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MINISTRY OF ENVIRONMENT
AND FORESTRY

NATIONAL **CLIMATE CHANGE** ACTION PLAN (NCCAP) 2018-2022

VOLUME III



MITIGATION TECHNICAL ANALYSIS
REPORT (MTAR) 2018-2022

2018

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For further information, please contact:

The Principal Secretary
Ministry of Environment and Forestry
Email: psoffice@environment.go.ke
Website: www.environment.go.ke

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National Climate Change Action Plan Task Force

Charles Sunkuli (Chair)	Principal Secretary, Ministry of Environment and Forestry
Clara Busolo	National Gender and Equality Commission
Martin Eshiwani	Ministry of Transport, Infrastructure, Housing and Urban Development
Lulu Hayanga	Office of the Attorney General and Department of Justice
Frank Msafiri	Kenya Climate Change Working Group
Lucy Ng'ang'a	Ministry of Agriculture, Livestock, Fisheries, and Irrigation
Faith Ngige	Kenya Private Sector Alliance
Joyce Njogu	Kenya Association of Manufacturers
David Nyantika	Ministry of Water and Sanitation
Philip Odhiambo	World Wide Fund for Nature Kenya (WWF-Kenya)
Stephen Osingo	Council of Governors
Erastus Wahome	The National Treasury and Planning
Elizabeth Wamalwa	The National Treasury and Planning
Esther Wang'ombe	Ministry of Energy
Pacifica Achieng Ogola	Ministry of Environment and Forestry (Joint Secretary)
Stephen M. King'uyu	Ministry of Environment and Forestry (Joint Secretary)

Secretariat / Climate Change Directorate

Charles Mutai	Samuel Muchiri
Moses Omede Jura	David B. Adegu
Thomas Lerenten Lelekoitien	Veronica Kioko
Augustine Kenduiwo	Steve Muhanji
Peter Omeny	Innocent Muriithi
Michael Okumu	Fiona Oweke

Mitigation Thematic Working Group

Pacifica Achieng Ogola	Ministry of Environment and Forestry
Stephen M. King'uyu	Ministry of Environment and Forestry
Mitchel Paula Akute	Ministry of Energy
Betsy Bowen	Kenya Industrial Research and Development Institute
Esther Gacanja	Ministry of Transport, Infrastructure, Housing and Urban Development
Alfred Gichu	Kenya Forest Service
Peninah Karomo	Rural Electrification Authority
Robin Mbae	Ministry of Agriculture and Irrigation
Maureen Kitheka	Kenya Maritime Authority
James Metto	KENGEN
Brian Muthoka	Council of Governors
Francis Mwangi	Kenya Civil Aviation Authority
David Njugi	Kenya Association of Manufacturers (KAM)
Michael Okoti	Kenya Agricultural and Livestock Research Institute
Walter Omondi	Ministry of Environment and Forestry
Silas Sanga	Ministry of Energy
Peter Omeny	Ministry of Environment and Forestry
Anne Omabia	National Environment Management Authority
Philip Dinga	Low Emissions and Climate Resilient Development (LECRD)
Tom Owino	NDC Partnership Consultant

Abbreviations and Acronyms

ABPP	African Biogas Partnership Program
AF	Adaptation Fund
AfDB	African Development Bank
AGB	Above-Ground Biomass
ASALs	Arid and Semi-Arid Lands
ATAR	Adaptation Technical Analysis Report
BAU	Business-As-Usual
CBIT	Capacity-Building Initiative for Transparency
BRT	Bus Rapid Transit
CCAP	Centre for Clean Air Policy
CCD	Climate Change Directorate
CDM	Clean Development Mechanism
CEEC	Centre for Energy Efficiency and Conservation
CFAs	Community Forestry Associations
CFLs	Compact Fluorescent Lights
CIDPs	County Integrated Development Plans
CIFs	Climate Investment Funds
CoG	Council of Governors

COP	Conference of the Parties
CPAs	Charcoal Producer Associations
CPEBR	Climate Public Expenditure and Budget Review
CSA	Climate Smart Agriculture
eBRT	Electric Bus Rapid Transit System
EOPS	Early Oil Pilot Scheme
ERC	Energy Regulatory Commission
FAO	Food and Agriculture Organization
FCPF	Forest Carbon Partnership Facility
FIP	Forest Investment Program
FPP	Forest Preservation Programme
FRA	Forest Resources Assessment
GCF	Green Climate Fund
GCPF	Global Climate Partnership Fund
GDC	Geothermal Development Company
GDP	Gross Domestic Product
GEEREF	Global Energy Efficiency and Renewable Energy Fund
GEF	Global Environment Facility
GFEI	Global Fuel Economy Initiative
GHG	Greenhouse Gas
GoK	Government of Kenya
GW	Gigawatt
GWh	Gigawatt hours
HFC	Hydrofluorocarbon
IC-FRA	Improving Capacity in Forest Resources Assessment in Kenya
ICAT	Initiative for Climate Action Transparency
ICPS	Improved Charcoal Production Systems
ICT	Information and Communication Technology
IFC	International Finance Corporation
ILRI	International Livestock Research Institute
INDCs	Intended Nationally Determined Contributions
IPCC	Intergovernmental Panel on Climate Change
IPP	Independent Power Producers
IPPU	Industrial Process and Product Use
IUCN	International Union for Conservation of Nature
CAA	Kenya Airports Authority
KAM	Kenya Association of Manufacturers
KCAA	Kenya Civil Aviation Authority
KEBS	Kenya Bureau of Standards
KEFRI	Kenya Forestry Research Institute
KENFAP	Kenya National Federation of Agricultural Producers
KenGen	Kenya Electricity Generating Company
KENHA	Kenya National Highways Authority

KEPSA	Kenya Private Sector Alliance
KES	Kenya Shillings
KETRACO	Kenya Electricity Transmission Company
KFS	Kenya Forest Service
KIRDI	Kenya Industrial Research and Development Institute
KMA	Kenya Maritime Authority
KPA	Kenya Ports Authority
KQ	Kenya Airways
KRA	Kenya Revenue Authority
KRC	Kenya Railways Corporation
KRRA	Kenya Rural Roads Authority
KURA	Kenya Urban Roads Authority
LAPSSET	Lamu Port and South Sudan Ethiopia Transport
LCPDP	Least Cost Power Development Plan
LDCF	Least Developed Countries Fund
LDVs	Light Duty Vehicles
LPG	Liquefied Petroleum Gas
LRT	Light Rail Transit
LULUCF	Land Use, Land-Use Change and Forestry
MDAs	Ministries, Departments and Agencies
MDBs	Multilateral Development Banks
MEF	Ministry of Environment and Forestry
MITC	Ministry of Industry, Trade and Cooperatives
MoAI	Ministry of Agriculture and Irrigation
M&E	Monitoring and Evaluation
MOE	Ministry of Energy (From Jan 2018)
MOEP	Ministry of Energy and Petroleum (Up to January 2018)
MPM	Ministry of Petroleum and Mining
MRT	Mass Rapid Transit
MRV	Monitoring, Reporting and Verification
MSW	Municipal Solid Waste
MTAR	Mitigation Technical Analysis Report
MTIHUD	Ministry of Transport, Infrastructure, Housing and Urban Development
MtCO ₂ e	Million Tonnes of Carbon Dioxide equivalent
Mtoe	Million Tonnes of oil equivalent
MTP	Medium-Term Plan
MTP III	Third Medium-Term Plan

MW	Megawatts
NAMA	Nationally Appropriate Mitigation Action
NAMATA	Nairobi Area Transport Metropolitan Authority
NCA	National Construction Authority
NCCAP	National Climate Change Action Plan
NCCC	National Climate Change Commission
NDC	Nationally Determined Contribution
NDMA	National Drought Management Authority
NEMA	National Environment Management Authority
NGOs	Non-Governmental Organizations
NTSA	National Transport and Safety Authority
OMCs	Oil Marketing Companies
PMFs	Performance Measurement Frameworks
PPCR	Pilot Program for Climate Resilience
PPP	Public Private Partnerships
PV	Photovoltaic
REA	Rural Electrification Authority
REDD+	Reducing Emissions from Deforestation and forest Degradation plus
REM	Rural Electrification Master plan
RERAC	Renewable Energy Resources Authority Committee
RERC	Rural Electrification and Renewable Energy Corporation
SACCO	Savings and Credit Co-Operative
SCF	Special Climate Fund
SEZ	Special Economic Zone
SDGs	Sustainable Development Goals
SGR	Standard Gauge Railway
SLEEK	System for Land-Based Emissions Estimation in Kenya
SREP	Scaling-Up Renewable Energy Program
TW	Terawatts
TWG	Thematic Working Group
ULCPD	Updated Least Cost Development Plan
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency International Development
USD	United States Dollar

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EXECUTIVE SUMMARY

This Mitigation Technical Analysis Report (MTAR) provides the evidence base for the prioritised climate change mitigation actions in the *National Climate Change Action Plan (NCCAP) 2018-2022*. It is underpinned by the understanding that climate change is the most serious global challenge of our time, and it is important that countries do not only implement actions that enhance adaptation to the already changing climate, but also act to mitigate further global temperature rise. *The Paris Agreement*, adopted at the 21st session of the Conference of the Parties to the UNFCCC (COP 21), charts a new course in the global climate effort by building upon the *United Nations Framework Convention on Climate Change (UNFCCC)* and, for the first time, bringing nearly all nations into a common cause to undertake ambitious efforts to combat climate change and adapt to its effects, with enhanced support to assist developing countries.

Since COP 21, countries have confirmed their intentions by ratifying the Paris Agreement and submitting their Nationally Determined Contributions (NDCs) to the UNFCCC. Kenya submitted its NDC in July 2015 when it deposited its instrument of ratification for the *Paris Agreement* under the UNFCCC. The NDC sets out an adaptation contribution of mainstreaming adaptation into Medium Term Plans and implementing adaptation actions. The mitigation contribution intends to abate greenhouse gas (GHG) emissions by 30% by 2030 relative to the business as usual (BAU) scenario (baseline) of 143 million tonnes of carbon dioxide equivalent (MtCO₂e). Achievement of the NDCs is subject to international support in the form of finance, investment, technology development and transfer, and capacity building.

Climate change action in Kenya is guided by the *Climate Change Act, (Number 11 of 2016)*, which provides a framework for mainstreaming climate change across sectors. The Act obligates the Cabinet Secretary responsible

for climate change affairs to formulate a five-year *NCCAP* that addresses all sectors of the economy, and provides mechanisms for mainstreaming climate change into all sectors and the County Integrated Development Plans (CIDPs). NCCAPs are to be approved by the National Climate Change Council that is chaired by His Excellency, the President of the Republic of Kenya.

The first *NCCAP*; *NCCAP 2013-2017* was launched in 2013 and was reviewed in 2016 to form the basis for the development of *NCCAP 2018-2022*. *NCCAP 2018-2022* is to guide Kenya on the priority adaptation and mitigation climate change actions that help define Kenya's low carbon climate resilient development pathway and lead to the achievement of Kenya's NDC targets. This MTAR builds on the Kenya's *NCCAP 2013-2017*, Second National Communication (SNC) and the NDC Sector Analysis Report 2017, and sets out to identify the actions to get Kenya on the right path towards achieving the 2030 mitigation targets defined in Kenya's NDC and the broader *Kenya Vision 2030*. It aims at identifying priority mitigation actions for the 5-year period (2018-2022) of the plan in each of the six mitigation sectors set out in Article 4.3 of the *UNFCCC* (agriculture, energy, forestry, industry, transport and waste). The analysis was guided by the need to clarify how Kenya will achieve the GHG emission reduction contribution of 30% or a net emission reduction of 42.9 MtCO₂e relative to the baseline. The information and analysis in this report identify and prioritise climate change mitigation actions, and provides the evidence base for updating of mitigation actions for *NCCAP 2018-2022*. The expected emission reductions resulting from the priority actions in each of the six mitigation sectors are estimated and summarised. The priority actions align with the Government's Big Four Agenda, and Sustainable Development Goals (SDGs).

To achieve the mitigation NDC target, Kenya has to reduce its GHG emissions by not

less than 42.9 MtCO₂e relative to the BAU scenario by 2030. This in turn requires Kenya to introduce policies, programs and technologies that encourage emission reductions and drive the country to low carbon development pathway. In NCCAP 2013-2017 and SNC, priority actions to reduce GHG emissions were identified and prioritised for implementation.

For NCCAP 2018-2022, a number of actions have been proposed, analysed and prioritised.

Table 1 shows a summary of the prioritised actions in the 6 sectors and their mitigation potential.

Table 1: Emission reduction potential of the prioritised mitigation actions (MtCO₂e).

Sector/Sub-sector	Agriculture Sector Prioritised Mitigation Action	Emission Reduction (tCO₂e)	
		Action up to 2022	Action up to 2030
Agriculture	Increase agroforestry area by 200,000 acres by 2022	1.66	3.71
Agriculture	Increase farm area under sustainable land management by 250,000 acres by 2022	0.55	0.77
Livestock	Implementation of Kenya's Dairy NAMA-267 HH by 2030	0.40	0.69
Total Sector Emission Reduction Potential of the Prioritised Actions		2.61	5.17
Sector/Sub-sector	Energy Sector Prioritised Mitigation Action	Emission Reduction (tCO₂e)	
		Action up to 2022	Action up to 2030
Energy Supply/Electricity Generation	Developing new 2,405 MW of grid-connected renewable electricity generation and retirement of three thermal plants by 2022	9.2	9.2
Energy demand side	Develop and distribute 4 million improved biomass (charcoal and biomass) stoves by 2022	6.3	6.3
	Develop and distribute 1 million clean energy (LPG, biogas, and ethanol) stoves by 2022	0.8	0.8
Total Sector Emission Reduction Potential of the Prioritised Actions		16.3	16.3
Sector/Sub-sector	Forestry Sector Prioritised Mitigation Action	Emission Reduction (tCO₂e)	
		Action up to 2022	Action up to 2030
Forestry	Reduce deforestation and forest degradation by rehabilitation and protection of additional 100,000 Ha of natural forests (including mangroves) by 2022	2.0	2.0
	Afforestation/reforestation/agroforestry of additional 100,000 Ha of land by 2022	2.0	4.8
	Restoration of 200,000 ha of forest on degraded landscapes (ASALs, rangelands) by 2022	5.4	13
	Increase area under private sector-based commercial and industrial plantations from 71,000 Ha to at least 121,000 Ha	1.0	1.0
Total Sector Emission Reduction Potential of the Prioritised Actions		10.4	20.8

Sector/Sub-sector	Industry Sector Prioritised Mitigation Action	Emission Reduction (tCO ₂ e)	
		Action up to 2022	Action up to 2030
Industry	Implementing the NAMA on charcoal	0.45	1.08
Total Sector Emission Reduction Potential of the Prioritised Actions		0.45	1.08
Sector/Sub-sector	Transport Sector Prioritised Mitigation Action	Emission Reduction (tCO ₂ e)	
		Action up to 2022	Action up to 2030
Road	Implementation of the Mass Rapid Transport System (Bus Rapid Transit System with Light Rail) for Greater Nairobi	0.55	2.30
Road/Rail	Transfer of Freight from Road to Rail Between Nairobi and Mombasa	0.82	1.1
Road	Improvement of the Heavy-Duty Truck Efficiency	0.32	0.97
Rail	Electrification of the SGR Line Between Nairobi To Mombasa by 2022	0.24	0.32
Total Sector Emission Reduction Potential of the Prioritised Actions		1.93	4.69
Sector/Sub-sector	Waste Sector Prioritised Mitigation Action	Emission Reduction (tCO ₂ e)	
		Action up to 2022	Action up to 2030
Solid waste	Implementation of the Solid Waste NAMA		
	With composting	0.10	0.13
	With land fill gas capture and electricity generation	0.62	0.79
	Incineration with electricity generation	0.36	0.46
Total Emission Reduction Potential (NAMA)		0.72	0.82
Total Emission Reduction Potential (Incineration with electricity generation)		0.36	0.46





CHAPTER ONE

Background and Context

1.1 Introduction

Climate change is a key global challenge of our time. It is important that countries not only implement actions that enhance adaptation to the already changing climate, but also act to mitigate further rise in global temperature. The Paris Agreement adopted at the Conference of the Parties (COP) 21 charts a new course in the global climate effort by building upon the United Nations Framework Convention on Climate Change (UNFCCC) and, for the first time, bringing nearly all nations to a united front toward undertaking envisaged ambitious efforts to combat climate change and adapt to its effects, and enhanced support to assist developing countries.

The Paris Agreement seeks to:

- Strengthen the global response to the threat of climate change, by keeping rise in global temperatures this century at well below 2.0 °C above pre-industrial levels;
- Strengthen the ability of countries to deal with impacts of climate change; and
- Pursue efforts to limit further increase in temperature to 1.5 °C

To achieve these ambitious goals, besides the provision of a universal platform for all countries to act toward the commonly agreed goal for responding to climate change, the UNFCCC provides mechanisms to pursue these goals, and binding obligations related to transparency and reporting, for all Parties, including such commitments by developing countries as to:

- Prepare, communicate, and maintain successive Nationally Determined Contributions (NDCs),¹ with the expectation that each party's successive NDC will represent a progression beyond its previous one, and that it reflects its highest possible ambition;

- Pursue domestic mitigation measures aimed at achieving their NDCs; and
- Report regularly on their emissions inventories, progress in implementing and achieving their NDCs, the support required and any support received.

For enhanced transparency of action and support, and to facilitate implementation and promote compliance, the agreement establishes a new mechanism with a more robustly enhanced transparency framework. Since COP 21, countries were invited to confirm their intentions by ratifying the Paris Agreement and submitting NDCs to the UNFCCC. In future, countries will be required to submit updated and more ambitious NDCs every five years.

Kenya's INDC^{2,3} automatically became its first NDC on 28th December 2016, when it deposited its instrument of ratification for the Paris Agreement under the UNFCCC.⁴ The NDC sets out Kenya's adaptation contribution of mainstreaming adaptation into Medium Term Plans (MTPs), and approach to implementing adaptation actions. The mitigation contribution intends to abate greenhouse gas (GHG) emissions by 30% by 2030 relative to the business as usual (BAU) scenario (baseline) of 143 million tonnes of carbon dioxide equivalent (MtCO₂e). Achievement of the NDC contributions is subject to international support in the form of finance, investment, technology development and transfer, and capacity building. Appropriate financial flows, a new technology framework, and an enhanced capacity building framework, are being put in place to support action by developing countries, in line with their own national objectives.



Climate change action in Kenya is guided by the *Climate Change Act*, (Number 11 of 2016), which provides a framework for mainstreaming climate change across sectors. The Act obligates the Cabinet Secretary responsible for climate change affairs to formulate a five-year *National Climate Change Action Plan* (NCCAP) that factors in all sectors of the economy, and provides mechanisms for mainstreaming climate change into all sectors and the County Integrated Development Plans (CIDPs). In accordance with the Act, NCCAP represents the national mechanism through which climate change is to be addressed in Kenya, including implementation of the country's NDC. NCCAP is to be approved by the National Climate Change Council (NCCC), which is chaired by His Excellency, the President of the Republic of Kenya.

NCCAP (2013-2017) was Kenya's first NCCAP. It was launched in 2013 and was reviewed in 2016 to form the basis for the development of NCCAP 2018-2022. NCCAP (2018-2022) is the updated NCCAP to guide Kenya on its priority climate change adaptation and mitigation actions, aimed at helping to define Kenya's low carbon climate resilient development pathway toward the achievement of Kenya's NDC targets. NCCAP 2018-2022 covers Kenya's climate actions over the 5-year period, from 2018 to 2022.

This Mitigation Technical Analysis Report (MTAR) 2018-2022 identifies the actions to get Kenya on the path toward the realisation of the mitigation targets for the year 2030, as defined in Kenya's NDC and the Kenya Vision 2030.⁵ MTAR 2018-

2022 seeks to identify priority mitigation actions in each of the six mitigation sectors set out in Article 4.3 of the UNFCCC, which are, agriculture, energy, forestry, industry, transport, and waste, for the period 2018-2022 of the plan. The focus during the Mitigation Technical Analysis was to clarify how Kenya would achieve the contribution of 30% reduction in greenhouse gas (GHG) emission by 2030, from the 2030 BAU specified in Kenya's NDC, which translates to a net emission reduction of 143 MtCO₂e relative to the baseline. The information and analysis in MTAR 2018-2022 identifies and prioritises climate change mitigation actions, and provides the evidence base for updating mitigation actions for NCCAP 2013-2017.

The analyses that underpinned the development of MTAR 2018-2022 also took cognisance of the Government's Big Four Agenda for the period 2018-2022, which focuses on delivering Food and Nutrition Security, Universal Health Coverage, Enhanced Manufacturing, and Affordable Housing, for Kenyans. They first clarify on the numbers underlying the baseline and NDC contribution as previously presented in NCCAP 2013-2017 and the country's Second National Communication (SNC) to the UNFCCC, followed by a presentation on the mitigation actions that were previously proposed, and prior NDC sector analyses.⁶ Finally, the mitigation actions proposed for NCCAP 2018-2022 are presented, analysed, and prioritised, based on their potential to mitigate GHG emissions .

MTAR 2018-2022 is organised in the following chapters:

- Chapter 1 – Introduction and Methodology
- Chapter 2 – Kenya's Baseline Emissions and the NDC
- Chapter 3 – Mitigation Actions and Impacts
 - Section 3.1. – Agriculture
 - Section 3.2 – Energy
 - Section 3.3 – Forestry
 - Section 3.4 – Industry
 - Section 3.5 – Transportation
 - Section 3.6 – Waste
- Chapter 4 – Implementation

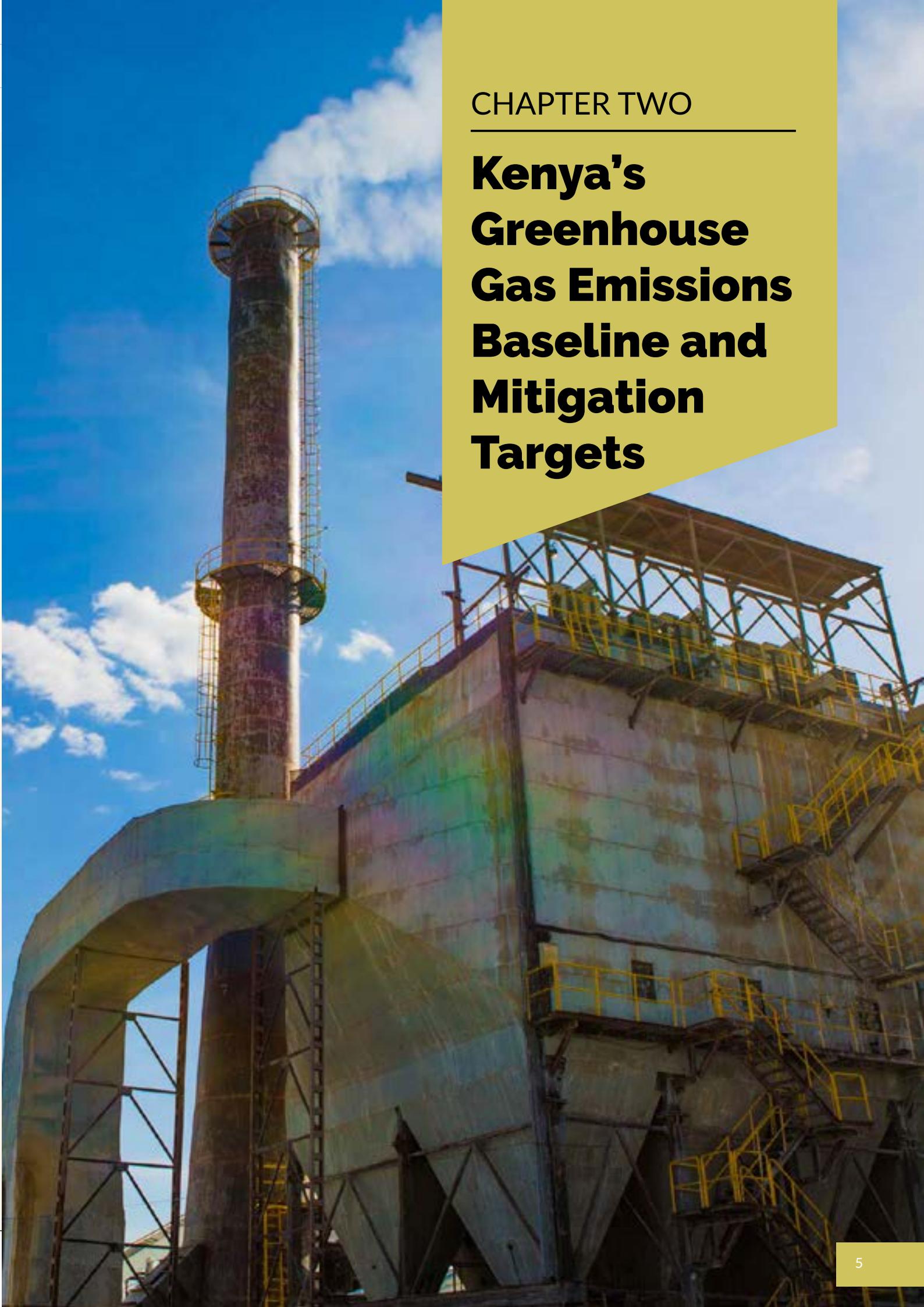
1.2 Methodology

MTAR 2018-2022 examined Kenya's options for realising the country's mitigation target as set out in the NDC's 6 mitigation sectors. Since MTAR 2018-2022 builds on previous work undertaken under NCCAP 2013-2017, Kenya's SNC, and the NDC Sector Analysis Report of 2017, a desk review of these documentations was first undertaken. This provided the basis for flagging out key themes and issues for further interrogation during meetings with stakeholders. Other documents that were reviewed include sector plans and policies with implication on climate

change action, and other relevant literature. These were undertaken with guidance from the Mitigation Thematic Working Group (MTWG).

Stakeholder engagements involved meetings with selected sector stakeholders, County Governments, and opinions from experts. The mitigation actions proposed in MTAR 2018-2022 were presented to the NCCAP Taskforce, which further scrutinised them and approved them to form part of NCCAP 2018-2022.



A photograph of a large industrial facility, likely a power plant or refinery. A prominent feature is a tall, dark cylindrical chimney on the left side, from which a thick plume of white smoke is billowing upwards into a clear blue sky. To the right of the chimney is a massive, light-colored storage tank with a complex network of yellow safety railings and walkways. The overall scene conveys a sense of heavy industry and environmental impact.

CHAPTER TWO

Kenya's Greenhouse Gas Emissions Baseline and Mitigation Targets

2.1: Kenya's Baseline Greenhouse Gas Emission Projections

MTAR 2018-2022 builds on NCCAP 2013-2017, SNC, and the NDC Sector Analysis Report of 2017. NCCAP 2013-2017 established the baseline GHG emissions projections for the six mitigation sectors set out in Article 4.3 of the UNFCCC, which are, agriculture, energy, forestry, industry, transport, and waste, up to the year 2030, as shown in Figure 2.1, and summarised in Table 2.1. A key finding from the analysis of emission

projections in the six sectors was that Kenya's total GHG emissions from all the six sectors combined would grow to about 100 and 143 million tonnes of carbon dioxide equivalent (MtCO₂e) by 2022 and 2030, respectively. In 2030, the highest amount of emissions would come from the energy sector, particularly electricity generation, followed by agriculture and forestry through land use, land-use change, and forestry (LULUCF).

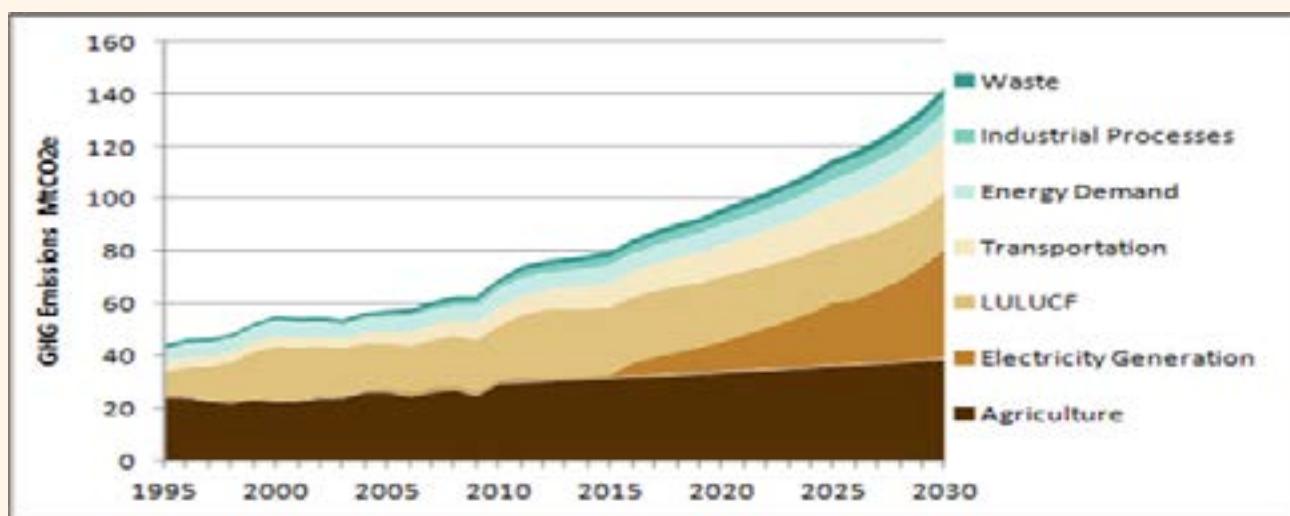


Figure 2.1: Baseline emission projections for Kenya (MtCO₂e per year) (GoK, 2013).

Table 2.1: Baseline emission projections for Kenya (MtCO₂e per year) (GoK, 2015).

Sector	Baseline GHG Emission (MtCO ₂ e)							
	1995	2000	2005	2010	2015	2020	2025	2030
Forestry (LULUCF)	10	21	18	21	26	25	23	22
Electricity Generation	0	1	1	1	1	12	24	41
Energy Demand	4	5	5	6	7	8	9	10
Transportation	4	4	4	7	9	12	16	21
Agriculture	24	23	26	30	32	34	36	39
Industrial Processes	1	1	1	2	3	4	5	6
Waste	1	1	2	2	2	3	3	4
Total	44	55	57	70	80	96	115	143

NCCAP 2013-2017 and the SNC identified and examined various mitigation options in the six mitigation sectors, to determine priority mitigation actions, and their associated mitigation potentials, as summarised in Figure 2.2 and Table 2.2. This analysis established that, out of the projected BAU GHG emission total of 143 MtCO₂e, Kenya had the technical potential to reduce 60% or 85.8 MtCO₂e by 2030. These findings, which have been applied as the baseline

emission projections in MTAR 2018-2022, formed the basis of Kenya's mitigation NDC that was set at 50% of the technical emissions reduction potential, or 42.9 MtCO₂e by 2030. This technical potential provided the basis for determining the overall 30% emission reduction target for Kenya, with each sector being considered for its widely differentiated potential, and costs.

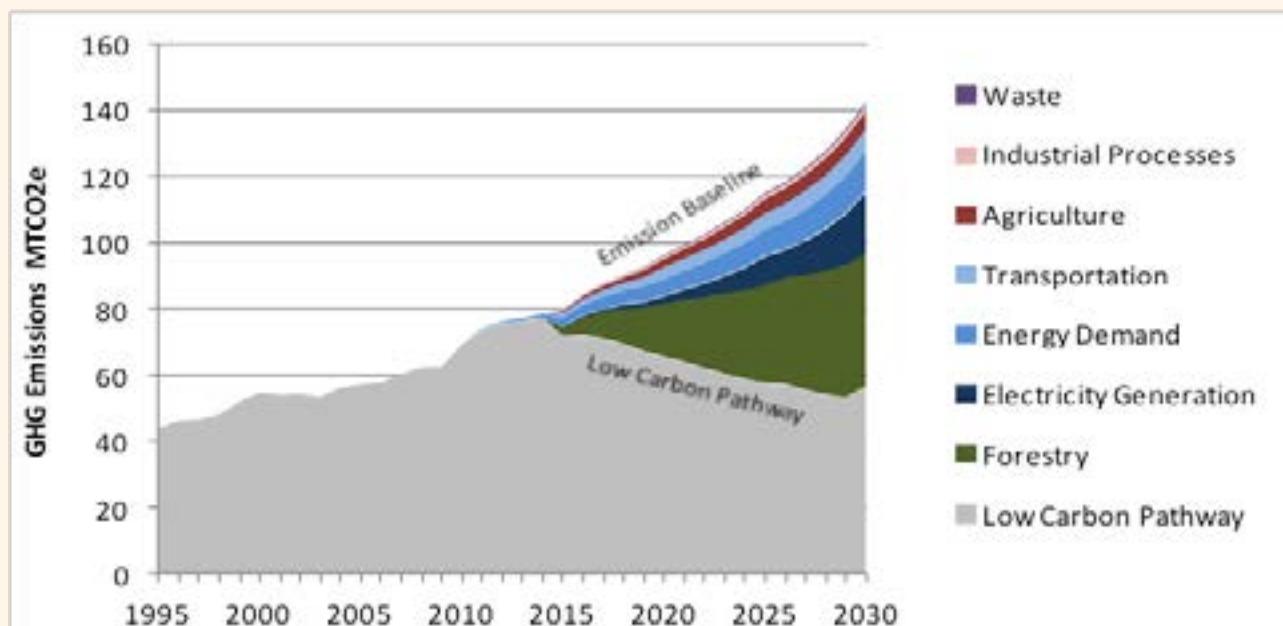


Figure 2.2: Kenya's mitigation potential for the six mitigation sectors (MtCO₂e per year) (GoK, 2013).

Table 2.2: Kenya's emission reduction potential, and NDC targets by sector (MtCO₂e per year) (GoK, 2015).

Sector	GHG Emission Reduction Potential (MtCO ₂ e)				NDC Target (MtCO ₂ e)
	2015	2020	2025	2030	
Forestry	2.71	16.24	29.76	40.2	20.10
Electricity Generation	0.28	2.24	8.61	18.63	9.32
Energy Demand	2.74	5.16	7.92	12.17	6.09
Transportation	1.54	3.52	5.13	6.92	3.46
Agriculture	0.63	2.57	4.41	5.53	2.77
Industrial Processes	0.26	0.69	1.03	1.56	0.78
Waste	0.05	0.33	0.5	0.78	0.39
Total Emission Reduction Potential				85.79	42.90
Total Emissions in 2030	8.21	30.75	57.36	143.00	143.00
% of Total Emissions in 2030				60%	30%

2.2: Kenya's Mitigation NDC and the Technical Mitigation Potential of the Sectors

Kenya's mitigation NDC, whose achievement is subject to international support in terms of finance, investment, and technology, is based on NCCAP 2013-2017 and analysis of Kenya's SNC to the UNFCCC. The NDC seeks to abate the country's GHG emissions by 30%, which is 42.9 MtCO₂e, by 2030, relative to the BAU scenario of 143 MtCO₂e.

While it could be assumed from the NDC target that all sectors would work toward mitigation goals, this does not necessarily translate into a 30% emission reduction target for each of the sectors, as shown in Table 2.2. The actual mitigation potential of each of the six sectors depends on a number of factors, including policy, resources, and how they are prioritised in the implementation of the mitigation actions under each of the sectors.

To achieve the NDC target, Kenya had to introduce policies, programs, and technologies that promote emission reductions, toward driving the country to a low carbon development pathway. The NDC Sector Analysis Report 2017 was valuable to this, as its review helped to appreciate what

could be realistically undertaken in each of the sectors, their prioritisation, planned actions, and important assumptions. Both low and high ranges of potential in the emission reductions for each of the six sectors were identified. These are shown in Table 2.3. Since the NDC Sector Analysis Report, a few changes have taken place in the six sectors, following the shifting in some priorities and government plans, some of which had significant implications on climate change mitigation. To achieve the mitigation NDC target, Kenya has to reduce its GHG emissions by not less than 42.9 MtCO₂e relative to the BAU scenario, by 2030, as established in NCCAP 2013-2017. For NCCAP 2018-2022, a number of actions have been proposed. Chapters 3 of MTAR 2018-2022 presents an analysis of the proposed mitigation actions by sector, and estimates of their mitigation potential. The actions are thereafter prioritised based on their mitigation potential, with a focus on low carbon climate resilient development towards the realisation of the country's NDC.

Table 2.3: Kenya's Emission Reduction Potential and the NDC Targets by Sector (MtCO₂e per year) (GoK, 2015).

Sector	Total Emissions (MtCO ₂ e)	Emission Reductions Relative to Baseline (MtCO ₂ e)				NDC Target
		High range*	Low range*	Technical Potential	2030	
	2030	2030	2030	2030	2030	2030
Forestry	22	20.1	11.3	40.2	20.10	
Electricity Generation	41	12.6	7.5	18.63	9.32	
Energy Demand	10	-	-	12.17	6.09	
Transportation	21	3.5	2.0	6.92	3.46	
Agriculture	39	2.8	1.6	5.53	2.77	
Industrial Processes	6	1.3	1.0	1.56	0.78	
Waste	4	0.4	0.4	0.78	0.39	
Total	143	40.1	23.8	85.8	42.9	

*The low target is aligned with the proportional contribution that the sector would need to make in order for there to be a high level of certainty that the overall target will be achieved if all other sectors also meet their low target reduction.

*The high target is intended to guide responsible ministries and agencies in terms of what they should objectively plan and prepare for should the sector require additional emission reductions.

CHAPTER THREE

Proposed Mitigation Actions for 2018-2022



3.1. Agriculture Sector

3.1.1 Mitigation Actions in the Agriculture Sector

The agriculture sector, which includes crop cultivation, livestock, and fisheries, is the source of livelihood for majority of the rural population in Kenya. The sector provides employment to more than 40% of the total population in Kenya, and over 70% of the population in rural Kenya.⁷ Agriculture is also a major contributor to Kenya's economy, contributing 26% of the Gross Domestic Product (GDP), and another 27% of GDP indirectly through linkages with such other sectors as manufacturing and trade.⁸

Agriculture is a devolved function which underscores the importance of County Governments in ensuring food security. The sector is large and complex in Kenya, with a multitude of public, parastatal, non-governmental, and private sector players.⁹ It is a priority sector of the Government and people of Kenya, because of the sector's importance to food and nutritional security; which is one of the pillars of the Government's Big Four Agenda for the 2018-2022 period. The sector is however a major contributor to the country's GHG emissions.

In 2015, the agriculture sector was the leading source of GHG emissions in Kenya, with the livestock sub-sector contributing about one half of the emissions. The livestock sub-sector is dominated by pastoralism, which is the most important economic and livelihoods activity in Kenya's Arid and Semi-Arid Lands (ASALs) that comprises of over 80% of the country's land area. The livestock sub-sector supports 20% of the Kenyan population, most of whom who live in

ASALs. The dairy industry is also a growing sub-sector, with milk production having increased from 495.2 million litres in 2012 to 650.3 million litres in 2016, which is an increase of about 30%.¹⁰ The combined effect of deforestation to open up croplands, extension of agriculture onto land with low potential; and the use of more basic farming techniques and technologies, due to cost and capacity barriers, make the current agricultural system unsustainable in the long term.

Kenya recently unveiled its *Kenya Climate Smart Agriculture Strategy 2017-2026*, which seeks, among others, to minimise GHG emissions from the sector. Climate Smart Agriculture (CSA) refers to agriculture that "sustainably increases productivity, enhances resilience, reduces/removes GHG emissions, and enhances the achievement of national food and nutrition security and development goals".¹¹

According to Kenya's SNC, emissions from agriculture were projected to increase from 30 MtCO₂e in 2010 to 39 MtCO₂e in 2030, as shown in Figure 3.1 and Table 3.1), largely driven by livestock-based methane emissions, which are projected to be 18.8 MtCO₂e in 2030, and in agricultural soils, amounting to 16.2 MtCO₂e by 2030. The sector also contributes Carbon Dioxide (CO₂), Methane (CH₄) and Nitrous Oxide (N₂O) emissions through such activities as conventional tillage, burning of the savannah and crop residues, and rice cultivation.

a. NDC Target for the Agriculture Sector

From the NDC Sector Analysis 2017, the indicative proportionate emission reduction target contribution from the agriculture sector by 2030 is 2.77 MtCO₂e, with a high and low range of 2.8 and 1.6 MtCO₂e, respectively, as shown in Table 3.2 and Figure 3.2. These do not have

to be necessarily delivered by the sector, since the actual sector GHG emission reduction will be based on the realistic opportunities available for emission reductions in the sector, together with the sector plans and budgetary provisions.

The agriculture sector should strive to meet the low range of emission reductions of 1.6 MtCO₂e by 2030, which requires that other sectors implement actions to achieve the high range emission reductions. In the five-year period of NCCAP 2018-2022 and NDC implementation plan,

the sector should focus climate change efforts on adaptation, while building expertise and improving data for mitigation action. It is on the basis of the above discussed baseline emissions that the mitigation actions proposed for the NCCAP 2018-2022 have been analysed in this report.

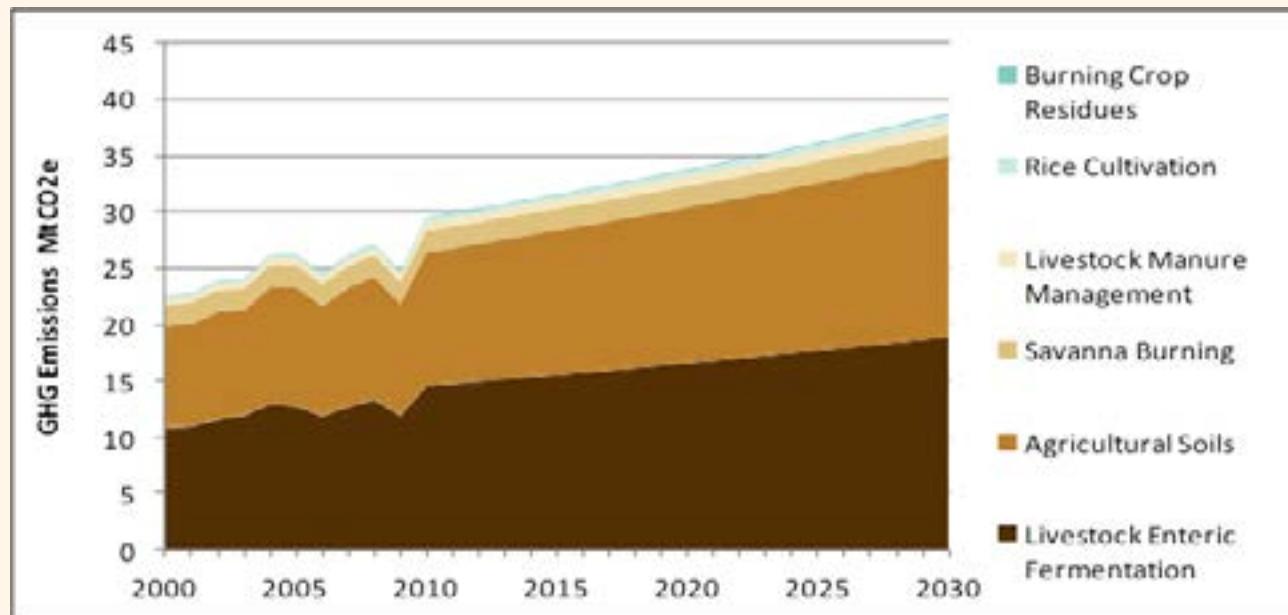


Figure 3.1: Agriculture sector baseline emission projection for Kenya (MtCO₂e) (GoK, 2015).

Figure 3.1: Agriculture sector baseline emission projection for Kenya (MtCO₂e) (GoK, 2015).

Agriculture Source	Agriculture Baseline GHG Emissions (MtCO ₂ e)						
	2000	2005	2010	2015	2020	2025	2030
Livestock Enteric Fermentation	10.8	12.7	14.5	15.5	16.5	17.7	18.8
Agricultural Soils	9.0	10.6	11.9	12.8	13.9	15.0	16.2
Savannah Burning	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Livestock Manure Management	0.6	0.7	0.8	0.8	0.9	1.0	1.1
Rice Cultivation	0.2	0.2	0.3	0.3	0.3	0.4	0.4
Burning Crop Residues	0.1	0.1	0.1	0.1	0.2	0.2	0.2
Total	22.6	26.3	29.6	31.4	33.6	35.9	38.5

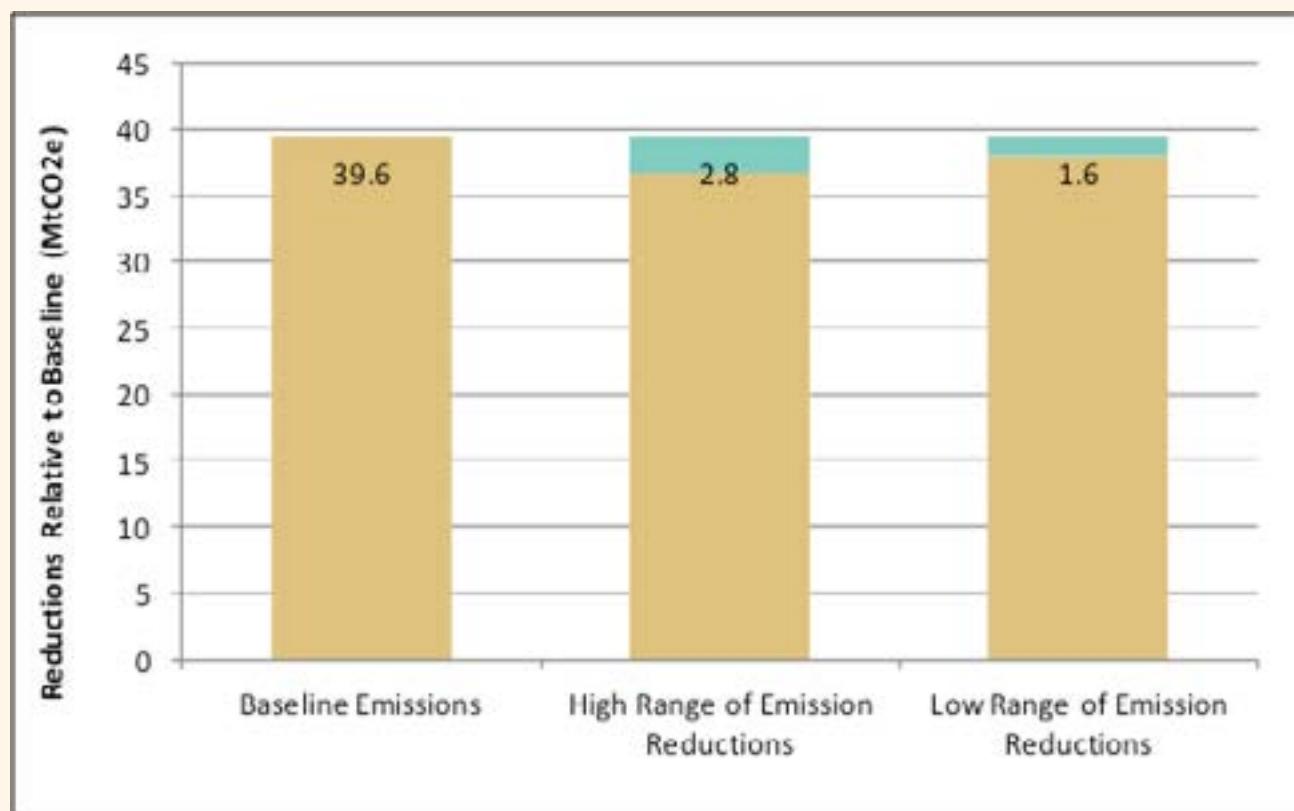


Figure 3.2: Comparison of 2030 baseline emissions and NDC target emission reductions (MtCO₂e) (GoK, 2017).

b. Mitigation Actions Identified in Kenya's Second National Communication

In NCCAP 2013-2017 and the SNC, the following three mitigation actions were prioritised for the agriculture sector, as shown in Figure 3.3:

- Limiting the use of fire in range and cropland management, which has mitigation potential of 0.29 MtCO₂e by 2030;
- Conservation tillage, which has mitigation potential of 1.09 MtCO₂e by 2030; and
- Agroforestry, which has mitigation potential of 4.16 MtCO₂e by 2030.

