CDM requirements. For instance, the two Development Bank of Ethiopia's PoAs that have been supported by the World Bank, have disseminated narrow sets of technologies compared to the potential in the PoA's broad design. The Ethiopia Clean Cooking Energy Program has managed to disseminate only domestic biogas out of the three approved technologies (biogas digesters, ethanol stoves, and improved cookstoves). The Ethiopia Off-Grid Renewable Energy Program has disseminated solar lamps and solar home systems out of the total four eligible technologies (also including mini-grids, solar-powered irrigation). This means that the CDM PoAs could be used in a much more comprehensive way, provided that the awareness and capacity of key stakeholders and other sector representatives in Ethiopia can be improved.

The main challenges are associated with the large numbers of very small, decentralized appliances distributed to rural areas, such as off-grid solar PV. Tracking serial number of distributed appliances and end users at the local level as per CDM monitoring requirements has been challenging. This has resulted in lower CER issuance against projected CER issuance targets. Currently, Ethiopia with the support from the World Bank is developing digital and web-based MRV systems for the off-grid activities to address such challenges.

In addition to the international carbon market mechanisms, Ethiopia is currently exploring domestic carbon market opportunities in the context of a GEF supported NAMA for composting (Interview 2020). GEF is providing financial support for the implementation of the underlying activities, while UNDP provides technical support. Credits would be generated by sequestration through peri-urban reforestation, renewable biomass, and the production of compost. Potential credit buyers

would be those who want to promote urban greenery and composting activities in Ethiopia. The Ministry of Urban Development and Housing will co-finance the creation of this voluntary market (AfDB 2017).

Finally, the carbon market potential for Ethiopia's ambitious plans to export electricity from renewable sources to her neighbour countries has been excluded in the first NDC, but could be revisited in consultation with importing countries, which may otherwise potentially claim the full mitigation benefit for their NDCs.

Participation requirements for paris-backed carbon markets

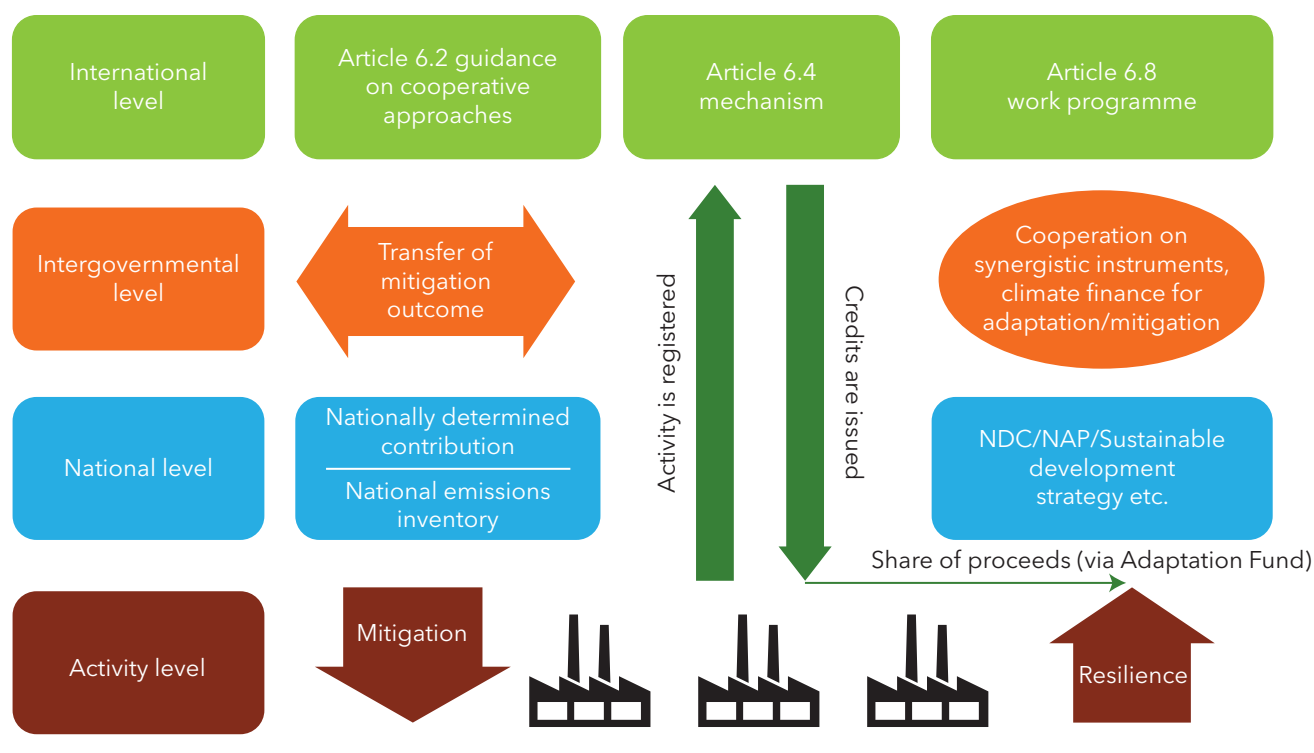
The major difference compared to the Kyoto Protocol (KP) is that under the PA all countries have NDCs that contribute to the long-term target of the PA. Article 6 of the PA recognizes that international cooperation can be a powerful approach to raise ambition in mitigation and foster sustainable development, provided cooperation partners respect the principles of environmental integrity. While there is no universal definition of environmental integrity, it is widely accepted that this means at least that international cooperation must not lead to an increase in global emissions, by applying "corresponding adjustments" in the NDC accounting of both buyer and seller country. Ethiopia has traditionally supported a strong interpretation of environmental integrity and mentioned this in the first NDC. Still, accounting questions are among the most controversial negotiation issues (Michaelowa et al. 2019). An additional negotiation issue concerns the differentiation of accounting rules for LDCs and SIDS. While UNFCCC rules remain unclear, it is likely that Ethiopia will need to put in place institutionalized procedures for performing such corresponding adjustments in order to participate in bilateral carbon market cooperation.

The PA offers Parties three modalities for voluntary cooperation, two market-based and one non-market-based approach that have direct implications for Ethiopia's NDC (see Figure):

- ▶ Article 6.2: Bilateral or multilateral 'cooperative approaches' that lead to the transfer of Internationally Transferred Mitigation Outcomes (ITMOs).
- ▶ Article 6.4: The crediting of mitigation activities by a UNFCCC-governed mechanism.
- ▶ Articles 6.8 and 6.9: Non-market approaches to international cooperation that will be promoted through an UNFCCC framework and work programme.

In the context of Articles 6.2 and 6.4, Parties can thus internationally transfer 'mitigation outcomes' to help achieve their NDCs. 'Mitigation outcome' is an umbrella term for emissions reduced, avoided or removed from the atmosphere and may also be a co-benefit of adaptation actions. As soon as mitigation outcomes are transferred to other Parties for NDC compliance or sold internationally to be used for non-NDC purposes (CORSIA or VCM), these mitigation outcomes become ITMOs. Another type of a 'mitigation outcome' will be the emission reduction credits generated by the UNFCCC Article 6.4 mechanism (called A6.4ERs). Also, these credits will turn into ITMOs if transferred internationally, resulting in a corresponding adjustment to Ethiopia's emissions balance. It should be noted that many key buyers of ITMOs (e.g., Sweden) have declared that they will only consider mitigation outcomes from the conditional component of the NDC; there may

FIGURE 9: ARCHITECTURE OF PARIS AGREEMENT CARBON MARKETS



be limited willingness to buy units coming from the unconditional part of the NDC. However, the impact of conditionality of NDC targets for Article 6 participation remains unclear as there is no clear UNFCCC rule in the PA rulebook and Parties have not applied the concept of conditionality consistently in defining their NDC targets.

Understanding Article 6 is important for integrating various forms of carbon market instruments within Ethiopia’s updated NDC accounting procedures, but also to identify and prioritize a broader range of potential opportunities. A key question is to which extent Ethiopia intends to rely on UNFCCC resources for emission credit registries and databases or develop dedicated domestic infrastructure going beyond the minimum required. Even relying fully on UNFCCC resources will require a stronger host country engagement compared to the KP, as all existing and new initiatives will need to be checked against their contribution to the NDC, and any potentially exported mitigation outcome needs to be reflected in Ethiopia’s NDC accounting as well as in Ethiopia’s biennial transparency reports (BTR).

UNFCCC negotiations on finalizing Article 6 rules have been delayed with a focus on remaining crunch issues that need to be resolved. Thus, it is only possible to outline the anticipated contours of required host country authorization processes for Article 6 activities and exports of Internationally Transferred Mitigation Outcomes (ITMO). It will not be possible to elaborate these processes as they depend on unfinished Article 6 rules.

Carbon market supply and demand dynamics

To develop a carbon market strategy, it is important to identify and prioritize sources of future carbon credit demand. For any actor, be it public or private, who wants to engage in the international carbon market it is crucial to understand the dynamics of demand and supply under the Article 6 mechanisms. The next three years will be decisive for the development of the Article 6 mechanisms. As the history of the CDM shows, early movers shape the design of an international market mechanism and will be able to harness a more robust pipeline of activities generating high quality carbon credits than the latecomers. Ethiopia is considered an important partner country due to its climate ambition, mitigation potential and LDC status, which allows for more flexibility to export carbon credits. Ethiopia has a chance to be among the frontrunners in Article 6. Moreover, this will allow Ethiopia to develop the required institutional capacity to authorize Article 6 activities, ITMO transfers and perform related accounting and reporting steps as per the Paris Agreement rulebook. Therefore, it is important to engage with countries that share common values with Ethiopia regarding environmental integrity and sustainable development to generate experience with Article 6 related procedures and pilot activities. However, there is also an increasing range of new sources of carbon market demand at the internal level including NDC-based ITMO demand from former developing countries such as South Korea, which introduced a domestic emission trading system that allows for importing international CERs. South Korea has been specifically looking for African cook stove CERs and has established contact with several CDM activities in Ethiopia and Eastern Africa.

Moreover, further multilateral agreements beyond the PA promise to generate carbon credit demand in particular the **ICAO CORSIA mechanism**. This mechanism will require airlines to be compensated for any emission increases against their baseline year. Ethiopian Airlines will participate in the ICAO CORSIA market mechanism and could therefore become a buyer of carbon credits from within Ethiopia. While this scheme becomes only effective in 2021, the rules for offset eligibility have been finalized and include the CDM, Gold Standard and Verra standards, all of which have activities in Ethiopia, as well as further carbon standards (ICAO 2020). The impact of the COVID-19 crisis on actual demand from CORSIA remains uncertain but there is a clear potential for mobilizing carbon credit demand from Ethiopian Airlines. Yet, CORSIA is set to initiate a paradigm shift regarding Ethiopia's participation in carbon markets, as it is projected to lead to the first instance of domestic demand for carbon credits. This is particularly important since Ethiopian Airlines is Africa's largest, fast-growing airline and a regional international aviation hub. This indicates a significant future demand for mitigation outcomes, including potential from other international airlines.

Similarly, voluntary offsetting of GHG emissions by companies or individuals may become more relevant internationally, but also from within Ethiopia, e.g., in the tourism sector since international tourists may be interested to voluntarily compensate their GHG emissions resulting from traveling to an in Ethiopia as part of broader global support of taking climate action. The global push towards GHG neutrality by mid-century has led many private companies and subnational governments to announce voluntary GHG neutrality targets that involve procuring carbon credits to compensate for emissions that cannot be reduced. This will be a dominant trend in the reconfiguration of the voluntary carbon market in the era of NDCs. There is a limited high price segment for those activities that demonstrably deliver high sustainable development impacts. The VCM has been smaller than

compliance markets, but important for forestry-based carbon credit transactions, and is also the only market and source of methodologies for credits from avoided deforestation (e.g., under REDD+) (Ecosystem Marketplace 2019). VCM activities have previously largely been undertaken without host country oversight (e.g., Letter of Approval) but will in the future also be brought under the NDC umbrella.

