



REPUBLIC OF RWANDA



DETAILED IMPLEMENTATION PLAN FOR THE NATIONALLY DETERMINED CONTRIBUTIONS (NDCs) OF RWANDA

September 2017

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List of Abbreviations

ABM	Adaptation Benefit Mechanism
ADB	Asian Development Bank
AF	Adaptation Fund
AfDB	African Development Bank
AREI	African Renewable Energy Initiative
BMUB	German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety
BRT	Bus Rapid Transit
BTC	Belgian Development Agency
CA	Cooperative Approaches
CAF	Cancun Adaptation Framework
CAIT	Climate Analysis Indicators Tool
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
CFL	Compact Fluorescent Lamp
Ci-Dev	World Bank's Carbon Initiative for Development
CIF	Climate Investment Funds
CMA	Conference of the Parties serving as the meeting of the Parties to the Paris Agreement
CNG	Compressed Natural Gas
COMIFAC	Central African Forest Commission
CoK	City of Kigali
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation
CPA	Component Project Activity
DFID	UK Department for International Development
DRR	Disaster Risk Reduction
EDCL	Energy Development Corporation Limited
EDPRS	Economic Development and Poverty Reduction Strategy
EU	European Union
FIP	Forest Investment Program
FONERWA	National Fund for Environment and Climate Change
GCF	Green Climate Fund
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GGCRS	Green Growth and Climate Resilience Strategy
GHG	Greenhouse Gases
GoR	Government of Rwanda
HAVC	Heat, Air Ventilation, and Cooling
HFO	Heavy Fuel Oil

IFC	International Finance Corporation
INDCs	Intended Nationally Determined Contributions
IPCC	Intergovernmental Panel on Climate Change
IPP	Independent Power Producers
ITMO	Internationally Transferred Mitigation Outcome
IUCN	International Union for Conservation of Nature
IWRM	Integrated Water Resource Management
KP	Kyoto Protocol
LDC	Least Developed Country
LDCF	Least Developed Country Fund
LED	Light Emitting Diode
LSE	London School of Economics
MIDIMAR	Ministry of Disaster Management and Refugee Affairs
MINAGRI	Ministry of Agriculture and Animal Resources
MINALOC	Ministry of Local Government
MINEACOM	Ministry of Trade, Industry, and East African Affairs
MINECOFIN	Ministry of Finance and Economic Planning
MINEDUC	Ministry of Education
MININFRA	Ministry of Infrastructure
MINIRENA	Ministry of Natural Resources
MINISANTE	Ministry of Health
MRV	Measuring, Reporting and Verification
MSW	Municipal Solid Waste
MWp	Mega Watt peak
NAEB	National Agricultural Export Development Board
NAMA	Nationally Appropriate Mitigation Actions
NAP	National Adaptation Plan
NAPA	National Adaptation Programme of Action
NDCs	Nationally Determined Contributions
NGO	Non-Governmental Organization
NIRDA	National Industrial Research and Development Agency
NISR	National Institute of Statistics of Rwanda
PA	Paris Agreement
PIF	Project Identification Form
PoA	Program of Activity
PPCR	Pilot Program for Climate Resilience
PPG	Project Preparation Grant
PPP	Public Private Partnerships
PSF	Private Sector Federation
PV	Photovoltaic
RAB	Rwanda Agriculture Board
RBC	Rwanda Biomedical Centre

RDB	Rwanda Development Board
REDD+	Reducing emissions from deforestation and forest degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries
REG	Rwanda Energy Group
REMA	Rwanda Environment Management Authority
RHA	Rwanda Housing Authority
RLMUA	Rwanda Land Management and Use Authority
RMPGB	Rwanda Mines, Petroleum & Gas Board
RMA	Rwanda Meteorology Agency
RNRA	Rwanda Natural Resources Authority
RRA	Rwanda Revenue Authority
RSB	Rwanda Standards Board
RTDA	Rwanda Transport Development Agency
RURA	Rwanda Utilities Regulatory Authority
RWFA	Rwanda Water and Forestry Authority
SB	Standardized baseline
SDG	Sustainable Development Goals
SDM	Sustainable Development Mechanism
SPCR	Strategic Programme for Climate Resilience
SREP	Scale-up renewable Energy Program
TA	Technical assistance
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
UR/CAVM	University of Rwanda / College of Agriculture, Animal Sciences and Veterinary Medicine
WASAC	Water and Sanitation Corporation
WtE	Waste to energy

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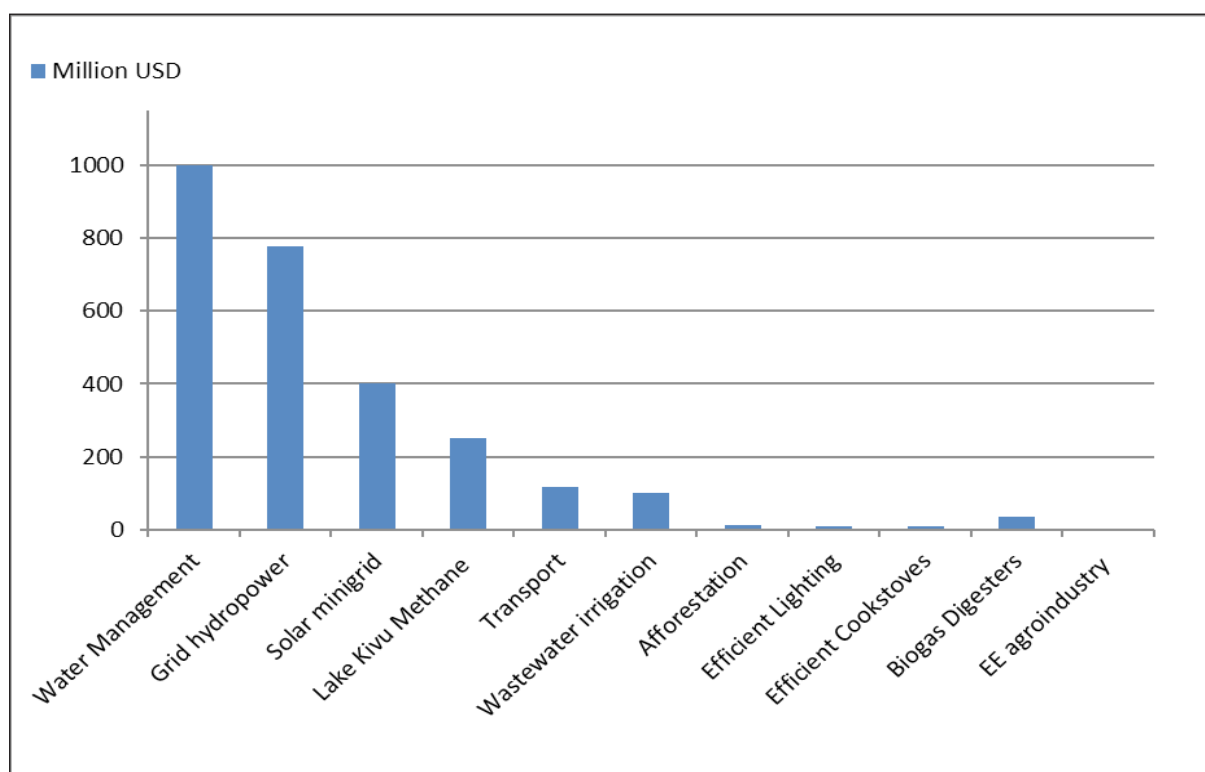
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1. Executive summary

Rwanda defined an ambitious Nationally Determined Contribution (NDC) covering a broad range of sectors: agriculture, forestry, water resources, land-use, disaster management; renewable energy, off-grid electrification, transport, industry, and waste. For each sector, the NDC provides a list of suggested measures to achieve adaptation and mitigation targets. The NDC states clearly that implementation of measures is conditional on Rwanda receiving financial resources and technical assistance by other countries.

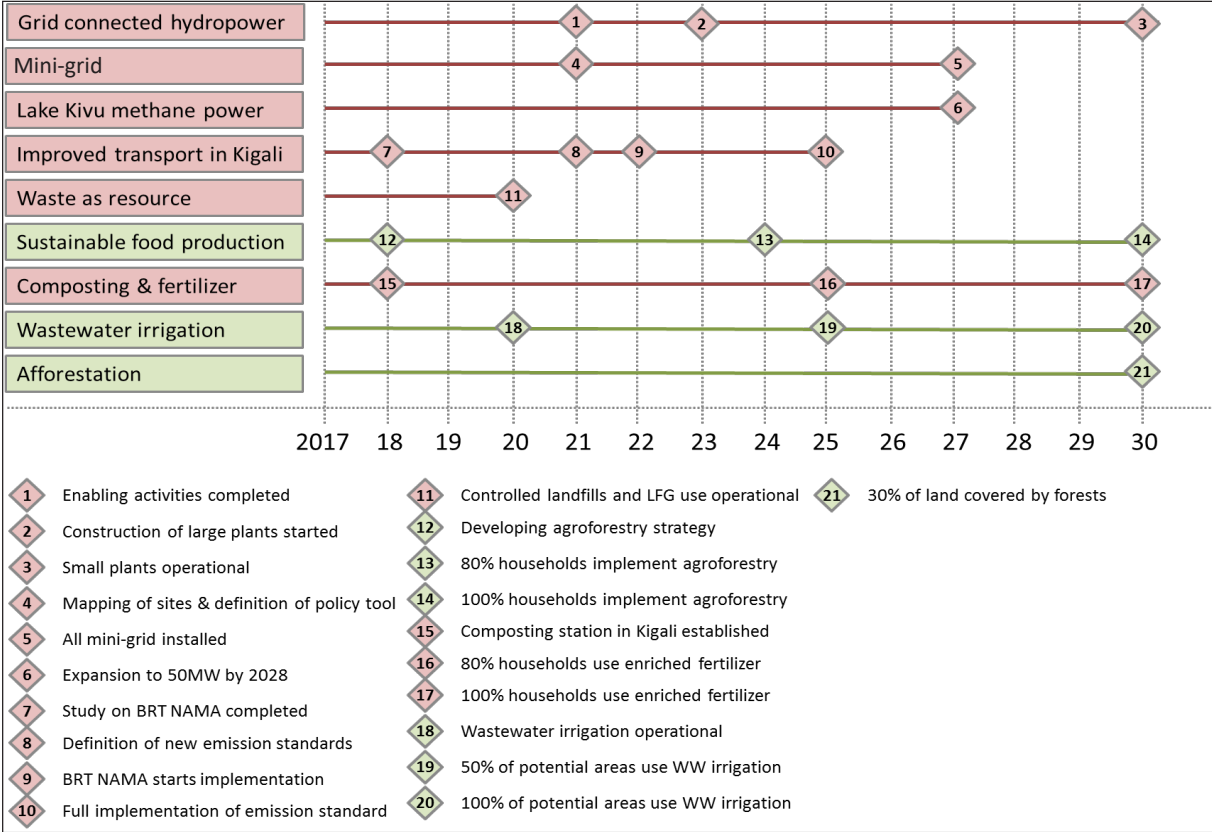
This implementation strategy prioritizes specific measures as not all measures listed in the NDC can be implemented at the same time. Their implementation costs are provided as far as they can be estimated at this point in time. Total costs reach at least 2.7 billion USD, their distribution is shown in the figure below.

Figure ES 1: Implementation costs of selected NDC measures



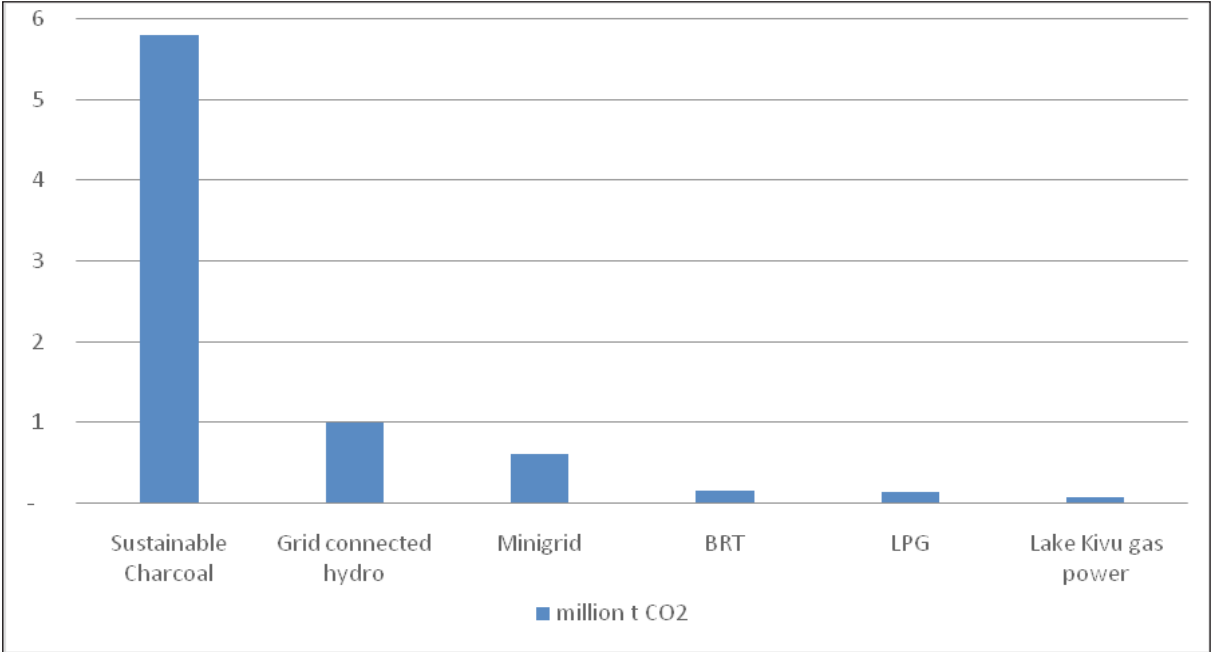
Some measures have already been partially implemented and thus implementation status is shown. Moreover, for each of the activities, milestones for implementation as well as the related timeline as suggested by the responsible institutions is shown, assuming that external funding would be forthcoming. Many activities have a time horizon that spans up to 2030, which is also the timeframe used in the NDC.

Figure ES 2: Timelines for implementation of NDC measures provided financing is available



Preliminary estimations of emission reductions are provided for those mitigation measures where sufficient data is available. The most attractive options are sustainable charcoal, grid-connected hydropower and solar mini grids.

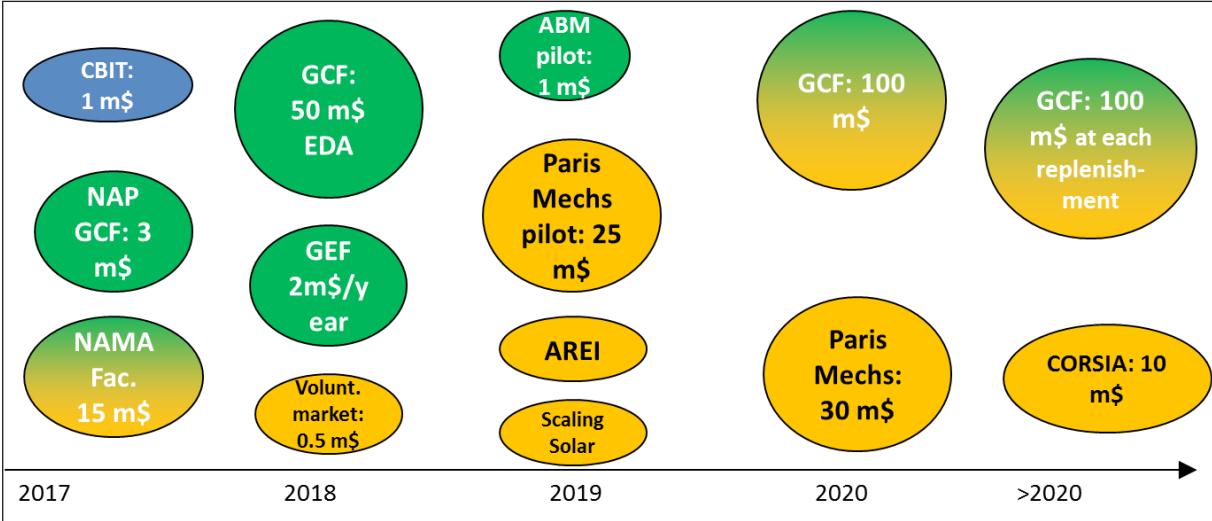
Figure ES 3: Cumulative mitigation potential of NDC measures in the period until 2030



Adaptation and sustainable development co-benefits are identified, linking the latter to the United Nations Sustainable Development Goals (SDGs). Capacity needs that must be addressed as well as barriers and risks that the different measures are facing are outlined. Main issues identified refer to the lack of coordination between institutions, lack of awareness in the private sector, project preparation (e.g. lack of feasibility studies) and access to finance.

Given the conditionality of all measures on external support, a financing strategy to mobilize investments (public and private, domestic and international) is a cornerstone of the NDC implementation strategy. Rwanda is internationally recognized as a reliable partner and successfully accessed different sources of finance in the past. This is a good starting point for engaging with international donors in the future as shown in the graph below.

Figure ES 4: Timeline of financing submissions to international climate finance providers



Key preconditions for a success of the financing strategy include strengthening of institutional capacity and coordination between different institutions, definition of a national climate change policy and proactive participation in the negotiation process at international level on the operationalization of the market mechanism under the Paris Agreement.

2. Introduction

2.1. Background on Rwandan vulnerability to climate change, adaptation and involvement in mitigation actions

Rwanda known as the “Land of a thousand hills” is a landlocked country of 26,338 km² located in Central Africa. It shares borders with Uganda in the north, Tanzania in the east, Burundi in the south and Democratic Republic of Congo in the west. The country has a population of approximately 11.6 million as of 2015; it is growing by 2.8% per year (GoR 2015). Rwanda has suffered severely from the Genocide against the Tutsi in 1994. Besides the loss of life and instability, it led it to a significant drop of the country’s Gross Domestic Product (GDP). Since that traumatic period, Rwanda has maintained political stability and achieved a remarkable increase of GDP from USD 1.7 billion in 2000 to USD 8.1 billion in 2015 (World Bank 2017). Rwanda’s ability to attract resources from the international private and public sector has contributed to this success.

Rwanda defined its long-term development goals in its strategy “Vision 2020”, which seeks to transition the country from an agriculture-based subsistence economy to a service-based middle-income country by 2020 (GoR 2012). Major milestones include transforming the still largely informal private sector, improving infrastructure and providing access to electricity. However, the dependency on foreign aid flows, which currently constitute 30-40% of the budget, represents a challenge.

Rwanda’s mid-term targets take the form of five-year plans since 2008. In 2013 the second Economic Development and Poverty Reduction Strategy (EDPRS II) was published (GoR 2013).

Rwanda is highly vulnerable to climate change because its population is heavily dependent on rain-fed agriculture including subsistence crops as well as tea and coffee for export. Extreme weather events have increased in frequency and impact, leading to significant loss of life and property. The highlands in the western and northern provinces are prone to floods, while droughts are threatening the eastern regions. Since 1970, the country has experienced a temperature increase of 1.4°C (GoR 2011). This trend is expected to continue, leading to adverse consequences for agriculture, health and livelihoods (GoR 2012). Annual losses from natural disasters can reach up to 23.9% of GDP (LSE 2015). Rainfall variability in Rwanda is expected to increase by 5 to 10% until 2030 (GoR 2015). Higher rainfall variability is connected to increased rainfall intensity and related disasters such as landslides, crop losses, destruction of infrastructure and health problems. At the same time higher rainfall variability leads to longer periods without rain, translating to proliferation of diseases, reduced land availability, crop yield decline, reduced food security and lower export earnings (GoR 2015).

In the field of climate policy Rwanda has gained international visibility. The country ratified the United Nations Framework Convention on Climate Change (UNFCCC) in 1995 and submitted the first and second national communications in 2005 and 2012, respectively. In 2009 the

Government of Rwanda (GoR) established a Climate Change and International Obligations Unit in the Rwanda Environment Management Authority (REMA), an institution under the Ministry of Natural Resources (MINIRENA). This Unit addresses the issues of climate change and coordinates the implementation of regional and international environmental agreements in Rwanda. In 2011 the National Climate Change and Low Carbon Development Strategy (GoR 2011) was developed. It underlines the need for low-emission development and potential mechanisms to meet the needs. EDPRS II (GoR 2013) highlights the green economy as a priority and identifies the National Environmental Fund (FONERWA) as key strategic tool. FONERWA, established in 2014, serves as “one stop shop” to mobilize and channel domestic and international resources into climate and environment projects. It has supported 32 projects as of June 2017 (FONERWA 2017).

With regard to adaptation, Rwanda developed its National Adaptation Programme of Action (NAPA) in 2006. NAPAs are tools for Least Developed Countries (LDCs) to identify priority activities that are considered most relevant to adapt to the urgent and immediate consequences of climate change. NAPAs have been established by the UNFCCC in 2001 and their development makes a country eligible under the Least Developed Countries Fund (LDCF) of the Global Environmental Facility (GEF). To prioritize project activities an eight-step process is followed that generates a list of projects. In Rwanda’s case, the following seven priority areas have been chosen: Integrated Water Resource Management (IWRM), information systems for early warning, promotion of non-agricultural income generating activities, promotion of intensive agro-pastoral activities; introduction of species resisting to environmental conditions, development of firewood alternative sources of energy; and a National Plan for Disaster Management (GoR 2006).

The NAPA process provided a first basis for adaptation programming in LDCs, but had a rather short-term orientation. In context of the Cancun Adaptation Framework (CAF)¹, Rwanda is in the process of formulating its National Adaptation Plan (NAP), which serves to identify the country’s adaptation needs in the medium to long term and define ways to address these needs. A NAP offers the opportunity to advance from the NAPA experiences into longer-term planning for adaptation. The main goal of the NAP process is to reduce vulnerability to climate change and to enhance adaptation planning capabilities and organic inclusion of adaptation into national strategies and policies. A NAP Project Identification Form (PIF), titled “Building the capacity of Rwanda’s government to advance the National Adaptation Planning process” was prepared by GoR and submitted to the GEF. It aims at reinforcing institutional capacity for the implementation of the Green Growth and Climate Resilience Strategy (GGCRS) over the course of 48 months and with three main components: 1) Technical and institutional capacity for the NAP process in Rwanda, 2) Funding the NAP process, and 3) Monitoring, reviewing and knowledge sharing to learn from the NAP process in Rwanda. The NAP PIF was approved in 2016 and preparatory activities for the Project Preparation Grant (PPG), which will develop the full project documents, are currently ongoing. The main deliverables identified in the PIF are: the development of costing estimates for financing Rwanda’s adaptation needs, a corresponding financing strategy,

¹ *The Cancun Adaptation Framework was established in 2010 to support international cooperation and actions on adaptation.*

monitoring and reviewing system of NAP process, long-term research programmes for supporting investments in adaptation, capacity building and awareness raising activities, gap analysis and needs assessment for a fully operational and sustainable climate information system, policies review to include an integrated approach to adaptation and their periodic review, guidelines and tools for data collection, dissemination of information on the NAP process and others (REMA 2016). The PPG will build on these results and could potentially expand the scope, supporting the definition of a national climate change policy; the preparation of a climate change action plan and the second vulnerability index assessment, which is due in 2017/2018 (REMA 2016).

In the context of mitigation Rwanda has successfully participated in the Clean Development Mechanism (CDM) under the Kyoto Protocol, as well as developed various Nationally Appropriate Mitigation Actions (NAMAs). Four individual CDM projects, mainly focusing on water treatment and efficient lighting, as well as 13 Programmes of Activities (PoAs) have been developed. The latter focus on a variety of projects such as renewable energy, biomass, and particularly efficient cook stoves. The following table summarizes the existing registered CDM PoAs and projects in Rwanda.

Table 1: Registered CDM PoAs and projects in Rwanda

Ref. no.	Name	Sector	PoA duration	Number of CPAs	CERs issued	Comments
9626	DelAgua Public Health Program in Eastern Africa	Water filters	02 Aug 12 - 01 Aug 40	16 (latest inclusion on 04/2016)	136,806	The PoA covers also efficient cookstove distribution
7247	Efficient CookStoves Programme: Rwanda	Cook stoves	29 Jan 13 - 28 Jan 41	1 (latest inclusion on 01/13)	-	
9596	Heat Retention Cooking in Less Developed Countries	Cook stoves	27 Feb 12 - 26 Feb 40	1 (latest inclusion on 03/13)	-	
6207	Improved CookStoves programme for Rwanda	Cook stoves	15 May 11 - 14 May 39	7 (latest inclusion on 02/16)	104,571	5 CPAs in Rwanda. Latest Component Project Activity (CPA) included in Cameroon
9948	Impact Carbon Global Safe Water Programme of Activities (PoA)	Water filters	17 Aug 13 - 16 Apr 41	3 (latest inclusion on 05/17)	-	Only one CPA in Rwanda
9847	Renewable Energy CDM Programme of Rwanda (RECPR)	Renewables	06 May 13 - 05 May 41	6 (latest inclusion on 09/15)	-	
10202	Gigawatt Global Programme of Activities	Renewables	15 Jan 14 - 14 Jan 42	1 (latest inclusion on 10/15)	-	
Other PoAs where Rwanda is listed as "Other host country"						
Ref. no.	Name	Sector	PoA duration	Number of CPAs	CER issuance (Rwandan CPAs)	Comments
7014	Improved CookStoves for East Africa (ICSEA)	Cook stoves	01 Apr 11 - 31 Mar 39	8 (latest inclusion 10/2016)	-	1 CPA in Rwanda, included on October 2016
7489	Project to replace fossil fuel based lighting with Solar LED lamps in East Africa	Lighting	16 Dec 12 - 15 Dec 40	1 (latest inclusion on 12/12)	-	CPA is located in Kenya
8239	African Clean Energy Switch – Biogas (ACES-Biogas)	Biogas	02 Jan 12 - 01 Jan 40	1 (latest inclusion on 12/12)	-	CPA is located in Kenya

8777	East Africa Renewable Energy Programme (EA-REP)	Renewables	21 Jan 12 - 20 Dec 40	1 (latest inclusion on 12/12)	-	CPA is located in Kenya
9672	Paradigm Sub Saharan Africa CookStove Programme	Cookstoves	30 Oct 12 - 29 Oct 40	2 (latest inclusion on 07/13)	-	1 CPA in Rwanda
10182	Biomass Energy Conservation Programme	Cookstoves	15 Feb 14 - 14 Feb 42	6 (latest inclusion on 10/16)	-	No CPA in Rwanda yet
Registered CDM projects						
Ref.	Name		Crediting period	Sector	CERs issued	Comments
3404	Rwanda Electrogaz Compact Fluorescent Lamp (CFL) distribution project		30 May 10 - 29 May 20 (Fixed)	Efficient lighting	27,000	2 issuances, for a total of around 27,000 CERs
4613	Rwanda Natural Energy Project: Water Treatment Systems for Rural Rwanda (Shyira and Fawe)		01 Jul 11 - 30 Jun 21 (Fixed)	Waste water treatment	-	Crediting period up to 2021. No issuance yet
4799	Rwanda Natural Energy Project: Water Treatment Systems for Rural Rwanda (Mugonero Esepan, Rwesero, Nyagasambu)		01 Jul 11 - 30 Jun 21 (Fixed)	Waste water treatment	-	Crediting period up to 2021. No issuance yet
8138	Nuru Lighting Project - Rwanda		01 Jan 13 - 31 Dec 22 (Fixed)	Efficient lighting	-	Crediting period up to 2021. No issuance yet

Sources: UNFCCC website² and UNEP DTU (2017a,b).

