



Republic of Rwanda

# Green Growth and Climate Resilience

National Strategy for Climate Change and Low Carbon Development

Kigali

October 2011



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*The Rwanda National Strategy on Climate Change and Low Carbon Development was developed over a period of nine months, from November 2010 to July 2011, as a collaborative effort between the Government of Rwanda, the Smith School of Enterprise and Environment (SSEE) at the University of Oxford, and the donor institutes UK DFID-Rwanda and the Climate and Development Knowledge Network (CDKN). The Principal Investigator was Professor Sir David King and the Programme Manager was Megan Cole, from SSEE. The project was coordinated by the Ministry of Natural Resources (MINIRENA), and was directed through a Steering Committee consisting of ten Cabinet Ministers from the following ministries: Disaster Management (MIDIMAR), Agriculture and Animal Resources (MINAGRI), Trade and Industry (MINICOM), Finance and Economic Planning (MINECOFIN), Education (MINEDUC), Infrastructure (MININFRA), Natural Resources (MINIRENA), Local Government (MINALOC) and Health (MOH).*

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## Executive Summary



Rwanda has seen significant economic development in recent years. Long-term vision, good governance and economic growth have made it attractive to foreign investors and ecotourism has taken off. Agricultural production has doubled since 2007, improving food security, mining has been privatised and contributes 38% of export earnings, and industry and services are expanding, providing off-farm jobs for the growing population. Development is supported by increasing access to electricity, now at 10.5%, and 2,300km of fibre optic cables recently laid across the country. Parliament has the highest percentage (60%) of women in the world and over 95% of children enrolled in primary school in 2009. Six years after joining the East Africa Community, Rwanda is contributing to development in the region.

But Rwanda's future socio-economic development is uncertain as its population grows and the climate changes, causing pressure on land, water, food and energy resources. Rwanda has the highest population density in Africa, and the population is growing at 2.8% per year. It is predicted that the population will more than double from 11 million today to 26 million by 2050, with a population density of 987 people per square kilometre<sup>[1]</sup>. Urbanisation is increasing, at 4.4% per year, with over 1 million people living in the capital city, Kigali. As pressure on the land increases, urbanisation will increase and urban centres will expand. If this urbanisation is properly managed and coupled with industry and services, it can be an instrument for wealth creation. Alternatively, there is a risk of urban slums developing and creating associated health and social problems. Job creation, education, health care and social protection are all needed to address population growth, while urban areas must be high density and resource efficient to support a growing skilled workforce.

Rwanda is currently highly vulnerable to climate change as it is strongly reliant on rain-fed agriculture both for rural livelihoods and exports of tea and coffee. It also depends on hydropower for half of its electricity generation, a driver of economic growth. Rwanda has experienced a temperature increase of 1.4°C since 1970, higher than the global average, and can expect an increase in temperature of up to 2.5°C by the 2050s from 1970. Rainfall is highly variable in Rwanda but average annual rainfall may increase by up to 20% by the 2050s from 1970. Projections for East Africa over Rwanda and Burundi show an increasing trend in rainfall intensity for both rainy seasons <sup>[2]</sup> which is likely to cause floods and storms which can result in landslides, crop losses, health risks and damage to infrastructure. Temperature rise may increase the spread of vector-borne diseases, air-borne and water-borne diseases, impacting on animal and human health, and could negatively affect crop yields, impacting food security and export earnings. Higher temperatures result in higher altitudes at which tea and coffee can be grown, which may significantly impact the land available for tea and coffee, and may result in land use conflict. Extreme weather already negatively impacts the economy and climate change could result in annual economic costs of just under 1% GDP by 2030 <sup>[3]</sup>.

Rwanda imports all of its oil-based products, which fuels 39% of Rwanda's electricity generation capacity, and its entire transport sector. As a landlocked country in equatorial Africa, transport is limited to road and air, and import and export costs are very high. Any increase in oil price has a significant negative effect on GDP and economic growth. Rwanda is fortunate in that it has large untapped clean energy resources in geothermal, hydro and solar, as well as a >300MW methane gas resource in Lake Kivu and multiple peat deposits. Together these have the potential to exceed Rwanda's electricity needs by 2020 and replace oil-fuelled power plants. This would provide domestic energy security, reduce greenhouse gas (GHG) emissions and be a major economic stimulus as payments abroad for oil are replaced by local expenditure for energy production and other development needs. Replacing chemical fertiliser imports with local alternatives has similar benefits. The challenge Rwanda faces lies in financing the exploitation of these energy resources.

Rwanda has one of the lowest emissions per capita in the world, estimated at 0.4 tCO<sub>2</sub>e/person, compared to a global average of 6.7 tCO<sub>2</sub>e/person, including land use change, in 2005 <sup>[4]</sup>. The baseline GHG emissions from 2005 used in the preparation of the Second National Communication to the UNFCCC set aggregate emissions or total CO<sub>2</sub> equivalent, amounting to 5,010Gg, dominated by agriculture and energy. Four key sources contributed 91% of aggregate emissions: N<sub>2</sub>O from agricultural soils (57%), CH<sub>4</sub> from enteric fermentation in domestic livestock (19%), CH<sub>4</sub> from residential energy from fuel combustion (8%) and CO<sub>2</sub> from road vehicles (5%). CO<sub>2</sub> emissions are mostly from transport and industrial processes though forest sequestration made Rwanda a net carbon sink in 2005. There are uncertainties in the GHG inventory however, due to inadequate representation, lack of basic data and application of emissions factors for different conditions.

Vision 2020 aims to transform Rwanda from a subsistence agriculture economy to a knowledge-based society earning 900 USD per capita, making Rwanda a middle income country by 2020. The Economic Development and Poverty Reduction Strategy (EDPRS) is the framework for achieving Vision 2020 and the Millennium Development Goals (MDGs). In order for Rwanda to tackle climate change, it needs to be mainstreamed into Vision 2020, EDPRS and Sector strategies. This Strategy aims to guide the process of mainstreaming climate resilience and low carbon development into key sectors of the economy. It provides a strategic framework (Figure 1) which includes a vision for 2050, guiding principles, strategic objectives, programmes of action, enabling pillars and a roadmap for implementation. Each Programme of Action has three to five focussed actions with a number of sub-actions. These are summarised at the end of the Strategy and detailed in the Sector Working Papers in Appendix B.

A vision for 2050 envisages Rwanda as a developed country, with a strong services sector, low unemployment and low levels of poverty. It is a country where agriculture and industry have a minimal negative impact on the environment, operating in a sustainable way, and enabling Rwanda to be self-sufficient regarding basic necessities. By 2050, development will be achieved with low carbon domestic energy resources and practices, reducing Rwanda's contribution to climate change while allowing it to be independent of imported oil for power generation. Finally, Rwanda will have the robust local and regional knowledge to be able to respond and adapt to changes in the climate and the resulting impacts, supporting other African countries as a regional services hub to do the same.