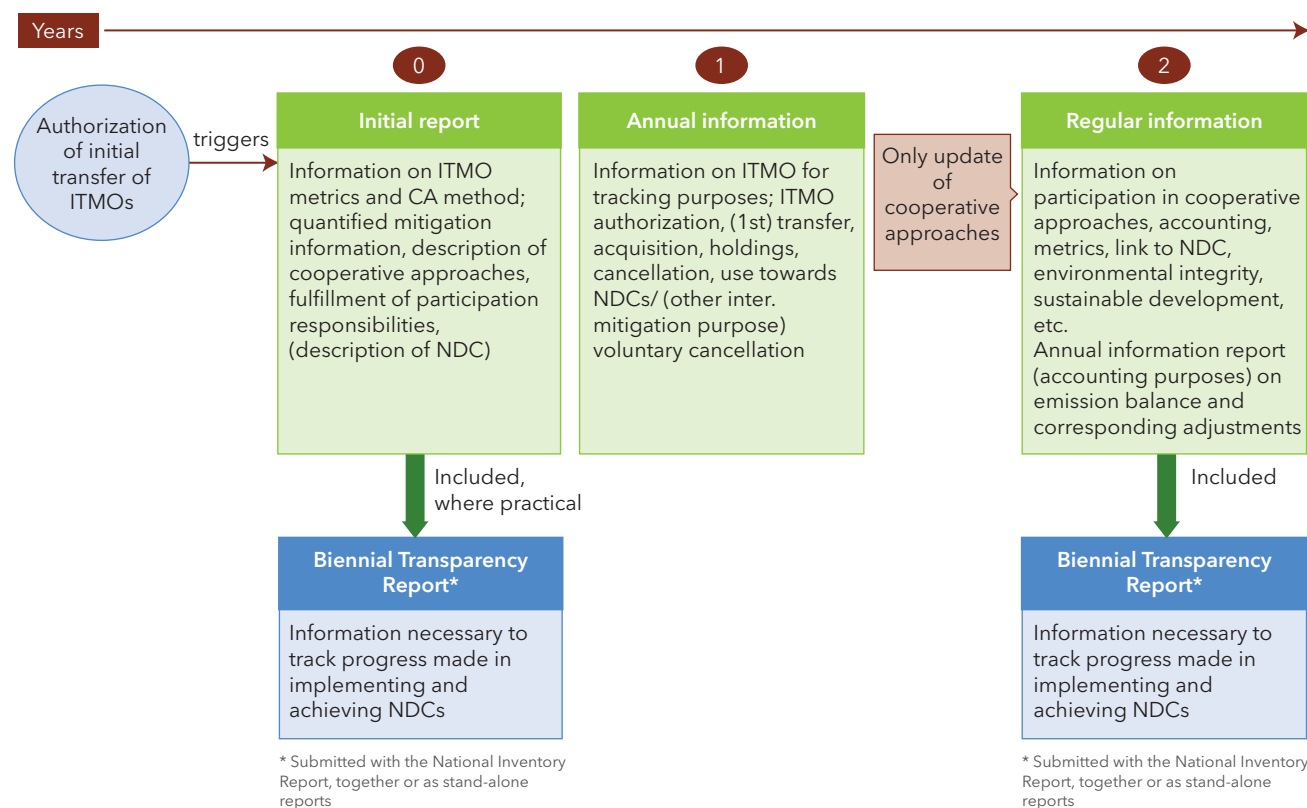
Ethiopia has been developing a concept for a domestic carbon market which can also be used to enhance ambition through mobilizing domestic sources of finance that leads to compensating domestic emissions. This means that such mitigation outcomes can still be counted towards Ethiopia's NDC targets since they represent a domestic policy instrument and do count towards other NDCs.

Support tools and procedures

Parties using Article 6 approaches is anticipated have three reporting obligations (subject to final UNFCCC agreement, not only on Article 6 but also the Enhanced Transparency Framework): An **Initial Report** will be submitted at the start of an activity, containing information on ITMO metrics used, application of corresponding adjustments, quantified information on mitigation, a description of the approach and the fulfilment of participation responsibilities. After the initial report, parties submit **annual information** on ITMO accounting, as well as **regular information** every two years on their participation in approaches, their emission balance and corresponding adjustments. This will be included in the **Biennial Transparency Reports (BTR)**, which contains the information to be reported as per the Enhanced Transparency Framework (Article 13). The annual information on ITMO accounting may also be included in the BTR. Paragraph 77(d) of the ETF Modalities, Procedures and Guidelines defines minimum reporting standards for the annual emissions balance of sources and sinks, which must be aligned with reporting on Article 6 activities. However, they will only become operationalized once there is agreement on reporting on cooperative approaches. This represents a direct link between Article 6 and ETF rules and should also be understood (Figure 10).

UNFCCC will host a '**Centralized Accounting and Reporting Platform**' (CARP) which assembles information on Article 6 activities that are provided in biennial transparency reports, such as a description of each cooperative approach, the expected mitigation outcomes and the participating Parties involved, public information on ITMOs, and all non-confidential information submitted by Parties in the context of their reporting obligations. The CARP will include non-confidential information submitted by Parties and also contains an Article 6 database with information on activities and corresponding adjustments, annual emission balances and information on ITMOs. For Parties that are not able to set up a national registry for tracking ITMOs, the UNFCCC Secretariat will set up a multilateral registry with the same functions that national registries need to perform. Reports will be evaluated by an Article 6 Technical Expert Review (A6TER). The information submitted by Parties will be reviewed by the technical experts regarding the consistency of information submitted, who may also provide recommendations. The reports of the A6TER will be forwarded for consideration under the ETF. Furthermore, the secretariat is requested to periodically compile a synthesis of review reports.

FIGURE 10: ARTICLE 6 REPORTING REQUIREMENTS AND LINKAGE WITH REPORTING UNDER THE ETF



Required procedures within GoE

While there is little disagreement on the reporting and review cycle, Parties have high uncertainty about what the reporting under Article 6 and the ETF will look like in practice. Since Article 6 reporting is so closely interlinked with the ETF, Parties need to ensure consistency across their reporting. Many reporting requirements are optional or include flexibility provision, but since participation in market mechanisms is voluntary, participating Parties will be required to report more comprehensively and consistently.

Moreover, there are substantial additional potential functions that each host country needs fulfil in order to provide oversight of all relevant steps in the Article 6 activity cycle, in particular for the Article 6.2 cooperation that will not rely on UNFCCC institutions. Authorization from the national authority is required so that activities and transfers can be tracked. Parties must approve all transfers and report the quantity of units transferred. In the case of Article 6.2, bilateral agreements can be reached for an ex-ante approval of all transfers from a certain activity. This will require the identification of a **national authority** in charge of providing these approvals upon assessment of the proposed activities, which is the EFCCC in this case.

Authorizing activities that can generate ITMOs (under Article 6.2) or A6.4ERs (under Article 6.4) is only the first step among many others. These include many of the functions that the CDM

Executive Board has provided under the Kyoto Protocol, e.g., approving baseline and monitoring methodologies (specifying additionality, crediting periods, MRV parameters and provisions), accrediting auditors, further legal requirements (e.g., appeals mechanism, safeguards). While these functions are likely to be provided by UNFCCC for participation in the Article 6.4 mechanism, the host country may still play a larger role. For cooperative approaches under Article 6.2, it is clear that UNFCCC will not provide these activity cycle functions, and host countries need to build required institutional capacities, which could differ across different approaches agreed with different Article 6 cooperation partners and buyers.

Currently, **ITMO authorization procedures** remain at the conceptual level and have not yet been clearly developed in Ethiopia, in large part due to the current lack of available UNFCCC rules. Existing institutions under the EFCCC, require capacity support to effectively authorize ITMO transfers, implement CA and perform Article 6 reporting responsibilities.

This may emerge as an important practical challenge for Ethiopia's participation in Article 6. Ethiopia therefore needs to understand which reporting processes and infrastructure for market approaches need to be established at the national level (e.g., to keep an inventory, how to authorize ITMO transfers and what the consequences are etc) and for which ones the international infrastructure operated by the UNFCCC Secretariat (e.g., CARP, incl. Article 6 registry, etc) can be used or flexibility provisions applied. Moreover, full integration of the Article 6 MRV, NDC accounting and reporting requirements mentioned above to capture the annual emission balances will be necessary.

At present, Ethiopia does not operate domestic carbon market infrastructure such as a registry or a consolidated carbon market database where relevant information on mitigation measures and future ITMOs transfer are recorded. A national registry under the CRGE exists, however, this does not systematically capture carbon market relevant information relating to transferable mitigation outcomes. Under the CDM, activities in Ethiopia utilized the CDM registry managed by the UNFCCC Secretariat, which tracks all issuances and initial transfers of CERs. However, there is no national account Ethiopia could use and there is uncertainty about the availability of a UNFCCC-operated Article 6 registry. While this is expected to materialize once Article 6 rules are final, the timeline for the availability of a UNFCCC registry and its functions remains currently unclear at least until COP26 in December 2021. This would offer Ethiopia the option to utilize this international registry and thus minimize the need for building capacity for national registry systems. A link to the national database for tracking all mitigation activities implemented under Article 6.4 shall, however, be ensured to allow monitoring from relevant institutions.

The implementation and operation of a national registry system can be a challenging task with regards to the time, expertise and resources required. Thus, if a reliable international registry exists, Ethiopia may prefer to use it. Until this becomes clear once Article 6 rules are being finalized, there could be interim solutions such as an excel-based database that allows Ethiopia to perform the book-keeping functions of a carbon market registry. This would be sufficient to collect information from potentially several international registries (i.e., registries operated by bilateral Article 6.2 cooperation partners, VCM registries) to allow supervision of the internationally transferred mitigation outcomes and facilitate tracking progress towards NDC goals. However, it may be challenging to capture all carbon market activities under voluntary carbon standards.

This may require Ethiopia to develop regulation or legislation mandating any party seeking to export carbon credits from Ethiopia to seek authorization from a designated national authority to prevent exports of Ethiopia's mitigation assets without due process, posing a risk for achieving NDC goals. Keeping a registry or database is necessary to be able to perform NDC accounting and reporting requirements.

Sustainable Development

Carbon markets also aim to promote sustainable development. Activities with high sustainable development contributions have also attracted higher prices, at least in the limited voluntary carbon market segments. Most of Ethiopia's CDM and VCM activities have strong sustainable development and adaptation benefits, e.g., improved cookstoves, renewable energy and forestry. Regarding forestry, Ethiopia is implementing the second "Green Legacy" campaign initiated by the Prime Minister to plant 20 billion trees by 2022. The African Development Bank supported Ethiopia in the development of a pilot methodology for the quantification of the adaptation impacts of solar water pumping under the so called "Adaptation Benefit Mechanism", which would potentially be integrated into Article 6.8. As a result, a close integration of Article 6 mitigation outcome accounting and reporting and SD reporting is recommended.