Despite being a major contributor to GHG emissions in the sector, livestock was not included in the prioritised mitigation actions because of the significant implementation barriers that the actions were envisaged to face. Mitigation action

is however considered essential in this sub-sector because of the sub-sectors' standing as the largest emissions source in the agriculture sector. The dairy sub-sector of this sub-sector has received appreciable interest, with significant work being undertaken to measure GHG emissions in the dairy sub-sector, and a Nationally Appropriate Mitigation Action (NAMA) being proposed for it. While the emission reduction potential is not significant at the national scale, initiatives in the dairy sub-sector are important mitigation actions.

The overall impact of the three actions on the sector's total emissions is best depicted in Figure 3.4. From the figure, it is evident that the opportunities for mitigation are limited in the agriculture sector. The practical strategy would therefore be to aim for the low range emission reduction target in the sector, while looking for larger mitigation actions in other sectors.

The mitigation actions proposed for prioritisation in the agriculture sector under NCCAP 2018-2022, as proposed by stakeholders in the sector, are shown in Table 3.3.

The following two actions have already been included in the energy sector and have therefore not been included for mitigation analysis under the agriculture sector:

- Increased adoption of biogas technology-use by 80,000 households, leading to abatement of 1.2 million tCO₂e by 2022 or an average of 3 tCO₂e per household

per year, which has been linked to biogas cooking in the energy sector; and

- Increased adoption of biogas technology-use by at least 200 abattoirs, leading to abatement of 0.8 million tCO₂e by 2022, which is linked to increased use of renewable fuel by industries and agro-processing under the energy sector's mitigation actions.

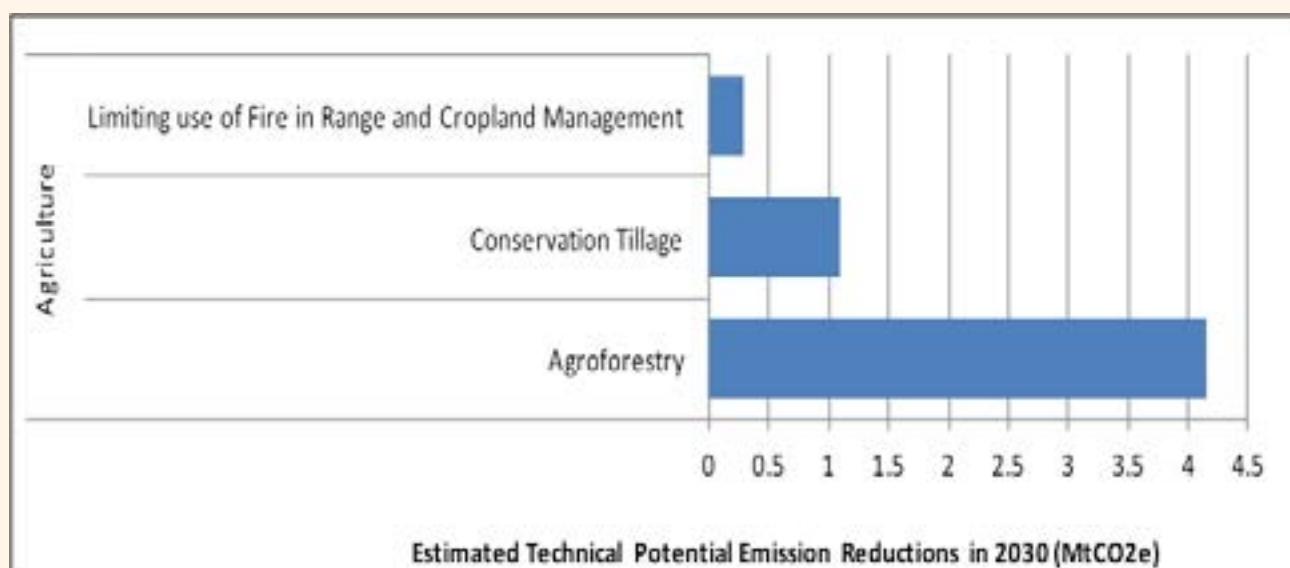


Figure 3.3: Technical potential emissions reductions in 2030 for Agriculture mitigation options (MtCO₂e) (GoK, 2017).

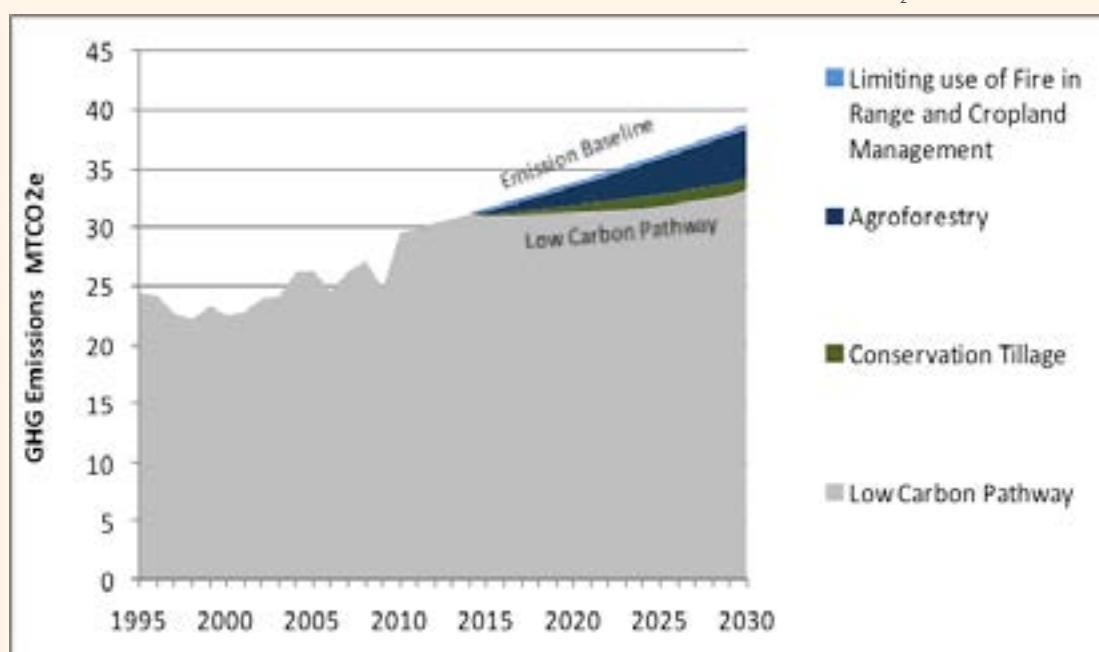


Figure 3.4: Technical Potential Emissions Reductions in 2030 for Agriculture Mitigation Options (MtCO₂e) (GoK, 2015).

Table 3.2: Agriculture priority actions emission reduction projection (MtCO₂e) (GoK, 2015).

Agriculture Source	Agriculture Emission Reduction Potential-2015 to 2030 (MtCO ₂ e)			
	2015	2020	2025	2030
Conservation Tillage	0.11	0.65	1.09	1.09
Agroforestry	0.28	1.66	3.05	4.16
Limiting use of Fire in Range and Cropland Management	0.24	0.26	0.27	0.29
Total	0.63	2.57	4.41	5.54

c. Proposed Mitigation Actions in the Agriculture Sector for NCCAP 2018-2022

For the following actions, it is not just the emission reduction potential that is significant at the national scale, but also the data required to make a reasonable estimate of their mitigation potential:

- Increased deep/offshore fishing fleet from 9 to 68 by 2022; and
- Increased number of farmers using low-carbon (recirculation) aquaculture systems from 20 to 180 by 2022.

The following low-carbon development options were considered for mitigation analysis and prioritisation in NCCAP 2018-2022:

- Increasing the total area under agroforestry at farm level by 200,000 acres (81,000 Hectares) by 2022;

- Increasing the farm area under sustainable land management by 250,000 acres (101,000 Hectares) by 2022;
- Implementing the Nationally Appropriate Mitigation Action (NAMA) for the dairy sub-sector;
- Putting 50% of the 30,000 hectares under rice production into efficient production technologies by 2022; and
- Increasing the area under rain-fed rice production from 400 hectares to 600 hectares by 2022.

These options are analysed in detail in Table 3.3.



Table 3.3: Proposed mitigation actions in the Agriculture Sector for the period 2018-2022.

Strategic Objective 3.1.2: Reducing GHG emissions from agricultural systems without compromising productivity				
Issue/Problem: Climate change is negatively impacting agricultural productivity and resilience of value chain actors, including households (farmers, pastoralists and fisher communities)				
Opportunity	Actions	Sector	Mitigation/Adaptation/	SDG Target
Agroforestry	Increase the total area under agroforestry at farm level by 200,000 acres (81,000 Hectares) by 2022.	Ministry of Agriculture, Livestock and Fisheries (MALFI), KFS, County Governments	Adaptation and mitigation	1, 2, 13, 15
Sustainable Land Management	Increase farm area under sustainable land management by 250,000 acres (101,000 Hectares) by 2022.	Ministry of Agriculture, Livestock, and Fisheries (MALFI), County Governments	Adaptation and Mitigation	1, 2, 13, 15
Efficient livestock management systems that enhance productivity.	Implement the Nationally Appropriate Mitigation Action (NAMA) for the dairy sub-sector 267,000 households involved in the programme leading to GHG emission reductions.	Ministry of Agriculture, Livestock, and Fisheries (MALFI), County Governments	Adaptation and mitigation	2, 1,15
Manure management	Increased adoption of biogas technology-use by 80,000 households leading to abatement of 1.2 million tCO ₂ e by 2022 (Linked to biogas cooking in the energy sector) Increase adoption of biogas technology use by at least 200 abattoirs leading to abatement of 0.8 million tCO ₂ e by 2022	Ministry of Agriculture, Livestock, and Fisheries (MALFI), County Governments	Adaptation and mitigation	2, 1,15
Overcapacity of artisanal fishing vessels	Increased deep/offshore fishing fleet from 9 to 68 by 2022	Ministry of Agriculture, Livestock, and Fisheries (MALFI),	Adaptation/ mitigation	1,2,14, and 15
Aquaculture production	Increased number of farmers using low-carbon (Recirculation) aquaculture systems from 20 to 180 by 2022	Ministry of Agriculture, Livestock, and Fisheries (MALFI),	Mitigation and Adaptation	1,2, 14,s and 15
Increased rice production	Put 50% of the 30,000 hectares under rice production into efficient production technologies by 2022. Increased area under rain-fed rice production from 400 hectares to 600 hectares by 2022.	Ministry of Agriculture, Livestock, and Fisheries (MALFI), County Governments	Adaptation and mitigation	1,2, 3,12, 13, 15

e. Increase the total area, under agroforestry at farm level by 200,000 acres (81,000 Hectares) by 2022.

Based on the previous three analyses, agroforestry is the mitigation option with the greatest emission reduction potential. Agroforestry is the interface between agriculture and forestry, and encompasses mixed land-use practices. The term refers to land-use practices in which trees and other woody perennials are spatially or temporally integrated with crops and livestock on a given unit of land. It is distinct from the forestry options, discussed in Chapter 5, because it targets lands that are currently in use for agriculture. The mitigation option encourages compliance with the Agricultural Farm Forestry Rules that require every land holder to maintain a compulsory farm tree cover of at least 10% on any agricultural land holding.¹⁴

Agroforestry mitigation option targets existing arable cropland and grazing lands that have high or medium agricultural potential. The total area of arable cropland and grazing land is estimated in the *Agricultural Sector Development Strategy 2010-2020* to be approximately 5,620,000 hectares. The current extent of tree cover on this agricultural land is not known, but at least, 10 per cent tree cover on farms is targeted by the *Agricultural (Farm Forestry) Rules 2009*. Without additional information on the total area of land under agroforestry at the farm level, the proposed action seeks to increase the total area under agroforestry at farm level by 200,000 acres by 2022. It is assumed that

achieving 5% of additional tree cover on these lands using agroforestry practices is possible and a reasonable mitigation scenario. Therefore, the low carbon scenario assumes that an additional 200,000 acres (81,000 hectares) is converted to agroforestry between the years 2018 and 2022. This is equivalent to an average afforestation rate of 16,200 hectares per year over the 5 years.

In NCCAP 2013-2017, SNC, and the NDC Sector Analysis, it was assumed that an addition 281,000 hectares of land would be converted to agroforestry between 2015 and 2030. This is equivalent to an annual average conversion rate of 18,000 hectares. While the proposed action is slightly less ambitious than in previous studies, the difference would not be significant in terms of GHG emission reductions. Therefore, the earlier rate of 18,000 hectares per year, which leads to the establishment of agroforestry in 90,000 hectares by 2022, has been assumed for the related emission reduction projections. Implementation of the agroforestry option should include data collection to determine the extent of existing tree cover on arable cropland and grazing land. Agroforestry would therefore lead to similar emission reduction patterns as previously estimated, but starting from 2018 through to 2022. As a result of this action, increasing amounts of emission would be expected beyond 2022, as shown in Table 3.4

Table 3.4: Projections of emission reduction from Agroforestry (MtCO₂e) (GoK, 2015).

Agriculture Source	Emission Reduction Potential-2018 to 2030 (MtCO ₂ e)			
	2018	2022	2027	2030
Agroforestry	0.28	1.66	3.05	3.71

To avoid double counting, agroforestry-related emissions are not accounted for in the forestry sector.

During the process of NDC Sector Analysis, the option of tillage conservation was revised to conservation agriculture/ sustainable land management, which recognises that a broad set of land management actions are required to reduce GHG emissions associated soil carbon. The key issue is that this action is based on minimum soil disturbance, adequate surface cover, and complex crop rotations, including other practices that contribute to improving soil fertility and structure; adding biomass and nutrients to the soil; causing minimal soil disturbance; and conserving soil and water. Three main elements that contribute to conservation agriculture are, tillage, legumes, and crop residues. Details of the action were covered in the NCCAP and NDC Sector Analysis Report of 2017.

Robust data regarding the mitigation potential of organic farming systems is scarce, and no such data could be found for Kenya during the process of developing MTAR 2018-2022. Organic farming is not a priority in Kenya, and is not promoted by the government.¹⁵ The Government of Kenya has programs to increase fertilizer usage, which are underpinned by the understanding that low rates of fertilizer application due to challenges of access, affordability, or lack of information, contribute to low yields for many farmers. Increasing and optimising fertilizer application would increase cropland productivity, but there is inadequate data to determine if this would result in a reduction of land clearing (i.e., converting grasslands or forested land to cropland). Additionally, there is no data on the

GHG emissions associated with land clearing or increased use of nitrogen fertilizer. More research is therefore needed on the relationships between crop production, fertilizer, and GHG emissions, to determine if this could be a mitigation option.¹⁶

Due to non-availability of reliable data on the prevalence of different land management practices, it was assumed in the NDC Sector Analysis that at least 25 per cent of the 9,500,000 hectares of rain-fed agricultural cropland in Kenya apply full tillage.¹⁷ With a further assumption that a 20% adoption rate for sustainable land management, and converting 20% of rain-fed agricultural croplands from full tillage to conservation tillage would mean converting 475,000 hectares over ten years, which translates to an annual average of 47,500 hectares.

Stakeholders in the agriculture sector have set a target of increasing farm area under conservation agriculture by 250,000 acres (101,000 hectares) by 2022. This is equivalent to an annual average of 20,200 hectares, which is slightly less than one half of the 47,500 hectares per year that was applied in the mitigation analysis of the SNC and the NDC Sector Analysis of 2017. Limiting the use of fire in range and cropland management is considered an aspect of sustainable land management. Therefore, the mitigation contribution of this action as determined in the SNC has been included under this action. Going by the SNC estimations, and applying proportionate adjustments, the emission estimations for this action are as shown in Table 3.5.

Table 3.5: Emission reduction projection from increased sustainable land management (MtCO₂e) (GoK, 2015).

	Emission Reduction Potential-2018 to 2030 (MtCO ₂ e)			
	2018	2022	2027	2030
Increase farm area under sustainable land management	0.29	0.55	0.75	0.77

**g. Implement the Dairy Nationally Appropriate Mitigation Action (NAMA):
267,000 households involved in the programme leading to Greenhouse Gas emissions reduction**

Reducing enteric methane in the livestock sector is another proposed mitigation action, which is consistent with the *Kenya Climate Smart Agriculture Strategy, 2016-2025* that prioritises reduction of emissions from livestock.¹⁸

A short-term action would be to reduce emissions in the dairy sector. A study by the Food and Agriculture Organisation (FAO) identified improving animal and herd productivity as one of the key pathways to reducing enteric methane emissions per unit of production. A combination of intervention packages aimed at improving feed availability and quality, improving herd health, and improved genetics could potentially result in reduction potential of 21-36% in emission intensity, relative to the baseline emission intensity.¹⁹ A mitigation action in this sub-sector would be considered a priority because of the large amount of GHG emissions from this sector. Significant work has been undertaken to measure GHG emissions in the dairy sector.

While the emission reduction potential in the dairy sector is not significant at the national scale, initiatives in this sector are priority mitigation actions and, a Dairy Sector Nationally Appropriate Mitigation Action (NAMA) has been proposed.²⁰

The main objective of this NAMA is to trigger low-carbon development in the dairy sector through introduction of climate-smart

livestock practices, and to bring the country's dairy production sector onto a low carbon and more resilient path. More specifically, it aims at transforming the Kenyan dairy GHG emissions while also achieving other important socio-economic and environmental benefits.

The NAMA aims at providing effective support to 267,000 dairy farmers, double milk output, increase household dairy enterprise net income by at least 50%, and provide additional benefits in the form of reduced labor and health burden of fuel wood collection, especially for women. It is estimated that the NAMA will help to reduce GHG emissions by 8.8 MtCO₂e over a 10-year period through the following 3 components initiatives:

- Increased dairy productivity (152,700 households): 4.14 MtCO₂e
- Energy efficiency in processing (151 facilities): 2.96 MtCO₂e
- Household biogas adoption (20,000 households): 0.98 MtCO₂e

Because energy efficiency and biogas emission reductions have been included under the energy sector, only the emission reductions due to increased dairy productivity have been considered under the Dairy NAMA, with the overall mitigation potential being as shown in Table 3.6:

Table 3.6: Emission reduction projection from implementation of the dairy NAMA (MtCO₂e) (GoK, 2017).

	Emission Reduction Potential-2018 to 2030 (MtCO ₂ e)			
	2018	2022	2027	2030
Implementation of Kenya's Dairy NAMA	0.03	0.40	0.69	0.69

h. Put 50% of 30,000 hectares under rice production into efficient production technologies and increase area under rain fed rice production from 400 hectares to 600 hectares by 2022

Two actions targeting rice production have been proposed by agriculture sector players. Emissions from rice production systems could be reduced through the promotion of rain-fed rice farming, and the development and promotion of programmes

and technologies for efficient rice production. Both actions are therefore important and should be implemented. However, their mitigation potentials have not been assessed because emissions from the flooding of rice are relatively

low in Kenya, and the potential reductions from mitigation actions would not be substantial enough at the national level to form a wedge in the low-carbon analysis, as shown in Table 3.1. Based

on the analysis in this section, the prioritised mitigation actions are summarised in Table 3.7.

Table 3.7: Emission Reduction Projection from Agriculture Sector Actions (MtCO₂e).

Agriculture Source	Emission Reduction Potential-2018 to 2030 (MtCO₂e)			
	2018	2022	2027	2030
Agroforestry	0.28	1.66	3.05	3.71
Increase farm area under sustainable land management	0.29	0.55	0.75	0.77
Implementation of Kenya's Dairy NAMA	0.03	0.40	0.69	0.69
Total	0.6	2.61	4.49	5.17

In order to achieve the recommended NDC target minimum of 1.6 MtCO₂e in emission reductions in 2030 for the agriculture sector, implementation of all the three priority actions is not necessary, as the technical mitigation potential of the three priority actions by 2030 is 5.17 MtCO₂e.

Conservatively, therefore, and focussing on food security mainly during the NCCAP 2017-2022 period, the sector priority actions could comfortably deliver the low range of emission reductions (1.6 MtCO₂e) by 2022 and the high range of emission reductions (2.8 MtCO₂e) by 2030.

3.1.3 Enablers

a. Technology

A summary of the key technologies associated with the three priority mitigation options in the agriculture sector is provided in Table 3.8. Enabling actions are required for monitoring, reporting, and verification.

Table 3.8: Key Technologies in the Agriculture Sector (GoK, 2017).

Mitigation Option	Key Technologies Required
Agroforestry	Nurseries, improved market access for small farms, extension service support, capacity building, research and pilot projects
Sustainable Land Management	Agriculture extension services, low cost tillage systems and equipment Extension services to educate pastoralists and farmers on the risks associated with using burning to manage range and croplands, and on the benefits of alternative practices
Kenya's Dairy NAMA	Formulation of improved feeds and feed additives to reduce enteric fermentation, development of breeding schemes, and improved herd health
Enabling actions	MRV capacity building, including data collection and inventory development

b. Capacity Building

Data required to calculate GHG emissions is lacking, and considerable uncertainty exists in the calculation of agriculture-based emissions, compared to energy, transport, and industrial sectors. Data and certainty for establishing the impact of mitigation options is also either lacking or inadequate. Significant work has however been undertaken on livestock emissions, including by the Mazingira Centre at the International

Livestock Research Institute (ILRI) in Nairobi.

In the five-year period of NCCAP 2018-2022 and NDC implementation plan, the sector should focus climate change efforts on adaptation, while building expertise and improving data for mitigation action. Agriculture experts note that there are strong barriers to actions on reducing emissions from livestock in the pastoral

areas, including the cultural and economic importance of cattle, and the resistance to change in rural communities. Awareness raising and education-related actions in this sector would be important to lay the groundwork for future mitigation and adaptation actions. This is particularly important because of the potential

positive benefits for pastoralists in ASALs and the large emissions generated by the sector.

There is also great need for more extension services to support agroforestry, tree nursery development, and related services.

c. Finance and Budgets

Table 3.9 is a summary of the budgets for implementation of the priority actions.

Table 3.9: Key Technologies in the Agriculture Sector.

Mitigation Option	Budgets (US \$)	Remarks
Agroforestry	-	Included in the <i>Climate-Smart Agriculture Programme</i>
Sustainable Land Management	279.70 million	This is the budget for implementing the Smart Agriculture Programme. It includes agroforestry. ²¹
Kenya's Dairy NAMA	222.6 million (149.73 million as private sector co-financing)	USD 56.06 million is requested from the GCF (application) ²² <ul style="list-style-type: none"> • \$ 9.77 million as non-returnable grant • \$ 10 million as credit guarantees • \$36.19 million as concessional credit.
Enabling actions	0.25 million	About a quarter of this is included in the CBIT project

3.2: Energy Sector

3.2.1 Overview

In Kenya, energy is mainly consumed in the manufacturing, commercial, transport, residential, power generation, and some street lighting sectors. This chapter covers energy consumed in all these sectors, except for the transport sector, which is the largest consumer of petroleum products, and is discussed in Section 3.5 of this report.

The energy sector in Kenya is largely dominated by biomass (68% of the national energy consumption), electricity (9%), and imported petroleum (21%)²³, with biomass (wood fuel, charcoal, and agricultural waste) providing the basic cooking and heating energy needs of rural communities, the urban poor, and the informal sector. Traditional energy production in Kenya is limited to biomass (wood and agricultural waste), and electricity from hydropower, geothermal, and other renewables (wind, biomass and solar). This is complemented by imported electricity, coal, oil, and oil products.

Clean and sustainable energy is essential for the realisation of Vision 2030²⁴ and the Government's Big Four Agenda, and is considered as one of the infrastructure enablers of the socio-economic

pillar of the Vision. The draft 2015 Energy and Petroleum Policy indicates that rapid growth in Kenya's economy over the past decade has been partly attributed to increased investment in the energy sector, particularly in the electricity sub-sector. The Government's Big Four Agenda pillars of Food and Nutrition Security, Affordable Housing, Enhanced Manufacturing, and Universal Health Coverage, are significantly energy-driven. Further, the development of renewable energy technologies represents a major opportunity for "Growth of green industries in manufacturing" in Kenya. This could be a major sector of industrial growth in Kenya if the country positions itself to be a regional technology hub.

In 2017, Kenya's primary energy consumption was 23.8 million tonnes of oil equivalent (Mtoe), with the residential sector consuming the most energy, at 77% of final consumption, followed by transport with 14%, and industry at 7%. The commercial and public sectors consume 1% with agriculture and forestry at less than 1%. Transport, commercial, and public, are the fastest growing energy-use sectors. The draft Energy and Petroleum Policy 2015 seeks "to ensure an

affordable, competitive, sustainable and reliable supply of energy to meet national and county needs at least cost, while protecting and conserving the environment.”²⁶ The Energy Bill, 2015, that seeks to consolidate the laws relating to energy and provide for National and County Government functions in relation to energy, was passed by the National Assembly in November 2016 and forwarded to the Senate for consideration.²⁷ The Bill establishes key institutions in the energy sector; promotes renewable energy; provides a framework for the exploration, recovery, and commercial utilisation of geothermal energy; regulates petroleum and coal activities; and regulates electricity supply and use.²⁸

Climate change mitigation analysis in the energy sector considers both energy supply (electricity generation) and energy demand, at the household, industrial, and commercial levels. The three main electricity generation sources in Kenya are hydro, geothermal, and thermal, which jointly make up 98% of electricity sent to the national grid under normal hydrological conditions. In 2017, the total electricity generation was 8,272 Gigawatt hours (GWh) constituting of 3,341 GWh (33%) of hydro, 4,451 GWh (44%) of geothermal and 2,165 GWh (21%) of thermal.²⁹ The balance of 2% was generated from bagasse, wind and solar.

Recently discovered coal resources are expected to play an important part in Kenya’s electricity sector, particularly its long-term planning, as set out in the *Power Generation and Transmission Master Plan 2015-2035*. The plan ranks coal as the fourth largest contributor to the country’s generation capacity, after geothermal, hydro, and imports in that order, starting from 2020 onwards. Coal-fired power plants in Lamu and Kitui are included in the baseline projection. Even so, it now appears that the first coal powered plant will be commissioned after 2022.

Kenya is however expected to develop its domestic coal, oil and gas reserves over the

next few years. The baseline includes only a small amount of crude oil production (about 2,000 barrels per day) starting in 2017 and rising modestly to 6,000 barrels per day by 2030. With the Early Oil Pilot Scheme having started in the first half of 2018 at about 2,000 barrels per day, it is now expected that Kenya could be producing 60,000 barrels per day by 2030. The emissions associated with fossil fuel production are not expected to be significant of the plan period but could pick up towards 2030 with increasing fossil fuel production.

Nuclear is also expected to play a role in Kenya’s electricity generation in 2030.³⁰ An updated *Least Cost Power Development Plan (LCPDP) 2017-2037*, which is currently being developed, is expected to reflect the adjusted generation technologies and timelines. Along with increased generation capacity, the Government of Kenya has prioritised action to increase grid connectivity, toward universal access by 2020.³¹ The national connectivity access rate increased from 47% in March 2013 to 70.3% in June 2017.³² For the off-grid communities, and with significant private sector involvement, stand-alone solar photovoltaic (PV) systems have been the most widely used technology in Kenya, and have well over 200,000 systems installed, and sales estimated at 20,000 systems per year.³³

On the demand side, fossil fuels and biomass are used to produce heat for productive purposes in the commercial and industrial sectors, and for cooking and heating purposes in the household sector. Since Kenyans rely on the traditional biomass as the primary energy source for heating and cooking, energy consumption in the residential sector is dominated by biomass. Fuel use, however, varies considerably between rural and urban populations, and income levels, as shown in Figure 3.5.

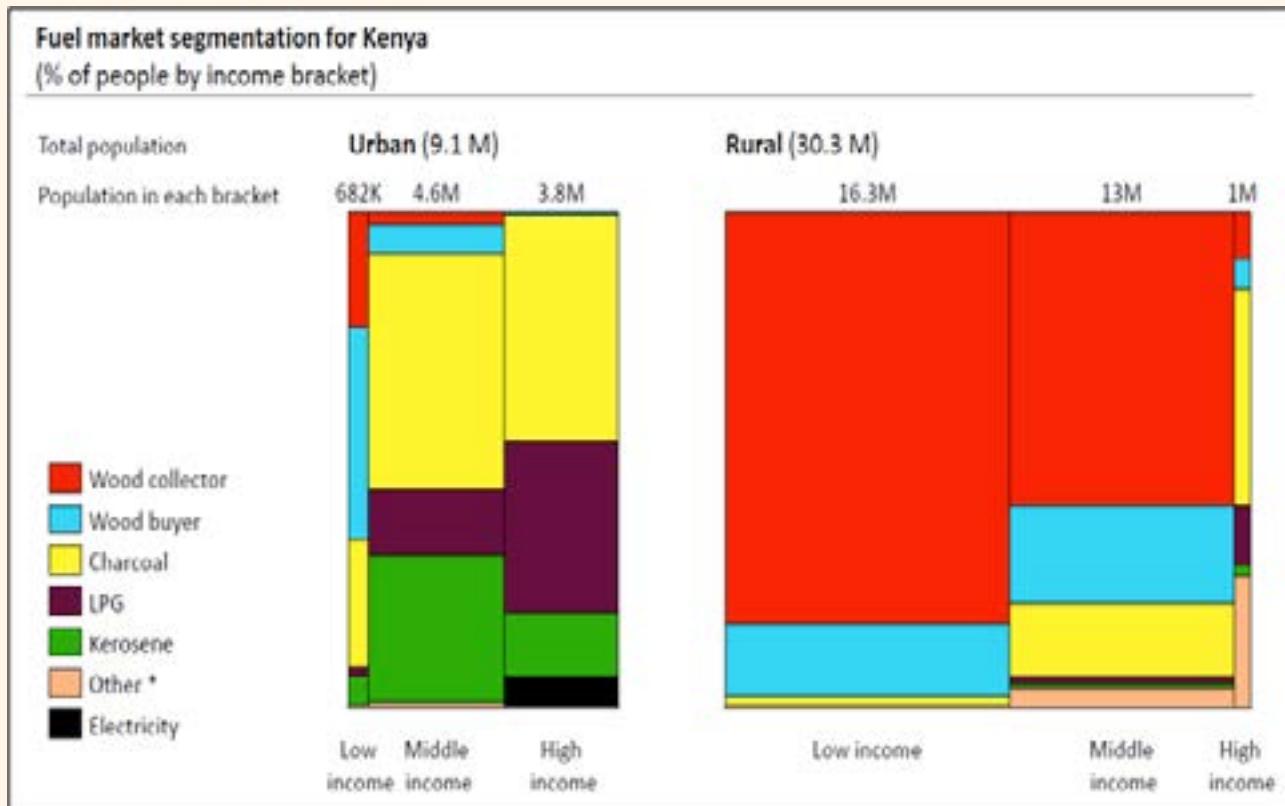


Figure 3.5: Domestic Users Fuel Market Segmentation (Dalberg, 2013).

About 87% of the rural population uses firewood for cooking, while 82% of the urban population uses charcoal for cooking.³⁴ Considered holistically, the annual contribution of charcoal to the economy is estimated to be about KES 135 billion.³⁵ The charcoal industry is however faced with several challenges, including unsustainable fuelwood resources, and the informal nature of the sector's operations.

Energy efficiency measures help to reduce energy consumption in households, and reduce energy costs in commercial and industrial services and products. The government, in partnership with stakeholders, has taken several energy efficiency and conservation initiatives. The Ministry of Energy (MoE), working with the Kenya Association of Manufacturers (KAM) has established a Centre for Energy Efficiency and Conservation (CEEC)

that promotes energy efficiency in private sector companies and public institutions, while Kenya Power has distributed compact fluorescent lights (CFLs). MoE has implemented improved cookstove programmes, and developed regulations that influence the update of such climate-related technologies as solar water heating, solar PV systems, and cookstoves. Additional information on the electricity sub-sector sector is annexed to this analysis (Annex 3.2.1).

This climate change mitigation analysis in the energy sector has been prepared against the backdrop of several circumstances in the sector, which have been summarised in this section. The analysis covers the actions prioritised by the sector. Petroleum products use for transportation are covered under Transport Sector (Section 3.2.5).

3.2.2 Mitigation Actions in the Energy Sector

GHG emissions associated with energy supply result from electricity generation and from domestic sources of primary fossil fuel energy. Emissions from energy demand are those related

to the combustion of fossil fuels by residential, commercial, and industrial energy end-users. Energy emissions that are related to the transport sector are not included in the energy sector, but

in the transport sector emissions in section 3.2.5.

Despite several challenges with developing a baseline projection for Kenya's electricity sector, one was agreed through a consultative process involving industry experts during the development

a. Baseline

In NCCAP 2013-2017 and the SNC, baseline emissions were based on actual historical data toward establishing the trend that was then extrapolated to obtain the 2030 figures, which put into consideration the government's plans, programs, and policies, including the *Least Cost Power Development Plan (LCPDP)* 2011-2031. Historic emissions for the supply side were based on actual generated and dispatched electricity, by generation type, not the installed capacity.

According to NCCAP 2013-2017 and SNC, the energy sector's contribution to GHG emissions was expected to increase sharply between 2015 and 2030. During the period, electricity generation emissions in the baseline scenario would grow in most or all the sectors, increasing from 1 MtCO₂e (1.3% of total national emissions) in 2015 to 41 MtCO₂e (28.7% of total national emissions) in 2030. Much of this projected increase was attributed to considerable addition of coal and natural gas generation capacity over the next fifteen-year period, to meet projected increasing energy demand in the then *LCPDP* 2011-2031. By 2016, Kenya had no significant GHG emissions related to the production of

of NCCAP 2013-2017. The baseline was re-validated during the preparation of Kenya's SNC.

primary fossil fuels (coal, crude oil and natural gas). However, the projected baseline includes small amounts of emissions that will result from the production of up to 6,000 barrels of crude oil per day by 2030. The baseline also includes a number of thermal plants, including 600 MW of coal generation (sub-critical technology) that was expected to come on stream from 2016.

During the same period, it was projected that GHG emissions from energy demand would grow from 7 MtCO₂e (8.8% of total national emissions) to 10 MtCO₂e (7.0% of total national emissions). As a result of the baseline projection trends of both the energy supply and demand sides explained above, total GHG emissions from the energy sector (electricity generation and energy demand, excluding transport), was 8 MtCO₂e (10% of the total national emissions) in 2015, and the sector's emissions were projected to grow to 51 MtCO₂e (35.7% of the total national emissions) by 2030. (See Figure 3.6 and Table 2.1). The BAU projections show that by 2030, electricity generation will be the highest emitter of GHG emissions in Kenya.



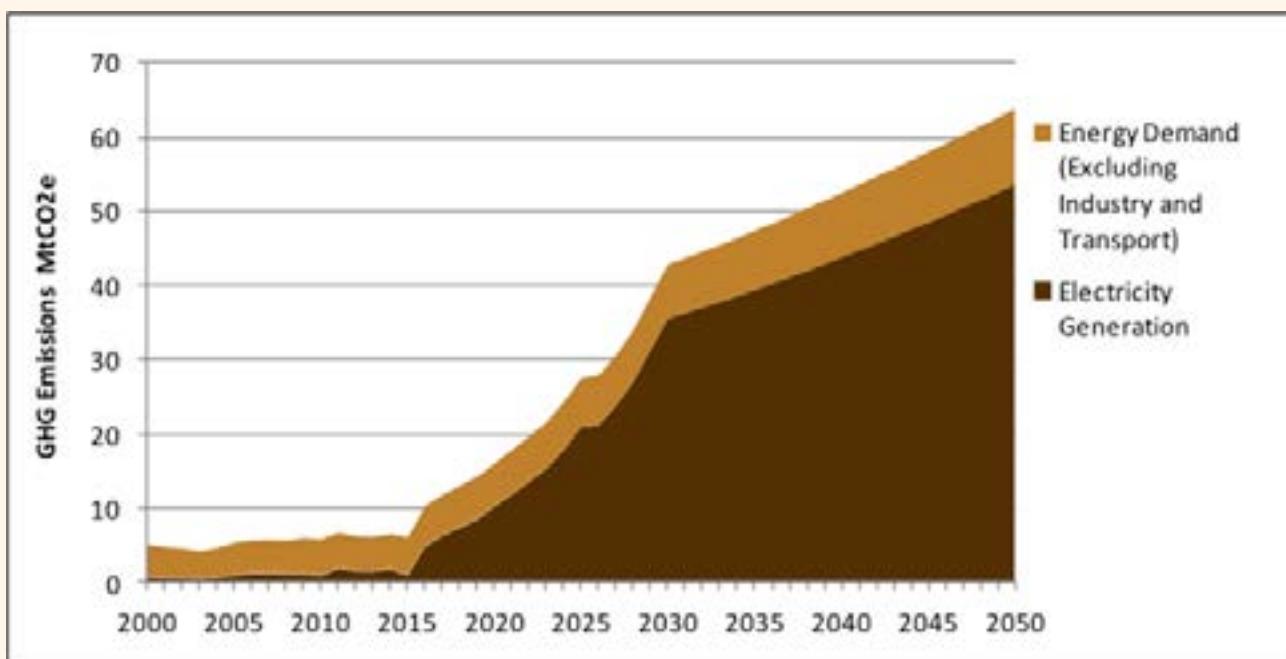


Figure 3.6: Energy sector baseline emission projection for Kenya (MtCO₂e) (GoK, 2015).

b. NDC Target for the Energy Sector

From the NDC Sector Analysis Report 2017 and the baseline emissions established in NCCAP 2013-2017, the NDC target proportionate emission reduction required from the energy sector is 15.4 MtCO₂e, which comprises of 9.32 MtCO₂e from electricity generation and 6.09 MtCO₂e from energy demand, as shown in Table 3.9. The proportionate contributions to emission reduction by the two energy sub-sectors, toward meeting the NDC overall target are shown in the table, as well. However, the actual contributions by the sector to emission reductions towards the achievement of Kenya's NDC need to be based on the realistic opportunities available for emission reduction in the sector, together with the sector plans and budgetary provisions.

Further, the NDC Sector Analysis Report 2017 and the referenced companion report (Update of Kenya's Emission Baseline Projections and Impact on NDC Target³⁶) show that relative to the baseline, there has been a significant shift in policy and planning that has impacted actual emissions since NCCAP 2013-2017 was developed in 2013 (See also Annex 3.2.2). While the Government's new Master Long Term Plan forecast to 2035 is consistent with the 2011 Updated Least Cost Development Plan (ULCPD) that was used to project emissions for NCCAP 2013-2017 and the SNC^{37,38}, there has been a general evolution in planning from 2011 to 2017.

Table 3.9: Technical emission reduction potentials and NDC for the energy sector (GoK, 2015).

	Emission Reduction Potential-2018 to 2030 (MtCO ₂ e)			
	2018	2022	2027	2030
Increase farm area under sustainable land management	0.29	0.55	0.75	0.77

The newer Master Long Term Plan forecast to 2035 in the electricity sector is dramatically lower than the forecast in the 2011 ULCPDP that was used to calculate the GHG emission baseline in NCCAP 2013-2017 and SNC. In the newer Master Long Term Plan, total supply drops by almost 40% by 2030, relative to that in NCCAP 2013-2017 and SNC baseline, and because most of this was to be supplied with coal-fired electricity generation. It is also projected that a dramatic drop in overall emissions of approximately 7.2 MtCO₂e will be witnessed, as shown by the green bar in baseline emissions in Figure 3.7.

Based on the scenario described above, the NDC Sector Analysis Report 2017 identified reasonable low and high range targets for emission reductions in the energy sector for 2030 as 12.6 MtCO₂e and 7.5 MtCO₂e, respectively (See Figure 3.7).

The low target (7.5 MtCO₂e) is aligned with the proportional contribution that the sector would need to make in for enhanced certainty that the overall target will be achieved if all other sectors also meet their low target of emission reduction. The high target (12.6 MtCO₂e) is intended to guide responsible ministries and agencies in terms of what they should objectively plan and prepare for should the sector require additional emission reductions. While total baseline emissions from the energy sector was 42.7 MtCO₂e, the low range and high range of emission reductions recognise that emission reductions of 7.2 MtCO₂e per year relative to the baseline (47% of the proportionate NDC target reduction for the sector of 15.4 MtCO₂e) have already been realised in the energy sector due to the shift in policy, planning, and actual generation as has been discussed above.

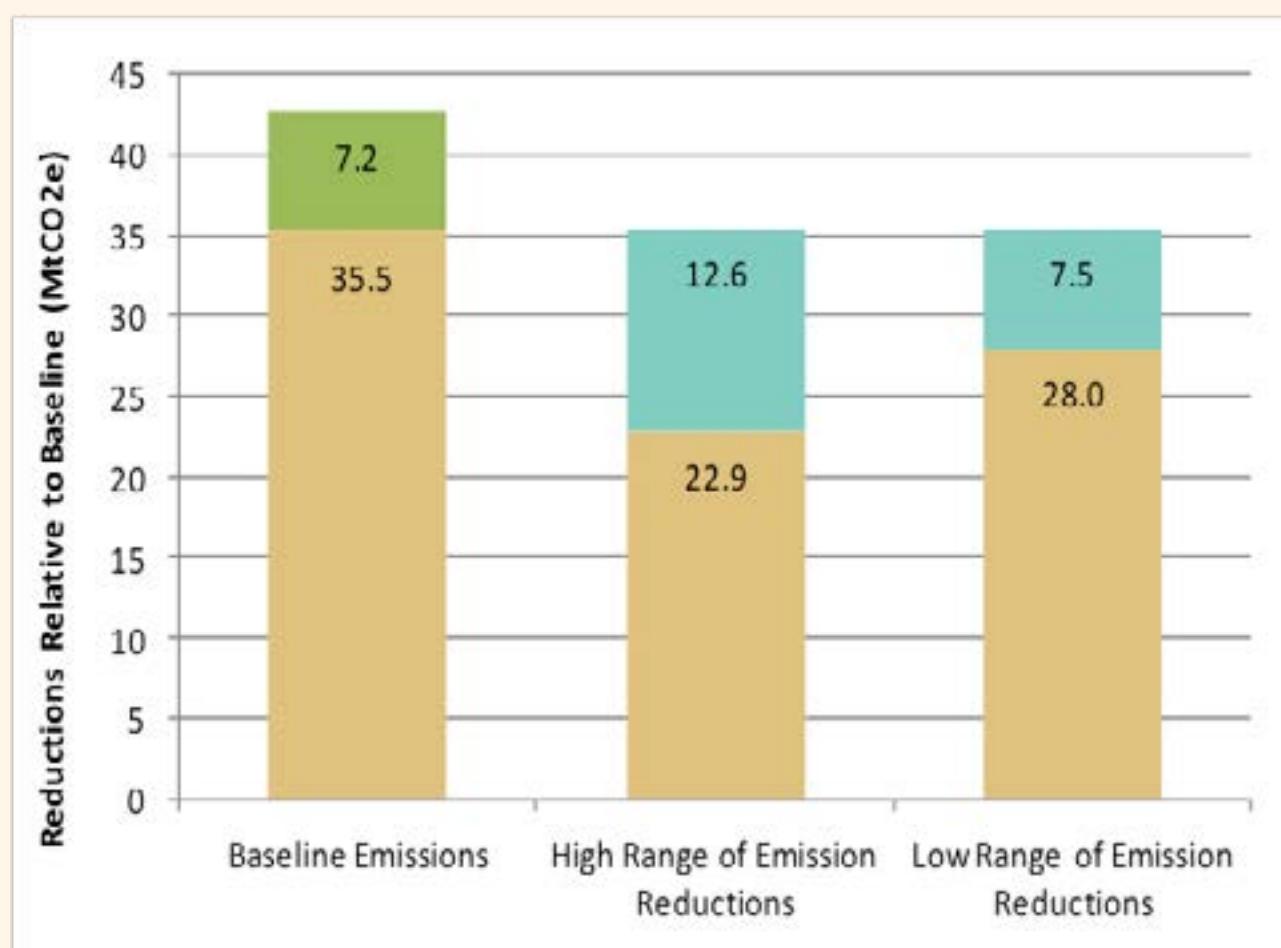


Figure 3.7: Comparison of 2030 baseline emissions and INDC target emission reductions (MtCO₂e) (GoK, 2017).

c. Mitigation Actions Identified in Kenya's Second National Communication

In NCCAP 2013-2017 and the SNC, twelve mitigation actions were proposed for the energy sector (supply and demand sub-sectors). A number of these have been implemented with varying degrees of success (Figure 3.8). Each of these options was assessed for its technical potential to contribute to emission reductions in the baseline in 2030.