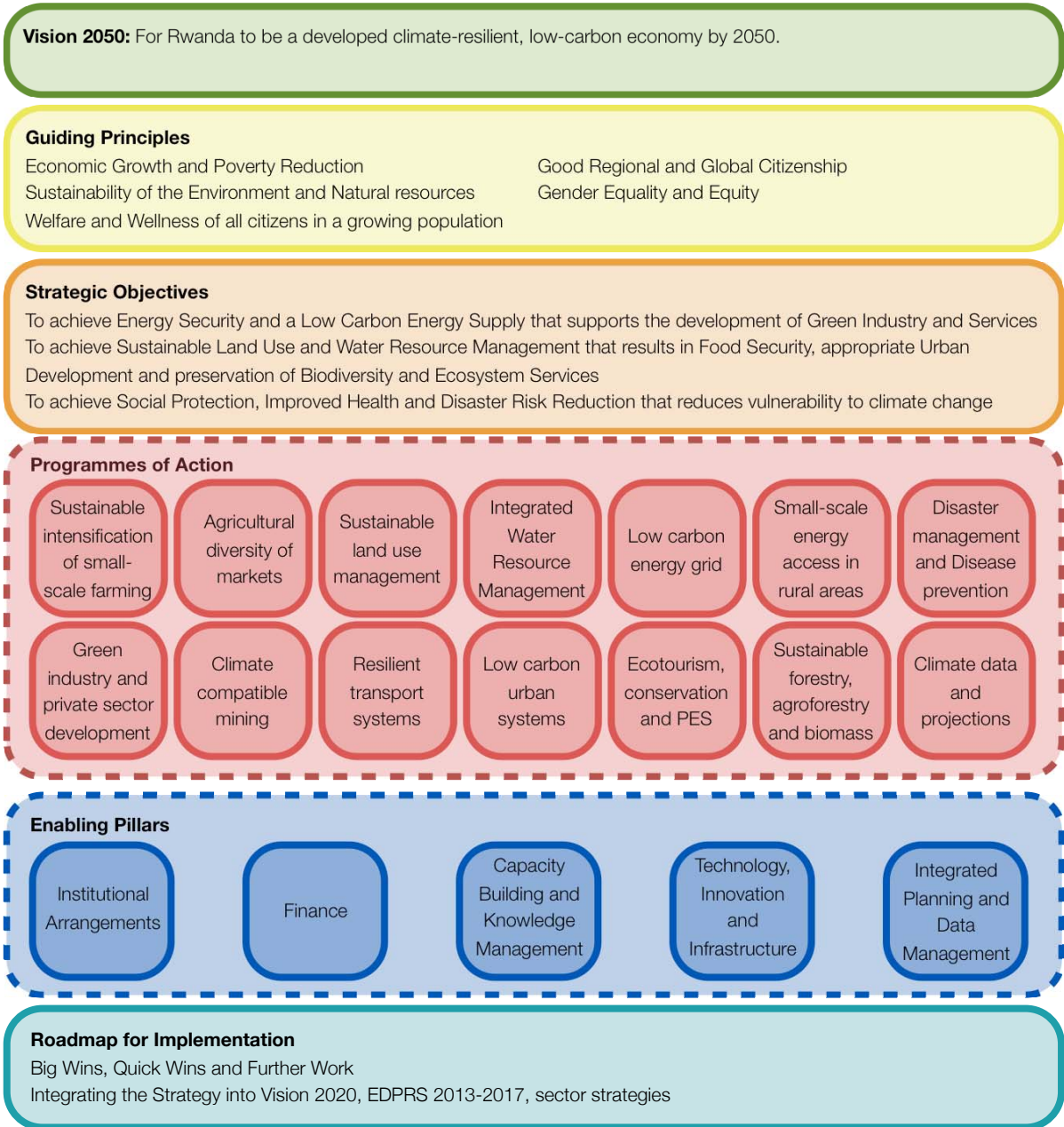


Figure 1: Strategic Framework for Rwanda's National Strategy on Climate Change and Low Carbon Development

### Big Wins

Amongst all the planned actions in this Strategy, there are a few 'big wins' that if implemented, will make a significant impact on adaptation, mitigation and economic development. These are likely to produce the greatest return on investment for Rwanda as they impact the whole economy in the long term. More details regarding each 'big win' are found in the Sector Working Papers in Appendix B. They have been split into low carbon development/mitigation and climate resilience/adaptation though there are synergies between them.

As the three largest sources of GHG emissions, agriculture, energy and transport are all addressed in the mitigation 'big wins', which will enable low carbon development, increasing food and energy security, reducing vulnerability to oil price spikes and reducing payments abroad.

## Low Carbon Development / Mitigation

- 1. Geothermal power generation:** Geothermal power is a clean, renewable, reliable and large-scale energy resource. There is an estimated potential of up to 700MW of geothermal power in Rwanda and this would exceed domestic electricity demand by 2020 if implemented. It uses known technology and could produce electricity at four times less the cost of diesel generated electricity currently in use in Rwanda. It could replace oil-fuelled power plants which currently supply 38MW of electricity and result in high GHG emissions and are vulnerable to oil price spikes. Geothermal power has near zero emissions, making it eligible for carbon credits. It is a domestic resource, not shared with neighbouring countries like methane in Lake Kivu and hydropower on the Rusizi and Akagera Rivers, and has relatively small land use impact, unlike peat. Geothermal energy, together with other renewable energy sources, will provide energy security, reduce energy costs and vulnerability to external economic shocks and ultimately promote economic development.
- 2. Integrated soil fertility management:** The crop intensification programme in Rwanda currently uses inorganic fertiliser to increase crop yields. These imported fertilisers produce a significant proportion of Rwanda's GHG emissions through soil nitrous oxide (N<sub>2</sub>O) emissions but also through the fertiliser manufacturing process and transportation. Demand for inorganic fertilisers can be reduced by applying an integrated approach to soil fertility and nutrient management, which employs agroecology, resource recovery and reuse, and fertiliser enriched composts. An integrated approach will significantly lower inorganic fertiliser demand, reduce dependence on oil, reduce GHG emissions and increase farm profitability due to reduced input costs for farmers. This will contribute to reducing vulnerability to external shocks. Such approaches also improve soil structure and the water retention capacity of soils leading to climate resilient agricultural ecosystems and sustainable food security.
- 3. High density walkable cities:** The growing population and increasing urbanisation will result in an increase in urban area in Rwanda. If this is not achieved in a high density manner, Rwanda will face unprecedented levels of urban sprawl, partly due to hilly terrain. This forces people to travel greater distances than necessary, with motorised transport resulting in GHG emissions and air pollution. Designing high density cities with corridors for pedestrians and cyclists and green public spaces, would reduce the need for energy intensive transport, improve quality of life and reduce the risk of flooding. Not only will this reduce GHG emissions and oil dependency, but also reduce the burden of transport costs to citizens. It also has adaptation benefits, as reduced urban sprawl limits the development of housing on steep slopes which are vulnerable to flooding and landslides.

## Climate Resilience / Adaptation

- 1. Irrigation infrastructure:** Rwanda has high annual rainfall which it has traditionally been able to exploit for seasonal agriculture. However, seasonal agriculture is vulnerable to climate change and population pressure, as even slight changes in rainfall patterns can have significant impacts on crop and livestock production. The uncertainty in the timing of wet seasons makes it difficult for farmers to know when to plant and to harvest to produce a good crop. Irrigation infrastructure gives farmers more control of the water resource and reduces the vulnerability to changing rainfall

patterns. It also allows for diversification of crops, such as rice, contributes to efficient land and water usage, and provides water to dry areas. Irrigation infrastructure forms a crucial component of Integrated Water Resource Management as improved watershed management allows for increased water supply and efficiency in other sectors, while also reducing disaster risks through the mitigation of floods and landslides.