Rwanda has actively participated in the development of CDM standardized baselines (SB), leading to two approved SBs on landfill gas capture (ASB0030) and grid emission factor (ASB0017).

Seven NAMAs are listed as “seeking support for preparation” in the UNFCCC NAMA registry, covering various economic sectors (UNFCCC NAMA Registry 2017):

- Sustainable Fertilizers Production and Use
- Developing a Sustainable Charcoal Value Chain in Rwanda
- Electrification with solar PV mini-grids in rural villages in Rwanda
- Promoting the use of Renewable Energy Solution for Households and Buildings
- Energy Efficiency Improvement in the Tea and Coffee Sector in Rwanda
- Bus Rapid Transit (BRT) in Kigali (with linkage to non-motorized transport)
- Waste-to-Energy (WtE) and improved waste management practices in Kigali

Both the CDM activities as well as the NAMAs suffer from a lack of financing which is due to the collapse of the prices for emission credits under the CDM since 2011 as well as a scarcity of international funding for NAMA implementation. So far, only the BRT in Kigali NAMA is being developed, with a detailed feasibility study expected by July 2018. Lack of expertise in preparing the NAMA documentation is also a major barrier (REMA 2015). This is a situation shared with many other countries where NAMAs concepts have been prepared, but lack of financial support and expertise is preventing their detailed preparation and implementation.

² <http://cdm.unfccc.int/ProgrammeOfActivities/registered.html> accessed on 13/06/2017

During the run-up to UNFCCC COP21 in Paris 2015, Rwanda submitted its intended Nationally Determined Contribution (NDC) which remained unchanged when Rwanda ratified the Paris Agreement in 2016. The NDC is based on the 2011 Green Growth and Climate Resilience Strategy (GoR 2011) and contains a long list of measures addressing mitigation of and adaptation to climate change to be implemented in the period between 2020 and 2030.

2.2. Scope of the report

This detailed implementation plan for Rwanda's NDC looks at each measure listed in the NDC as well as further relevant measures and provides a prioritization of efforts based on stakeholder consultations undertaken in May and June 2017. It estimates the costs and sustainable development co-benefits of the measures as well as Measurement, Reporting and Verification (MRV) of results and suggests timelines for their implementation. Moreover, it assesses to which extent international financing for NDC measures can be mobilized through international institutions like the Green Climate Fund (GCF), the Adaptation Fund, multilateral development banks, bilateral cooperation and market mechanisms under the Paris Agreement.

For each measure, this report provides information on the baseline scenario, target values from national documentation, current status of implementation, responsible institutions, cost estimates, implementation timelines and indicators for MRV.

In separate chapters, data gaps encountered during the assessment as well as potential international financing sources for the prioritized measures are discussed. With regards to the latter it needs to be stressed that the framework for international climate finance under the Paris Agreement still remains unclear and thus GoR needs to carefully watch for the emergence of new and potentially attractive sources of finance.

3. The Rwandan NDC in the international context

This section provides background on why and how NDCs are relevant in the Paris Agreement (PA), including the relationship with the new market mechanisms introduced by the PA, i.e. the Cooperative Approaches (CAs) under Art. 6.2 and the Sustainable Development Mechanism (SDM) under Art. 6.4. The section continues by summarizing key sectors and information as contained in the submitted NDC, for both mitigation and adaptation. It also covers additional mitigation and adaptation actions that have not yet been included in the NDC but were considered relevant by the stakeholders encountered. Finally, an overview of the main stakeholders relevant for NDC implementation is presented.

3.1. NDCs within the Paris Agreement and their link to the market mechanisms

The long-term goals of the PA include to:

- prevent average global temperature increase of above 2°C by 2100 and undertaking efforts for limiting them to 1.5°C;
- achieve a net balance between sources and sinks of greenhouse gases (GHG) in the second half of the century;
- increase the capacity to adapt to the adverse consequences of climate change; and
- generate financial flows that are consistent with the goals above.

Unexpectedly, entry into force of the PA was already achieved on 4 November 2016, so that the first session of the Conference of the Parties serving as the Meeting of the Parties to the Paris Agreement (CMA 1) could start in November 2016 in Marrakech.

Parties of the UNFCCC had met in Lima in 2014 and decided to build the future climate regime on nationally specified contributions to meet the mitigation and adaptation challenge. This resulted in the development of intended NDCs of all countries. This bottom-up approach is fundamentally different from the Kyoto Protocol system, which has specified the emission reduction targets of individual (industrialized) countries in a top-down process. Under the PA each country ratifying the agreement submits its NDC. Every five years NDCs will be reviewed and “ratcheted upwards” as specified in PA Art. 4.3. This way it is ensured that no country slides back to ambition levels of previous NDCs. To date, 191 countries, covering 98.9% of global emissions (CAIT 2017) have submitted their (i)NDC to the UNFCCC and 148 countries have ratified the PA.

Art. 3 of the PA defines Parties’ efforts to achieve the targets identified under Art. 2 as a progression increase over time. It also recognizes that developing country Parties will need support “for the effective implementation of the Agreement” (UNFCCC 2015).

Art. 7 establishes a global goal of adaptation, aiming at “enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change, with a view to contributing to sustainable development and ensuring an adequate adaptation response in the context of the

temperature goal referred to in Art. 2" (UNFCCC 2015). It recognizes the global dimension of the adaptation challenge and stresses the importance of adaptation as a tool for protecting people, livelihoods and ecosystems. It also acknowledges the special needs of the LDCs, especially those most exposed to the negative effects of climate change. Article 7 also stresses the importance of international cooperation to enhance adaptation actions. It refers to the CAF and reinforces its importance. Specific attention is given to the engagement in adaptation planning processes and also on towards implementation of actions. A periodic adaptation communication is also mentioned but no detail is provided regarding the form and content of this communication. Rules for such communications are currently under negotiation.

The PA also, unexpectedly, includes a whole article on new market mechanisms (Art. 6). These mechanisms, defined in Art. 6.2 (CAs) and Art. 6.4 (SDM) can be used by all countries to reach the targets of their NDCs, both as sellers or buyers at the same time. This requires appropriate rules to avoid any potential double counting and ensure the environmental integrity of the mechanisms. These rules are to be finalized by 2018 but progress to date has been slow.

The general interpretation of Art. 6.2 sees the CAs as a tool for parties to transfer Internationally Transferred Mitigation Outcome (ITMOs) abroad as per their convenience, for instance through specific bilateral agreements. It does not pose any restriction in terms of type of mitigation outcomes that could be covered under these provisions. CAs could be playing an important role in the future climate regime: even if some views tend to identify the CAs as only a means for transferring ITMOs in the context of linking emission trading schemes rather than actual generation of emission reduction, there is room for developing different initiatives under the CA framework, similarly to bilateral forms of cooperation. However, this mechanism has still to be defined in detail: the text of Art. 6.2 explicitly mentions only the environmental integrity and transparency principles, while Art. 6.3 clarifies the voluntary nature of the CAs.

On the other hand, the SDM is a centralized mechanism under the supervision of the CMA³ that shows several elements taken from the CDM structure: a central governing body (similar to the CDM Executive Board), public and private participation, and utilization for fulfilling NDCs with transferrable emission reduction units but only usable by one party (Art. 6.5). This provision aims at avoiding double counting of emissions reductions. The main goal is "to promote the mitigation of GHG emissions while fostering sustainable development" (Art. 6.4 a).

3.2. Brief description of Rwanda's NDC

Rwanda's NDC is based on the National Strategy for Climate Change and Low Carbon Development (GoR 2015). Rwanda's long-term vision expressed in that strategy is to transform itself into a climate resilient economy with secure low-carbon energy supply, green services and industry. The NDC is separated into an adaptation component and a mitigation component. The adaptation component is listed first highlighting the country's vulnerability to climate change.

³ *Conference of the Parties serving as the meeting of the Parties to the Paris Agreement.*

Food security is ensured by sustainable land use and Water Resource Management. Sustainable urban development, ecosystem-based services, appropriate social protection and better health and disaster risk reduction (DRR) strategies increase the resilience of Rwanda’s population. Many of the specific adaptation activities that are proposed in the NDC are identical with those listed in GoR (2011) but with different targets and timeframes. The Green Growth and Climate Resilience Strategy 2011 has a timeframe spanning until 2050, while the NDC published in 2015 envisions implementation of mitigation and adaptation activities until 2030. Thus, they have been formulated several years ago and are at different stages of implementation today. The focus sectors of the adaptation contribution are: Agriculture, Forestry Tourism, Water use, Land use and Cross-cutting measures.

The mitigation component is framed by the country’s vision for adaptation. It envisages emission reductions that deviate from the business-as-usual scenario by 2030. It is conditional on the provision of international support for finance, technology and capacity building. The precise mitigation potential of the proposed measures has not been calculated yet and will be informed by the Third National Communication. Mitigation target sectors are Energy, Transport, Industry, Waste and Forestry. To long term vision of the mitigation contribution is to pave the road towards a low-carbon economy that provides secure low-carbon energy supply and avoids deforestation. Table 2 provides an overview of all measures as specified in the NDC (GoR 2015) according to sectors.

Table 2: List of measures set out in Rwanda’s NDC

Adaptation
Agriculture
<i>Programme 1: Sustainable intensification of agriculture</i>
Action A1.1: Mainstreaming agro ecology techniques using spatial plant stacking as in agro forestry, kitchen gardens, nutrient recycling, and water conservation to maximize sustainable food production
Action 1.2: Utilizing resource recovery and reuse through organic waste composting and wastewater irrigation
Action A1.3: Using fertilizer enriched compost
Action A1.4: Mainstreaming sustainable pest management techniques to control plant parasites and pathogens
Action A1.5: Mainstreaming sustainable pest management techniques to control plant parasites and pathogens
Action A1.6: Soil conservation and land husbandry
Action A1.7: Irrigation and water management
<i>Programme 2: Agricultural diversity in local and export markets</i>
Action A2.1: Add value to agricultural products through processing to meet its own market demand for food stuffs
Forestry
<i>Programme 3: Sustainable Forestry, Agroforestry and Biomass Energy</i>
Action A3.1: Promote afforestation/reforestation of designated areas through enhanced germplasm and technical practices in planting and post-planting processes
Action A3.2: Employ Improved Forest Management for degraded forest resources
Tourism
<i>Programme 4: Ecotourism, Conservation and Payment for Ecosystem Services Promotion in Protected Areas</i>
Action A4.1: Maximize business tourism (the largest source of export revenues) through strategic conference management in order maximize the distribution and volume of business travelers throughout the year
Water
<i>Programme 5: Integrated Water Resource Management and Planning</i>
Action A5.1: Establish a national integrated water resource management framework that incorporates district and community based catchment management

Action A5.2: Develop water resource models, improved meteorological services, water quality testing, and improved hydro-related information management
Action A5.3: Develop a National Water Security Plan to employ water storage and rain water harvesting, water conservation practices, efficient irrigation, and other water efficient technologies
Land use
<i>Programme 6: Integrated approach to Sustainable Land Use Planning and Management</i>
Action A6.1: Employ an integrated approach to planning and sustainable land use management
Action A6.2: Improve spatial data by harnessing ICT and GIS (Geographic Information System) technology
Cross-cutting
<i>Programme 7: Disaster Management</i>
Action A7.1: Conduct risk assessments and vulnerability mapping
Action A7.2: Establish an integrated early warning system, and disaster response plans
Action A7.3: Employ community-based disaster risk reduction (DRR) programmes designed around local environmental and economic conditions, to mobilize local capacity in emergency response, and to reduce locally specific hazards
<i>Programme 8: Climate data and projections</i>
Action A8.1: Improve observation facilities to provide all climate information necessary for future monitoring, climate trend detection, management of climate variability, early warning and disaster management
Mitigation
Cross-cutting
<i>Programme 1: Low Carbon Energy Mix</i>
Action M1.1: Establishment of new grid connected renewable electricity generation capacity in the form of large-scale hydro power plants and solar PV power
<i>Programme 2: Sustainable Small Scale energy installation</i>
Action M2.1: Installation of solar PV mini-grids in rural communities
<i>Programme 3: Energy efficiency and demand side management</i>
Action M3.1: Increase energy efficiency through demand-side measures and grid-loss reduction
Action M3.2: Promote environmentally sustainable use of biomass fuels
Transport
<i>Programme 4: Efficient resilient transport system</i>
Action M4.1: Bus Promotion of public transport, improvement of transport infrastructure, setting vehicles' emission standards and regulations and integrated national transportation planning
Industry
<i>Programme 5: Green industry and private sector development</i>
Action M5.1: Scale up resource efficiency to reduce energy demand in agro processing industries
Action M5.2: Establishment of Eco-industrial park of Green Industry complex
Waste
<i>Programme 6: Implementation of Low carbon urban systems</i>
Action M6.1: Utilization of urban waste as a high value resource stream
Forestry
<i>Programme 7: Sustainable Forestry, Agro forestry and Biomass Energy</i>
Action M7.1: Mandate licensing of sustainable charcoal production techniques

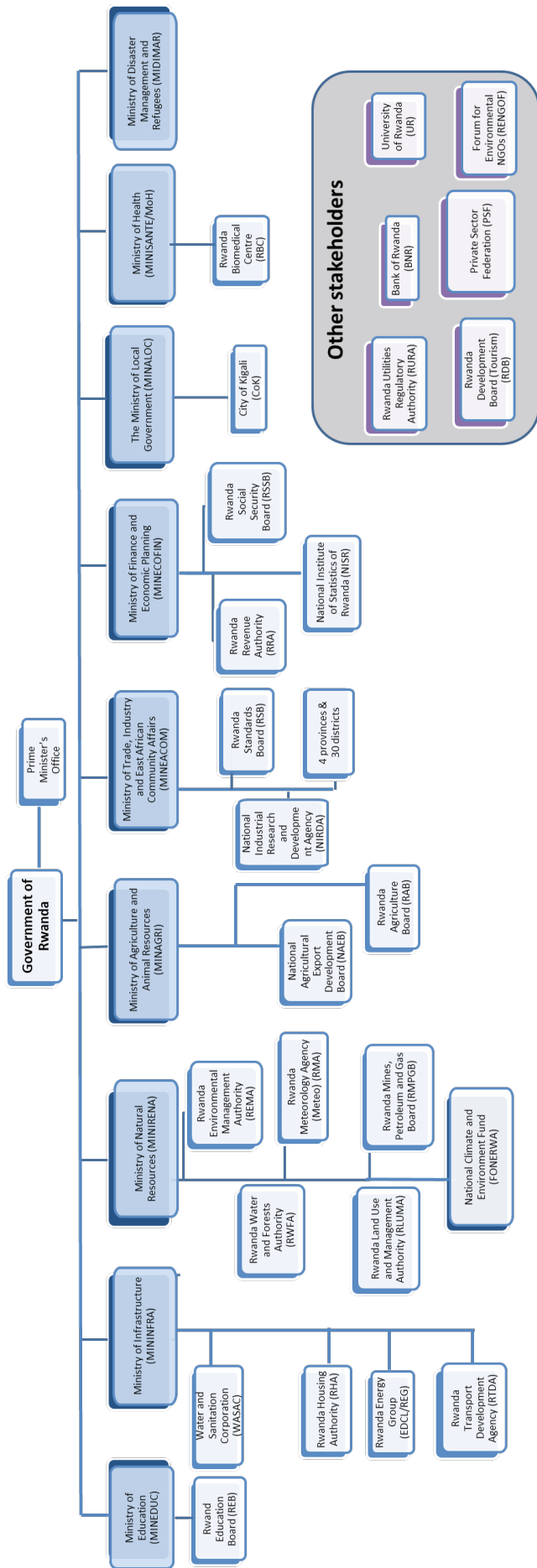
Source: GoR (2015)

The NDC implementation strategy is to be built upon the following five pillars: Institutional Arrangements, Finance, Capacity Building and Knowledge Management, Technology, Innovation and Infrastructure, and Integrated Planning and Data Management. These aspects are taken into account in the implementation plan elaborated below.

3.3. Mapping of relevant stakeholders

There is a large list of stakeholders that are relevant to varying degrees for NDC implementation. Figure 1 gives a broad overview over the line ministries and the other relevant authorities and bodies that have a role in the implementation plan of the selected measures.

Figure 1: Overview of relevant stakeholders for NDC implementation



Source: Author's elaboration

4. Proposed actions for mitigation and adaptation to achieve NDC goals

Based on the author's experience with NDC formulation and implementation and the results of the stakeholder missions in May and June 2017, Table 3 below provides an adjusted list of activities that serve as a basis for the NDC implementation plan. This list includes additional measures that were listed in the GGCRS (GoR 2011) or raised by stakeholders: Lake Kivu methane-to-power project, climate compatible mining, and vector-based disease prevention. Measures where synergies are identified and can be exploited have been merged. This leads to 22 actions sorted according to their thematic area.

Table 3: Adjusted list of NDC measures

Activity No	Activity name	NDC reference	Relevant sector(s)	Overall purpose	Priority
1	Grid connected hydropower	M1.1	Energy	Mitigation	High
2	Solar mini-grid	M2.1	Household	Cross-cutting	High
3	Lake Kivu methane-to-power project	Non-NDC	Energy	Mitigation	High
4	Demand side management (lighting, cookstoves)	M3.1 and M3.2	Household	Cross-cutting	High
5	Renewable biomass	M7.1 and M3.2	Energy	Mitigation	Medium
6	Improved public transport infrastructure and services in Kigali	M4.1	Transport	Mitigation	High
7	Energy efficiency in the agro-processing sector	M5.1	Industry	Mitigation	Medium
8	Development of eco-industrial parks	M5.2	Industry	Mitigation	Medium
9	Climate compatible mining	Non-NDC	Mining	Cross-cutting	Low
10	Waste as resource	M6.1	Waste	Mitigation	High
11	Sustainable food production	A1.1	Agriculture	Cross-cutting	High
12	Composting and fertilizer enrichment	A1.2, A1.3	Agriculture	Mitigation	High
13	Wastewater irrigation	A1.2	Waste/ Agriculture	Cross-cutting	Medium
14	Integrated land use planning	A6.1, A6.2	Agriculture	Cross-cutting	Medium
15	Soil conservation	A1.5	Agriculture	Cross-cutting	High
16	Integrated pest management	A1.4	Agriculture	Adaptation	Medium
17	Irrigation	A1.6	Agriculture	Cross-cutting	High
18	Integrated Water Resource Management	A5.1; A5.2 and A5.3	Cross-sectoral	Cross-cutting	Medium
19	Afforestation	A3.1	Forestry	Cross-cutting	Medium
20	Improved forest management	A3.2	Forestry	Cross-cutting	Medium
21	DRR programmes (early warning, community-based)	A7.1, A7.2, A7.3 and A8.1	Cross-sectoral	Adaptation	High
22	Vector-based disease prevention	Non-NDC	Health	Adaptation	High

For each measure, a brief introduction is provided followed by a table that presents key information for each activity. Based on discussions during the stakeholder consultations in May and June 2017, the activities are categorized as low, medium or high level of priority. The tables summarize relevant information such as the current baseline, current implementation status, timeline and milestones for implementation. Using available information derived from existing literature and

reports from GoR, development institutions and interaction with stakeholders, the investment cost for the implementation of each measure is provided. Where no information was found, the cell in the table is marked with N/A. Many of the activities have cross-cutting effects and generate mitigation, adaptation and sustainable development co-benefits. Therefore the table sheds light on these benefits and links them to the respective UN Sustainable Development Goals (SDGs). In order to provide a full picture of each measure, relevant stakeholders are identified as well as capacity building needs.

4.1. Grid connected hydropower

The main target for the energy sector is to provide sufficient, reliable and affordable electricity to support economic growth and livelihood improvements. To achieve this goal, it is necessary to expand the generation capacity connected to the national grid. Least cost analysis of the generation options shows that large hydropower plants (together with geothermal) are the lowest-cost resource. Also, small and mini hydro is expected to contribute, although their cost structure is less attractive (AfDB, 2013a). This expansion plan of the hydropower capacity will be implemented together with the development of power generation based on methane. New demand of electricity will be driven by the constant increase of the population and also by the increase in the urbanization rate. Diversification of the energy mix is becoming more important in order to ensure reliability of the supply, minimize generation costs and also reduce the share of carbon-intensive sources of energy.

Hydropower has the advantage of providing emission-free electricity, however also negative aspects should be considered. Large projects can affect the surrounding areas significantly, affecting the ecosystem and in some cases requiring relocation of local communities. Increase in the power generation capacity is in line with the priority areas of the EDPRS II that target the increase of the electricity generation and also increased access to energy for rural population.

In order to increase the efficiency of the sector, participation of the private sector (i.e. Independent Power Producers, IPPs) will be incentivized through enhanced regulation and providing investment certainty over time through contractual agreements (i.e. Power Purchase Agreements). In some case private companies benefitted from fixed feed-in tariff for renewable electricity and also from partial guarantees (such as in the case of Lake Kivu methane-to-power project) to reduce political and other risks.

The main benefits generated by this measure are related to mitigation, i.e. reduction of GHG emissions, while other sustainable development co-benefits are related to the creation of new job opportunities, increased access to electricity, reduction of other harmful pollutants (e.g. SO_x and particulate matters). In order to speed up implementation and to ensure that a proper MRV system is in place as per CDM requirements, it would be possible to include new hydro project in the registered CDM PoA (i.e. PoA 9847: Renewable Energy CDM Programme of Rwanda). This would allow the generation of Certified Emission Reductions (CERs) that can be either used

against the mitigation targets of the NDC or sold to other Parties. The latter implies that these emission reductions are not accounted against NDC targets. If the CERs are to be used to fulfil the NDC, then all credits will be cancelled to avoid potential double counting. Inclusion in a registered PoA is simple as new CPAs can be included without undergoing the full registration process at UNFCCC level but just obtaining the Designated Operational Entity approval, i.e. reducing the required time by 6-12 months. Applying CDM methodology ACM 0002, a cumulated mitigation potential of 1.0 million t CO₂ is estimated, using the information in Table 4 below.

Table 4: Grid connected hydropower

Activity Name	Grid connected hydropower		Priority	High
Activity No.	1	NDC label	M1.1	
Purpose	Mitigation	Sector	Energy	
Baseline Scenario				
The current (2016) domestic electricity generation mix is composed of hydro (49.4%), natural gas/methane (21.5%), diesel/HFO (16.2%), solar (10.3%) and peat (2.6%).The estimated annual GHG emissions for the year 2012 is approximately 0.16 million tCO ₂ e, multiplying by a factor of 25 in the baseline scenario to reach 3.97 million tCO ₂ e in 2030 (REMA 2015).				
Target¹				
Development of 119.2 MW of large hydro (three projects: Rusizi III, 49 MW and Rusumo Falls, 26.7 MW), Nyabarongo II-1, 43.5MW and development of 71.668 MW small and mini hydro.				
Current implementation status / ongoing activities				
82.27 MW of installed capacity in 2015 (not included in the targeted 191 MW to be installed, both large and small plants). The 500 kW Gaseke Hydro Power Project, supported by FONERWA (FONERWA 2017) is reported as under implementation.				
Responsible line ministry	MININFRA			
Responsible lead entity	REG			
Other stakeholder involved	RURA, MINIRENA, REMA, RWFA, RSB, MINECOFIN, FONERWA, Private sector, civil society			
Cost estimates				
2900 – 3500 USD/ kW, large plants and 5000 USD/kW small plants (Stakeholder consultation, May 2017) Total cost for large hydro development (considering 3500 USD/kW and 119.2 MW planned): 417,2 million USD Total cost for small/mini hydro development (considering 5000 USD/kW and 71.67 MW)= 358 million USD Total cost including large and small plants: 775.5 million USD				
Timeline	Full commissioning of large plants by 2028, small plants to be fully commissioned by 2030. Enabling activities completed by 2021			

Activity Name	Grid connected hydropower	Priority	High
Milestones	<ul style="list-style-type: none"> The following enabling activities can be completed by 2021 <ul style="list-style-type: none"> Capacity building for relevant ministries and entities in the implementation, management and monitoring of the enabling activities Potential revision of law and regulation Power Purchase Agreement (PPA) covering a long span of time All large plants have commenced construction by 2023. Commissioning before 2028 (if technically feasible). Emission reduction would be around 315,590 tCO₂/year if all plants are operation in 2028 At least 68.8 MW of small and mini plants to start construction by 2023; remaining 2.87 MW to commence construction before 2025. All mini and small plants to be operational by 2030. The initial batch of plants for a total capacity of 68.8 MW would reduce around 199,790 tCO₂/year from 2028 (if all plants are operational), while the remaining 2.736 MW of capacity would reduce around 8,320 tCO₂/year from 2030. Total emission reductions for small scale plants would be around 208,120 tCO₂/year once all plants are in operation (i.e. from 2030) Total tCO₂/year reduced by the hydropower plants (large and small) would be around 0.5 million tCO₂/year from 2030. Assumption for the calculation: grid loss 15% (15% is the target by 2030 under Demand side management activities. It is considered for simplicity already achieved in 2028); electricity calculations are based on the theoretical electricity generation based on total capacity and average operating hours sourced from the UNEP DTU CDM pipeline². Actual supply to the grid might vary depending on final design of the plants and also on the capacity and agreements with the grid to purchase the electricity produced by the new hydro plants. Grid emission factor: 0.604 tCO₂/MWh (sourced from the registered standardized baseline for Rwanda (ASB0017: Rwanda grid emission factor, ver. 01.0) valid until 24 October 2018 (UNFCCC 2017) 		
Adaptation benefits	<ul style="list-style-type: none"> Increased water management through flood and drought control (for project including a reservoir for water storage). Increase in agricultural production due to better water management and less exposure to extreme events. 		
Co-benefits	<ul style="list-style-type: none"> Reduction of pollutants: SO_x, NO_x, particulates, etc. Increased reliability of power supply Grid extension and enhanced access to energy Potential for new business opportunities Reduced quantity of imported of fossil fuels and related expenditure for 		
Relevant Sustainable Development Goals			
			
MRV system/ indicators	<ul style="list-style-type: none"> MW installed (by year) MWh supplied to the grid from new hydropower plants (by year) USD/kW actually spent (disaggregated by plant size, i.e. mini, small and large) Access to electricity/new connection to grid Reliability of electricity supply (% of time with power cuts, number of events per year) Business opportunity created tCO₂e/year reduced 		

Activity Name	Grid connected hydropower	Priority	High
Capacity building needs	<ul style="list-style-type: none"> Institutional capacity building for planning of generation capacity; design, implementation and monitoring of supporting policy instruments 		
Barriers	<ul style="list-style-type: none"> Limited data beyond planned projects Limited private sector participation Limited funds Detailed feasibility studies still missing 		
Risks	<ul style="list-style-type: none"> Exposure to extreme meteorological events such as drought that affect energy production Social-economics and environmental impacts of large hydropower plants 		


4.2. Mini-grids

Mini grid systems are the most promising alternatives when considering off-grid power generation. The possibility of installation in remote areas without the need of the investment for the connection to the national grid makes mini grid systems a very promising option for providing energy access to rural communities. This is also reinforced by the decreasing prices of technology. The NDC targets the installation of both solar and hydro mini-grids to serve rural communities for a total installed capacity of 120 MWp by 2030 including the possibility of storing energy to increase efficiency of use. As reported by REMA, mini-grids offer also good opportunities for private investments through Build, Own, Operate; maintain and Manage business models in the form of Public Private Partnerships (PPPs).