RECOMMENDATIONS ON CARBON MARKETS

- ▶ Encourage **bilateral and regional Article 6 cooperation** through outreach to Article 6 buyers and preparing domestic Article 6 institutional capacity. Related, be aware of competitive calls for proposals for Article 6 pilot activities by buyer countries and support Ethiopian-based organizations to submit proposals
- ▶ Carefully consider the **level of complexity** of required carbon market infrastructure and activity cycle oversight (e.g., registry/database, accreditation of auditors, baseline and monitoring methodologies, carbon credit issuance) including 'interim'/'no regret' solution prior to finalizing UNFCCC Article 6 rules and resulting lack of clarity on what type of infrastructure will be provided by UNFCCC
- ▶ **Align Article 6 reporting** with NDC accounting, integration with existing responsibilities and capacities (e.g., inventory reports, annual emission balance, biennial transparency report)
- ▶ Consider levying an **administrative SoP on Article 6 ITMO transactions** to mobilize resources required to establish and sustain institutional capacity in particular for Article 6.2 cooperation which explore potential for domestic or regional guidelines or regulation on **exporting carbon credits from voluntary carbon standards** require host country authorization
- ▶ **Analyse potential for CDM transition** in light of emerging UNFCCC rules, including potential from existing operational activities with active crediting periods, but also institutions (DNA), capacity (approval of activities) & infrastructure (UNFCCC registry, accreditation)
- ▶ **Domestic carbon market activities** can enhance ambition, as carbon credits do not leave the country and can therefore be accounted towards domestic NDC achievement. This may allow for an increase in the unconditional contribution if significant volumes are being achieved. Ethiopia may study further on whether to use international carbon standards (e.g., Gold Standard) for generating domestic carbon credits or whether to set up a domestic standard, taking into account costs and benefits, capacity requirements and demand potential including from voluntary compensation from private sector, individuals and tourism sector (enabling tourists/industry actors to compensate for travel emissions from flights, accommodation etc.)
- ▶ Actively contribute to shaping the **finalization of UNFCCC rules by contributing lessons learnt from Ethiopia's carbon market experience** to the international negotiations. Ethiopia has a very prominent role in the LDC Group, but also AGN, which are important negotiation blocs in Article 6 negotiations.
- ▶ Study potential **carbon credit demand from Ethiopian Airlines** through the ICAO CORSIA mechanism. Although international aviation emissions are not part of the NDC, Ethiopian Airlines may purchase mitigation outcomes from sectors covered under the NDC. This can help in achieving NDC targets, but also requires specific accounting provisions.
- ▶ Make use of **regional experience sharing and exchanges** among peers, for instance in the context of the East Africa Alliance. This will enable all countries in the region to draw on lessons and insights from each other.

CHAPTER 6

MITIGATION MRV AND ADAPTATION M&E

KEY MESSAGES ON MITIGATION MRV & ADAPTATION M&E

- ▶ The MRV/M&E Framework should be fully aligned on the 10YDP MRV/M&E Framework, sectoral targets and GHG inventories.
- ▶ Focus on key performance indicators that are relevant for GHG emission pathways and adaptation actions.
- ▶ The MRV/M&E Framework should be elaborated further based on the evolving UNFCCC accounting and reporting requirements for NDCs and means of implementation.
- ▶ A new and complete GHG inventory should be compiled as a basis for regular BTR reporting as well as Ethiopia's second NDC update submission ahead of 2026.

Looking back over two decades of reporting, under the United Nations Framework Convention on Climate Change (UNFCCC), the Kyoto Protocol and its Clean Development Mechanism (CDM), or the Bali Action Plan and its Nationally Appropriate Mitigation Actions (NAMAs), provides the international community with vast experience in the field of Monitoring, Reporting and Verification (MRV) of climate action. These MRV methodologies have matured primarily in the context of mitigation, since mitigation outcomes are typically defined to meet emission reduction targets and may sometimes need to be verifiable in order to trade mitigation outcomes on international carbon markets. In contrast, adaptation targets have not been as widely adopted, as a result MRV and M&E of adaptation actions have seen less methodological progress and adaptation benefits are often not verifiable. While there is some methodological progress made in the context of the Adaptation Fund, Green Climate Fund and AfDB's Adaptation Benefit Mechanism, achievements can currently not be used at the international level. Thus, the section on adaptation refers to progress tracking using the term Monitoring & Evaluation (M&E).

The MRV and NDC framework needs to work towards full alignment with Articles 4 (Mitigation), 6 (Cooperative Approaches), Article 7 (Adaptation) and 13 (Enhanced Transparency Framework). Under the Paris Agreement - Article 13 specifies the following elements of reporting in Biennial Update Reports (BTRs).⁴³

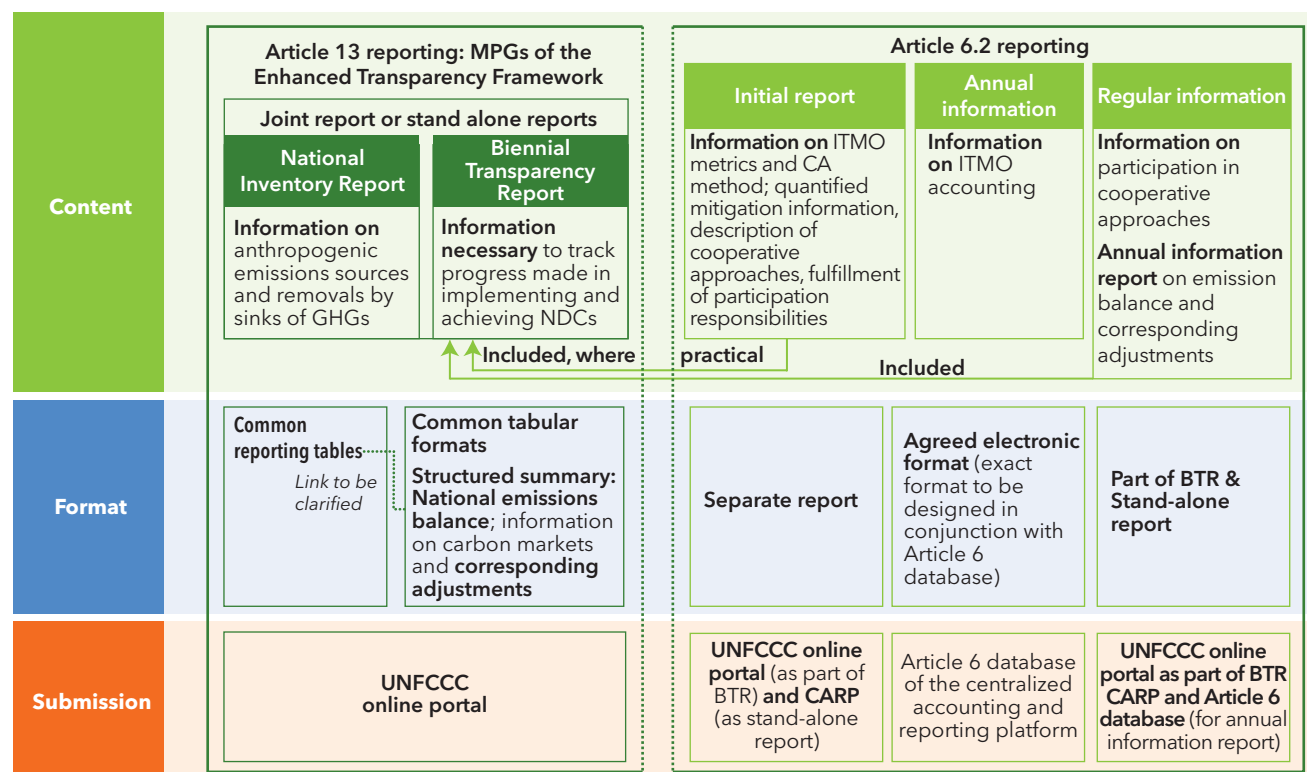
43 The BTRs will supersede Biennial Update Reports (BURs).

- ▶ MRV of GHG-emissions for the National Inventory Report (NIR) (Article 13.7a).
- ▶ MRV of mitigation and M&E of adaptation efforts contained in the NDC (investments, actions and activities, climate impacts and co-benefits, etc.) (Article 13.7b).
- ▶ MRV of climate change impacts and adaptation (Article 13.8).
- ▶ MRV on support received, with particular regard to financial support, capacity building and technology transfer from national or international sources (Article 13.10).

Decision 18/CMA1 of COP 24 defines MRV requirements under Article 13. It puts an end to the generic bifurcation between industrialized and developing countries. Now, a “trifurcation” applies. All countries are to submit biennial transparency reports (BTRs) from 2024, applying common reporting formats, built around a National Inventory Report (NIR). The NIR is to be developed using 2006 IPCC inventory guidelines and common global warming potentials of the 5th Assessment Report of the IPCC. The CMA is to update these when the IPCC publishes new versions. LDCs like Ethiopia can report “at their discretion”; there are no deadlines for improvement/“graduation”. However, working towards meeting international best practices will allow Ethiopia to make a robust case to demonstrate ambition and climate policy leadership. The GEF is to provide financing for BTRs. Description of NDCs is mandatory in BTRs, and the intent to use market mechanisms needs to be reported.

Mandatory reporting for all includes accounting for market mechanisms, through “corresponding adjustment” of emissions according to transfers of ITMOs, as well as information on sustainable development promotion, environmental integrity and transparency. Also, a list of mitigation policies

FIGURE 11: LINKS BETWEEN MRV OF ARTICLE 13 AND ARTICLE 6



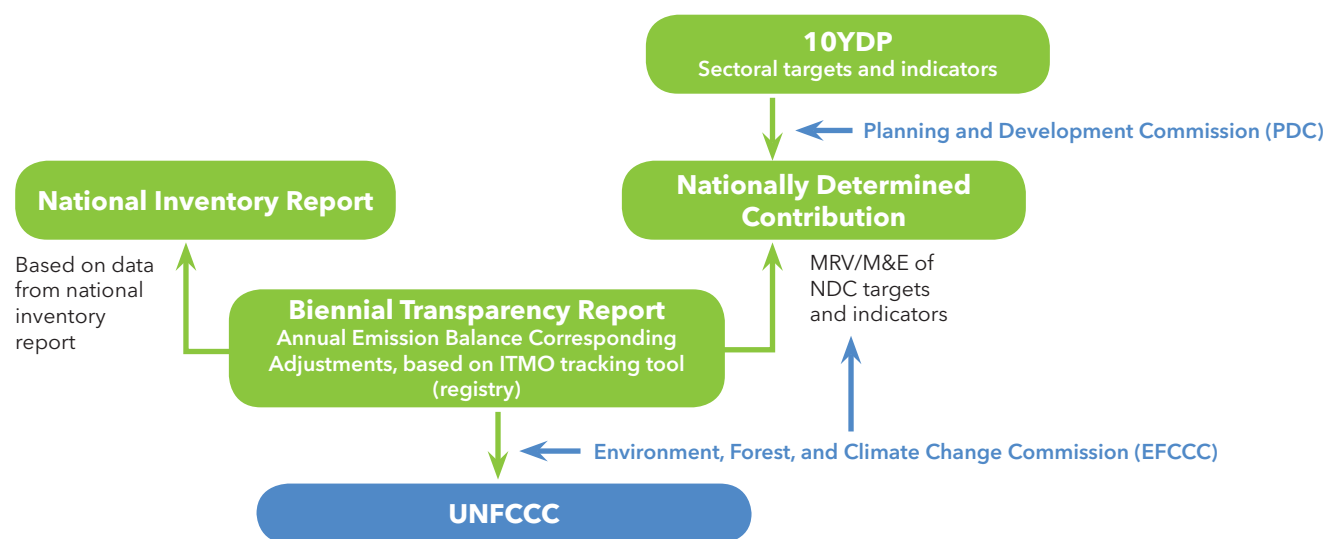
Source: Authors.

needs to be provided. Voluntary reporting includes methodologies for emissions projections, climate change impacts, adaptation action, monitoring and evaluation of adaptation, addressing loss and damage and cooperation action. The links between Article 13 and Article 6 reporting are shown in Figure 11.