2. **Robust road network:** Rwanda, at 0.56km/km<sup>2</sup>, has one of the densest road networks in Africa. As the dominant mode of transportation, all sectors – agriculture, mining, industry and services – and therefore the economy relies on this road network. These roads vary in quality, from tarmac highways to dirt tracks. The poor quality roads have a detrimental effect on the economy, contributing to a large proportion of food produce being lost during transit to market. The majority of the network is also unprepared for current weather events, let alone future variations due to climate change. Thus the entire economy is vulnerable to the effects of climate change. Building and maintaining the roads in a way that is not only suitable for the value of the route, but also resilient to more extreme weather events, will reduce Rwanda's vulnerability and promote economic development, particularly in rural areas.
3. **Centre for Climate Knowledge for Development:** Rwanda is located in equatorial Africa, which lacks sufficient data to produce robust climate projections. Although temperature will rise, the level of increase is uncertain. Future rainfall patterns are even more uncertain, as annual rainfall could increase or decrease and rainfall intensity may increase. This uncertainty makes it very difficult to plan for future adaptation in Rwanda, which is particularly important for agriculture, water resource management, disaster management and land use planning. A Centre for Climate Knowledge for Development, working with the Rwanda Meteorological Service and research institutions, will contribute significantly to improving climate data and projections and translating them into policy options for decision makers to guide the country onto a climate resilient development path. This is explained more fully in the report of the same name in Appendix F.
4. **Agroforestry:** Rwanda does not have the land available to expand its forests and plantations, yet the majority of the population depends on wood for cooking and will continue to do so until electricity is available and affordable for all. Agroforestry will provide wood for fuel and social protection while avoiding deforestation. Different tree species will be used in agroforestry to provide construction materials as well as livestock fodder and food (fruit and nuts) which improve food security. Agroforestry has multiple additional benefits, namely reduced soil erosion and increased resilience to heavy rains through improved slope stability; water management and nutrient recycling which improve agricultural production; and carbon sequestration. Agroforestry in Rwanda will be guided by latest best practices and research, such as those developed by the World Agroforestry Centre (ICRAF).

## Quick Wins

The big wins are large scale economy-wide programmes that will take years to be fully implemented. There are a number of immediate 'quick wins' that can be implemented to begin addressing the Enabling Pillars. They focus on mainstreaming climate resilience and low carbon development into initiatives that are currently underway.

1. **Institutional Framework:** Use the Integrated Development Programme (IDP) to facilitate implementation of climate resilient low carbon development in rural areas, incorporating the Vision 2020 Umurenge Programme. Sectors are already working together to improve development in

rural areas and the Rural Development Task Force can be used to incorporate climate resilience into the IDP.

2. **Finance:** Operationalise the National Fund for Climate and Environment (FONERWA) to facilitate access to international climate finance, especially Fast Start Finance for adaptation. Capacity and finance will be required to make it operational and start channeling climate finance into implementation planning.
3. **Integrated Planning and Data Management:** Implement regular measuring and reporting of energy use across sectors to develop a GHG emissions profile and future energy requirements. More accurate knowledge of energy demands will enable better short and long term planning of energy resource management. This will also support applications for climate finance which require that GHG emissions are Measurable, Reportable and Verifiable (MRV).
4. **Capacity Building:** Review and expand Technical and Vocational Educational and Training (TVET) to develop skills needed for the Strategy implementation. The Workforce Development Agency has proposed a TVET qualifications framework which will facilitate the development of new qualifications in areas such as renewable energy, agroforestry and irrigation.
5. **Knowledge Management:** Set up an online Climate Portal to communicate the National Strategy to the public and international community, thereby raising awareness and facilitating knowledge sharing. This has been done successfully by India and South Korea and is particularly important for adaptation as all Rwandans need to take steps to become climate resilient.
6. **Technology:** Use the Strategy to complete the UNEP Technology Needs Assessment already underway to speed up technology transfer for key sectors of the economy, particularly energy, water and agriculture.
7. **Infrastructure:** Implement resource efficient design in the Special Economic Zone (SEZ) in Kigali which is in the first stage of construction. This will include energy efficiency lighting, energy and water metering, wastewater recycling and recycling of other waste products. The SEZ guarantees reliable electricity supply to businesses, and this should be generated from renewable energy sources.

## Financing the Strategy

The two biggest constraints to Rwanda achieving Vision 2050 are human capacity and access to finance. There are many sources of finance that can be used to implement the Strategy. Rwanda has yet to fully exploit climate finance opportunities that exist, and these opportunities will increase substantially over the next decade. Fast start finance for adaptation and mitigation in LDCs and the new Green Climate Fund may provide significant funds but cannot be relied upon. In Appendix H, a Climate Finance Toolkit is provided to enable government ministries to source and access finance for climate resilience and low carbon development activities from numerous funds. Though significant, the international climate funding flowing into Rwanda will not be sufficient to finance the Strategy. Thus, it will be crucial for the government to secure domestic sources of revenue and leverage private capital for low carbon and adaptation activities. FONERWA will be the centrepiece of Rwanda's climate financing plan, attracting and streamlining climate finance with the Strategy, and leveraging private investment for low carbon initiatives. The Clean Development Mechanism and voluntary carbon markets offer a potential source of revenue for public and private mitigation initiatives. Estimates of potential carbon revenues for hydroelectric dams, geothermal power plants, efficient cookstoves and organic waste management are detailed in the Finance Sector Working Paper in Appendix B.



## Roadmap to Implementation

This Strategy is the first attempt at plotting a climate resilient and low carbon development pathway for Rwanda. It is the start of a continuous process which is described in the Enabling Pillars and it will be implemented through the Programmes of Action. The next step is to set up and operationalise the institutional arrangements, namely the Technical Coordinating Committee, the National Fund for Climate and Environment (FONERWA), and the Centre for Climate Knowledge for Development (CCKD). These institutions will utilise the Sector Wide Approach and work closely with development partners, civil society, academia and the private sector. The Technical Coordinating Committee will facilitate the incorporation of the Strategy into Vision 2020, EDPRS II and sector policies. Further work is then required to perform cost-benefit analysis on the Programmes of Actions and apply for climate finance. This will inform the revision of detailed sector strategies and annual budgets. In parallel, short term capacity building programmes will be initiated and work done to develop a long term plan to provide the support required to implement the Strategy. The Roadmap to Implementation is shown in figure 2 below.

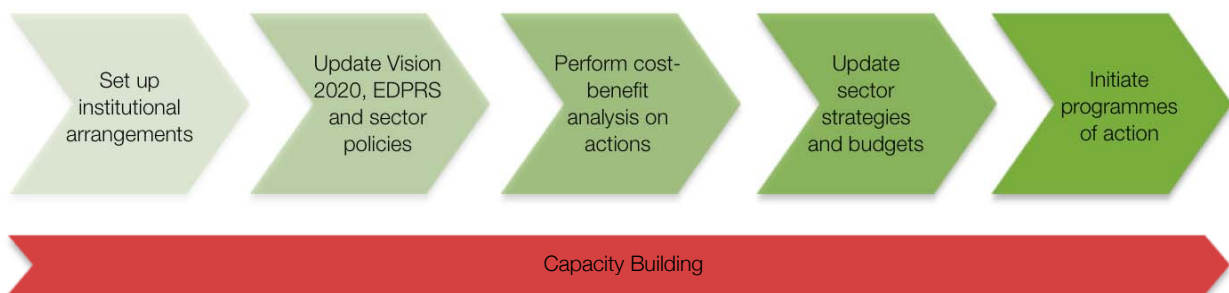


Figure 2: Roadmap to implementation

Through this Strategy, Rwanda has taken a big step towards achieving socio-economic development that is resilient to economic, social and environmental shocks related to population growth, oil price and climate change. Rwanda is choosing to leapfrog the detrimental development pathways of the past and take the opportunities that technology transfer and climate finance offer. Adaptation to climate change is crucial if Rwanda is to maintain its economic growth in the future. A greater understanding of how the climate will change will facilitate adaptation planning in the coming years, however 'no regret' measures such as natural resource management, expanding irrigation infrastructure and agroforestry can begin to address adaptation in the short term. Reducing dependence on oil by investing in domestic energy resources and using alternatives to chemical fertiliser will provide major stimulus for the economy and create off-farm jobs, while also reducing the national carbon footprint. Rwanda has made much progress in the past decade, but aspires to achieve even more.