In the NDC Sector Analysis Report 2017, it was established that in order to achieve the 7.5 MtCO₂e recommended low range of emissions reduction target in 2030, as shown in Figure 3.7, flexibility existed, and hence it was not necessary to fully implement all the twelve mitigation options. Figure 3.8 illustrates the estimated mitigation potential of the twelve options. A key observation from all the previous analysis is that, besides the flexibility in existing options for achievement of the GHG emission reduction target, the development

of geothermal power, other renewable, and cookstoves, had the highest mitigation potential.

The greatest opportunity for mitigation was in geothermal expansion, which envisaged the addition of 2,775 MW of geothermal by 2030. In 2013 the total electricity generation in Kenya was 8,087 GWh, with geothermal constituting only 19.77% of the generation. By 2017, the generation had increased to 10,205 GWh, with geothermal contributing 43.62% of the generation. During that period, the installed geothermal capacity increased from 363 to 652 MW. Regarding other renewable, significant interest has been placed on wind, photovoltaics (PV) and thermal solar energy sources. The installed capacity for wind however remains low, at 25 MW, although the 300 MW Turkana wind is due for commissioning will increase the contribution of wind to the generation.

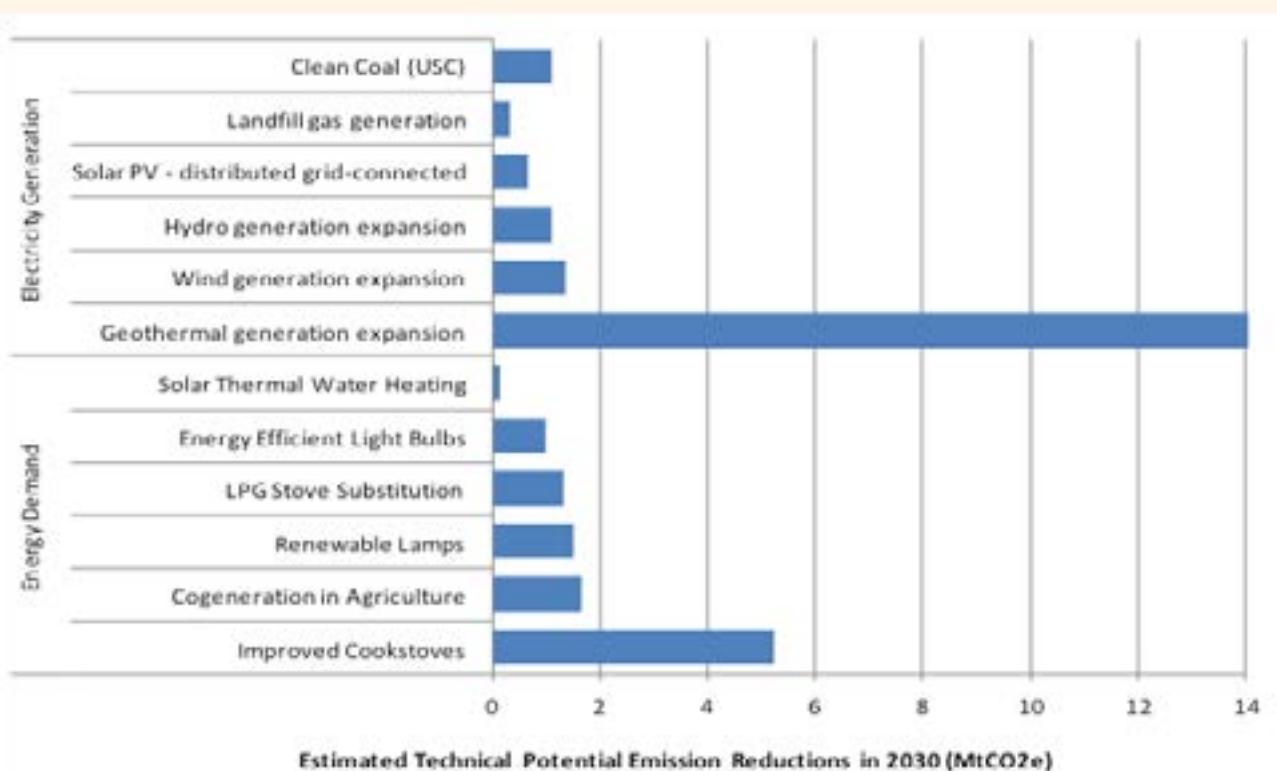


Figure 3.8: NCCAP 2013-2017 mitigation options and their technical potential emission reductions by 2030 (GoK, 2017).

The next biggest opportunity is in the realm of clean cooking. It is in this regard that cookstoves require to be addressed in a substantive way so as to achieve the recommended emission reduction target in the energy demand sub-sector. At a minimum, biomass cooking should improve by 10% from the 2010 baseline average efficiency (baseline efficiency is estimated to be approximately 18-20%, accounting for the existing penetration of improved cookstoves) by 2030, so as to deliver emission reductions in line with the overall technical potential of energy demand mitigation options. Improvements greater than 10% from the baseline average efficiency would substantially reduce the need to implement a wide range of such other mitigation options as energy efficiency improvements in lighting or industry.

Due to challenges with data capture and general monitoring, and while it is known that a number of energy efficient biomass stoves, and clean fuel (ethanol and Liquid Propane Gas (LPG)) stoves have been distributed during the NCCAP 2013-2017 period, adequate data to determine the extent of these actions is yet to be captured. In addition, through the Ministry of Petroleum

and Mining, the Government has initiated a pilot program on subsidised cooking gas in Machakos and Kajiado Counties, with further expansion being planned. The program targets poor households that use firewood, charcoal, and kerosene, for cooking. As part of the clean cooking drive, the Government, through the Energy Regulatory Commission (ERC), has published new draft regulations allowing firms to apply for licences to operate reticulated systems to transport LPG directly to households. However, biomass consumption is still growing, but at a slower rate than the other fuel sources (2.7% per annum between 2000 and 2014 compared to 6.2% for electricity and 3.6% for oil).³⁹

Adoption of distributed and grid connected solar PV continues to grow, although there is no credible data on the actual number of distributed solar PV units that are in use currently. In 2014, Strathmore University commissioned the first 600 kW grid connected solar PV system in Kenya.

No coal, landfill gas, cogeneration plants were installed during the NCCAP 2013-2017 implementation period.

d. Proposed mitigation actions for the energy sector under NCCAP 2018-2022

The following six mitigation options were proposed for consideration in the energy supply/electricity generation sub-sectors, for analysis and prioritisation in NCCAP 2018-2022:

- Development of new 2,405 MW capacity of grid-connected renewable electricity generation, and retirement of three thermal plants by 2022;
- Increase in the capacity for generation of 250 MW of captive renewable energy by 2022;
- Expansion, refurbishment, and modernization of electricity infrastructure with unspecified Kilometres of new lines, and new or upgraded transformers by 2022;
- Increase in the use of green energy along agricultural value chains by 5 MW by 2022;
- Promotion of increased use of renewable energy resources (small hydros, solar PV, biogas, biomass, wind, and hybrid systems) and undertaking research on possible application and extent of use of renewable energy resources by 2022; and
- Improvement of operational efficiency in generation and reduction of transmission and distribution losses

These actions, which are summarised in Table 3.10, were proposed by stakeholders in the energy sector, led by the Ministry of Energy. Through the Mitigation Thematic Working Group and further consultations, stakeholders in the energy sector, including the private sector and aviation sub-sector players, were consulted and their feedback appropriately incorporated.

As a preliminary analysis, the following actions were dropped from further mitigation analysis and prioritisation for inclusion in NCCAP 2018-2022 due to lack of adequate information, and insufficient scale to make significant mitigation impacts relative to the low range NDC mitigation target:

- Expansion, refurbishment, and modernisation of electricity infrastructure with unspecified Kilometres of new lines and new or upgraded transformers by 2022;
- Increased use by 5 MW of green energy along agricultural value chains by 2022; and
- Promotion of increased use of renewable energy resources (small hydros, solar, biogas, biomass, wind and hybrid

systems), and undertaking of research on possible application and extent of use of renewable energy resources by 2022.

After consultations with the energy and private sector stakeholders, it was established that some of the proposed generation of captive power using renewable energy, especially in the sugar sector, were also included in the grid-connected generation capacities. Therefore, to avoid double counting, the action to increase generation of captive power was also excluded from further mitigation analysis.

The following two actions were therefore prioritised for mitigation analysis and prioritisation in NCCAP 2013-2018.

- Development of new 2,405 MW of grid-connected renewable electricity generation and retirement of three thermal plants by 2022; and
- Improvement in operational efficiency in generation and reduction of transmission and distribution losses.

These options are analysed in detail hereinafter.



Table 3.10: Proposed priority mitigation actions in the energy supply sub-sector for the period 2018-2022.

Strategic Objective 3.2.1: Ensure an electricity supply mix based mainly on renewable energy, and which is resilient to climate change and, promote energy efficiency.				
Issue/Problem: Renewable (and affordable) electricity supply with low GHG emissions needs to increase, to meet the demands of a growing population and industrialising nation.				
Opportunity	Actions	Sector	Mitigation/Adaptation	SDG Target
Availability of renewable energy resources	Develop 2,405 MW of new renewables (Geothermal: 913 MW, Solar PV: 442 MW, Hydro: 93 MW, Wind: 800 MW, Biomass/Biogas: 157 MW and Distributed solar and mini-grids: 30 MW), and retire 300 MW of thermal plants (Kipevu: 120 MW, IberAfrica: 108.5 MM and Tsavo: 74 MW) by 2022	MoE, ERC, KenGen, Kenya Power (KP), County Governments, Local Non-Governmental Organisations (NGOs), Private sector, Geothermal Development Company (GDC)	Adaptation and Mitigation	1,7,8,9,11, 2, 13
Potential for generation of captive renewables	Increase the generation capacity of captive renewable energy by 250 MW by 2022 (at least 50 MW of solar PV, wind, hydro and 200 MW of cogeneration)	Industry, Kenya Association of Manufacturers (KAM), Kenya Industrial Research and Development Institute (KIRDI), MoE, ERC	Adaptation and mitigation	7,9,12,13
Significant proportion of the population are either not connected to the grid or have unreliable supply of electricity	Expand, refurbish, and modernise electricity infrastructure with Unspecified Kilometres of new lines and new or upgraded transformers by 2022.	MoE, KP, Kenya Electricity Transmission Company (KETRACO), ERC	Mitigation and adaptation	1,2, 3,7,13,15
Available renewable energy resources	Increase by 5 MW, the use of green energy along agricultural value chains by 2022	MoE, Ministry of Agriculture and Irrigation, Ministry of Industrialisation and Enterprise Development, KIRDI, GDC, ERC	Mitigation and adaptation	1,2,7,9,13
Available renewable energy resources	Promote increased use of renewable energy resources (small hydros, solar PV, biogas, biomass, wind, and hybrid systems) Undertake research on possible application and extent of use of renewable energy resources	MoE, County Governments, ERC	Enabling	1,2,7,9,13
Inefficiencies in electricity generation, supply, and use	Improvement of operational efficiency in generation and, reduction in transmission and distribution losses <ul style="list-style-type: none">• Reduce electricity transmission and distribution losses from current 18% to 14% by 2020;• Improve the utilisation and efficiency in the electricity system through demand management;• Optimise the operations of the Seven Forks Dams;• Promote such efficient lighting	MoE, ERC, KenGen, KP, KAM, Kenya Private Sector Alliance (KEPSA), Ministry of Transport, Infrastructure, Housing and Urban Development (MTIHUD), KIRDI	Mitigation and adaptation	

	<p>technologies as Light Emitting Diodes (LED) and Compact Fluorescence Lights (CFL) bulbs (Distribution to households);</p> <ul style="list-style-type: none"> • Building efficiencies through codes and standards; • Energy efficiency programmes for users (industries, National and County governments, and households); • Awareness, training, skills, and incentives for energy efficiency programmes (Enabling activities); and • Establishment of Standards and labeling for at least 5 additional products 			
Biennial updates of the power development plans	<p>Mainstreaming climate change in the electricity planning process</p> <ul style="list-style-type: none"> • Development and application of tools to integrate climate change considerations and broader development impacts into electricity sector master planning processes: <ul style="list-style-type: none"> - Develop a draft prototype of assessment tools, including methodology development workshops with relevant stakeholders, by the fourth quarter of 2018; - Development of concepts and workshop series on how to integrate the tools into the LCPDP process, by the fourth quarter of 2018; and - Regular reporting of climate change mitigation and adaptation implications in the electricity sector master planning documents. 	MoE, ERC, KP	Enabling activity	
Primary fossil fuel production (currently all plans are unconfirmed)	<p>Mainstream climate change considerations in the planning of the primary fossil fuels (crude oil, gas, and coal) production activities:</p> <ul style="list-style-type: none"> • Incorporate the climate change impacts, especially the GHG emissions of the production processes, in the national GHG estimation inventory • Assess the impact of proposed production activities on the realisation of Kenya's NDC 	Ministry of Petroleum and Mining, Ministry of Environment and Forestry, ERC	Enabling	



e. Developing new 2,405 MW of grid-connected renewable electricity generation and retirement of three thermal plants by 2022

Meeting future demand for electricity in Kenya and keeping the average emission intensity of the grid to as low enough as meets the NDC target, will require substantial deployment of renewable energy technologies. A key strategy of the Government is to increase the proportion of renewable sources of electricity in the grid, while reducing or minimising the development and use of fossil fuel generation plants.

The proposed new/additional generation capacity of 2,405 MW is comprised of the following generation technologies, whose details are shown in Table 3.11, and are based on the planned generation during the *Third Medium-Term Plan (MTP III)* between 2018 and 2022:

- Geothermal: 913 MW
- Solar PV: 442 MW
- Hydro: 93 MW
- Wind: 800 MW
- Biomass/Biogas: 157 MW
- Distributed solar and mini-grids: 30 MW

As part of the action to increase the proportion of electricity generation from renewables in the grid, the Government also plans to retire the following three grid-connected thermal plants, which have a total capacity of about 300 MW, and whose Power Purchase Agreements are expected to expire during the 2018-2022 period:

- Kipevu: 120 MW in 2019
- IberAfrica: 108.5 MM in 2019
- Tsavo: 74 MW in 20121

Whilst the electricity sector's GHG emission projections in MTAR 2018-2022 are based on the *MTP III*, the most recent projections for the electricity sector's development are contained in the draft ERC's new *LCPDP 2017-2037*. Both *MTP III* and *LCPDP 2017-2037* project similar pathways in the short term, as they are both based on committed electricity generation capacity. However, for projections in the longer-term, covering up to 2030 and beyond, *LCPDP 2017-2037* deviates significantly from *MTP III*.

The latest *LCPDP* contains significantly lower demand forecasts than previous estimates, despite accommodating the already committed Vision 2030 flagship projects in the demand projections. It also projects a more significant role for solar PV, wind, and geothermal, in the place of coal, oil, and natural gas, due to the most recent information on increasingly competitive costs of renewable energy technologies. Geothermal provides stable power and is more resilient to climate change than hydro power, although geothermal power development is comparatively more capital intensive and its exploration is riskier.

Although the focus of MTAR 2018-2022 is on the plan for the period between 2018 and 2022, an analysis was undertaken to access the longer-term implication of *LCPDP 2017-2037*. Results of the analysis have been presented as Annex 3.2.2 in this Report.



Table 3.11: Proposed additions of renewables (2018- 2022) with CAPEX estimates (MoE, 2018).

Technology	Capacity (MW)	Year of Installation	Estimated Budget (Million USD)
Geothermal			Based on 3,557 USD/kW
Olkaria V	158	2019	562
Olkaria I Additional unit 6	70	2019	249
Olkaria I & IV Upgrade and Top-Up	47	2020	167
Olkaria I refurbishment	6	2021	21
Olkaria VI-PPP	140	2022	498
Olkaria Agil	140	2022	498
Wellheads Modular Plants	47	2019	167
GDC Menengai Phase 1 (Sosian, Quantum and Orpower 22)	105	2022	373
GDC Menengai Phase II	60	2021	213
Orpower 4	60	2021	213
Orpower 4	10	2021	36
Marine Power Akiira	70	2022	249
Total	913		3,247
Biomass			Based on 3,045 USD/kW
Kwale Sugar	10	2020	30
Cummins	10	2020	30
Roadtech (Kisaju)	10	2019	30
Biogas Holdings	0.25	2022	1
Rea Vipingo DWA	1.44	2020	4
Thika way Investment	10	2020	30
Crystal Energy	40	2021	122
Sukari	35	2021	107
Sustainable Energy Management	40	2022	122
Sub Total	157		477
Wind			Based on 2,030 USD/kW
Ngong Wind Farm III	10	2020	20
Meru (Isiolo) Wind Farm I	80	2021	162
Turkana Wind	300	2018	609
Oldanyat	10	2021	20
Kipeto Wind	100	2020	203
Prunus	50	2021	102
Electrawinds Kenya (Bahari) Phase I	90	2022	183
Chagmel/Chania Green	50	2020	102
Kinangop/Aeolus	60	2022	122
Aperture Green	50	2022	102
Total	800		1,624

Technology	Capacity (MW)	Year of Installation	Estimated Budget (USD)
Hydro			
Tindinyo,	1.5	2019	Based on 3,970 USD/kW 6
KTDA	32.8	2022	130
Global Sustainable	23.9	2020	95
Powertech (Gatiki)	9.6	2022	38
Mutunguru	7.8	2019	31
Western hydro	10	2020	40
Frontier	5.6	2020	22
Kianthumbi	0.55	2020	2
Greenlight Holdings	1.5	2021	6
Sub Total	93		370
 Solar			
Strathmore	0.55	2018	Based on 1,695 USD/kW 1
Marco Borero	1.5	2019	3
Alten	40	2020	68
Kenergy Renewables	40	2019	68
Vateki International Holdings	40	2021	68
Greenmillenia Energy	10	2021	17
Solarjoule	10	2020	17
Kopere Solar Park (Subuiga)	40	2022	68
Radian	40	2020	68
Elodosol (Cedate)	40	2020	68
Makindu	30	2021	51
Izera Ranch	10	2022	17
Asachi Powertech	10	2022	17
Quaint Energy	10	2019	17
Astonfield Sosian	10	2022	17
Tarita (Cherab Isiolo)	40	2021	68
Garissa Solar Plant	50	2018	85
Belgen	10	2022	17
Sayor	10	2022	17
Total	442		749
Total estimated capex for all the renewables			
6,468			

In addition, new grid-connected biomass, solar PV, wind, and hydro, are proposed under this action. To facilitate increased investment in renewable energy, an Atlas mapping out of the renewable energy resources in 44 Counties has been developed. Implementation and prioritisation of the projects may consider a mixed renewable portfolio approach that balances regional resources, transmission and distribution requirements, investment costs, technical barriers, and specific grid demands.

The Rural Electrification Authority has implemented a pilot mini-grid at Biyamadhow in Wajir South Constituency that will serve up to 200 homes in the town. The mini-grid comprises of a 60 kW solar unit with a 40 kW diesel backup to ensure uninterrupted power supply to the

residents. Plans are underway to install 25 similar solar/diesel systems in the five off-grid Counties of Wajir, Mandera, Marsabit, Turkana, and Garissa by 2020, with possible hybridisation to reduce GHG emissions. Solar PV and wind, which could be more effectively installed incrementally, have the challenge of intermittency, especially as grid-connected power sources.

Further promotion of direct use of renewable energy resources is also planned. Such applications not only offer long term cost-effective solutions, but also mitigate climate change. With the planned industrial park in Nakuru by 2022, the proposed activities include promotion of direct use of geothermal resources to power such various industrial applications as boilers and dryers. The applications could support

such agro-processing activities as milk and meat processing, fish farming, greenhouse heating, and flower farming. Furthermore, direct use of solar energy for applications like water pumping, heating, and even desalination, will be considered.

For recreational purposes, more geothermal steam baths have been proposed for the period up to 2022. This follows the successful pilot of the Olkaria Geothermal Spa, which has been operational since 2012. Estimation of the mitigation potential of direct application of

renewable energy has not been possible due to lack of data on the feasible extent of the proposed actions, and for determination of the baselines.

However, from conservative positions, it is considered that estimation of the emission reductions in the electricity generation sub-sector through new grid-connected renewables adequately represents the sub-sector's mitigation potential, given their relative contributions. The total mitigation potential of the action relative to the BAU is summarised in Table 3.12.

Table 3.12: Projection of emission reductions from actions in the energy supply sub- sector (MtCO₂e).

Action	Emission Reduction Potential-2018 to 2030 (MtCO ₂ e)			
	2018	2022	2027	2030
Developing new 2,405 MW of grid-connected renewable electricity generation and retirement of three thermal plants by 2022	4.09	13.20	13.20	13.20

Trends in emission reductions have been estimated based on the plants listed in Table 3.10. From the analyses, up to 13.20 tCO₂e of GHG emission reductions relative to the baseline could be realised by 2022 through implementation of the proposed renewable energy projects, and the retirement of the three thermal plants between 2017 and 2022.

This action, as a priority, coupled with the technical mitigation potential of 13.20 MtCO₂e

by 2022, could deliver the high range of emission reductions of 12.6 MtCO₂e by 2030. However, from conservative positions, and given that not all planned projects are likely to come on stream as planned, sector stakeholders agreed that, typically, about 70% on-schedule implementation would be more realistic. The adjusted potential for emission reduction is shown in Table 3.13.

Table 3.13: Projections in emission reductions from actions in the energy supply sub- sector (with 70% completion) (MtCO₂e).

Action	Emission Reduction Potential-2018 to 2030 (MtCO ₂ e)			
	2018	2022	2027	2030
Developing new 2,405 MW of grid-connected renewable electricity generation, and retirement of three thermal plants by 2022	2.9	9.2	9.2	9.2

Beyond 2022, net emission reductions will depend on the type and scale of additional generation capacity that will be installed. The existing power development plans for that period indicate increased addition of fossil-fuel based generation capacity, which would result in increased GHG emissions. Such increase in GHG emissions would have to be netted from mitigation benefits, in order to estimate the final mitigation potential of the grid mix. Annex 3.2.2 (Implication of the 2017-2037 LCPDP for National Climate Change Action Plan) presents a brief analysis of the expected emission trends up

to 2030, based on LCPDP 2017-2037.

Improvement in energy efficiency and energy conservation is a key strategy in NCCAP 2018-2022 -. The electricity grid system experienced 18% transmission and distribution losses in 2017. In the Annual Report and Financial Statement for the Year Ending 30 June 2017, Kenya Power and Lighting Company (KPLC) sought to reduce this from 'double to single digit' levels, while the ULCPDP provides a target range of 1-5% for the whole system. At the 2017 generation level of 10,205 GWh, and assuming that the losses are

real (not book losses), a reduction of 1% loss is equivalent to a saving of 102 GWh (0.06 MtCO₂e) per year with the current grid mix that has an emission factor of 0.6 tCO₂e/MWh. A 10% loss reduction (from 18% to 8%) would mitigate 0.6 tCO₂e per year.

Assuming a reduction of 4% (from 18% to 14%), this would have a mitigation contribution of 0.24 MtCO₂e by 2022. This is not significant in relation to the low (7.5 MtCO₂e) and high (12.6 MtCO₂e) range of emission reduction target for the sector. It is therefore not prioritised for NCCAP 2018-2022, despite the fact that it is a planned action that is already ongoing, and should be monitored to track its contribution to the NDC. Nonetheless, it is not expected to significantly contribute to the NDC, unless the efficiency gains are significant, i.e., reduction of losses by at least 5%.

Optimisation of the Seven Forks Dam entails the operation of the cascade of dams as one big generating plant other than individual units. Preliminary Hydrological and Solar Modelling studies conducted by Tropical Power and Oxford University show that one unit of water at Masinga dam is more valuable than a unit of water at the downstream dams, because such a single unit of dam may be used to generate power from all five dams. The study concludes that:

- If the cascade is run optimally, there would be 15% more water in the system at the end of the 12-month period, compared to the baseline, to generate the same amount of power, as in the baseline; and
- If the system is run optimally at a continuous rate of 460 MW, then the amount of water in Masinga would be the same at the end of the year as at the

beginning, and that 54% more power could have been generated than in the baseline. This would be equivalent to a reduction of 1.2 MtCO₂e per year with the current grid mix.

These results assumed perfect forecast information on load and inflows, and neither prioritisation of water uses (irrigation, power generation, etc.) nor any required environmental flows was taken into account. Therefore, to implement the optimisation, weather forecasting and hydrology monitoring equipment, together with trained staff, would be key requirements. Because the initiative is still at the study stage, it has not been prioritised for inclusion in NCCAP 2018-2022.

From the above analyses, it was concluded that the only significant action in the electricity generation sub-sector that should be prioritised for implementation under NCCAP 2018-2022, so as to contribute to the NDC mitigation target, is the development of 2,405 MW of new renewables by 2022. Nonetheless, the other actions should be implemented, monitored, and reported for their contribution to the NDC.

On the energy demand sub-sector, the following actions were proposed for mitigation analysis by stakeholders in the energy sector (See Table 3.14):

- Development and distribution of 4 million improved biomass (charcoal and biomass) stoves by 2022; and
- Development and distribution of 1 million clean energy (LPG, biogas, and ethanol stoves) by 2022.

These two options on the energy demand sub-sector are discussed in detail hereafter.

f. Development and Distribution of 4 Million Improved Biomass (Charcoal and Biomass) Stoves by 2022

Over 80% of Kenyan households depend on biomass (charcoal and fuelwood) for primary energy, most of which is non-renewable. This leads to deforestation and indoor air pollution. Enhancing energy security and reducing dependence on unsustainable biomass energy resources is therefore of utmost importance. The action entails the design, manufacture, and distribution of improved cookstoves that either use charcoal or firewood. This action is closely linked to the implementation of the NAMA for the charcoal sector in Kenya, the only action prioritised for the industry sector, and agroforestry with respect to growing fuelwood trees, which is an action in the agriculture sector.

For 4 million biomass (2 million charcoal and 2 million fuelwood) stoves to be in use by 2022, it has been assumed that in each of the five years from 2018 to 2022, at least 400,000 new stoves of each of the two types will be distributed. It is also assumed that these stoves will have a thermal efficiency level that is at least 10% higher than the baseline stoves of 10-18%. The assumed distribution trend for improved stoves is shown in Table 3.15. With the assumed efficiency level, and for an average national Non-Renewable Biomass Fraction of 92% for Kenya,⁴⁰ the average emission reduction per stove per year would be about 2 tCO₂e for charcoal, and 2.5 tCO₂e for firewood. These values have been used in the estimation of the potential for emission

reduction by this mitigation action. It is assumed in this analysis that after 2022, the total number of improved stoves in use will remain constant, at 4 million units. Any future initiatives to increase the adoption levels would be evaluated during the development of NCCAP 2023-2027.

To realise the adoption and use of 4 million efficient biomass stoves, the following activities, among others, have been proposed:

- Establishment of loan programmes through micro-finance institutions and other affordable schemes, to assist with the up-front cost of cookstoves;
- Promotion of local manufacture, development, and enforcement of quality standards and servicing of clean cookstoves, e.g., through tax-relief incentives for manufacturers, training (in both management and technical competencies), loans, and other support required by local service providers;
- Support for local businesses to stock improved cookstoves, with emphasis on youth- and women-led businesses; and
- Establishment of timber plantations for sustainable biomass supply, through various programmes, including agroforestry.



Table 3.14: Proposed priority mitigation actions in the energy demand sub-sector for the period 2018-2022.

Strategic Objective 3.2.2: Enhancing energy security, and reducing dependence on unsustainable energy resources				
Issue/Problem: 80% of Kenyans depend on biomass for primary energy, most of which is non-renewable. This leads to indoor air pollution and deforestation				
Opportunity	Actions	Sector	Mitigation	SDG Target
80% of Kenyans depend on biomass for primary energy.	<ul style="list-style-type: none"> Develop and distribute 4 million improved biomass stoves by 2022 <ul style="list-style-type: none"> -Charcoal (2 million) -Biomass (2million) 	MoE, KFS, ERC, County Governments, Local NGOs, Private sector	Mitigation and adaptation	1,2,3, 7,13,15
Existing technology, resources, and potential market for LPG, ethanol, and biogas	<ul style="list-style-type: none"> Develop and distribute 1 million clean energy stoves by 2022 <ul style="list-style-type: none"> -Develop LPG, biogas, and ethanol stoves and related supply chains 	Ministry of Petroleum and Mining (MPM), MoE, KFS, ERC, County Governments, Local NGOs, Private sector	Mitigation and adaptation	1,2,3, 7, 13,15
	<ul style="list-style-type: none"> Strengthen the institutional frameworks to oversee household energy services, and provide an adequate policy framework for the promotion of sustainable wood fuel production and plantations (See agriculture sector) Strengthen supervision and law enforcement with regard to sustainable wood fuel supply strategies 	MPM, MoE, MEF, KFS, ERC, County Governments, Local NGOs, Private sector	enabler	

Table 3.15: Emission reductions through development and distribution of 4 million improved biomass stoves by 2022.

	tCO ₂ e per stove per year	2018	2019	2020	2021	2022	2030
Number of Charcoal Stoves		200,000	600,000	1,200,000	1,600,000	2,000,000	2,000,000
Number of Biomass Stoves		200,000	600,000	1,200,000	1,600,000	2,000,000	2,000,000
Emission Reductions from Charcoal Stoves	2.00	400,000	1,200,000	2,400,000	3,200,000	4,000,000	4,000,000
Emission Reductions from woodfuel Stoves	2.50	500,000	1,500,000	3,000,000	4,000,000	5,000,000	5,000,000
Total Annual ER from Improved Stoves (MtCO₂e)		0.90	2.70	5.40	7.20	9.00	9.00
Total Annual ER from Improved Stoves -Adjusted for 70% Implementation Rate (MtCO₂e)		0.63	1.89	3.78	5.04	6.30	6.30

From Table 3.15, it could be estimated that the mitigation potential of this action is 9 MtCO₂e by 2022, and that it stays constant at that level through to 2030 unless other actions are implemented to increase the level of adoption of improved stoves after 2022. This would be equivalent to 120% of the low target (7.5 MtCO₂e), which is aligned with the proportional contribution that the sector would need to make for there to be a high level of certainty that the overall target will be achieved if all other sectors also meet their low target reduction by 2030. The potential mitigation contribution would be nearly 148% of the proportionate NDC contribution

target for the energy demand sub-sector by 2030.

While the distribution targets are quite ambitious, they are considered achievable with enhanced private sector participation and, appropriate and well targeted incentives. However, stakeholders in the energy-sector agreed that 70% successful implementation rate for projects is more realistic and should be applied to adjust the above mitigation potential. The adjusted emission reduction levels from distribution and adoption of improved biomass stoves are also included in Table 3.15. The adjusted mitigation potential of the action by 2022 is 6.3 MtCO₂e, which is 84% of the 7.5 MtCO₂e low level NDC target for the sector.

g. Develop and Distribute 1.5 Million Clean Energy (LPG, Biogas, and Ethanol) Stoves by 2022

This action has the potential to transform cooking in the country in a significant way. However, it requires noteworthy development of the fuel supply chains, including storage, distribution, and dispatch facilities. While LPG is to be imported in the foreseeable future, there is already some ethanol production with substantial opportunity for increased production by the sugar companies in the country, besides other potential producers. Distribution of ethanol stoves has been successfully piloted in the country, and a number of initiatives, most of which are under development, are targeting the expansion of ethanol production and use as a cooking fuel in Kenya. Biogas generation requires availability of adequate amount of such bio digester feedstock as biodegradable waste or livestock dung, and significant capital investment at household level.

Kenya's overreliance on biomass as a source of energy is perpetuated by poverty, especially in rural areas; low electrification levels; and high cost of modern energy; among others. There has been a recent push towards the use of LPG, ethanol, biogas, and solar energy, as alternative sources of household cooking energy, due to diminishing biomass stocks and greater awareness of such adverse impacts of biomass use on the environment as deforestation and pollution. Industry data show that LPG consumption increased from 93,000 tonnes in 2013 to 151,700 tonnes in 2016 and 189,000 tonnes in 2017, which is a 25% increase in 1 year. Kenya has set a 100% access target for clean cooking solutions, to be achieved by 2022. To attain this, and realise other related benefits, it is planned that between 2018 and 2022, up to 1 million households, with additions from institutions, in Kenya will shift to using clean fuels. This will require a number of interventions similar to those applied toward the promotion of improved biomass stoves. As part of the clean cooking drive, the Government, through ERC, has published new draft regulations allowing firms to apply for licences to operate reticulated systems

that will transport LPG directly to households.

Additional activities required to promote the switch to clean fuels, most of which will target urban areas. These include:

- Exploring the feasibility of expanding LPG use in rural areas (e.g., supply, distribution, cost impact on uptake, need for subsidy/loan programmes, etc.);
- Scaling up of biogas technology, and related research, to increase access to clean energy to more households across the country;
- Construction of 6,500 digesters every 5 years for domestic use, and 600 biogas systems in various schools and public facilities by 2022.
- Developing strategic depots with clean fuels (LPG and ethanol) storage tanks and bottling machines, stocking gas cylinders of various sizes and, reviewing LPG supply regulations, which allow for localised large-scale storage with piped and metered distribution for concentrated communities;
- Establishing a loan programme through micro-finance institutions, or some other suitable arrangements, to assist with the up-front costs of cookers and cylinders;
- Promoting local manufacture and servicing of clean cookers, e.g., through tax-relief incentives for manufacturers; training and loans for local service providers
- Supporting local businesses to stock and deliver LPG to consumers;
- Engaging women and youth groups in the clean fuels supply chain;
- Promoting the production and uptake of such clean bio-fuels as bio-ethanol, for cooking;

- Promoting and increasing the production of fuel briquettes from such non-forest biomass as sugarcane bagasse, sawdust, and human waste,) with emphasis on women- and youth-empowerment; and
- Promoting the transition to clean cooking with such alternative fuels as LPG, ethanol, and other clean fuels in urban areas.

The Government of Kenya is piloting a USD 20million subsidised LPG programme (Mwananchi Gas Project) in two counties (Machakos and Kajiado) ⁴¹. Kisumu County is putting up a USD 3 million biogas plant that will use both industrial and human waste feedstock in an attempt to protect its forests⁴². There are also programmes working to roll out large scale adoption of ethanol cooking.

Table 3.16 presents the emission reduction estimates for this action. It is assumed that in each of the five years from 2018-2022, 100,000 stoves of each of the three types stoves, namely, LPG, biogas, and ethanol, will be distributed. The total emission reduction potential of this action is 1.19 MtCO₂e per year by 2022, before adjustment of the 70% project completion rate. This is equivalent to 15% of the low target (7.5 MtCO₂e), which is aligned with the proportional contribution that the sector would need to make for there to be a high level of certainty that the overall target will be achieved if all other sectors

also meet their low target reduction by 2030. The potential mitigation contribution is nearly 61% of the proportionate NDC contribution target for the energy demand sub-sector by 2030.

Both actions for the energy demand side have significant mitigation impacts. Table 3.17 shows the combined mitigation impact of the two priority energy demand actions. If implemented as proposed, and allowing for 70% success rate, the two energy demand actions would make a mitigation contribution of 7.1 MtCO₂e per year by 2022 and 2030, provided the distributed stoves continue to be used or get replaced as they age out.

In the NDC Sector Analysis (2017), it was established that the mitigation high target for the whole energy sector was 12.6 MtCO₂e, and that this target was intended to guide responsible ministries and agencies in terms of what they should objectively plan and prepare for should the sector require additional emission reductions by 2030.

The mitigation potential of the proposed two actions in the energy demand sector is about 56.3% of this target in 2022, with another 8 years to go. The energy demand sub-sector therefore has the potential to deliver about 16% higher emission reductions than the 2030 NDC proportionate target for the sub-sector by 2022.

Table 3.16: Emission reductions through development and distribution of 1.5 million clean energy stoves by 2022.

	tCO ₂ per stove per year	2018	2019	2020	2021	2022	2030
Number of LPG Stoves		100,000	200,000	300,000	400,000	500,000	500,000
Number of Biogas Stoves		50,000	100,000	150,000	200,000	250,000	500,000
Number of Ethanol Stoves		50,000	100,000	150,000	200,000	250,000	500,000
Emission Reductions from LPG Stoves/HH per year	1.19	119,000	238,000	357,000	476,000	595,000	595,000
Emission Reductions from Biogas Stoves/HH/year	1.19	59,500	119,000	178,500	238,000	297,500	297,500
Emission Reductions from Ethanol Stoves/HH/year	1.19	59,500	119,000	178,500	238,000	297,500	297,500
Total Annual ER from Clean Fuel Stoves (MtCO₂e)		0.238	0.476	0.714	0.952	1.190	1.190
Total Annual ER from Clean Fuel Stoves - Adjusted for 70% Implementation rate (MtCO₂e)		0.167	0.333	0.500	0.666	0.833	0.833

Table 3.17: Emission reductions through energy demand actions by 2022.

Stove Types	Emission Reduction (tCO ₂ e)					
	2018	2019	2020	2021	2022	2030
Charcoal Stoves	280,000	840,000	1,680,000	2,240,000	2,800,000	2,800,000
Biomass/firewood Stoves	350,000	1,050,000	2,100,000	2,800,000	3,500,000	3,500,000
LPG Stoves	83,300	166,600	249,900	333,200	416,500	416,500
Biogas Stoves	41,650	83,300	124,950	166,600	208,250	208,250
Ethanol Stoves	41,650	83,300	124,950	166,600	208,250	208,250
Total Annual ER (tCO₂e)	796,600	2,223,200	4,279,800	5,706,400	7,133,000	7,133,000
Total Annual ER (MtCO₂e)	0.8	2.2	4.3	5.7	7.1	7.1

The mitigation potential of the proposed actions in the energy sector are summarised in Table 3.18.

Table 3.18: Summary of the prioritised mitigation actions in the energy sector (2018-2022).

Sub-sector	Action	Emission Reduction (tCO ₂ e)	
		Action up to 2022	Action up to 2030
Energy Supply/Electricity Generation	Developing new 2,405 MW of grid-connected renewable electricity generation, and retirement of three thermal plants by 2022	9.2	9.2
Energy demand side	Developing and distributing 4 million improved biomass (charcoal and biomass) stoves by 2022	6.3	6.3
	Developing and distributing 1 million clean energy (LPG, biogas, and ethanol) stoves by 2022	0.8	0.8
Total Sector Emission Reduction Potential of the Prioritised Actions		16.3	16.3



3.2.3 Enablers of Mitigation Action in the Energy Sector

a. Technology

A summary of the key technologies associated with some priority mitigation options in the energy sector, is provided in Table 3.19. The enabling actions are essential to monitoring, reporting, and verification of the actions.

Table 3.19: Key technologies in the energy sector (GoK, 2017).

Sub-Sector	Mitigation Option	Key Technologies Required
Energy Supply/ Electricity Generation	Geothermal	Feasibility studies and resource assessments, test drilling, directional and deeper drilling and construction of production wells, steam condensing turbines, injection optimisation, scaling/corrosion, inhibition, reservoir simulation modeling.
	Wind	Wind turbine siting, electric system integration, advanced rotors and blades, advanced turbine control and condition monitoring, advanced drive trains, generators, and power electronics.
	Solar	PV module manufacturing, cell efficiency, stability and lifetime, inverters, charge controllers, system structures, off-grid solar home systems.
	Hydro	Hydropower turbines technologies are mature. Some of the promising technologies under development are variable-speed and matrix technologies, fish-friendly turbines, hydrokinetic turbines, abrasive-resistant turbines, and new tunneling and dam technologies.
	Co-generation	Gasification technology, high-efficiency boiler and combustion technology, demonstration and awareness raising.
Energy Demand	Improved Cookstoves	Improved heat retention, formulation of standards for cookstoves, regulating fuel wood harvesting to reflect true value of resource. National Forestry Inventory and monitoring to determine sustainable forest harvesting levels.
	Clean fuel stoves	LPG and ethanol storage and distribution, standards for clean fuels and stoves, ethanol and briquette stove technology, LPG and ethanol safety regulations, briquette manufacturing technologies, ethanol production technologies

b. Capacity Building

There is need for improved data on biomass energy usage in Kenya. Enhanced capacity for research and data gathering is needed in the biomass sub-sector. Additional capacity is also required in agroforestry to support the growing of trees for fuel wood in farms.

The following capacity building actions are proposed to support energy sector mitigation actions:

- Training and public awareness programmes on energy efficiency; and
- Training in technical skills required for renewable energy at different scales. Examples include, the Strathmore University training programmes on solar PV, and the training by Kenya Power International (Institute of Energy Studies and Research) on renewable energy technologies. While Kenya Power intends to train about 100 students per year, GDC and KenGen are training an average

of 60 participants per year in the United Nations University – Geothermal Training Programme on geothermal development.

To facilitate infrastructure development, especially transmission and distribution lines, it is necessary to develop a policy to guide vegetation management, wayleaves acquisition, and corridors for energy infrastructure. This will minimise environmental degradation and also prevent challenges, such as those delaying the transmission of power from the Lake Turkana Wind Power Project.

The Climate Change Act 2016 requires for steps to be taken to enhance the mainstreaming of climate change objectives in sector strategies. A degree of misalignment exists between planning documents and processes related to climate change mitigation, and those from the electricity supply sector. In addition, no means of quantitatively assessing the costs and benefits of options in the electricity sector with regards to

climate change and development outcomes exist. As such, these costs and benefits are currently not integrated in analysis or pathway development for the *LCPDP*. Such tools are in the process of development by the Ministry of Energy and the *LCPDP* planning committee, supported by the Ambition to Action project. For the electricity sector planning, the following two key actions have been planned as enablers:

- Development of tools to integrate climate change considerations and broader development impacts into the electricity sector master planning processes. The tools should be developed, which can assess and quantify the impacts of different electricity sector pathways for national development objectives and climate change, including key Sustainable

Development Goals (SDGs). These tools should be applied in the biennial *LCPDP* processes to determine the optimal pathways that consider the costs and benefits associated with assessed impacts.

Regular reporting of climate change mitigation implications in the electricity sector master planning documents, like the biennial Least *LCPDP* reports, or their equivalent, should include clear information on what the proposed electricity sector pathways mean in terms of GHG emissions, and how these plans relate to national climate change mitigation and adaptation objectives, as set out in Kenya's most current NDC and NCCAP.

c. Finance and Budgets

Table 3.20 is a summary of the budgets required for implementation of the priority climate change mitigation actions in the energy sector.

Table 3.20: Estimated budgets for priority mitigation actions in the energy sector.

Mitigation Option	Budgets (Million US \$)	Remarks
Development of new 2,405 MW of grid-connected renewable electricity generation	6,468	See Table 3.11. The CAPEX is based on the estimated capital costs of the various technologies as provided in the <i>ULCPDP 2011-2030</i>
Development and distribution of 4 million improved biomass (charcoal and biomass) stoves	-	-
Develop and distribute 1 million clean energy (LPG, biogas, and ethanol) stoves	-	-

3.3: Forestry Sector

3.3.1.: Overview

This chapter focuses on the climate change mitigation role of forests, and covers climate change mitigation analysis in the forestry sector and other land-use and land use change sector, normally referred to as the *LULUCF* sector, in Kenya. It covers natural forestlands, as well as such other types of vegetation as grasslands and bush lands. In the *LULUCF* sector, the transitions in forests, through clearing of forested lands for agriculture, urban development or settlement, and wood harvesting, account for most GHG emissions involving carbon dioxide (CO_2) in the sector. The predominant gas in this sector is CO_2 , but there are also emissions of such other greenhouse gases as CH_4 and N_2O , arising from imperfect burning of wood left in the field, in case of forest conversion to other uses.

The analysis considers the impact of human activities that change the way land is used or affect the amount of carbon in existing aboveground biomass, belowground biomass,

deadwood/litter, and soil carbon pools. The *LULUCF* sector includes estimates of emissions and removals of greenhouse gases associated with increases or decreases of carbon in living biomass as land-use changes occur over time for example, in the conversion of a forest area to cropland, or when establishing new forest lands through reforestation or afforestation.

Kenya has a total area of 58.0 million hectares, of which 1.1 million hectares are inland water bodies. The country is composed of seven different agro-ecological zones (See Figure 3.15). The land consists of 82% arid and semi-arid lands (ASALs) and 18% humid to semi-humid land.⁴³ The Kenya Forest Service (KFS) defines a forest as land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 15% or trees able to reach these thresholds. This includes natural and planted plantation forests in state and private lands.