Setting up viable and effective MRV/M&E systems in Ethiopia – consistent with the ETF requirements – and strengthening existing capacities will be a continuous process leading to improvements over time as UNFCCC requirements evolve. It builds on recent work on CRGE M&E system undertaken by the Environment and Climate Research Centre (ECRC) at the Policy Studies Institute (PSI) in conjunction with several government entities, as well as international best practices from, among others, the Initiative for Climate Action Transparency (ICAT) and the Capacity-Building Initiative for Transparency (CBIT).⁴⁴

Moreover, the NDC MRV and M&E Framework will be fully integrated with the 10YDP targets and indicators for each sector. Even though the NDC and 10YDP have been finalized in parallel, the final published 10YDP targets and indicators for each sector again have been aligned to ensure full consistency. However, for NDC MRV and M&E, a subset of the more comprehensive 10YDP M&E framework is sufficient. Only those indicators that are relevant to determining emissions reductions, adaptation impacts or means of implementation should be considered in the NDC-specific MRV and M&E framework, as shown in Figure 12. As far as possible, data will be disaggregated by gender.

FIGURE 12: NDC MRV AND M&E FRAMEWORK AND REPORTING



6.1 Mitigation (MRV)

In Ethiopia, MRV practices have seen an important development over the past years. Since the inception of the Climate Resilient Green Economy (CRGE) strategy in 2011, this notably includes:

- ▶ Set-up of the MRV directorate in 2016.
- ▶ Development of MRV frameworks for major CRGE-sectors in 2016 as part of the GTPII (2015/16-2019/20) to track progress with performance indicators in a policy matrix.

44 See for example ICAT (2019): <https://bit.ly/3oRPIMz>

- Development of MRV frameworks for the National Adaptation Plan in 2019 with sizeable overlaps with CRGE-related MRV practices among the implementing institutions.
- Prospect of EU Action support under the 11th European Development Fund that notably includes support to EFCCC on capacity building around MRV over the critical period of 2019-2022.

Developing national MRV systems in Ethiopia is a lengthy and ongoing process that has seen already substantial attention by various donor organizations, development agencies and research institutions. As presented below in the table, attempt was made to identify priority areas in terms of setting up a robust MRV-system in the near future. Table 22 compiles most recent analyses of current needs of MRV systems in Ethiopia, indicating both the problems and potentials to address the issues during the period of the updated NDC:

TABLE 22: RECENT ANALYSES OF CURRENT NEEDS OF MRV SYSTEMS IN ETHIOPIA

Identified areas of support required to improve Ethiopia's MRV	Relevance for updated NDC
<i>Annex of the 2019 Action Document for Climate Change Sector Reform Performance Contract 2019-2022 in Ethiopia under the European Development Fund⁴⁵</i>	
MRV directorate understaffed and inexperienced.	MRV requirements will be more complex and demanding during NDC commitment periods (see above). This requires both adequate staff levels, but also institutional capacity in particular regarding coordination of entities relevant for NDC MRV in tracking progress producing BTR. These should be.
CRGE/Climate Change Units (CCUs) in need of intensive training on IPCC 2006 guidelines and on best practices for data collection in their respective sectors.	Use of IPCC 2006 Guidelines recommended for next inventory as this facilitates compliance with ETF modalities from 2024 onwards.
MRV directorate and CRGE/CCUs in need of extensive IT support and equipment.	Required to operate digital MRV/M&E systems.
Need for the Central Statistical Agency (CSA) to set up an operational climate change/MRV unit for international reporting, in liaison with EFCCC.	Integration of MRV/M&E with general national statistical data.
Need for key AFOLU players (EFCCC, pertinent ministry bodies...) to work together on generating IPCC-compliant MRV data on land use and land use change for prospective GHG-inventories.	Relevance of the sector, including cross-sectoral interactions (in particular land and energy).
Preparation and validation of national inventories for BURs and NCs.	Consolidated inventory for all sectors for available data vintages (until 2020?) following IPCC 2006 guidance should be prepared during first NDC implementation period and submitted as part of Ethiopia's 3. National Communication.
Need to operationalize MoU with the Ethiopian Geospatial Agency for the MRV Directorate being able to use official maps.	Not addressed

45 See: <https://bit.ly/2TNRfLZ>

Identified areas of support required to improve Ethiopia's MRV	Relevance for updated NDC
Better access to quality data through state-of-the-art technology, especially in the AFOLU sector and better cooperation with regional entities.	Not addressed
<i>CRGE Overview Report: Progress in Implementing the CRGE 2011-2019</i>	
GoE should rapidly operationalize and update existing MRV frameworks in accordance with international best practices, the technical unit of the CRGE Facility/EFCCC and the financial unit of the CRGE Facility/MoF should jointly establish a task force to achieve this by 2021 overseen by the CRGE Inter-Ministerial Steering Committee.	Strengthening NDC MRV framework in line with evolving PA rulebook (Article 4,6,13).
EFCCC, MoF and PDC should ensure the use of the same sets of consistent indicators by all institutions involved in the M&E processes.	NDC MRV and M&E frameworks and indicators in line with 10YDP, to the extent possible.
CRGE Inter-Ministerial Steering Committee should require all Ministries to participate in the implementation of the updated NDC and integrate climate change considerations into internal planning, including from GTPII and the new 10-year plan; Monitoring should take place based on the chosen set of core indicators, complemented by further context- and sector-specific indicators, overseen by PDC.	NDC MRV and M&E frameworks and indicators in line with 10YDP, to the extent possible.

In summary, the MRV/M&E Framework for the 10YDP should be used to track progress on sectoral targets. Progress indicator from for all sectors from the 10YDP have been reviewed during the NDC update preparation. Further review of all 10YDP targets and indicators and ensure consistency with GHG inventory and BRT reporting requirements will be made to facilitate tracking progress on achieving NDC targets. A new GHG consolidated GHG inventory should be compiled prior to next NDC update.

6.2 Adaptation (M&E)

As discussed above adaptation focusses on M&E rather than MRV. The M&E for the adaptation section is already built into the Table. The indicators were developed via.

- ▶ Review of existing documentation including: the NAP-ETG, and the updated M&E indicators for the CRGE and the NDC.
- ▶ Extensive consultation via three-day workshop with officials and sector experts to ensure the actions and indicators were aligned to the 10-year Development plan (as of 23rd December 2020).

Table shows that the indicators, baselines and targets are based on the 10YDP. The advantage of this approach is that there is an increased likelihood that data and information will be collected

as it is important not just for international reporting obligations but also to the implementation of a critical domestic policy. The compromise is that the indicators and baseline may not always be perfect for measuring the adaptation component of the NDC. Nevertheless, in an environment of constrained resources and capacity this compromise is judged reasonable.

Capacity building with the identified stakeholders who will undertake the tracking and collection of the monitoring data and those implementing and reporting on the action will be essential. Capacity building will need to be intensive and sustained with those directly responsible for collecting and reporting on the data. It will seek international support for this capacity building as M&E will be essential to the successful implementation of this NDC, its reporting to the UNFCCC and its ability to attract a wider range of sources of finance. Finally, critical institutional issues discussed in the Mitigation MRV section above equally apply to this adaptation section.

RECOMMENDATIONS ON MITIGATION MRV AND ADAPTATION M&E

- ▶ The MRV/M&E Framework should be further aligned on the 10YDP MRV/M&E Framework and sectoral targets, focusing on key performance indicators that are relevant for GHG emission pathways and adaptation actions. This requires agreeing with each sector ministry on which KPIs are relevant for NDC accounting and reporting.
- ▶ Conversely, results from 10YDP MRV/M&E evaluation processes need to be considered in light of their relevance for the NDC. This requires close cooperation between EFCCC (responsible for the NDC) and PDC (responsible for the 10YDP).
- ▶ The NDC MRV and M&E framework may need to be updated as NDC accounting and reporting rules under the Enhanced Transparency Framework evolve. Moreover, further adjustments to the 10YDP key performance indicators may result in updates to the NDC MRV and M&E framework.
- ▶ Adaptation indicators whose quantified baselines and targets are missing will need to be developed as the NDC is implemented.
- ▶ Building on the NAP M&E technical paper, which identifies indicators and the responsible entities for delivering each of the 18 NAP adaptation options, long-term adaptation M&E responsibilities for the enhanced NDC linked to the 10YDP need to be identified.

CHAPTER 7

CONCLUSIONS AND RECOMMENDATIONS

Ethiopia has developed an ambitious NDC. It has maintained its impressive level of ambition in Mitigation of its GHG emissions from its first NDC and enhanced the robustness of its baselines, projections and targets. Adaptation has been made more central to this enhanced NDC, with very clear baselines, targets, and indicators. In terms of resources required to implement the activities set out in this NDC a high-level breakdown has been prepared providing guidance of the magnitude of resources required and a clear demarcation between conditional and unconditional financing. Implementing such an impressive and ambitious programme of work will be challenging. This report has set out several enabling environments that will need to be implemented for the realization of this NDC implementation, as set out below.

Political commitment	In addition to the NDC, the newly launched 10YDP and Ethiopia's 2050 Low Emission Development Strategy (currently under development) as well as Ethiopia's Green Legacy Initiative (GLI) are clear indicators of Ethiopia's commitment to both adaptation and mitigation measures. Support should be replicated across sectoral strategies and at regional and Woreda levels, contributing to the implementation of this enhanced NDC.
Policy processes	<p>Streamline NDC implementation with current and future national and sectoral strategies and policies to derive maximum benefits and for effective utilisation of limited resources.</p> <p>Build on early successes such as CRGE and 1st NDC implementation.</p> <p>Ethiopia tries to develop a comprehensive national vulnerability and risk assessment, with regional differentiation and resolution, this could serve as a baseline for measuring adaptation progress and impact of interventions (to reduce vulnerability and increase climate resilience). This also applies to regional and Woreda level risk and vulnerability assessments that need to be updated to compliment previous assessments e.g., the Woreda vulnerability assessment (covering 400 Woredas) conducted by the National Disaster Risk Management Commission.</p>
Institutional framework	<p>Improve Ethiopia's climate change institutional architecture to unlock maximum beneficiation of current investments in climate change, including for climate change adaptation.</p> <p>Whereas the CRGE structures are working adequately at the national level, the capacity of regional and local institutions to discharge national climate policy or climate finance delivery mandate still needs to be strengthened.</p>

Monitoring and evaluation	There is a need to continually develop a robust MRV and M&E framework for adaptation and mitigation, at national and sub-national levels. Such a framework would benefit from periodic updating of information, for example by undertaking national and sub-national vulnerability and risk assessments or updating and refining the national emissions inventory every 3-5 years.
	Strengthen adaptation finance tracking.
	Adoption of the selected adaptation indicators for programme and project level monitoring. The indicators should be updated periodically as needed and communicated widely to stakeholders.
	Increasing accessibility to climate adaptation data at national, regional and Woreda levels. This information can be obtained from climate risk and vulnerability assessments at national, regional and Woreda level as well as project level data that will augment available national data.
	Strengthening an information portal or database for adaptation information and data to support policy development and implementation efforts.
	Continuing to develop and strengthen the transparency framework, with a focus on tracking progress on adaptation measures.
Resource mobilisation	All projects requiring climate finance will require detailed budgets with a clear demarcation between climate and development needs.
	Put in place a climate finance tracking mechanism.
	On the resource requirement figures, Ethiopia should continually refine it as more detailed data and information becomes available.
	Adopt a blended financing approach to resource mobilisation to tap into all appropriate financing sourcing such as climate finance, private sector, development partners, internal resources etc.
Carbon markets	Build on existing experience and use bilateral cooperation to establish the institutional framework and capacity to participate in Article 6 mechanisms.
Integrate NDC into regional plans	Operationalize the NDC by integrating national goals into regional plans and harmonizing the national target with regional interventions.
Stakeholder engagement	Improve coordination of all actors (development partners, development finance institutions, private sector, academia etc.) to identify synergies and avoid duplication of efforts.
	Continue to strengthen efforts to engage stakeholders in climate adaptation policy development.
	Establish structured stakeholder engagement platforms for information exchange of information and lessons learnt.
	Strengthen public awareness around climate adaptation efforts.
Capacity building	There is need to improve the capacity (human resource, technology transfer, financing, training) for institutions directly involved in NDC implementation.
	Promote embedding of capacity in institutions.