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## Acronyms and Abbreviations



ACMAD	African Centre of Meteorological Applications for Development	EWS	Early Warning System
AMCEN	African Ministerial Conference on the Environment	EWSA	Energy, Water and Sanitation Authority
AMSL	Above Mean Sea Level	FONERWA	National Fund for Climate and Environment in Rwanda
BAU	Business as Usual	FSF	Fast Start Funding
CBA	Cost-Benefit Analysis	GCM	General Circulation Model
CCKD	Centre for Climate Knowledge for Development	GDP	Gross Domestic Product
CDC	Community Development Committee	GEF	Global Environment Facility
CDKN	Climate and Development Knowledge Network	GHG	greenhouse gas
CDM	Clean Development Mechanism	GIS	Geographic Information System
CIC	Climate Innovation Centre	GoR	Government of Rwanda
CMIP3	Coupled Model Intercomparison Project 3	ICPAC	Prediction and Climate Applications Centre
COF	Climate Outlook Forum	ICRAF	International Centre for Research in Agroforestry
COMESA	Common Market for Eastern and Southern Africa	ICS	Improved Cookstoves
COP	Conference of Parties	ICT	Information and Communications Technology
CPAF	Common Performance Assessment Framework	IDP	Integrated Development Programme
CTCN	Climate Technology and Technical Network	IEA	International Energy Agency
DDP	District Development Plans	IGAD	Inter-governmental Authority on Development
DFID	UK Department for International Development	IGF	Inter-governmental Forum for Mining, Minerals, Metals and Sustainable Development
DRR	Disaster Risk Reduction	IPCC	Inter-governmental Panel on Climate Change
DNA	Designation National Authority	IRDA	Industrial Research and Development Agency
EAC	East African Community	IRST	Institute of Scientific and Technological Research
EDPRS	Economic Development and Poverty Reduction Strategy	ISAR	Rwanda Agricultural Research Institute
EIA	Environmental Impact Assessment	IWRM	Integrated Water Resources Management
EID	Enhanced Infectious Disease		

JADF	Joint Action Development Forum	RRA	Rwanda Revenue Authority
KIST	Kigali Institute for Science and Technology	RRECPC	Rwanda Resource Efficient and Cleaner Production Centre
kWh	kilowatt hours		
LAMA	Locally Appropriate Mitigation Action	RMS	Rwanda Meteorological Service
LAPA	Locally Appropriate Plans of Action	RNRA	Rwanda Natural Resources Authority
LDC	Least Developed Country	RTDA	Rwandan Transport Development Agency
LGCF	Local Government Consultative Forum	RURA	Rwanda Utility Regulatory Agency
MDG	Millennium Development Goals	RWF	Rwandan Franc
MIDIMAR	Ministry of Disaster Management and Refugee Affairs	SEZ	Special Economic Zone
MIGEPROF	Ministry of Gender and Family Promotion	SMEs	Small and Medium Enterprises
MINAGRI	Ministry of Agriculture and Animal Resources	SNC	Second National Communication
MINALOC	Ministry of Local Government and Social Affaires	SSEE	Smith School of Enterprise and the Environment
MINEDUC	Ministry of Education	SWAp	Sector Wide Approach
MINECOFIN	Ministry of Finance and Economic Planning	SWG	Sector Working Group
MINICOM	Ministry of Trade and Industry	SWP	Sector Working Paper
MININFRA	Ministry of Infrastructure	TEC	Technology Executive Committee
MINIRENA	Ministry of Natural Resources	TVET	Rwanda's Technical and Vocational Education and Training Policy
MOH	Ministry of Health	UNCCD	United Nations Convention to Combat Desertification
MRV	Measurable, Reportable and Verifiable	UNEP	United Nations Environment Program
MW	megawatts	UNFCCC	United Nations Framework on Climate Change Convention
NAMA	Nationally Appropriate Mitigation Actions	UNIDO	United Nations Industrial Development Organisation
NAPA	National Adaptation Programme of Action	USD	United States Dollar
NIE	National Implementing Entity	V11	11 most climate change vulnerable countries
NISR	National Institute of Statistics of Rwanda	VAT	Value Added Tax
NLUDMP	National Land Use and Development Master Plan	VUP	Vision 2020 Umurenge Programme
NUR	National University of Rwanda	WBCSD	World Business Council on Sustainable Development
PEI	Poverty Environment Initiative	WCRP	World Climate Research Programme
PES	Payment for Ecosystem Services	WDA	Rwandan Workforce Development Authority
PSF	Private Sector Federation		
RDB	Rwanda Development Board		
REMA	Rwanda Environmental Management Authority		
RHA	Rwanda Housing Authority		

## Definition of Key Terms



**Climate change** is a change in climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods. (UNFCCC)

The following working definitions have been used in this Strategy and are taken directly from DFID documentation.

“Climate change is a new and constantly evolving agenda. There is continuing discussion between stakeholders, not least within the international negotiations, as to what is really meant by terms like adaptation and mitigation.

**Adaptation** can be used to refer to additional activities needed to prepare for climate change. This typically involves specific interventions (larger storm drains or new crop varieties) but can also involve broader social or economic strategies (e.g. migration to urban centres could be an adaptation strategy in some contexts).

**Climate resilience** can be used to describe a broader agenda than adaptation as defined above. It captures activities which build the ability to deal with climate variability – both today and in the future. Climate resilience building activities include many existing development investments including those in the agriculture, food security, health, land management and infrastructure sectors.

**Mitigation** refers to efforts to limit or absorb gas emissions which contribute to climate change. Emissions can be limited by moving away from dirty fossil fuels (i.e. wind power) or by being more efficient when using energy (reducing consumption). Greenhouse gases can also be removed from the atmosphere by plants (called carbon sequestration). One way of managing the deployment of mitigatory activities is through an international carbon market.

**Low carbon development** is distinct from mitigation. Mitigation is about cutting emissions. Low carbon development reframes this challenge and argues that in some cases, the low carbon option is also the best development option for low income countries.”

Climate resilience and low carbon development can be combined into the term '**climate compatible development**' and illustrated with the figure below, courtesy of CDKN.

**Green growth** is an emerging concept that recognises that environmental protection is a driver of global and national economic development. It refocuses society on achieving qualitative growth rather than simply increasing GDP.