In the rural context, increasing energy access provides a strong contribution towards achievement of adaptation and other sustainable development co-benefits. The main ones are the availability of a modern source of energy and reduction of harmful pollutants due to combustion of fossil fuels, reduction of consumption of non-renewable biomass from forests, reduction of the time/cost needed for collecting fuel, increased socialization opportunities and safety, increased educational opportunities. Access to energy would also create new businesses and job opportunities.

These benefits are likely to be more significant for women, as they are traditionally in charge of seeking fuel for domestic uses, including lighting. Applying CDM methodology AMS-I.L, a cumulated mitigation volume of 0.6 million t CO₂ is calculated for the period until 2030, applying the information in Table 5 below.

Table 5: Mini-grids

Activity Name	Mini-grids		Priority	High
Activity No.	2	NDC label	M2.1	
Purpose	Mitigation	Sector	Energy	
Baseline Scenario				
Rural communities use fossil fuel based electricity generation in off-grid areas (i.e. diesel gensets or kerosene and fuelwood for domestic uses)				
Target				
Solar and hydro mini-grid systems, to supply both households and productive uses. Total target is 120 MWp installed by 2030				
Current implementation status / ongoing activities				
<ul style="list-style-type: none"> Two mini-grids have been installed (Stakeholder consultation, June 2017) 				
Responsible line ministry	MININFRA			
Responsible lead entity	EDCL/REG			
Other stakeholder involved	RURA, MINECOFIN, FONERWA, MINIRENA, REMA, RSB, Private sector, civil society			
Cost estimates				
Considering the cost for 1 Wp with storage as 1 USD , the total cost for 120 MWp will be 120,000,000 USD				
Timeline	Around 10 years for full deployment			
Milestones	<ul style="list-style-type: none"> Detailed mapping of the potential sites for the mini-grids, considering solar radiation and water resources for hydropower available and also socio-economic variables (by 2021) Definition of appropriate policy tool for supporting mini-grid implementation (by 2021) such as subsidies Installation could start before 2020. Conservatively, it is considered that half of the mini-grid will be installed by 2023 and the remaining one by 2027 			
Adaptation benefits	<ul style="list-style-type: none"> Reduced dependency on availability of biomass, which is depending also on weather conditions Reduced pressure on the forests and protect biodiversity Increase opportunities for education, which indirectly increase resilience 			
Co-benefits	<ul style="list-style-type: none"> Reduced pollutants from indoor combustion of fossil fuel for lighting. Women and children are main beneficiaries. Reduced time and cost for seeking fuel. Women and children are main beneficiaries Increased socialization opportunities and safety New business opportunities and new jobs 			
Relevant Sustainable Development Goals				
				
MRV system/ indicators	<ul style="list-style-type: none"> Amount of installed capacities in MWp MWh supplied per year (by mini-grid) Number of customers served by each mini-grid Actual cost of each mini grid (i.e. USD/MWp) Number of private companies involved tCO₂e/year reduced 			
Capacity building needs	<ul style="list-style-type: none"> Enhanced off-grid energy planning and identification of effective solutions for implementation including new mechanisms to mobilize private investments Technical capacity installation and maintenance of the systems Engagement with local population to gain commitment 			

Activity Name	Mini-grids	Priority	High
Barriers		<ul style="list-style-type: none"> • High up-front investment • PV quality and high cost of batteries for storing solar power 	
Risks		<ul style="list-style-type: none"> • Lack of sufficient purchasing power of rural population for PV off grid • Difficulties in monitoring the equipment actually in use 	

4.3. Lake Kivu methane-to-power project



Lake Kivu is located across the border between the Democratic Republic of Congo and Rwanda. This lake has a high content of methane due to volcanic activity. It is estimated that the lake contains around 55 billion m³ of methane. It is estimated that the associated potential power production could reach 700 MW. However this figure must be shared equally between Rwanda and Democratic Republic of Congo.

Currently there is an existing 26 MW plant already installed and in operation, operated by Kivuwatt, as subsidiary of the American company Contour Global. Kivuwatt plans an expansion up to around 100 MW, while by December 2015 another private company, Symbion Power through its subsidiary Symbion Power Lake Kivu Ltd., signed a Power Purchase Agreement with the government for the purchase of electricity from a new 50 MW power plant. In addition to the power supply, an important component of this measure is to ensure the avoidance of limnic eruptions.

Due to the composition of the lake, with high concentration of methane and CO₂ in the lower layers of the water, there is a serious risk that the CO₂ could be released. This would put in danger the population living in the surrounding as in this case the gases released from the lake could create a deadly cloud. This has occurred already at least in two occasions in Cameroon in lakes with a similar composition of Lake Kivu.

The explosion that occurred in 1986 in Lake Nyos killed around 1700 people. Extraction of methane from the lake is at the same time a way to reduce the risk of limnic eruptions and a manner to increase and diversify Rwandan electricity generation. Although not directly mentioned in the NDC, expansion of the power generation capacity using methane from Lake Kivu fits into the stated goal of expanding methane based energy generation (GoR 2015). Using the information in Table 6 below, a cumulative mitigation potential of 0.065 million t CO₂ is calculated until 2030 applying CDM methodologies AM 0029 and ACM 0002.

Table 6: Lake Kivu methane-to-power project

Activity Name	Lake Kivu methane-to-power project		Priority	High
Activity No.	3	NDC label	Non NDC action	
Purpose	Mitigation	Sector	Energy	
Baseline Scenario				
The estimated annual GHG emissions for the year 2012 is approximately 0.16 million tCO ₂ e, multiplying by a factor of 25 in the baseline scenario to reach 3.97 million tCO ₂ e in 2030 (REMA 2015).				
Target				
Potential installation of additional 50 MW.				
Current implementation status / ongoing activities				
30MW are already installed and in operation				
Responsible line ministry	MININFRA			
Responsible lead entity	REG			
Other stakeholder involved	REG, private companies (e.g. Kivuwatt, Symbion Power) financial institutions including those involved in the first phase (i.e. AfDB's private sector arm, the Emerging Africa Infrastructure Fund; Belgian Investment Company for Developing Countries; Netherlands Development Finance Company; and the European Financing Partners, civil society			
Cost estimates				
Cost for the first phase:128 million USD Assuming a similar cost structure (i.e. around 4.92 million USD/MW), full operations 50 MW from Symbion Power) could cost up to 250 million USD in total.				
Timeline	Expansion of the 50 MW under Symbion Power could be realized by 2028			
Milestones	<ul style="list-style-type: none"> Total installed capacity to reach 80 MW by 2028 			
Adaptation benefits	<ul style="list-style-type: none"> Diversification of the energy mix reducing share of sources that are affected by extreme weather events (i.e. hydropower) 			
Co-benefits	<ul style="list-style-type: none"> Provision of energy from a reliable source and increase grid stability Reduction of the risk of limnic eruptions Job creation Reduce the cost of imported fuels Reduction of pollutants associated with fossil fuel based power generation 			
Relevant Sustainable Development Goals				
 				
MRV system/ indicators	<ul style="list-style-type: none"> MW installed MWh supplied to the grid (MWh/year) tCO₂e/year reduced 			
Capacity building needs	<ul style="list-style-type: none"> Further research on the actual potential using the methane in Lake Kivu Increase domestic experience with methane-based power generation 			
Barriers	<ul style="list-style-type: none"> Access to finance 			
Risks	<ul style="list-style-type: none"> Limnic eruption Accuracy of data on quantity of gas estimates might be optimistic Delays in construction and commissioning due to the peculiarity of the project 			

4.4. Demand side management

Reducing energy consumption is a priority for achieving emission reductions. In Rwanda the majority of the population uses inefficient stoves and over 2 million households⁴ are living in

⁴ This is based on an average of 4.3 persons per household (REMA 2015)

rural areas, or around 83% of the total population (NISR 2016). Dissemination and use of efficient cookstoves would serve two goals: reducing GHG emission through the reduction of the firewood or other fossil fuel consumed with the same level of service, and at the same time achieving adaptation and sustainable development co-benefits. These benefits are: reduced time for seeking fuel for cooking, which is normally carried out by girls and women, reduction of harmful pollutant due to indoor combustion, reduced pressure on forests and natural environment and reduced fuel cost for households.

Demand side management measures envisaged by the NDC also cover the distribution of more efficient lamps for urban population (i.e. compact fluorescent lamps; CFLs, and Light emitting diode, LED). The dissemination of efficient lamps will allow the achievement of emission reductions due to the reduced energy consumption. In addition, it could contribute to the improvement of the peak load management, which is a critical topic in Rwanda. Some estimates calculate that the peak load could increase from 51 MW in 2008 to 328 MW in 2020 (AfDB 2013a). If coupled with appropriate disposal of existing lamps, this measure would also achieve a safe disposal of the existing lamps: depending on the technology used, harmful materials can be found in lamps, including mercury.

There are currently 3 registered PoAs in Rwanda targeting the dissemination of improved cookstoves: the PoA 9672 (Paradigm Sub Saharan Africa Cook Stove Programme), the PoA 7247 (Efficient Cook Stove Programme: Rwanda) and the PoA 9596 (Heat Retention Cooking in Less Developed Countries). In addition, also the PoA 7014 (Improved Cook Stoves for East Africa) could be explored as it is a multiple-country PoA and in October 2016 included a new CPA located in Rwanda. Also the PoA 9626 (DelAgua Public Health Program in Eastern Africa) includes the distribution of cookstoves, together with the dissemination of water filters. The latest CPAs included in the PoA 9626, i.e. in April 2016, have distributed around 161,000 efficient cookstoves⁵. As explained in previous sections, inclusion of the dissemination plans in a registered PoA would increase the potential to benefit from market mechanism revenues or, in case the mitigation outcomes are not sold in the market, they can be used against the NDC targets. Revenues from market mechanisms would provide an important source of income for local communities to improve their livelihoods. Also water filters have an important role in improving livelihoods particularly in rural areas, reducing both emissions but more importantly water borne diseases. Currently 25% of the population has no access to safe drinking water sources (UNICEF 2017).

Another important element for demand side management is the definition and enforcement of building codes to reduce energy consumption setting minimum performance standards for new buildings. Rwanda is actively defining a set of energy and water efficiency standards to be applied to building from mid-2018 (Stakeholder consultation May 2017). Similarly to other developing countries, increase in urbanization, demographic growth and income increase all lead to an increase in the number of new building in urban areas, especially in the city of Kigali. Long term planning to include also climate change consideration is necessary for avoiding that

⁵ http://cdm.unfccc.int/ProgrammeOfActivities/poa_db/RVUJL2DMZ7HBKC1PEG4O8NA0WSI6TX/view accessed on 10.06.2017

new buildings are built in an inefficient manner and no efficient techniques and technologies are considered, locking in related emissions for decades. In September 2016 Rwanda Housing Authority (RHA) signed a Memorandum of Understanding with the Singapore Building and Construction Authority to promote green buildings (Stakeholder consultation May 2017). The Rwanda Urban Planning Code (MININFRA 2015)⁶ defines standards for the following set of measures:

- structural stability, strength and durability
- functional requirements
- safety and disaster risk mitigation; environmental soundness
- accessibility
- efficient and effective use of resources
- energy efficiency and use of renewable energies
- rain and surface water harvesting
- natural lighting and ventilation
- hygiene and sanitation
- ensuring durability through maintenance

Seven categories of buildings are identified depending on: total floor area (square meters), number of storeys and on the total number of people that can be hosted⁷. The building code covers virtually every aspect of building construction, from building material and envelope, shading and artificial/natural lighting, energy efficiency and use of renewable sources, efficient equipment, water efficiency measures, Heat, Air Ventilation, and Cooling (HAVC).

Table 7: Demand side management measures

Activity Name	Demand side management		Priority	High
Activity No.	4	NDC label	M3.1 and M.32	
Purpose	Cross-cutting	Sector	Household	
Baseline Scenario				
Existing technology used: inefficient lighting (tube lighting, incandescent lamps); inefficient cooking (three stones); 83.3% of people use firewood for cooking (NISR 2016) Grid loss are currently at around 21%				
Target				
<ul style="list-style-type: none"> • Dissemination of CFL/LED lamps to replace inefficient ones • NDC target is to disseminate improved cookstoves to 100% of all households in needs by 2030 • Grid loss to be reduced to 15% by 2030 • Building code to enter into force in 2018 				
Current implementation status / ongoing activities				
Under FONERWA's project "Integrated Land, Water Resources and Clean Energy Management" 1,000 improved stoves are being distributed. Under the project "Sustainable Management and Environmental Rehabilitation for Poverty Reduction", 600 families have been provided with solar lanterns. Also the "Sustainable Forest and Watershed Resources Management in Nyagatare District" project envisages the support to over 20,000 households to access improved cookstoves, The "Congo Nile Ridge Foothills Integrated Environment Project" aims at increasing the number of household using of efficient cookstoves among the target group of over 25,000 households. (FONERWA 2017). Efficient lighting dissemination plans are targeting the distribution of both LEDs and CFL to both rural and urban population A Rwanda Green Building Code was launched in 2016.The certification process for green building is now in place.				
Responsible line ministry	MININFRA			
Responsible lead entity	REG			

6 The code has been published as an annex to the Official Gazette n 20 bis of 18/05/2015 (MININFRA 2015)

7 One category, 1 A, is defined as "Temporary structures which can be removed without compensation" (MININFRA 2015).

Activity Name	Demand side management	Priority	High
Other stakeholder involved	REMA, RHA, RDB, MINECOFIN, FONERWA, MINALOC, RSB, MINSANTE, private sector, civil society		
Cost estimates			
<p>Lighting 4 USD per LED, 1.2 USD per CFL. It is assumed that lamps will be distributed to 80% of rural population and 30% of urban population, i.e. around 1.8 million households. Considering that each household will be supplied with 2 lamps (half LED, half CFL), the total costs reach around 9.4 million USD. Total cost might change depending on the technology and wattage of the lamps to be distributed.</p> <p>Cookstoves It is assumed that efficient cookstoves will be distributed to 80% of the rural population and to 50% of the urban population, for a total of around 1.9 million households. The PoA 9626 recently distributed around 161,000 cookstoves which are then deducted from the total number, resulting in around 1.76 million cookstoves to be distributed. The total cost for the distribution of the same amount of efficient cookstoves is around 9.2 million USD, considering a unit price of 5.3 USD³. According to GoR (2016) implementation of the full set of measures including taxes on charcoal, reducing taxes on other efficient fuels, support to cookstoves producers, support to alternative livelihood for charcoalers and support to forestry management projects would cost 0.6 billion USD⁴.</p>			
Timeline	<p>Dissemination of efficient equipment could start by 2020 and be completed by 2030, assuming around 200,000 efficient cookstoves can be distributed every year.</p> <p>For lighting equipment, around 3.39 million lamps will be distributed. Around 340,000 lamps will have to be distributed per year to reach the target.</p> <p>For water filters, the same roll out could be envisaged, i.e. 200,000 water filters disseminated every year. Considering 2.8 million people without access to clean water, or around 650,000 households, around 3.3 years would be needed for the water filter distribution. This plan might change depending on improvement of population access, regardless of the water filter distribution, to clean water.</p> <p>Grid loss: grid loss to be reduced to 15% from 21% by 2030</p> <p>Building codes: the code will be implemented by 2018, its actual enforcement will be evaluated in the following years</p>		
Milestones	<ul style="list-style-type: none"> • Definition of the most effective model for the dissemination of cookstoves and lighting equipment (i.e. identification of an appropriate price for each cookstove to be distributed; definition of the procedures for providing maintenance for cookstoves), and definition of a plan for the dissemination program by 2020 • 200,000 efficient cookstoves distributed each year in the period 2020-2030 • 340,000 efficient lighting equipment distributed each year in the period 2020-2030 • 200,000 water filters distributed each year in the period 2020-2024 		

Activity Name	Demand side management	Priority	High
Adaptation and mitigation benefits	<p>Lighting</p> <p>Mitigation</p> <ul style="list-style-type: none"> - Reduced emissions through substitution of fossil fuel based lighting <p>Adaptation</p> <ul style="list-style-type: none"> - Increases opportunities for education, indirectly increasing population resilience to extreme weather events - Reduced cost for fuel purchase, which indirectly increases population resilience due to improved living conditions <p>Cookstoves</p> <p>Mitigation</p> <ul style="list-style-type: none"> - Reduced GHG emissions due to reduced consumption of fossil fuel and to the use of renewable biomass <p>Adaptation</p> <ul style="list-style-type: none"> - Reduced dependence on non-renewable biomass whose availability is also dependant on climatic conditions - Reduction of pressure on forest resources and thus lower impact of extreme precipitation events due to reduced runoff <p>Water filters</p> <p>Mitigation</p> <ul style="list-style-type: none"> - Reduced emissions from boiling water <p>Adaptation</p> <ul style="list-style-type: none"> - Increased drinkable water availability, also in the case of extreme weather event as such as floods - Availability of drinkable water even in the event of a large scale break out of water borne disease <p>Grid loss component</p> <p>Mitigation</p> <ul style="list-style-type: none"> - Emission reductions due to improved energy utilization <p>Building</p> <p>Mitigation</p> <ul style="list-style-type: none"> - Emission reductions due to efficient equipment and improved building design <p>Adaptation</p> <ul style="list-style-type: none"> - Enhancement of buildings' climate resilience 		
Co-benefits	<p>Common elements</p> <ul style="list-style-type: none"> • Improved health and reduced indoor pollution • Reduced cost of fuel/bills • Increased time availability for productive activities (as opposed to seeking fuel) • Reduced pressure on natural resources used as fuel <p>Lighting</p> <ul style="list-style-type: none"> • Improved socialization • Improved educational opportunities • Increased awareness on energy efficiency benefits and options <p>Cookstoves</p> <ul style="list-style-type: none"> • Improved health and reduced indoor pollution • Reduced cost of fuel • Reduction of fuelwood and charcoal used for cooking <p>Water filters</p> <p>Improved health and reduced water borne diseases</p> <ul style="list-style-type: none"> • Increased productivity • Improved health education <p>Grid loss</p> <ul style="list-style-type: none"> • Improved grid management including peak load • Reduced inefficiencies and associated GHG emissions <p>Building</p> <ul style="list-style-type: none"> • Reduce material and energy consumption (reduction of the environmental footprint of buildings) • Utilization of domestic resources and reduction of imports • Long term economic savings for building users • Improved livelihood through enhanced building design 		
Relevant Sustainable Development Goals			

Activity Name	Demand side management	Priority	High
			
MRV system/ indicators	<p>Lighting</p> <ul style="list-style-type: none"> Number of lamps sold and rated power (MW) per year <ul style="list-style-type: none"> MWh saved by efficient lighting systems per year Number of lamps in operation per year <p>Cookstoves</p> <ul style="list-style-type: none"> Number of cookstoves distributed per year Quantity of non-renewable biomass (or fossil fuel) saved by the efficient stoves per year (t/year) Number of efficient stoves in operation in each year <p>Water filter</p> <ul style="list-style-type: none"> Number of water filter distributed per year Quantity of non-renewable biomass (or fossil fuel) saved by the water filters per year (t/year) Number of water filters in operation in each year <p>Grid loss</p> <ul style="list-style-type: none"> Grid loss in each year (%) Electricity savings due to reduction of grid loss (kWh/year) <p>Building</p> <ul style="list-style-type: none"> Water consumption(litres/m²) Energy consumption (kWh/ m²) Number of buildings implementing the new code <p>All components</p> <ul style="list-style-type: none"> tCO₂e/year reduced 		
Capacity building needs	<ul style="list-style-type: none"> Raise awareness on efficient equipment correct use, maintenance and associated benefits Increase institutional know-how on efficient technologies Increase capacities for enforcement of standards and codes Awareness about economic advantages of solar PV is not there Understanding green building technology Understanding NAMA concept Technology training for siting and developing infrastructure Train inspectors to check compliance with green building minimum standards 		
Barriers	<p>Lighting</p> <ul style="list-style-type: none"> High initial cost Low quality and short lifetime of the efficient lamps Awareness of the public on lighting options <p>Cookstoves</p> <ul style="list-style-type: none"> High initial cost Low quality of the efficient equipment Low awareness of the public on the benefits of improved cookstoves <p>Water filters</p> <ul style="list-style-type: none"> Initial investment cost Awareness on the importance of safe water and available alternatives <p>Grid</p> <ul style="list-style-type: none"> High investment cost Lack of sufficient technical skills Status of existing technology <p>Buildings</p> <ul style="list-style-type: none"> Higher initial cost for efficient buildings Split incentive Lack of awareness on benefits of efficient building 		

Activity Name	Demand side management	Priority	High
Risks	Lighting <ul style="list-style-type: none"> • Ensure safe disposal of existing lamps • Remote monitoring needed Cookstoves <ul style="list-style-type: none"> • Remote monitoring needed • Ensure continued use of efficient cookstoves, including maintenance • Production capacity might not be sufficient for an ambitious dissemination program Water filters <ul style="list-style-type: none"> • Ensure continued use of water filters, including maintenance • Remote monitoring needed Grid <ul style="list-style-type: none"> • Lack of sufficient technical skills • Costs of new technologies and measures to reduce grid loss Buildings <ul style="list-style-type: none"> • Low enforcement level of the building code 		

4.5. Renewable biomass

Biomass in many developing countries is the main source of energy for both rural and urban population. In Rwanda, biomass accounts for 85% of the primary energy consumption (AfDB, 2013a). Main consumption of biomass is related to charcoal use for cooking needs. Reduction of charcoal consumption is however treated in the section on demand side management above, as this is related to the dissemination of improved cookstoves.

This section will mainly deal with the creation of a sustainable charcoal value chain to reduce the wood demand for charcoal production and to the dissemination of domestic and institutional biogas digesters to collect and use biogas from human and animal waste for energy uses. This option is relevant for rural areas without access to the grid or to other sources of energy and could be an effective mean to reduce non-renewable biomass consumption. Use of biogas is reported as an increasingly important measure (Stakeholder consultation May 2017). An ideal deployment of biogas digesters would be the installation at households where also a few animals could contribute the amount of waste collected thus increasing the amount of biogas available. Cumulative mitigation potential for LPG, using approaches of CDM methodology AMS I.E and assuming all biomass is non-renewable, reaches 0.13 million t CO₂ by 2030.