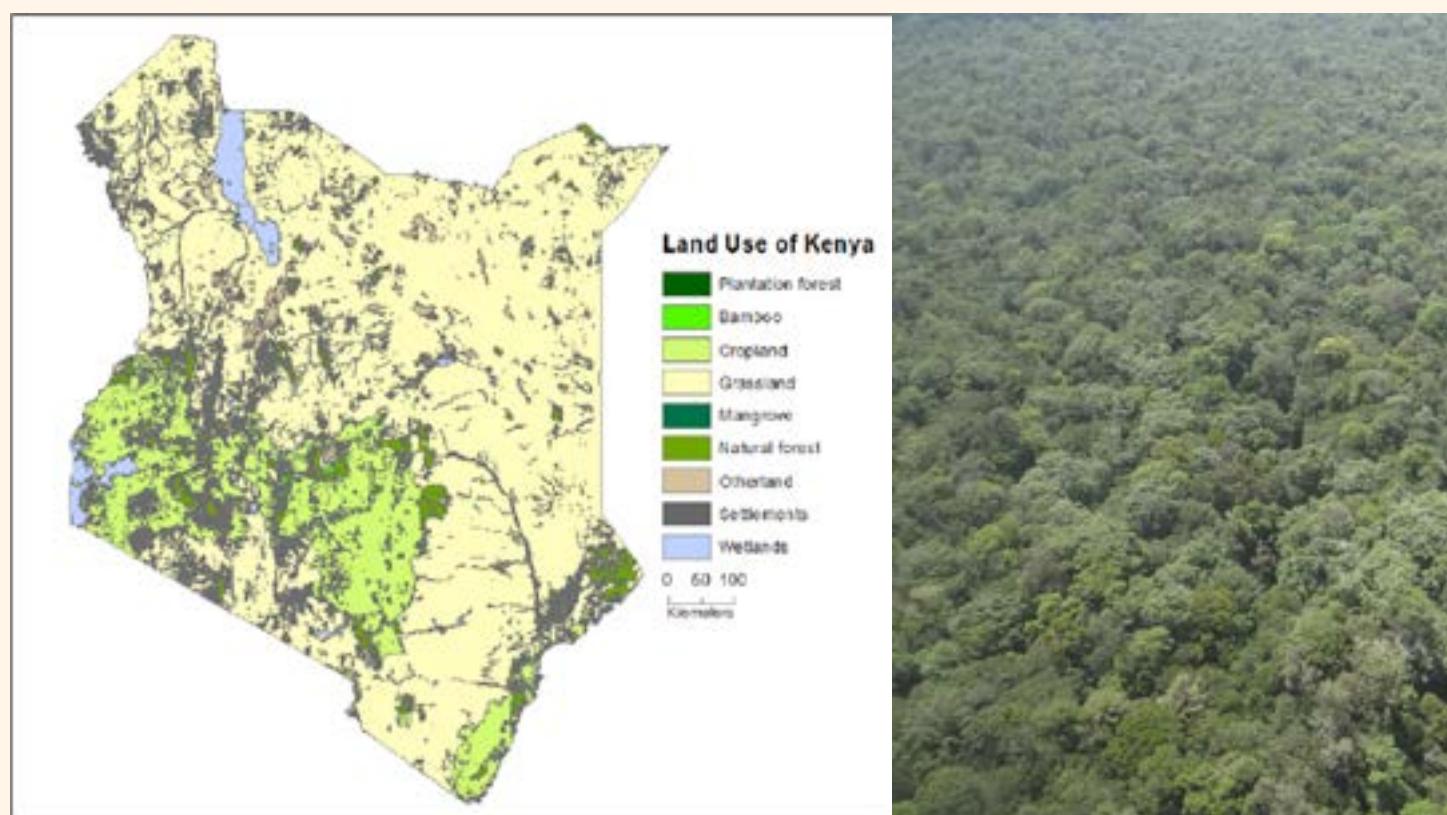


Figure 3.15: Priority mitigation actions in the waste sector for the period 2018-2022 (GoK, 2016).

The official estimate of the forest cover in Kenya by 2016 was 6.9% of the land area. This area comprises of natural forests, plantation forests, open woodlands, and a small amount of mangrove forests in coast. The most luxuriant forests are found in the humid to semi-humid areas in Western Kenya, the mountain areas, and in the Coast. According to the Land Use map by the Forest Preservation Programme (FPP, 2013) most forest plantations are found in Central and Western Kenya.

The ASALs zone extends over the whole Northern and Eastern Kenya, except the lower south East (Lamu County), where Boni forest is found, and according to the Land Use map, the main land use type in these areas is grassland. In ASALs, there are also scattered natural forests, which are however small in area.⁴⁴ Along the coastal strip of Kenya, there are unique forests, namely the mangrove forests, which are scattered along the coastline. The most common tree generations are Rhizophora, Ceriops, and Avicenia. The largest continuous mangrove forests are found in Lamu, Gazi, and Mombasa areas.

In principle, vegetation types and forest structure follow the agro-ecological zones. Forests with large amounts of above-ground biomass (AGB) are found in humid to semi-humid zones, while those with less AGB are found in arid areas. However, below-ground biomass (BGB) could be high also in arid areas, as was found out in the IC-FRA pilot inventory when the soil samples were analysed.

Kenya's forestry sector is central to the country's economy and its future. Forests rank high as some of the most important national assets in terms of economic, environmental, social, and cultural values. It is estimated that the forest sector contributes about KES. 7 billion to the economy annually, and employs over 50,000 people directly and other 300,000 indirectly. Five key forests regulate 75% of the country's renewable water supplies, while more than 80% of the energy generated in Kenya comes from wood. Forests offer water catchments and biodiversity conservation functions, and are

handy in mitigating climate change by acting as carbon sinks.

Deforestation and forest degradation have been rife in Kenya since independence, with the result that at present, the country is among countries of the world with a forest cover that is less than 10% of total land mass. The principal drivers of this trend were summarised as:

- Clearance for agriculture, which is linked to rural poverty and rapid population growth;
- Unsustainable utilisation of forest products, including timber harvesting, charcoal production, and grazing in forests; and
- Past governance and institutional failures in the forest sector.

According to KFS, a wall to wall forest resource mapping of 2013 showed that the forest cover in Kenya declined from 8% (4,670,877.3 hectares) in 1990 to 6% (3,492,116.2 hectares) in 2000, signalling an overall downward trend in carbon biomass stocks. The water towers and catchment areas, where more than 75% of the country's renewable surface water originates, are severely threatened. However, as a result of a number of Government actions, the forest cover increased marginally from 4.18 million hectares (7.22 %) in 2016 to 4.22 million hectares (7.29%) in 2017 . Much of the increase in forest cover is attributed to the entry of private commercial plantations and the sparsely populated woodlands. In 2017, the area under natural forests stood at 4.03 million hectares, while the area under Government forest plantations stood at 0.1351 million hectares.

In NCCAP 2013-2017, it was estimated that total GHG emissions from the LULUCF sector was 21 MtCO₂e per year, which was 30% of total national emissions in 2010, and was projected to increase to 26 MtCO₂e, which is 32.5% of the total national emissions by 2015 before reducing to 22 MtCO₂e per year (15.4%) by 2030. At this level, the forestry sector would be the second highest emitter of GHGs after the agriculture sector. To mitigate climate change in the forestry

sector, the following three actions were proposed in both NCCAP 2013-2017 and SNC:

- Restoration of forests in degraded lands;
- Rehabilitation of degraded forests; and
- Reduction of deforestation and forest degradation.

In the NDC Sectoral Analysis Report 2017, these mitigation actions were further analysed to determine the sectors' potential to contribute to Kenya's NDC mitigation target. It was determined that relative to the proportionate mitigation reduction target for the sector of 20.1 MtCO₂e by 2030, the sector's mitigation potential was between 11.3 and 20.1 MtCO₂e per year, with a technical maximum potential of 40.2 MtCO₂e per

year by 2030.

The government is taking action to address climate change in the forestry sector, including through tree planting initiatives and preparatory activities to enable the country participate in reducing emissions from deforestation and forest degradation plus (REDD+) role of conservation, sustainable management of forests, and enhancement of forest carbon stocks, as a climate change mitigation process. Under the Bonn Challenge, Kenya has established a restoration target of 4,210,000 hectares by 2030, as described in Table 3.25. The Bonn Challenge is a global effort to restore 150 million hectares of the world's degraded and deforested lands by 2020 and 350 million hectares by 2030.⁴⁵

Table 3.25: Kenya - Existing forest restoration targets (Bonn Challenge, 2016).

Category	Description	Existing Restoration Target
Forest Land without Trees - Planted Forests and Woodlots	Planting of trees on formerly forested land. Native species or exotics and for various purposes, fuel-wood, timber, building, poles, fruit production, etc.	4,100,000 hectares
Degraded Forest Land - Silviculture	Enhancement of existing forests and woodland of diminished quality and stocking, e.g., by reducing fires and grazing and by liberation thinning, enrichment planting, etc.	10,000 hectares
Agricultural Land - Agroforestry	Establishment and management of trees on active agricultural land (under shifting agriculture), either through planting or regeneration, to improve crop productivity, provide dry season fodder, increase soil fertility, enhance water retention, etc.	100,000 hectares

In this MTAR, the mitigation actions that were proposed in NCCAP 2013-2017 and SNC, together with those that have been proposed for NCCAP 2018-2022, have been assessed, analysed, and prioritised for inclusion in NCCAP 2018-2022. They are:

- Reduction in deforestation and forest degradation by rehabilitation and protection of an additional 100,000 hectares of natural forests (including mangroves) by 2022, with an abatement potential of 2 MtCO₂e by 2030;
- Afforestation/reforestation/agroforestry of an additional 100,000 hectares of land by 2022, with an abatement potential of 4.8 MtCO₂e by 2030;
- Restoration of 200,000 hectares of forest on degraded landscapes (ASALs,

rangelands) by 2022, with an abatement potential of 13 MtCO₂e by 2030;

- Increasing of area under private sector-based commercial and industrial plantations from 71,000 hectares to at least 121,000 hectares, with an abatement potential of 1 MtCO₂e by 2030; and
- Three forest resources efficiently utilised in all counties, especially dryland forests, by 2022.

While these actions are considered ambitious relative to the past performance, they do not meet the Bonn Challenge targets, and just meet the NDC mitigation target for the sector, which is considered a major potential contributor to the realisation of the target, given the relatively low cost of their implementation.

3.3.2 Mitigation Actions in the Forestry Sector

Forestry plays an important role in both mitigation and adaptation to climate change.⁴⁶ Focus of this MTAR is the mitigation role since the adaptation role has been addressed in the Adaptation Technical Analysis Report.

Mitigation could be achieved through activities in the LULUCF sector that increase the removal of greenhouse gases (GHGs) from the atmosphere, or decrease emissions by sources that lead to an accumulation of carbon stocks. An important feature of LULUCF activities in this context is their potential reversibility, hence, non-permanence of the accumulated carbon stocks. Forests play a role in mitigating the harmful effects of GHG emissions by acting as a “sink” for sequestering carbon and storing it for long periods of time. Therefore, forests present a significant global carbon stock accumulated through growth of trees and an increase in soil carbon.

The Forest Conservation and Management Act, 2016 (Section 42) indicates that indigenous forests and woodlands are to be managed on a sustainable basis for, inter alia, carbon sequestration. Section 8 indicates that KFS is to manage water catchment areas in relation to soil and water conservation, carbon sequestration, and other environmental services; and Section 21 notes that County Governments are to promote afforestation activities.

The Global Forest Resources Assessment 2010 (FRA 2015) estimates that the world's forests and other wooded lands store more than 485 billion tonnes of carbon (53% in the biomass, 8% in dead wood and litter and 39% in soil). While sustainable management, planting, and rehabilitation of forests could conserve or increase forest carbon stocks, deforestation, degradation, and poor forest management reduce carbon stocks. For the world as a whole, carbon stocks in forest biomass decreased by an estimated 0.22 billion tonnes annually during the period 2011-2015. This was mainly because of a reduction in the global forest area.⁴⁶

According to the baseline analysis of NCCAP 2013-2017 and SNC (See Chapter 2 of this MTAR), the LULUCF sector is the second largest contributor to Kenya's GHG emissions after agriculture, accounting for 32.5% of emissions in 2015, largely as a result of deforestation through clearing of forested lands for agriculture; wood harvesting, for fuelwood, charcoal and other wood products; and urban development or settlement. According to the analysis, in the baseline or business-as-usual (BAU) scenario, LULUCF emissions would increase from 10 MtCO₂e in 1995 to 26 MtCO₂e in 2015 and then decline gradually to 22 MtCO₂e by 2030 as shown in Figure 3.16.⁴⁸

The decrease from 2015 would be as a result of a number of policies and initiatives by the



Government in its efforts to increase the forest towards the constitutional target of 10%. However, the forestry sector is also vulnerable to climate change, which is expected to have important effects on the composition, growth rates, and regenerative capacity. Reports

show that climatic changes are expected to increase desertification and forest degradation, with impacts on the economic benefits and livelihoods derived from the forestry sector.

c. Baseline

The *LULUCF* sector includes estimates of emissions and removals of GHGs associated with increases or decreases of carbon in living biomass as land-use changes occur over time. Such land-use changes include the conversion of a forest area to cropland, when establishing new forest lands through reforestation or afforestation.

Kenya's forest cover has been substantially reduced over the last 50 years, signalling an overall downward trend in carbon biomass stocks over the period. However, recent reports indicate that the forests have started to recover because of various Government initiatives, and it is currently estimated that the country's forest cover is between 7 and 8%. The predominant gas in this sector is CO₂, but there are also emissions of other GHGs like CH₄ and N₂O that arise from imperfect burning of wood left in the field, in case of forest conversion to other uses.

According to the SNC baseline scenario, the *LULUCF* sector emissions were about 21 MtCO₂e (30% of the total national emissions) in 2010. The emissions were projected to increase to 26 MtCO₂e (32.5% of the total national emissions) in 2015 before reducing gradually to 22 MtCO₂e (15.4% of the total national emissions) by 2030

(Figure 3.16 and Table 2.1). Loss of forest land alone accounted for nearly 86% of the projected total forestry sector emissions in 2030. Table 3.26 shows a breakdown of the *LULUCF* baseline emissions between the year 2000 to 2030. Figure 3.16: Forestry sector baseline emission projection for Kenya (MtCO₂e) (GoK, 2015).

Estimates on the carbon stocks of forests, which comprises of the remaining forest land in the *LULUCF* sector, has the highest uncertainty of emission estimates, because of uncertainty in the actual extent of total forest cover, activity data, and emissions factors. In the NDC Sector Analysis 2017, the biomass literature available as part of the System for Land-Based Emissions Estimation in Kenya (SLEEK) project was reviewed. It was established that total biomass stocks of forests were underestimated in the modelling work conducted for Kenya's Second National Communication (SNC), yet this is one of the primary data sources for estimating net baseline emissions. More modelling and forest inventory data would be required to determine if net baseline emissions are more or less than the baseline *LULUCF* emissions projected in SNC, as summarised in Figure 3.17.⁴⁹

Table 3.26: Forestry sector baseline emission projection for Kenya (MtCO₂e) (GoK, 2015).

LULUCF Sector	LULUCF Baseline GHG Net Emissions (MtCO ₂ e)						
	2000	2005	2010	2015	2020	2025	2030
Forest Land	14.1	14.1	19.7	19.7	20.2	17.8	18.9
Cropland	4.6	3.4	4.6	6.0	4.5	4.4	2.9
Grassland	0.3	0.3	0.2	0.3	0.3	0.3	0.3
Wetlands	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Settlements	0.1	0.0	-0.1	0.0	0.0	0.1	0.0
TOTAL	19.1	17.8	24.4	26.0	24.9	22.6	22.1

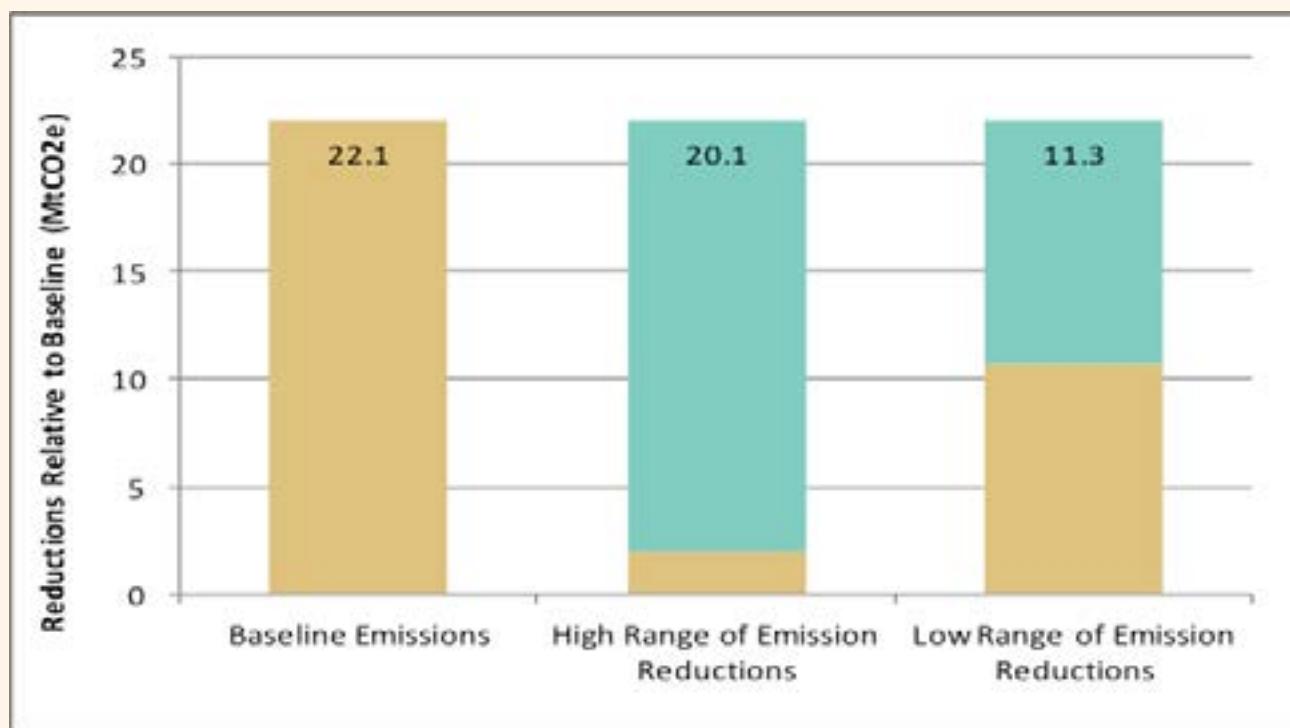


Figure 3.17: Comparison of baseline GHG emissions and the NDC target emission reductions (MtCO₂e) (GoK, 2017).

d. NDC Target for the Forestry Sector

The proportionate emission reduction contributions required from the forestry sector to meet the NDC overall target was estimated in Table 2.2 (Chapter 2) as 20.1 MtCO₂e, against a sector baseline emission level of 22 MtCO₂e and a total sector emission reduction potential of 40.2 MtCO₂e per year by 2030. The NDC Sector Analysis Report 2017 determined a reasonable low (minimum) GHG emission target reduction for the forestry sector as 11.1 MtCO₂e per year, and a high target for GHG emission reduction of 20.1 MtCO₂e (Figure 3.3.3). Both the low and high

targets for the sector are very high (51% and 915 of the total sector emission in 2030) reduction potentials of the sector because of the unique position of the forestry sector in creating net sinks of carbon when, for example, new forests are planted. It is possible for emission reductions to exceed baseline emissions as identified by the maximum technical potential of 40.2 MtCO₂e in NCCAP 2013-2017. Emission reductions in the forestry sector are attractive because of the relatively low cost of creating these carbon sinks, compared to actions in other sectors.⁵⁰



e. Mitigation Actions Identified in Kenya's Second National Communication and the NDC Sector Analysis (2017)

In both NCCAP 2013-2017 and SNC, the following three mitigation actions were analysed and prioritised for implementation:

- Restoration of 960,000 hectares of forests on degraded lands, with an average annual sequestration rate of 33.9 tCO₂e per hectare between 2015 and 2030, leading to the abatement of 2.2 MtCO₂e in 2015 and 32.6 MtCO₂e in 2030;
- Reforestation of degraded forests by reforesting 240,000 hectares of degraded forests between 2015 and 2030, at an average annual sequestration rate of 25.2 tCO₂e per hectares. This would lead to 0.4 Mt CO₂e in 2015, rising to 6.1 MtCO₂e in 2030; and

- Reducing deforestation and forest degradation on about 63,000 hectares of forest by 2030, which, after allowing for leakage and potential increase in agroforestry and plantations, was estimated at 75% of the total sequestered carbon. The average abatement potential was based on the average above-ground carbon density of Kenyan forests of 95.4 tCO₂ converted to other land uses, based on FAO data.⁵¹ Consequently, about 0.1 MtCO₂e would be abated in 2015, rising to 1.6 MtCO₂e in 2030.

Based on the above three priority mitigation options, the technical mitigation potential of the forestry sector was further assessed in the NDC Sector Analysis Report, with the results as illustrated in Figure 3.18.



Figure 3.18: Technical potential emission reductions (MtCO₂e) in 2030 of mitigation options (NDC Sector Analysis 2017) (GoK, 2017).

f. Proposed Mitigation Actions for the NCCAP 2018-2022 in the Forestry Sector

The following three mitigation actions were proposed for assessment and analysis for the forestry sector before their prioritisation for inclusion in NCCAP 2018-2022 as shown in Table 3.27. These actions were proposed by stakeholders in the forestry sector, led by KFS,

with further consultations among members of the Mitigation Thematic Working Group.

- Reduce deforestation and forest degradation by rehabilitation and protection of an additional 100,000

- hectares of natural forests (including mangroves) by 2022;
- Afforestation/reforestation/agroforestry of additional 100,000 hectares of land by 2022;
 - Restoration of 200,000 hectares of forest on degraded landscapes (ASALs, rangelands) by 2022;
 - Increasing the area under private sector-based commercial and industrial plantations from 71,000 hectares to at least 121,000 hectares; and
 - Three forest resources efficiently utilised in all counties, especially dryland forests, by 2022.

The first three options are the same as those previously assessed and analysed under NCCAP 2013-2017, SNC and the NDC Sector Analysis. However, the proposed implementation scales slightly vary from those previously considered. The consultations conducted during the NCCAP (2018-2022) development process have not been as extensive and detailed as those conducted during the NCCAP (2013-2017) development process, and the subsequent NDC Sector Analysis (2017). Therefore, for the mitigation analysis of the prioritised actions, the values, information, and assumptions made during the two earlier analyses have been applied; the latest being the NDC Sector Analysis Report (2017). Adjustments have been made to compensate for the scale of the proposed actions

g. Reduce deforestation and forest degradation by rehabilitation and protection of additional 100,000 hectares of natural forests (including mangroves) by 2022

This action is similar to the action ‘Reducing Deforestation and Forest Degradation’ that was prioritised and analysed in the NDC Sector Analysis 2017. The action is a component of the REDD+ programme, and includes measures to reduce emissions from deforestation and forest degradation, relative to a pre-determined reference case or BAU scenario. In the NDC Sector Analysis (2017), it is reported that increasing Kenya’s forest cover to 10% would also entail halting and eventually reversing deforestation and forest degradation, such that net forestation would increase.

There is considerable uncertainty in the historic rate of deforestation. FAO data of 2010 indicates that the historic deforestation rate between 1990 and 2010 was approximately 12,000 hectares per year.⁵² The most recent FAO Global Forest Resources Assessment in 2015 indicates that the deforestation rate of Natural Forests was approximately 26,000 hectares per year over the same 20-year period, but the total area of Natural

Forest actually increased between 2000 and 2010. Reducing deforestation and forest degradation on about 100,000 hectares of natural forest by 2030, which, after allowing for leakage and potential increase in agroforestry and plantations, was estimated at 75% of the total sequestered carbon. The average abatement potential was based on the average above-ground carbon density of Kenyan forests of 95.4 tCO₂ converted to other land uses, based on FAO data.⁵³ Consequently, about 2.0 MtCO₂e would be abated in 2030.

Other actions that contribute to reduction in deforestation and forest degradation, such as sustainable charcoal production, and efficient biomass cookstoves, have been discussed under the industry and energy sectors, respectively. Agroforestry is covered under both forestry and agriculture sectors, and has also been included in the energy sector to the extent that fuel trees are involved.

h. Afforestation/reforestation/agroforestry of additional 100,000 Ha of land by 202

This action involves planting trees on lands that have been severely degraded, and is the same as the; 'Rehabilitation of Degraded Forests' action that had been previously planned. The action includes work on lands that do not strictly meet the definition of forest because they have fallen below a threshold of tree cover or biomass density. These degraded forests are characterised by significantly diminished tree cover and inhibited natural regeneration. This action also includes planting trees in farmlands through agroforestry practices.

In NCCAP (2013-2017), it was assumed that 20% of net increase in forest cover would be achieved through rehabilitation. This meant that 240,000 hectares would be replanted over a period of fifteen years, or approximately 16,000 hectares per year between 2015 and 2030. Achievement of the Bonn Challenge target of

planting of trees on 410,000 hectares of formerly forested land would exceed the NDC target.

The proposed action, targeting replanting of 100,000 hectares of additional land over the 5-year period means, planting, on average, 20,000 hectares per year between 2018 and 2022. This target is slightly more ambitious than the previous target. Therefore, if this could be the adopted rate for the next 12 years to 2030, an additional 240,000 hectares would be planted over the period

At an average annual sequestration rate of 25.2 tCO₂e per hectare between 2015 and 2030 (15 years),⁵⁴ reforestation of degraded forests by reforesting 100,000 hectares of degraded forests between 2015 and 2030 would be required. This would lead to 0.8 Mt CO₂e in 2018, rising to 2.0 Mt CO₂e in 2030. With 240,000 hectares planted over the 12-year period (2018 to 2030), 4.8 Mt CO₂e would be sequestered by 2030.



i. Restoration of 200,000 ha of forest on degraded landscapes (ASALs, rangelands) by 2022

This action targets degraded lands of all types of land uses, including grazing lands, bushland, woodland, and forest, where previously established tree cover has been reduced and degraded by excessive harvesting of wood and non-wood products, poor management, repeated fires, grazing, or other disturbances that damage soil and vegetation to a degree that inhibits or severely delays the re-establishment of forests.

NCCAP(2013-2017) assumed that half of the 10% tree cover would be achieved by 2030 through 'Restoration of forests on degraded lands', resulting in the establishment of 1.2 million hectares of forest to be restored over 15 years, an average of 80,000 hectares per year over the period.

Consultations with KFS experts established that 80% of this amount, or approximately 960,000 hectares, could be attained through enhanced natural regeneration of degraded lands, by conservation and sustainable management over the period 2015 to 2030, whereas the other 20% could be attained through tree planting.

This action had the GHG abatement potential of about 32.6 MtCO₂e per year by 2030.

For NCCAP (2018-2022) however, restoration of 200,000 hectares through this action over the next 5 years (2018 to 2022) has been proposed. This is an average of 40,000 hectares to be restored per year over the period. If this rate of restoration is sustained for the next 12 years (2018 to 2030), a total of 480,000 hectares would be restored by 2030. This is significantly less than the 1.2 million hectares that was assumed in previous analyses. Restoration of 200,000 hectares of forests on degraded lands will have an average annual sequestration rate of 33.9 tCO₂e per hectare between 2015 and 2030,⁵⁵ abatement 0.9 MtCO₂e in 2018, and 5.4 MtCO₂e in 2030. If the same rate of restoration (40,000 hectares per year) is maintained to the year 2030, over the 2018-2030 12-year period, 480,000 hectares of forest would be restored. This would result in the abatement of 13.0 tCO₂e by 2030.

g. Other Proposed Actions

Stakeholders in the forestry sector proposed the following two additional actions:

- Increasing the area under private sector-based commercial and industrial plantations from 71,000 hectares to at least 121,000 hectares; and
- Three forest resources efficiently utilised in all counties, especially dryland forests, by 2022.

The action to increase the area under private sector-based commercial and industrial plantations from 71,000 hectares to at least

121,000 hectares would result in an additional 50,000 hectares of plantation forest. At an average annual sequestration rate of 25.2 tCO₂e per hectare between 2015 and 2030 (15 years),⁵⁶ this would lead to an abatement of about 1.0 MtCO₂e by 2030.

Efficient utilisation of firewood and charcoal have already been accounted for in the energy sector (through improved cookstoves) and industry sector (through implementation of the NAMA for the Charcoal Sector in Kenya). To avoid double counting, the emission reductions have therefore not been considered here.

Table 3.27: Priority mitigation actions in the forestry sector for the period 2018-2022.

Strategic Objective 3.27: To increase tree cover to 10% of the total land cover				
Issue/Problem: Increasing GHG emissions from deforestation and degradation of forest ecosystems and other landscapes				
Opportunity	Actions	Sector	Mitigation	SDG
REDD+ Initiative, Community Forest Associations, Participatory Forest Management Plans	<p>Reduce deforestation and forest degradation by rehabilitating and protecting an additional 100,000 hectares of natural forests (including mangroves) by 2022</p> <ul style="list-style-type: none"> • Community/participatory forestry management; • Limiting access to forests; • Preventing disturbances through improved enforcement and monitoring; • Developing alternative technologies to reduce demand for biomass (e.g., clean cooking and efficient charcoal production); • Carbon stock enhancement (tree planting) in existing forests; and • Financial innovations, including payments through REDD+ / carbon markets. 	MEF, KFS, KEFRI, CoG, County Governments, Community Forestry Association (CFAs), Private Sector, NGOs	Mitigation	1,7,1 5, 13, 6
Afforestation/reforestation/agroforestry potential in the counties	<p>Support afforestation and reforestation in Counties, with the aim of planting one million trees per County per year.</p> <ul style="list-style-type: none"> • Institute an annual National Tree Planting Day; • Implement the National Mangrove Ecosystem Management Plan; • Revive Green Schools Programme, ie., 10% of school land areas planted with trees; • Increase tree nurseries and, the production and availability of tree seedlings; • Tree planting; • Expand and protect mangrove forest cover (for coastal adaptation and blue carbon sequestration); • Promote trees on farms; • Forest management and planning; • Silviculture interventions; and • Promote tree-planting on farms. 	MEF-KFS, MAI, KEFRI, CoG, County Governments, Farmers, Community Institutions, Private sector	Mitigation	7,9,1 2,13, 15
African Forest Landscape Restoration Initiatives	<p>Restoration of up to 200,000 hectares of forest on degraded landscapes (ASALs, rangelands)</p> <ul style="list-style-type: none"> • GCF Dryland Resilience Project: 	MEF-KFS, MAI, NDMA, KEFRI, National Treasury,		1,7,8, 9

	<ul style="list-style-type: none"> - Enhanced natural generation of degraded lands through conservation and sustainable management; - Ecosystem-based adaptation through rangeland and forest landscape restoration and sustainable management (sites include rangelands, woodlands/forests, wetlands, and croplands); and - Process to initiative restoration processes on 33% of land area in 7 counties. • AFR100 commitment in 2016 to restore 5.1 million hectares: <ul style="list-style-type: none"> - Analysis of priority landscapes, and existing restoration successes; - Economic analysis of available restoration options; and - Identification of financing options to scale up landscape restoration. 	Frontier Counties Development Council, 7 ASAL County Governments, IUCN, FAO, UNEP, Greenbelt Movement, Community institutions		
Encourage sustainable timber production on privately-owned land	<p>Increase area under private sector-based commercial and industrial plantations from 71,000 hectares to at least 121,000 hectares</p> <ul style="list-style-type: none"> • Establish standards and regulations for sustainable forestry management (starting with voluntary, and moving to regulated) 	KEPSA, KAM, Private Sector (Tea Industry, Kenya Commercial Bank, Green Pot Timsales, Rai Ply, Kakuzi, LaFarge, East Africa Breweries)	Mitigation	1,7,8, 9
Increase efficiency of use of forest products <i>Linked to energy efficiency improvement (Energy and Industry Sectors)</i>	<p>Three forest resources efficiently utilised in all counties, especially the dryland forests, by 2022</p> <ul style="list-style-type: none"> ▪ The three areas of focus are timber, charcoal, and firewood <p><i>(establish the current number of forest resources, and number of forest resources efficiently utilised [determine the metric])</i></p>	MEF-KFS KEFRI CoG County Governments	Mitigation	
Enabling action (capacity development and technology)	MRV technologies, including remote sensing and global positioning systems, and computer tagging and tracking systems	MEF-KFS	Enabling	

The mitigation options and their potential are summarised in Table 3.28.

Table 3.28: Potential emission reduction of the prioritised actions in the forestry sector (MtCO₂e per year).

Options	GHG Emission Reduction Potential by 2030 (MtCO ₂ e)	
	Action up to 2022	Action up to 2030
Reduce deforestation and forest degradation by rehabilitating and protecting an additional 100,000 hectares of natural forests (including mangroves) by 2022	2	2
Afforestation/reforestation/agroforestry of an additional 100,000 hectares of land by 2022	2	4.8
Restoration of 200,000 hectares of forest on degraded landscapes (ASALs, rangelands) by 2022	5.4	13
Increase area under private sector-based commercial and industrial plantations from 71,000 hectares to at least 121,000 hectares	1	1
Total Emission Reduction Potential in 2030	10.4	20.8

From analysis of the four options, the proposed actions in the forestry sector, if implemented only up to 2022, will not be able to deliver the low range emission reduction target required for the sector. However, if the actions are continued at the same rate up to 2030, the abatement potential meets the high range of the emission reductions target of 20.1 MtCO₂e per year in 2030. Because the forestry sector offers one of

the cheapest options to achieve the NDC target, it is advisable that the targeted areas for all the actions be reviewed with a view to setting more ambitious targets. In this way, the Government will be able to meet the NDC mitigation target even if other sectors, like agriculture, are not able to achieve their sectoral targets.

3.3.3 Enablers

a. Technology

The required mitigation technologies and initiatives for the forestry sector are summarised in Table 3.29.

Table 3.29: Key mitigation technologies and initiatives in the LULUCF sector.

Mitigation Option	Key Technologies Required
Restoration of forests on degraded lands	Community forestry programmes, research into degraded lands and appropriate conservation techniques and, forest management and planning, protection and conservation programmes.
Rehabilitation of degraded forests	Tree nurseries and production of tree seedlings, tree planting, tree genetics, forest management and planning, and silvicultural interventions.
Reducing deforestation and forest degradation	Technologies for community monitoring, forest management tools, development of alternatives to reduce demand for fuel wood, financial innovations, including payments through carbon markets.
Enabling actions	MRV technologies, including remote sensing and global positioning systems, computer tagging and tracking systems).

The details of the technologies were provided in the NDC Sector Analysis Report 2017.

Actions to ensure effective restoration of forests on existing degraded lands in Kenya will accelerate natural processes by removing or reducing such barriers to natural forest regeneration as soil degradation, competition with weedy species, and reducing disturbance from grazing, wood harvesting, and fire. Actions include protection and conservation actions, including limiting or prohibiting access to forests; community management programmes; and preventing disturbances through enforcement and monitoring. Forest restoration and sustainable enhancement of forest carbon stocks through sustainable forest management or conservation could fall within the “plus” scope of REDD+ and be part of the government’s REDD+ strategy.

b. Capacity Building

To improve data quality and monitoring capacity in the sector, it will be necessary to train staff in order to enhance their ability to measure, report on, and verify (MRV) the

c. Finance and Budgets

The following are some of the known financial requirements of the proposed actions in the forestry sector:

- USD 5.65 million for implementation of the National Mangrove Ecosystem Management Plan;⁵⁷
- Restoration of forests on degraded lands USD 2.2 - 3.4 billion over the period 2017

Rehabilitation of degraded forests involves planting seedlings over an area of land where the forest has been harvested or damaged by fire, disease, or human activity. Tree planting, if performed properly, could result in the successful regeneration of a deforested area. Plantations established through afforestation or reforestation could effectively sequester carbon. Agroforestry or initiatives to plant trees on farms are considered in the NDC agriculture analysis. Clean Development Mechanism (CDM) projects under the “Afforestation and Reforestation” category were restricted to include actions to replant trees, particularly commercial or indigenous tree species, on areas of land that had no forest cover since 1990.

actions and achievements of forestry projects. This includes improving the knowledge and understanding of carbon biomass stocks in Kenya.

to 2030. (0.8-1.3 billion USD by 2022 (NCCAP); and

- Reforestation of degraded forests (USD 0.56 - 0.71 billion) to 2030. (0.2-0.27 billion USD by 2022).



3.4: Industry Sector

3.4.1 Overview

Kenya's primary industrial sector comprises of manufacturing, construction, mining, and quarrying, among others, as the key sub-sectors. Although Kenya is the most industrially developed country in the East Africa region, manufacturing still accounted for only 14% of its GDP in 2017.⁵⁸ The industrial sector is critical to achieving Vision 2030 goal of transforming Kenya into "a newly-industrialising, middle-income country, providing a high quality of life by 2030."⁵⁹ Kenya's Industrial Transformation Programme seeks to revitalise the sector and turn Kenya into an industrial hub.⁶⁰ Industrialisation has been the modernising force in every developed and emerging economy, and this is likely to be the case for Kenya, with industry acting as the bedrock upon which the country will grow GDP, while growing incomes. The development of renewable energy technologies represents a major opportunity for "Growth of green industry in manufacturing" in Kenya. This could be a major sector of industrial growth in Kenya if it could position itself to be a regional technology hub, whilst in the same regard it could also be a significant missed opportunity if not pursued.

The country has economically viable quantities of coal, iron ore, fluorspar, titanium, gypsum, limestone, soapstone, gemstones, soda ash, diatomite, lead, gold, silicon oxide, and marble. Recent discoveries of oil, gas, and rare earth minerals suggest that these will be potentially important resources for Kenya going forward. There has been little exploitation of these resources, and development of the mining and quarrying sector is expected to support such resource-based industries as iron and steel industries, cement industries, building and construction, chemical industries, and ornamental industries, among others. The oil, coal, and other mineral resources sub-sectors have been identified as additional priority sub-sectors under the Economic Pillar of Vision 2030. Development and decisions in the sub-sectors are expected to impact the future profile of industrial sector GHG emissions.

GHG emissions in the industrial sector include both process-related emissions involving

chemical and/or physical change of inputs, and production and use of hydrofluorocarbons (HFCs). The sub-sectors of importance, with regard to GHG emissions in Kenya, include mineral products, pulp and paper, food and beverage, and consumption of HFCs. Other industrial process sub-sectors, like chemical industry, and metal production, were determined to have no significant production activities leading to GHG emissions.⁶¹ Direct GHG emissions of carbon dioxide are a result of cement production, lime production, and soda ash production. HFC emissions are related to the import of HFCs into Kenya through products and bulk imports.

Cement manufacturing, which is the leading emitter of GHGs in the industrial sector in Kenya,⁶² is identified as a core industrial sub-sector, given the growing demand for cement from within Kenya and from neighbouring countries. Another major emitter in the industry sector is the charcoal manufacturing sub-sector, which still operates informally despite its key role in Kenya's energy sector. Charcoal manufacturing is an important part of the Kenyan economy, but the wood-fuel sector is systematically neglected in formal economic analyses, due to its informal nature.

Kenya's industrial sector (excluding direct fuel combustion) contributed 3.8 % (3 MtCO₂e per year) of total national GHG emissions (80 MtCO₂e per year) in 2015.⁶³ These emissions are projected to increase to 4.2% (6 MtCO₂e per year) by 2030.⁶⁴ This is because of the significantly larger contributions by the LULUCF sector, energy, and agriculture sectors, and the fact that Kenya produces insignificant amounts of industrial gases like perfluorocarbons and hydrofluorocarbons, that have high global warming potentials (5,000 to 10,000 times the global warming potential of CO₂).

With direct fuel combustion emissions included, the absolute emissions from Kenya's industry sector are projected to grow from 5.4 MtCO₂e in 2015 to 9.9 MtCO₂e in 2030, with their proportion to the total national emissions remaining constant at around 7% through the period.⁶⁵

In the NDC Sector Analysis 2017, the following three mitigation actions were prioritised:

- Improved charcoal production, with a mitigation potential of about 1.6 MtCO₂e per year by 2030;
- Cement energy efficiency improvement, with a mitigation potential of about 0.2 MtCO₂e per year by 2030; and
- Industrial energy efficiency improvement, with a mitigation potential of about 1.1 MtCO₂e per year by 2030.

In this MTAR, the three mitigation options have been reassessed and analysed together with the other options that were presented by the industry sector representatives. The analysis has prioritised the following mitigation actions for implementation in NCCAP 2018-222:

- Implementation of the NAMA for the charcoal sector in Kenya, with a mitigation potential of 5 MtCO₂e per year by 2030; and

3.4.2 Mitigation Actions in the Industry Sector

The emissions baseline for the industrial processes sector is aligned with the sector definitions of the Intergovernmental Panel on Climate Change (IPCC) for Industrial Processes and Product Use (IPPU). These definitions cover GHG emissions occurring from industrial processes from the use of GHGs in products and from non-energy use of fossil fuel carbon. One exception to this alignment is that charcoal production from the partial combustion of fuelwood is included as an industrial process, while in the IPCC Guidelines it is included in the energy sector along with charcoal consumption.

With the envisaged accelerated industrialisation,⁶⁶ GHG emissions are expected to increase under the BAU scenario, unless Kenya makes deliberate efforts and plans to identify and take the low carbon development pathway in its industrialisation programme. Cement manufacture, which is the leading emitter of GHGs in the industrial sector in Kenya⁹⁸, is identified as a core industrial sub-sector, with a growing demand for cement from within Kenya and from neighbouring countries. There are two aspects of cement production that

- Improvement in industrial energy efficiency, with a mitigation potential of about 1.1 MtCO₂e per year by 2030.

Implementation of cement energy efficiency improvement, a mitigation potential of about 0.2 MtCO₂e per year by 2030, has been considered unrealistic, for having insignificant mitigation result, while the industrial symbiosis action has been proposed for inclusion in the Solid Waste NAMA, which is already prioritised for implementation in NCCAP 2018-2022 in the waste sector.

Although industrial energy efficiency improvement and cement energy efficiency improvement have been included in this section as potential mitigation actions, the mitigation benefits should not be counted as additional, since these have been accounted for in the energy sector actions. Their inclusion here is purely to create visibility of these options for the manufacturing sub-sector whose members are expected to lead their implementation.

result in emissions of GHG emissions in form of carbon dioxide. The first is the chemical reaction involved in the production of the main component of cement, clinker, as carbonates (largely limestone) are decomposed into oxides (largely lime) and carbon dioxide by the addition of heat.

The second source of emissions is the combustion of fossil fuels to generate the energy required to heat the raw ingredients to well over 1,000 °C. Some of the cement manufacturers in Kenya have been using coal to fire their kilns as a way of managing the escalating fuel costs, a practice which increases GHG emissions from the sector. Process emissions from cement manufacturing could be reduced by replacing clinker in the cement mix with such alternative materials as Pozzolana. These process or industry, and their associated energy emissions are most often reported separately in GHG emissions inventories, with the combustion emissions going to the energy sector. However, in the NDC Sector Analysis 2017, the energy emissions were included in the industry sector emissions, basically because the expected mitigation actions would be implemented

mostly by the cement manufacturers.

Another major emitter in the industry sector is the charcoal manufacturing sub-sector, which still operates informally mainly using traditional inefficient technologies. Current legislation in Kenya has legalised sustainable charcoal production, and efforts are underway by the government to implement this legislation.⁶⁷ Although charcoal manufacturing is an

important part of the Kenyan economy, the wood-fuel sector is systematically neglected in formal economic analyses, due to its informal nature. Emissions in the charcoal sub-sector could be reduced by using sustainably sourced biomass feedstock, improved kilns, and efficient cookstoves, an approach that is the basis of the NAMA for the charcoal sector in Kenya.

a. Baseline

According to NCCAP 2013-2017 and SNC, where only the industrial processes were considered under the industry sector emissions, charcoal production biomass feedstock was assumed to be 100% renewable, the industry sector emissions in the BAU scenario were projected to double from 3 MtCO₂e (3.8% of the total national

GHG emissions) in 2015 to 5.5 MtCO₂e (3.8% of the total national GHG emissions) in 2030 (Figure 3.19 and Table 2.1). Cement manufacture was identified as the largest industrial process that contributes nearly 80% industry sector emissions between 2010 and 2030.

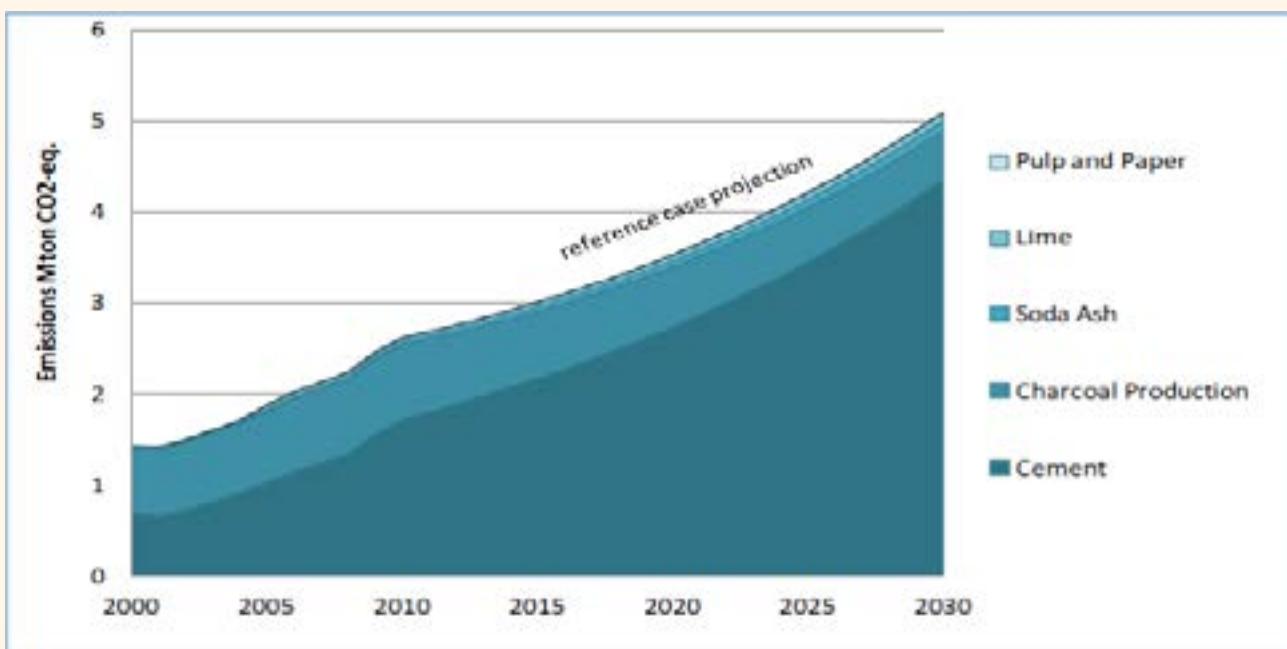


Figure 3.19: Industry sector baseline emission projection for Kenya (MtCO₂e) (GoK, 2013).