CHAPTER 8

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APPENDIXES

APPENDIX A

ASSUMPTIONS AND LIMITATIONS

Main parameters fed into the GEM by sector and module⁴⁶

Module System Dynamics model	Main input parameters and data sources
Population	Population data are obtained from national statistics and the forecast is aligned with the Medium Variant of the UN World Population Prospects.
GDP growth	GDP growth rates by economic sector were obtained from national statistics and additional information on long term sectoral growth and sectoral shares was obtained from the 10-year Transformation Plan and Long-Term Strategy to 2050.
Energy demand	Energy demand data was obtained from the IEA database. In GEM, energy demand is modelled as a function of population and GDP (see above).
Climate assumptions	Climate assumptions were obtained from the World Bank Climate Change Knowledge Portal.
Government	All data for the government sector were obtained from national statistics.
Selected emission factors/ GWPs	<ul style="list-style-type: none"> ▪ Energy: Emission factors in the model were obtained from the IPCC. The following emission factors are used for the respective fuel sources (excluding biomass, for which emission factors were provided): <ul style="list-style-type: none"> ♦ Coal: 94.6 Ton/TJ (Bituminous Coal). ♦ Petroleum: 69.3 Ton/TJ (Motor gasoline). ♦ Natural gas: 56.1 Ton/TJ (Natural gas). ♦ Electricity: Based on EIA, emissions per TJ are endogenously calculated based on electricity generation by source and the respective emission factor for electricity generated from coal, gas and petroleum-based sources. ♦ Biomass: 76.6 Ton/TJ for the historical analysis. ▪ IPPU: Industry and process related emissions were calibrated according to data obtained from Ethiopia's NIR. Emissions are influenced by GDP for the industrial sector. The emission factor (emission intensity) was calculated.

⁴⁶ Note that the GEM includes more modules than economic sectors, including social, political, demographic and biophysical representations of Ethiopia. For an overview of current state of affairs of data inputs, please refer to the Documents "WRI_NCE_Ethiopia_Data_Sheet" and "WRI_Technical_documentation_GEM_NCE_Ethiopia_20200425".

Module System Dynamics model	Main input parameters and data sources
	<ul style="list-style-type: none"> ▪ Livestock: Livestock emission factors for dairy cattle, cattle, sheep and chicken were obtained from the national livestock inventory (past and future values). For estimating emissions for all other species considered in GEM and not included in the inventory, emission factors were obtained from Ethiopia's 2nd National Communication to the UNFCCC. ▪ Managed soils: Emissions from managed soils are calibrated to match NIR emissions from managed soils. The emission factors for estimating emissions from the various sub-categories were obtained from Ethiopia's 2nd National Communication to the UNFCCC. ▪ Waste: Based on Ethiopia's NIR. Emissions factors for solid waste disposal were calculated based on NIR waste emissions and total solid waste generation (obtained Ton CO₂eq/Ton of waste generated). The emission factor for wastewater was estimated calculated based on total sludge generation and NIR emissions from wastewater. ▪ Land: CO₂eq emissions from land are estimated based on land use changes and the carbon factor considered for each land use class. Carbon factors for Ethiopia were estimated based on IPCC 2006 guidelines and refined based on calibration to ensure land use emissions are consistent with NIR data. For land under sustainable agriculture practices, additional carbon sequestration of 0.356 tons is considered based on USAID (2017)*. The following carbon factors are used for land use classes considered in GEM: <ul style="list-style-type: none"> ♦ Settlement land: 0 Ton/ha ♦ Forest land: 100 Ton/ha ♦ Agriculture: 16.43 Ton/ha ♦ Fallow land: 40 Ton/ha ♦ Grassland: 25 Ton/ha ♦ Wetlands: 31.2 Ton/ha

* USAID (2017) - Cost and benefit analysis for Climate-Smart Agricultural (CSA) practices in the coastal Savannah Agro-Ecological Zone (AEZ) of Ghana.

Adaptation

The content in the adaptation section of the NDC Technical Report is predicated on several assumptions, some of which would need to be validated and clarified by the Government of Ethiopia. These assumptions are as follows:

- ▶ The development of Ethiopia's National Adaptation Plan (NAP) and its companion documents (including the NAP Implementation Roadmap, the NAP M&E Working Paper, the NAP Resource Mobilization Strategy, and the NAP Gender Analysis) was a detailed, comprehensive, and well-structured exercise, which involved participatory elements and incorporated stakeholder engagement.
- ▶ The NAP development process reviewed, referred to, and integrated major elements from pre-existing sectoral climate resilience strategies, and was based on sound scientific and technical information.

- ▶ The revised set of CRGE indicators prepared by the EFCCC is final, and officially endorsed by the Government of Ethiopia.
- ▶ The baselines for 2015, 2016, 2017, and 2018 for the CRGE indicators, in the indicator reference sheets finalized by the EFCCC (with inputs from ECRC) are accurate and reliable for use in the NDC.

Limitations that imposed a minor degree of constraint on the analysis underpinning the adaptation component include the following:

- ▶ Lack of access to certain materials that could have been instructive, such as Woreda level risk and vulnerability hazard maps.
- ▶ Delayed sharing of some documents by counterparts, which prevented the documents from being reviewed for this draft (but the documents will be reviewed for the next and final revision).
- ▶ Lack of access to an English language version of the draft ten years development plan, which has prevented cross-referencing with the plan to check alignment of priority adaptation interventions.

APPENDIX B

RESULTS OF THE PRIORITIZATION SCREENING OF ADAPTATION INTERVENTIONS

Sector: Agriculture

PRIORITIZATION CRITERIA		Enhancing food security by improving agricultural productivity in a climate-smart manner	Livestock diversification, including selection of drought-resistant animal breeds	Improved animal breeding and feeding systems	Strengthen and expand animal health services	Prevent and control the spread of vector-borne diseases and macro parasites	Improve rangeland and pastureland management and diversification, including selection of drought-resistant animal breeds	Apply climate-resilient agricultural practices	Increase the use of organic fertilizers	Expand the use of improved crop varieties	Strengthen crop disease and pest monitoring systems	Strengthening drought and crop insurance mechanisms
Criteria Category (in PESTLE Framework)	Criteria											
	Alignment with the 10 Years Development Plan (10YDP)	3	2	3	1	1	3	3	1	2	2	2
	Alignment with the National Adaptation Plan (NAP)	3	3	3	3	3	3	3	3	3	3	3
Political	Alignment with relevant sectoral climate resilience strategy	3	3	3	3	3	3	3	3	3	3	3
	Cost-effectiveness	3	2	2	3	3	3	0	1	2	3	2
	Suitability for resource mobilization	3	3	3	3	3	3	2	2	3	3	2
Economic (and Financial)	Suitability for private sector investment	3	3	3	3	3	3	2	2	3	3	3
	Economic development co-benefits	3	3	3	3	3	3	2	2	3	3	3

PRIORITIZATION CRITERIA														
Social	Alignment with Sustainable Development Goals (SDGs)	3	3	2	2	2	2	3	1	3	1	3	2	1
	Alignment with the Sendai Framework for Disaster Risk Reduction	1	1	1	1	1	1	1	1	1	1	1	1	1
Technological	Gender-responsiveness and equity	2	2	2	2	2	2	2	2	2	2	2	2	2
	Ability to support sustainable livelihoods and job-creation	3	3	3	3	3	3	3	2	2	2	3	3	2
	Technological ease	2	2	2	2	2	1	2	0	2	2	2	2	3
	Technological trade-offs	2	2	2	2	2	2	2	0	2	2	2	2	2
	Technological risks	2	2	2	2	2	2	2	0	1	2	2	2	3
	Technological leap-frogging	3	3	3	3	3	3	3	2	2	2	3	3	2
	Availability of CRGE indicator and baseline data	3	1	1	1	1	1	3	2	1	1	1	1	1
Legal (and Institutional)	Suitability for existing institutional arrangements	2	2	2	2	2	2	2	2	2	2	2	2	1
	Feasibility within existing legal and regulatory frameworks	3	3	3	3	3	3	3	3	1	3	3	3	2
	Alignment with regional and continental obligations	3	3	3	3	3	3	3	3	1	3	3	3	3
Environmental	Ability to reduce vulnerability and build adaptive capacity	3	3	3	3	3	3	2	2	2	2	2	3	3
	Environmental co-benefits	3	2	2	2	2	2	0	2	2	2	2	2	2
	Mitigation co-benefits	2	1	2	1	1	1	1	0	1	0	0	2	2
	Environmental risks	2	2	2	2	2	2	0	1	0	1	0	2	2
	Total (out of a maximum possible score of 72)	60	54	55	53	52	58	37	38	50	55	50	55	50
	Total out of a 3-point scale (total/24)	2.5	2.25	2.291	2.208	2.166	2.416	1.541	1.583	2.083	2.291	2.083	2.291	2.083

Scoring Scale: High (3), Moderate (2), Low (1), Unknown (0)

Sector: Land Use and Forestry

PRIORITIZATION CRITERIA													
Criteria Category (in PESTLE Framework)	Criteria	Strengthening sustainable natural resource management through safeguarding landscapes and watersheds	Improving soil and water harvesting and water retention mechanisms	Improving ecosystem resilience through conserving biodiversity	Enhancing sustainable forest management	Promote agrobiodiversity	Integrate climate change adaptation in natural resource management and planning	Rehabilitate deforested watersheds to reduce soil erosion	Area closures of deforested watersheds, land and gullies to reduce soil erosion	Improve wildlife and biodiversity management	Plan and implement forest health measures	Community-based rehabilitation of degraded forests	Afforestation and reforestation of degraded forest land
Political	Alignment with the 10 Years Development Plan (10YDP)	3	3	2	2	2	2	2	1	2	2	1	3
	Alignment with the National Adaptation Plan (NAP)	3	3	3	3	3	3	3	3	3	3	3	3
	Alignment with relevant sectoral climate resilience strategy	3	3	3	3	2	2	3	1	3	2	1	2
Economic (and Financial)	Cost-effectiveness	3	3	3	3	2	3	2	0	2	3	3	3
	Suitability for resource mobilization	3	3	3	3	3	3	3	0	3	3	3	3
	Suitability for private sector investment	2	2	1	2	1	2	1	1	2	2	1	2
Social	Economic development co-benefits	3	3	2	3	3	3	3	0	3	3	2	3
	Alignment with Sustainable Development Goals (SDGs)	3	3	3	3	2	2	2	1	3	2	2	3
	Alignment with the Sendai Framework for Disaster Risk Reduction	2	2	2	1	1	2	2	2	1	2	2	2

PRIORITIZATION CRITERIA														
Gender-responsiveness and equity	2	2	2	2	2	2	2	2	2	2	2	1	2	2
Ability to support sustainable livelihoods and job-creation	3	2	3	3	2	3	2	3	3	3	3	1	3	3
Technological ease	3	3	3	3	2	3	3	2	3	3	3	2	3	3
Technological trade-offs	3	3	3	3	2	3	3	2	3	3	3	2	3	3
Technological risks	3	3	3	3	2	3	3	2	3	3	3	2	3	3
Technological leap-frogging	2	2	2	2	3	2	2	3	2	2	2	0	2	2
Availability of CRGE indicator and baseline data	3	1	1	3	1	1	1	3	1	3	3	0	1	3
Suitability for existing institutional arrangements	2	2	2	2	2	2	2	2	2	2	2	0	2	1
Feasibility within existing legal and regulatory frameworks	3	3	3	3	3	3	3	3	3	3	3	0	3	3
Alignment with regional and continental obligations	3	3	3	3	3	3	3	3	3	3	3	0	3	3
Ability to reduce vulnerability and build adaptive capacity	3	3	3	3	2	3	3	2	3	3	3	3	3	3
Environmental co-benefits	3	3	3	3	2	3	2	3	3	3	3	3	3	3
Mitigation co-benefits	2	2	2	3	1	1	1	3	1	2	2	1	2	3
Environmental risks	3	3	3	3	2	3	2	3	3	3	3	3	3	3
Total (out of a maximum possible score of 72)	63	60	58	62	50	55	55	59	27	58	61	55	63	
Total out of a 3-point scale (total/24)	2.625	2.5	2.416	2.583	2.083	2.291	2.458	1.125	2.416	2.541	2.291	2.625		