Table 8: Renewable biomass

Activity Name	Renewable biomass		Priority	Medium
Activity No.	5	NDC label	M7.1 and M3.2	
Purpose	Mitigation	Sector	Energy	
Baseline Scenario				
Current charcoal production is not sustainable and leads to high consumption of wood causing forest depletion. 83.3% of people use firewood for cooking, 15.0% charcoal, 0.8% crop waste, 0.2% LPG and biogas (NISR 2016). In urban areas, the share of charcoal increases to over 67%, which makes the switch to LPG more important to reduce non-renewable biomass consumption.				
Target				

Activity Name	Renewable biomass	Priority	Medium
<p>3500 domestic biogas digesters and 15 institutional biogas digesters annually. Increasing average charcoal yields up to 50% by 2030. Development of a sustainable charcoal value chain that can reduce demand of wood in charcoal production, leading to a potential reduction of 5.77 million tCO₂ (GoR 2015) Diffusion of LPG for cooking up to 25% in urban areas, i.e. around 106,500 households (out of the total 426,000 in urban areas (NISR 2016). If 25% of urban households will use LPG for cooking, around 87,000 tons of charcoal could be saved each year, achieving emission reduction for around 32,300 tCO₂/year. Calculations are based on: average consumption of charcoal in urban areas (MININFRA 2016), default factors for Net Calorific Value, Emission Factor and fraction of non-renewable biomass from CDM Methodology AMS-I.E. ver. 7 (UNFCCC 2017b)</p>			
Current implementation status / ongoing activities			
<p>Production of charcoal is supervised at local level. It is not easy to gather information on the enforcement of existing regulations. The existing NAMA “Developing a Sustainable Charcoal Value Chain in Rwanda” is not active (Stakeholder consultation May 2017)</p> <p>By end of June 2016, 9168 biogas digesters and 85 institutional biogas have been installed in the country⁵. Under FONERWA’s project “Integrated Land, Water Resources and Clean Energy Management” 50 biogas digesters are being built. Also under another project “Karongi District Integrated Green Village Project” 854 vulnerable households are being supplied with biogas digesters”. Also the “Sustainable Forest and Watershed Resources Management in Nyagatare District” project envisages the installation of 200 biogas digesters (FONERWA 2017)</p>			
Responsible line ministry	MININFRA, MINALOC		
Responsible lead entity	REG/EDCL		
Other stakeholder involved	RURA, RHA, MINIRENA, REMA, RWFA, RSB, MINECOFIN, REG/EDCL FONERWA, Districts, Private companies, civil society		
Cost estimates			
<p>Detailed measures for the sustainable charcoal value chain are not identified yet. Cost for the production of one tonne of sustainable charcoal is not known.</p> <p>Regarding biogas digesters, 900 USD are estimated for an 8m³ digester. For institutional ones, whose size is bigger, conservatively 21,680 USD for 30 m³ digester are considered. Total annual costs are (900 USD x 3500 + 15 x 21,680 USD) = around 3.5 million USD/year</p> <p>Costs for LPG are not available.</p>			
Timeline	N/A		
Milestones	<ul style="list-style-type: none"> N/A 		
Adaptation benefits	<ul style="list-style-type: none"> Reduced GHG emissions from fossil fuels and non-renewable biomass consumption for cooking Reduced pressure on forests and thus reducing negative effects of extreme climatic events due to reduced runoff Increased budget availability indirectly increases population resilience through improvement of the living conditions Improved human and animal waste management reduces the risk of disease spreading 		
Co-benefits	<ul style="list-style-type: none"> Reduced deforestation and consumption of non-renewable biomass Improved human and animal waste management in rural areas Reduced consumption of fossil fuels or non-renewable biomass for cooking. Increase crop production by using biogas fertilizer Reduced time spent by women and children for collecting fuel wood. 		
Relevant Sustainable Development Goals			

Activity Name	Renewable biomass	Priority	Medium
MRV system/ indicators	<p>Sustainable charcoal component:</p> <ul style="list-style-type: none"> Quantity of improved charcoal produced per year Quantity of wood saved for each t of improved charcoal produced ha of degraded forest rehabilitated/ha of forest managed in a sustainable manner <p>Biogas digesters component:</p> <ul style="list-style-type: none"> Number of biogas digesters installed and in operation Number of households and institutions using newly installed biogas digesters Quantity of fossil fuel/non-renewable biomass saved due to the use of the biogas <p>LPG component</p> <ul style="list-style-type: none"> Quantity of LPG distributed to households Number of new households using LPG for cooking needs <p>All components:</p> <ul style="list-style-type: none"> tCO₂e/year reduced 		
Capacity building needs	<p>Sustainable charcoal component:</p> <ul style="list-style-type: none"> Train charcoal producers in improved charcoal carbonization techniques Training of charcoal producers on promotion and marketing. Making users aware regarding the benefits of the improved process to incentivize purchase of charcoal produced sustainably (Stakeholder consultation May 2017) <p>Biogas digesters component:</p> <ul style="list-style-type: none"> Awareness among rural community on biogas digesters and related benefits. Training of Local Authorities (sector level) on quality control of biogas plant. <p>LPG component:</p> <ul style="list-style-type: none"> Awareness raising among households on the benefits of using LPG Increase expertise on LPG production and distribution 		
Barriers	<p>Sustainable charcoal component:</p> <ul style="list-style-type: none"> Price of improved charcoal higher than traditional one. Long process to get cutting permit The initial investment for improved charcoal carbonization techniques is higher compared to the traditional one <p>Biogas digesters component:</p> <ul style="list-style-type: none"> Technology is too expensive for poor households Lack of sufficient maintenance of existing biogas plants and on LPG use <p>LPG component:</p> <ul style="list-style-type: none"> Sufficient availability of LPG both in rural and urban areas Cost of LPG compared to other alternatives Existence of an LPG distribution infrastructure Safety concerns with LPG 		
Risks	<p>Sustainable charcoal component:</p> <ul style="list-style-type: none"> Quality of the improved charcoal is not sufficient to drive the market <p>Biogas digesters component:</p> <ul style="list-style-type: none"> Low number of biogas digester actually in use and their effectiveness in providing biogas Lack of sufficient maintenance of existing biogas plants <p>LPG component:</p> <ul style="list-style-type: none"> Households revert to traditional cooking systems, for instance due to scarcity of LPG, or prices increase 		

4.6. Improved public transport infrastructure and services in Kigali

Transport is recognized as one of the key elements for socio-economic and environmental development in Rwanda (REMA 2013). The transport sector, driven by the increasing urbanization


and also by the population growth, is expected to increase its emission from 0.53 million tCO₂ in 2012 to 3.1 million tCO₂ in 2030 (REMA 2015). As experienced in virtually all developing countries, private ownership of cars is also going to increase together with income increase. The increase in the vehicle fleet (the NDC estimates that vehicles will increase by 16%, while light duty vehicles by 20% by 2030) is connected with an increase in fuel import and consumption and negative effects both economically and environmentally - regarding air quality and associated diseases, affecting livelihood in urban areas (for instance because of noise), and also safety concerns. Limiting the increase of private motorized vehicle use is thus a priority for both contributing to a clean and safe environment and reducing GHG emissions. This also ensures a better mobility for all citizens and avoids the overcrowding of existing roads that leads to the congestion of traffic. Different measures can be implemented for reducing the environmental impacts of transport: promotion and strengthening the public transport, improvement of transport infrastructure, setting vehicle standards, and enhanced transport planning.

Strengthening the public transport is one of the most important measures to limit the increase of motorized vehicles and of the associated GHG emissions. Improvements in the public transport systems would increase the share of persons using public systems instead of private vehicles, limiting the number of private cars and vehicles on the roads, which would otherwise lead to congestions and high emissions of harmful pollutants in urban areas. The NDC highlights the following actions: construction of central bus terminal(s) and customer service; standardized route optimization planning and implementation; planning, rehabilitation and construction of intra-modal passenger terminals; construction of 17 km Bus Rapid Transit (BRT) main corridor and 6 modern interchanges; construction of dedicated "rush hour" high speed bus lanes. Different activities are being carried out in this sub-sector. It is important to note that there is an ongoing NAMA for the construction of the BRT in Kigali which is currently in the design phase and results should be available in 2018. In addition to the above measures, also other activities are being implemented: cashless ticketing through smart cards, non-motorized transport support through cycling lanes, and identification of bus lane for peak hours. Many others are currently being explored such as cable car transport, Compressed Natural Gas (CNG) public transport, bus information system.

This is to be complemented by physical improvement of the transport infrastructure, such as construction of new pedestrian and bicycle lanes improved transport infrastructure like improving the road surface can increase the resilience to extreme weather events. Moreover, in order to reduce emissions per km vehicle standards are to be improved. GoR (2015) envisages enforcing fleet renewal and scrappage (heavy, medium, mini-bus), setting emission standards (equivalent to EU standards) and standardized compliance and inspections for non-Rwandan registered vehicles. The cumulated mitigation potential for the BRT system by 2030 reaches approximately 0.16 million t CO₂. Emission reductions are extrapolated from a similar BRT project in the region, using CDM methodologies AM0031 and AMS-III.C.

Table 9: Improved transport infrastructure and services in Kigali

Activity Name	Improved transport infrastructure and services in Kigali		Priority	High
Activity No.	6	NDC label	M4.1	
Purpose	Mitigation	Sector	Transport	
Baseline Scenario				
Continued operation of current bus fleet and moto taxis				
Target				
<ul style="list-style-type: none"> • Construction of 17 km BRT • Construction of 30 km of dedicated bus lanes • 650 bus shelters • Development of a Central Inter-city Bus Terminal • Construction of 140 km of non-motorized transport lanes by 2018 • Multimode connection of the Bugesera airport with Kigali centre • Integrated smart ticketing system with micro processing ability (1 million smart cards) • Establishment of a Public Transport Operation control centre • Fleet renewal • Emission standards • Higher efficiency fuels and low carbon technologies for new vehicle • Enhanced compliance and inspections 				
Current implementation status / ongoing activities				
<p>Feasibility studies and preliminary designs to be accomplished by 2018</p> <ul style="list-style-type: none"> • Dedicated bus lanes 0.9km • 107 km of non-motorized transport lanes are built (as of 2017) • Issuance of public transport services licences • Tax exemption on importation on big buses for public transport • Tax levy on imported used cars for more than 10 years • Motor vehicle technical inspection centre • User-friendly ticketing system in Kigali • Ongoing projects: 1) Developing Capacity for Climate Resilient Road Transport Infrastructure (financed by AfDB, Nordic Development Fund and GoR); 2) Rwanda Feeder Road Development Project (financed by World Bank) (FONERWA 2017b) 				
Responsible line ministry	MININFRA			
Responsible lead entity	RTDA			
Other stakeholder involved	RURA, MINALOC, CoK, MINECOFIN, FONERWA, operators, REMA, MINIREMA, Private sector transport operators, financial institutions, civil society			
Cost estimates				
<p>The investment cost is estimated at around 42.2 million USD⁶ (AfDB, 2013b). Actual cost can be estimated only based on actual measures to be implemented and actual targets. Multimodal facility for connecting Bugesera Int. Airport and Kigali: 11.4 million USD. Other measures: around 63.3 million USD⁷. While there is no information on the BRT NAMA costs, according to REMA (2015) many of the activities covered with this budget should be included in the NAMA.</p>				
Timeline	<p>A timeline is proposed only for the BRT NAMA: it could commence implementation by 2022. Definition of clear rules and framework for the selected activities could be achieved by 2021. Actual enforcement of the new standards and regulations cannot be forecasted.</p>			

Activity Name	Improved transport infrastructure and services in Kigali	Priority	High
Milestones	<p>BRT development</p> <ul style="list-style-type: none"> Detailed study on the BRT NAMA to be completed by 07/2018 Identification and securing financial resources by 2021 Actual implementation commences in 2022 <p>Emission standards</p> <ul style="list-style-type: none"> Definition of new emission standards by 2021 Phased introduction of the standard from 2021 to 2025 Full implementation and enforcement of the standard from 2025 <p>Enhanced compliance and inspections</p> <ul style="list-style-type: none"> New codes and procedures can be defined by 2021 New compliance and inspection procedure in place and enforced from 2022 <p>Higher efficiency fuels and low carbon technologies for new vehicle</p> <ul style="list-style-type: none"> Introduction of higher efficiency fuels and new technologies is likely to be driven by the existence of stringent emission standards. Hence it would not commence before 2021. <p>Fleet renewal N/A</p>		
Adaptation and mitigation benefits	<p>Mitigation benefits</p> <ul style="list-style-type: none"> Increase attractiveness and effectiveness of public transport which reduces motorized private transport and related emissions Reduced emissions related to the implementation of the BRT Reduced emissions due to expansion of non-motorized transport <p>Adaptation benefits</p> <ul style="list-style-type: none"> Increase transport infrastructure resilience 		
Co-benefits	<ul style="list-style-type: none"> Reduction of harmful pollutants and of associated diseases Reduction of fossil fuel imports Improved mobility for citizens Reduction of traffic congestion Reduced travel time for short distance trips Reduced traffic accidents and injuries Improved health due to increased physical activity and aerobic exercise Availability of low cost means of transport for low-income segments of society 		
Relevant Sustainable Development Goals			
			
MRV system/ indicators	<ul style="list-style-type: none"> Number of passengers using the public transport each year Km of new bus lanes built Number and type of technology solution implemented (such as the cashless ticketing) Share of public transport (as a % of the total) tCO₂e/year reduced Km of non-motorized infrastructure built Share of public transport (as a % of the total) <p>Share of non-motorized transport modes (as a % of total modes)</p> <p>Emission standards</p> <ul style="list-style-type: none"> Emission reduction achieved per km <p>Higher efficiency fuels and low carbon technologies for new vehicle</p> <ul style="list-style-type: none"> Share of new efficient fuels over the total volume of fuel used <p>Enhanced compliance and inspections)</p> <ul style="list-style-type: none"> Number of inspection per year and number of violation of the standards identified per year <p>Fleet renovation</p> <ul style="list-style-type: none"> Number of new vehicles introduced and number of old vehicles scrapped each year tCO₂e/year reduced 		

Activity Name	Improved transport infrastructure and services in Kigali	Priority	High
Capacity building needs	<ul style="list-style-type: none"> • Capacity building on transport planning and related economics at institutional level • Increased awareness among citizens on the benefits of public transport over private motorized transport • Knowledge of state-of-the-art solutions and options to limit private motorized transport increase • Experiences from neighbouring countries implementing similar measures • Capacity building for local companies (Stakeholder consultation May 2017) • Expertise on standard setting and on their enforcement 		
Barriers	<ul style="list-style-type: none"> • Schedules are not respected • Tendency of private operators to serve trunk lines only because feeder lines are less profitable under route bundling system (Stakeholder consultation May 2017) • Continued increase of private motorized transport • Road congestion increases travel time also for public transport • Involvement of private companies might be difficult • Infrastructure investment costs are high • Lack of financial resources for renewing the existing fleet • New efficient vehicles are too expensive for the majority of the population 		
Risks	<ul style="list-style-type: none"> • Lever or ridership is lower than planned, undermining economic forecasts and mitigation targets • Low level of enforcement of the new standards and regulatory requirements • New efficient fuels do not pick up in Rwanda 		

4.7. Energy efficiency in the agro-processing sector

The main component of this measure aims at the improvement of energy efficiency in the production process for coffee and tea. Based on experiences in other countries (REMA 2015), this could lead to reductions in energy costs by 15-20%. The ultimate goal is to reduce the consumption of firewood and also electricity. Especially firewood is important, as it is strictly related to the exploitation of natural resources and forests depletion. In order to identify appropriate measures in the tea and coffee industries, energy audits will be needed.

The coffee and tea sector have a great economic potential, hence introduction of improved processes and energy efficiency measures represent opportunities for reducing costs and environmental impacts, as well as enhancing management of the production cycle and overall expertise on the company to identify bottlenecks and inefficiencies. Companies undergoing this process would benefit from this process due to strengthened competitiveness against other domestic and international actors (e.g. better marketing of the products, cost reduction, improved relationships with stakeholders). To reduce further the environmental impacts of the companies processing tea and coffee, also measures targeting water efficiency will be introduced.

Table 10: Energy efficiency in the agro-processing sector

Activity Name	Energy efficiency in the agro-processing sector		Priority	Medium
Activity No.	7	NDC label	M5.1	
Purpose	Mitigation	Sector	Industry	
Baseline Scenario				
Inefficient technologies/processes applied for drying, roasting and processing of tea and coffee.				
Target				
Increase efficiency by 5% per year up to at least 30% in 2021				
Current implementation status / ongoing activities				
<p>Use of bagasse based cogeneration is being explored. It is reported that 4 year study will be needed. (Stakeholder consultation May 2017. From 2012 up until today, under the Resource Efficient and Cleaner Production Program, mitigation interventions such as energy efficiency in boilers, installation of steam flow meters, construction of fire wood shed, cutting fire wood by use of power chain saws, installation of temperature controller and telemographs using fire wood without bark and reducing the distance or gap between fire bars were used by tea companies in order to increase resource efficiency. Through using the abovementioned practices and technologies the firewood consumption could be reduced from 3.7 to 2.1 stere per t tea (43% reduction of firewood consumption) and almost 1290 t CO₂/year reduced.</p> <p>A funding proposal has been submitted by MINIRENA to GCF for NAMA preparation and piloting best practices under rural green economy and resilient development programme,</p>				
Responsible line ministry	MINEACOM			
Responsible lead entity	NIRDA			
Other stakeholder involved	NAEB MINAGRI, RDB, MINEACOM, FONERWA, RSB, , EUCL, REMA, private sector, civil society			
Cost estimates				
USD 2M for NAMA preparation, piloting and promotion of best practices. However, the cost of the full project implementation will be determined by further studies				
Timeline	N/A			
Milestones	<ul style="list-style-type: none"> • Energy audit on regular basis(e.g. quarterly, annually, etc.) • Establish of energy efficiency measures and technologies • Establish energy efficiency standards for new factories and promote international Eco- labelling • Financial models • NAMA project design • MRV system design • Demonstration of selected energy efficient technologies • National Scale- up of best practices 			
Adaptation benefits	<ul style="list-style-type: none"> • Increased resilience of tea and coffee plantations • Reduced pressure on forests and thus reducing negative effects of extreme climatic events due to reduced runoff 			
Co-benefits	<ul style="list-style-type: none"> • Reduced energy consumption • Reduced deforestation • Reduced emissions (i.e. NO_x, particulates) • Reduction of fuel costs due to improved energy use • Increased competitiveness on the market 			
Relevant Sustainable Development Goals				
				
MRV system/ indicators	<ul style="list-style-type: none"> • Amount of fossil fuel(s) and firewood saved (t/year) per production batch • Number of companies/plantation deploying energy efficiency measures • kWh per year due to energy efficiency measures • tCO₂e/year reduced 			
Capacity building needs	<ul style="list-style-type: none"> • Increase awareness on impacts of industrial activities on climate change for Tea and coffee companies • Training on competitiveness impact of industrial energy efficiency • Increase of knowledge on market mechanisms • On the job training on new technologies/production processes 			


Activity Name	Energy efficiency in the agro-processing sector	Priority	Medium
Barriers		<ul style="list-style-type: none"> Lack of resources for implementing energy efficiency measures Low awareness in private company on the benefit of energy efficiency Lack of expertise on efficient solutions for production processes 	
Risks		<ul style="list-style-type: none"> Limited expertise with new production processes/technologies prevents the achievement of the expected results Low familiarity with energy audits 	

4.8. Development of eco-industrial parks

The underlying idea of eco-industrial parks is to group together different industries in an area, so that they can develop stronger synergies for improving their production processes and at the same time reducing their environmental impacts. For instance common waste water can be collected and treated in a more efficient manner than compared to individual water treatment measures. Monitoring of their compliance with national standards and regulations and also monitoring of their environmental performance is facilitated for government institutions due to the location in a selected area. The initial plan is to target production of chemicals and agro-processing companies. Zoning of the industrial parks will take into account the type of industries that will be clustered together to maximize synergies.

Table 11: Development of eco-industrial parks

Activity Name	Development of eco-industrial parks		Priority	Medium
Activity No.	8	NDC label	M5.2	
Purpose	Mitigation	Sector	Industry	
Baseline Scenario				
In 2016: <ul style="list-style-type: none"> 10 companies implement green practice 220 companies implement best practices 39 green technologies are deployed 14,697 t CO₂eq/year reduced 32,180m³/year water use reduction (Stakeholder consultation May 2017)				
Target				
800 ha have been earmarked for creating green industrial parks in different districts. Targets in 2018: <ul style="list-style-type: none"> 18 companies will implement green practice 300 companies will implement best practices 57 green technologies will be deployed 30,350t CO₂eq/year reduced 52,500m³/year water use reduction (Stakeholder consultation May 2017)				
Current implementation status / ongoing activities				
In two locations activities have already commenced: Kigali SEZ 276 ha. 1 st phase completed while the second phase is 95% developed and 70% booked. New park Bugesera 330 ha, 1 st phase 100 ha ongoing and following phases as new industries request to join. According to information from MINEACOM activities also commenced in other locations: Rwamagana (50ha), Huye (50ha), Rusizi (45ha) and Nyabihu (44ha). For these industrial parks land acquisition and detailed engineering study have been conducted. Moreover, a detailed engineering study for the Musanze industrial park (164ha) has been completed and land acquisition is ongoing. Finally, for the Muhanga Industrial park (63ha) a detailed engineering study was completed while expropriation is pending (Stakeholder consultation May 2017).				
Responsible line ministry	MINEACOM			
Responsible lead entity	MINEACOM			

Activity Name	Development of eco-industrial parks	Priority	Medium
Other stakeholder involved	MININFRA, MINECOFIN, MINAGRI,, MINIRENA, REMA, FONERWA, WASAC, NIRDA,RDB, REG, MINALOC, Private sector, civil society		
Cost estimates	N/A, depending on the type of measures to be implemented		
Timeline	N/A		
Milestones	<ul style="list-style-type: none"> N/A 		
Adaptation benefits	<ul style="list-style-type: none"> Improved water availability for downstream activities through enhanced water management reducing potential shortage of water especially in case extreme weather events 		
Co-benefits	<ul style="list-style-type: none"> Reduction of operational cost Industrial symbiosis Pollutants reduction Introduction and dissemination of green practices (i.e. green labelling, improved standards, green buildings for industrial production, promotion of renewables) Reduction of the overall footprint of the industries located in the industrial park 		
Relevant Sustainable Development Goals			
			
MRV system/ indicators	<ul style="list-style-type: none"> Number of plants built in eco- industrial park Number of companies involved in green production Number of green technologies applied kWh saved per year m³ of water per year saved Number of energy audits carried out tCO₂e/year reduced 		
Capacity building needs	<ul style="list-style-type: none"> Technical training on different types of interventions and technologies that could be deployed within the industrial park Awareness raising in the private sector on the benefits of joining the green industrial park Generate climate change awareness in industries and public institutions Training on competitiveness impact of industrial energy efficiency Increasing knowledge on market mechanisms 		
Barriers	<ul style="list-style-type: none"> Limited interest of private companies Lack of an effective incentive scheme to mobilize private companies (e.g. tax exemption) 		
Risks	<ul style="list-style-type: none"> Lack of experience with new technologies or production processes can lead to limited results (i.e. energy and water savings are lower than expected) 		

4.9. Climate compatible mining

The mining sector is increasingly important in the Rwandan economy. While its contribution to the GDP is limited to 1.2%, it is expected to increase to 5.3% by 2018 and it is already now the second most important exporting sector in the country, having generated 210.6 million USD of foreign exchange⁸. The main mineral exported is cassiterite, which made over 55% of total export followed by coltan and wolfram, with over 22% each in 2014 (REMA 2015).


⁸ Rwanda Development Board: <http://www.rdb.rw/rdb/mining.html> accessed on 11/06/2017

Rwanda also implemented a mineral traceability scheme since 2010. The mining sector is however associated with high negative social and environmental impacts. This is due to the invasive nature of the mining activity, which requires soil excavation leading to erosion and loss of forest or arable land. Also waste water treatment is a key issue to reduce environmental impacts of the mining activity. In addition, also energy consumption needs to be addressed to reduce associated GHG emission. As a result, the main interventions planned in this sector are (GoR 2011):

- Energy efficiency
- Renewable energy use (reduction of on-site generation from fossil fuels either through grid electricity or renewable energy on-site generation)
- Waste water management
- Capacity building

Table 12: Climate compatible mining

Activity Name	Climate compatible mining		Priority	Low
Activity No.	9	NDC label	Non NDC	
Purpose	Cross-cutting	Sector	Mining	
Baseline Scenario				
All active mines are complying with water use efficiency Mines use fossil fuel powered gensets for meeting their electricity needs No detailed information is available regarding energy efficiency or details on renewable energy use (REMA, 2017)				
Target				
80% of total mines to phase out fossil fuel use, through electricity by 2018. No target available for following years. All mines comply with water use efficiency (no further details available) No detailed information is available regarding targets for energy efficiency or details on renewable energy use				
Current implementation status / ongoing activities				
25% of mines use electricity (i.e. fossil fuel use is phased out). No information on the source of the energy, if from grid or from on-site renewable generation. All active mines are complying with water use efficiency (no further details available)				
Responsible line ministry	MINIRENA			
Responsible lead entity	RMPGB,			
Other stakeholder involved	PSF, MININFRA, RNRA, MINEACOM, Private companies, civil society			
Cost estimates				
N/A				
Timeline	2 to 5 years (GoR 2011)			
Milestones	<ul style="list-style-type: none"> • N/A 			
Adaptation and mitigation benefits	<p>Mitigation benefits</p> <ul style="list-style-type: none"> • Emission reductions due to energy efficiency measures and use of renewable energies and grid electricity to phase out carbon-intensive electricity produced by on-site gensets <p>Adaptation benefits</p> <ul style="list-style-type: none"> • Improved water availability for downstream activities through enhanced water management reducing potential shortage of water especially in case extreme weather events 			

Activity Name	Climate compatible mining	Priority	Low
Co-benefits	<ul style="list-style-type: none"> • Reduction of fossil fuel consumption through the use of renewable energy sources and energy efficiency • Reduction of pollutants due to fossil fuel consumption for on-site power generation • Improved waste water management reduces the risk of contamination of other water resources • Improved water management and reduction of risk of contamination 		
Relevant Sustainable Development Goals			
			
MRV system/ indicators	<ul style="list-style-type: none"> • Number of companies deploying climate compatible mining • % of electricity consumed from: <ul style="list-style-type: none"> - Grid - Own fossil fuel based generation - Own renewable generation • Number of mines inspected every year • Water effluent composition to monitor major pollutants due to mining operations • tCO₂e/year reduced 		
Capacity building needs	<ul style="list-style-type: none"> • Trained technicians • Share experiences with other countries and creation of a regional forum for Mining and Metallurgy 		
Barriers	<ul style="list-style-type: none"> • Lack of renewable energy resources at the mining sites • Lack of grid connections at mining sites • Companies might not be willing to bear the initial investment 		
Risks	<ul style="list-style-type: none"> • Lack of data on actual water quality monitored continuously • Renewable sources generate less electricity than planned and companies revert to the use of fossil based gensets 		

4.10. Waste as resource

Waste constitutes not only an economic but also an environmental problem. Especially in developing countries with high urbanization and economic growth rates the amount of municipal solid waste (MSW) that is produced is rising. The waste sector is subdivided into solid waste and waste water subsectors. The activity “Waste as resource” is targeting the solid waste sub-sector.

The current state of the waste sector is described by REMA (2015). The waste sector is regulated by the Rwanda Utilities Regulatory Authority (RURA), while the Rwanda Environmental Management Authority (REMA) is responsible for planning, coordination and enforcement. Waste management practices and technology are evolving, especially in urban compared to rural areas. The national solid waste disposal rate of households is at 10%, while it is 45% for urban areas. Significant quantity of solid waste is already being composted, although it is not clear whether this takes place under aerobic or anaerobic conditions. Landfills and private solid waste collection services exist in Rwanda, the largest of which can be found in the region of Kigali. Kigali’s MSW is disposed at the Nduba landfill since 2012 (City of Kigali, 2013). REMA (2015) however finds that there is a lack of centralized infrastructure, especially in urban areas beyond Kigali. Although there is basic service coverage with regard to collection and disposal, only about

45% of waste is disposed in urban areas via private dust bins or public refuse dumps (REMA 2015). There appears to be no broadly applied system for sorting at source. Some individual efforts are undertaken by companies such as COCEN to compost and recycle (Bazimenyera et al. 2012).