If carbon emissions from the use of unsustainably harvested biomass (assumed to be 35% of total biomass usage) were considered, emissions from charcoal production would be substantially larger as shown in Figure 3.20. These emissions are usually accounted for in the LULUCF sector. However, in this MTAR, the emissions have been discussed under industry sector to facilitate the assessment of the option to implement the NAMA for the charcoal sector in Kenya.

In the BAU scenario of NCCAP 2013-2017 and SNC, it was assumed that all the charcoal was produced using traditional earth mound kilns, which generally have a low efficiency of 10-22%. Charcoal production emits CO₂ and CH₄ from incomplete combustion of biomass. More efficient carbonisation technologies or kilns reuse these gasses in the carbonisation process hence have lower emissions.

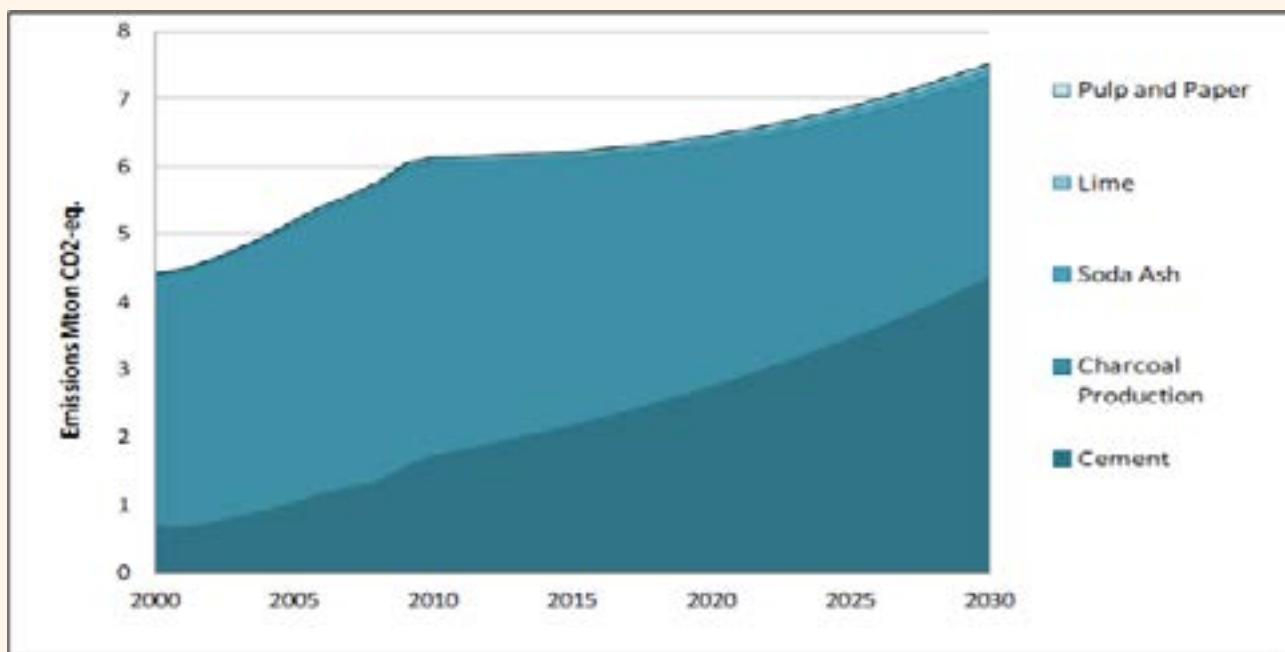


Figure 3.20: Industry sector baseline emission projection for Kenya, including 35% non-renewable biomass for carbon production (MtCO₂e) (GoK, 2013).

In the NDC Sector Analysis Report of 2017, the baseline industry sector GHG emissions, including emissions from energy used by the industry sector, were estimated at 5.4 MtCO₂e (6.8% of the total national GHG emissions) in 2015. This was projected to increase to 9.9 MtCO₂e (6.9% of the total national GHG emissions) by

2030 (See Figure 3.21). In the analysis, the fuel combustion emissions associated with the industry sector, which is already accounted for in the energy sector were included because implementation of the mitigation options, would focus on the manufacturing sector.

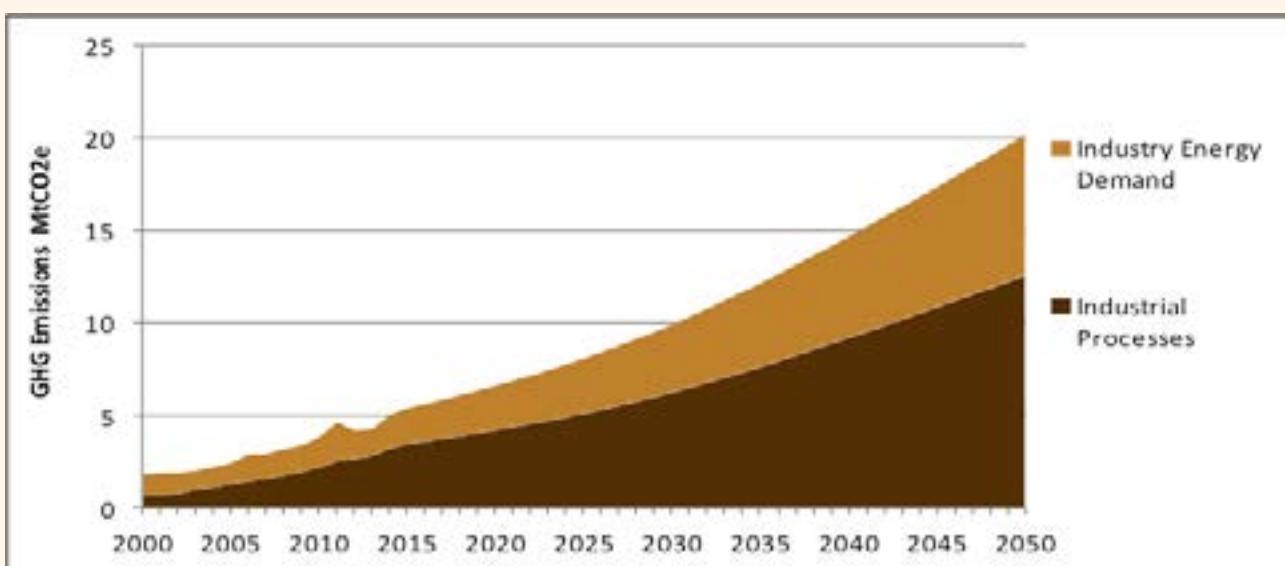


Figure 3.21: Industry sector baseline emission projection for Kenya, including fuel combustion emissions (MtCO₂e) (GoK, 2017).

b. NDC Target for the Industry Sector

The proportionate emission reduction contributions required from the industry sector to meet the NDC overall target was estimated in Table 2.2) as 0.78 MtCO₂e, against a sector baseline emission level of 5.5 MtCO₂e, and an emission reduction potential of 1.6 MtCO₂e per year by 2030. This did not include industry sector fuel combustion emissions, which were included in the energy sector emissions. In

the NDC Sector Analysis Report of 2017, and with the fuel combustion emissions included, the total baseline emissions were estimated to be 9.9 MtCO₂e per year by 2030. The NDC Sector Analysis Report 2017 determined a low (minimum) GHG emission target reduction for the industry sector as 1.0 MtCO₂e per year and a high target for GHG emission reduction of 1.3 MtCO₂e (See Figure 3.22).¹³⁶

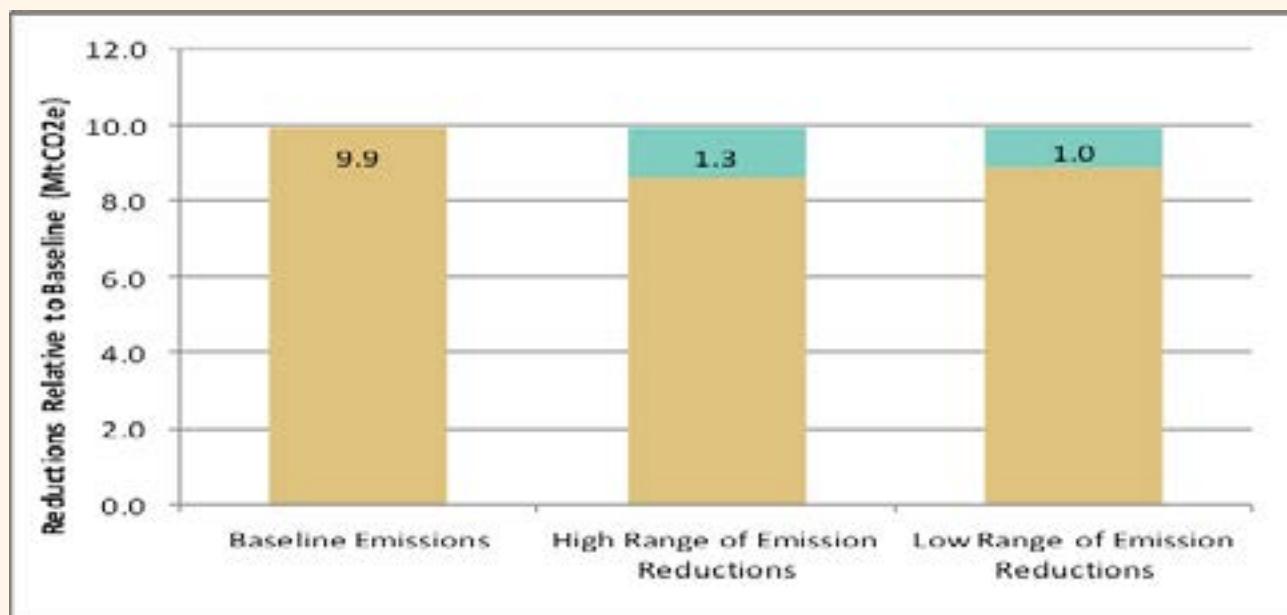


Figure 3.22: Comparison of baseline GHG emissions (including industry sector energy emissions) and the NDC target emission reductions (MtCO₂e) (GoK, 2017).

In this MTAR, it has been regarded more effective and practical to consider the implementation of a mitigation option that covers the whole charcoal supply chain from biomass feedstock production, kiln efficiency improvement, and adoption of

efficient cookstoves. It is however important that the reporting of emissions is aligned with the sector definitions of the Intergovernmental Panel on Climate Change (IPCC) for the six sectors with regard to inventory reporting.

c. Mitigation Actions Identified in Kenya's Second National Communication

In NCCAP2013-2017andSNC,onlyonemitigation action, which is improved charcoal production with the mitigation potential of 1.56 MtCO₂e by 2030, was proposed and analysed for the industry sector (See Figure 3.23 and Table 3.30).

This action was based on the introduction of more efficient kilns for charcoal production, assuming that the BAU emissions could be reduced by 75% through the use of more efficient charcoal kilns (50% adoption by 2030) compared to the traditional earth mound charcoal kilns. This would be mostly through policy interventions

promoting the use of efficient kilns. The mitigation option regarding improved charcoal production considers a shift from the use of traditional earth mound kilns, which generally have an efficiency of 10% to 22% (calculated using oven-dry wood with zero percent water content) to increased use of improved charcoal production systems (ICPS) using retort kilns with an efficiency of approximately 30% to 42%.⁶⁸ This mitigation opportunity still exists and was the basis of the NAMA for the Charcoal Sector in Kenya Proposal thatwasdevelopedin2016, butwithawiderscope.

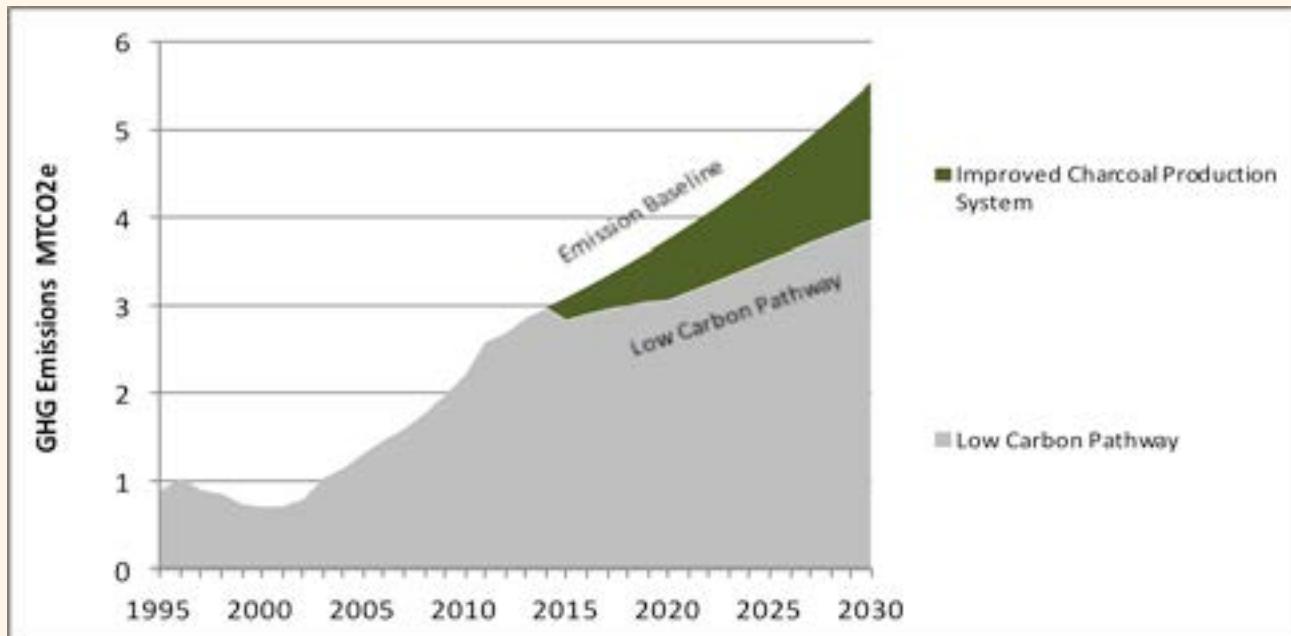


Figure 3.23: NCCAP 2013-2017 mitigation options and their technical potential emission reductions in 2030 (GoK, 2017).

Table 3.30: Projected emission reductions (MtCO₂e) from improved charcoal production (GoK, 2017).

	Emission Reductions (MtCO ₂ e)			
	2015	2020	2025	2030
Improved Charcoal Production System	0.26	0.69	1.03	1.56

The NDC Analysis Report 2017, on the other hand analysed mitigation options addressing two types of GHG emissions. The first type being industrial process-related emissions and the other type being industry sector energy-related emissions. In Kenya, industrial process emissions are dominated by charcoal and cement manufacturing, but no mitigation

options exist in the cement manufacturing process as all the existing and new plants would already be optimised with respect to Pozzolana blending.⁶⁹ However, significant mitigation opportunities, estimated at 1.56 MtCO₂e by 2030, exist with respect to charcoal production-related emissions (See Figure 3.24).

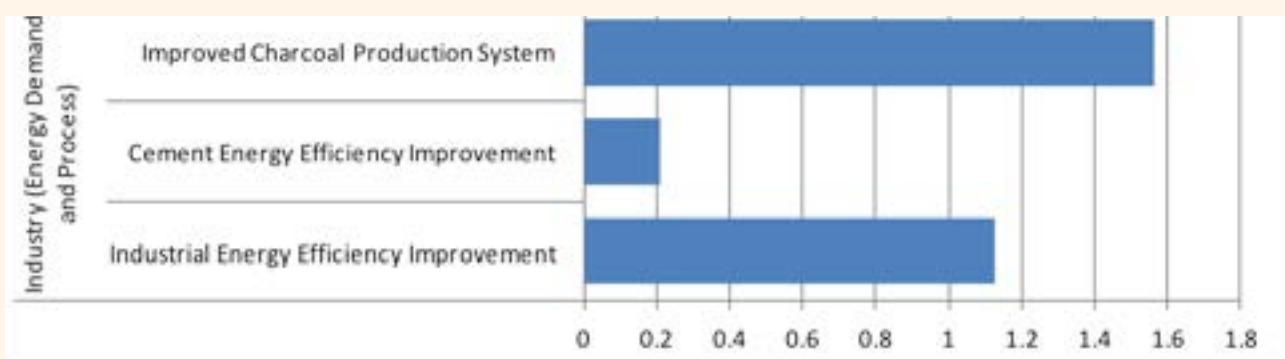


Figure 3.24: Estimated technical potential emission reductions in 2030 (GoK, 2017).

Improvements in energy efficiency cover mitigation actions that improve industrial energy efficiency (fuel-combustion and electrical energy). In the NDC Sector Analysis Report 2017, the energy efficiency improvement actions for the cement sector were separately analysed from those of the rest of industry sector. In the cement industry, which is the highest emitting industry in Kenya, about 40% of emissions are direct energy-related emissions from fossil fuel combustion for calcination and 5 to 10% are indirect energy-related emissions from electricity consumption used to power machinery.⁷⁰ A 10% improvement in total energy efficiency through equipment improvements in the cement sub-sector by 2030 was assumed in the analysis.

In view of the recent trend in the Kenyan cement sector, which shows that coal is the preferred fuel substitute, and considering that Kenya is expected to mine its own coal soon, emission reductions through efficiency improvements relative to the baseline do not look realistic for the cement sub-sector. It is recognised that some effort will be made by the cement sector to improve energy efficiency, the related emission reductions would be insignificant,

hence this action has not been analysed further for prioritisation in NCCAP 2018-2022.

On the other hand, the industrial energy efficiency mitigation option that assumed a 15% energy efficiency improvement by 2030, is realistic and feasible. The industrial and commercial sector in Kenya is dominated by small and medium enterprises, which use a wide range of equipment and appliances with varying degrees of mitigation options. The upfront costs are often a barrier to adoption of the energy efficient technologies.

In the following section, both process-related emissions for charcoal production and energy related-emissions for the industry have been analysed and prioritised for inclusion in NCCAP 2018-2022. However, it should be noted that while implementation of these two options would be in the industry sector, the emission reductions associated with improvements in industrial energy efficiency would be accounted for in the energy sector, while those associated with the use of renewable biomass for charcoal production would be accounted for in the LULUCF sector in order to avoid double counting.

d. Proposed Mitigation Actions for NCCAP 2018-2022 in the Industry Sector

The mitigation actions proposed in the industry sector for the 2018-2022 period are shown in Table 3.31. These actions were proposed by stakeholders in the industry sector, led by KAM. The actions address improvement in energy efficiency.

The following options for low carbon development have been analysed for prioritisation in NCCAP 2018-2022. The options are of the following broad types:

- Actions that address industrial process-related emissions:
 - NAMA for the charcoal sector in Kenya; and
 - Optimised cement production to reduce GHG emissions from clinker production.

- Actions that address energy used in the industry sector and waste generated from the sector:

- Improving industrial efficiency through energy audits and energy standards;
- Improved waste recycling and re-use through industrial symbiosis; and
- Use of sustainable energy resources for industrial heating.

- Industrial symbiosis:

- Set up waste exchange clearance centres in all Special Economic Zone (SEZ) by 2022 (This action should be made part of the implementation of the Solid Waste NAMA in the Waste Sector);

- Undertake a baseline survey of all SEZs and Industrial Parks (IPs) by 2022;
- Set up a waste and bye-product exchange database for match making;
- Set up common waste management facilities for all SEZ (effluent Treatment Plants) by 2022; and

- Establish infrastructure for waste recovery, reuse and recycling to create 20,000 decent green jobs by 2022 (5% of jobs created under four sectors: leather, textiles and apparel, fish and agro-processing).

These options are analysed in detail in Table 3.31.

Table 3.31: Priority mitigation actions in the industry sector for the period 2018-2022.

Strategic Objective 3.4: Promote/encourage the growth of green industry, to drive jobs in the manufacturing sector				
Issue/Problem: Inefficient use of green resources				
Opportunity	Actions	Sector	Mitigation	SDG
Energy efficiency	<ul style="list-style-type: none"> • Increase the number of companies participating in energy efficiency initiatives by 1,000, and increase the number of energy audits by 1,000 by 2022; • Develop Minimum Energy Performance Standards (MEPS) for 5 more appliances, and upscale the existing testing facilities to include these 5 appliances 	Ministry of Industry, Trade and Cooperatives (MITC), KIRDI, Kenya Bureau of Standards (KEBS), KAM, KIRDI, Private Sector (Industrialists)	Mitigation and Enabler	9,12,13
Industrial symbiosis.	<ul style="list-style-type: none"> • Set up waste exchange clearance centres in all Special Economic Zone (SEZ) by 2022 (This action should be made part of the implementation of the Solid Waste NAMA in the Waste Sector) <ul style="list-style-type: none"> - Undertake a baseline survey of all SEZs and Industrial Parks (IPs) by 2022 - Set up a Waste and Bye-product Exchange database for match making. • Set up common waste management facilities for all SEZ (effluent Treatment Plants) by 2022. • Establish infrastructure for waste recovery, reuse and recycling to create 20,000 decent green jobs by 2022 (5% of jobs created under four sectors: leather, textiles and apparel, fish and agro-processing) 	MITC, KIRDI, KAM, KIRDI, Private Sector (Industrialists), KEPSEA, County Governments	mitigation	9,12,13, 17
Industrial process improvements and optimization	<ul style="list-style-type: none"> • Implement the NAMA for the Charcoal Sector in Kenya. (Linked to the forestry sector mitigation actions) • Introduce process improvements and energy efficiency in the cement sector (Energy efficiency already covered in the energy sector) • Increase number of entities adopting environmentally sound technologies by 50% by 2022 • Promote sustainable energy sources for industrial heating processes (Under energy sector) 	KFS, MITC, KEBS, KIRDI, KAM, KEPSEA, Farmers, KEFRI, Charcoal producers, Cement manufacturers, County Governments, Police, MEF, Private Sector	Mitigation	9,13,17,
Eco- innovation for productivity and competitiveness	<ul style="list-style-type: none"> • Strengthen academia- industry- government- civil society (quadruple helix) collaboration to boost research and innovation for productivity and competitiveness, and attract funding opportunities. 	MITC, KIRDI, KAM, KEPSEA, Private sector, Academia, Civil society	Capacity building	9,12,13, 17

e. Actions that Address Industrial Process-Related Emissions

Implementation of the NAMA for the Charcoal Sector in Kenya

The aim of developing a NAMA for charcoal sector in Kenya was to trigger a low-carbon development, toward minimising the impact of the current charcoal value chain, while acting on causes of deforestation and improving energy independence for the country. Charcoal production leads to carbon dioxide and methane emissions from incomplete combustion of biomass, and also from using non-renewable biomass to produce charcoal. Although the NAMA is at the national level, it requires a very strong involvement of the County governments, and the forestry sector. This is particularly important because in Kenya, charcoal management is a devolved function and implementation of the NAMA will have important impacts at the county or local level. The NAMA estimates that 40% of the forestry BAU emissions (7.6 MtCO₂e) in 2010 were due to charcoal production.⁷¹

Biomass is the main source of cooking energy for households in Kenya, and a major energy source for the whole country. In 2013, 72% of the country's total primary energy supply came from bioenergy and waste.⁷² According to KFS, a large share of the biomass used is in the form of charcoal, which provides 70% of household energy in urban areas, and 30% in rural areas. With rapid population growth and urbanisation, charcoal use is likely to remain high for decades to come. The charcoal sector employs nearly 1 million people in production and trade, and has been estimated to contribute USD1.6 billion per year (same as the national tea industry) to Kenya's economy.⁷³ The charcoal sub-sector operates informally and is at present outside of the Kenyan fiscal system. Often considered as an industry of the poor, one of the challenges that exists with regards to introducing new technologies into the sector is the need for these to be both affordable, as well as offering optimal recovery of the wood fuel that is used.

In Kenya, annual demand for wood is estimated at 41.7 million cubic metres (m³), including 18.7 million m³ for fuel wood and 16.3 million

m³ for charcoal, but the amount that could be harvested sustainably is estimated to be just 31.4 million m³.⁷⁴ That means that every year, Kenya loses 10.3 million m³ of wood from its forests, which is a serious environmental concern.

While charcoal production now occurs almost entirely in the informal sector, it has great potential to be transformed through effective regulation, to become environmentally sustainable and contribute to low carbon development in Kenya. Previously, Kenya tried to ban charcoal production in order to protect forests, but given that both charcoal production and sale are mostly informal, those efforts have not been successful. With the *Forests (Charcoal) Regulations 2009*, known as the "Charcoal Rules", Kenya set out to try a different approach, adopting policies and regulatory frameworks to formalise the charcoal sector by requiring that, in order to obtain a license, producers organise themselves in Charcoal Producer Associations (CPAs). As of 2013, there were about 150 CPAs across Kenya. The CPAs would be responsible for sourcing wood sustainably and ensuring that their members harvest the right species, use the right carbonisation technologies, and sell from central collection points. They are also expected to facilitate charcoal deliveries and negotiate better prices, given that, even with the CPAs in place, nationally, an estimated 78% of profits goes to transporters and retailers, and only 22% to producers.

Most County Governments have yet to adopt charcoal legislation, even though they have a key role to play in implementing national policies under Kenya's new devolved government system. Access to finance remains a major challenge for CPAs, and producers need significantly more capacity-building.

f. Implementing the NAMA on charcoal

In an effort to support the charcoal value chain and address most of the charcoal subsector challenges, the Government, with UNDP support, commissioned the development of a NAMA for Kenya's charcoal sector. Kenya's NAMA for the charcoal value chain, has the following three main objectives:⁷⁵

- **Achieving a sustainable supply of biomass:** Two options are being considered: one relies on community-based forest management, and the other uses private-sector-based forest management. There would also be activities to raise awareness of sustainability issues, of the government's goals, and of different stakeholders' roles in achieving those goals. This is to be achieved by working with the County Governments, the KFS, KEFRI, and universities. According to the NAMA Proposal, the NAMA is expected to reduce the emissions from deforestation linked to charcoal production by up to 75% (3.9 MtCO₂eq) per year by 2030.
- **Implementing efficient charcoal production technologies:** This intervention would disseminate efficient charcoal production technologies to all commercial producers in Kenya through the CPAs, with a goal of ensuring that

90% of large scale charcoal production is done using efficient technologies. The emission reduction target for this intervention is to reduce the BAU emissions by 90% (1.08 MtCO₂eq) per year by 2030.

- **Establishing a charcoal certification and labelling scheme:** This intervention would develop a simple but robust nationwide certification and labelling scheme for all of the charcoal sourced from local biomass and producers. The assumption is that charcoal consumers would be able to easily identify and purchase only sustainably sourced and efficiently produced charcoal. The proposed activities include certifying biomass and charcoal production (carbonization and briquetting).

The NAMA, when fully implemented, has the potential to reduce emissions by a total of 5 MtCO₂e per year by 2030. However, because the sustainable biomass component has already been accounted for in both the forestry and agriculture sectors, only the 1 MtCO₂e reduction potential of the component on implementing efficient charcoal production technologies has been accounted for under the industry sector.

f. Introduce Process Improvements and Energy Efficiency in The Cement Sector

Sources of GHG emissions are very different for the cement and charcoal manufacturing sectors. Process emissions from the cement sector are due to calcination, whereby limestone releases CO₂ as it is heated in the kiln and transformed into clinker.

A reduction of process and energy emissions from cement is feasible by replacing a certain amount of clinker with slag or Pozzolana (the latter being volcanic ash that is abundantly available in Kenya), which reduces emissions of CO₂ from the heating of limestone to produce clinker. However, this is not considered a low-carbon option because existing cement plants either use the maximum allowable level of Pozzolana in the blended cement or are at advanced stages of

implementing such blending projects because they are financially very attractive. New cement plants are designed for maximum Pozzolana blending.

While improvement in energy efficiency actions are expected in the cement sector and are estimated to have the potential of reducing emissions by about 0.2 MtCO₂e per year by 2030 with ambitious assumptions,⁷⁶ the mitigation results are unlikely because cement manufacturers have been shifting to coal to reduce costs. Also Kenya is expected to start mining its own coal, a significant proportion of which will be used by the cement sector. This action has therefore not been prioritised for NCCAP 2018-2022.

g. Industrial Energy Efficiency

As already discussed above, this option assumed a 15% improvement in energy efficiency by 2030. Industrial efficiency improvements reduce cost, and enhance competitiveness and profitability, while promoting a clean and healthy environment. There are already institutions in the country offering energy efficiency support services, including professional technical services for developing, designing, and implementing energy efficiency projects to suit the needs of commercial, institutional, and industrial consumers. This is therefore a feasible and realistic mitigation option.

Results from energy audits undertaken in different commercial and industrial facilities in Kenya indicate potential for measures like the

use of more efficient pumps and motors. With payback times of less than two years, savings in electricity consumption of between 8% (for a tourist resort) and 26% (for a tea factory) could be achieved.⁷⁷ Fuel efficiency improvements of more than 9% could be achieved for a boiler in a tea factory through adjustment of the oxygen used for combustion, a measure with a payback time of about half a year. If longer payback times of up to five years would be acceptable, the level of energy savings would be significantly higher. From the NDC Sector Analysis Report 2017, the mitigation potential of this action would be 1.1 MtCO₂e by 2030.

h. Industrial Symbiosis.

Industrial symbiosis involves setting up of waste exchange clearance centres in all Special Economic Zone (SEZ) by 2022. The action seeks to improve recycling and re-use, with the ultimate objective of reducing industrial waste, while improving utilisation efficiency of inputs. A baseline survey of all SEZs and Industrial Parks (IPs) to determine the extent and potential for industrial symbiosis is yet to be undertaken, and there is not enough information to estimate the mitigation potential of this action. The action also proposes to set up:

- A waste and by-product exchange database for match making;
- Common waste management facilities for all SEZ (effluent treatment Plants) by 2022; and
- Infrastructure for waste recovery, reuse and recycling to create 20,000 decent

green in the leather, textiles and apparel, fish and agro-processing sub-sectors.

While the action has some mitigation potential, depending on the nature and amount of the waste involved, it is proposed that it be included and implemented as part of the Solid Waste NAMA, which is one of the mitigation actions proposed for the waste sector, with an emission reduction potential of 0.79 MtCO₂e per year by 2030.

This NAMA is based on Circular Economy Solid Waste Management Approach for Urban Areas, and is well aligned with the industrial symbiosis approach. Table 3.32 is a summary of the emission reduction potential of the only prioritised mitigation actions in the industry sector.

Table 3.32: Emission reduction projection from industry sector actions (MtCO₂e).

Option	Emission Reduction Potential-2018 to 2030 (MtCO ₂ e)	
	2022	2030
Implementing the NAMA on charcoal	0.45	1.08
Total	0.45	1.08

Even with partial implementation of the NAMA for the charcoal sector in Kenya (5 MtCO₂e per year by 2030) alone, the sector's high range of emission reductions (1.3 MtCO₂e per year by

2030) could be easily surpassed without the fuel combustion related emission reduction activities, which would be accounted for in the energy sector.

3.4.3 Enablers

a. Technology

The NAMA for charcoal sector in Kenya requires the adoption of technologies in the whole charcoal value chain, from establishing sustainable forests, improving charcoal kilns, and more efficient charcoal-burning technologies.

Improvement in industrial energy efficiency will need technology transfer, including acquisition of such efficient equipment as

motors, pumps, boilers, with efficient air flow control systems, burners, air pre-heaters, waste heat recycling facilities, and other energy management and control systems. Table 3.33 is a summary of the key technologies required for the priority mitigation actions in the sector.

Table 3.33: Key mitigation technologies and initiatives in the industrial sector (GoK, 2017).

Mitigation Option	Key Technologies Required
Improved Charcoal Production Systems	Metal kiln or drum kiln charcoal production technologies, regulations to control illegally produced charcoal.
Cement Energy Efficiency Improvement	Efficient cement kilns, including high efficiency motors and drives, variable speed drives, high efficiency calcifiers, and efficient grinding technologies, energy management and process control systems, oxygen-enhanced combustion, waste heat utilization; clinker substitutes (pozzolans); and biomass and waste fuels.
Industrial Energy Efficiency Improvement	Motors with variable speed drives / high efficiency motors, more efficient boilers, upgraded burners, air preheaters, waste heat recycling/utilization, biomass fuel substitution, combined heat and power systems, energy management and control systems

b. Capacity Building

Local producers often lack the skills, raw material, and investment capacities to switch to more efficient technologies.

c. Finance and Budgets

Financial resources for implementation of the NAMA are estimated to be USD. 77,327,592.

3.5: Transport Sector

3.5.1 Overview

Kenya's transport sector consists of road, rail, air, water (maritime and inland water), pipeline and non-motorised transport, and immediate means sub-sectors.⁷⁸ The sector is very vital for its facilitation of most of the other sectors of the country's economy, and is also the largest consumer of petroleum products, accounting for more than two thirds of the total petroleum products consumed in the country. The Integrated National Transport Policy of 2009 puts emphasis on an efficient transport system, noting that it is an important prerequisite for facilitating national and regional integration, promoting trade and economic development, contributing

to poverty reduction and wealth creation, and achieving the objectives of Vision 2030.

Kenya's vehicle fleet size by 2016 was estimated at 2.38 million. Of this, slightly more than 870,000 and 860,000 units were motorcycles and cars, respectively⁷⁹. Figure 3.25 shows Kenya's 2016 vehicle fleet by type. Based on these fleet estimates, the vehicle penetration rate in Kenya by mid-2016 was about 30 per 1,000 population (excluding motorcycles), which was still lower than the African countries' average of 44 vehicles per 1,000 population.

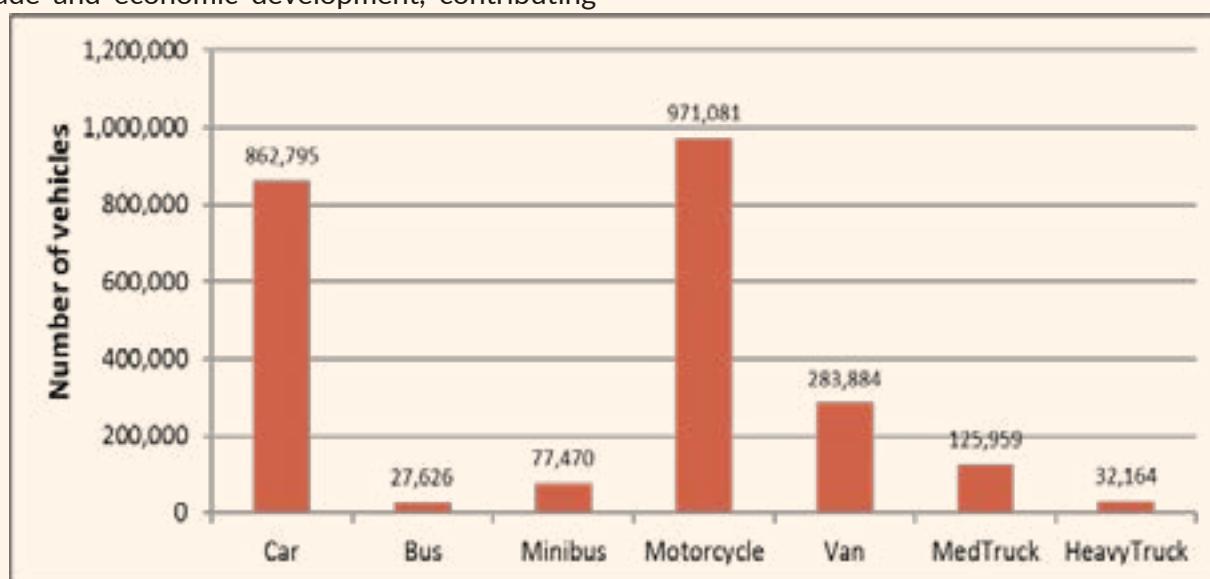


Figure 3.25: Kenya's vehicle fleet (2016) (World Bank, 2017).

The transport sector has been experiencing tremendous growth and the total vehicle population (including motorcycles) is expected to increase to 3.0 million by 2020. At this rate of growth, vehicle penetration rate is expected to hit 69.9 vehicles per thousand population by 2030 (See Figure 3.26).⁸⁰

The National Transport and Safety Authority (NTSA) estimated the fleet size at the end of 2015 as 2,776,374 vehicles and an average 10% annual increase in number of vehicles. By 2020 and 2030, it is projected that Kenya will have 4.1 and 5 million vehicles, respectively,⁸¹ 46% of which will be privately owned cars, a trend that is consistent with the growing economy

and rising income levels.⁸² At the same time, the registration of motorcycles rose from 6,350 in 2006 to 166,870 in 2015.⁸³ According to a study conducted by the Energy Regulatory Commission (ERC) under the Global Fuel Economy Initiative (GFEI) in 2015, the average fuel economy of Kenya's 110,474 light duty vehicles (LDVs) in 2012 was as 7.5 litres per 100 kilometres (L/km) compared to the global average of 7.2 L/100km, and the average CO₂ emission was 181.7g/km for the period 2010-2012. Under the GFEI, the global target referred to as "50by50" is designed to achieve 50 per cent reduction in the average CO₂ emission and fuel consumption by the year 2050.

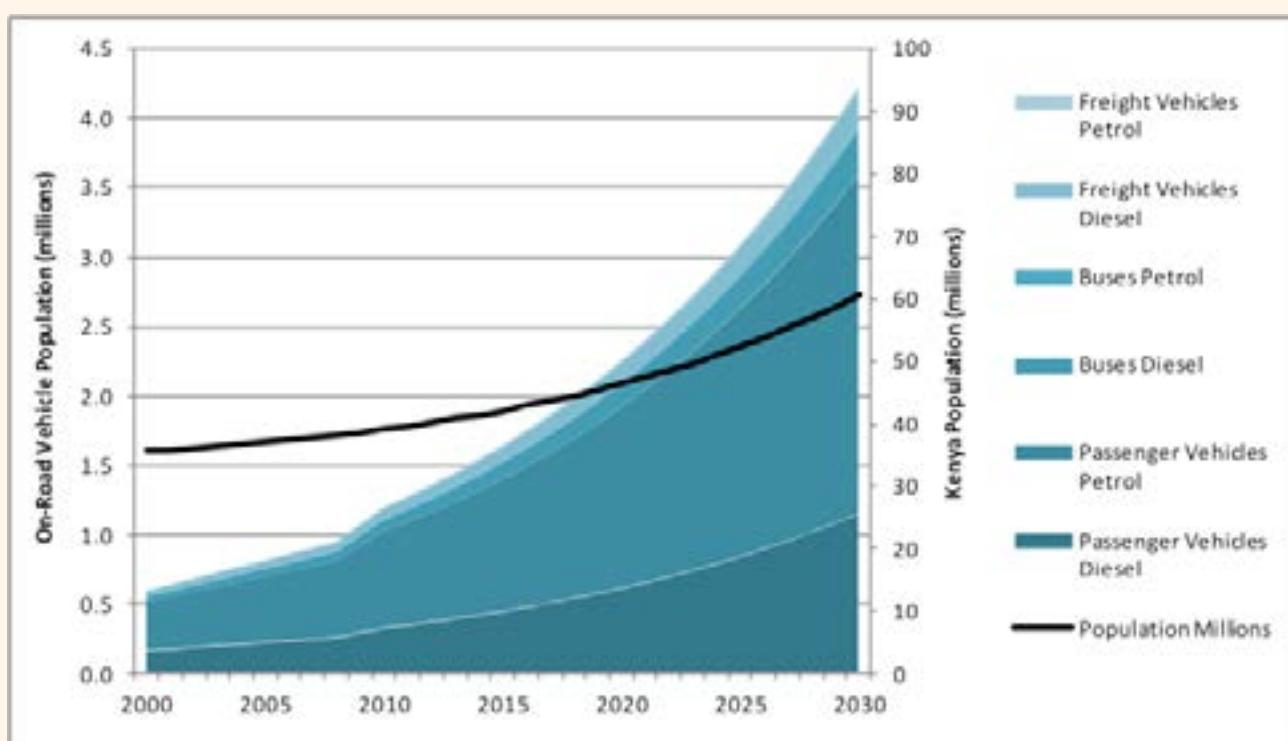


Figure 3.26: Vehicle numbers, type and population growth (2000 to 2030) (MEF, 2015).

Kenya has implemented many transport sector infrastructural development programmes over the last 15 years, which seek to meet the growing demand for transportation services arising from economic growth and rapid urbanisation, and aim at addressing the challenges in the sector. Most importantly, a number of these projects seek to address climate change through low carbon climate resilient development pathways.

The transport sector in Kenya is a significant source of GHG emissions, directly accounting for about 11.3% of Kenya's total GHG emissions in 2015. GHG emissions attributable to the transport sector are projected to grow to about 14.7% by 2030 as a result of the sector's steady growth. In NCCAP 2013-2017, a number of priority mitigation actions were identified in the transport sector, most of which offer opportunities for savings on imported fuels through improved efficiency, alternate modes of transport, and fuel substitution, besides other benefits.

In the NDC Sector Analysis Report of 2017, it was determined that the strategic mitigation actions to improve transport systems could deliver 2.0 to 3.5 MtCO₂e by 2030, through a number of actions, some of which have begun implementation. In this section, low carbon development actions have been presented, evaluated, and prioritised, based on their mitigation potential. The

following four actions have been prioritised, while several others have been listed for action:

- Implementation of the Mass Rapid Transport System (Bus Rapid Transit System with Light Rail) for Greater Nairobi (mitigation potential of 0.66 MtCO₂e annually by 2022 and 2.3 MtCO₂e by 2030);
- Transfer of Freight from Road to Rail Between Nairobi and Mombasa (mitigation potential of 0.82 MtCO₂e annually by 2022 and 1.1 MtCO₂e annually by 2030);
- Improvement of the Heavy-Duty Truck Efficiency (mitigation potential of 0.97 MtCO₂e annually by 2030); and
- Electrification of the SGR Line between Nairobi to Mombasa by 2022 (0.24 MtCO₂e per year by 2022 and 0.32 MtCO₂e by 2030).

The proportionate emission reductions required from the transport sector to meet the NDC target is 3.46 MtCO₂e, with a possible high and low range of 2.0 and 3.5 MtCO₂e by 2030. Different combinations of the above prioritised actions will deliver beyond the proportionate NDC target. The BRT action assumes that all the vehicles are diesel propelled and that starting

with 100 BRT buses in 2018, the number of buses will gradually increase to 800 by 2022 and 2,400 by 2030. If electric or LPG/Natural Gas buses are included, the action will deliver more emission reductions than estimated.

The transfer of freight from road to rail has only considered the stretch from Nairobi to Mombasa. However, by 2022, it will be possible to transfer shift cargo to rail on the Nairobi-Kisumu SGR line with a corresponding increase in mitigation benefits. If the grid continues to be green, further mitigation benefits will accrue from electrification of the rail line. However, if the grid emission factor goes above 0.28 tCO₂/MWh (currently at around 0.4 tCO₂/MWh, and expected to be practically

zero by 2022), electrification of the train becomes a net emitter relative to a diesel train baseline.

The above priority actions will be supported by important, but less significant actions, in the aviation and maritime sub-sectors, among others, that nevertheless have mitigation benefits but have not been prioritised simply because of their individual low mitigation potential. However, the actions are important for reasons other than climate change mitigation and must therefore be prioritised against those other obligations when it comes to implementation.

3.5.2 Mitigation Actions in the Transport Sector

In the NDC Sector Analysis Report 2017, six mitigation options were analysed for the transport sector. The option with the largest mitigation potential was the development of an extensive mass transit system for Greater Nairobi in the form of bus rapid transit (BRT) corridors, complemented by light rail transit (LRT) in high thoroughfare corridors. This public transport system had an abatement potential of approximately 2.3 MtCO₂e a year by 2030. The second largest mitigation potential is the 30-

40% shift of cargo⁸⁴ from road to rail between Mombasa and Nairobi having a potential of approximately 1.1 MtCO₂e a year in 2030. The third highest option is the improvement of the Heavy-Duty Truck Efficiency with mitigation potential of 0.97 MtCO₂e annually by 2030. These three options in different configurations could deliver more emission reductions than the NDC target for the transport sector. There are other mitigation actions that have been assessed but not prioritised for inclusion in NCCAP 2018-2022.

a. Baseline

The transport sector is the largest consumer of liquid fossil fuels in Kenya, accounting for 81.3% (68.5% by road transport and rail and 12.5% by

aviation) of final consumption of oil products in 2017 (See Figure 3.27).⁸⁵ Combustion of fossil fuels result in carbon dioxide emissions.