Scoring Scale: High (3), Moderate (2), Low (1), Unknown (0)

Sector: Water

PRIORITIZATION CRITERIA	Criteria Category (in PESTLE Framework)	Criteria	Improving access to potable water
	Political	Alignment with the 10 Year Development Plan (10YDP)	3
		Alignment with the National Adaptation Plan (NAP)	3
		Alignment with relevant sectoral climate resilience strategy	3
	Economic (and Financial)	Cost-effectiveness	3
		Suitability for resource mobilization	3
		Suitability for private sector investment	2
		Economic development co-benefits	3
	Social	Alignment with Sustainable Development Goals (SDGs)	3
		Alignment with the Sendai Framework for Disaster Risk Reduction	2
		Gender-responsiveness and equity	2
		Ability to support sustainable livelihoods and job-creation	2
	Technological	Technological ease	2
		Technological trade-offs	3
		Technological risks	3
		Technological leap-frogging	2
	Legal (and Institutional)	Availability of CRGE indicator and baseline data	3
		Suitability for existing institutional arrangements	3
		Feasibility within existing legal and regulatory frameworks	3
		Alignment with regional and continental obligations	3
	Environmental	Ability to reduce vulnerability and build adaptive capacity	3
		Environmental co-benefits	2
		Mitigation co-benefits	2
		Environmental risks	2
	Total (out of a maximum possible score of 72)	60	
	Total out of a 3-point scale (total/24)	2.5	

Scoring Scale: High (3), Moderate (2), Low (1), Unknown (0)

Sector: Energy

PRIORITIZATION CRITERIA	Criteria Category (in PESTLE Framework)	Criteria	Enhancing alternative and renewable power generation and management
	Political	Alignment with the 10 Year Development Plan (10YDP)	3
		Alignment with the National Adaptation Plan (NAP)	3
		Alignment with relevant sectoral climate resilience strategy	3
	Economic (and Financial)	Cost-effectiveness	2
		Suitability for resource mobilization	3
		Suitability for private sector investment	3
		Economic development co-benefits	3
	Social	Alignment with Sustainable Development Goals (SDGs)	3
		Alignment with the Sendai Framework for Disaster Risk Reduction	1
		Gender-responsiveness and equity	2
		Ability to support sustainable livelihoods and job-creation	3
	Technological	Technological ease	2
		Technological trade-offs	2
		Technological risks	2
		Technological leap-frogging	3
	Legal (and Institutional)	Availability of CRGE indicator and baseline data	3
		Suitability for existing institutional arrangements	2
		Feasibility within existing legal and regulatory frameworks	1
		Alignment with regional and continental obligations	3
	Environmental	Ability to reduce vulnerability and build adaptive capacity	2
		Environmental co-benefits	3
		Mitigation co-benefits	3
		Environmental risks	2
	Total (out of a maximum possible score of 72)	57	
	Total out of a 3-point scale (total/24)	2.375	

Scoring Scale: High (3), Moderate (2), Low (1), Unknown (0)

Sector: Industry and Mining

PRIORITIZATION CRITERIA	Criteria Category (in PESTLE Framework)	Criteria	Developing adaptive industry systems	Developing efficient value chain and marketing systems
	Political	Alignment with the 10 Year Development Plan (10YDP)	1	2
		Alignment with the National Adaptation Plan (NAP)	3	3
		Alignment with relevant sectoral climate resilience strategy	0	0
	Economic (and Financial)	Cost-effectiveness	2	3
		Suitability for resource mobilization	2	2
		Suitability for private sector investment	2	2
		Economic development co-benefits	3	3
	Social	Alignment with Sustainable Development Goals (SDGs)	1	3
		Alignment with the Sendai Framework for Disaster Risk Reduction	1	1
		Gender-responsiveness and equity	2	2
		Ability to support sustainable livelihoods and job-creation	3	3
	Technological	Technological ease	2	2
		Technological trade-offs	2	2
		Technological risks	2	2
		Technological leap-frogging	3	3
	Legal (and Institutional)	Availability of CRGE indicator and baseline data	2	1
		Suitability for existing institutional arrangements	2	2
		Feasibility within existing legal and regulatory frameworks	1	2
		Alignment with regional and continental obligations	2	2
	Environmental	Ability to reduce vulnerability and build adaptive capacity	2	1
		Environmental co-benefits	2	2
		Mitigation co-benefits	2	2
		Environmental risks	2	2
	Total (out of a maximum possible score of 72)	44	47	
	Total out of a 3-point scale (total/24)	1.833	1.958	

Scoring Scale: High (3), Moderate (2), Low (1), Unknown (0)

Sector: Transport

PRIORITIZATION CRITERIA							
Criteria Category (in PESTLE Framework)	Criteria	Building sustainable transport systems	Climate resilient designs and safety standards for transport systems	Revise transportation planning, project screening and development process to take climate change into account	Implement adaptive asset management systems based on projected changes in climate	Facilitate movement of aid and support to communities affected by climate hazards	Protect transportation infrastructure from climate hazards
Political	Alignment with the 10 Year Development Plan (10YDP)	2	2	1	1	1	1
	Alignment with the National Adaptation Plan (NAP)	3	3	3	3	3	3
	Alignment with relevant sectoral climate resilience strategy	3	3	3	3	2	3
Economic (and Financial)	Cost-effectiveness	2	2	2	2	2	2
	Suitability for resource mobilization	2	2	1	1	2	2
	Suitability for private sector investment	3	2	1	1	2	2
Social	Economic development co-benefits	3	3	3	3	3	3
	Alignment with Sustainable Development Goals (SDGs)	3	3	2	2	3	2
	Alignment with the Sendai Framework for Disaster Risk Reduction	3	3	2	2	3	3
	Gender-responsiveness and equity	2	2	2	2	2	2
	Ability to support sustainable livelihoods and job-creation	3	2	2	2	3	3

PRIORITIZATION CRITERIA							
Criteria Category (in PESTLE Framework)	Criteria	Building sustainable transport systems	Climate resilient designs and safety standards for transport systems	Revise transportation planning, project screening and development process to take climate change into account	Implement adaptive asset management systems based on projected changes in climate	Facilitate movement of aid and support to communities affected by climate hazards	Protect transportation infrastructure from climate hazards
Technological	Technological ease	1	1	2	2	2	2
	Technological trade-offs	2	2	2	2	3	2
	Technological risks	2	2	2	2	2	2
	Technological leap-frogging	3	3	3	3	3	3
Legal (and Institutional)	Availability of CRGE indicator and baseline data	3	3	1	1	1	3
	Suitability for existing institutional arrangements	2	2	2	2	2	2
	Feasibility within existing legal and regulatory frameworks	2	2	2	2	2	2
Environmental	Alignment with regional and continental obligations	3	2	2	2	3	3
	Ability to reduce vulnerability and build adaptive capacity	3	3	3	3	3	3
	Environmental co-benefits	3	2	2	2	2	2
	Mitigation co-benefits	3	2	2	2	2	2
	Environmental risks	2	2	2	2	2	2
	Total (out of a maximum possible score of 72)	58	53	47	47	53	54
	Total out of a 3-point scale (total/24)	2.416	2.208	1.958	1.958	2.208	2.25

Scoring Scale: High (3), Moderate (2), Low (1), Unknown (0)

Sector: Urban Settlements

PRIORITIZATION CRITERIA					
Criteria Category (in PESTLE Framework)	Criteria	Increasing the resilience of urban systems	Improve provision of and condition of housing	Enhance urban greenery	Undertake adaptive urban planning
Political	Alignment with the 10 Year Development Plan (10YDP)	3	3	3	2
	Alignment with the National Adaptation Plan (NAP)	3	3	3	3
	Alignment with relevant sectoral climate resilience strategy	3	3	2	3
Economic (and Financial)	Cost-effectiveness	2	1	2	2
	Suitability for resource mobilization	2	1	2	2
	Suitability for private sector investment	2	1	2	1
Social	Economic development co-benefits	3	3	2	2
	Alignment with Sustainable Development Goals (SDGs)	3	3	3	3
	Alignment with the Sendai Framework for Disaster Risk Reduction	3	3	1	3
	Gender-responsiveness and equity	2	2	2	2
	Ability to support sustainable livelihoods and job-creation	2	3	3	2
Technological	Technological ease	2	2	3	3
	Technological trade-offs	2	2	3	3
	Technological risks	2	2	3	3
	Technological leap-frogging	3	3	2	2
Legal (and Institutional)	Availability of CRGE indicator and baseline data	1	1	3	1
	Suitability for existing institutional arrangements	2	2	2	2
	Feasibility within existing legal and regulatory frameworks	2	2	2	2
	Alignment with regional and continental obligations	2	3	3	2

PRIORITIZATION CRITERIA					
Criteria Category (in PESTLE Framework)	Criteria	Increasing the resilience of urban systems	Improve provision of housing and condition of	Enhance urban greenery	Undertake adaptive urban planning
Environmental	Ability to reduce vulnerability and build adaptive capacity	3	3	3	3
	Environmental co-benefits	2	2	3	2
	Mitigation co-benefits	2	1	3	2
	Environmental risks	2	1	3	3
	Total (out of a maximum possible score of 72)	53	50	58	53
	Total out of a 3-point scale (total/24)	2.208	2.083	2.416	2.208

Scoring Scale: High (3), Moderate (2), Low (1), Unknown (0)

Sector: Health

PRIORITIZATION CRITERIA					
Criteria Category (in PESTLE Framework)	Criteria	Improving human health systems through the implementation of changes based on an integrated health and environmental surveillance protocol	Climate-Sensitive disease prevention and management	Improve basic health services	Improve emergency medical services
Political	Alignment with the 10 Year Development Plan (10YDP)	1	1	3	1
	Alignment with the National Adaptation Plan (NAP)	3	3	3	3
	Alignment with relevant sectoral climate resilience strategy	3	3	3	2
Economic (and Financial)	Cost-effectiveness	3	3	2	2
	Suitability for resource mobilization	3	3	3	2
	Suitability for private sector investment	1	1	2	2
	Economic development co-benefits	3	3	3	3
Social	Alignment with Sustainable Development Goals (SDGs)	1	1	2	1
	Alignment with the Sendai Framework for Disaster Risk Reduction	1	1	1	3
	Gender-responsiveness and equity	2	2	2	2
	Ability to support sustainable livelihoods and job-creation	3	3	3	3
Technological	Technological ease	3	2	2	2
	Technological trade-offs	3	2	2	2
	Technological risks	3	3	3	3
	Technological leap-frogging	3	3	3	3

PRIORITIZATION CRITERIA					
Criteria Category (in PESTLE Framework)	Criteria	Improving human health systems through the implementation of changes based on an integrated health and environmental surveillance protocol	Climate-Sensitive disease prevention and management	Improve basic health services	Improve emergency medical services
Legal (and Institutional)	Availability of CRGE indicator and baseline data	1	1	1	1
	Suitability for existing institutional arrangements	2	2	3	3
	Feasibility within existing legal and regulatory frameworks	3	3	3	3
Environmental	Alignment with regional and continental obligations	2	2	3	3
	Ability to reduce vulnerability and build adaptive capacity	3	3	3	3
	Environmental co-benefits	2	2	2	2
	Mitigation co-benefits	1	1	1	1
	Environmental risks	3	3	3	3
	Total (out of a maximum possible score of 72)	53	51	56	53
	Total out of a 3-point scale (total/24)	2.208	2.125	2.333	2.208