Table 13: Waste as resource

Activity Name	Waste as resource		Priority	High
Activity No.	10	NDC label	M6.1	
Purpose	Mitigation	Sector	Waste	
Baseline Scenario				
<p>The waste sector will grow substantially in the BAU scenario based on projections of economic growth, population growth and urbanization. Expected emissions from landfills will be high if no measures are implemented to reduce emissions (GoR2015). According to REMA (2015) the estimated CO₂ emissions are rising from 240,000 tCO₂e in 2012 to 811,000 tCO₂e in 2030. According to information gathered during the stakeholder mission in May 2017, there is a remaining landfill capacity at Nduba of 3 years. A new sanitary landfill with sorting, composting, strong quality control and leachate treatment is planned. This landfill will be 9km away from the city and have a capacity of 50 years. According to the stakeholders a GCF concept note has been submitted through the United Nations Development Programme (UNDP) for financial support of 28 million USD.</p>				
Target				
<p>The target set out by the NDC is to develop and implement landfill regulations in all urban areas and promote the utilization of LFG for power generation. A NAMA option specified by REMA (2015) implements landfill gas utilization resulting in emission reductions of 586,000 tCO₂e per year from 2030 onwards. To implement this action semi- or fully controlled landfills need to be established, in conjunction with LFG plants for power generation. The mitigation potential is high due to the large amounts of methane which is a potent driver of climate change.</p>				
Current implementation status / ongoing activities				
<p>A NAMA is developed for the waste sector. However, the current NAMA development status is not clear.</p>				
Responsible line ministry	MINALOC and MININFRA			
Responsible lead entity	Municipalities: City of Kigali and districts			
Other stakeholder involved	RURA, RHA, MINIRENA, REMA, Private sector, NGOs, Civil Society, Religious institutions, WASAC, REG, MINEACOM, MINAGRI, RDB, civil society			
Cost estimates				
<p>The costs are considered to be high. However, the landfill constructions or upgrade need to be done anyway at some point and the electricity generated creates a revenue stream that lowers the financial costs in the long run (REMA, 2015).</p>				
Timeline	<p>Since concrete policies and actions need first to be formulated, eventually under the waste NAMA, which require technical studies and government approval, controlled landfills and LFG utilization plants can be expected to be operational by 2020 at the earliest. At the Nduba landfill the activities could start sooner (REMA, 2015). WASAC is planning to build five faecal sludge plants, one in Kigali and 4 other ones in districts around Lake Kivu (Rubavu, Rusizi, Karongi) and in Musanze. These plants will be accompanied with new landfills within five years.</p>			
Milestones	<ul style="list-style-type: none"> Reduction of waste landfilled (GoR 2011) 			
Adaptation benefits	<ul style="list-style-type: none"> Creation of revenue generation opportunities of stakeholders in the waste management process chain (IPCC, 2007). Sector less vulnerable to than agriculture Potential to recover energy and use it for other purposes (IPCC 2007) 			
Co-benefits	<ul style="list-style-type: none"> Improved air, water and soil quality Reduction of leachate Improved cleanness of environment 			
Relevant Sustainable Development Goals				

Activity Name	Waste as resource	Priority	High
MRV system/ indicators	<ul style="list-style-type: none"> • Amount of landfill gas (LFG) captured (m³/year) • Power produced with LFG (MWh) • Amount of waste landfilled (t/year) • Amount of waste treated and landfilled (t/year) • Number and capacity of waste treatment plants • tCO₂e/year reduced 		
Capacity building needs	<ul style="list-style-type: none"> • New waste management technology training (Stakeholder mission May 2017) • Private sector training in waste management policies and technologies (Stakeholder mission May 2017) • Attracting skilled people to waste management (Stakeholder mission May 2017) • Capacity development for national LFG and improved landfill design & implementation (REMA 2015) • Capacity development for improved waste collection in urban and rural areas (REMA 2015) 		
Barriers	<ul style="list-style-type: none"> • Lack of centralized infrastructure to coordinate waste sector nation-wide in urban centres (REMA 2015) • Securing adequate land as available land is limited (REMA 2015) • Financial resources (Stakeholder mission May 2017) • Limited capacity in sustainable waste management (project design) • Low quality waste handling equipment (Stakeholder mission May 2017) 		
Risks	<ul style="list-style-type: none"> • Sorting not done properly (Stakeholder mission May 2017) • Potential low financial attractiveness for private companies 		

4.11. Sustainable food production

The background, importance and vision of the agricultural sector for Rwanda's are described in a variety strategic documents, such as the Economic Development and Poverty Reduction Strategy 2013-2018 (GoR 2013), Rwanda's Vision 2020 (GoR 2012), the GGCRS 2011 (GoR 2011), and the Strategic Plan for the Transformation of Agriculture in Rwanda 2013 – 2018 (MINAGRI 2013). The sector has a high relevance for Rwanda as a major share of the population is dependent on it. The sector is the main motor of economic growth according to Vision 2020 and EDPRS II (GoR 2013).

The agricultural sector is experiencing challenges in form of significant loss of fertile soil. 50% of the country's farm land is object of modest to severe soil erosion and nutrient depleted due to excessive farming. The technique to make Rwanda's agricultural sector more sustainable is agro forestry, which is a production system which combined elements of agriculture with elements of forestry. It integrates trees among or around cropland in order to create a more healthy, ecologically sound and productive farming system. Agroforestry has the potential to alleviate poverty through income generation and diversification, energy and water security and biodiversity. The NDC sets out the target of increasing the share of households applying agro forestry to 100% by 2030. The Vision 2020 envisages to achieve 85% agroforestry by 2020 already, which would require a national tree coverage of 30%. To achieve this Rwanda would need to more than double its efforts to increase agroforestry (GoR 2011). Food production in Rwanda can also be improved by introducing species that are resilient to drought.

Table 14: Sustainable food production

Activity Name	Sustainable food production		Priority	High
Activity No.	11	NDC label	A1.1	
Purpose	Cross-cutting	Sector	Agriculture	
Baseline Scenario				
Food security seasonally fluctuating due to low harvests caused by weather variations that are sometimes associated with floods, droughts and soil erosion (GoR 2015).				
Target				
The country plans to mainstream agro ecology technologies in the agricultural sector. It is envisaged that all households (100%) which are involved in the agricultural sector apply agro forestry sustainable food production until 2030 (GoR 2015). Sustainable food production also includes the introduction of species that are particularly resilient to drought.				
Current implementation status / ongoing activities				
According to the stakeholders a continuous food production improvement process is in place for which SDG indicators have already been customized on the national, provincial and district level, but not fully implemented yet. District Development Plans of MINALOC are being revised to feed into the EDPRS of MINECOFIN (Stakeholder consultation May 2017).				
Responsible line ministry	MINAGRI			
Responsible lead entity	RAB			
Other stakeholder involved	REMA,RWFA, RLUMA, Private Sector, PALEF (NGO), MINIRENA, NAEB, Meteo Rwanda, development partners, civil society			
Cost estimates				
N/A				
Timeline	According to the GGCRS the development of a joint agroforestry strategy is planned by 2018. The implementation of the strategy and the diffusion of agroforestry practices through Rwanda’s agricultural sector will take longer.			
Milestones	<ul style="list-style-type: none"> • Developing an agroforestry strategy (GoR 2011) • 80% of households implementing agroforestry • 100% of households implementing agroforestry 			
Adaptation & mitigation benefits	<p>Mitigation Benefits</p> <ul style="list-style-type: none"> • GHG stored in agro forestry vegetation such as trees. • Reduced GHG emissions from land use change <p>Adaptation benefits</p> <ul style="list-style-type: none"> • Increased food security through restored soil fertility and increased crop stability • Increased food security due to reduced soil erosion • More diverse nutrition, improving health • Production of fruits and nuts (and medicine) for households or to generate revenue on markets • Cleaner water through reduced nutrient and soil runoff • Pervasion of drought resistant species • Poverty reduction through increased wood production, enhancing resilience in times of disasters 			
Co-benefits	<ul style="list-style-type: none"> • Provision of fuelwood • Wood production and value addition • Lower need for pesticides 			
Relevant Sustainable Development Goals				

Activity Name	Sustainable food production	Priority	High
MRV system/ indicators	<ul style="list-style-type: none"> Number/percentage of farming households implementing agroforestry (GoR 2011) Ha of agriculture area with agro forestry practices 		
Capacity building needs	<ul style="list-style-type: none"> Ensure that weather information reaches the farmers in an understandable form (Stakeholder consultation May 2017) Investment in research in order to generate results relevant for the country (Stakeholder consultation May 2017) Close gap between grassroots level and experts. Involve former before policy instruments are developed (Stakeholder consultation May 2017) 		
Barriers	<ul style="list-style-type: none"> Definition of a cost effective MRV framework Assessment of costs 		
Risks	<ul style="list-style-type: none"> Lack of awareness and adhering to traditional agricultural practices prevents adoption of agro-forestry 		


4.12. Composting and fertilizer enrichment

There is a need to raise agricultural productivity in Rwanda, considering the limited available land and the high population density of the country. The Rwanda Fertilizer Assessment 2014 finds that the country needs to increase its fertilizer consumption more than four-fold in order to meet the agriculture sector growth targets set out by the Strategic Plan for Agriculture Transformation (USAID 2014).

Composting is a natural process that makes intuitive sense in the area of waste management. It is inexpensive, reduces the amount of MSW, enhances the efficiency of recycling and incineration activities, and produces high value soil for agricultural purposes. For a country like Rwanda, which anticipates rising amounts of MSW in the future and is in need of a source of domestic organic fertilizer, this technique is highly suitable (World Bank 2000).

Table 15: Composting and fertilizer enrichment

Activity Name	Composting and fertilizer enrichment		Priority	High
Activity No.	12	NDC label	A1.2, A1.3	
Purpose	Mitigation	Sector	Waste/Agriculture	
Baseline Scenario				
Rwanda's topography is characterized by steep slopes. Together with the high population density of (448 people/km ² in 2017) there is significant pressure on natural resources leading to land degradation. Climate change induced extreme weather events such as extreme rains have severe effects on arable lands resulting in soil erosion, fertility decline and low agricultural production. The country is dependent on imported inorganic fertilisers for its agricultural activities. In 2014, 36,000 t of fertilizer were imported, a number that is likely to increase in subsequent years. While they are suitable for increasing the productivity, intensive use of inorganic fertilizer has adverse impacts on environment and climate change. In the baseline scenario this situation is not expected to change (GoR 2015).				
Target				
The country envisages the promotion, recovery and reuse of organic waste to restore soil fertility to promote recovery and reuse of both organic waste and wastewater in order to restore and maintain soil fertility. Composting is a technique that is currently only used at a small scale, but is planned to reach 100% of households involved in agriculture production by 2030. In a next step composted organic waste is enriched by blending it with other nitrogen and phosphorus containing nutrients. This will replace a certain share of inorganic fertilizers, adding valuable nutrients to soils. Rwanda envisages switching from inorganic fertilizers to fertilizer enriched compost by 2030 (GoR 2015). Target of the measure is to reduce GHG emissions from the fertilizer production process.				
Current implementation status / ongoing activities				
A fertilizer blending plant is under development under Moroccan cooperation (Stakeholder mission May 2017).				
Responsible line ministry	MINAGRI			

Activity Name	Composting and fertilizer enrichment	Priority	High
Responsible lead entity	RAB		
Other stakeholder involved	REMA, RLUMA, UR/CAVM, Private Sector, MINIRENA, RDB, civil society		
Cost estimates			
Although composting rarely generates profits on its own, it involves little investment and operating costs. When viewed in context of an integrated solid waste management system and considering the numerous co-benefits such as reduced soil erosion, composting provides significant economic benefits (World Bank 2000).			
Timeline	100% of households could be reached by 2030		
Milestones	<ul style="list-style-type: none"> Composting station established in Kigali by 2018 (FONERWA 2017b) 80% of households practice organic waste recycling by 2018 (FONERWA 2017b) 80% of farmers use compost enriched fertilizer by 2025 100% of farmers use compost enriched fertilizer by 2030 		
Adaptation benefits	<ul style="list-style-type: none"> Enhances effectiveness of fertilizer application, thereby supporting agricultural activities of vulnerable farmers Reduced water contamination leads to better overall water quality Reduces compostable waste related health risks such as dengue fever. Critical since disease related problems expected to grow. Improved soil properties/quality and reduced soil erosion Destroys pathogens in waste (IPCC 2007) 		
Co-benefits	<ul style="list-style-type: none"> Reducing amount of MSW landfilled Enhances recycling and incineration activities Reduced chemical fertilizer Reduction of methane emissions Improves cities overall waste collection system Integration of informal sector in collection, separation and recycling 		
Relevant Sustainable Development Goals			
			
MRV system/ indicators	<ul style="list-style-type: none"> Amount of waste composted (t/year) Quantity of compost produced (t/year) Quantity of compost sold in the market (t/year) Number of farms applying enriched compost (GoR 2011) tCO₂e/year reduced 		
Capacity building needs	<ul style="list-style-type: none"> Definition of quality standards and their enforcement Awareness raising on waste management options and sorting techniques Awareness raising amongst farmers on composting and related benefits Last soil mapping in Rwanda has been carried out 1989. If fertilizer is to be used effectively research needs to be undertaken into agro-ecological zones of the country and fertilizer needs of different species. Bacterial vs fungal dominant compost is suitable for different species and needs to be examined (FONERWA 2017b) 		
Barriers	<ul style="list-style-type: none"> Recent uptake and growing use of chemical fertilizers 		
Risks	<ul style="list-style-type: none"> Integration of activity into agricultural community will be important to ensure uptake. Quality and price of the compost produced unclear factor yet. Both factors will be critical for farmers' willingness to use the fertilizer. 		

4.13. Wastewater irrigation

Like the volume of MSW also the volume of waste water is rising with increasing population, urbanization and economic growth. Waste water can be a valuable source for farmers for irrigation of high-value edible crops, which reduces not only the dependency on inorganic fertilizers but at the same time also provides a source of irrigation water (Qadir et al. 2010).

Table 16: Waste water irrigation

Activity Name	Wastewater irrigation		Priority	Medium
Activity No.	13	NDC label	A1.2	
Purpose	Cross-cutting	Sector	Waste/Agriculture	
Baseline Scenario				
Waste water irrigation is currently mainly practiced in correction centres under national prisons (GoR 2015). Otherwise, it is not practiced.				
Target				
With regard to wastewater irrigation, there are different targets and timelines: In the short term, treating wastewater is the priority while in the long run, reuse of the treated water is targeted to address increasing water scarcity, and increase drought resilience as well as restoring and maintaining soil fertility. The target is to implement wastewater irrigation nation-wide by 2030.				
Current implementation status / ongoing activities				
The waste water sector is developing with regard to practices and technology in Rwanda. In urban centres such as Kigali there is currently no centralized sewerage system with waste water treatment. Just larger building complexes such as hospitals, hotels, etc. have on-site treatment plants (Mbateye, et al., 2010). According to REMA (2015) a process for the design of a centralized sewerage system for the Nyarugenge district of Kigali has been initiated and feasibility studies for the Kicukiro and Gasabo districts have been commissioned. A central sewage system in Kigali is planned with financial support from AfDB and European Investment Bank (EIB) from 2018 onwards, ending in A Waste Water Treatment Plant (WWTP) with a capacity of 12,000 m ³ /day is planned in Kigali together with other WWTP in 6 secondary cities. Moreover, 4 fecal sludge Treatment Plants are to be commissioned in 2020/2021.				
Responsible line ministry	MINAGRI, MINIRENA, MININFRA			
Responsible lead entity	RAB, RLUMA			
Other stakeholder involved	MINAGRI, RAB, REMA, RWFA, RURA, Private Sector, , civil society, WASAC, higher learning and research institutions			
Cost estimates				
The Kigali waste water treatment plant is expected to cost around USD 100 million.				
Timeline	According to the GGCRS the utilization of the waste stream needs 3 years of initiation and development before operation (GoR 2011).			
Milestones	<ul style="list-style-type: none"> Guidelines for waste water irrigation developed; 50% of potential areas using wastewater for irrigation 100% of potential areas using waste water for irrigation 			
Adaptation & mitigation benefits	<p>Mitigation benefits</p> <ul style="list-style-type: none"> Reduction of methane emissions <p>Adaptation benefits</p> <ul style="list-style-type: none"> Increased food production/security Reduced soil erosion Reduced water contamination Increased employment opportunities 			
Co-benefits	<ul style="list-style-type: none"> Reduced imports of chemical fertilizer Water and fertiliser efficient use 			
Relevant Sustainable Development Goals				
MRV system/ indicators	<ul style="list-style-type: none"> Volume of waste water used for irrigation (m³/year) Ha of productive land using waste water irrigation COD/BOD of waste water tCO₂e/year reduced 			
Capacity building needs	<ul style="list-style-type: none"> Capacity building on sanitation technologies (Stakeholder consultations May 2017) Capacity building on standardization process of waste water irrigation (to insure safety) Awareness on applicability and benefits of waste water use in irrigation 			


Activity Name	Wastewater irrigation	Priority	Medium
Barriers		<ul style="list-style-type: none"> Financing infrastructure and land acquisition requires international financing (Stakeholder consultations May 2017) Lack of sufficient technical capacity (Stakeholder consultations May 2017) 	
Risks		<ul style="list-style-type: none"> Wastewater flows from urban areas are untreated and laden with a spectrum of excreted bacterial, viral, protozoan, and helminthic pathogens. This can present a health risk when entering water sources used for irrigation (Drechsel et al. 2010) 	

4.14. Integrated land use planning

Fertile land for agricultural purposes is becoming scarcer due to a variety of reasons such as land erosion, urbanization, pollution, population growth, urbanization and last but not least the impacts of climate change. Other areas are distributed among landholders who use it for competing interests. While some are using it to achieve food security, others use it for power supply, nature conservation and other purposes. In order to find a good balance among these competing objectives land use planning can help to find a solution that is aligned to the country's priorities.

Table 17: Integrated land use planning


Activity Name	Integrated land use planning	Priority	Medium
Activity No.	14	NDC label	A6.1, A6.2
Purpose	Cross-cutting	Sector	Agriculture
Baseline Scenario			
Due to the relatively small size of the country and the high demographic pressure in terms of population growth and urbanization, competition for land is expected to increase. The results of the competing uses for land can be seen today. Examples include settlements at steep slopes and in floodplains, deforestation, overcrowded urban areas and overstressed waste management systems (FONERWA 2017b), to the impacts of climate change such as increase rainfall variability and more intense extreme weather events will exacerbate the situation (GoR 2015).			
Target			
1. Employ an integrated approach to planning and sustainable land use management; In order to adapt to the changing demands on land resources Rwanda envisages to implement a planning and zoning regulatory framework, initiatives regarding systematic land registration and land tenure regularization reform. These reforms entail plot size reductions for single family houses from 600 m ² to 300 m ² by 2016 and 2030, respectively.			
2. Improve spatial data by harnessing ICT and GIS (Geographic Information System) technology; In addition to these reform processes, the country will develop a National Spatial Data Infrastructure (SDI) that provides access to land information resources and enables the identification of fundamental datasets for management of land and water resources, monitoring, supporting economic development, and improving planning processes. Thus, Rwanda is better equipped to respond to the impacts of climate change. Rwanda plans to have an operational National SDI by 2030 (GoR 2015).			
Current implementation status / ongoing activities			
A project sponsored by UK Department for International Development (DFID) has started in 2009 and runs until 2018. It is entitled Land Tenure Regularization Support Programme (LTRSP) and focuses on improving the capacity of existing Land Administration System with total resources of UK£31.41 million.			
Progress regarding target 1: District Land Use Plans (DLUPs) have been approved and 5 Districts have been audited for land use compliance (FONERWA 2017b)			
Progress regarding target 2: Land use portal has been established in 2014. (FONERWA 2017b)			
Responsible line ministry	MINAGRI MINIRENA		
Responsible lead entity	RAB RLUMA		
Other stakeholder involved	MINAGRI, RAB, NAEB, RHA, REMA, RWFA, MININFRA, RNRA, MINALOC, Private sector, civil society		
Cost estimates			

Activity Name	Integrated land use planning	Priority	Medium
N/A			
Timeline	<ul style="list-style-type: none"> National Spatial Data Infrastructure will be operational by 2030 		
Milestones	<ul style="list-style-type: none"> 100% of land used according to Land Use Masterplan by 2018 (MINIRENA presentation on GGCRS implementation progress) Web-based spatial data infrastructure portal accessible by 2018 (MINIRENA presentation on GGCRS implementation progress) Land Admin Info System operational and accessible by staff from all sectors by 2018, enabling online land transfers and subdivisions (MINIRENA presentation on GGCRS implementation progress) 		
Adaptation & mitigation benefits	<p>Mitigation benefits</p> <ul style="list-style-type: none"> Reduction of uncontrolled land development that would lead to: <ul style="list-style-type: none"> inefficient transport systems increased energy demand If more land is available due to improved land management frameworks, additional forest plantations can be build that serve as carbon sink <p>Adaptation benefits</p> <ul style="list-style-type: none"> Improved resilience of rural land Underlying data beneficial for activities from other sectors such as water management and DRR Reduction of uncontrolled land development that would lead to: <ul style="list-style-type: none"> over-burdened water and sanitation systems leading to reduced livelihoods loss of biodiversity food insecurity 		
Co-benefits	<ul style="list-style-type: none"> Governmental land planning capacity increased Uncontrolled land use change will lead to further loss of Rwanda's unique natural and cultural heritage 		
Relevant Sustainable Development Goals			
			
MRV system/ indicators	<ul style="list-style-type: none"> Ha of land covered under the new planning tools (ha/year) National Land Use Planning portal for dissemination of information (multi-level district, region, national) (Stakeholder consultations May 2017) 		
Capacity building needs	<ul style="list-style-type: none"> Training on the job for RLUMA staff and local policymakers involved in land use-related decisions (Stakeholder consultations May 2017) Study tours (Stakeholder consultations May 2017) Although Rwanda has facilities in place for GIS mapping and ICT infrastructure these are not used sufficiently. In order to use the GIS software to increase climate resilience technical capacity with the software needs to be created (FONERWA 2017b) 		
Barriers	<ul style="list-style-type: none"> High competition of land users Limited capacity in land use planning 		
Risks	<ul style="list-style-type: none"> Poor coordination of integrated land use implementation Lack of guidelines on special data infrastructure will prevent cities from integrating spatial information in their climate resilience planning 		

4.15. Soil conservation

Land degradation is a problem that is prevalent in large parts of Sub-Saharan Africa. The reasons for it are various, ranging from increased agricultural pressures to meet food demand of growing populations to impacts of climate change. Measures to conserve arable land include terrace agriculture, which is particularly useful in areas that are characterised by steep slopes. Terraces are certain parts of slopes that have been transformed to flat surfaces. Due to the reduced slope the terrain is benefitting from lower water run-off and less soil erosion.

Table 18: Soil conservation

Activity Name	Soil conservation		Priority	High
Activity No.	15	NDC label	A1.5	
Purpose	Cross-cutting	Sector	Agriculture	
Baseline Scenario				
The majority of Rwanda's crop land (90%) is located at slopes which have a gradient of 5 – 50%. Such conditions make the land vulnerable to impacts of climate change such as heavy rainfall leading to soil erosion and permanent fertility loss (GoR 2015).				
Target				
Rwanda intends to install land protection structures such as radical and progressive terraces. Additionally the development of an intensive agroforestry programme will be promoted with a target of covering 100% of arable land.				
Current implementation status / ongoing activities				
According to information from MINAGRI 103,918 ha of radical terraces and 913,884 ha of progressive terraces have been implemented by June 2017				
Responsible line ministry	MINAGRI			
Responsible lead entity	RAB			
Other stakeholder involved	MINIRENA, NAEB, MINALOC, REMA, RWFA, RLUMA, Private Sector, civil society			
Cost estimates				
1-2 million RWF/ha radical terracing, 300,000 -500,000 RFW/ha progressive terracing				
Timeline	N/A			
Milestones	<ul style="list-style-type: none"> 90% of arable land protected 			
Adaptation & mitigation benefits	<p>Mitigation benefits</p> <ul style="list-style-type: none"> Reduced emissions of reducing the emission of CO₂, CH₄ and N₂O as soil restoration activities lead to carbon sequestration. <p>Adaptation benefits</p> <ul style="list-style-type: none"> Reduced soil erosion leads to <ul style="list-style-type: none"> less eutrophication of water catchments less sedimentation of reservoirs and waterways Advancing food and nutritional security Increased income for farmers and food security Increased land for agricultural production Increased efficiency in fertilizer usage Improved water quality Enhanced soil resilience to extreme weather events 			
Co-benefits	<ul style="list-style-type: none"> Conservation of biodiversity below and above ground Job creation 			
Relevant Sustainable Development Goals				
				
MRV system/ indicators	<ul style="list-style-type: none"> Progression of soil erosion Number of hectares protected with terraces Increases in food production in target areas 			
Capacity building needs	<ul style="list-style-type: none"> Radical terrace construction and maintenance Techniques of soil conservation Integrated soil fertility management 			
Barriers	<ul style="list-style-type: none"> Limited financial resources for the vast area of land that needs protection (second stakeholder mission) Limited technical capacity to implement soil protection strategies (second stakeholder mission) 			
Risks	<ul style="list-style-type: none"> Activity interrelated with other activities that decrease soil erosion (e.g. agroforestry and afforestation). Monitoring of outcomes needs to be aligned with other activities to avoid overlap. 			

4.16. Integrated pest management

Sustainable pest management (also called integrated pest management) is an effective way for sustainable intensification of agricultural activity without the need for synthetic pesticides. Weeds, pathogens and invertebrates are the reason for significant crop losses that translate to poverty and decreased food security. Estimates say that crop losses due to pests may represent food that could feed over 1 billion people (Birch et al. 2011). Synthetic pesticides, however, produce additional problems and come often with high costs. Sustainable pest management can lead to higher yields from the same area of land without the negative consequences of synthetic pesticides (Pretty 2015).