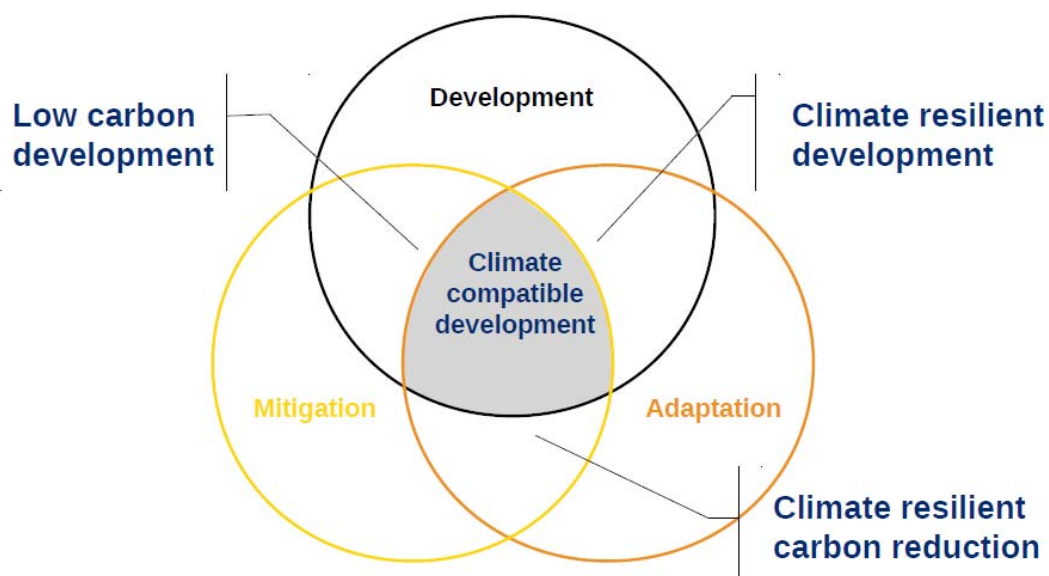


Figure 3: Climate compatible development



## Introduction



Rwanda is a country with great potential and opportunities. Its government is committed to combating one of the greatest challenges of our time, climate change, a decision that will benefit the whole of Rwandan society. This strategy is one of the initial steps on a pathway which leads to a sustainable, secure future where Rwanda is prepared for the risks associated with climate change, population growth and rising oil prices. The 'National Strategy for Climate Change and Low Carbon Development' aims to build upon work that is already being done in Rwanda on climate change, focusing the various projects and policies into a holistic national document which encompasses long-term direction and short-term actions.

Rwanda has been committed to addressing the challenge of climate change since 1998 when it ratified the United Nations Framework Convention on Climate Change (UNFCCC) and later the Kyoto Protocol in 2003. Rwanda submitted its Initial National Communication to the UNFCCC in 2005, National Adaptation Programmes of Action (NAPA) in 2006, and will soon submit its Second National Communication, which includes a report 'Evaluation of GHG Mitigation Options'. In 2009 a Climate Change Unit was set up within the Rwanda Environmental Management Authority (REMA), overseeing the Designated National Authority (DNA) to coordinate carbon market activities, and a study was done on the Economics of Climate Change for Rwanda. In 2010 the application was submitted for a Rwanda National Implementing Authority (NIE) to access international resources under the UNFCCC's Adaptation Fund. As a Partner State to the East African Community (EAC), Rwanda contributed to the EAC Climate Change Policy in 2010 and EAC Climate Change Strategy in 2011.

As a Least Developed Country (LDC), Rwanda has priority status for adaptation and is not required to take action to reduce its greenhouse gas (GHG) emissions. However, Rwanda has emerged at the forefront with like-minded countries to push for action in the international climate negotiations. It is a member of the Climate Vulnerable Forum (V11) and the Cartagena Dialogue group.

The focus thus far has been on adaptation as Rwanda is highly vulnerable to climate change due to its dependence on rain-fed agriculture. However the focus is shifting to climate resilience and low carbon development which addresses both adaptation and mitigation, whilst focusing on sustainable economic growth and poverty reduction. Rwanda has the opportunity to leapfrog old technologies and destructive development pathways, and build a green economy, resilient to oil prices spikes and a changing climate.

'Vision 2020' describes Rwanda's aspirations for achieving economic development and poverty reduction and is supported by EDPRS, the framework for implementation from 2008 to 2012. This Strategy however, looks beyond 2020 to 2050, and recommends actions that Rwanda can take in the short to medium term to ensure its future stability and prosperity in a changing climate and uncertain energy future.

The purpose of the Strategy is threefold:

1. To guide national policy and planning in an integrated way,
2. To mainstream climate change into all sectors of the economy, and
3. To position Rwanda to access international funding to achieve climate resilience and low carbon development.

The Strategy calls upon national planners to chart a new development pathway for integrated sector planning that balances cross-cutting issues of resource management. The Strategy is the first step in a continuous process, geared to set Rwanda on a course to identify, describe and monitor its current and future vulnerabilities, and take self-determined actions towards building a robust economy.

## 1.1 Methodology

The Rwanda National Strategy on Climate Change and Low Carbon Development was developed over a period of nine months, from November 2010 to July 2011, as a collaborative effort between the Government of Rwanda, the Smith School of Enterprise and Environment (SSEE) at the University of Oxford, and the development partners, DFID-Rwanda and the Climate and Development Knowledge Network (CDKN). The project was coordinated by the Ministry of Natural Resources (MINIRENA), and was directed through a Steering Committee consisting of ten Cabinet Ministers from the following ministries: Disaster Management (MIDIMAR), Agriculture and Animal Resources (MINAGRI), Trade and Industry (MINICOM), Finance and Economic Planning (MINECOFIN), Education (MINEDUC), Infrastructure (MININFRA), Natural Resources (MINIRENA), Local Government (MINALOC) and Health (MOH).

The Strategy development had five phases shown in Figure 4, though stakeholder engagement was a core component throughout the project. Before the project commenced in November, a two-month inception phase enabled the research team coordinator to engage with the relevant government Ministers in Kigali to gain their support and guidance. In November, SSEE appointed eight researchers to cover ten key sectors – agriculture, built environment, energy, finance, forestry, land, mining, industry, transport and water. Researchers were allocated desk space in relevant ministries to facilitate stakeholder engagement, and were supported by a team of 12 expert advisors based in or near Oxford. In each ministry, a counterpart was appointed to work in direct collaboration with the respective SSEE researcher.

Further assistance was provided through the recruitment of four interns, who undertook web-based learning, data collection, analysis, report writing, translation, site visits and interviews. Reports done by the interns are included in Appendix G and address Private Sector Investment in Green Technologies, a Proposed Energy Research Centre and Rural Impacts of Climate Change and Low Carbon Development in Rwanda: Transforming Rural Livelihoods and Energy Use.

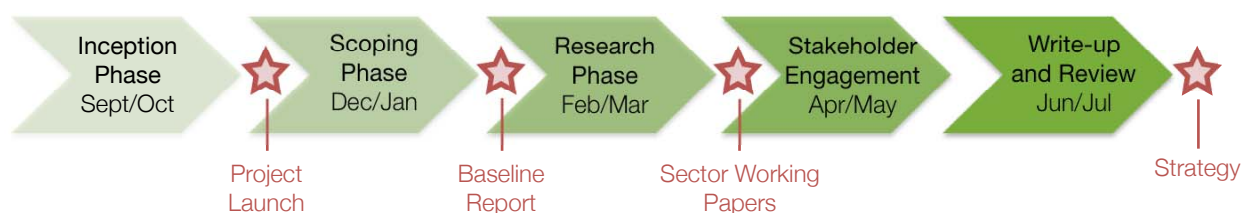


Figure 4: Project timeline and deliverables

The project was launched on 25 November 2010 by the Steering Committee, followed by a stakeholder workshop with 88 people representing government, academia, private sector, development partners and civil society.

## Baseline Scoping

The next phase consisted of baseline scoping and the production of a Baseline Report (Appendix A) which consisted of a comprehensive review of the current status of each sector and all the ministry policies and strategies. The Baseline Report also reviewed climate policy, adaptation and mitigation actions and economics. Baseline scoping was conducted in country by the SSEE research team drawing on a range of data collection tools including key stakeholder interviews, site visits and review of a range of secondary data sources including government policies and reports, academic literature, and grey literature consisting of media reports, technical briefs and project evaluations. Once finalised, the Baseline Report was used to identify key areas for further investigation through the production of the Sector Working Papers, which formed the main conduit for stakeholder engagement.