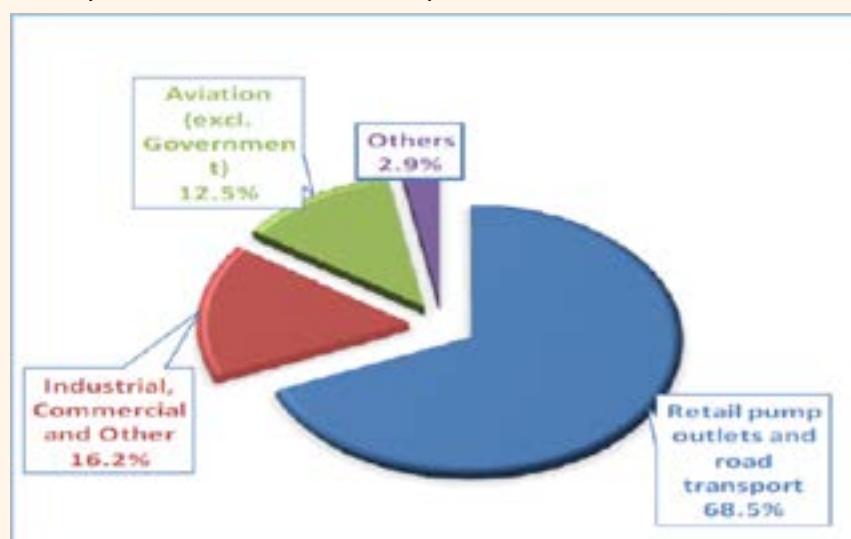
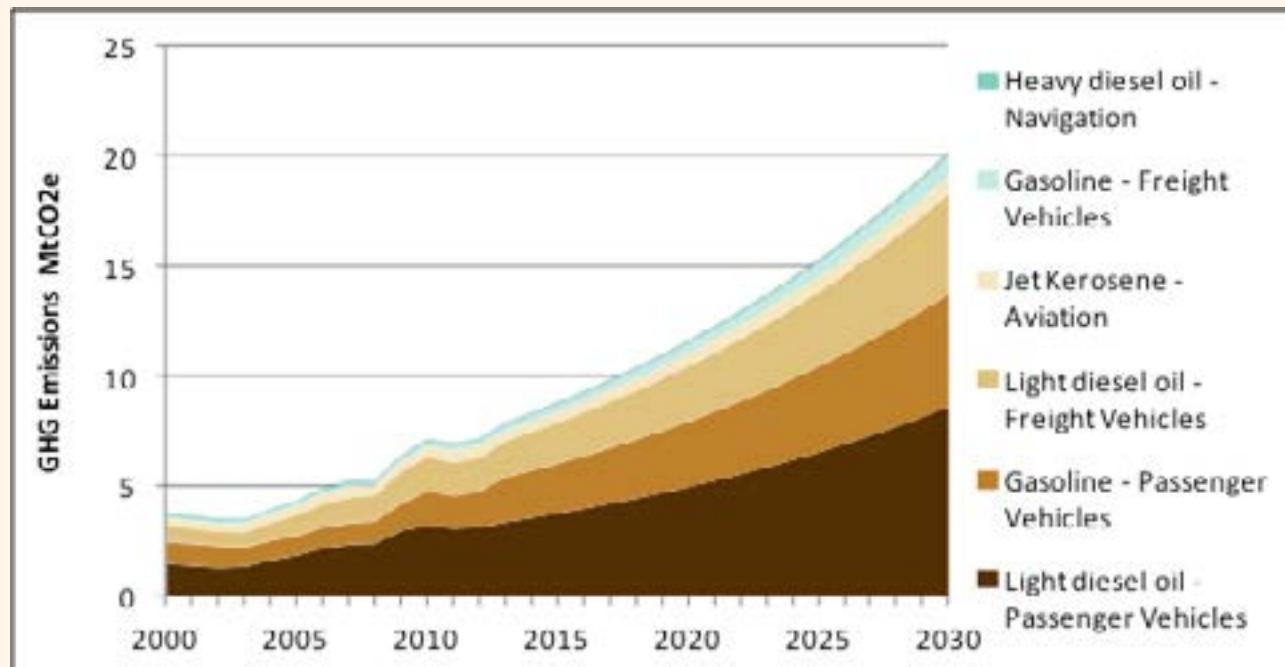


Figure 3.27: Fossil fuel consumption by sector in Kenya (KNBS, 2018).

According to NCCAP 2013-2017, transport emissions in the BAU scenario were projected to grow from 9 MtCO₂e in 2015 to 21 MtCO₂e

in 2030 ⁸⁶. Much of this increase was attributed to increased population of light duty vehicles over the period. (See Figure 3.28 and Table 2.1).



b. NDC Target for the Transport Sector

The proportionate emission reduction contributions required from the transport sector to meet the NDC overall target was estimated in the NDC Sector Analysis Report of 2017 to be 3.46 MtCO₂e by 2030 (See

Table 2.2). In the same analysis, the mitigation potential for the transport sector was estimated as lying between 3.5 and 2.0 MtCO₂e, the high and low range of emission reductions, respectively, as illustrated in Figure 3.29.

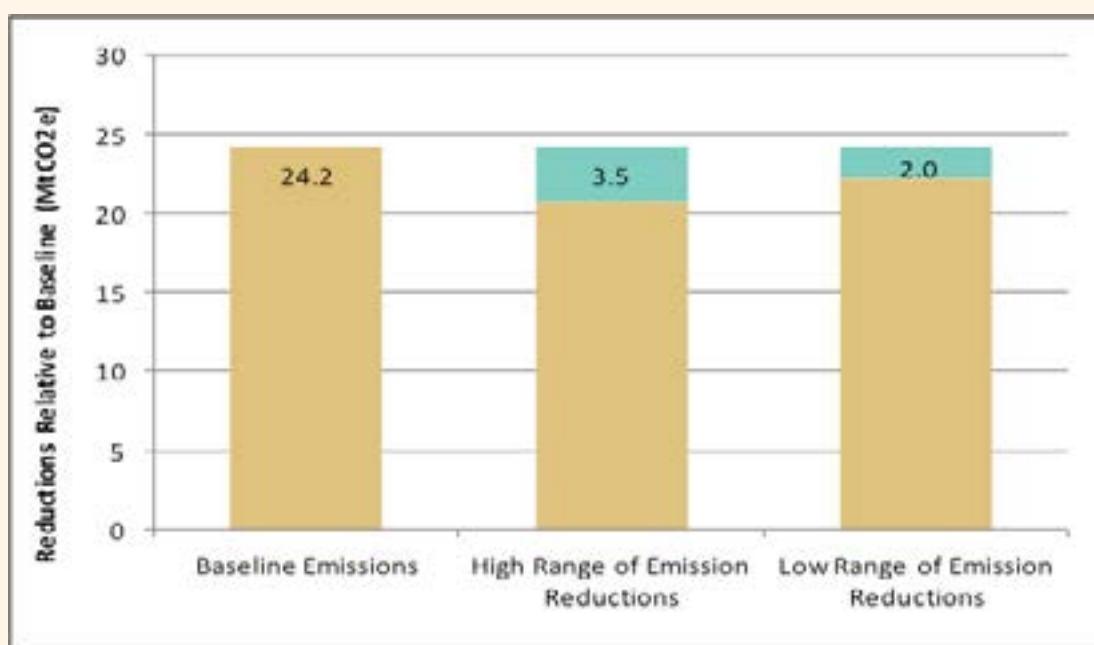


Figure 3.29: Comparison of 2030 baseline emissions and NDC target emission reductions (MtCO₂e) (GoK, 2017).

From the analysis, it was evident that the transport sector was not expected to make a significant contribution to the NDC target beyond the proportionate contribution, and the sector was not likely to compensate for the much lower proportionate contributions expected from other sectors, like agriculture. However, the prioritised mitigation actions have the potential

to surpass the proportionate NDC target for the transport sector and support other sectors with less mitigation potential. It is however noted that due to the high cost of mitigation in the transport sector relative to such other sectors as forestry, it may not be possible to implement all the prioritised mitigation actions in full over the plan period.¹²²

c. Mitigation Actions Identified in Kenya's Second National Communication

In NCCAP 2013-2017 and SNC, seven mitigation actions were proposed and analysed for the transport sector (Figures 3.30 and 3.31). The option with the largest mitigation potential was the development of an extensive mass transit system for the greater Nairobi in the form of bus rapid transit (BRT) corridors, complemented by light rail transit (LRT) in very high thoroughfare corridors. This public transport system had an abatement potential of approximately 2.8 MtCO₂e per year in total by 2030. The second largest mitigation potential was the introduction of biodiesel, with a 10% blend requirement, which has potential of 1.2 MtCO₂e per year GHG emission reductions by 2030, but is no longer considered a viable option because production of adequate biodiesel is no longer envisaged. Bioethanol remains a feasible option, if the sugar industry increases production that will be required also by the bioethanol stoves (see energy sector).¹¹⁵

Two BRT system NAMAs have been proposed and one of them was successful in its application, and is being considered for support of up to Euro 20 million for implementation. In addition, Kenya's SGR from the Port of Mombasa to Nairobi has been constructed and is operational. The stretch of the line from Nairobi to Kisumu is under construction. This will facilitate high speed train transport and has started to shift a significant amount of freight from road to rail. The SGR may have shifted passenger travel from road or air to rail, but adequate data is not available. The line also offers an opportunity for electrification, which has already started. Implementation of the large truck efficiency improvement action is yet to be fully developed and implemented, but is on course for implementation over the next 5 years.

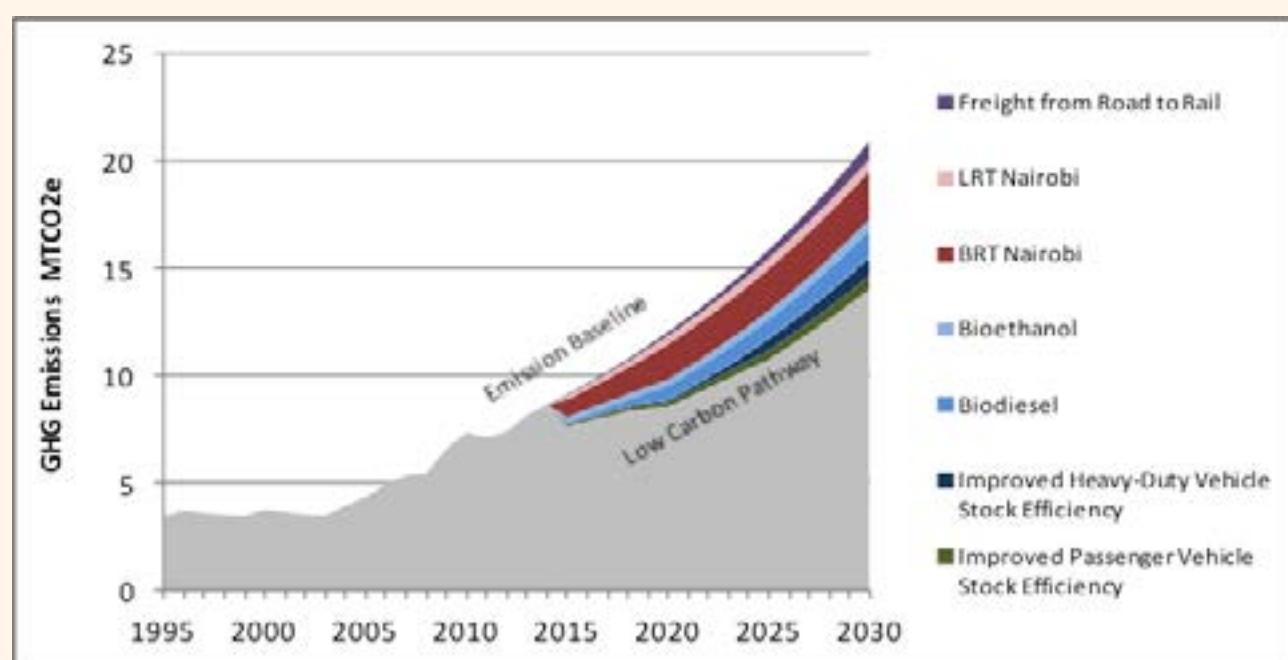


Figure 3.30: NCCAP 2013-2017 mitigation options and technical potential emission reductions in 2030 (GoK, 2013).

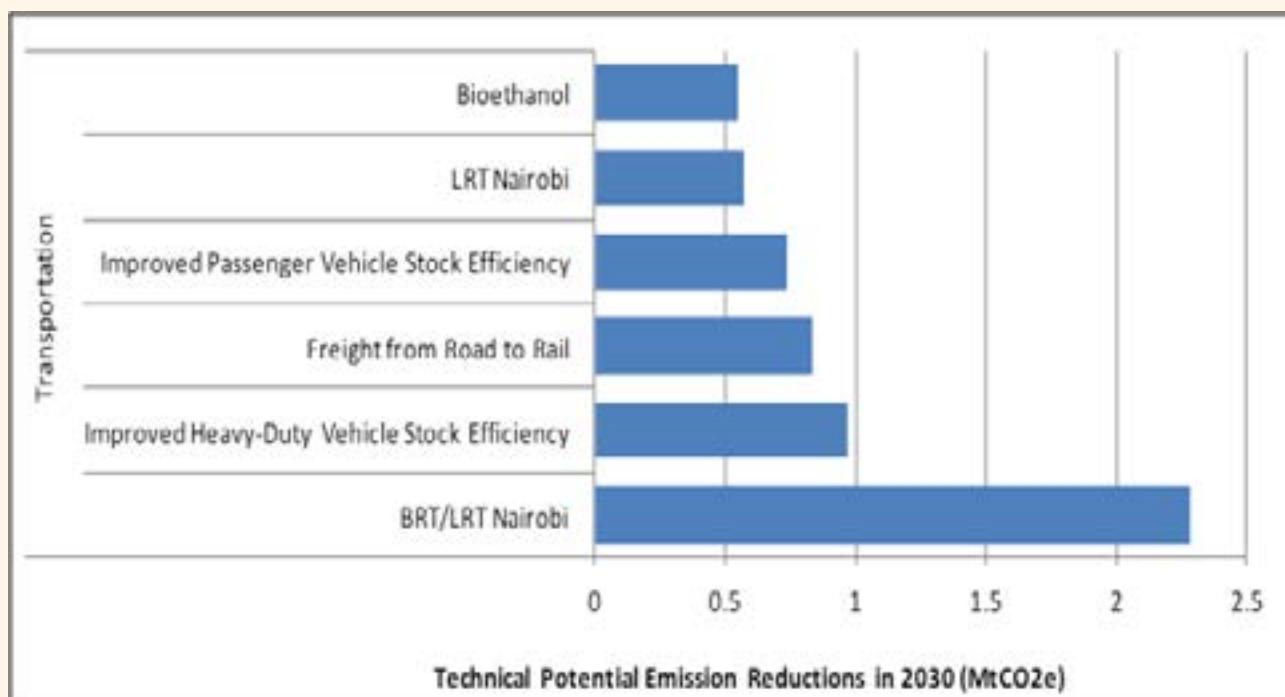


Figure 3.31: Mitigation potential of various mitigation options in the transport sector (GoK, 2017).

d. Proposed Mitigation Actions for the NCCAP 2018-2022 in the Transport Sector

The mitigation actions proposed in the transport sector for the 2018-2022 period are shown in Table 3.34. These actions were proposed by the State Department of Transport, in consultation with key sector players and development partners. The four prioritised actions are:

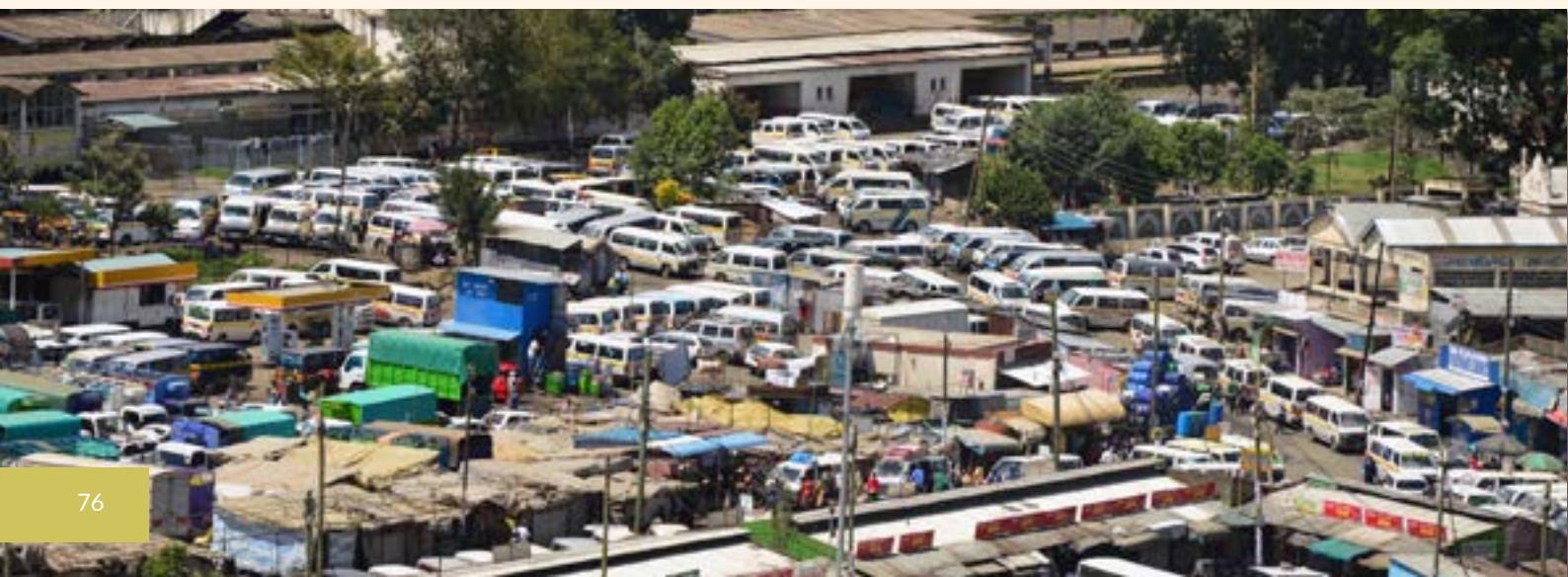
- Implementation of the Mass Rapid Transport System (Bus Rapid Transit System with Light Rail) for Greater Nairobi;
- Transfer of Freight from Road to Rail Between Nairobi and Mombasa;
- Improvement of the Heavy-Duty Truck Efficiency; and
- Electrification of the SGR Line Between Nairobi to Mombasa by 2022.



Table 3.34: Proposed priority mitigation actions in the transport sector for the period 2018-2022.

Strategic Objective 1: Establishment of efficient, safe, sustainable, and world-class transportation system and logistic services				
Issue/Problem: Operational inefficiency, heavy congestion, heavy fuels, and high fuel consumption leading to high levels of GHG and air pollutant emissions				
Opportunity	Actions	Sector	Mitigation/Adaptation	SDG Target
Need for affordable, safe, and efficient public transport for passengers and freight	<ul style="list-style-type: none"> • Design, construct, and implement 70 km of the Bus Rapid Transit for Nairobi Metropolitan Area; • Upgrade the Nairobi commuter rail system; • Extend of the SGR from Nairobi to Naivasha by 2022; • Shift at least 30% of road passengers (Nairobi-Mombasa); and Shift at least 30% of road freight (Nairobi-Mombasa) . 	MOTIHUD, Nairobi Area Transport Metropolitan Authority (NAMATA), County governments, Kenya Railways Corporation (KRC)	Mitigation	7, 9.1, 10, 11.2, 13
Reduced fuel consumption and fuel overhead costs	<ul style="list-style-type: none"> • Electrify the SGR (Nairobi to Mombasa) by 2022; • Develop and start implementation of a roadmap for the improvement of heavy-duty truck efficiency improvement, including increased use of low-rolling resistance tyres, super structure fittings etc., vehicle standards; • Construct and commission the 2nd runway at JKIA to reduce holding of aircrafts and diversions by 2022; and • Establish a new Air Navigation Area Control Centre by 2020. 	MOTIHUD, KRC, National Transport Authority (NTSA), County governments, KETRACO, Kenya Civil Aviation Authority (KCAA), Kenya Airports Authority (KAA)	Mitigation	7.2, 7.3. 9, 11.2,12.2
Adoption of electric modes of transport to improve air quality	<ul style="list-style-type: none"> • Import and pilot the use of 150 electric hybrid vehicles (buses, GoK cars) by 2019, and provide appropriate incentives for their use by 2022; • Pilot the use of electric 2- and 3-wheeler vehicles in at least two counties by 2020; and • Develop and implement Standards for electric/hybrid vehicles in Kenya by 2019. 	MOTIHUD, NTSA, County governments, KETRACO, KP, Kenya Urban Roads Authority (KURA), Kenya National Highways Authority (KENHA), Kenya Rural Roads Authority (KURA)Kenya Bureau of Standards (KEBS), Kenya Revenue Authority (KRA)	Adaptation and Mitigation	7.2, 7.3 11.2, 3.9

Transit oriented development	<ul style="list-style-type: none"> Update and implement planning and building control regulations to encourage compact development, mixed use, and reduced provision of parking near MRT stations; Construct 150 km of NMT facilities, including pedestrian and bicycle access within and to town centres and MRT stations; and Review and implement the <i>Integrated National Transport Policy 2021</i> 	MOTIHUD, County governments, National Construction Authority (NCA)	Mitigation	9.1, 11.2,
Uptake of low carbon technologies (aviation and maritime)	<ul style="list-style-type: none"> Install shore power infrastructure for 4 berths to provide power to the ships while at berth instead of using their engines (cold ironing project); Purchase of 2 new aircraft (B787) which have fuel efficient engines; Domesticate and implement international standards on aviation (ICAO Annex 16 Vol 4) by 2021 and maritime (MARPOL Annex VI) by 2020; Implement Service Charter on Sustainable Aviation Fuels (certification and use of biodiesel production for captive use at the airports) by 2020; and Install and commission 0.5 MW of solar power plant at Moi International Airport by end 2018. 	KCAA, KPA, KQ, KAA, SDOT MOTIHUD(SDMA), Kenya Ports Authority (KPA), Kenya Maritime Authority, (KMA), Kenya Airways (KQ), KEBS	Mitigation	7.2, 7.3, 9.1, 11.2, 14
Capacity Building and Awareness Creation	<ul style="list-style-type: none"> Train officers on GHG emissions quantification and mechanisms of reduction, fuel consumption data reporting requirements, and low carbon technology 	Transport, KCAA, KMA, SDMSA, KPA, KQ, KAA and SDOT.	Capacity Building	13.3, 11.2, 17.19



e. Implementation of the Mass Rapid Transport System (Bus Rapid Transit System with Light Rail) for Greater Nairobi

On 9th February 2018, the President of the Republic of Kenya issued an executive order creating the Nairobi Metropolitan Area Transport Authority (NAMATA). The authority covers the Counties of Nairobi City, Kiambu, Kajiado, Machakos and Murang'a, and has the mandate of formulating a 'sustainable integrated public transport strategy' based on bus rapid transit (BRT) and commuter rail routes.

BRT is a system that provides for buses to have their own segregated ways within cities. It is a high-quality bus-based transit system that provides for dedicated lanes, with busways and iconic stations, typically aligned to the center of the road, off-board fare collection, and fast and frequent operations. The system brings efficiency and reliability within the public transit systems of a city. It is sometimes viewed as an alternative version of Light Rail Transit, where articulated buses are used in place of trains. Where such buses are used for BRT, they are much cheaper to install and they allow for flexibility of routing and timing. A more attractive and reliable public transport system will increase the share of the population that uses public transport, and non-motorised transport will be encouraged through improved bicycle lanes and sidewalks.

Kenya plans to develop a mass rapid transport system that comprises 5 routes of BRT, complimenting light rail transport. The Government of Kenya expects to have designed, constructed, and operationalised a total of 70 km of BRT within Nairobi Metropolitan Area covering lines 1, 2, 3 and 5 by 2022.⁸⁸ Detailed

design work has started on the first BRT Line 3, the 13-km route along Ngong-Juja Road, with an emission reduction potential of 0.04 MtCO₂e annually through replacing private cars, matatus, and bus trips, and some non-motorised transport with public transport, improved flow of traffic, acceptance of traffic lights, and integration of different modes of transport in the public concept..⁸⁹

Another BRT NAMA, developed as an electric bus rapid transit system (eBRT) and running from Jomo Kenyatta International Airport to the city centre (route Ndovu/A104), is yet to get international climate funding⁹⁰. According to the eBRT NAMA proposal, the mitigation potential of this action (Ndovu Route BRT) would be 0.46 MtCO₂e annually, because it is a very busy route and the eBRT would apply renewable electricity instead of diesel.⁹¹

The Nairobi commuter rail system is also to be upgraded to provide efficient movement of passengers from the SGR terminal in Syokimau to the city centre. This upgrading is part of the Nairobi Metropolitan Mass Transport Master Plan that aims at creating a mass rapid transport (MRT) system comprised of bus rapid transit and commuter rail, complemented by NMT.

Assuming that the number of BRT buses would gradually increase from 100 in 2018 (for Line 3 only) to 1,200 (for Lines 1,2, 3) by 2022, covering the 70 km BRT routes in Nairobi Metropolitan Area, and that the BRT bus capacity would be the limiting factor, with each line having



a mixture of 140-passenger articulated buses and 70-passenger standard buses. The buses would make several return trips daily, resulting in an emission reduction potential of the action estimated at 0.66 MtCO₂e by 2022. Due to inadequate data, it was not possible to estimate the mitigation potential of this action by 2030. However, in NCCAP 2013-2017 and SNC, the mitigation potential of this action was estimated at 2.3 MtCO₂e by 2030.

The complementing Nairobi Commuter Rail Service is to be developed in three phases involving the modernisation of the currently underused routes, and building of extensions. The existing 100 km track and signalling on four routes between central Nairobi, Ruiru, Syokimau, Kikuyu, and Embakasi Village would be upgraded in Phase 1. New rolling stock would be purchased and new stations opened on existing routes, and a 6.5 km branch would be built to serve Jomo Kenyatta International Airport.⁹²

Against a background where 85% of Nairobi's population do not own a car, the project aims at increasing capacity on the routes from 5 million passengers per year to 15 million initially, and eventually 60 million.

Services to Thika, Limuru, and Lukenya would be extended in Phase 2, while Nairobi would be linked with such satellite towns as Ongata Rongai, Kiserian, Ngong, Kiambu, Ruai, and Kangemi in Phase 3.

To be developed under a PPP concession, the commuter rail and BRT projects could be partly funded with €20m from KfW, currently under appraisal. The German Federal Enterprise for International Co-operation would provide technical support.

Due to inadequate information, including on timelines, the emission mitigation potential of the light rail component has not been included in the mitigation potential estimation for NCCAP 2018-2022.



f. Transfer of Freight and Passengers from Road to Rail Between Nairobi and Mombasa

A large majority of freight movements (imports and exports) have been undertaken by road transport. This scenario assumes that approximately 30-40%⁹³ of transit freight is moved on SGR by 2030. With the SGR operating, the Government has now started to transfer freight from road to the rail system. Besides its potential climate change mitigation benefits, rail is energy- and time-efficient, cost-effective, saves road maintenance costs, and reduces safety exposure on our road. In NCCAP 2013-2017, SNC and the NDC Sector Analysis Report 2017, and with an assumption that 30-40% of the road freight will be shifted to rail, it was estimated that the

mitigation potential of this action is 0.82 MtCO₂e annually by 2022, and 1.1 MtCO₂e by 2030.

The freight data applied for the estimation were obtained from the Mombasa - Nairobi Railway Project, Feasibility Study Report by China Road and Bridge Corporation for the GoK in 2011. The forecasted freight figures in the study are closer to 40% of the total cargo handled at the Port of Mombasa. With increasing proportion of the freight being shifted to rail, the GHG emissions abatement of this action could be increased significantly.

g. Electrification of the SGR Line Between Nairobi to Mombasa by 2022

Electrification of the SGR is expected to lead to further emission reductions for both freight and passenger operations. Typically, an electric train emits between 20% and 35% less carbon per passenger mile than a diesel train.⁹⁴ However, the exact mitigation potential of electrification of the SGR line will depend on the exact grid mix. With increasing cargo, if Kenya's grid energy mix were to remain green (with a grid emission factor lower than 0.28 tCO₂e/MWh, now it is around 0.4 tCO₂e/MWh but is expected to get to nearly zero by 2022), and the train system was electrified, the GHG emissions reductions

through this action could be increased by up to 0.24 MtCO₂e in 2022 and 0.32 MtCO₂e by 2030.

With the planned coal generation after 2022, the mitigation contribution of this action would be negligible relative to the NDC target for the transport sector, and could even be reversed with the action becoming a net emitter. A contract to construct 14 sub-stations between Nairobi and Mombasa has already been signed for electrification of the SGR line.



h. Improvement of the Heavy-Duty Truck Efficiency

Improvement of the heavy-duty truck efficiency could be achieved through many different policies, including new vehicle fuel efficiency standards, removing low efficiency vehicles from the market, and providing subsidies or incentives for higher efficiency vehicles. Higher efficiency vehicles include, hybrid and electric vehicles that could significantly reduce emissions per kilometre, provided that the national electricity generation mix remains predominantly based on renewable generation. The technical potential of the improvement in freight vehicle efficiency mitigation option considered an improvement of approximately 15% in overall freight vehicle efficiency in 2030 resulting in 0.97 MtCO₂e emission reductions. A 1% improvement in overall freight vehicle efficiency in 2030 would reduce emissions in the order of 0.064 MtCO₂e.⁹⁵ The adoption of technologies to improve vehicle fuel efficiency could be complemented with support programmes that monitor and enforce vehicle emission standards. Testing and inspection of vehicles, either as a mandatory program or as part of highway enforcement, even if it affects only a small percentage of vehicles, could still significantly improve overall vehicle emission efficiency, as they target the highest emitters.

The total mitigation potential of the prioritised mitigation actions in the transport sector is summarised in Table 3.35. While the transport

sector has the potential to deliver the sector's high range emission reduction target towards the delivery of the NDC mitigation targets by 2030, most of the four prioritised actions have to be implemented to a significant degree. The transfer of freight from road to rail has the potential to double the emission reductions, if about 60-80% of the freight is transferred to rail. In addition, the BRT also has significant potential for enhanced emission reductions through faster BRT route development, and increased number of buses on the routes. According to NCCAP 2013-2017 and SNC, up to 2.3 MtCO₂e of GHG emission reductions could be realised through a mass transit system that achieves an estimated peak hourly ridership of 148,000 passengers in 2030. This mitigation potential has been applied for the BRT in 2030.

The emission reduction associated with electrification of the SGR assumes a clean grid mix by 2022 (a grid emission factor of zero tCO₂e/MWh), which is expected by 2022. If, however, fossil fuel generation is added, as is expected after 2024, this action will seize to reduce GHG emissions at a grid emission factor of 0.27 tCO₂e/MWh and become a net emitter as the grid gets dirtier. The priority actions, combined, are therefore able to deliver the 3.5 MtCO₂e high range of emissions target by 2030, with a significant part of the contribution coming from the BRT system with light rail.

g. Other Mitigation Options

Several other mitigation options that could contribute to emission reductions but are not significant enough to individually have an impact on the NDC target have not been analysed above. However, they have been listed below. The technical mitigation potentials of

the options have not been estimated either because additional information would be required, or quantification of the emission reductions at this stage would be too inaccurate to justify the value. Table 3.35 presents a summary of the additional mitigation options.

Table 3.35: Summary of additional mitigation options for the transport sector.

Additional Mitigation Options	Preliminary Estimates of Emission Reduction Potential
Aviation actions that have been proposed contribute to mitigation, but quantification requires studies to establish baselines.	<ul style="list-style-type: none"> Construct and commission the 2nd runway at JKIA, to reduce holding of aircrafts and diversions by 2022; and Establish a new Air Navigation Area Control Centre by 2020.
Non-Motorised Transport	<ul style="list-style-type: none"> Encourage transit oriented development, including non-motorised transport; Update and implement planning and building control regulations to encourage compact development, mixed use, and reduced provision of parking near MRT stations; and Construct 150 km of NMT facilities, including pedestrian and bicycle access within and to town centres and MRT stations.
Update of low carbon technologies (aviation and maritime) combines several activities that contribute to mitigation	<ul style="list-style-type: none"> Install off-shore power infrastructure for 4 berths, to provide power to the ships while at berth instead of using their engines (cold ironing project); Purchase 2 new aircraft (B787), which have fuel efficient engines; Domesticate and implement international standards on aviation (ICAO Annex 16 Vol 4) by 2021 and maritime (MARPOL Annex VI) by 2020; Implement Service Charter on Sustainable Aviation Fuels (certification and use of biodiesel production for captive use at the airports) by 2020; and Install and commission 0.5 MW of solar power plant at Moi International Airport by 2018.
Electrification of vehicles	<ul style="list-style-type: none"> Develop and implement standards for electric/hybrid vehicles in Kenya by 2019; Shift to electric 2- and 3-wheelers and electric hybrid vehicles in Kenya (the shifts are however not expected to be significant relative to the NDC target for the sector in the 2018-2022 period. During this period the initiatives will be piloted. Typical fuel consumption of a petrol/diesel 3-wheeler lies between 2.3 to 9 L/km).
Electric Motorcycles	Shift from petrol motorcycles (100cc) to electric motorcycles of a similar power (This could likely reduce emissions in the order of 60% or roughly a reduction of 56 gCO ₂ e/passenger· km shifted based on the emission intensity of the grid in 2015. However, if significant fossil fuel electricity generation is developed (~5000 additional megawatts by 2030), the reduction falls to approximately 18% or roughly a reduction of 14 gCO ₂ e/passenger· km shifted. If the 2-wheelers replace cyclists, there would be no mitigation benefits, especially if the electricity is not clean and the manufacture of lead batteries are considered. Typical 2-wheeler emissions are 19 to 55 g/km).
Road Passenger to Rail	Shift from passenger private vehicle to rail (This would likely reduce emissions in the order of 80% or roughly a reduction of 288 gCO ₂ e/passenger· km shifted, which assumes a low road passenger vehicle occupancy (2 persons)).
Air Passenger to Rail	Shift from passenger air travel to rail on domestic short haul (This would likely reduce emissions in the order of 60% or roughly a reduction of 104 gCO ₂ e/passenger· km shifted).
Transport of Oil by Pipeline	Shift of the transport of oil by truck to pipeline (This would likely reduce emissions in the order of 90% or roughly a reduction of 10 gCO ₂ e/barrel ·km shifted based on the adoption of electric pumping stations).

3.5. 3 Enablers

a. Technology

A summary of the key mitigation technologies in the transport sector is provided in Table 3.36.

Table 3.36: Summary of key technologies in the transport sector.

Mitigation Option	Key Technologies Required
Public Transit (BRT and/or LRT)	Financial incentives and modification of road infrastructure to create enabling conditions, consideration of electric rail and hybrid electric buses (provided Kenya's energy mix remains largely based on renewables)
Freight and Passenger Vehicle Fuel Efficiency	Hybrid or electric vehicles, electric vehicle charging network, fuel efficiency standards for new or imported used vehicles, regulatory and economic framework that will lead to reduction of old inefficient vehicles, vehicle testing equipment. Hybrid or electric vehicles, fuel efficiency standards for new or imported used vehicles, regulatory and economic framework that will lead to reduction of old inefficient vehicles.
Freight and Passenger from Road to Rail	Efficient engines and streamlined locomotives, logistical planning to maximize loads and reduce engine idling, consideration of electrification (provided Kenya's energy mix remains largely based on renewables)
Electrification of Rail	Stable, adequate and clean electrify supply, electric train technology, electrification of rail lines

b. Capacity Building

Staff will need training and capacity building on the management of a mass rapid transit system, including on the maintenance of the BRT buses. Similar expertise will be required

for the train system. Further, capacity to construct and maintain reliable power lines for electrified rail systems will be critical for successful electrification of the rail system.

c. Finance and Budgets

NCCAP 2013-2017 estimates the cost of the proposed multiple line BRT+ system and the LRT at USD 250 million and USD 1.75 billion, respectively.⁹⁶ A study commissioned by the Kenya National Highways Authority (KeNHA),

and carried out by the Institute for Transportation and Development Policy (ITDP), reported that the best BRT service plan for Route 1 (Ndovu / A104) would require about USD 240.7 million.⁹⁷

3.6: Waste Sector

3.6.1 Overview

Kenya, with an urban population of 30% of total population in 2017, is urbanising at the rate of 4.15% annually (See Figure 3.32). At the same time, urban life styles are changing as the economic status of urban dwellers improves, which results in the generation of an ever-growing daily amount of municipal solid waste (MSW) that is currently estimated at 0.5 kg per capita, and wastewater. In most urban areas, the amount of MSW generated is growing faster than the rate of urbanisation. This is making waste management, in such areas as Nairobi, a major challenge.

In most urban areas of Kenya, MSW disposal is a neglected area and a major environmental health hazard. The cost of disposal of large quantities of waste is often beyond the financial capacities of County Governments that have the responsibility for MSW disposal. There is also poor institutional capacity and low political will to address the problem, with most urban areas in Kenya lacking the facilities for safe disposal of MSW. The most common MSW disposal practice is uncontrolled dumping in official and also in illegal dumpsites, which are operated in an unsystematic, unplanned, and highly unsanitary way.

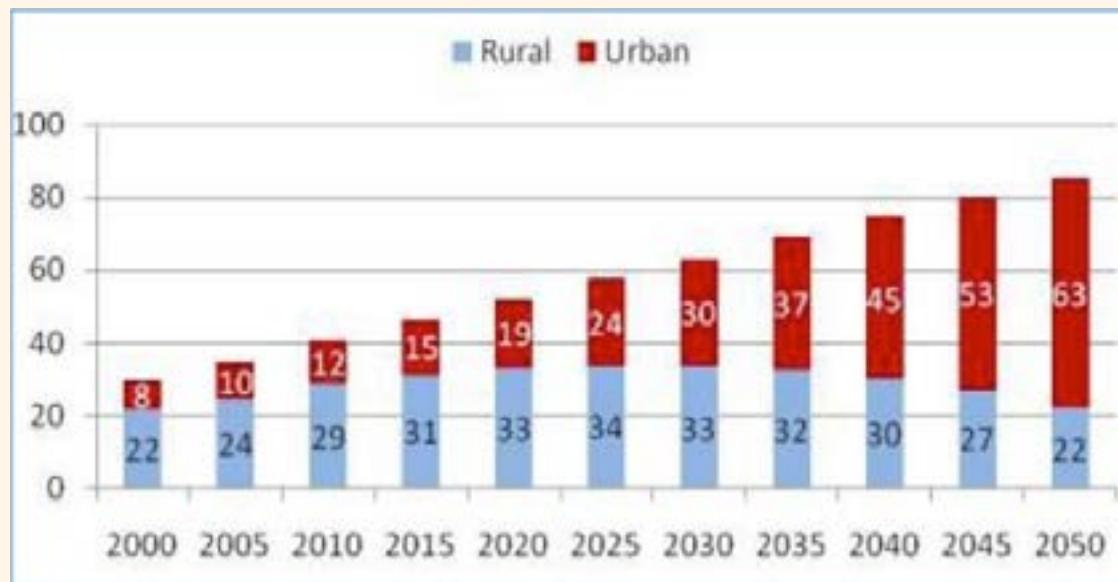


Figure 3.32: Kenya's urban and rural population, 2000-2050 (World Bank, 2013).

Besides the environmental health hazards associated with poor MSW disposal, badly managed waste also has negative consequences in terms of GHG emissions. Waste, through the processes of disposal, treatment, recycling, and incineration, produces GHG emissions, the most significant of which is methane (CH_4). Major sources of CH_4 production are solid waste disposal to land, and wastewater and sewage treatment. Waste incineration, like other forms of combustion, generates CO_2 . According to SNC, the waste sector is the lowest contributor to GHG emissions of all sectors.

About 3% of Kenya's GHG emissions from 2015 to 2030 will be from the waste sector, mostly as a result of methane generation from solid waste dumpsites, sewage, and wastewater disposal.⁹⁸ This represents an increase in GHG emissions from the waste sector from 2 Mt CO_2e per year in 2010 to 4 Mt CO_2e in 2030.

NCCAP 2013-2017 and SNC identified one priority mitigation action, namely, landfill gas methane capture and generation, with an abatement potential of 0.78 Mt CO_2e per year by 2030. In the NDC Sector Analysis Report of 2017,



it was determined that this strategic mitigation action could deliver between 0.2 and 0.4 MtCO₂e against the NDC proportionate GHG emission reduction target of 0.39 MtCO₂e by 2030.

In this section, mitigation actions in the waste sector are presented, evaluated, and prioritised, based on their mitigation potential. One mitigation action has been prioritised for implementation for the period 2018 to 2022, while several other actions have been listed for implementation during the same period. The prioritised action is the implementation of the Solid Waste NAMA to achieve 30% waste

recovery (recycling, land fill, and composting) and 70% controlled dumping (tipping, compacting, and recovery) in at least one urban area in 20 Counties by 2022. For Nairobi urban area only, the NAMA entitled 'A Circular Economy Solid Waste Management Approach for Urban Areas in Kenya' (Solid Waste NAMA)⁹⁹ has an abatement potential of 0.1 MtCO₂e per year by 2030. In the GHG estimations, as in NCCAP 2013-2022 and SNC, a constant solid waste generation per capita and fraction organic have been assumed.

3.6.2 Mitigation Actions in the Waste Sector

For priority mitigation action of implementing the Solid Waste NAMA, the mitigation potential was estimated as 0.1 MtCO₂e per year by 2030, with emission reductions coming from both plastic recycling and composting of the organic

components. If instead, the organic component is used to generate landfill methane gas, which is then used for electricity generation, the total emission reductions would be 0.79 MtCO₂e by 2030.

a. Baseline

According to NCCAP 2013-2017 and SNC, the waste sector emissions in the BAU scenario are projected to double from 2 MtCO₂e in 2015

to 4 MtCO₂e in 2030. Much of this increase is attributed to increasing urbanisation and changing urban lifestyles (See Figure 3.33 and Table 3.37).

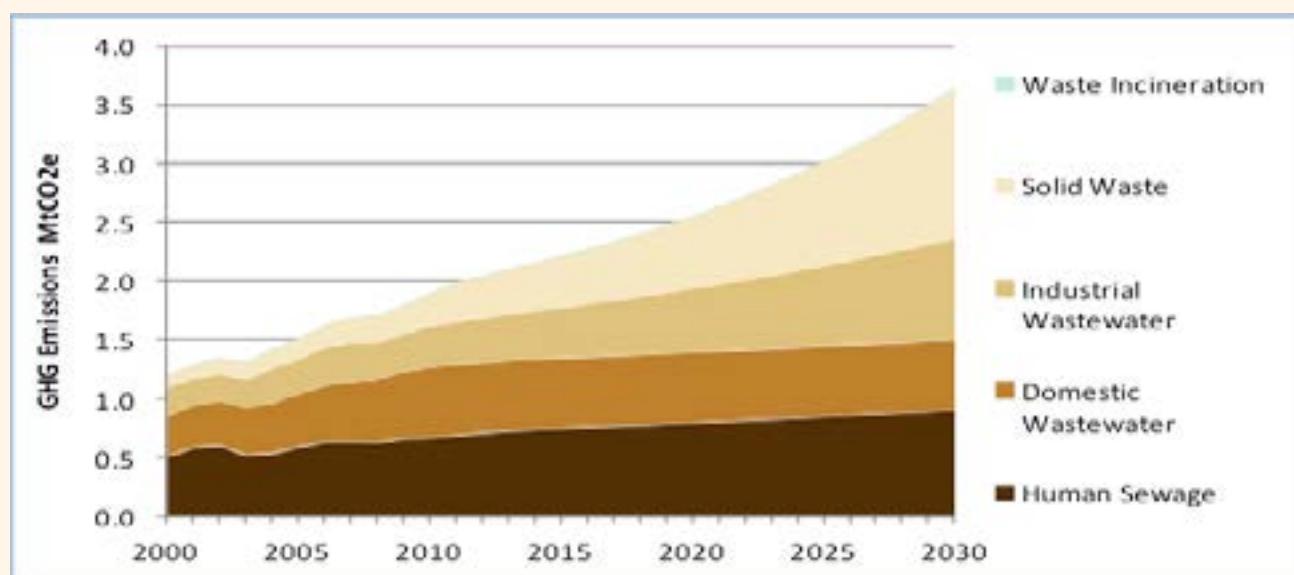


Figure 3.33: Waste sector baseline emission projection for Kenya (MtCO₂e) (GoK, 2015).

At present, waste is estimated to account for approximately 3% of total national emissions, a contribution that is expected to remain relatively

constant in the future to 2030. This contribution is the lowest of all Kenya's six emission sectors.

Table 3.37: Waste sector baseline emission projection for Kenya (MtCO₂e) (GoK, 2015).

Waste Source	Waste Baseline GHG Emissions (MtCO ₂ e)						
	2000	2005	2010	2015	2020	2025	2030
Human Sewage	0.5	0.6	0.7	0.7	0.8	0.8	0.9
Domestic Wastewater	0.3	0.5	0.6	0.6	0.6	0.6	0.6
Industrial Wastewater	0.2	0.3	0.3	0.4	0.5	0.7	0.9
Solid Waste	0.1	0.2	0.3	0.4	0.6	0.9	1.3
Waste Incineration	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	1.2	1.5	1.9	2.2	2.6	3.0	3.7

b. NDC Target for the Waste Sector

The proportionate emission reduction contributions required from the waste sector to meet the NDC overall target was estimated in the NDC Sector Analysis Report of 2017 as 0.39 MtCO₂e by 2030 (See Table 2.2). In the same analysis, the mitigation potential for the waste sector was estimated as lying between 0.4 and 0.2 MtCO₂e, the high and low range of emission reductions, respectively, as illustrated in Figure 3.34.¹⁰⁰

Because of the limited mitigation opportunities, the waste sector in Kenya is not expected to make a significant contribution to the overall realisation of the NDC mitigation target. The mitigation potential estimates and prioritised mitigation action is however based largely on solid waste generation in Nairobi. There is therefore potential for replication in other major urban areas, provided adequate data is collected, and the action prioritised by the associated urban areas.

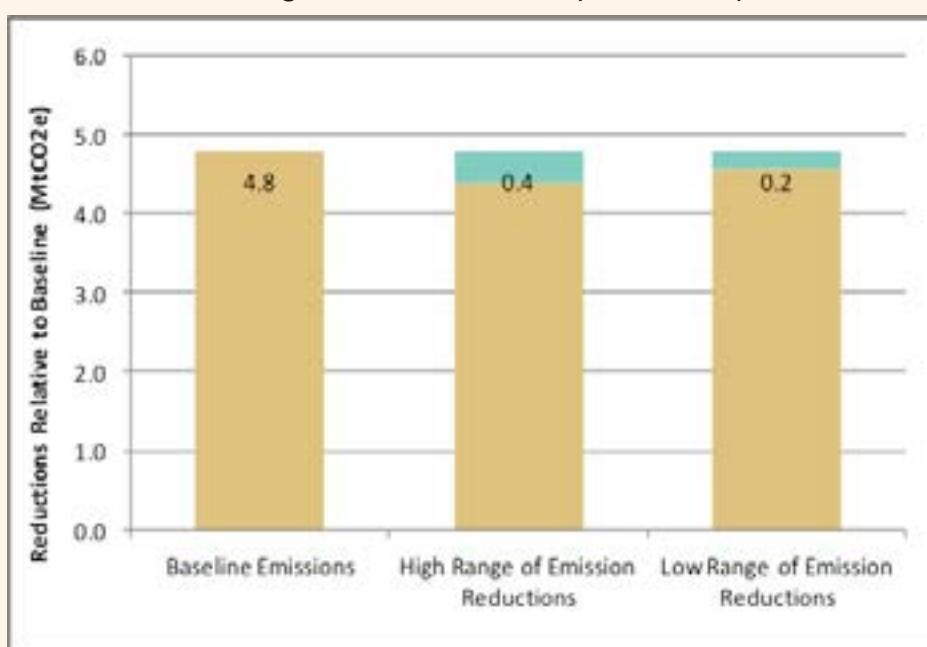


Figure 3.34: Comparison of 2030 baseline emissions and NDC target emission reductions (MtCO₂e) (GoK, 2017).

c. Mitigation Actions Identified in Kenya's Second National Communication

In NCCAP 2013-2017 and SNC, only one mitigation action, namely, land fill gas capture and utilisation, which has mitigation potential of 0.78 MtCO₂e by 2030, was proposed and analysed for the waste sector (See Figure 3.35). While several studies and proposals have been undertaken towards solid waste management project implementation in Nairobi's Dandora dumpsite, no action has actually been implemented. The Government has however banned the use of collapsible packaging plastics, which has indirectly contributed to solid waste management in the country. A

number of County Governments are currently developing their waste management strategies.