Table 19: Integrated pest management

Activity Name	Integrated pest management		Priority	Medium
Activity No.	26	NDC label	A1.4	
Purpose	Adaptation	Sector	Agriculture	
Baseline Scenario				
Agricultural pests and diseases are burdening rural sections of society that are depending on revenue generation and food security from successful harvests. As a consequence of climate change the proliferation of pests and diseases is expected to become more critical (GoR 2015). Under normal circumstance, chemicals would be used for pest treatment.				
Target				
Rwanda intends to reduce the burden of agricultural pests and diseases by promoting a variety of sustainable pest management techniques. First a cropping system will be introduced that produces a variety of crop and fodder yields while simultaneously being resilient against plant parasites and pathogens such as striga weed and stemborers. Secondly, a "push-pull system" will be introduced for maize, sorghum, millets rice plantations based on desmodium legume and Napier grass. Such a system is also increasing soil fertility and agricultural yields. The yields from Napier grass and desmodium can in turn be used to provide a steady supply of fodder for livestock, thereby improving livestock based nutrition (milk and meat) (GoR 2015).				
Current implementation status / ongoing activities				
According to the GGCR (2011) the mainstreaming of "push-pull systems" is ongoing. According to information from MINAGRI there is generally a lack of funding around pest and weed management. MINAGRI has stressed the need for more research to better anticipate and prepare for future pests and diseases.				
Responsible line ministry	MINAGRI			
Responsible lead entity	RAB			
Other stakeholder involved	REMA, UR/CAVM, Private Sector, civil society, Donors, NAEB,			
Cost estimates				
N/A				
Timeline	2025			
Milestones	<ul style="list-style-type: none"> • Introduction and adoption of push-pull systems 			
Mitigation benefits	<ul style="list-style-type: none"> • Natural pest management techniques cause lower GHG emissions compared to pesticides that need to be produced, transported and applied with suitable equipment • Reduced GHG emissions from enteric fermentation of livestock 			
Co-benefits	<ul style="list-style-type: none"> • Higher revenues for farmers • Higher yields improving food security • More stable agricultural ecosystems • Lower health risks due to reduced risk of chemical pesticides • Reduced cost for chemical pesticides 			
Relevant Sustainable Development Goals				

Activity Name	Integrated pest management	Priority	Medium
MRV system/ indicators	<ul style="list-style-type: none"> • % of farms up-taking up “push-pull” strategies • Push and Pull on-station research report available • Number of plant doctors trained • Number of plant clinics operational • Ha of arable land applying sustainable pest management techniques at farms • Quantity of chemical pesticide reduced through pest management (t/ year) • Number of research studies on pest control conducted 		
Capacity building needs	<ul style="list-style-type: none"> • Create awareness and expertise of farmers on integrated pest management 		
Barriers	<ul style="list-style-type: none"> • Lack of awareness and expertise among farmers • Lack of information on appropriate technologies for IPM • Although agricultural research is growing in Rwanda, there is significant need to expand research into cultivation and pest reduction practices (FONERWA 2017b) 		
Risks	<ul style="list-style-type: none"> • Effectiveness of the integrated pest management system vs. chemical pesticides lower than expected 		

4.17. Irrigation

Irrigation practices are a pressing need in many developing countries due to population growth and increased food consumption. Rwanda is a country that was traditionally marked by comparatively high rainfall, which it could successfully exploit in the past. Reliance on rainfall however comes with dependencies on seasonal water changes and make planning and growing of crops more difficult. This particularly difficult if the rainfall patterns change dramatically due to human-induced climate change. Irrigation infrastructure provides farmers with control over water resources and reduces their vulnerability (GoR 2011).

Table 20: Irrigation

Activity Name	Irrigation	Priority	High
Activity No.	17	NDC label	A1.6
Purpose	Cross-cutting	Sector	Agriculture
Baseline Scenario			
The agricultural sector of Rwanda is mostly rain-fed which entails a high dependence on weather and makes it vulnerable to extreme weather events such as droughts or floods. Only 4% of land with irrigation potential had been equipped with irrigation technology by 2012 (GoR 2015). Under the BAU scenario only a small amount of resources would flow into the increase of irrigation solutions. It is expected that irrigation practices would not change significantly (GoR 2016)			
Target			
Rwanda’s target is to ramp up investment in irrigation infrastructure in order to increase agricultural yields and improve food security. To achieve this a “district irrigation master plan” will be established in conjunction with small scale schemes based on available water catchments. The GGCRS specifies that emphasis in to be placed on rainwater harvesting and the collection and treatment of wastewater in urban areas. The target is to increase the land under irrigation to 11% by 2030.			
Current implementation status / ongoing activities			

Activity Name	Irrigation	Priority	High
<p>According to the Ministry of Finance, irrigation is of very high priority for the country, particularly in the Eastern province (Stakeholder consultation May 2017). There are several FONERWA projects that contain irrigation components, usually in conjunction with watershed or rainwater harvesting components (FONERWA 2017a). MINAGRI has also supported irrigation schemes, which are expected to cover 19,000 ha of marshland and hillsides (FONERWA 2017b). MINAGRI operates many schemes such as Kirehe, Kagitumba center pivots, rice dams (Kajevuba). Rwanda also received international support. The World Bank for example launched the Rural Sector Support Project in 2001 as well as the Land Husbandry, Water Harvesting and Hillside Irrigation Project in 2010. The projects support investment into irrigation, erosion control and improvement of the agricultural value chain. Together with contributions from USAID and Canada resources in this area sum up to over 106 million USD (FONERWA 2017b). Rwanda has also entered into a bilateral agreement with Morocco in 2016, which will support irrigation among other focus areas.</p>			
Responsible line ministry	MINAGRI		
Responsible lead entity	RAB		
Other stakeholder involved	REMA, RWFA, Private Sector, civil society, Donors, MINALOC, MININFRA, UR/CAVM, RLUMA		
Cost estimates			
Costs of the high green Scenario (2015 – 2030): Capital: 1.0 billion USD (GoR 2016) ⁸			
Timeline	<ul style="list-style-type: none"> Irrigation masterplan to be developed by 2018 		
Milestones	<ul style="list-style-type: none"> 100% coverage at 80 lpcd (GoR 2016) 50% of reservoirs are multi-use (GoR 2016) 88% of supply provided through piped distribution systems (GoR 2016) Increased standpipes/connections (GoR 2016) Community-based systems paired with small-scale RWH for irrigation (GoR 2016) 		
Adaptation & mitigation benefits	<p>Mitigation benefits</p> <ul style="list-style-type: none"> If applied efficiently irrigation reduces nitrogen losses including nitrous oxide emissions <p>Adaptation benefits</p> <ul style="list-style-type: none"> Higher revenues for farmers Higher yields improving food security Reduced dependence on weather fluctuations 		
Co-benefits	<ul style="list-style-type: none"> Increase health of soil fauna Training on technically more complex irrigation technologies (e.g. drip irrigation) requires and builds capacity of local farmers 		
Relevant Sustainable Development Goals			
			
MRV system/ indicators	<ul style="list-style-type: none"> Percentage of households using irrigation techniques Number of hectares under irrigation Percentage Number of households possessing water harvesting reservoirs Number of water storage infrastructure built for irrigation purposes (dams, sheet) Number of households using small scale irrigation technology Number of water use associations created under irrigation schemes 		
Capacity building needs	<ul style="list-style-type: none"> Increase awareness on water harvesting techniques irrigation techniques Train technicians to be able to be able to manage small / medium irrigation systems 		
Barriers	<ul style="list-style-type: none"> Difficult topography for irrigation High upfront investment cost for implementation of irrigation schemes Lack of information on distribution of water resources 		
Risks	<ul style="list-style-type: none"> Conflicts between uses of large water management infrastructures As irrigation programmes expand it will be necessary to observe the country's water needs in order to avoid water shortages. Risks of overexploiting the country's water resources could be mitigated by promoting efficient irrigation techniques such as piped conveyance and drip irrigation (FONERWA 2017b) 		

4.18. Integrated Water Resource Management (IWRM)

Integrated water resource management (IWRM) has the objective to ensure sustainable use of water resources for socio-economic development. It is a cross-sectoral activity that is defined by the Global Water Partnership as “a process which promotes the co-ordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems” (UNEP 2009). Elements of IWRM is the scoping and characterization of available water resources, rehabilitation of watersheds, rainwater harvesting, storm water management, catchment afforestation.

Table 21: Integrated Water Resource Management (IWRM)

Activity Name	Integrated Water Resource Management (IWRM)		Priority	Medium
Activity No.	18	NDC label	A5.1; A5.2 and A5.3	
Purpose	Cross-cutting	Sector	Cross-sectoral	
Baseline Scenario				
<p>There are rich freshwater resources in the country and high rainfall combined with limited consumption has not required water management in terms of monitoring, storage and coordinated irrigation until now. Thus, a gap exists with regard to reliable data on which policy decisions could be based. With increasing population, urbanization, industrial growth and pollution, accelerated depletion of water resources is anticipated to become a problem in the future. In fact FONERWA (2017b) argues that heavy sediments in rivers, pollution from agricultural chemicals and industrial effluents are strong evidences for increasing water resource degradation over the last years. Even though Rwanda has a high water potential, it is still a water scarce country with 670 cubic meters of water per capita per year and 25% of the population still unable to access safe drinking water (UNICEF 2017). Climate change adds another level of uncertainty to future water availability (GoR 2011). The main challenge for Rwanda will be to meet the increasing water demand, while facing decreasing water availability. The country’s capacity to manage its water resources is limited in terms of s limited in terms of human resources, institutional systems, and infrastructure (FONERWA 2017b). In the baseline scenario, no IWRM is envisaged (GoR 2016).</p>				
Target				
<p>1) Establish a national integrated water resource management framework that incorporates district and community-based catchment management</p> <ul style="list-style-type: none"> • integrate management of water resources at the district and community levels • define catchment wide responsibilities • cluster catchment partner-districts according to sub-catchment regions • improve understanding of water users within districts and catchments • IWRM framework cascaded down to district and catchment levels • catchments committees and water users associations (WUAs) will be established and trained at district level to cover all the 30 districts by 2030 • detailed catchment management plans developed and implemented for all the nine identified main catchments areas by 2030. <p>2) Develop water resource models, improved meteorological services, water quality testing, and improved hydro-related information management</p> <ul style="list-style-type: none"> • develop water balances at district and catchment levels, supported by hydrological models, improved rainfall monitoring, and a better understanding of agro-meteorology and water quality testing • identify national water datasets to enable monitoring of the water balance • model abstraction and future demand • surface water quality monitoring • upgrade the existing 53 gauging stations to real time data stations by 2030. <p>3) National Water Security Plan to employ water storage and rain water harvesting, water conservation practices, efficient irrigation</p> <ul style="list-style-type: none"> • establish a comprehensive National Water Security Plan to expand water storage and irrigation infrastructure, rainwater harvesting, water conservation and water efficiency practices • assessment of the current water storage capacity • implement the water resources master plan which identified potential sites for multipurpose dam construction countrywide for improved water storage • Rainwater harvesting will also be mandatory and will be made an integral part building codes by 2030. • Increase number of water monitoring stations 				

Activity Name	Integrated Water Resource Management (IWRM)	Priority	Medium
Current implementation status / ongoing activities			
<p>Elements of IWRM have been implemented by MINIRENA showing positive results in the past such as the stabilization of Lake Cyohoha's water level in Bugesera or the restoration of Rugezi wetland complex (MINIRENA 2017). A five year programme sponsored by USAID with approximately 9 million USD entitled the "Rwanda Integrated Water Security Programme" has been finalized in 2016. It has promoted IWRM capacity at different levels of government.</p> <p>Currently MINIRENA is being supported by the Netherlands to map the four catchments throughout the country (Water for Growth project) (FONERWA 2017b). The project aims at to improving water and land management policies, strengthen the capacity of relevant institutions regarding IWRM, create a knowledge base around water and land management, and mobilize investment into IWRM through the 18million EUR IWRM Investment Fund.</p> <p>Although no effective framework on IWRM has been established yet, several steps have been undertaken on the way to its establishment. According to FONERWA (2017b) the water law is under review at the moment, a ministerial order on water utilization has been revised and an Inter-Ministerial Committee as well as Water Consultative Commission have been established.</p> <p>According to recent stakeholder consultations in June 2017, water infrastructure, catchment plans and a rain water harvesting strategy have been developed. Moreover, water monitoring stations have been installed on several rivers and a water management information system has been developed.</p>			
Responsible line ministry	MINIRENA		
Responsible lead entity	RWFA		
Other stakeholder involved	MINAGRI, UR/CAVM, MININFRA, Meteo Rwanda, REMA, civil society, WASAC, PSF, RLUMA, City of Kigali and MINALOC		
Cost estimates			
Costs of the high green Scenario (2015 – 2030): 1.0 billion USD (GoR 2016) ⁹			
Timeline	Community level IWRM framework implemented: 2 years (GoR 2011)		
Milestones	<ul style="list-style-type: none"> • Implementation of effective IWRM governance framework with on the national level • Establishment of District and Community Based Catchment Management framework under National IWRM Framework • Effective coordination across ministries and sectors at the national, district, and watershed level established • Develop a comprehensive monitoring, information management, and permitting program 		
Adaptation & mitigation benefits	<p>Mitigation benefits</p> <ul style="list-style-type: none"> • Improved quality and quantity of water resources will support new and existing hydropower plants <p>Adaptation benefits</p> <ul style="list-style-type: none"> • Water security maintained • Reduced water pollution 		
Co-benefits	<ul style="list-style-type: none"> • Benefits for fishing and lake ecosystems • Expanding technical capacities and collaboration between involved entities 		
Relevant Sustainable Development Goals			
			
MRV system/ indicators	<ul style="list-style-type: none"> • Data on water quality and quantity (e.g. water levels of relevant water catchments, water pollution, etc.). Data on water quality and quantity are collected by RWFA, website not set up yet due to split of agency (Stakeholder Consultation May 2017) • The existing monitoring framework needs to be expanded to all catchments of the country in order to monitor seasonal data at catchment level (FONERWA 2017b) 		
Capacity building needs	<ul style="list-style-type: none"> • Local level capacity building on district level, especially with regard to daily behaviour. (Stakeholder Consultation May 2017) • Institutional need on central level for projection and modelling competence. Capacity Needs Assessment underway and to be finalized by late July. (Stakeholder Consultation May 2017) • MINIRENA is working on reducing the country-wide water consumption while at the same time trying to achieve increased irrigation targets. Institutional coordination regarding water allocation needs to be enhanced (FONERWA 2017b). 		


Activity Name	Integrated Water Resource Management (IWRM)	Priority	Medium
Barriers	<ul style="list-style-type: none"> Lack of awareness on all levels (Stakeholder Consultation May 2017) Inability to integrate actions from various sectors as this measure is cross-sectoral and contains elements of other activities (Stakeholder Consultation May 2017) Overlapping institutional mandates due to cross-cutting nature of IWRM (FONERWA 2017b) Mobilizing financial support for IWRM and capacity building at all catchments that are not covered by the Dutch sponsored Water for Growth project. 		
Risks	<ul style="list-style-type: none"> Different interests competing for access to water (including differentiation according to quality) (Stakeholder Consultation May 2017) 		

4.19. Afforestation

Afforestation is an effective way to tackle mitigation and adaptation challenges in a country. Forests have the ability to absorb CO₂ and producing at the same time fuelwood that can replace fossil fuels. At the same time it provides a number of adaptation related benefits such as reduced soil erosion, run-off in steep areas and water purification. Since afforestation is often less cost intensive than energy conservation related measures it can be utilized to combat climate change. Due to the genocide in 1994 many communities have been displaced that have been returning in later years, settling in forest areas. To earn a living many returnees build their livelihood on the basis of deforestation which leads to a massive loss of forest cover over the years.

Table 22: Afforestation


Activity Name	Afforestation		Priority	Medium
Activity No.	19	NDC label	A3.1	
Purpose	Cross-cutting	Sector	Forestry	
Baseline Scenario				
With 97% of cooking energy coming from forests, the sector provides the major share of the country's primary energy needs. This has led to a significant gap of wood products that reached 12 million m ³ in 2009. As long as the high demand for wood is not reduced the forestry sector is anticipated to remain pressured (GoR 2015).				
Target				
The country intends to enhance its afforestation efforts by using of germplasm, species site matching, timing of tree planting and post planting care. Moreover, mixed-species approaches will be used that increase ecosystem resilience and biodiversity. By 2030 a sustained surface cover of 30% of national land surface will be achieved from 28.8% in 2013 (GoR 2015). Given a total surface area of Rwanda of 2.38 million ha dryland excluding water bodies and that the 2013 values regarding current forest surface still apply, there remains an afforestation need of approximately 31,605 ha to reach the target.				
Current implementation status / ongoing activities				
There is an annual plantation plan that set out hillside plantation of 8400 ha, which is normally reached. In addition agroforestry measure on 46,000 ha annually. The latter, however, is more difficult to monitor (Stakeholder consultations May 2017). Furthermore a tree seed centre has been restructured and a seed strategy has been elaborated in order to ensure sustainable supply of planting material in quality and quantity. Annual regeneration of forests averages ~500 ha. There are several forestry projects funded by the national climate fund FONERWA, ADB, BTC, Netherlands, COMIFAC, and IUCN. Rwanda committed 2 million hectares for landscape restoration.				
Responsible line ministry	MINIRENA			
Responsible lead entity	RWFA			
Other stakeholder involved	MININFRA, REMA, FONERWA, RAB, RLUMA, civil society, districts, Private Sector, MINALOC			
Cost estimates				
Afforestation and reforestation costs reach 300-400,000 RWF/ha (Stakeholder Consultations May 2017). Total costs to reach the afforestation target of 31,605 ha amount to 13.1 million USD ¹⁰ .				

Activity Name	Afforestation	Priority	Medium
Timeline	If the annual plantation plan of 8400 ha is being implemented and no loss of forest area occurs, the target would be reached in the fourth year.		
Milestones	<ul style="list-style-type: none"> N/A30% of the country area covered by forests 50% of degraded landscape restored 		
Mitigation & adaptation benefits	<p>Mitigation benefits</p> <ul style="list-style-type: none"> Reduce emissions from sequestration / improved GHG sink capacity <p>Adaptation benefits</p> <ul style="list-style-type: none"> Protection of soils and watersheds Prevention of soil erosion Forest offers ecosystem related sources of income and improved livelihood 		
Co-benefits	<ul style="list-style-type: none"> Restoration of natural landscape Biodiversity gains 		
Relevant Sustainable Development Goals			
			
MRV system/ indicators	<ul style="list-style-type: none"> Surface area where afforestation and reforestation activities are implemented Number of trees planted each year Change in survival rate Make use of the national forest inventory (Stakeholder Consultations May 2017) 		
Capacity building needs	<ul style="list-style-type: none"> Forest pathology, entomology and forestry economics knowledge needed (Stakeholder Consultations May 2017) General public awareness on benefits of woodlots and agroforestry (Stakeholder Consultations May 2017) Forests management skills 		
Barriers	<ul style="list-style-type: none"> Limited research in suitable forestry species Investment costs are high (Stakeholder Consultations May 2017) Lack of private capital, no bank loans available (Stakeholder Consultations May 2017) 		
Risks	<ul style="list-style-type: none"> Site and species selection (domestic species growing slowly and not giving return, risk of Eucalyptus monoculture) (Stakeholder Consultations May 2017) Low involvement of the private sector 		

4.20. Improved forest management

Improved forest management entails activities that lead to increased carbon stocks within forests and can reduce CO₂ emissions compared to BAU forestry practices. Studies show that conventional logging leads to high amounts of GHG emissions, while improved harvesting lead to significantly lower emissions. After the typical time span of 30 years carbon stocks are predicted to be distinctly higher in forests that are sustainably managed (Putz et al. 2008). Rwanda has published the updated version of its National Forestry Policy in 2010, which highlights the role that improved management of forest plays for the country (MINIRENA 2010).

Table 23: Improved forest management


Activity Name	Improved forest management		Priority	Medium
Activity No.	20	NDC label	A3.2	
Purpose	Cross-cutting	Sector	Forestry	
Baseline Scenario				
68% of forests are privately owned. The expansion of Rwanda's forestry resources is slow without a strong management framework. Land for forest expansion is scarce (GoR 2015).				
Target				
Rwanda intends to maximize the productivity of existing land resources in order to increase tree coverage and biomass production without using new land. Rwanda's target is to develop public-private partnerships for sustainable forest management of all forestry plantations until 2030. Forest operators will be responsible for afforestation and maintenance of forests for commercial purposes (GoR 2015).				
Current implementation status / ongoing activities				
Policy documents have been updated such as the National Forestry Policy, Forestry Sector Strategic Plan, and National Forestry Management Plan. Moreover, District Forestry Management Plans have been elaborated in 24 districts. Concessions contracts are running with private actors for better forestry management (including exploitation) of some forests to increase productivity. Co-management agreements with tea factories are running. More concession agreements are being negotiated with investors for good forestry management.				
Responsible line ministry		MINIRENA		
Responsible lead entity		RWFA		
Other stakeholder involved		MININFRA, EDCL, REMA, FONERWA, RAB, RLUMA, PSF, civil society		
Cost estimates				
Improved forest management costs 1 million RWF/ha (Stakeholder Consultations May 2017). To calculate total investment cost, the number of hectares of forestry plantations is necessary.				
Timeline		Implementation of improved forest management requires 5 years (GoR 2011)		
Milestones		<ul style="list-style-type: none"> 50% of degraded forests rehabilitated (GoR 2011) Wood yields improved from current 7.9 m³/ha per year to 15 m³/ha per year 		
Mitigation & adaptation benefits		<p>Mitigation benefits</p> <ul style="list-style-type: none"> Reduce emissions from sequestration <p>Adaptation benefits</p> <ul style="list-style-type: none"> Protection of soils and watersheds Prevention of soil erosion Forest offers ecosystem related sources of income and improved livelihood 		
Co-benefits		<ul style="list-style-type: none"> Restoration of natural landscape Biodiversity gains 		
Relevant Sustainable Development Goals				
				
MRV system/ indicators		<ul style="list-style-type: none"> Forest area degraded/rehabilitated Wood yields tCO₂e/year reduced Building on national forest inventory (Stakeholder Consultations May 2017) 		
Capacity building needs		<ul style="list-style-type: none"> Forest pathology, entomology and forestry economics knowledge needed (Stakeholder Consultations May 2017) General public awareness on benefits of woodlots and agroforestry (Stakeholder Consultations May 2017) 		
Barriers		<ul style="list-style-type: none"> Investment costs are high (Stakeholder Consultations May 2017) Lack of private capital, no bank loans available (Stakeholder Consultations May 2017) 		
Risks		<ul style="list-style-type: none"> Site and species selection (domestic species growing slowly and not giving return, risk of Eucalyptus monoculture) (Stakeholder Consultations May 2017) 		

4.21. DRR programmes (early warning, community-based)

The goal of Disaster Risk Reduction (DRR) activities is to reduce the adverse impacts of natural hazards such as floods, droughts and cyclones but also non-climate related hazards such as earthquakes. Disasters are the developments on society and environment that follow after a natural hazard has taken place. A variety of factors determines how resilient a population is to hazards and in turn how severe a disaster will be. Systemic factors entail food production, buildings, regulations, structure of the financial system, etc. determine a countries resilience.

Table 24: DRR programmes (early warning, community-based)

Activity Name	DRR programmes (early warning, community-based)		Priority	High
Activity No.	21	NDC label	A7.1, A7.2, A7.3, A8.1	
Purpose	Adaptation	Sector	Cross-sectoral	
Baseline Scenario				
Rwanda is vulnerable to climate related disasters like droughts, floods and landslides. Due to climate change seasonal droughts are expected to be longer, which will be particularly problematic for the East of the country. Moreover, the expected temperature increase will lead to a proliferation of diseases. Also floods and landslides, which typically occur after intense rainfall events are expected to increase in frequency (FONERWA 2017b). To plan and implement adaptation actions more effectively it is necessary to conduct comprehensive risk and vulnerability assessments, which is not anticipated in the baseline scenario (GoR 2015).				
Target				
<ol style="list-style-type: none"> 1. Countrywide risk assessments completed by 2030 (GoR 2015) 2. Establishment of early warning system for natural disasters and improvement of preparedness (GoR 2015) 3. Community-based DRR including improved farming techniques, first aid training, public awareness for disease prevention, relocation of 30,000 households from high risk zones by 2030 (GoR 2015) 4. Establishment of improved observation facilities to provide high quality climate data for monitoring and early warning. (GoR 2015) 5. Review contingency plans and develop districts disaster management plans; 6. A national matrix contingency plan will be established (covering strong winds) 				
Current implementation status / ongoing activities				
<p>A project has been implemented between 2010 and 2014 with the focus to establish an early warning and disaster preparedness system in flood prone areas of the Gishwati ecosystems. The project has been supported by a 15.9 million USD grant from GEF with co-financing from UNDP and the Rwandan Government. Another activity funded by the LDCF with a grant of USD 8.8 million and co-financing of approximately 45 million USD started in 2017. It aims at increasing the capacity of vulnerable communities through diversification of livelihoods and by raising awareness for adaptation practices (FONERWA 2017b) Also several ongoing FONERWA projects focus on climate monitoring in Rwanda (FONERWA 2017a). Finally, A project is being developed to establish a Centre for Climate Knowledge and Development (CCKD) that is envisaged to improve climate data and projections. This project is still in the proposal phase and in being developed by Meteo Rwanda and REMA (FONERWA 2017b).</p> <p>Progress regarding target 1: The Rwanda Risk Atlas 2015 has been developed, Disaster Risk and Vulnerability Reports have been developed, Hazard prone areas have been mapped (FONERWA 2017b).</p> <p>Progress regarding target 2: A disaster online portal has been established, the disaster communication system has been merged with an early warning system, early warning system implemented for 57% of disasters, early warning system protocols are being developed, early warning system trainings conducted, 100% of districts have been trained regarding emergency plans, 70% of districts have district disaster management plans, 60% of districts have contingency plans, national contingency plans are available, guidelines for mainstreaming DRM are available (FONERWA 2017b).</p> <p>Progress regarding target 3: 85% households relocated from high-risk zones, 11 DRR groups established, 2 Persons per Sector trained as fast responders, DRM awareness carried out, DRR Secondary School course introduced (FONERWA 2017b)</p> <p>Progress regarding target 4: 85% of all monitoring stations operational, 40% data in digital format, key stakeholders have been identified for climate projections team and reports, climate analysis software available, 2 modelling staff dedicated to climate modelling, 4 high-capacity computers available,</p>				
Responsible line ministry	MIDIMAR			
Responsible lead entity	MIDIMAR			

Activity Name	DRR programmes (early warning, community-based)	Priority	High
Other stakeholder involved	Meteo Rwanda, MINIRENA, REMA, MINALOC, MININFRA, NISR, UR, MINEDUC, RDF, RNP, civil society		
Cost estimates	N/A		
Timeline	According to GGCRS the implementation of community based DRR takes 2 years. The NDC measure, however, has additional elements that have not been included in GGCRS.		
Milestones	<p>Milestones of target 1 (FONERWA 2017b):</p> <ul style="list-style-type: none"> Updating the Risk Atlas to include storms and lightning, and to cover more areas Thunderstorm hazard mapping and mitigation strategy Risk (for Ritsiro) – underway (needs assessment completed) Risk and Vulnerability maps for Lake Kivu <p>Milestones of target 2 (FONERWA 2017b):</p> <ul style="list-style-type: none"> Disaster communication system and early warning system fully operational; Early warning system implemented for 80% of disasters; Indigenous Knowledge integrated in EWS; Disaster Inventory System “DesInventar” set up Disaster fund setup; Hazard warning MoUs signed (MTN, Tigo and Airtel) <p>Milestones of target 3 (FONERWA 2017b):</p> <ul style="list-style-type: none"> Voluntary DRR groups established in all Provinces; DRR clubs established in Higher Learning Institutions; 10 Fast-responder Teams established, trained and equipped; National DRR awareness week arranged and celebrated annually. <p>Milestones of target 3 (FONERWA 2017b):</p> <ul style="list-style-type: none"> 90% of all monitoring stations operational 85% of data in digital format Climate projection team established Quarterly projection reports (long term) Strategic capacity development strategic plan submitted for funding; 4 climate modelling staff trained; National Climate Modelling Centre Established 		
Adaptation & mitigation benefits	<p>Adaptation benefits</p> <ul style="list-style-type: none"> Reducing impacts of extreme weather events mitigation disasters, saving lives and improving health Reducing vulnerability to poverty by diversifying farmers’ crops and techniques Better monitoring leads to more efficient food supply chain Serving the poorest sections of society, which are often hit hardest by disasters <p>(Vorhieß et al. 2016)</p>		
Co-benefits	<ul style="list-style-type: none"> Improved governance and better organization of involved entities Improved women’s involvement in community level activities 		
Relevant Sustainable Development Goals			
			
MRV system/ indicators	<ul style="list-style-type: none"> Population covered by DRR programmes Creation of a disaster monitoring tool Type and number of DRR programs implemented Number of early warning systems in place and active 		


Activity Name	DRR programmes (early warning, community-based)	Priority	High
Capacity building needs		<ul style="list-style-type: none"> Official notification to MINECOFIN and Parliament for MIDIMAR to be part of budget planning session (Stakeholder consultation May 2017) Sendai framework 2015-2030: Proactive disaster prevention (Stakeholder consultation May 2017) Capacity building on the update and use of the Risk Atlas and how to incorporate it into local planning (FONERWA 2017b) Capacity building for Meteo Rwanda and MIDIMAR on how to analyse data and conduct climate projections 	
Barriers		<ul style="list-style-type: none"> MIDIMAR has only one official overseeing department for community training. Collaboration with other institutions for training and awareness raising is necessary. Option would be talkshows on community radios, but this requires resources (Stakeholder consultation May 2017) There are no resources for impact evaluation. Other ministries doubt that they should provide indicators, and they claim that they have no specific budget. Terminology is often alien to involved entities (Stakeholder consultation May 2017) Mind-set of population – unwillingness to relocate due to ancestral lands and unease about compensation (Stakeholder consultation May 2017) 	
Risks		<ul style="list-style-type: none"> An early warning system will only be useful if the weather information can effectively be accessed by farmers (FONERWA 2017b) 	

4.22. Vector based disease prevention

Seven pathogens out of the 74 known to be present in Rwanda are vector based (GoR 2015). GoR is committed to rationalize the use of resources to ensure adequate health care to the population. Due to climate change, the range of vectors for dangerous diseases could expand. Henninger (2013) for example argues that the geographical proliferation of Malaria will shift due to the changing climate. Especially in Sub-Saharan Africa changes in the length of rainy season and rain intensity can increase the length of the malaria transmission period. Also the report “Economic of Climate Change in Rwanda” highlights that climate change could increase the health burden from malaria significantly. A Malaria risk model estimates that the risk of Malaria could be increased for rural population by 150% by 2050 (SEI 2009). However, it needs to be pointed out that many different factors influence incidence rates of diseases such as Malaria. Population growth, urbanization and changed settlement structures have a significant effect as well and are difficult to disentangle from the pure climate effect (Henninger 2013).