Scoring Scale: High (3), Moderate (2), Low (1), Unknown (0)

Sector: Climate Services and Disaster Risk Reduction

PRIORITIZATION CRITERIA	Criteria Category (in PESTLE Framework)	Criteria	Improving early warning systems	Improve disaster risk management planning and preparedness	
	Political	Alignment with the 10 Year Development Plan (10YDP)		2	3
		Alignment with the National Adaptation Plan (NAP)		3	3
		Alignment with relevant sectoral climate resilience strategy		2	2
	Economic (and Financial)	Cost-effectiveness		3	3
		Suitability for resource mobilization		3	3
		Suitability for private sector investment		1	1
		Economic development co-benefits		3	3
	Social	Alignment with Sustainable Development Goals (SDGs)		3	3
		Alignment with the Sendai Framework for Disaster Risk Reduction		3	3
Gender-responsiveness and equity			2	2	
Ability to support sustainable livelihoods and job-creation			3	3	
Technological	Technological ease		2	2	
	Technological trade-offs		2	2	
	Technological risks		3	3	
	Technological leap-frogging		3	3	
Legal (and Institutional)	Availability of CRGE indicator and baseline data		3	3	
	Suitability for existing institutional arrangements		3	3	
	Feasibility within existing legal and regulatory frameworks		3	3	
	Alignment with regional and continental obligations		3	3	
Environmental	Ability to reduce vulnerability and build adaptive capacity		3	3	
	Environmental co-benefits		3	3	
	Mitigation co-benefits		1	1	
	Environmental risks		3	3	
	Total (out of a maximum possible score of 72)		60	61	
	Total out of a 3-point scale (total/24)		2.5	2.541	

Scoring Scale: High (3), Moderate (2), Low (1), Unknown (0)

Sector: Crosscutting (Other)

PRIORITIZATION CRITERIA										
Criteria Category (in PESTLE Framework)	Criteria	Building social protection and livelihood options of vulnerable people	Mainstreaming endogenous adaptation practices	Developing and using adaptation technologies	Reinforcing adaptation research and development	Strengthen safety net systems for vulnerable groups	Enhance access to financial services for vulnerable groups	Support livelihood diversification for vulnerable groups	Strengthen multidisciplinary research on adaptation	Enhance adaptation and technology development and adoption
Political	Alignment with the 10 Year Development Plan (10YDP)	3	1	2	2	3	1	2	2	2
	Alignment with the National Adaptation Plan (NAP)	3	3	3	3	3	3	3	3	3
	Alignment with relevant sectoral climate resilience strategy									
Economic (and Financial)	Cost-effectiveness	2	0	0	0	2	0	0	0	0
	Suitability for resource mobilization	0	0	0	0	0	0	0	0	0
	Suitability for private sector investment	1	0	0	0	1	0	0	0	0
Social	Economic development co-benefits	2	2	2	2	2	2	2	2	2
	Alignment with Sustainable Development Goals (SDGs)	2	2	2	2	2	2	2	2	2
	Alignment with the Sendai Framework for Disaster Risk Reduction	2	2	2	2	2	2	2	2	2
	Gender-responsiveness and equity	2	2	2	2	2	2	2	2	2
	Ability to support sustainable livelihoods and job-creation	2	2	2	2	2	2	2	2	2

PRIORITIZATION CRITERIA										
Criteria Category (in PESTLE Framework)	Criteria	Building social protection and livelihood options of vulnerable people	Mainstreaming endogenous adaptation practices	Developing and using adaptation technologies	Reinforcing adaptation research and development	Strengthen safety net systems for vulnerable groups	Enhance access to financial services for vulnerable groups	Support livelihood diversification for vulnerable groups	Strengthen multidisciplinary research on adaptation	Enhance adaptation and technology development
Technological	Technological ease	2	2	2	2	2	2	2	2	2
	Technological trade-offs	0	0	0	0	0	0	0	0	0
	Technological risks	0	0	0	0	0	0	0	0	0
	Technological leap-frogging	0	0	0	0	0	0	0	0	0
Legal (and Institutional)	Availability of CRGE indicator and baseline data	1	1	1	1	1	1	1	1	1
	Suitability for existing institutional arrangements	0	0	0	0	0	0	0	0	0
	Feasibility within existing legal and regulatory frameworks	0	0	0	0	0	0	0	0	0
	Alignment with regional and continental obligations	0	0	0	0	0	0	0	0	0
Environmental	Ability to reduce vulnerability and build adaptive capacity	2	2	2	2	2	2	2	2	2
	Environmental co-benefits	0	0	0	0	0	0	0	0	0
	Mitigation co-benefits	0	0	0	0	0	0	0	0	0
	Environmental risks	0	0	0	0	0	0	0	0	0
	Total (out of a maximum possible score of 72)	24	19	20	20	24	19	20	20	20
	Total out of a 3-point scale (total/24)	1	0.791	0.833	0.833	1	0.791	0.833	0.833	0.833

Scoring Scale: High (3), Moderate (2), Low (1), Unknown (0)