## Sector Working Papers and Reports

Nine Sector Working Papers (SWPs) were produced for the identified key sectors (Appendix B). A working paper was not proposed for Industry as UNEP were finalising their report 'Mainstreaming resource efficient and cleaner production into Rwanda's policies and strategies'. Education was incorporated into each SWP and an expert review instead of a SWP on Health was produced. A 'thinkpiece' was written in parallel to provide the foundation for the Strategy. The SWPs reviewed vulnerabilities and opportunities for climate compatible development; identified focus areas for further analysis; identified international best practice and case studies applicable to Rwanda; and analysed and presented options for implementation. Each working paper developed an action plan with suggested policies and actions, their timelines, responsible Ministries, key indicators and sources of finance. They were then used to facilitate stakeholder engagement in Rwanda with government, civil society, private sector, academia and development partners. They contain the justification and the details for each of the programmes of action in the Strategy.

## Stakeholder Engagement

Following the production of the Sector Working Papers, the research team entered a period of focused stakeholder engagement. Before this consultation process started the SWPs were distributed to the respective ministries, and subsequently to other key stakeholders for input and critical feedback. During the period of stakeholder engagement, the contents of the working papers were presented in a sector-based working committee meetings held at the ministry level, which allowed for further feedback from participants, which included representations from non-governmental organisations, donor groups, private sector and research institutes. Feedback for the working papers was also obtained from DIFD-Rwanda, CDKN and the SSEE expert advisors. From the stakeholder engagement process a number of programmes of action were developed which form a core component of the Strategy. These programmes underwent a further review and approval process to be refined and ensure that they could be implemented.

Over the course of the project, over 450 stakeholders were interviewed, 15 workshops attended and site visits to 20 locations in all provinces were conducted by the research team. This enabled them to understand the Rwandan context and gain ownership from stakeholders.

### **Strategy Write Up and Review**

A draft Strategy underwent a three week review by government counterparts, CDKN and DFID-Rwanda as well as an international panel of eight global experts selected by SSEE. The final Strategy underwent a two month long review by Ministers as well as an independent review to prepare for final approval by Cabinet.

## Rwanda's Development Pathway



### 2.1 Current Resources and Economic Base

Rwanda, known as the “land of a thousand hills”, is a small, fertile country covering some 26,338km<sup>2</sup> of equatorial East Africa. With an altitude ranging from 900m to 4,500m above mean sea level (AMSL), Rwanda has a temperate climate and average annual rainfall of 1,200mm. The Upper Nile Basin occupies 67% of Rwanda and drains 90% of its surface waters, with the remaining 10% draining into the Congo Basin. With 8% natural forest cover, 10% marshlands cover (including cultivated land and peat bogs) and 101 lakes, Rwanda is a biodiversity hotspot, home to more endemic mammals, birds, reptiles and amphibians than any other African country<sup>[4]</sup>.

Rwanda has a young population of 11 million people, growing at 2.8% per year, and is the most densely populated country in Africa. The majority of the population farm small hillside plots in the rural areas, though urbanisation is increasing at 4.4% per year. Currently 20% of people live in urban areas, nearly half of whom live in Kigali. Much effort has been made to improve education, health and family planning over the past decade, and universal access to basic education (MDG2) is nearly a reality, with 2.3 million children attending primary school in 2010, 51% of them girls.

Rwanda is strongly reliant on rain-fed agriculture which contributes 35% of GDP (Figure 5a) and employs 80% of the national workforce. Staple foods include bananas, plantains, cassava, beans, maize, sweet potatoes, wheat, rice and irish potatoes. Tea and coffee exports earned USD 81 million in 2009, 44% of export earnings (Figure 5b). Minor exports include horticulture, pyrethrum, hides and skins. Although Rwanda has the potential to be food secure, variable rainfall patterns and limited irrigation infrastructure, transport and post-harvest storage, often results in food insecurity.

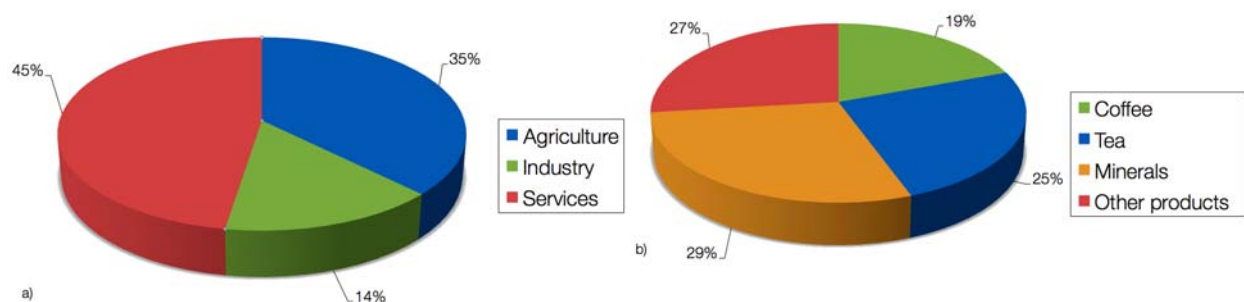


Figure 5: a) GDP\* and b) export revenue# of Rwanda

Data Source: Rwanda Development Board (RDB), data is \*a mean of 2006-2009 and #from 2009

Rwanda hosts deposits of gold, tin, tungsten, coltan and gemstones, though resources and reserves are unknown as minimal exploration drilling has been done. Even though the mining industry is small, it contributed 38% of Rwanda's export earnings in 2010 with USD96.4 million, and has the potential to triple production by 2020. There is also significant potential for value addition and product diversification through processing of domestic and imported ores and manufacturing of construction materials and jewellery, and potential to develop a mining services industry for the country and the region.

Rwanda is landlocked and has limited transport infrastructure, with no rail link to the ocean and few all-weather roads. It is entirely dependent on oil imports which accounted for 16% of total imports by cost in 2010. This results in very high transport charges, accounting for some 40% of costs. Rwanda joined the East African Community (EAC) in 2005 and has since more than doubled trade with EAC partner states to USD600 million in 2010. Rwanda is a net importer in the EAC and is aligning its budget, trade, and immigration policies with its regional partners. Rwanda was admitted to the Commonwealth in 2009.

Rwanda's main energy source is biomass, sourced mainly from on-farm trees and plantations of fast growing eucalyptus trees. Access to electricity is increasing, with 13% of the population currently connected, though this is centred on the capital city, Kigali, and there remains limited access in rural areas. Electricity generation capacity is low at 95MW, dominated by hydropower and oil-fuelled power plants, and domestic electricity prices at USD 0.24/kWh are still high. Rwanda has over 1,000MW potential, from geothermal power, methane gas, peat deposits, biogas, regional hydropower, small scale hydro and solar PV. This would provide enough power to meet energy demand (maximum 400MW by 2020) and allow Rwanda to export electricity.

Industry employs 4% of the national workforce and contributes 14% to GDP, half of which comes from the construction sector, with a target of 26% of GDP by 2020. Manufacturing is dominated by food processing, beverages and tobacco. Micro, small and medium enterprises, both formal and informal, comprise 98% of businesses in Rwanda and 41% of all private sector employment. Services currently contribute 45% to GDP and are dominated by wholesale and retail trade (14%), real estate and business services (10%) and transport and communication (8%). Tourism is one of Rwanda's largest foreign exchange earners, grossing USD207 million in 2010, due largely to gorilla tracking in Volcanoes National Park, and ecotourism in Nyungwe Forest and Akagera National Park.