Table 25: Vector based disease prevention

Activity Name	Vector based disease prevention		Priority	High
Activity No.	22	NDC label	Non-NDC	
Purpose	Adaptation	Sector	Health	
Baseline Scenario				
Malaria is the most critical vector-borne disease prevalent in Rwanda. In the baseline scenario the climate change and the related increased weather variability is expected to increase proliferation of the disease.				
Target				
N/A				
Current implementation status / ongoing activities				

Activity Name	Vector based disease prevention	Priority	High
<p>The disease burden from vector-borne diseases in terms of incidents and morbidity has significantly decreased over the last decade due to interventions from the Global Fund, the USAID President's Malaria Initiative and other projects. More specifically the incident rate in 2012 had decreased by 86% from 2005 levels (MINISANTE 2013). In 2013 the National Strategic Plan for Integrated Vector management (2013 – 2017) has been established. It has the goal to strengthen preventive measures against vector borne diseases and create capacity in the Ministry of Health to adapt to disease outbreaks. This plan, however, does not take into account climate data.</p>			
Responsible line ministry	MINISANTE		
Responsible lead entity	RBC		
Other stakeholder involved	MINAGRI, MINALOC, MIDIMAR, Meteo Rwanda, civil society		
Cost estimates			
N/A			
Timeline	N/A		
Milestones	<ul style="list-style-type: none"> N/A 		
Mitigation benefits	<ul style="list-style-type: none"> Difficult to assess as GHG emissions related to health influenced by numerous factors 		
Co-benefits	<ul style="list-style-type: none"> Increase income/productivity due to reduced sickness time Reduced health costs for households and at an aggregate level Reducing mortality rate 		
Relevant Sustainable Development Goals			
			
MRV system/ indicators	<ul style="list-style-type: none"> % of population covered with disease prevention activities Reduction of cases of vector based infections and sickness Number and type of pathogens covered in the program 		
Capacity building needs	<ul style="list-style-type: none"> Official notification to MINECOFIN and Parliament for MIDIMAR to be part of budget planning session (Stakeholder) 		
Barriers	<ul style="list-style-type: none"> Level of awareness on vector based diseases at local level Low coordination between ministries Limited financial resources 		
Risks	<ul style="list-style-type: none"> It needs to be ensured that a clear link is established between climate change and increase in Malaria incidents and/or morbidity. Spending international climate resources for actions that are climate-unrelated endangers the country's credibility and availability to access finance. 		

5. Institutional responsibilities

Table 26 below shows institutional responsibilities for each measure.

Table 26: Responsible line ministries and implementing entities

No.	Activity name	Responsible line ministry	Responsible lead entity	Other stakeholders
1	Grid connected hydropower	MININFRA	REG	RURA, MINIRENA, REMA, RWFA, RSB, MINECOFIN, FONERWA, Private sector, civil society
2	Solar mini-grid	MININFRA	REG	RURA, MINECOFIN, FONERWA, MINIRENA, REMA, RSB, Private sector, civil society
3	Lake Kivu methane-to-power project	MININFRA	REG	REG, private companies (e.g. Kivuwatt, Symbion Power) financial institutions including those involved in the first phase (i.e. AfDB's private sector arm, the Emerging Africa Infrastructure Fund; Belgian Investment Company for Developing Countries; Netherlands Development Finance Company; and the European Financing Partners, civil society
4	Demand side management (lighting, cookstoves, water filters)	MININFRA	REG	REMA, RHA, RDB, MINECOFIN, FONERWA, MINALOC, RSB, MINISANTE, private sector, civil society
5	Renewable biomass	MININFRA MINALOC	REG	RURA, RHA, MINIRENA, REMA, RWFA, RSB, MINECOFIN, REG/EDCL FONERWA, Districts, Private companies, civil society
6	Improved public transport infrastructure and services in Kigali	MININFRA	RTDA	RURA, MINALOC, CoK, MINECOFIN, FONERWA, operators, REMA, MINIREMA, Private sector transport operators, financial institutions, civil society
7	Energy efficiency in the agro-processing sector	MINEACOM	NIRDA	NAEB MINAGRI, RDB, MINEACOM, FONERWA, RSB, EUCL, REMA, private sector, civil society
8	Development of eco-industrial parks	MINEACOM	MINEACOM	MININFRA MINECOFIN, MINAGRI, MINIRENA, REMA, FONERWA, WASAC, NIRDA, RDB, REG, MINALOC, Private sector, civil society
9	Climate compatible mining	MINIRENA	RMPGB	PSF, MININFRA, RNRA, MINEACOM, Private companies, civil society
10	Waste as resource	MINALOC MININFRA	Municipalities, CoK and districts	RURA, RHA, MINIRENA, REMA, Private sector, NGOs, Civil Society, Religious institutions, WASAC, REG, MINEACOM, MINAGRI, RDB, civil society
11	Sustainable food production	MINAGRI	RAB	REMA, RWFA, RLUMA, Private Sector, PALEF (NGO), MINIRENA, NAEB, Meteo Rwanda, development partners, civil society
12	Composting and fertilizer enrichment	MINAGRI	RAB	REMA, RLUMA, UR/CAVM, Private Sector, MINIRENA, RDB, civil society
13	Wastewater irrigation	MINAGRI MINIRENA MININFRA	RAB, RLUMA	MINAGRI, RAB, REMA, RWFA, RURA, Private Sector, civil society, WASAC, higher learning and research institutions
14	Integrated land use planning	MINAGRI MINIRENA	RAB, RLUMA	MINAGRI, RAB, NAEB, RHA, REMA, RWFA, MININFRA, RNRA, MINALOC, Private sector, civil society
15	Soil conservation	MINAGRI	RAB	MINIRENA, NAEB, MINALOC, REMA, RWFA, RLUMA, Private Sector, civil society
16	Integrated pest management	MINAGRI	RAB	REMA, UR/CAVM, Private Sector, civil society, Donors, NAEB,

No.	Activity name	Responsible line ministry	Responsible lead entity	Other stakeholders
17	Irrigation	MINAGRI	RAB	REMA, RWFA, Private Sector, civil society, Donors, MINALOC, MININFRA, UR/CAVM, RLUMA
18	Integrated Water Resource Management	MINIRENA	RWFA	MINAGRI, UR/CAVM, MININFRA, Meteo Rwanda, REMA, civil society, WASAC, PSF, RLUMA, City of Kigali and MINALOC
19	Afforestation	MINIRENA	RWFA	MININFRA, REMA, FONERWA, RAB, RLUMA, civil society, districts, Private Sector, MINALOC
20	Improved forest management	MINIRENA	RWFA	MININFRA, EDCL, REMA, FONERWA, RAB, RLUMA, PSF, civil society
21	DRR programmes (early warning, community-based)	MIDIMAR	MIDIMAR	Meteo Rwanda, MINIRENA, REMA, MINALOC, MININFRA, NISR, UR, MINEDUC, RDF, RNP, civil society
22	Vector-based disease prevention	MINISANTE	RBC	MINAGRI, MINALOC, MIDIMAR, Meteo Rwanda, civil society

Source: GoR2011, 2015; Stakeholder mission June 2017

6. Main data gaps

During the preparation of this report several major data gaps have been identified. Addressing them would allow the definition of a more detailed and robust implementation plan. While specific information missing is highlighted in the previous section with regard to each specific activity evaluated, this section will summarize the main gaps encountered. Also, potential actions to close the gaps are proposed.

- Monitoring of the current mitigation activities is not systematically implemented, with cases where no data is collected or where the information is collected but only at local level. Increasing MRV capacity is key for the GoR to keep track of the progresses made for each action and to communicate the results achieved to national stakeholders and the international community. In light of the requirement under the PA, MRV and accounting rules will have fundamental role to ensure environmental integrity of the new market mechanisms and also to ensure comparability of different NDCs.
- Lack of detailed information on investment costs. Particularly for the adaptation measures, there is no clear information on the associated investment cost. This gap should be closed by planning activities including the costing of selected measures. Such detailed costing should also provide additional indications on which actions to be prioritized considering cost/benefit analyses and identifying activities that are most cost-effective. In some cases costing is provided, but the disaggregation level is not sufficient to identify costs of specific components clearly.
- Lack of clear/updated timelines and milestones for the implementation of the proposed measures and lack of information on the current implementation status. Closing this gap requires more detailed planning, but it is also contingent on the actual resources for monitoring the implementation of the proposed activities. In many cases availability of sufficient resources is not in the hand of the GoR and hence timelines might have to be shifted over time. Information might be available at the local level for some activities, and hence dissemination should be enhanced.
- Lack of detailed feasibility studies. This affects the validity of forecasts and will require additional time for preparation, slowing the NDC implementation process. Preparation of feasibility studies allows more accurate planning and improve also accuracy of costing estimates.

As discussed in the previous sections, a robust MRV framework could support closing this gap, through the gathering of relevant information to ensure proper supervision and overview of the current activities, already during the detailed planning phase. While more stringent MRV requirements increase monitoring costs and could require specific expertise that might not be easily available in all ministries and institutions, the benefits will outweigh costs.

7. Potential sources of finance

This section introduces the available sources of international finance that could provide support for NDC implementation. The total amount required for the implementation of the NDC measures exceeds 2.7 billion USD by 2030. This estimation is not covering the full set of measures, but it only includes those measures for which a cost estimate was possible, i.e. grid connected-hydropower, solar mini-grid, Lake Kivu methane-to-power project, efficient lighting and efficient cookstoves dissemination, biogas digesters, transport, energy efficiency in agro-processing, waste water irrigation, IWRM and afforestation.

In many cases, cost estimates were possible only for some of the activities in one specific sector (e.g. for demand side management: lighting and cookstoves have a cost estimate, while water filters and grid loss reduction do not, the cost of the BRT in Kigali is not known while other measures have been estimated using existing literature). Thus, the real magnitude of the investment needed will be substantially higher than 2.7 billion USD. As discussed in section 6, it is important to close this gap: it would allow GoR to have a better understanding of the volume of resources needed and also on the potential sources of finance that need to be involved. It would also allow a better evaluation and prioritization of the measures.

It should be noted that access to domestic sources of finance is a prerequisite for the successful implementation of the prioritized measures presented in this report and that international finance will not provide sufficient funds for the full implementation of the complete set of measures discussed here. Relevant line ministries should be able to allocate part of their budget to the implementation of the measures that are aligned with national priorities. The ability to mobilize domestic public and private resources shows national commitment and demonstrates readiness for implementation of larger mitigation and adaptation programmes with international support. International donors are interested in supporting programmes that are sustainable in the long term from a financial point of view, i.e. beyond the period in which international support is granted.

The national budget however, if available, will be limited compared to the magnitude of the resources required. It should therefore be used to create the enabling environment for private investment that can cover the existing gaps and barriers to facilitate private investments. Private participation in mitigation activities would be facilitated for those activities that generate revenues and thus can generate stable business opportunities, such as renewable power generation. Appropriate policy instruments and other incentive schemes should be identified for those measures where private sector could be mobilized (e.g. measures where revenues are generated).

FONERWA is playing a pivotal role as the centrepiece of Rwanda's climate finance. This is due to its ability to leverage domestic resources and increasing expertise in identifying and supporting

country's readiness for accessing international finance, such as in the case of the GCF. FONERWA became the largest African demand-based fund (Chennells 2015) and it is the most important climate finance vehicle in Rwanda. Another strength of FONERWA that would increase its effectiveness as key actor regarding climate finance is the ability to engage with different entities, from national ministries and authorities to private companies and international institutions and to leverage support from these different sources, including domestic public and private ones. FONERWA is closely cooperating with the main institutional entities that are involved in the climate change sector in Rwanda, namely MINIRENA, REMA and MINECOFIN (Becault et al. 2016). FONERWA is also aiming at achieving GCF accreditation, which would increase the importance of the Fund for channelling international resources in the country.

Rwanda has received extensive support from international sources over the past years and the country is perceived as a reliable counterpart by international donors. Several Rwandan entities (e.g. MINIRENA, REMA, RNRA and MINAGRI) received climate finance, which highlights the capacity of involved entities to access climate finance. At the same time the need of enhanced coordination and overview on different activities is increased, in order to develop a more organic strategy for accessing international finance. Many contracts for foreign aid on environmental protection and climate change are signed between donors and MININFRA (Becault et al. 2016).

The most active donors in supporting Rwanda's efforts for enhancing country readiness have been the Department for International Development of United Kingdom (DFID), the GCF and the Climate and Development Knowledge Network (CDKN) that together provided around 3.5 million USD between 2012 and 2016 (Becault et al. 2016). Further, Rwanda was able to attract resources from several bilateral and multilateral donors in the past.

The key bilateral ones are DFID with 26 million GBP to FONERWA for seed capitalization, German Development Corporation (KfW) with 7 million USD, USAID with 3 million USD, the Italian Ministry for Environment with 2 million USD and the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) with 8 million USD. Regarding multilateral agencies most prominent are the GEF with 23 million USD, the Least Developed Countries Fund with 24 million USD, UNDP with 5 million USD, EU with around 9 million USD, the Adaptation Fund with 10 million USD, Scale-Up Renewable Energy Program (SREP) with a 50 million USD programme. The following table summarizes key sources of finance and differentiates the sources by the type of measure (technical assistance (TA) or implementation) they could be supporting and the timeframe for accessing them (immediate, medium term).

Table 27: Sources of finance for different types of measures and their availability

Source of finance	Type of measure (TA, implementation)	Availability (immediate, medium, long)	Indicative amount of finance (million USD)	Comments
NDC help desk/LEDS global partnership	TA	Immediate	In kind expert support	
Belgian NDC initiative	TA	Immediate		Small initiative, unclear whether future rounds established, Rwanda already accessed this initiative
Capacity-building Initiative for Transparency (CBIT)	TA	Immediate	0.9 -1.2	Mainly focused on MRV
Initiative for climate action transparency	TA (MRV)	Immediate		Focus on MRV
Climate Technology Center and Network	TA	Medium-long		At the moment no funding is available from CTCN. However, if resources would be again available, it could be another source of support
GCF NAP readiness	TA on adaptation	Immediate	3	Adaptation
NAMA Facility	TA (NAMA design support) Implementation	Immediate	0.2-0.5 per project (Design) 5 – 20 per project (implementation)	Mitigation, 5 th round envisaged in third quarter of 2017
Global Environmental Facility (GEF)	TA & implementation	Immediate	2 – 2.4	Mitigation, Adaptation and crosscutting
Least Developed Country Fund (LDCF)	TA & implementation	Immediate		Adaptation
Green Climate Fund (GCF)	Implementation	Immediate	Up to 50 per proposal	Mitigation, Adaptation and crosscutting
Adaptation Fund (AF)	Implementation	Medium-long term	10	Rwanda reached the limit of funding (i.e. 10 million). However depending on future development, it could be again an important source of finance for adaptation
Scaling solar (World Bank)	Implementation	Immediate		Mitigation, solar power
German International Climate Initiative (ICI)	Implementation	Immediate	5 per project	
Voluntary market	Implementation	Immediate		Price range is quite broad, average of around 6.7 USD/tCO ₂ , Focus cookstoves and rural electrification, afforestation and reforestation
CDM	Implementation	Immediate		Clv-dev initiative (World Bank), procurement schemes (Sweden, Norway) price ranges between 2 and 10 USD/tCO ₂
African Renewable Energy Initiative (AREI)	Implementation	Immediate		Wide range of RE project financing
Pilots on PA new mechanisms	Implementation	Medium term	25	Support for pilot implementation mainly focusing on mitigation

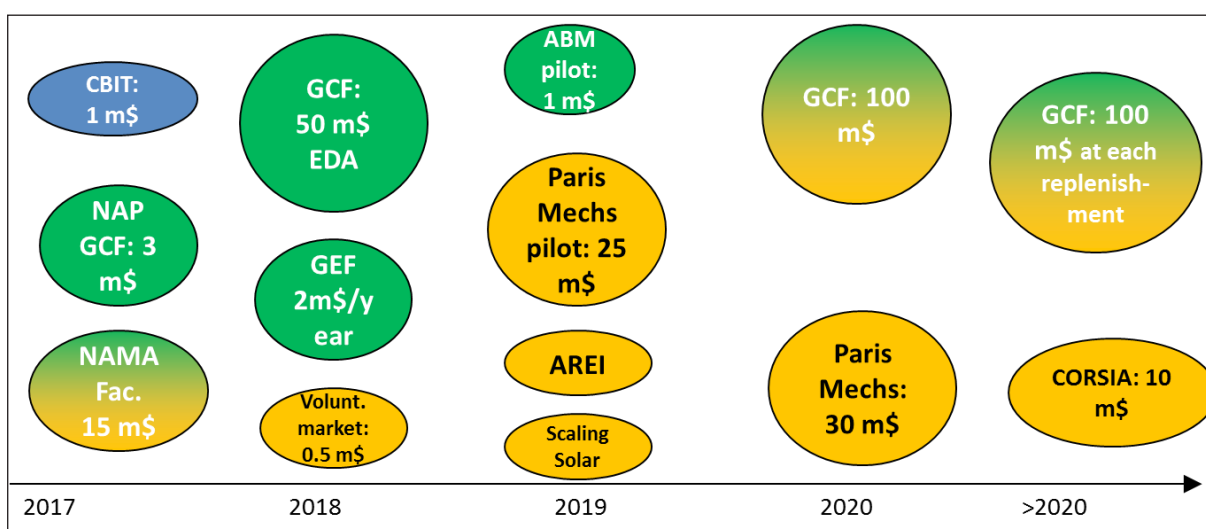
Source of finance	Type of measure (TA, implementation)	Availability (immediate, medium, long)	Indicative amount of finance (million USD)	Comments
Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)	Implementation	Medium term	10	Offsets for the aviation sector
Adaptation Benefit Mechanism (ABM)	Implementation	Medium term		Support for adaptation initiatives, using a results' based finance approach

Source: author's elaboration

7.1. Main international sources of finance for Rwanda

There are different sources of finance that the country can approach for financing its NDC actions. However, not all of the sources discussed so far are available in the short-term. Some of them need to be further developed under the new Paris regime such as the new market mechanisms. Figure 2 illustrates the volume, purpose (mitigation/adaptation) and timeframe to access the most important sources of international support.

Figure 2: Strategy for accessing finance for Rwanda's NDC implementation



Source: Author's elaboration (adaptation in green, mitigation in yellow, and technical assistance in blue)

One of the currently most prominent sources of finance is the GCF. The GCF was established in Cancun, Mexico in 2010 as an operating entity of the financial mechanism of the UNFCCC. The fund has raised over 10 billion USD until now. It is committed to a balanced allocation of its resources between mitigation and adaptation projects. 50% of the adaptation projects will be provided for most vulnerable countries (LDCs, Small Island Developing States (SIDS) and African countries. REMA has been selected to serve as national designated authority for GCF. MINIRENA is the Rwandan Accredited Entity: it can manage proposal up to 50 million USD while it has some limitation regarding the type of financial instrument that can handle (i.e. MINIRENA is not accredited to manage lending).

FONERWA is developing a pipeline of proposals for the GCF, so synergies and overlaps between the activities that are being developed under the NDC and those from the GCF pipeline could be exploited. FONERWA is seeking direct accreditation to the GCF. At the moment, however, project approval decisions are made only by the GCF Board, which is meeting just three times per year, resulting in a slow approval process. Furthermore, requirements in terms of necessary documentation (e.g. the GCF proposal template itself, as well as annexes such as feasibility studies) are complex resulting in significant resource needs for proposal preparation (GCF 2017).

Rwanda has already undertaken efforts to request GCF resources in the future by finalizing accreditation of the required national institutions and developing a pipeline of projects⁹.

Depending on the characteristics of Rwanda's GCF project pipeline it is important to distinguish between the different funding windows of the GCF. Besides the main adaptation and mitigation window described above, the fund has also established the Private Sector Facility (PSF), which enables the GCF to finance private sector mitigation and adaptation projects directly. This funding window specifically addresses barriers to private sector investment in climate activities such as market failures, lack of capacity or awareness. Corporates, insurance companies, pension funds etc. can access concessional finance through the PSF. The PSF could be engaged to gain support also for new structures for private/public cooperation such as Public-Private Partnerships (PPP).

Another way to access resources from the GCF is related to the support programmes for proposals development. The first support programme is the 200 million USD "Micro- Small-, and Medium-Sized Enterprises Pilot Programme", which is part of the PSF and aims at supporting enterprises of various sizes in addressing mitigation and adaptation (GCF 2016a). The second support programme is the "Enhanced Direct Access" programme that provides 200 million USD for pilot projects that make use of the GCF's direct access modalities. And the last support programme is entitled "Mobilising Funding at Scale Pilot Programme", aiming at supporting innovative and high-impact programmes from the private sector. The last programme has no approved modalities yet. These supporting programs could be accessed to enhance proposals already in the Rwandan pipeline and to build domestic expertise and know how.

Finally the fund established the project preparation facility, which supports accredited entities with grants of 1.5 million USD in preparing necessary proposal documents such as feasibility studies, environmental social and gender studies, risk assessments, etc. As a Rwandan direct access entity to the GCF, MINIRENA already submitted a GCF project preparation funding application entitled "Rural Green Economy and Climate Resilient Development Programme" in 2016. The goal of the program is to strengthen the resilience of Rwanda's poorest district against impacts of climate change. The proposal envisages the establishment of low carbon rural industries and green job opportunities, based on four pillars: (a) affordable, low carbon settlements and industries as growth hubs; (b) climate-resilient production of tea; (c) sustainable forest management and watershed management; and (d) knowledge development and transfer

9

Pipeline is not publicly available

(GCF 2016b). The project preparation grant of 1.5 million USD has been approved by the GCF.

Another important source of finance are the Climate Investment Funds (CIF). Channelled through AfDB, World Bank and International Finance Corporation (IFC), Rwanda is recipient of resources from the CIF. With a capitalization of 8.3 billion USD the CIF are supporting 72 LDCs and middle income countries with mitigation and adaptation since 2008. CIF funds are intended to create an enabling environment and attract private sector resources in order to create transformational impacts (CIF 2017a). The CIF consist of four sub-programmes, three of which are of particular relevance for Rwanda: The Forest Investment Program (FIP), The Pilot Program for Climate Resilience (PPCR) and the Scaling Up Renewable Energy Program (SREP).

Rwanda is intending to use FIP funding to further develop its already strong forestry policy. PPCR funding will be used to conserve water resources and expand the hydropower fundament on which its industry is built. A scoping mission and a joint mission for FIP and PPCR have taken place in November 2015 and May 2017, respectively. Next steps are formulation of an investment plan (CIF 2017b). Moreover, the PPCR has committed resources for the development a Strategic Programme for Climate Resilience (SPCR), acknowledging Rwanda's need for a strategic approach for climate resilience. A draft version of this document is currently in circulation (FONERWA 2017b). Finally, SREP funding will be used to catalyse investment into further renewable energy generation capacity. A SREP investment plan has been developed in November 2015 that specifies the status of Rwanda's energy sector and prioritizes renewable energy investment options for the country (CIF 2015). Moreover, SREP has committed 250 million USD for Rwanda, focusing on mini-grid and off-grid solar technologies. A recent project proposal of a total of 48.9 million USD has been approved for the establishment of a fund that supports private sector investments in off-grid electrification (CIF 2017c).