In 2015, the Ministry of Environmental and Natural Resources (MENR), with support from the USAID-funded UNDP-managed Low Emission Capacity Building Programme, developed a solid waste NAMA entitled 'Circular Economy Solid Waste Management Approach for Urban Areas in Kenya'. This NAMA has provided the basis for the prioritised climate change mitigation action for the waste sector.

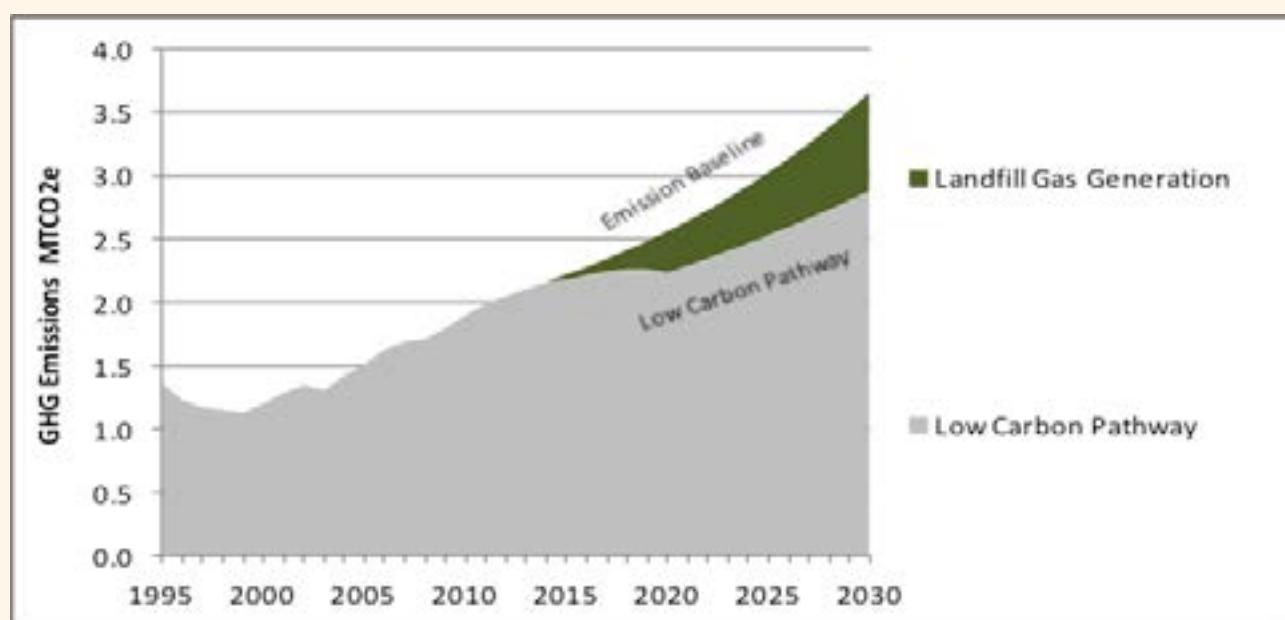


Figure 3.35: NCCAP 2013-2017 Mitigation Options in the Waste Sector and their Technical Potential Emission Reductions in 2030 (GoK, 2017).

Table 3.37

	Emission Reductions Potential (MtCO ₂ e)			
	2015	2020	2025	2030
Landfill Gas Capture and Generation	0.05	0.33	0.50	0.78

d. Proposed Mitigation Actions for the NCCAP 2018-2022 in the Transport Sector

The mitigation actions proposed in the waste sector for implementation in the 2018-2022 period are shown in Table 3.38. These actions were proposed by stakeholders from County Governments, NEMA, and other

stakeholders. A number of the proposed actions are enablers and have not direct mitigation impacts. However, they are expected to contribute significantly to the implementation of actions that have direct mitigation impacts.

Table 3.38: Priority mitigation actions in the waste sector for the period 2018-2022.

Strategic Objective 3.6: Improved solid waste management in major urban areas				
Issue/Problem: Poor solid waste management system in major urban areas of the country is leading to poor sanitation, low waste collection levels, and environmental pollution.				
Opportunity	Actions	Sector	Mitigation/Adaptation/	SDG Target
Poor solid waste management in major urban areas	<ul style="list-style-type: none"> Implement the Solid Waste NAMA to achieve 30% waste recovery (recycling, land fill, and composting) and 70% controlled dumping (tipping, compacting, and recovery) in at least one urban area in each of selected 20 Counties by 2022; and Explore options for methane capture and power generation at landfill sites. 	MEF-NAMA, CoG County Governments, private sector, NGOs	Mitigation	2, 1, 6, 13
Enabling Action (policy, plans, and regulation)	<ul style="list-style-type: none"> Adopt the Zero Waste policy to substantially reduce waste generation, through prevention, reduction, recycling, and reuse; Develop extended producer responsibility regulations; Formulate a policy to increase use of recycled and biodegradable content in packaging materials; Prepare County-based waste management plans that are consistent with the National Waste Management Strategy and other relevant policies; and Enact County laws that include waste recovery and disposal, to serve as regulatory requirements for use of waste as a resource by 2019. 	CoG County Governments MEF-NEMA	Enabling	

The following low carbon development options have been analysed for prioritisation in NCCAP 2018-2022:

- Implementation of the solid waste NAMA; and
- A Circular Economy Solid Waste Management Approach for Urban Areas in Kenya.

Assessment of the mitigation potential of this action and related assumptions has been based on the NAMA Proposal, together with information from both NCCA 2013-2017, SNC, and the NDC Sector Analysis Report 2017. The mitigation potential of the action is based on solid waste generation in Nairobi only, as there was no adequate data on other urban areas. However, the action targets at least 20 urban areas.

e. Implementation of the solid waste NAMA; A Circular Economy Solid Waste Management Approach for Urban Areas in Kenya

A NAMA proposal for a 'Circular Economy Solid Waste Management Approach for Urban Areas in Kenya' was developed by the MENR in 2016. The NAMA concept included the creation of recycling points for waste sorting and subsequent recycling, and composting facilities for organic waste treatment. The recycling and reuse would substantially reduce the amount of disposed waste and the related GHG emissions. The NAMA would support the recycling of up to 600 tonnes of waste each day, thereby reducing GHG emissions by more than 800,000 tonnes of CO₂e over the 15-year project period. If implemented successfully, and scaled up to other cities, it has the potential to be an NDC mitigation option. This NAMA is the only priority mitigation action proposed for the waste sector.

The NAMA, which has an abatement potential of 0.1 MtCO₂e per year by 2030, applies the circular economy concept that offers a unique opportunity for urban governments (cities and municipalities) in Kenya to transform Municipal Solid Waste (MSW) management practices, and to accelerate the adoption of sustainable MSW management methods, with significantly more recycling than currently practised. Instead of waste being collected for disposal only, the NAMA facilitates the diversion of at least 90% of collected waste away from disposal sites and towards various recycling practices. The NAMA aims at significantly improving MSW collection, recycling, and composting, through a robust framework and incentives for the private sector.

The mitigation component of the NAMA is the composting of the organic fraction of the solid waste, to produce commercial organic manure

with a mitigation potential of only 0.1 MtCO₂e per year. An alternative technology that could be applied on the organic fraction after recycling is the methane capture with power generation. This approach has a mitigation potential of 0.79 MtCO₂e per year by 2030. At the forecasted solid waste generation rate of Nairobi by 2022 (5,791 tonne/day)¹⁰¹, and assuming no significant change in the proportion of the waste that is biodegradable, the GHG emission reductions are estimated at 0.62 MtCO₂e per year by 2022. Previous assessments have estimated that Nairobi's Dandora dumpsite alone could generate between 11 to 64 MW of electricity from the captured gas at the site. For optimal mitigation benefits, implementation of the NAMA, but with gas capture and electricity generation, would be the preferred route.

The estimations are based on data from a Japan International Cooperation Agency (JICA) study in 2010 on solid waste management in Nairobi, which reported that Nairobi produced 2,400 tons of waste every day, only 38% of which is collected, and less than 10% recycled. Due to limited data on the amounts of waste in other major urban areas, only the Nairobi figures were used for the estimations. A constant waste per capita and a fixed fraction collection rate was assumed for the period after 2015. Therefore, a higher mitigation potential could be expected if the other major urban areas are considered.

f. Waste-to-Energy Incineration

Although this option has been rejected in previous consultations with key stakeholders and was not included in the recommended options for NCCAP 2018-2022, it still offers an opportunity for addressing the solid waste management problem in the bigger cities in Kenya, which are, Nairobi, Mombasa, Kisumu, Nakuru, and Eldoret. Plans are at an advanced planning stage for a waste-to-energy plant in Eldoret. Bamburi cement is incinerating tires and municipal waste near Mombasa.

Waste-to-energy incineration is popular in Europe, where nearly one quarter of all municipal solid waste is incinerated, with France alone having 126 waste-to-energy plants, while Germany has 121, and Italy 40. Modern waste-to-energy incineration plants operate within the strict emission limits of the European Union, and adopt modern back-end flue gas treatment technology to drastically reduce the release of heavy metals and dioxins produced from the burning.

In cities where land is in short supply like Nairobi, “waste-to-energy” incineration saves precious space, generates electricity, prevents the release of toxic chemicals into groundwater, and reduces the release of methane. From Nairobi’s 2,400 tonnes of MSW generated every day, a waste-

to-energy” incineration plant would produce 35-40 MW of renewable electricity (Ethiopia is producing 25 MW from 1,400 tonnes of MSW in the Reppie project, Koshe landfill site). This would reduce not less than 0.17 MtCO₂e of GHG emissions annually, with the potential for growth as the urban waste generation increases with increasing urban population in future.

Given Nairobi’s forecasted solid waste generation (5,791 tonne /day by 2022 and 7,427 tonne/day by 2030)¹⁰², the projected emission reductions from this action would be 0.36 and 0.46 MtCO₂e per year by 2022 and 2030, respectively. This assumes that all waste is incinerated. A feasibility study together with the related data would be required to guide further decisions making on this.

As previously discussed, in NCCAP 2013-2017 and the NDC Sector Analysis Report, additional options were not considered for analysis, mainly because of lack of reliable data to accurately estimate emission reduction potentials. These include the use of human waste for methane generation, industrial waste and composting, and wastewater management. The total mitigation potential of the prioritised action in the waste sector is summarised in Table 3.39.

Table 3.39: Proposed priority mitigation actions in the waste sector for the period 2018-2022.

Action	GHG Emission Reductions (tCO ₂ e)	
	Action up to 2022	Action up to 2030
Implementation of the Solid Waste NAMA		
With composting	0.10	0.13
With land fill gas capture and electricity generation	0.62	0.79
Incineration with electricity generation	0.36	0.46
Total Emission Reduction Potential (NAMA)	0.72	0.82
Total Emission Reduction Potential (Incineration with electricity generation)	0.36	0.46

From Table 3.39, it is evident that the NAMA implemented with land fill gas capture and electricity generation has a higher mitigation potential than incineration with electricity use. The two options are mutually exclusive as they

apply to the same solid waste. With either of the options fully implemented, the waste sector would be able to deliver the 0.4 MtCO₂e high range of emission reductions target by 2030.

g. Other Mitigation Options in the Waste sector not considered in the Emissions Reduction Analysis.

According to the NDC Sector Analysis Report 2017, and during the consultation meetings for NCCAP 2018-2022, a number of other mitigation options were proposed. The options are summarised in Table 3.40, but

have not been further analysed, mostly due to lack of adequate data and other relevant information. There is need to capture data on the various wastes to facilitate future analyses.

Table 3.40: Summary of Additional Mitigation Options for the Waste Sector for the Period 2018-2022 (GoK, 2017).

Additional Mitigation Options	Details/Preliminary Estimates of Emission Reduction Potential
Landfill gas flaring	This is similar to the landfill gas methane capture option, but the captured methane is simply burnt to avoid its release to the atmosphere. It is the second-best option because no electricity is produced and is not considered further in the mitigation scenario. Its mitigation potential would be similar to that calculated for landfill gas generation, if modern high efficiency flare technology was used. With older candle flares, up to 10% of the methane could be released un-burnt.
Wastewater treatment	A potentially feasible solution that could be considered in a future analysis. A 2010 study on agro-industrial wastewater suggested that the potential for methane capture and utilisation is relatively low because the methane potentials per cubic metre of wastewater are much lower than solid substrates due to the low content in organic material and high-water content. ¹⁰³
Waste-to-energy generation	Better suited to areas with a scarcity of space for landfill (because of the lower costs of using landfill) and waste with a lower moisture and higher energy content (less likely in Kenya because of a high organic waste content). ¹⁰⁴ While incineration could still prove beneficial under these conditions, there is a significant overlap with the option of electricity generation from landfill gas without appropriate waste separation practices, which are not currently found in Kenya. Bamburi cement operates a waste to energy incinerator in Mombasa. Geocycle collects, segregates, and incinerates waste, including biomass, waste oil, and waste tyres in the Bamburi kiln, in place of imported coal. The firm reports that it uses international waste management standards that leave no residue after disposal. Lafarge, Bamburi's parent company, states that scrap tyres used for thermal energy in a cement kiln could reduce GHG emissions by roughly 30% for every tonne of coal replaced, along with an expected 10 to 15% reduction in nitrogen oxide, but work is needed to determine GHG emission reductions in the Kenyan context. ¹⁰⁵
Anaerobic Composting	This involves a two-stage process of anaerobic digestion and composting. It could treat organic waste to recover energy in the form of biogas, and compost in the form of a liquid residual. Both would reduce methane emissions and produce a soil conditioner. In addition, the biogas could generate electricity via gas engines. However, it needs a feed stream of source-separated organic wastes, typically in the form of animal manure (which is not readily collected in Kenya) or municipal organic wastes (which are not collected in Kenya). Agricultural residues are considered as a cogeneration option in the country's energy sector.

3.6. 3 Enablers

a. Technology

A summary of the key mitigation technologies in the waste sector is provided in Table 3.41.

Table 3.41: Summary of key technologies in the transport sector.

Mitigation Option	Key Technologies Required
Solid Waste NAMA, incorporating, separation, recycling, composting, and landfill gas capture and utilisation	<ul style="list-style-type: none"> Waste sorting, separation and recycling technologies, incentives for collection, and recycling; and Landfill gas recovery systems, improved rates of collection and disposal, improved management of landfills, including daily cover, leachate systems, compaction, waste depth, regulatory framework for rights to landfill gas, incentives to install methane capture and energy utilisation facilities, feed-in tariff, MRV programme

b. Capacity Building

As a Country, Kenya is faced with limited technical competencies in waste management. This has led to poor management of waste management facilities and equipment, and their failure to attain optimal operating capacities.¹⁰⁶

Implementation of the fast component of the NAMA entails significant sorting of various types of waste, which include plastics, paper, glass, metal, and other electronic components. Awareness and separation at source is required.

Implementation of the landfill gas capture and utilisation (for energy) mitigation option consists of several hard and soft technologies. Hard technologies include, landfill gas recovery

systems that are employed in recovering/collecting the landfill gas (which consists primarily of methane and carbon dioxide in an almost equal ratio) for combustion; and compaction systems that compact the waste to increase a landfill's carrying capacity.

Other technologies are leachate systems that collect leachate to prevent it from percolating into and polluting ground water resources and energy generation and utilisation facilities. The main soft technology for Kenya is appropriate institutional and regulatory framework.

c. Finance and Budgets

According to the Solid Waste NAMA proposal, the estimated cost of the NAMA for the pilot phase in Nairobi alone is USD 39 million. The National Waste Management Strategy

estimates that about USD 300 million¹⁰⁷ would be required to implement the full strategy, which includes the management of both solid and liquid waste in major urban areas of Kenya.







CHAPTER FOUR

Implementation

4.1 Introduction

Over the Vision 2030 period, climate change action will be implemented through selected and prioritised measures covering both mitigation and adaptation. The mitigation-related actions, together with their mitigation potential, have been analysed in Chapter 3 of this MTAR, while the adaptation potential and broader benefits have been analysed in ATAR 2018-2022, which is Volume 2 of NCCAP 2018-2022.

It is intended that the implementation of each of the priority mitigation actions be developed as part of the early implementation stages. This section therefore defines the implementation approach and initial preparatory steps, and also provides an effective basis for ongoing planning by entities involved in implementation of the actions. It is also intended that the implementation will be scalable and flexible. More detail and work will be required before a detailed implementation plan could be developed for each of the mitigation actions. Both 'quick wins' and 'big wins' should be prioritised during implementation.

It is assumed that the appropriate level of resources required to ensure efficient and effective implementation of each of the priority

mitigation actions will be allocated. This includes financial investment, the management of staff and stakeholder time, staff training and development, and the application of appropriate organisational management and governance processes and procedures.

In the approach, provision has been made for carrying out Risk Assessment of the actions early in the implementation process. Risk assessment, will reflect adequate consideration of key risks to the implementation, throughout the entire implementation process, and not just at the beginning. This is particularly important as significant behaviour change is expected for successful delivery of the proposed actions.

This chapter covers the implementation of the prioritised mitigation actions in this MTAR, including the measurement, reporting, and verification (MRV) of the progress. The MRV indicators are high level and will be developed in detail at the action level. Most of the actions have either started or are ready, awaiting immediate kick-off activities. Detailed plans will be developed at the Sectoral and County levels, as well.

4.2 Implementation Approach

To ensure effective implementation of the plan, the priority actions in this MTAR and NCCAP 2018-2022 have been aligned with the existing National Climate Change Framework Policy (2016), the Climate Change Response Strategy (2010), the Climate Change Act (2016), ongoing programmes such as the Big Four Agenda 2018, existing structures, and the established development planning frame work for Vision 2030 that is implemented through a series of 5-year Medium Term Plans (MTPs) at the National level, with County Governments implementing County Integrated Development Plans (CIDPs) that are aligned to the National MTPs.

Throughout the implementation process, appropriate and just-in-time capacity building and awareness creation activities will be carried out. In order to realise Vision 2030 and deliver

the NDC mitigation targets for Kenya by 2030, implementation must be an ongoing process, and must respond to changes in the climate, demographics, economic development, and energy trends, both nationally and internationally.

There are a wide range of sectors and stakeholders that will be involved in the implementation of the mitigation actions that have been prioritised in this MTAR. It will be essential for the National Government to play a prominent role, given the need for leadership and coordination between different layers of government and other stakeholders, including the private sector and civil society.

The set of priority mitigation actions identified in this MTAR is not exhaustive, but offers a first perspective on the prioritised set of actions

that could be implemented. However, the set of measures has the potential to support the country's delivery of the NDC mitigation target by 2030, and have been prioritised for implementation, mostly through integration in the MTP process.

While the prioritised mitigation actions present obvious advantages and benefits once implemented, it is clear that many barriers must be overcome for NCCAP 2018-2022 to fully deliver on its promise. Implementation will only succeed with harmonised coordination across all sectors. Finance will be required and at the appropriate scale so as to effectively support implementation of the prioritised actions, and envisaged broader institutional needs. Leadership, inter-agency coordination, sustainable stakeholder engagement, and effective MRV frameworks will also be critical to enable successful and timely implementation of the mitigation actions. Some of these aspects have been discussed under enablers for each of the six sectors in chapter 3. It is envisaged that the NCCAP 2018-2022 MRV system will be integrated into the National Monitoring and

Evaluation (M&E) Framework that covers Vision 2030, NCCAPs, and NAP 2015-2030, addressing both Kenya's long-term development goals that are enshrined in Vision 2030 and fulfilling the country's global obligations towards combating climate change, including Kenya's NDC.

Additionally, capacity building and awareness creation activities will be critical in Kenya at all levels of government and with all stakeholders to ensure adequate public support and human capacity to implement the actions prioritised in this MTAR and NCCAP 2018-2022. To create common and adequate understanding of the benefits of implementation, and overcome potential resistance to change that could accompany implementation of the actions, effective communication of the benefits of the actions will be required at many levels across government, the private sector, and within the civil society. Training and awareness creation will be a cross-cutting and ongoing process in the implementation of the prioritised actions and delivery of NCCAP 2018-2022. Table 4.1 presents the mitigation implementation matrix.



Table 4:1: Mitigation Implementation Matrix

Sector	Issue/problem	Strategic Objective	Actions	Expected Outputs)	Expected Outcomes	Key Performance Indicators	Responsible Agency	Time Frame	Estimated Budget
Agriculture	Climate change is negatively impacting agricultural productivity and the resilience of value chain actors, including households (farmers, pastoralists and fisher communities)	Reducing GHG emissions from agricultural systems, without compromising productivity	<ul style="list-style-type: none"> Increase the total area, under agroforestry at farm level by 200,000 acres (81,000 hectares) by 2022. Increase farm area under sustainable land management by 250,000 acres (101,000 hectares) by 2022. Implement the Dairy Nationally Appropriate Mitigation Action (NAMA)-267,000 households involved in the programme leading to Greenhouse Gas emissions reductions. 	200,000 acres of farmland agro-forested 250,000 acres of farm area under sustainable land management 267,000 households participating the dairy NAMA	<p>Increased tree cover and increased sequestration</p> <p>Improved agricultural production</p> <p>Improved dairy sector productivity with reduced emissions</p>	Acres of farmland agro-forested GHG emissions from the agriculture sector	Ministry of Agriculture, Livestock, Fisheries, and Irrigation (MALFI), KFS, County Governments	5 years	
Energy Supply	Renewable (and affordable) electricity supply with low GHG emissions needs to increase to meet the demands of a growing population and industrializing nation.	Ensure an electricity supply mix based mainly on renewable energy that is resilient to climate change, and promote energy efficiency	Develop 2.405 MW of new renewables (Geothermal: 913 MW, Solar: 442 MW, Hydro: 93 MW, Wind: 800 MW, Biomass/Biogas: 157 MW and Distributed solar and mini-grids; 30 MW) and retire 300 MW of thermal plants (Kipevu: 120 MW, IberAfrica: 108.5 MW and Tsavo: 74 MW) by 2022	Additional 2.405 MW of renewable electricity in the grid	<p>Adequate and reliable clean electricity with reduced GHG emissions</p> <p>GHG emissions from the energy supply sub-sector</p>	Additional generation capacity in MW of renewable electricity added to the grid	MoE, ERC, KenGen, KP, County Governments, Local NGOs, Private sector, GDC	5 years but phased out specific project s	
Energy demand	80% of Kenyans depend on biomass for primary energy most of which is non-renewable. This leads to indoor air pollution and deforestation	Enhancing energy security and reducing dependence on unsustainable energy resources	<ul style="list-style-type: none"> Develop and distribute 4 million improved biomass stoves by 2022 -Charcoal (2 million) -Biomass (2million) Develop and distribute 1 million clean energy stoves by 2022 -Develop LPG (500 units), biogas (250 units), and ethanol (units) stoves and related supply chains 	<ul style="list-style-type: none"> • 4 million stoves distributed and in use in Kenya • 1 million clean fuel stoves distributed and in use in Kenya (500 LPG, 250 biogas and 250 LPG) 	<ul style="list-style-type: none"> Reduced biomass use for cooking and heating Reduced GHG emissions from cooking and heating 	<p>Number of stoves distributed and in use</p> <p>GHG emissions from cooking and heating</p>	MoE, KFS, ERC, County Governments, Local NGOs, Private sector	Phased out distribution of stoves over 5 years (400,000 stoves per year)	Ministry of Petroleum and Mining (MPM), MoE, KFS, ERC, County Governments, Local NGOs, Private sector

Forestry	Increasing GHG emissions from deforestation and degradation of forest ecosystems and other landscapes	Reduce deforestation and forest degradation by rehabilitation and protection of additional 100,000 hectares of natural forests (including mangroves) by 2022 via: -Community/participatory forestry management -Limiting access to forests -Preventing disturbances through improved enforcement and monitoring -Developing alternative technologies to reduce demand for biomass (e.g., clean cooking, efficient charcoal production, briquetting) -Carbon stock enhancement (tree planting) in existing forests -Financial innovations including payments through REDD+ / carbon markets	100,000 Ha of forest with covered by the REDD+ program by 2022	Increased forest cover and increased GHG sequestration	Area of forest rehabilitated and protected in hectares. GHG emissions from the action	MEF, KFS, KEFRI, CoG, County Governments, Community Forestry Association (CFAs), Private Sector, NGOs	5-year phased out implementation (20,000 hectares per year)
		Support afforestation and reforestation in Counties, with the aim of planting one million trees per County per year (additional 100,000 hectares by 2022): -Institute an annual National Tree Planting Day -Implement the National Mangrove Ecosystem Management Plan. -Revive Green Schools Programme – 10% of school land areas planted with trees -Increase tree nurseries and production and availability of seedlings -Tree planting -Expand and protect	100,000 hectares of additional reforested/afforested land by 2022	Increased forest cover and GHG sequestration	Area afforested/reforested in hectares. GHG emissions from the action	MEF-KFS, MALFI, KEFRI, CoG, County Governments, Farmers, Community Institutions, Private sector	5-year phased out implementation (20,000 hectares per year)
	Forestry						

Table 4.1: Mitigation Implementation Matrix

Sector	Issue/problem	Strategic Objective	Actions	Expected Outputs)	Expected Outcomes	Key Performance Indicators	Responsible Agency	Time Frame	Estimated Budget
			mangrove forest cover (for coastal adaptation and blue carbon sequestration) -Promote trees on farms -Forest management and planning -Silviculture interventions sequestration) -Promote trees on farms -Forest management and planning						5-year phased out implementation (40,000 hectares per year)
Forestry	Increasing GHG emissions from deforestation and degradation of forest ecosystems and other landscapes	To increase tree cover to 10% of the total land cover	Restoration of up to 200,000 hectares of forest on degraded landscapes (ASALS, rangelands) •GCF Dryland Resilience Project -Enhanced natural regeneration of degraded lands through conservation and sustainable management -Ecosystem-based Adaptation through rangeland and forest landscape restoration and sustainable management (sites include rangelands, woodlands/forests, wetlands, and croplands) -Process to initiative restoration processes on 33% of land area in 7 counties. •AFR100 commitment in 2016 to restore 5.1 million hectares -Analysis of priority landscapes, existing restoration successes -Economic analysis of restoration options -Identification of financing options to scale up landscape restoration	200,000 hectares of degraded landscapes restored by 2022	Increased forest cover and GHG sequestration	Area of degraded landscapes restored in hectares.	MEF-KFS, MALFI, NDMA, KEFRI, National Treasury and Planning, Frontier Counties Development Council, 7 ASAL County Governments, IUCN, FAO, UNEP, Greenbelt Movement, Community institutions		

Forestry	Increasing GHG emissions from deforestation and degradation of forest ecosystems and other landscapes	Increase area under private sector-based commercial and industrial plantations from 71,000 hectares to at least 121,000 hectares •Standards and regulations for sustainable forestry management (voluntary moving to regulated)	At least 50,000 hectares of additional plantations by 2022	Increased forest cover and increased GHG sequestration	Area of additional private plantations in hectares. GHG emissions from the action	KEPSA, KAM, Private Sector (Tea Industry, Kenya Commercial Bank, Green Pot Timsales, Rail Ply, Kakuzi, Lafarge, East Africa Breweries)	5-year phased out implementation (10,000 Ha per year)
	Inefficient use of resources	Promote/encourage the growth of green industry to drive jobs in the manufacturing sector	Implement the NAMA for the Charcoal Sector in Kenya. (Linked to the forestry sector mitigation actions)	1.6 million tons of renewable charcoal produced per year by 2030	Reduced depletion of forests and GHG emissions from charcoal production	Amount of sustainable charcoal produced in efficient kilns GHG emissions from charcoal production	KFS, MITC, KEBS, KIRDI, KAM, KEPSA, Farmers, KEFRI, Charcoal producers, County Governments, Police, MEF
Industry	Operational inefficiency, heavy congestion, heavy fuels, and high fuel consumption leading to high levels of GHG and air pollutant emissions	Establishment of efficient, safe, sustainable, world-class transportation system and logistic services	Implementation of the Mass Rapid Transport System (Bus Rapid Transit System with Light Rail) for Greater Nairobi	13 km of BRT system constructed and operational	Efficient low carbon mass transport operational	Length of BRT system installed and operational Passenger-km travelled by the BRT	MOTIHUD, Nairobi Area Metropolitan Authority (NAMATA), County governments, Kenya Railways Corporation (KRC)
Transport	Improvement of the Heavy-Duty Truck Efficiency	Transfer of Freight from Road to Rail Between Nairobi and Mombasa	30% of freight transferred from road to rail	Average	Efficient low carbon mass transport operational	Length of BRT system installed and operational GHG emissions of the urban transport system	MOTIHUD, KRC, National Transport Authority (NTSA), .
	Electrification of the SGR Line Between Nairobi To Mombasa by 2022	Nairobi To Mombasa SGR electrified	Clean rail transport	and passenger-km moved by electric trains	MOTIHUD, KRC, National Transport Authority (NTSA) Country	5 years with annual incremental increases in efficiency	1-2 years

Table 4.1: Mitigation Implementation Matrix

Sector	Issue/problem	Strategic Objective	Actions	Expected Output(s)	Expected Outcomes	Key Performance Indicators	Responsible Agency	Time Frame	Estimated Budget
Waste	Poor solid waste management system in major urban areas of the country leading to poor sanitation, low waste collection levels and environmental pollution	Improved Solid Waste Management in Major Urban Areas	Implement the Solid Waste NAMA to achieve 30% waste recovery (recycling, land fill and composting) and 70% controlled dumping (tipping, compacting, and recovery) in at least one urban area in each 20 counties by 2022	30% waste recovery (recycling, land fill and composting) and 70% controlled dumping (tipping, compacting, and recovery) in at least one urban area in each 20 counties by 2022	Improved solid waste management	GHG emissions of the urban transport system Proportion of solid waste that is recycled GHG emissions in the waste sector	Governments, KETRACO.) MEF-NAMA, Cog County Governments, private sector, NGOs		

4.3 The Enablers

Besides the specific enablers identified for each sector in Chapter 3, the prioritised mitigation actions outlined in Chapters 3 would not be possible without processes that support implementation of the actions; the enablers. These provide a foundation for current and future actions, and will be continuously reviewed and improved.

a. Institutional Infrastructure

1. Enabling Leadership and Responsibility

Kenya has consistently demonstrated its commitment to tackling climate change, both domestically and internationally, and has taken steps to comply with international commitments to tackle climate change. Kenya ratified the United Nations Framework Convention on Climate Change (UNFCCC) in 1994, and has been a party to the Kyoto Protocol since 2005. Since then, Kenya has been building up technical and institutional capacities in climate change policy. The country has taken steps to comply with its national pledges, including the Paris Agreement which it ratified in 2016, having developed the country's NDC.

In line with the Climate Change Act 2016, the development NCCAP 2018-2022, together with the supporting MTAR 2018-2022 and ATAR 2018-2022, which define Kenya's low carbon climate resilient pathway towards the realisation of Vision 2030, has been led by the Cabinet Secretary for Environment and Forestry. While Vision 2030 will be spearheaded by the President, the implementation will be the responsibility of every citizen of Kenya in government, private sector, civil society, political organisations, and other institutions.

NCCAP 2018-2022 and MTAR 2018-2022 are

The broad but key enablers are institutional infrastructure, legal and regulatory framework, fund mobilisation (finance and budgets) capacity building and knowledge management, and integrated planning and data management. These enablers have been discussed in detail hereafter.

aligned with Kenya's development aspirations as articulated in Vision 2030, the Big Four Agenda and other national development goals. NCCAP 2018-2022 requires transformation of core systems necessary for the effective functioning of the economy, such as energy, transport, and food systems. Such transformation often involves messy and conflicted processes requiring navigation and engagement by high-level leaders, and broader coalitions of support.

Inspirational, high-level leadership will play a crucial role in initiating and sustaining implementation of this ambitious plan. However, the critical role played by individual leaders in driving the plan processes means that long-term implementation is potentially vulnerable to political transitions and shifting priorities by leadership. Strategies to effectively manage political transitions, such as institutionalisation of the implementation process, are therefore essential for the long-term viability in delivering the NDC and Vision 2030.

Broadly, the National Government will provide overall leadership, play a facilitative role, and provide an enabling environment (institutional, legal, infrastructure etc.) upon which the plan will be established.

2. Supporting Inter-Agency Coordination and Roles

To implement this plan, it is critical for Kenya to create institutional arrangements that allow for transparent and effective flow of information, knowledge, and financial resources. Given the highly multi-sectoral nature of the plan, and the focus on the mainstreaming of a cross-cutting issue (issue-based), the institutional and resource mobilisation set-up to support its implementation must inherently involve multiple structures and mechanisms.

Counties will align their Strategic Plans and CIDPs to Vision 2030 which is the National development blue print for the period up to the year 2030, MTP III and NCCAP 2018-2022 through consultative processes. For efficiency and effectiveness, and to ensure legal compliance, this will be established on the institutional structures and responsibilities defined in the *Climate Change act 2016*.

While the prioritised mitigation actions could be allocated to specific ministries to lead in their implementation, they are cross-cutting and multi-sectoral in nature. They also involve other stakeholders, including the civil society and private sector. Therefore, responsibility for implementation rests with many stakeholders, operating at different levels and scales. This makes co-ordination a big challenge. The specific roles of different stakeholders in facilitating,

synergising, and supporting the transition process are defined in the *Climate Change Act 2016*.

The Climate Change Directorate (CCD) will be the focal climate change institution. All concerned ministries, departments and agencies have a role to play. A similar management arrangement could be mirrored at the County level where, through the multi-stakeholder structures, both at the National and County levels, civil society and the private sector will also play crucial roles not only in the coordination, but also in the policy implementation process. It is also understood that all individual citizens in Kenya, through their own awareness and voluntary approach to behavioural change and resource use, are the ultimate implementers of a number of the actions. Public knowledge and awareness raising will be an ongoing and continuous component of the implementation.

Each of the ministries, departments and agencies (MDAs) involved in the implementation of the actions will designate a focal point to be accountable for the implementation of the prescribed policy responses and actions that concern their ministry, department, or agencies.

Kenya has established a Climate Fund to receive and manage climate funds that flow into the country. CCD is responsible for



UNFCCC engagement and documentation.

Research and innovation is essential in facilitating low carbon development. The Ministry of Education will work on capacity building in schools, while universities and research institutions will research on some of the challenges facing the country. To this end, research institutions will be called upon to reorient their research, innovation, and training towards activities that target priority mitigation actions. It is especially important to ensure that innovations are actually reaching practitioners that transform research results into something functional.

Banks and financial institutions, including insurance companies, savings and credit co-operative organisations (SACCO), and microfinance institutes will be required to develop and provide innovative products and services that support the priority actions. Such facilities will be critical in encouraging entrepreneurs and enterprises. Media and, information and communication technology (ICT) will also play a crucial role in awareness raising. This will bring about the much needed behaviour and attitudes change towards low carbon development and associated action.

The Kenya National Bureau of Statistics (KNBS) is responsible for the acquisition, documentation, dissemination, and preservation of micro-data and related metadata.

There are many opportunities for mitigation actions at the County level. However, effective coordination between the two levels of government, and the required support for implementation actions at the County Government level, will be prerequisite to success, and for building synergies and avoiding duplications that could lead to waste. The private sector will play an important role in implementing this through adoption of the mitigation technologies and practices in a self-sustaining way.

The above-mentioned arrangements represent collaborative mechanisms that will bring responsible authorities and stakeholder groups together, on a regular basis, to discuss, develop, and validate policy, strategies, and actions.

Participatory planning will continue to be applied at the sub-national level. The structures and roles will be established in a formal way and described in more detail as part of the initial implementation steps for the planned actions.

The institutional infrastructure will facilitate the mainstreaming of the actions into Vision 2030, sector policies and strategies, and annual budgeting and planning processes. To ensure that local needs are met, mainstreaming the actions into policy and planning at the sub-national and county levels is also necessary. Participatory planning will continue to be applied at the sub-national level.



b. Appointing Low Carbon Development Champions

National and sub-national champions will play a crucial role in making the case for change and providing leadership during the change process. It is essential that there be a champion at the national level to guide NCCAP 2018-2022 through both the approval process and the initial years of implementation. The national champion will not only drive the process forward, but ensure good communication and coordination between all players involved in implementation, as well. The Cabinet Secretary for Environment and Forestry will appoint the national champion.

In addition, climate change champions or institutional focal points will be appointed from senior ministry levels down to the County

level. The role of the champions (focal points) will be to act as focal points (one-stop shop) for the implementation of actions at their respective levels and within their organisations. Although the government has urged each and every citizen of Kenya to be a champion for achievement of the sustainable development goals, especially Goal 13 that challenges the government to “take urgent action to combat climate change and its impacts,” the role of coordinating all related efforts is critical and has been assigned to CCD, which is the Secretariat to the National Climate Change Council (NCCC).

c. Ensuring Sustainable Stakeholder Engagement

Stakeholders are the people who will be affected by the actions or who could influence them. Stakeholders either influence the change or are affected by the change, and are uniquely positioned to help or hinder implementation of the change. Through a stakeholder analysis

process, CCD will identify and enlist support from stakeholders. This process will help the team begin to discover ways to influence relationships and strategies to ensure that the project had the appropriate involvement and support from the key stakeholders.

d. Legal and Regulatory Framework

The Legal and regulatory framework for climate change provides legitimacy, regulates conduct, and establishes sanctions that could ensure compliance. Because of the potential impact of climate change on the realisation of Vision 2030, and in furtherance of the UNFCCC principles, the government has put in place the necessary policy,

regulatory, and institutional framework through the *Climate Change Act*, which was passed into law in 2016. This Act will provide most of the required legal framework for implementation of the priority mitigation actions. However, for some actions, a review of the legal frameworks at the sectoral or County levels will be required.

e. Fund Mobilisation

Adequate and predictable financial resources are a crucial component for achieving Kenya's ambitious mitigation objectives. To implement the actions, significant fund mobilisation will be required and must be prioritised in the implementation arrangements. It is estimated that Kenya will need more than USD 15 billion to finance the proposed mitigation measures by 2022. Given the extent of projected climate action in Kenya, it is important to ensure that all sources of finance could be mobilised, including international, domestic, public, and private, and through Public-Private Partnerships (PPPs). Kenya

therefore requires a suitable framework to attract and efficiently utilise climate finance.¹⁰⁸ Therefore, fund mobilisation measures will be fast-tracked for successful implementation of the actions.

A good starting point for fund mobilisation would be a comprehensive analysis of current and soon to be climate funds, identifying funds by sector, size, mandate, type of finance, project types, decision-making structure, application procedure, status in Kenya, including local contacts, project examples, links, and the key contacts. The country has already built significant internal capacity, including the establishment of

the Climate Change Fund that will allow Kenya to access climate finance. In addition, the overall investment climate of Kenya has been, and should continue to be, strengthened through targeted policy reviews and implementation, while building mechanisms to facilitate the use of public finance to leverage private investment. Implementation will also include targeting specific PPPs.

The Cancun Agreements at COP16 made significant progress on areas related to climate finance, including the establishment of a Green Climate Fund, securing USD 100 billion per year in long-term financing for developing countries by 2020 from a mix of public and private sources, establishment of the Adaptation

f. Sources of Funds

1. Climate Finance

Up to now, most funds dedicated to climate-related expenses have come from international funders. To raise the amount needed for Kenya to pursue a low carbon development, current levels of international funding will need to increase significantly and be complemented with national and private sector financing.

Developed nations have set a goal of mobilising USD 100 billion per year by 2020 to support mitigation and adaptation activities in developing countries. To ensure that Kenya is effectively positioned to access this financing on its climate and development priorities, Kenya has established a National Climate Change Fund that will effectively manage and implement the projects, and track climate finance, hence improving transparency and accountability. A number of Counties are also at different stages of establishing their own climate change funds.

Climate finance remains central to achieving low-carbon, climate resilient development. The global climate finance architecture is complex and always evolving. Funds flow through multilateral channels, both within and outside of the UNFCCC Financial Mechanism, and increasingly through bilateral, as well as through regional and national

Committee, and establishment of a Nationally Appropriate Mitigation Actions (NAMAs) registry.

Kenya has developed a number of NAMAs that need to source climate financing as part of the implementation of NCCAP 2018-2022. Any emission reduction commitments made by Kenya in the future will need to be against the business-as-usual (BAU) baselines already established in NCCAP 2013-2017, and elsewhere, and their economic impacts must first be analysed.

Initially, the early implementation activities will be funded through the national budget.

Climate finance refers to additional or incremental investment made in activities aimed to climate proof programs and projects against climate change impacts including deliberately reducing greenhouse gas (GHG) emissions.

Source: GoK (2016); Climate Public Expenditure and Budget Review (CPEBR)

climate change channels and funds. In 2014 alone, it is estimated that that USD 62 billion in public and private sources were directed to developing countries from developed countries.¹⁰⁹ There are more than forty multilateral and bilateral climate funds and programmes that are active in the sub-Saharan region.¹¹⁰ Therefore, there are numerous international sources that could help fund Kenya's prioritised mitigation actions. Monitoring the flows of climate finance is difficult, as there is no agreed definition of what constitutes climate finance or consistent accounting rules. The wide range of climate finance mechanisms continues to challenge coordination. However, efforts to increase inclusiveness and complementarity, and to simplify access continue.

Kenya has great potential to attract the financial resources it needs to develop in a low-carbon way, but at the rate implied rate in Vision 2030, Kenya will need to leverage much more funds from both multilateral and other bilateral sources, including such new donor countries as China, Saudi Arabia, Brazil, and India.¹¹¹ Vision 2030 already highlights the need for significant resources to move Kenya to a newly industrialising, middle-income country by 2030. If the country is to follow a low

carbon development pathway to achieve its goal, it will require specific financing needs, either substituting or adding to the already established ones. Such a development pathway would allow Kenya to attract substantial external funding.

Between 2005 and 2015, the Government had committed approximately USD 370million to climate change action, while development partners had committed USD 1.94 billion to programmes that they classified as having a 'significant' or 'principal' climate change component¹¹². With focus particularly on public climate financing mechanisms, there are a number of channels through which climate finance flows, including multilateral climate funds are dedicating to addressing climate change. Several developed countries have also established climate finance

2. Multilateral Channels for Climate Finance

Established in 1991, the Global Environment Facility (GEF) is an operating entity of the Financial Mechanism of the UNFCCC, serving in the same function for the Paris Agreement, and with a long track record in environmental funding. As of March 2017, the GEF's cumulative funding approval amounted to USD 4.7 billion, making the GEF the largest single source of cumulative multilateral funding for climate change actions.

The GEF also administers the Least Developed Countries Fund (LDCF) and the Special Climate Change Fund (SCCF) under the guidance of the UNFCCC Conference of the Parties (COP). As of October 2017, the LDCF and SCCF had made cash transfers to projects of USD 493 million and USD 201 million, respectively. Also formally linked to the UNFCCC, is the Adaptation Fund (AF), with total cash transfers to projects of USD 237 million by end 2017.

The Green Climate Fund (GCF) of the UNFCCC was agreed at the Durban COP and became fully operational with its first projects approved at the end of 2015. By October 2017, the implementing partner network of the GCF had grown to 59 Accredited Entities and the GCF had approved a total of 54 projects with USD 2.6 billion in GCF funding commitments.

At COP 16, the Standing Committee on Finance was established under the UNFCCC

initiatives or are channelling climate finance through their bilateral development assistance institutions. Many developing countries, including Kenya, have also set up regional and national funds and channels to receive climate finance.

The types of climate finance available vary from grants and concessional loans, to guarantees and private equity. The architecture has differing structures of governance, modalities, and objectives. While the transparency of climate finance that is programmed through multilateral initiatives is increasing, detailed information on bilateral initiatives, and regional and national funds are often less readily available.

to assist COP in meeting the objectives of the Financial Mechanism of the Convention. The Standing Committee on Finance¹ has been tasked with, among other things, preparing a biennial assessment of climate finance flows, the second of which was published in 2016 and detailed flows from 2013-2014 (UNFCCC, 2016).

A substantial volume of climate finance has been channelled through institutions that are not directly under the guidance of the UNFCCC COP. The Climate Investment Funds (CIFs) established in 2008 are administered by the World Bank, but operate in partnership with regional development banks, including the African Development Bank (AfDB). The CIFs include a Clean Technology Fund with USD 2.75 billion in cash transfers by October 2017, and a Strategic Climate Fund (SCF), with USD 856 million in cash transfers to projects as of October 2017. The SCF is composed of the Pilot Program for Climate Resilience (PPCR), the Forest Investment Program (FIP), and the Scaling-Up Renewable Energy Program for Low Income Countries (SREP).

Multilateral Development Banks (MDBs) play a prominent role in delivering multilateral climate finance, with climate finance commitments of USD 27.4 billion made in 2016 alone¹¹³. Many have incorporated climate change considerations into their core lending and operations, and most MDBs now also administer

climate finance initiatives with a regional or thematic scope. The World Bank's carbon finance unit has established the Forest Carbon Partnership Facility (FCPF) to explore how carbon market revenues could be harnessed to reduce emissions from deforestation and forest degradation, forest conservation, sustainable forest management and the enhancement of forest carbon stocks (REDD+). It also manages the Partnership for Market Readiness and the Bio Carbon Fund. The European Investment Bank administers the EU Global Energy Efficiency and Renewable Energy Fund (GEEREF).