Rwanda's low tax revenue, narrow export base and limited infrastructure led the Government of Rwanda (GoR) to embark on a programme of mobilising private investments in industry and services. The Information and Communication Technology (ICT) sector is considered a flagship for the country's economic prosperity and a tool for transforming the Rwandan economy. 2,300km of fibre optic cables have recently been laid across the country in an effort to provide broadband access and make Rwanda one of the most connected countries in Africa.

Rwanda has seen impressive economic growth of 8.5% GDP per year for the past 5 years and recent reforms in doing business have gained Rwanda international recognition and increased foreign investment. GDP reached USD5.5 billion in 2010, translating into USD541 per capita, a large improvement from USD200 in 2000. With political stability, well-functioning institutions, rule of law and zero tolerance for corruption, Rwanda is an attractive place to invest. Foreign investment opportunities lie in agriculture (tea and horticulture), power generation, tourism, infrastructure and mining. Rwanda has a trade in goods deficit of over USD1 billion (20% of GDP) with imports five times larger than exports.

## 2.2 Development Challenges

Rwanda is a unique country with many distinctive features that play a role in its development. Its demography, natural resources, current economic base and governance will largely determine its development in the coming decades. Current challenges for economic development in Rwanda include access to finance, human capacity, land scarcity and high electricity and transport costs (due to reliance on imported oil). Rwanda faces three major threats to its development that are set to worsen over the coming years - climate change, oil prices and population growth.

### Climate Change

Rwanda, located in the tropical belt, sits astride two key climatic regions, East Africa and Central Africa, each with contrasting controls and drivers on climate. There is a lack of sufficient climate data in equatorial Africa and these factors make Rwanda troublesome to simulate in climate models. Within the region of East Africa one climate centre exists currently, the IGAD (Inter-Governmental Authority on Development) Prediction and Climate Applications Centre (ICPAC) in Nairobi, Kenya. There is also a pan-African centre, the African Centre of Meteorological Applications for Development (ACMAD) in Niamey, Niger. Both centres provide meteorological and climate information that covers Rwanda, mainly in the form of observational information and seasonal forecasts. Neither centre provides detailed spatial and sectoral interpretation of the information, which remains the responsibility of individual countries. In Rwanda, this function lies with the Rwanda Meteorological Service (RMS).

Records of annual mean temperature show a significant increasing trend between 1971 and 2010 of  $0.35^{\circ}\text{C}$  per decade for four stations across Rwanda (Figure 6a). This increase is slightly higher than the observed global average of  $0.27^{\circ}\text{C}$  per decade from 1979 to 2005<sup>[6]</sup>. In contrast, no significant trend is found for Rwanda rainfall over an earlier period of the 20th century (1931-1990) using 26 stations (Figure 6b) and inter-annual variability is high. However, there was a step-change to slightly higher annual rainfall totals in the early 1960s, which reflects a climatic event seen across much of East Africa<sup>[7]</sup>.

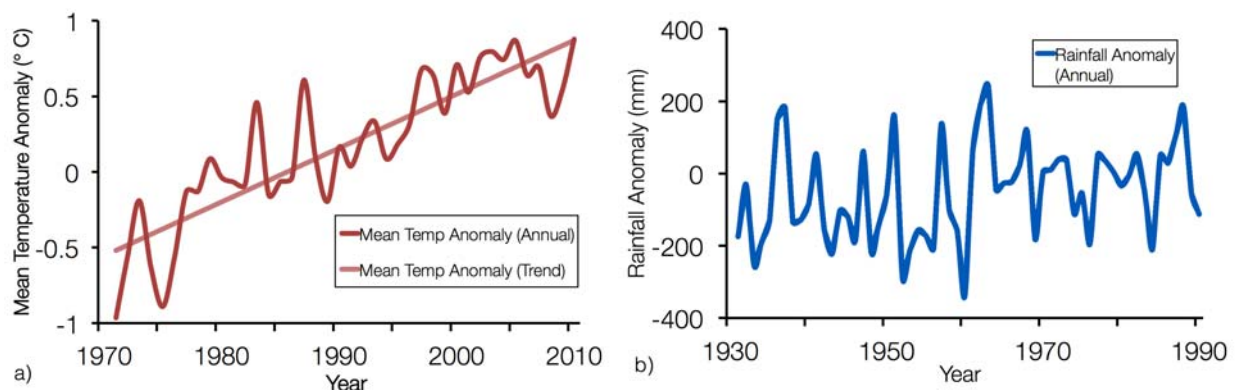


Figure 6: Annual anomaly and trend for a) temperature<sup>\*</sup> and b) precipitation<sup>#</sup> of Rwanda

Data Source: RMS, data is from \*4 stations and #26 stations

Climate projections for Rwanda reveal a warmer climate with a likely increase in rainfall, though some models project a decrease (Figure 7). Projections were taken from the 19 General Circulation Models (GCMs) from the World Climate Research Programme (WCRP) Coupled Model Intercomparison Project 3 (CMIP3)<sup>[8]</sup>. Those shown here can be described as a 'medium' emissions scenario (A1B), yet still project a

temperature increase of up to 2.5°C by the 2050s and up to 4°C by the 2080s. Climate model projections for rainfall are more uncertain, which is reflected in the spread of results on the plot, and show an increase in annual rainfall of up to 20% by the 2050s and 30% by the 2080s. Projections for East Africa over Rwanda and Burundi show an increasing trend in rainfall intensity for both rainy seasons<sup>[2]</sup>. Further details on Rwanda's climate data and analysis can be found in Appendix E.

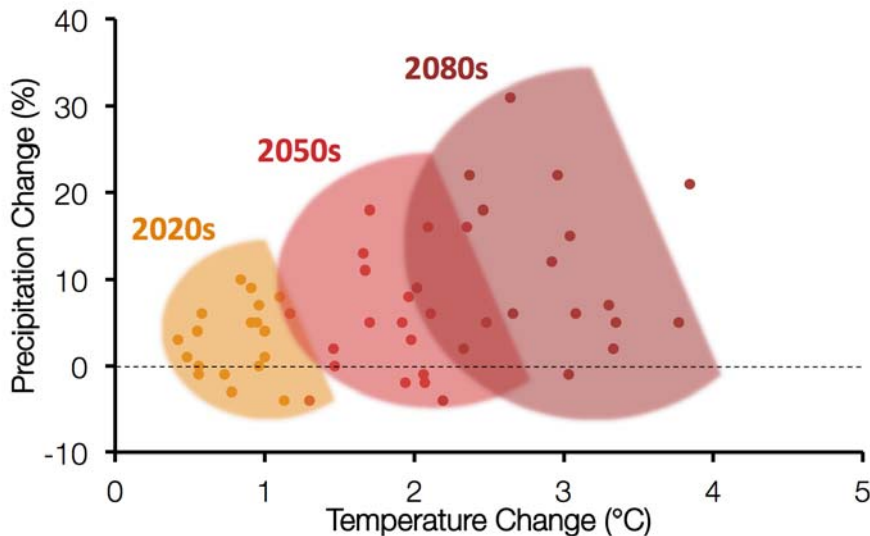


Figure 7: Predicted\* annual change in temperature (°C) and precipitation for Rwanda for the 2020s, 2050s and 2080s.