The Global Environmental Facility (GEF) is also a provider of financial resources for mitigation and adaptation activities. The GEF supports developing countries in meeting the objectives of international environmental agreements such as the Kyoto Protocol and the Paris Agreement but also in other not climate-related areas such as biodiversity. In addition to the GEF Trust Fund the GEF's main financing vehicle; there are other trust funds under the GEF such as the LDCF. Until today the GEF has financed 41 projects in Rwanda that sum up to a total grant volume of over USD 153 million with co-financing of over 750 million USD (GEF 2017). Over 95 million USD of these GEF grants, however, have been allocated for regional projects that benefit numerous countries. Attributing this amount to Rwanda alone would overstate the actual financial flows from the GEF to Rwanda. When looking only at the portfolio of the national projects, one finds three adaptation projects and 3 mitigation projects over the last 10 years. The mitigation projects amount to approximately USD 20 million and the adaptation projects to approximately 24 million USD. Extrapolating these financial contributions into the future the country can expect on average of 2 - 2.4 million USD per year for both mitigation and adaptation plus an undefined amount from regional projects.

The AF is another important source of multilateral resources for adaptation activities. The fund has been established under the Kyoto Protocol and committed 418 million USD since 2010. A project proposal has been submitted by MINIRENA which has been approved in January 2013. The project is reducing the vulnerability of the rural population in the Northern and Western region of the country through integrated natural resource management and promotion of alternative livelihoods (AF 2015). However, a total sum of over 9.9 million USD have been approved by the AF for this project, which represents an obstacle for further resource allocation to Rwanda because of the fund's 10 million USD country cap. This cap has been established in the 13th meeting of the AF Board as a "temporary measure" with a view to ensure equitable allocation of resources across countries (AF 2016). As long as this cap is in place no further contribution from the AF to Rwandan projects can be expected. If however, new resources are made available for the AF (for instance through the procedures of PA Art. 7) the temporary cap can be expected to disappear. In fact the fund already analysed different options of modifying the cap (AF 2016).

Regarding NAMAs, the most prominent source of support for NAMA development and implementation is the NAMA Facility. The NAMA Facility was established jointly by BMUB and the UK's Department of Energy and Climate Change (DECC). The institution provides technical and financial support for ambitious and innovative NAMA concepts that are ready for implementation and waiting for funding. The selection process is competitive and favours innovative and ambitious NAMA proposals. An important assessment criterion for NAMA proposals is the proposal's ability to induce a "transformational change". To meet this requirement projects need to enable a significant shift towards low-carbon development and contain the potential of replication/upscaling. So far it supported 21 NAMA concepts in 17 countries with a total of about 200 million EUR. The NAMA Facility opens periodic calls and has requirements in terms of documentation to be submitted. These should be considered carefully when planning for the application¹⁰. The 5th call is expected to open in the fourth quarter of 2017.

There are a number of other potential initiatives that could be harnessed by Rwanda. The AREI provides support to a broad range of projects that promote energy access together with the installation of renewable energy systems. The main goal is to achieve installation of 300 GW of new renewable energy capacity by 2030, with 10 GW of new capacity by 2020 (AREI 2017). Also, the World Bank's initiative 'Scaling Solar', provides support for the scaling up of solar power projects and programmes in Africa offering a complete support package, from identification of the project location, to projects proposal preparation and financial structuring. The initiative is already active in Zambia, Ethiopia, Senegal and Madagascar (Scaling Solar 2017).

Finally it needs to be pointed out that Rwanda has a good track record in the context of bilateral cooperation, having developed agreements with countries such as Germany, the United Kingdom, Belgium, Italy and the United States. Bilateral agreements can have an important role in the implementation of the NDC, as specific tailor-made activities of common interest can be developed and target key sectors in a more effective manner. Previous experience shows that

¹⁰ [More information on the NAMA Facility are available here](#)

Rwanda is a reliable partner and it should engage with existing partner countries and explore new options for cooperation with new strategic ones.

7.2. Existing and new market mechanisms

It is important to consider the emerging market mechanisms under the PA as their future operationalization provides new opportunities for accessing climate finance and support to both mitigation and adaptation activities. The Cooperative Approaches (CA) of Art. 6.2 offer the opportunity to develop bilateral cooperation mechanisms with other Parties. Rwanda could develop specific agreements with partner countries to implement mitigation actions in a verifiable manner and having the mitigation outcomes either sold in the market or used against national mitigation targets. Being conditional to international support, the mitigation contribution of Rwanda should benefit from such support. Operational rules, particularly accounting requirements, will be key to ensure environmental integrity of the CA.

The SDM of Art. 6.4, given its similarities with the CDM, represents a support mechanism for project and program based activities. Depending on the final operational rules, the SDM could be also covering sectoral actions and hence contribute to a broader transformation of key sectors as opposed to the CDM that could not reward policies. Development of pilot activities on the SDM will be crucial to gain practical experience on their functioning. Another element to be taken into account is related to the potential transition of CDM projects to the post-2020 climate regime. This is relevant for those activities that could be implemented under the CDM and for existing registered activities especially PoAs which give the opportunity to include unlimited CPA over the crediting period. Investor's confidence in the carbon markets, however, is still affected by the low prices of CERs and the current lack of clarity on how the new modalities and procedures of the new mechanisms will look like nor any decisions regarding transition from CDM to SDM was taken so far. In the short term, other options for effective marketing of the available CERs could be explored. National procurement schemes are viable options already available to secure revenues for registered CDM activities. Most countries active in this field are Norway and Sweden. Following the first commitment period of the Kyoto Protocol in 2008-2012 which saw Norway signing agreements for a total of 23 million CERs, the Ministry of Finance is now allowed to procure up to 60 million credits generated up to and including 2020 to meet the target of 30% emission reduction by 2020 (Ministry of Climate and Environment of Norway 2016). The Swedish Energy Agency has been responsible for the Swedish Programme for International Climate Change Mitigation (formerly called the Swedish CDM and JI programme) and declared the target of purchasing up to 40 million tCO₂ from the flexible mechanisms of the KP, especially from LDCs (SEA 2017). The Agency is also diversifying its support and participating in multilateral initiatives such as the World Bank's Carbon Initiative for Development (Ci-Dev) and the Pilot Auction Facility (PAF).

Ci-Dev is another important procurement program: launched by the World Bank in 2011, it has a 100 million USD budget for technical assistance and procurement of CDM credits from energy

access projects in low-income countries, with a strong focus on Africa and PoA, linking issuance of carbon credits to the payments, as a results-based finance instrument. It is already supporting activities in 8 countries Africa with the purchase of CERs at a certain price up to 2024 (Ci-Dev 2015)¹¹. Other options for marketing CERs are the UNFCCC Go Climate Neutral Now website that supports voluntary cancellation of CERs to companies and individuals.

One additional potential source of demand in the medium term is the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA). It was adopted by the International Civil Aviation Organization in October 2016 to limit aviation emissions growth by 2020. Least Developed Countries, Small Island Developing States and landlocked countries will be exempted, unless these countries participate voluntarily to the CORSIA. Moreover, also countries whose airlines have a share of less than 0.5% of international air traffic volume will be exempted. In the mid-term, CORSIA could represent a potential source of demand for offset credits for those airlines with binding limitations.

In order to engage more effectively with existing international climate finance institutions, definition of integrated approaches for NDC implementation would increase chances of receiving funds. This refers to the design of program ideas that combine existing activities ongoing in the country. Combining NAMAs and registered CDM activities, together with identification of bankable project ideas and robust institutional arrangements, will demonstrate the transformation potential of the proposed activities and their readiness for implementation. This could be for instance used to strengthen GCF proposals and to gain support for both NAMA implementation and for stranded CDM activities. The CDM would also provide a solid MRV framework to be used under the NAMA and potentially a results-based finance tool that could be linked to the disbursement from the GCF (or another financing institution). Mitigation outcomes that are issued could be either transferred to other Parties or voluntarily cancelled, thus contributing to the achievement of the NDC targets.

Possible uses of the CDM as a results-based finance tool should be explored in more details. For instance CDM activities, in particular PoAs, have a strong potential to fulfil the Investment Criteria of the GCF and registered ones could be used to demonstrate readiness for investment. This is due to the possibility of inclusion of an unlimited number of CPAs over time that can drive the paradigm shift potential in a sector. The registered PoAs presented in section 2.1 could potentially provide an infrastructure for quickly scaling up mitigation actions in selected sectors, as new CPAs could be included without undergoing the CDM registration process at the UNFCCC. According to PoA procedures, CPAs can be included after the Designated Operational Entity checks that the PoA documents are aligned to the general CDM rules and procedures and also to the specific PoA requirement. There are several registered PoAs available for activities related to efficient cookstove distribution under the NDC. Another potential case is for grid-connected renewable energy generation that could be implemented under PoA 9874 or distribution of LEDs under PoA 7489. There are several benefits to this approach: avoidance of a long and risky registration

¹¹ *More information on the Ci-Dev initiative are available at: <https://www.ci-dev.org/>*

process under the CDM, possibility of issuing CERs that have a value on the market or that can be voluntary cancelled and accounted against NDC targets; utilization of a well-established MRV framework that allows tracking and communicating of the mitigation contribution achieved in a verifiable and transparent manner. As shown in section 2, many of the registered CDM activities have a crediting period that goes beyond 2020, with a renewable crediting period of 21 years (7 years, renewable twice, stand-alone projects) or 28 years for PoAs, which would continue even beyond 2030. This signals the need of supporting these activities both in the pre-2020 and post-2020 period. Given the current low CER price, these registered activities are in need of financial support to ensure continuation of the verifications and issuance of CERs. Those PoAs for which Rwanda is listed as host country alone have a combined potential of over 6.3 million CERs by 2020 (UNEP DTU, 2017b). This volume of potential emission reduction could increase when considering also PoAs where Rwanda is listed as “other host country” and registered stand-alone CDM projects. Some of these PoAs are not including CPAs since few years, the main factor being the negative market situation that makes CER issuance unattractive. Receiving support for the mitigation activities registered under the CDM is also consistent with the intention of GoR to make use of market mechanisms, and also with the necessity for international support for the implementation of the mitigation component of the NDC.

Voluntary markets are another immediate option for immediate support for mitigation activities, especially those that have a strong sustainable development component (e.g. cookstoves or forestry activities). Given the high contribution to sustainable development, there is a market for credits issues by such projects. The voluntary market could provide support: the average price on the voluntary market reached an average of 3 USD/tCO₂e, ranging from 0.50 USD/tCO₂e to more than 50 USD/tCO₂e. Afforestation credits from activities in Africa were transacted at a price higher than the average, i.e. 6.7 USD/tCO₂e (Hamrick and Gallant, 2017). However, given the structure of the PA where all Parties will have mitigation targets and thus could be at the same time buyers and sellers of credits, the voluntary market might lose relevance in the future. Selling emission reductions in the voluntary market could limit the domestic contribution from specific sectors towards achieving national targets.

There is an increasing interest from donors in potential new mechanisms that can provide results-based financing for adaptation results (e.g. World Bank, AfDB). The concept could, similarly to the CERs issued for the achievement of mitigation results, would reward delivery of adaptation benefits in a results-based manner, i.e. payments are issued only after the issuance of related adaptation units that certify the delivery of adaptation benefits (the system being explored by AfDB is called Adaptation Benefit Mechanism (ABM)). These developments should be followed closely as these new approaches might become available in the near term and thus support implementation of adaptation activities.

The main financial sources that could provide support to the measures evaluated in this report are summarized in the following table. In many cases, the same institution could be appropriate for multiple activities.

Table 28: Potential sources of finance for NDC measures

No.	Measure (NDC reference)	Type of measure	Potential sources of finance
1	Grid hydro (M1.1)	Mitigation	GCF, market mechanisms, voluntary market, International Climate Initiative, NAMA Facility, Global Environmental Facility, Nordic Climate Fund, World Bank Transformative Carbon Asset Facility, Procurement schemes (for registered CDM activities), AREI, AfDB, PA new mechanisms
2	Solar mini-grid(M2.1)	Mitigation	GCF, market mechanisms, voluntary market, International Climate Initiative, SREP, NAMA Facility, Global Environmental Facility, World Bank Ci-Dev, Nordic Climate Fund, World Bank Transformative Carbon Asset Facility, Procurement schemes (for registered CDM activities), AREI, AfDB, Scaling Solar, PA new mechanisms, Voluntary markets
3	Lake Kivu methane-to-power project (non NDC)	Mitigation	Private sector investors
4	Demand Side Management (M3.1 & M3.2)	Cross-cutting	GCF, market mechanisms, voluntary market, International Climate Initiative, NAMA Facility, Global Environmental Facility, World Bank Ci-Dev, Nordic Climate Fund, World Bank Transformative Carbon Asset Facility, Procurement schemes (for registered CDM activities), AREI, AfDB, PA new mechanisms, Voluntary markets
5	Renewable biomass (M3.2 & M7.1)	Mitigation	GCF, market mechanisms, voluntary market, International Climate Initiative, NAMA Facility, Global Environmental Facility, World Bank Ci-Dev, Nordic Climate Fund, World Bank Transformative Carbon Asset Facility, Procurement schemes (for registered CDM activities), AREI, AfDB, PA new mechanisms, Voluntary markets
6	Improved public transport infrastructure and services in Kigali(M4.1)	Mitigation	GCF, International Climate Initiative, Global Environmental Facility, Nordic Climate Fund, NAMA Facility, World Bank Transformative Carbon Asset Facility, AfDB, PA new mechanisms, Voluntary markets
7	Energy efficiency in the agro-processing sector(M5.1)	Mitigation	GCF, Nordic Climate Fund, World Bank Transformative Carbon Asset Facility, Bilateral activities e.g. Italy, NAMA Facility, AREI, AfDB, GEF, LDCF, PA new mechanisms
8	Development of Eco-industrial park (M5.2)	Mitigation	GCF, Nordic Climate Fund, World Bank Transformative Carbon Asset Facility, Bilateral activities e.g. Italy, NAMA Facility, AREI, AfDB, GEF, LDCF, PA new mechanisms
9	Climate Compatible Mining (non NDC)	Mitigation	GCF, Nordic Climate Fund, World Bank Transformative Carbon Asset Facility, Bilateral activities e.g. Italy, NAMA Facility, AfDB, GEF, LDCF, PA new mechanisms, Voluntary markets
10	Waste as resource (M6.1)	Mitigation	GCF, Adaptation Fund, Nordic Climate Fund, Cross-cutting, Bilateral activities e.g. Italy, AfDB, GEF, LDCF, PA new mechanisms, Voluntary markets
11	Sustainable food production (A1.1)	Cross-cutting	GCF, Adaptation Fund, Nordic Climate Fund, Bilateral activities e.g. Italy, AfDB, GEF, LDCF
12	Composting + fertilizer enrichment (A1.2)	Cross-cutting	GCF, Adaptation Fund, Nordic Climate Fund, Bilateral activities e.g. Italy, AfDB, GEF, LDCF

No.	Measure (NDC reference)	Type of measure	Potential sources of finance
13	Wastewater irrigation (A1.2)	Cross-cutting	GCF, Adaptation Fund, Nordic Climate Fund, Bilateral activities e.g. Italy, AfDB , GEF, LDCF, Adaptation benefits pilots
14	Integrated land use planning (A6.1 & A6.2)	Cross-cutting	GCF, Adaptation Fund, Nordic Climate Fund, Bilateral activities e.g. Italy, AfDB , GEF, LDCF
15	Soil conservation (A1.5)	Cross-cutting	GCF, Adaptation Fund, Nordic Climate Fund, Bilateral activities e.g. Italy , AfDB, GEF, LDCF, Adaptation benefits pilots
16	Integrated pest management (A1.4)	Cross-cutting	GCF, Adaptation Fund, Nordic Climate Fund, Bilateral activities e.g. Italy , AfDB, GEF, LDCF, Adaptation benefits pilots
17	Irrigation (A1.6)	Cross-cutting	GCF, Adaptation Fund, Nordic Climate Fund, Bilateral activities e.g. Italy, AfDB , GEF, LDCF, Adaptation benefits pilots
18	Integrated Water Resource Management (A5.1; A5.2 and A5.3)	Cross-cutting	GCF, Adaptation Fund, Nordic Climate Fund, Bilateral activities e.g. Italy, AfDB , GEF, LDCF, Adaptation benefits pilots
19	Afforestation (A3.1)	Cross-cutting	GCF, Adaptation Fund, Nordic Climate Fund, Bilateral activities e.g. Italy, REDD+, Voluntary markets, AfDB, GEF, LDCF, Adaptation benefits pilots
20	Improved forest management (A3.2)	Cross-cutting	GCF, Adaptation Fund, Nordic Climate Fund, Bilateral activities e.g. Italy, REDD+, voluntary markets, AfDB, GEF, LDCF
21	DRR programmes - early warning, community-based (A7.1, A7.2, A7.3, A8.1)	Adaptation	GCF, Adaptation Fund, Nordic Climate Fund, Bilateral activities e.g. Italy, World Bank Disaster Risk Financing and Insurance Program, GEF, LDCF
22	Vector-based Disease Prevention (non NDC)	Adaptation	GCF, Adaptation Fund, Nordic Climate Fund, Bilateral activities e.g. Italy, GEF, LDCF

Source: author's elaboration

8. Conclusions, recommendations and next steps

This section provides a summary of the main recommendations and next steps for the implementation of measures under Rwanda's NDC:

- Build on existing activities. NDC implementation should start from projects already implemented to demonstrate readiness as ability to identify viable projects is a positive factor for attracting donors' support. Building on ongoing adaptation and mitigation activities also allows to harness experience generated within ministries and agencies. This should build on activities under the CDM and NAMAs which could be accelerated provided sufficient capacity and financial resources are made available. Pilot activities implemented or planned by FONERWA are a good example of projects supported by domestic finance that need international support for scaling up to the level required by the NDC.
- NDC implementation unit within FONERWA or MINECOFIN. Explore the benefits and cost of an NDC implementation unit within FONERWA/MINECOFIN. It could support the identification of bankable projects ready for submission to international financiers as well as detailed feasibility studies for envisaged NDC activities. The unit should be responsible for inter-ministerial coordination, implementation and monitoring/reporting on the aggregate level, while at sectoral level responsibilities would still lie with existing line ministries.
- Closing the existing data gaps as identified in section 6 would allow the definition of a more solid implementation plan having a better overview of ongoing activities and also for improving planning of future ones. If necessary GoR could try to mobilize technical assistance funding to close existing data gaps.
- Develop a detailed financing strategy. The following recommendations are most relevant:
 - Prioritization of the NDC measures. Prioritization of the measures that are to be implemented over the NDC timeframe (i.e. up to 2030) and a constant update depending on the developments in the Rwandan context and national priorities are necessary. This allows the understanding on which activities to focus on and subsequently which institutions to target for funding.
 - Strengthen climate finance access. To strengthen Rwanda's access to climate finance the country should further participate in the development of investment plans, as it did with the SREP. These investment plans provide a strong basis for

identifying specific activities, sources, timelines and support in proposal writing processes. Further the country should target the different GCF funding windows depending on project types in the pipeline that is being developed. At the same time it is recommended to closely follow the newest GCF board decisions to be abreast of new potential funding opportunities. And finally, it is recommended to develop and submit a proposal to the NAMA Facility. Existing NAMAs could be potentially considered for submission in the 5th call depending on the current state of development.

- Develop a technical assistance coordination strategy. It is recommended that REMA and FONERWA collaborate to engage with international donors that support NDC implementation. Prioritization of the proposed measures and identification of potential source of finance is a necessary condition to gain financial support. To increase chances of gaining support, a structured approach should be developed taking into consideration the NDC implementation plan as a whole, rather than focusing on specific measures as stand-alone activities. An important component would be to continuously update the strategy as per relevant developments on the financiers' side (e.g. GCF Board decisions, emergence of new financing vehicles) and with regards to rules, demand and prices of market mechanisms.
- Plan allocation of domestic resources and required competences for securing funding from international sources. Engaging with donors in many cases requires the preparation of project/programme documentation meeting strict requirements, such as the case of GCF or the NAMA Facility. Knowledge management and technical capacities are necessary to meet these requirements: preparation of documentation, demonstrating readiness of the proposed activities, definition of institutional arrangement, initial quantification of the mitigation and adaptation impacts and MRV schemes. Developing high-quality technical proposals is a time and resource consuming activity that requires proper budget allocation. It is important to utilize international support (both financial and capacity building) to develop national expertise on project identification and proposal preparation.
- Mobilize private sector investments. Private financial resources will be key to implement the set of measures identified by the NDC. International finance and public domestic resources should be used to create the enabling environment for attracting private resources into mitigation and adaptation activities. This will also ensure long term sustainability of the implemented actions once public and international support is phased out. Measures that generate revenues are the ideal candidates for involving private companies. However, also innovative approaches for involving private actors should be identified in those sectors

where private participation has been traditionally low. This could be done for instance with the participation in the CORSIA mechanism and participation of the national company RwandAir, or introduction of innovative schemes for allow private participation in the transport or waste sector.

- Mobilize additional co-finance sources. Co-finance is crucial for demonstrating ownership on the selected measure and to ensure long term sustainability of the proposed activities. Only if the level of co-financing is seen as sufficient will climate finance institutions be willing to finance projects. Different sources of co-finance should be explored in more details such as mobilizing private foundations that are active in the climate change field. Another option would be the identification of appropriate structure to facilitate private participation, such as Public-Private Partnerships (PPP). As resources are limited, especially when it comes to climate finance, it will be key to understand if there is the risk of hard competition for resources amongst countries and also between measures within one country.
- Advocate for stronger availability of adaptation finance. GoR should advocate at the international level for an increased availability of resources for adaptation activities, given the importance of adaptation for countries like Rwanda that are severely exposed to the adverse consequences of climate change. This involves preparation of submissions to relevant UNFCCC bodies on specific topics to build momentum.
- Linking CDM PoAs, NAMAs and the NDC. The hydro power PoA no. 9847, or the cookstoves PoAs. no. 9672, no. 7247 no. 9596 and no. 7014 allow quick inclusion of NDC-related activities in a certification scheme managed by the UNFCCC. Existence of well-established MRV procedures under the CDM and the third party verification ensure that emission reductions are accounted in a transparent manner. Where possible, utilization of the SB reduces costs. In a similar way, NAMAs can serve as a platform for attracting multiple sources of financing, including international and domestic ones. CERs can be used as a proof of operation for the underlying activity and financiers would be disbursing money only once results are delivered on a results-based financing approach. Another option is the use of CERs for the achievement of the NDC targets through voluntary cancellation to avoid double counting. The existence of a large portfolio of methodologies and also SBs allow the utilization of the CDM activities beyond pure offsetting but providing a new approach that could be appealing for potential donors.
- Increase inter-ministerial coordination in order to ensure that institutional activities are developed taking into account different views from different ministries and priorities are aligned. This is particularly important for cross-sectoral measures with overlapping ministerial responsibilities such as integrated water resource management (IWRM). Strong inter-ministerial coordination avoids parallel structures in different ministry that

fulfil the same purpose and increases the capacity available in planning of new policies and measures and identification of gaps. Coordination could be facilitated by the NDC implementation unit.

- Definition of a national climate change policy. Currently there is no national climate change policy in Rwanda. Although climate change is considered in different documents there is no stand-alone policy. It is rather included in other policy documents such as those related to development or environment. Definition of a dedicated climate change policy would help address the previous recommendation on inter-ministerial coordination, as institutional actors would have a clearer framework for their climate change related actions, including roles and responsibilities. It would also express and reinforce the importance of climate change for Rwanda and its effort to implement mitigation and adaptation measures.
- Harmonization of existing and definition of new MRV procedures for different sectors. Responsibility for monitoring the outcomes of the activities should lie with the respective line ministries (or their subordinate agencies). Progresses towards mitigation and adaptation goals should be tracked systematically and it is important to ensure comparability and transparency of the data collected. This would allow GoR to have full overview of the status of the different activities and also at a more aggregate level (e.g. at sectoral level). Technology development is an important factor to be considered, as it facilitates MRV tasks, especially for those activities that traditionally faced barriers, such as forestry projects or those activities with large number of devices deployed in remote areas (e.g. cookstoves or solar lighting). This should be combined with institutional capacity building to actually implement MRV. MRV however refers also to monitoring of the financial flows. Responsibility for MRV of international financial flows should lie with MINECOFIN, supported by FONERWA and REMA. Reporting should be coordinated through REMA. Monitoring financial flows is necessary to enhance transparency in fund allocation and use, to help accessing sources of international finance in the future. Sufficient resources and expertise should be allocated to this activity.
- Active participation in the shaping of Paris Mechanisms rules to ensure interests of LDCs, such as Rwanda, are considered in the international negotiation process, including stringent rules to avoid double counting and ensuring environmental integrity. Given the potential of the CDM portfolio in Rwanda, it is recommended to support the transition of the CDM into the PA. This would build investors' confidence for future mechanisms and safeguard existing mitigation investments. At the same time Rwanda should identify pilot projects of Article 6 mechanisms that create experiences and readiness for implementation. Beyond the PA, GoR should actively participate in relevant activities currently being developed. This is the case of the development of the airline offset emission scheme CORSIA: it should be followed closely as this is an opportunity to generate demand for emission reduction certificates from projects in Rwanda. Making

use of the negotiation fora will give visibility to Rwanda's progress towards its NDC implementation and the selected financing approaches for mitigation and adaptation activities.

- Participation in the evolution of GCF procedures. Rwanda should participate actively in the definition of the operational rules of the GCF, including advocating for simplified access modalities, especially for NDCs. In general, participation in this process would allow Rwanda to bring to the negotiation table issues that are specific to LDCs and in particular from Sub-Saharan Africa. Developing relationships with other parties will increase exposure and effectiveness of Rwanda's participation.
- Evaluation and introduction of "no regrets" policy instruments. No-regret options are those options whose implementation is cost efficient and not accompanied by hard trade-offs. One example would be the introduction of a vehicle's import tax or a building standard. These activities do not require extensive initial investments for the preparation of the new policy instrument (resources will, however, be needed to monitor enforcement over time) but the impacts can be significant for one sector.

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