APPENDIX C

COMPLETENESS CHECK OF EMISSION SOURCES CONTAINED IN THE CRGE

FIGURE 13: COMPLETENESS CHECK OF EMISSION SOURCES CRGE: ENERGY SECTOR

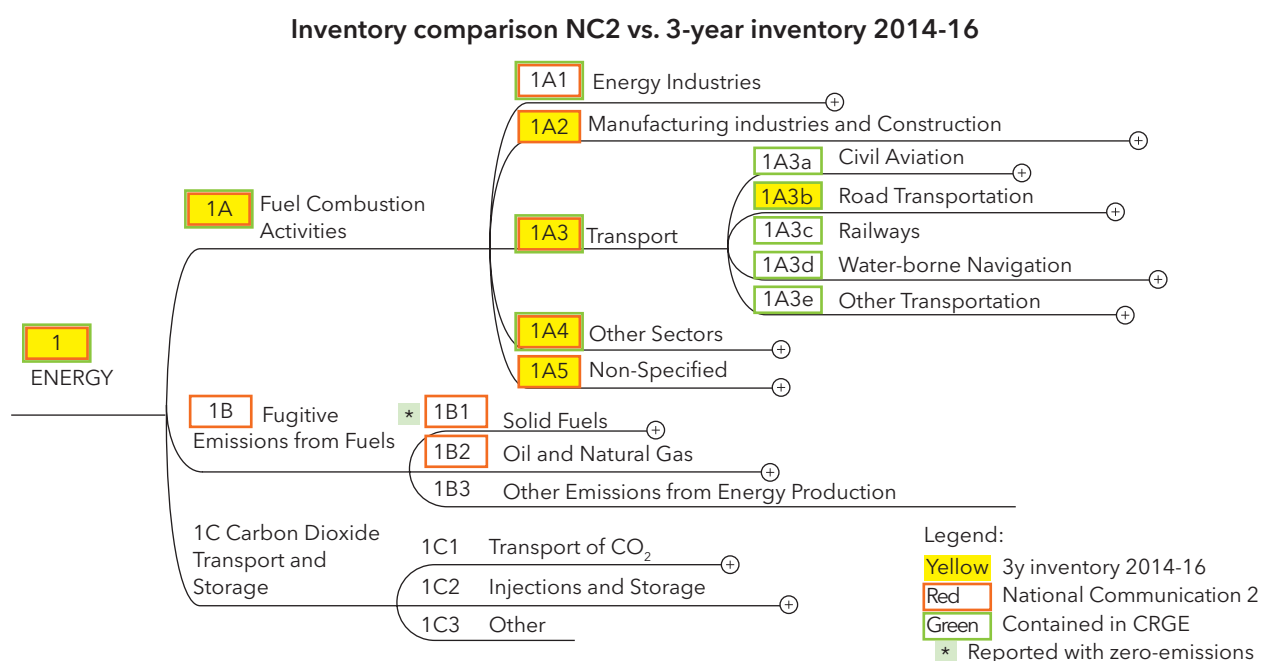


FIGURE 14: COMPLETENESS CHECK OF EMISSION SOURCES CRGE: IPPU SECTOR

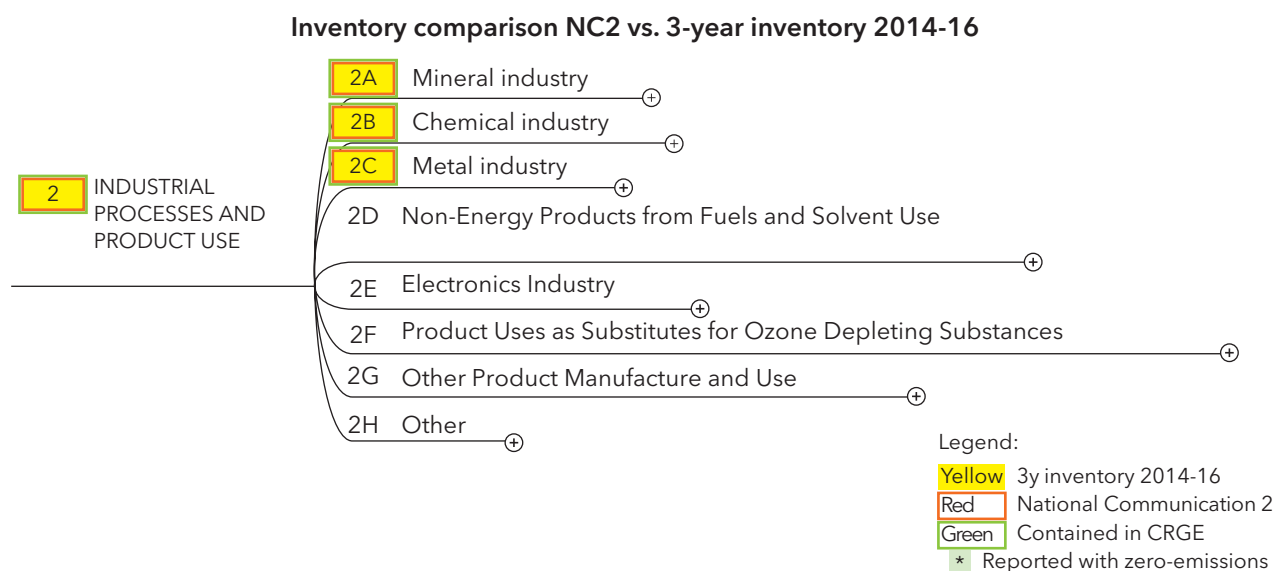


FIGURE 15: COMPLETENESS CHECK OF EMISSION SOURCE CRGE: WASTE

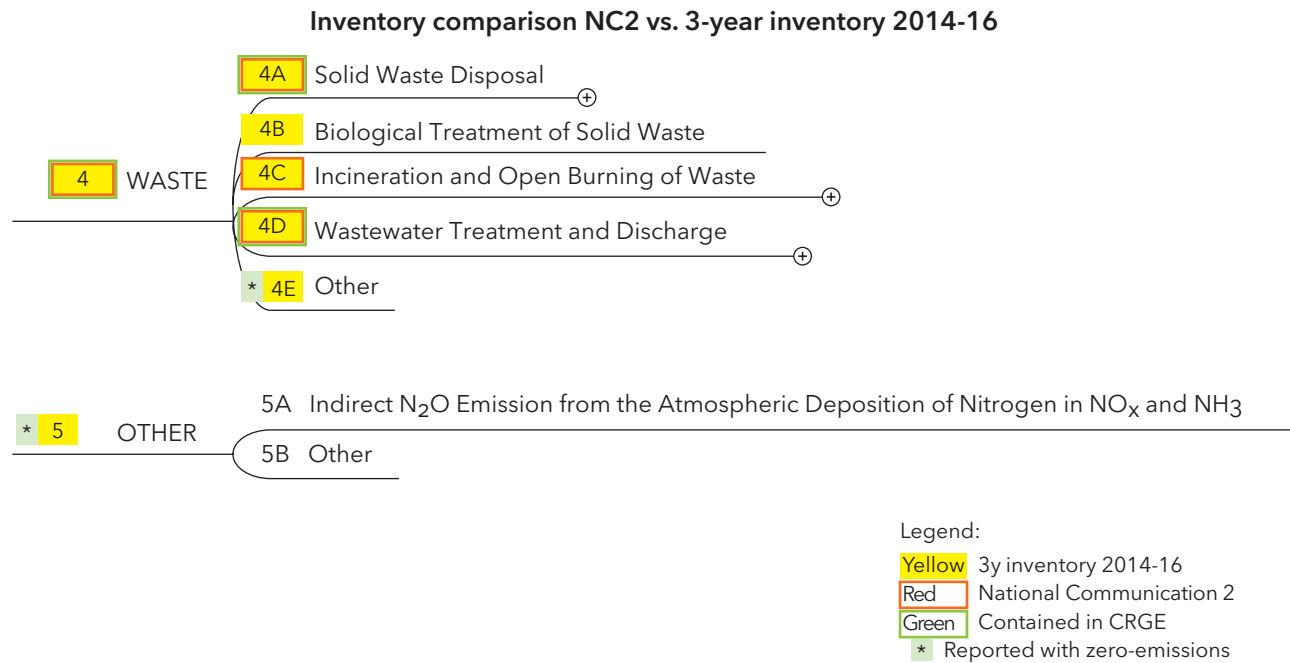
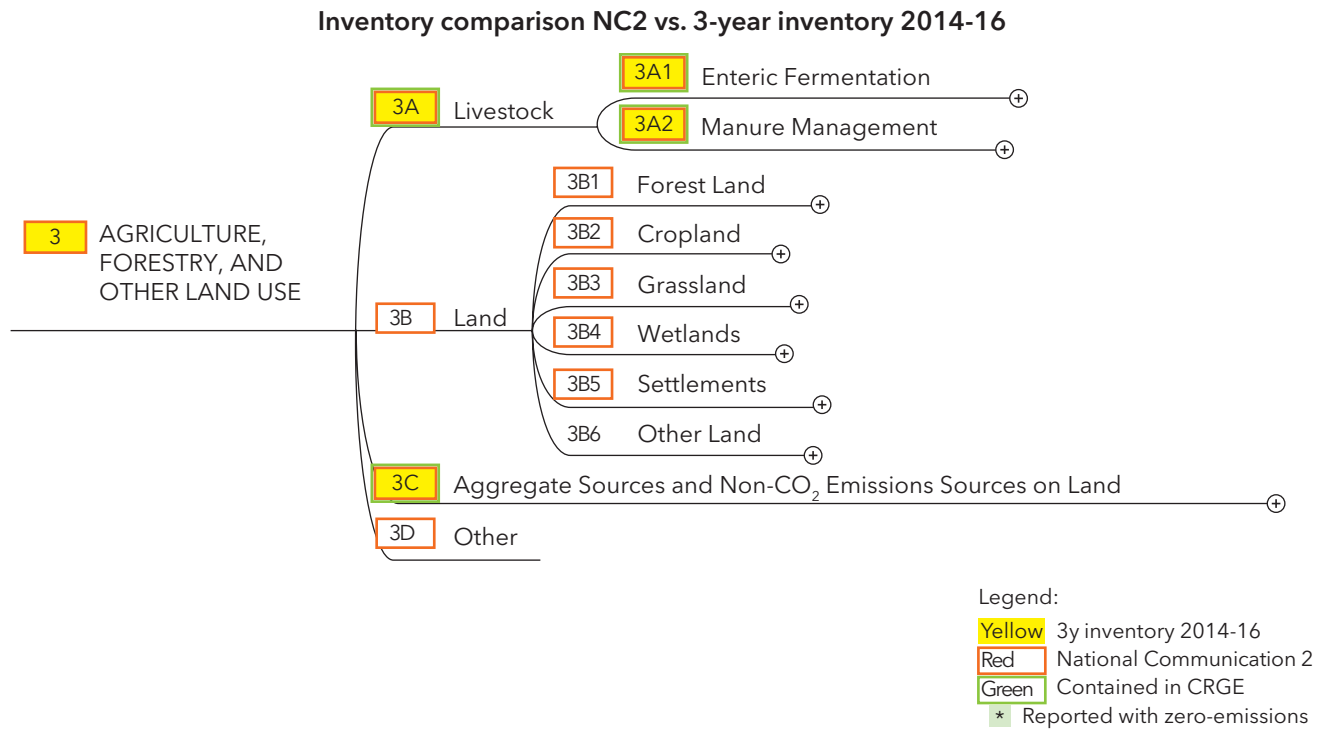


FIGURE 16: COMPLETENESS CHECK OF EMISSION SOURCES CRGE: AFOLU SECTOR



Note: Key category 3.C only includes 3.C.3 (urea application) and 3.C.6 (emissions from manure management).

APPENDIX D

FURTHER MITIGATION ANNEXES

D 1. Detailed comparison between CRGE and GEM sectors and policies

- ▶ Please see the separate document in Zip folder “Annexes to ETH_NDC Update Technical Report”
- ▶ “PCG_Overview_emissions_and_policies_GEM_Annex_version_2021_01_15” (Excel file)
- ▶ Sheets “Summary comparison CRGE & GEM” and “Detailed comparison CRGE & GEM”.

D 2. Documentation of collaboration with WRI and sector representatives

- ▶ Please see the separate document in Zip folder “Annexes to ETH_NDC Update Technical Report”
- ▶ “PCG_Documentation GEM adjustments_2020_12_30” (PDF)
- ▶ “PCG_Summary_feedback_sectors_2020_12_30” (PDF).

D 3. Emission sources covered in GEM vs. second national communication

Table A1: Overview of completeness of the emission sources considered in the Green Economy Model (GEM) vis-à-vis the key categories identified in the second National Communication (NC2).

Key categories NC2	Significance of emissions in 2013 as reported by NC2 (in Mt CO ₂ eq)	Modules represented in the GEM	Comments
ENERGY	21.75	"Energy"	-
1A Fossil Fuel combustion activities (1A.1-4)	21.74	"Coal", "petroleum", "natural gas", "biofuels and waste (incl. biomass)"	Use of IEA-data on energy demand with data vintage until 2016; Potential underestimation due to high residential petroleum demand for off-grid electricity production with diesel generators.

Key categories NC2	Significance of emissions in 2013 as reported by NC2 (in Mt CO ₂ eq)	Modules represented in the GEM	Comments
1B Fugitive emissions from fuels (1B.1-2)	0.01	-	Category missing
IPPU	1.76	"INDUSTRY"	Disaggregation of industry into subsectors to calculate real GDP (Mining and Quarrying, Manufacturing, Electricity gas and water, Construction). GHG-intensity of industry-GDP is calculated and projected by dividing industry-GDP by industry-emissions (covers all IPPU-emissions reported in NC2). The 3-year inventory is used for comparison, and simulated IPPU-emission values locate between the observed values of NC2 and 3-year inventory.
2A Mineral industry (2A.1-3)	0.917	"Industry"	
2B Chemical industry (2B.7)	0.000182	"Industry"	
2C Metal industry (2C.1)	0.84	"Industry"	
Agriculture, Forestry and Other Land Uses (AFOLU)	115.23	"Managed soils", "Land", "Livestock"	Separation into three subsectors
3A Livestock (3A.1-2)	66.16	"CH ₄ emissions from enteric fermentation"; "CH ₄ emissions from manure management"	Comprises all types of heads of animal as suggested by IPCC 2006; full alignment with the currently ongoing effort to update the calibration of the model with the updated Tier-2 GHG-inventory in the livestock sector conducted by UNIQUE forestry and land use GmbH for MoA in the context of the new BUR is currently under way. All relevant data have been provided to WRI.
3B Land (3B.1-5)	32.60	"CO ₂ emissions from land" (incl. change in carbon stock for agriculture to forest, fallow land to forest, agriculture to fallow land, waste to settlement, forest to settlement, wetland to fallow land and fallow land to grassland.	Comprises all five land use change categories using up-to-date carbon factors.

Key categories NC2	Significance of emissions in 2013 as reported by NC2 (in Mt CO ₂ eq)	Modules represented in the GEM	Comments
3C Aggregate sources and non-CO ₂ emissions sources on land (3C.1; 3C.3-7)	16.47	"Direct N ₂ O emissions from manure management (3C.4)"; "direct N ₂ O emissions from urine and dung deposited on pasture (3C.4)"; "Indirect emissions from manure management (3C.6); "Direct emissions from managed soils (3C.3; 3C.4; 3C.5).	3C.7 missing (with 0,288 Mt CO ₂ eq very little significant); 3C.1 is comprised under "Energy - Biofuels and Waste."
3D Other (3D.1 "Harvested wood products")	0.00909	-	Missing
Waste	7.42	"Waste"	
4A Solid waste disposal	3.58	"Municipal solid waste generation"	
4B Biological treatment of solid waste	No data	-	Missing/No data
4C Incineration and open burning of waste	0.103	-	Missing/No data
4D Wastewater treatment and discharge	3,73	"CH ₄ emissions from wastewater"	Considers methane emissions from sludge generation/wastewater.
International bunkers	1.08	-	Missing
1A.3.a.i International aviation	1.08	-	Missing

D 4. List of policy assumptions

- ▶ Please see the separate document in Zip folder "Annexes to ETH_NDC Update Technical Report" "PCG_Emissions_and_policies_version_2021_01_15" (Excel file)
- ▶ Sheets "GEM policies" and "Policy assumptions" (previous submission).

D 5. GEM policy modifications

- ▶ Please see the separate document in Zip folder "Annexes to ETH_NDC Update Technical Report"
- ▶ "PCG_GEM_policy_modifications_2021_01_15"
- ▶ Sheet "IPPU cement".

D 6. Target levels of emissions by year

- ▶ Please see the separate document in Zip folder “Annexes to ETH_NDC Update Technical Report”
- ▶ “PCG_Emissions_and_policies_version_2021_01_15” (Excel file)
- ▶ Sheet “Emission pathways”
- ▶ **See “PCG_Overview_emissions_GEM_2021_03_22 EFCCC” for an overview of total and sectoral emissions in the current submission.** Moreover, “WRI_Emissions summary 2021_03_18” provides the emission outputs of the GEM directly. For an alternative model run where the full reforestation and restoration policy is implemented until 2030, please see the Excel “WRI_alternative_results Ethiopia NDC_30_percent_by_2030”. Note that WRI is on request of the Pegasys Consortium working on a full breakdown of emissions per sector. This will be included in the final submission.

D 7. Livestock policy interventions

- ▶ Please see the separate document in Zip folder “Annexes to ETH_NDC Update Technical Report”
- ▶ “UNIQUE forestry and land use GmbH input data for livestock interventions_2020_12_23”.

D 8. Livestock policy intervention updates for alignment with 10YDP

- ▶ Please see the separate document in Zip folder “Annexes to ETH_NDC Update Technical Report”
- ▶ “UNIQUE_IEFs revised as per 10YDP milk yield targets_2021_03”.

D 9. Biomass energy use

- ▶ Please see the separate document in Zip folder “Annexes to ETH_NDC Update Technical Report”
- ▶ “PCG_estimate_biomass_energy_July 2021”.