The African Development Bank also finances enhanced climate finance readiness in African countries through the German-funded Africa Climate Change Fund (ACCF), whose

first projects were approved in 2015. The African Development Bank is also the Trustee for the Africa Renewable Energy Initiative (AREI) and will house the AREI Trust Fund with expected USD 10 billion in resources.

Both MDBs and UN Agencies act as implementing entities for the GEF, SCCF, LDCF, AF and the GCF. The UN-REDD Programme that was made operational in 2008, brings together UNDP, UNEP and the FAO to support REDD+ activities. The International Fund for Agriculture and Development (IFAD) administers the Adaptation for Smallholder Agriculture Programme (ASAP) that supports smallholder farmers in scaling up climate change adaptation in rural development programmes.

3. Bilateral Channels for Climate Finance

A significant share of public climate finance is spent bilaterally, administered largely through existing development agencies, although a number of countries have also set up special bilateral climate funds. The Climate and Policy Initiative estimated that USD 12-19 billion was directed through governments, ministries, and bilateral agencies in 2014 in addition to what was spent through climate funds and development finance institutions, including climate related ODA.¹¹⁴

As of April 2017, Germany's International Climate Initiative had provided USD 2.7 billion for more than 500 mitigation, adaptation, REDD+ projects since its establishment in 2008. The United Kingdom (UK) government has committed USD

12.7 billion to its International Climate Fund through to 2021, and so far, has channelled a substantial share of ICF money through dedicated multilateral funds, including the CIFs and the GCF. Together with Germany, Denmark and the EC, the UK also contributes to the NAMA Facility. Germany, the UK and Denmark also support the Global Climate Partnership Fund (GCPF). Germany and the UK also support the USD 141 million REDD+ Early Movers Programme (REM). Norway's International Forest Climate Initiative has pledged USD 377 million each year since 2008 through bilateral partnerships, multilateral channels, and Civil Society.



4. Regional and National Channels and Climate Change Funds

Several developing countries have established regional and national channels and funds with a variety of forms and functions, resourced through

international finance and/or domestic budget allocations and the domestic private sector.

5. National Financing and Private Sector Investment

The challenges to accurately estimating funding for climate change activities are even stronger on the national front. However, Kenya has developed significant capacity in this area with appropriate codes and accounting systems, which are yet to be effectively used for tracking public, and even, climate funds.

The key actor in Kenya is the National Treasury. The main role of the MEF should be to facilitate linking of the policy formulation processes with the institutional architecture and the national budgetary system. The effectiveness of climate finance, particularly in the long term, "depends critically on the strength of the public finance management system."

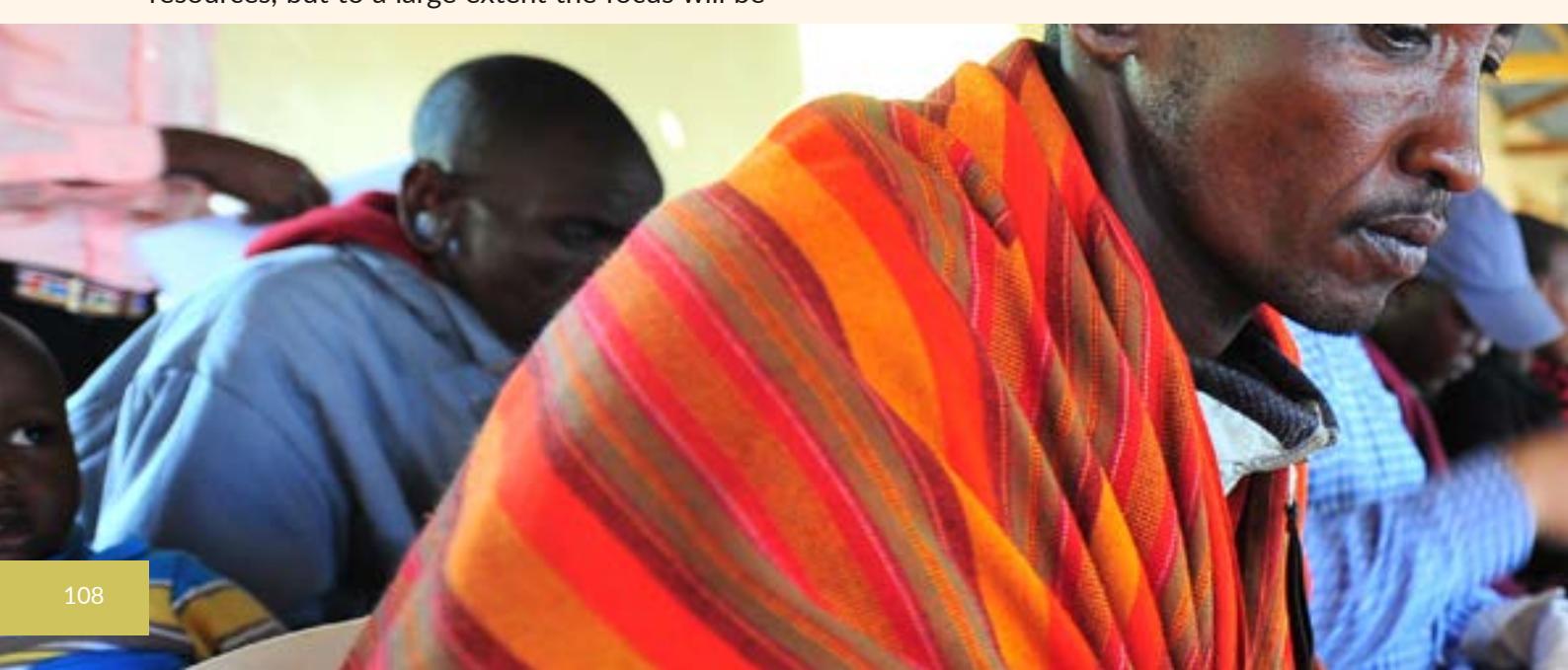
6. Private Sector investment

Despite the potential sources of international finance and the prospects of increasing investments from the National Government, these funds will fall short of the financial requirements of the Kenya's low carbon climate resilient pathway actions in NCCAP 2018-2022. Private foreign direct investment (FDI) will play a critical role in placing Kenya on the low carbon development path. In the past, emerging markets experienced a boom in FDI, which represented 39% of external financial flows, increasingly exceeding ODA in the African continent.¹¹⁵ Despite a global decrease in FDI during the year 2014, Africa was the continent least affected and its "FDI project numbers remain substantially above pre-2008 levels"¹¹⁶ FDI will continue to flow to the region, which will not only focus on projects to tap the continent's vast natural resources, but to a large extent the focus will be

shared with consumer products and retail, as well as technology, media, and telecommunications.¹¹⁷

Mobilising private finance at an appreciable scale requires equating or reducing the risks of low carbon investments to the same level as those faced by alternative, conventional investments. Particular attention should be given to delivering market-based signals, conducive macroeconomic policies, providing basic infrastructure and security.¹¹⁸

To leverage international funds and private FDI for low carbon development, the government of Kenya will need to align policies and institutions around a budget making process that uses its public resources strategically. International funds and public finance should be used to leverage private investment.



7. Capacity Building and Knowledge Management (Training and Awareness Creation)

To effectively implement NCCAP 2018-2022, significant awareness will be created regarding the plan at all levels of government, and among the public, non-governmental organisations, and the private sector. Awareness creation programmes will therefore be initiated early as part of the implementation plan, and will be sustained throughout the implementation process. In addition, financial and technical capacities will have to be built among the stakeholders, especially government planners at all levels. The capacity building will be in the form of just-in-time training, followed by immediate practical application of the concepts and tools that will be developed by CCD.

Training is necessary on key aspects of implementation as a way of preparing key implementers and stakeholders for implementing the plan. In addition, further technical training will be required for various stakeholders on sectoral and technical aspects of implementing the strategy in specific sectors and counties.

Many of the prioritised mitigation actions are knowledge-intensive and require new skills across sectors and management levels. Capacity building efforts create the foundations of adaptive management and stakeholders' ability to implement the plan. With strengthened coordination at the national, sectoral, and County Government levels and appropriate technical support, CCD, with the support from NCCC and the Council of Governors (CoG), will develop a comprehensive capacity building plan as one of

the first steps in the implementation. The plan will target government sectors, County Governments, and ministries, departments, and agencies.

The capacity building component encompasses codifying and integrating knowledge, and transferring knowledge and tools developed during the project to the local partners and stakeholders. In the short term, key government staff from all government ministries and key institutions will undergo capacity building in the plan. To build capacity in specific areas, Kenya will bring in international experts to work with and train National and County Government employees. Kenya will also send government employees to other countries to receive high quality on-the-job experience and training. Scholarships will be provided for graduate study on international courses in the fields related to various priority actions.

Significant capacity building is required for the Kenya National Bureau of Statistics (KNBS) to provide good quality and timely data. Capacity and training needs include good observational network, efficient telecommunications system, data processing facilities for product generation and data archival, trained human resources, and effective dissemination system. Further training and capacity building for sectoral staff will be required in sectoral GHD emission baselines and emission factors. All actions to create awareness and build capacity will build on exiting efforts.



8. Integrated Planning and Data Management

Climate change is a cross-cutting issue with long-term impacts on Kenya's economy. Due to the multi-sector constraints facing the country, integrated planning of multiple sector measures is necessary. Such planning systems will enable the Government to invest in the most efficient way, producing the maximum return on investment, while accommodating different sector needs during the implementation of NCCAP 2018-2022.

To facilitate data and facts-based decisions and scenario planning, the collection, analysis, and application of robust data across sectors will be required. An integrated set of analyses will be required to understand the feedbacks and interconnections between various climate-sensitive systems under future scenarios. The

institutional arrangements in the *Climate Change Act 2016*, together with the application of the MTP and CIDP processes, will provide the framework for integrated planning and data management.

With regard to mitigation measures, the most critical data sets required currently are those needed to generate emission baselines and business-as-usual scenarios for the various sectors. Key variables are ongoing activity data and GHG emission factors. There are significant data gaps in the forestry sector and biomass energy subsector. Additional manpower is needed to address these gaps in data collection, measurement, and analysis, along with additional training and associated costs.

4.4 Monitoring, Reporting and Verification (MRV) system

a. Introduction

The principal objective of the Monitoring, Reporting, and Verification (MRV) system is to measure, report, and verify accomplishments of an action in terms of achieving its stated specific goals and objectives. The "burden of proof" that an action is effective and is making a difference falls upon the efforts and reporting undertaken by the MRV system. The MRV system will address critical information from the proposed action activities, and monitors, reports, and verifies outcomes using commonly accepted methodologies and practices that meet the high standards and expectations of both national and international stakeholders and donors.

For Kenya, an MRV system is necessary to ensure effectiveness and accountability of climate change actions, including the implementation of NCCAP 2018-2022 actions, for the realisation

of a low carbon climate-resilient growth and sustainable development. NCCAP 2018-2022 (MTAR Component) seeks to assist the country in realising the following broad objectives:

- Achieve sustainable development goals as envisaged in Vision 2030; and
- Realise climate change mitigation¹¹⁹

The MRV system will enhance transparency in tracking the progress towards the realisation of the above objectives. The goals and measures for tracking performance with regard to NCCAP 2018-2022 (MTAR Component) therefore inherently arise from these objectives. The focus of the MRV effort will be the two intrinsic goals for all sectors of the Kenyan economy. The areas of focus for the MRV system are summarised in Table 4.2.

Table 4.2: MTAR MRV focus areas.

MTAR Objectives	Intrinsic UGGDS Goals
Objective 1 – To mitigate climate change and attract climate financing.	Mitigate GHG Emissions Attract climate financing
Objective 3 – Achieve development goal as per Vision 2030 and attract development financing	Sustainable Development Goals (SDGs) and Socio-Economic Co-benefits Attract development financing

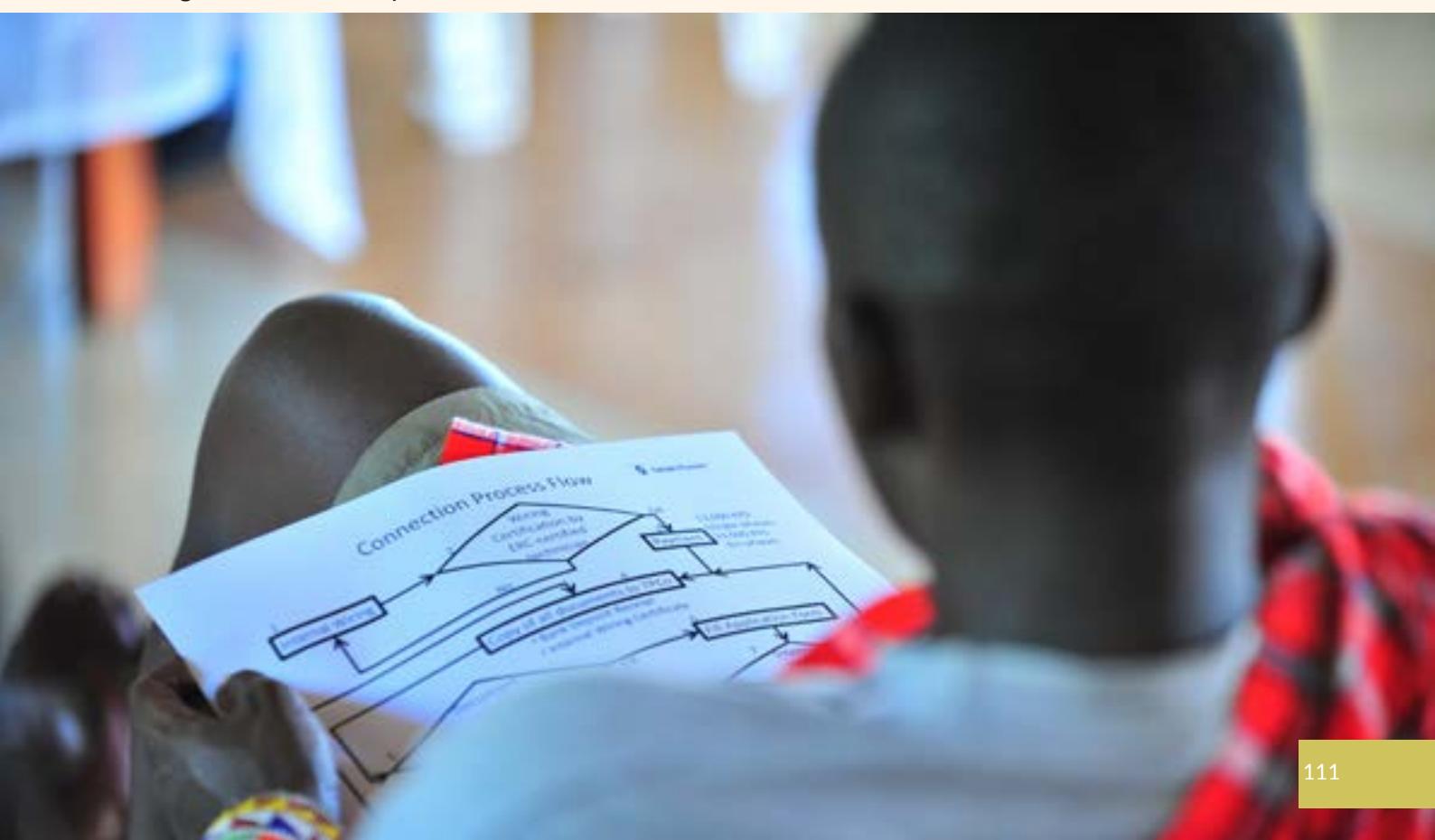
Three key aspects of MRV system are of particular relevance to the implementation of the MTAR in Kenya. First, planning, implementation, and decision-making on effective use of resources all require monitoring and evaluation, with baseline data and indicators. In general, a set of tools is used before the intervention takes place, or after the intervention to track expected or realised outcomes. For MTAR implementation, the baseline data and indicators have already been determined for most of the actions, but there are gaps that need to be filled before implementation of the various mitigation actions starts. In most cases, determination of the baseline scenario and indicators will be part of the detailed project proposal. This will help to ensure that resources for sustainable development and low carbon development are well spent, and that the results are communicated back to decision makers and stakeholders for any appropriate actions or decisions.

Climate change interventions will be linked to the delivery of sectoral development objectives and are consistent with national priorities. However, monitoring, reporting and verification on these mitigation actions will require the strengthening of existing information systems that also integrate the MRV requirements of MTAR 2018-

2022. As part of the plan's implementation, and through the ongoing Capacity-building Initiative for Transparency (CBIT) and Initiative for Climate Action Transparency (ICAT) projects, the MRV system will be reviewed to integrate the MRV requirements of MTAR 2018-2022. While ICAT will focus on the energy sector, CBIT will support the development of an MRV system for all the six UNFCCC mitigation sectors in Kenya.

Secondly, for Kenya to receive international support for its voluntary contributions to tackle climate change, the MRV system will be necessary. The MRV system will include a registry to keep track of whether the international support promised is really being provided, and the sustainable development benefits realised as well as monitoring, reporting and verifying whether climate change actions are in operation, how successful they are, and to what extent they reduce emissions and create effective adaptation. The development of relevant gender sensitive indicators as part of Kenya's monitoring and reporting system, will be also crucial.

An effective MRV system for Kenya's REDD+ activities will enable the country to access larger scale international support, and has received international support for building the required



institutional and technical capacity. In addition, a REDD+ system needs to link to a wider national system for MRV, to avoid duplication and increase coherence, especially with changes in reporting needs for all stakeholders.

For both the voluntary contributions and REDD+ activities, the MRV system will provide the required information for the purpose of sharing benefits (carbon credits) with communities involved in the implementation of certain measures. Such a system also includes a definition of benefit sharing arrangements.

Third, Kenya has reporting obligations to the UNFCCC. The biennial update reports (BURs)

containing updates of national GHG inventories, including a national inventory report and information on mitigation actions, needs, and support received, is to be prepared every two years, while the national communication containing the same information, among others, is to be prepared every four years. The MRV system and the associated data will be used as the basis for preparing the reports.

The section that follows covers the MRV system that would be integrated into the national framework to realise the above key aspects of the MRV system.

b. The Proposed Monitoring and Evaluation (M&E) Framework for the National Climate Change Policy Implementation

Effective implementation of MTAR 2018-2022 and hence NCCAP 2018-2022 is highly dependent on the internal “feedback” generated through monitoring, reporting, and verification (MRV) processes. Without an MRV system, it would be impossible for the Government to assess the effectiveness of investments in mitigation, or to determine whether the funds are being spent well.

The MRV framework is underpinned by the need to promote efficiency and effectiveness in service delivery to achieve results, and transparency and accountability in the use of available resources. In addition, the continuation of international funding for climate change activities depends on an effective MRV.

banks, and other providers of finance, need the results of MRV systems to validate the effectiveness of the funds they provide. Therefore, securing further financial support for implementation of the mitigation actions will be dependent on successful establishment of the MRV framework.

To assist in the process of effective and efficient implementation of the mitigation actions, as well as to promote lesson-learning through this process, it is development of a clear set of building blocks, to organise the monitoring, reporting and verification of the implementation process, is important.



c. Monitoring, Reporting and Verification (MRV) System

A key component of the proposed M&E Framework for the implementation of NCCAP 2018-2022 would be an overarching MRV system that could deliver both MRV over GHG emissions and mitigation activities, and monitoring and reporting on the adaptation activities. The MRV system will assist by:

- Providing guidance on the implementation of climate change response actions (both adaptation and mitigation actions), whether in the form of policies, projects, programmes; or business ventures;
- Helping fulfil Kenya's international reporting obligations: for example, by assisting in developing its GHG inventory and tracking mitigation and adaptation actions ready to report to the UNFCCC through National Communications (NCs) process. The MRV system will formalise and institutionalise the process for producing the GHG inventory and NCs; and
- Demonstrating the country's climate finance readiness and providing a strong platform for attracting international climate finance flows from multilateral and bilateral development partners.

The proposed MRV system will involve the following three broad activities:

- Measurement and monitoring: Data and information will be gathered, quality checked and fed into the system. Monitoring will be a continuous process capturing all the data in real time. The formats and procedures, together with the instruments, for data collection are to be predetermined.
- Data analysis and reporting: The data is analysed and used to calculate other parameters and/or get information in prescribed formats. The results are then used to prepare a monitoring report in an appropriate but predetermined format.
- Verification (and evaluation): The report is then used by a third-party verifier to verify that all activities have been carried out as planned and that the expected results have been realised. Usually, a verification process includes a site visit by the verifier. After a verification activity, a verification report is produced by the verifier. The report can be positive or negative depending on the findings.

The MRV system will be built on existing institutions, capacities, and skills. The agreed structure for implementation of NCCAP 2018-2022 will be used for data collection and internal data quality checks and reporting. Existing M&E systems within the MDAs and



M&E related governance structures will be used to collect and analyse data before reporting for the MRV system. The actual data to be collected will be determined within the sectors and underpinned by the mitigation actions.

However, arrangements required by the MRV system and the additional functions of the various participants in the M&E Framework require a significant capacity. This capacity will be built over time in different sectors of the Kenyan economy and capacity building activities will be identified and planned as part of the implementation of NCCAP 2018-2022. Different aspects and components of the MRV system will be built in a phased-out manner.

As part of the implementation of NCCAP 2018-2022, the MRV system will be integrated into and made part of the M&E Framework for the implementation of NCCAP 2018-2022. As part of

the integration, SDG indicators will be reviewed to sharpen and align the indicators with Kenya's SDG targets. The final M&E Framework will be appropriate as a basis for ensuring the full implementation of NCCAP 2018-2022 and for the development of specific performance indicators and targets for each mitigation action by sector. The framework also proposes accountabilities for the actors that are tasked to implement them.

However, to meet international reporting obligations to the UNFCCC through National Communications, GHG inventories will need to be produced on a regular basis. Therefore, there is need for a clear methodology and team in place to continually improve the transparency, accuracy, completeness, comparability, and consistency of the GHG inventory each time it is produced. This will be set up through the CBIT project.

d. Monitoring

Each lead ministry, department and agency for which accountabilities have been identified under the costed implementation strategy will have a role to play in monitoring and reporting. It is expected that as each partner in the NCCAP 2018-2022 implementation process tailors the indicative strategy guidance to its own work planning, specific performance measurement frameworks (PMFs) to organise the monitoring and reporting function for each partner will also have to be developed as part of the planning process, with guidance from the CCD, to ensure a common format that can easily be consolidated.

Such individual PMFs, as well as the overarching PMF, will present, for each category of results (outcomes and outputs in particular), performance indicators and targets, as well as methods and data sources to be used to streamline the monitoring and reporting responsibilities.

In addition to monitoring and enforcement against the M&E Framework, the implementation of NCCAP 2018-2022 will undergo an independent external evaluation in 5 years' time, while some specific mitigation actions will undergo annual third-party verification reviews. The recommendations resulting from this evaluation will then feed into the revision process for future action. This revision is to be carried out

based on a thorough public consultation process and review of the results at that point in time.

To this end, it will have a team of experts working on each of the six mitigation sectors to monitor projects so as to ensure their effectiveness, measure, report, and verify (MRV) project outcomes, and provide appropriate access to information on projects and outcomes to the public. This will be done in a manner that is transparent, cost-efficient, utilizes a sound institutional framework, and provides transparent, consistent, comparable, complete and accurate data. Preferably, such efforts will be internationally comparable with the efforts of other parties to the UNFCCC, especially in terms of determining an appropriate baseline approach and identifying the methodologies pursued in the estimations of the GHG emission reductions. The MRV system should establish the environmental integrity of mitigation actions and ensure that no double-counting occurs. Finally, the MRV system must recognize the unique set of circumstances, requirements, and limitations of Kenya and those of involved stakeholders, and will therefore be developed by the local stakeholders with appropriate international support.

e. Reporting

The various ministries, departments and agencies (MDAs) concerned with implementation of NCCAP 2018-2022 are expected to report on a quarterly and semi-annual basis on their progress in the implementation of their respective tasks and in the attainment of their expected results under NCCAP 2018-2022. This information will be reported to the CCD, and copied to the National Treasury and the Ministry of Devolution and Planning. Monitoring reports generated through the MRV system will also follow the same reporting hierarchy and frequency. However, the data and information reported will be different and will be in accordance with the MRV system requirements.

The National Climate Change Council (NCCC) under the Ministry of Environment and Forestry (MEF): The reporting from the various ministries, departments and agencies will be consolidated as relevant at the national level by CCD. CCD will be tasked with preparing a consolidated annual progress report on the overall implementation of NCCAP 2018-2022, for consideration by the Climate Change Council. CCD will also be responsible for the development of the MRV system and its integration into the M&E Framework for implementing NCCAP 2018-2022. CCD will provide guidance to the

various MDAs as they develop their PMFs and reporting formats, to ensure consistency and focus on result-based management in the implementation of NCCAP 2018-2022.

The Ministry of Devolution and Planning will review development plans and budgets of county governments to ensure they mainstream climate change and low-carbon development issues. It will in addition review relevant reports from the county governments to ensure the quality of the reporting, and consolidate reporting on county-level actions towards the implementation of NCCAP 2018-2022 on a semi-annual basis. This information will be reported to the National Treasury and CCD.

The National Treasury and the Ministry of Devolution and Planning will be responsible for resource mobilization, formulation of national budgets, and disbursement of NCCAP 2018-2022 budgetary resources, financial accountability, and budget monitoring and reporting. It will also review quarterly and semi-annual reports from the ministries, departments and agencies concerned, to ensure that resource use is in line with expected and actual progress in implementing NCCAP 2018-2022.



Development Partners will support the M&E framework and in particular the development of a MRV system by providing financial and technical assistance for the integration of the MRV system into the M&E Framework, the operationalisation of the M&E system; the refinement of indicators, tools and processes; and the implementation of M&E activities, capacity building for M&E, and use of M&E products.

Civil society and private sector organisations, through their representation on the multi-stakeholder frameworks, will also play a key role in the monitoring function. This will be done, for instance, through their review of the consolidated progress reports on the implementation of NCCAP 2018-2022. They will also provide feedback from civil society and the private sector to present their own evidence on the pace of progress of the implementation and their own reporting on their actions towards the implementation of NCCAP 2018-2022.

f. Evaluation and Verification

The first independent evaluation of NCCAP 2018-2022 should take place in 2020 and should ideally be commissioned by the Climate Change Council. A steering committee under CCD will be set up to develop the terms of reference and to provide guidance to the independent evaluation team contracted to conduct this evaluation. This steering committee will constitute a balanced representation of the various ministries, departments and agencies involved in the implementation of the policy, donors supporting the policy implementation process, civil society and private sector representatives involved in

Due to the importance of quality reports for the proposed M&E framework and the setting of appropriate performance targets, particular attention should be paid to the equal application of criteria and standards, as well as the comparable use of formats in reporting. To assume their roles, the various M&E actors therefore need certain capacities, both in terms of human resources and technical know-how. In addition, CCD, given its key role in consolidated reporting at the national level, will require adequate capacity to perform this function effectively. Care should be taken, as part of the early activities in operationalising the institutional framework for the implementation of the policy, to provide adequate resources for this monitoring function, in both CCD and the line and cross-cutting ministries that have to report on their actions. Communication over NCCAP 2018-2022 and priorities for the current MTP, together with regular engagement with all stakeholders and partner organisations will be critical to its success.

g. Implementation of Monitoring

A starting point for all monitoring activities will be the determination of the key indicators that best give a quantitative or qualitative indication of performance or achievement relative to the goals identified above.

The baseline scenario is the scenario for a given measure that reasonably represents the status before implementation of the measure. For each action, and for the baseline scenario, the baseline anthropogenic emissions by GHG

policy implementation. Ideally, this steering committee should be chaired by a representative with strong credentials in evaluation.

For mitigation related measures and activities, and for which emission reductions will be determined, annual third-party verification will be carried out in accordance with the established standards such as CDM and the Gold Standard. The verification requirements, which are part of the MRV system, will be incorporated in the M&E Framework for NCCAP 2018-2022 implementation.

sources, climate resilience as well as sustainable development indicators will be determined before implementation of NCCAP 2018-2022 action.

Implementation results will then be tracked and monitored relative to the baseline indicators.

For each action, a monitoring plan will be prepared before the action is implemented. Each monitoring plan will define the parameters to be monitored for GHG emission reductions

determination with the following details:

- Type of parameter;
- The data unit;
- Description of the parameter;
- Measurement criteria/means of measurement;
- Source of the data;
- Frequency of data collection;
- Quality assurance/quality control arrangements for the data;
- Other remarks or comments; and
- Appropriate data collection tools will be

designed for use before implementation to ensure completeness and consistency.

Monitoring procedures will also include corresponding indicators for sustainable development benefits, financial management, and the implementation status.

The data will be analysed to obtain performance indicators that provide signals for action. Data gathering is a costly and time-consuming exercise and will be well-targeted. The need for collecting and utilising information has been stressed and large amounts of data will be collected and processed into useable information. But it has to be kept in mind that information per se is only valuable when it is focused and used to a specific end.

h. Low Carbon Development Reports

As part of the plan implementation, the Government will be preparing a State of the Low Carbon Development Report on a regular basis. This report will inform the public about the status of progress in the implementation of the mitigation actions and help the country take the right course and make solid advances towards a low carbon development through monitoring and reporting its progress.

The report will provide the public with a clear overview of the government's plan for low carbon development, diverse public and private efforts

and their achievements, as well as an international benchmarking of the country's current standing based on objective performance indicators. The first edition of the report, the report also includes a substantial amount of background information to help domestic and global readers to understand Kenya's national context and prospect for low carbon development transition.

This report will be compiled by CCD, using information from various sectors of the economy.

i. Delivery of Low Carbon Development Training and Knowledge Sharing Workshops for Stakeholders

The first workshop for the public and private sector will be held in the first quarter of 2019, introducing an overview of low carbon development pathway in the areas of policy and technology.

Subsequent Workshops in the Climate Change Knowledge Sharing Program will be held on need-basis and as determined and scheduled by CCD in consultation with the National Climate Change Council.

Reference List

- ¹ Central to the success of COP21 and the Paris Agreement were the Intended Nationally Determined Contributions (INDCs), which were submitted by more than 190 countries, including Kenya, during 2015. These set out each country's approach and initial best efforts to reducing emissions and adapting to a changing climate, and strengthening these efforts in the years ahead.
- ² Government of Kenya (2013). National Climate Change Action Plan: 2013-2017. Nairobi: Ministry of Environment and Natural Resources. Accessed at: <http://www.kccap.info>
- ³ Government of Kenya (2015). Kenya's Intended Nationally Determined Contribution (INDC), 23 July 2015.
- ⁴ Kenya submitted its Intended NDC, which previously had been submitted to the UNFCCC on 25th July 2015, as its NDC when it ratified the Paris Agreement. See: Government of Kenya (2015). Kenya's Intended Nationally Determined Contribution, 23 July 2015. Nairobi: Ministry of Environment and Natural Resources. Accessed at: http://www4.unfccc.int/submissions/INDC/Published%20Documents/Kenya/1/Kenya_INDC_20150723.pdf.
- ⁵ Kenya's long-term plan that aims to transform Kenya into "a newly-industrialising, middle-income country providing a high quality of life by 2030 to its citizens."
- ⁶ Ministry of Environment and Natural Resources (2017). Kenya's Nationally Determined Contribution Sector Analysis Report: Evidence Base for Updating the National Climate Change Action Plan. Nairobi: Government of Kenya.
- ⁷ Government of Kenya (2013), Ministry of Devolution and Planning; Vision 2030 Second Medium Term 2013-2017 (Transforming Kenya: Pathway to Devolution, Socio-economic Development, Equity and National Unity).
- ⁸ Food and Agriculture Organization of the United Nations (FAO); <http://www.fao.org/kenya/fao-in-kenya/kenya-at-a-glance/en/>
- ⁹ Food and Agriculture Organization of the United Nations (FAO); <http://www.fao.org/kenya/fao-in-kenya/kenya-at-a-glance/en/>
- ¹⁰ Kenya National Bureau of Statistics (2017).
- ¹¹ Food and Agriculture Organisation of the United Nations (FAO (2013)); Climate Smart Agriculture Sourcebook.
- ¹² The low target is aligned with the proportional contribution that the sector would need to make in order for there to be a high level of certainty that the overall target will be achieved if all other sectors also meet their low target reduction while the high target is intended to guide responsible ministries and agencies in terms of what they should objectively plan and prepare for should the sector require additional emission reductions.
- ¹³ The low target is aligned with the proportional contribution that the sector would need to make in order for there to be a high level of certainty that the overall target will be achieved if all other sectors also meet their low target reduction while the high target is intended to guide responsible ministries and agencies in terms of what they should objectively plan and prepare for should the sector require additional emission reductions.
- ¹⁴ Government of Kenya (2009); Ministry of Agriculture; Agriculture Act (Cap. 318) on farm forestry rules.
- ¹⁵ GoK (2017), Ministry of Environment and Natural Resources; NDC Sector Analysis Report
- ¹⁶ GoK (2017), Ministry of Environment and Natural Resources; NDC Sector Analysis Report

¹⁷ Brown, S., Grais, A., Ambagis, S., Pearson, T. (2012). Agricultural GHGs in East and West Africa: Baseline emissions and mitigation potential. CCAFS Working Paper No. 13. Copenhagen: CGIAR Program on Climate Change, Agriculture and Food Security.

¹⁸ Government of Kenya (2017)

¹⁹ FAO and New Zealand Agricultural Greenhouse Gas Research Centre (2017). Options for low emission development in the Kenya dairy sector - reducing enteric methane for food security and livelihoods. Rome: FAO. Page VIII.

²⁰ <https://ccafs.cgiar.org/nationally-appropriate-mitigation-actions-kenya's-dairy-sector#.WsfAhkxuLXO>

²¹ GoK (2017), Ministry of Agriculture, Livestock and Fisheries; Kenya Climate Smart Agriculture Strategy 2017-2026

²² GoK (2017), Ministry of Agriculture, Livestock and Fisheries; Kenya's Dairy NAMA Concept Note

²³ Institute of Economic Affairs (2015), Situation Analysis of Energy Industry, Policy and Strategy for Kenya

²⁴ Government of Kenya (2007); Kenya Vision 2030.

²⁵ GoK (2018), Kenya National Bureau of Statistics; The Economic Survey 2018

²⁶ Government of Kenya (2015), Nairobi: Ministry of Energy and Petroleum, page 11; Draft National Energy and Petroleum Policy

²⁷ Parliament of Kenya (2017); Bill Tracker 2 February 2017.

²⁸ Government of Kenya (2015); The Energy Bill, 2015.

²⁹ Kenya Power and Lighting Company, Annual Report 2018

³⁰ Government of Kenya (2016); Electricity Generation and Transmission Master Plan 2015-2035

³¹ Kenya Power (2016); Milestones in Kenya's Electricity Sector.

³² Kenya Power and Lighting Company; Annual Report 2018

³³ Stock Taking and Gap Analysis Report (2013), cited in Ministry of Energy and Petroleum (2016); Sustainable Energy for All: Kenya Action Agenda

³⁴ GoK (20130, Ministry of Environment, Water and Natural Resources; Analysis of Demand and Supply of Wood Products in Kenya.

³⁵ GoK (2013), Ministry of Environment, Water and Natural Resources; Analysis of Demand and Supply of Wood Products in Kenya.

³⁶ GoK (2017), Ministry of Environment and Natural Resources and the StARCK+ Technical Assistance to the Government of Kenya Component; Update of Emission Baseline Projections and Impact on Kenya's NDC Targets

³⁷ GoK (2016), Energy Regulatory Commission; Electricity Generation and Transmission Master Plan 2015-2035

³⁸ GoK (2016), Energy Regulatory Commission; Updated Least Cost Power Development Plan Study Period: 2011-2031

³⁹ International Energy Agency; <https://www.iea.org/>

⁴⁰ UNFCCC; Default values of fraction of non-renewable biomass; <https://cdm.unfccc.int/DNA/fNRB/index.html>

⁴¹ National Oil Corporation of Kenya; <http://nationaloil.co.ke/gas-yetu-the-mwananchi-gas/>

⁴² <https://www.standardmedia.co.ke/article/2001278983/kisumu-county-starts-construction-of-sh300-million-bio-energy-centre-to-mitigate-climate-change>

⁴³ GoK, (2016), Kenya Forest Service; Improving Capacity in Forest Resources Assessment in Kenya (IC-FRA); Proposal for National Forest Resources Assessment in Kenya (NFRA)

- ⁴⁴ GoK, (2016), Kenya Forest Service; Improving Capacity in Forest Resources Assessment in Kenya (IC-FRA): Proposal for National Forest Resources Assessment in Kenya (NFRA)
- ⁴⁵ Bonn Challenge (2016). Kenya. Accessed at: <http://www.bonnchallenge.org/flr-desk/kenya>
- ⁴⁶ Government of Kenya, Forest Policy, 2014. page 5.
- ⁴⁷ The UNFCCC; <https://unfccc.int/topics/land-use/workstreams/land-use--land-use-change-and-forestry-lulucf>
- ⁴⁸ Government of Kenya (2015), Second National Communication, page 9
- ⁴⁹ Government of Kenya (2017), NDC Sector Analysis Report, page 47
- ⁵⁰ Valatin, G. and Price, C. (2013), How Cost-Effective is Forestry for Climate Change Mitigation? Challenges and opportunities for the World's Forests in the 21st Century. Volume 81 of the series Forestry Science. Pages 297-339.
- ⁵¹ Food and Agricultural Organization (2010)
- ⁵² Food and Agricultural Organization (2010). Global Forest Resource Assessment Country Report: Kenya.
- ⁵³ Food and Agricultural Organization (2010)
- ⁵⁴ GoK (2013), Ministry of Environment and Natural Resources; NCCAP 2013-2017
- ⁵⁵ GoK (2013); Ministry of Environment and Natural Resources; NCCAP 2013-2017
- ⁵⁶ GoK (2013), Ministry of Environment and Natural Resources; NCCAP 2013-2017
- ⁵⁷ GoK (2017), Ministry of Environment, Natural Resources And Regional Development Authorities; National Mangrove Ecosystem Management Plan
- ⁵⁸ GoK (2018), Kenya National Bureau of Statistics; Economic Survey 2018.
- ⁵⁹ GoK (2008). Kenya Vision 2030.
- ⁶⁰ GoK (2015), Ministry of Industrialisation and Enterprise Development; Kenya's Industrial Transformation Programme.
- ⁶¹ GoK (2015), Ministry of Environment and Natural Resources; SNC
- ⁶² GoK (2015), Ministry of Environment and Natural Resources; SNC
- ⁶³ GoK (2015), Ministry of Environment and Natural Resources; SNC
- ⁶⁴ GoK (2015), Ministry of Environment and Natural Resources; SNC
- ⁶⁵ GoK (2017), Ministry of Environment and Natural Resources; NDC Sector Analysis Report
- ⁶⁶ GoK (2008). Kenya Vision 2030.
- ⁶⁷ GoK (2015), Ministry of Environment and Natural Resources; SNC
- ⁶⁸ GoK (2013), KFS; Analysis of the Charcoal Value Chain in Kenya
- ⁶⁹ Adam, J.C. (2009). Improved and ore environmentally friendly charcoal production system using a low-cost retort kiln (Eco-charcoal), Renewable Energy (January).
- ⁷⁰ GoK (2017), Ministry of Environment and Natural Resources; NDC Sector Analysis Report 2017
- ⁷¹ Shammakh, B., Caruso, H., Elkamel, A., Crsoset, E. and Douglas, P.L. (2008). Analysis and Optimization of Carbon Dioxide Emission Mitigation Options in the Cement Industry. Dhahran, Saudi Arabia: Department of Chemical Engineering, King Fahd University of Petroleum and Minerals, Science publications.
- ⁷² GoK (2016), Ministry of Environment and natural Resources; NAMA for Charcoal Sector in Kenya
- ⁷³ See: <https://www.iea.org/countries/non-membercountries/kenya/>.
- ⁷⁴ GoK (2013), KFS; Analysis of the Charcoal Value Chain in Kenya; <http://www.kenyaforestservice.org/documents/redd/Charcoal%20Value%20Chain%20Analysis.pdf>.

⁷⁵ GoK (2013), Ministry of Environment, Water and Natural Resources; Analysis of Demand and Supply of Wood Products in Kenya; <http://www.kenyaforestservice.org/documents/redd/Analysis%20of%20Demand%20and%20Supply%20of%20Wood%20Products%20in%20Kenya.pdf>

⁷⁶ GoK (2016); Nationally Appropriate Mitigation Actions (NAMA) for the Charcoal Sector in Kenya

⁷⁷ GoK (2017), Ministry of Environment and Natural Resources; NDC Sector Analysis Report 2017

⁷⁸ GoK (2017), Ministry of Environment and Natural Resources; NDC Sector Analysis Report 2017

⁷⁹ GoK, Ministry of Transport (2009); Integrated National Transport Policy - Moving a Working Nation

⁸⁰ World Bank Group and Korea Green Growth Trust Fund (2017); Motorization Management in Kenya Report

⁸¹ GoK, Ministry of Environment and Forestry (2015), SNC

⁸² GoK, Energy Regulatory Commission (2015) Report on Global Fuel Economy Initiative Study in Kenya (GFEI)

⁸³ GoK, National Transport and Safety Authority (2016); New Motor Vehicles Statistics for the Last 10 Years.

⁸⁴ GoK, National Transport and Safety Authority (2016); New Motor Vehicles Statistics for the Last 10 Years.

⁸⁵ The exact amounts of freight shifted have been taken from the Mombasa – Nairobi Railway Project: Feasibility Study Report by the China Road and Bridge Corporation for the Government of Kenya

⁸⁶ GoK, Kenya National Bureau of Statistics; Economic Survey 2018

⁸⁷ The updates of the Kenya's SNC show a projected value of 19 MtCO₂e by 2030.

⁸⁸ GoK, MoEF (2015); NDC Sector Analysis Report

⁸⁹ Secorum, L. (2017). 'This is our future' – Kenya's croton tree touted as new biofuels crop. The Guardian (10th January); <https://www.theguardian.com/sustainable-business/2017/jan/10/croton-oil-biofuels-kenya-food-security-farming-africa>

⁹⁰ GoK, Ministry of Transport, Infrastructure, Housing and Urban Development Comments on NCCAP dated 13th May 2018

⁹¹ GoK, NAMA Proposal for Line 3 BRT System; <http://www.nama-facility.org/projects/mass-rapid-transport-system-for-nairobi/>

⁹² GoK, MENR and UNDP-LECB Programme (2015); Nationally Appropriate Mitigation Action for Bus Rapid Transit Plus in Greater Nairobi

⁹³ GoK, MENR and UNDP-LECB Programme (2015); Nationally Appropriate Mitigation Action for Bus Rapid Transit Plus in Greater Nairobi

⁹⁴ Metro Report International; Nairobi Moves Ahead With Transport Plans; <http://www.metro-report.com/news/single-view/view/nairobi-moves-ahead-with-transport-plans.html>

⁹⁵ The GoK has however set a target of transferring 40% of the road freight to rail.

⁹⁶ Rail Safety and Standards Board (2007) and Professor Roger Kemp at Lancaster University; Traction Energy Metrics" (pdf)

⁹⁷ GoK, MoEF; NDC Sector Analysis Report (2017)

⁹⁸ GoK NCCAP 20013-2017

⁹⁹ ITDP (2015); <https://www.itdp.org/wp-content/uploads/2015/02/Nairobi-Ndovu-A104-BRT-Service-Plan.pdf>

¹⁰⁰ GoK, MEF (2015); SNC

¹⁰¹ GoK, MoEF (2015); NDC Sector Analysis Report

¹⁰² City Council of Nairobi (2010); Solid Waste Management in Nairobi-A Situation Analysis by University of Cape Town

¹⁰³ City Council of Nairobi (2010); Solid Waste Management in Nairobi-A Situation Analysis by University of Cape Town

¹⁰⁴ Fischer, E. et al. (2010).

¹⁰⁵ UNEP (1996), Division of Technology, Industry and Economics; International Source Book on Environmentally Sound Technologies for Municipal Solid Waste Management, IECT Technical Publication Series 6.

¹⁰⁶ Kenya Engineer (2017). Bamburi Cement adopts waste tyres as a source of energy; <http://www.kenyaengineer.co.ke/features/item/2358-bamburi-cement-adopts-waste-tyres-as-a-source-of-energy>; and Luck, S. and Laroche, J. (2017). Burning tires pitched as 'locally sourced, lower carbon' fuel for Nova Scotia (24th March); CBC News.

<http://www.cbc.ca/news/canada/nova-scotia/burning-tires-as-local-low-carbon-fuel-1.4038919>

¹⁰⁷ GoK (2015); NEMA; National Waste Management Strategy

¹⁰⁸ GoK (2015); NEMA; National Waste Management Strategy

¹⁰⁹ GoK (2016), Ministry of Environment and Natural resources; Sessional Paper No. 3 of 2016 on National Climate Change Framework Policy

¹¹⁰ OECD, 2015

¹¹¹ Henrich Boll Stiftung (North America), Climate Funds Update; <https://climatefundsupdate.org/global-climate-finance-architecture/>

¹¹² African Development Report 2012: Towards Green Growth in Africa

¹¹³ GoK (2016); Kenya Climate Public Expenditure and Budget Review Report

¹¹⁴ EBRD et al., no date

¹¹⁵ CPI, 2015

¹¹⁶ African Development Report 2012: Towards Green Growth in Africa.

¹¹⁷ Ernst and Young 2015: EY's attractiveness survey Africa. Available at [http://www.ey.com/Publication/vwLUAssets/EY-africa-attractiveness-survey-2015-making-choices/\\$FILE/EY-africa-attractiveness-survey-2015-making-choices.pdf](http://www.ey.com/Publication/vwLUAssets/EY-africa-attractiveness-survey-2015-making-choices/$FILE/EY-africa-attractiveness-survey-2015-making-choices.pdf)

¹¹⁸ Ibid.

¹¹⁹ African Development Report 2012; Ernst and Young 2015

¹²⁰ The international development partners are looking for results-based GHG mitigation. They wish to see rigidly developed and quantified GHG baselines and GHG mitigation reductions. These must be rigidly defined, monitored, reported, and independently verified on an annual basis.



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