\*Projections are taken from the A1B scenario of 19 GCMs from CMIP3

Rwanda is vulnerable to the impacts of climate change as its economy is largely dependent on rain-fed agriculture. Rwanda already experiences floods and droughts due to the El Niño and La Niña phenomenon, with the most recent flooding occurring in April and May 2011 in Musanze, Nyabihu and Rubavu districts. The financial implications are significant and the flood in 2007, the most severe of recent events, is estimated to have cost a minimum of USD4-22 million in two districts alone<sup>[3]</sup>. Increases in temperature and changes to rainfall patterns, resulting in floods and droughts, can significantly reduce crop yields, negatively impacting livelihoods, food security and export earnings. The steep, hilly topography makes Rwanda particularly susceptible to landslides. Flooding and storms are a safety risk and cause damage to houses, mines, industrial sites, and major infrastructure including pipelines, power lines, roads, and dams. Damages not only have a direct cost in repairs and reconstruction, but also a knock-on effect on the economy as a whole, particularly in critical services such as power and transport. The FUND national model for Rwanda estimates annual economic costs from climate change to just under 1% of GDP<sup>[3]</sup>.

In the tropics it takes only 1°C of average temperature change to begin to alter the suitability of some key crops. Liu et al.<sup>[9]</sup> predict that Rwanda will be a hotspot of food insecurity due to climate change, along with many of its neighbouring countries. Maize, the staple food for more than a quarter of a billion East Africans, is particularly vulnerable to heat changes and to water stress. The suitability of maize as a crop is forecast to drop by 15% or more by 2020 in much of sub-Saharan Africa<sup>[10]</sup>. Rice yields are known to rapidly decline due to temperature change: showing a 10% decline in yield for every 1°C rise in growing season minimum temperature<sup>[11]</sup>. Crops may be further negatively affected by new parasites and pests which thrive in the new climate. Climate change may cause food insecurity not only in Rwanda but in the whole region and may result in increased migration and urbanisation.



Recent studies in Kenya have shown that temperature rise would increase the optimum altitude for growing tea from between 1,500m and 2,100m AMSL to between 2,000m and 2,300m AMSL<sup>[12]</sup>. Coffee and tea, Rwanda's cash crops, are likely to require higher altitudes as temperatures increase, which may reduce the amount of suitable land available due to differing soils and steeper slopes. It could also cause land use conflict as small-scale farmers of alternative crops, such as maize, cabbage, peas and passion fruit, compete for land with tea and coffee producers.

Climate change could affect water security and food security, and as a result, could increase levels of poverty and force subsistence farmers into informal urban settlements. Rwanda's energy security may be at risk as hydropower contributes 50% of electricity, making it vulnerable to variation in rainfall and evaporation. Droughts reduce generating capacity of hydroelectric dams, and floods increase soil erosion and siltation which can damage dams. A good example of this is the drought in 2004 in Rwanda which reduced hydropower capacity so much so that the government was forced to rent diesel power plants to meet domestic demand. Regional planning is underway to complete four hydropower plants on the Rusizi River to supply Rwanda, the Democratic Republic of Congo (DRC) and Burundi with 500MW of hydropower. The power plants are being designed to use the maximum capacity of current river flows, which may be affected by climate change and therefore affect the capacity and efficiency of the plants.

Tourism, one of Rwanda's largest earners of foreign exchange, is dependent on the survival of gorillas in the Volcanoes National Park, and the preservation of the Nyungwe and Gishwati forests and Akagera National Park. These areas of natural beauty are biodiversity hotspots and are vulnerable to change in temperature and rainfall which could reduce viable habitat and allow the spread disease. The health of farm animals and humans is also at risk, particularly amongst those living below the poverty line, and as temperatures rise, diseases could spread to new areas, particularly higher altitudes. Out of the main livestock diseases in Rwanda, ticks (as ectoparasites), tick-borne diseases and trypanosomosis are the most likely to be sensitive to climate change<sup>[13]</sup>. There are seven vector-borne diseases (the most sensitive to climate) in Rwanda that affect human health with malaria, tick bite fever and bilharzia or schistosomosis most likely to be affected by climate change. Human health would also be negatively impacted by natural disasters which can contribute to malnutrition, epidemics of diseases such as cholera.

In order to safeguard biodiversity and ecosystems services; to ensure food, water and energy security; and to support future socio-economic development, Rwanda must adapt to the changing climate and become climate resilient.

## Oil Price

Oil is expensive and continues to increase in value as demand exceeds supply and new resources become more difficult to extract. As oil reserves decline and additional costs are added to compensate for GHG emissions, oil prices are likely to increase. Rwanda imports all of its oil-based products used for energy generation and transport, at a cost of USD210 million (2009 dollars) per year, which in 2008 represented 4.7% of GDP. This heavy reliance on imported oil absorbs national finances that could be better spent on domestic energy which creates jobs and drives the local economy. It also puts Rwanda at risk from oil price spikes. For example, the inflation spike from 5% to 20% in 2008 (Figure 8) was largely attributable to the increasing global oil price. Inflation reduced to 2007 levels once the oil price crashed. The International Energy Agency (IEA) estimates that a 10% increase of oil price reduces GDP of oil-importing countries by 0.2% on average, though Rwanda's economy would be more affected than most due to its high dependence on oil.

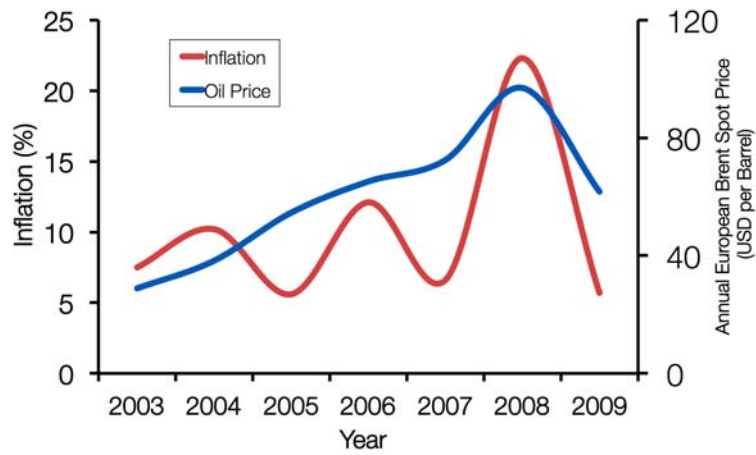


Figure 8: Global oil price and consumer price index for Rwanda

Data Source: IEA, 2010, National Institute for Statistics of Rwanda (NISR), 2010

Further economic growth underpinned by a reliance on fossil fuels will only make Rwanda’s economy more susceptible to such price shocks. For a robust development strategy, Rwanda’s economy must be decoupled from oil. Postponing investments in measures that decouple oil demand from economic growth will increase the challenge of doing so in the future.

### Population Growth

Rwanda has a predominately young population (45% below age 14 <sup>[1]</sup>) of 11 million (Figure 9), and the highest population density in Africa. If the current high level of population growth, 2.8% per annum, goes unchecked, Rwanda can expect a population of 26 million by mid-century (Figure 9), more than doubling the population density to 987 people per square kilometre <sup>[1]</sup>. Similar population growth is expected across Africa, with an estimated population of 2 billion by 2050 <sup>[1]</sup>, and this may impact on Rwanda through migration or pressure on food, water and energy resources. As the population grows, the amount of productive agricultural land per capita will reduce. People will be forced off the land into urban areas in search of employment opportunities. If properly managed and coupled with industry and services it can be an instrument for wealth creation.

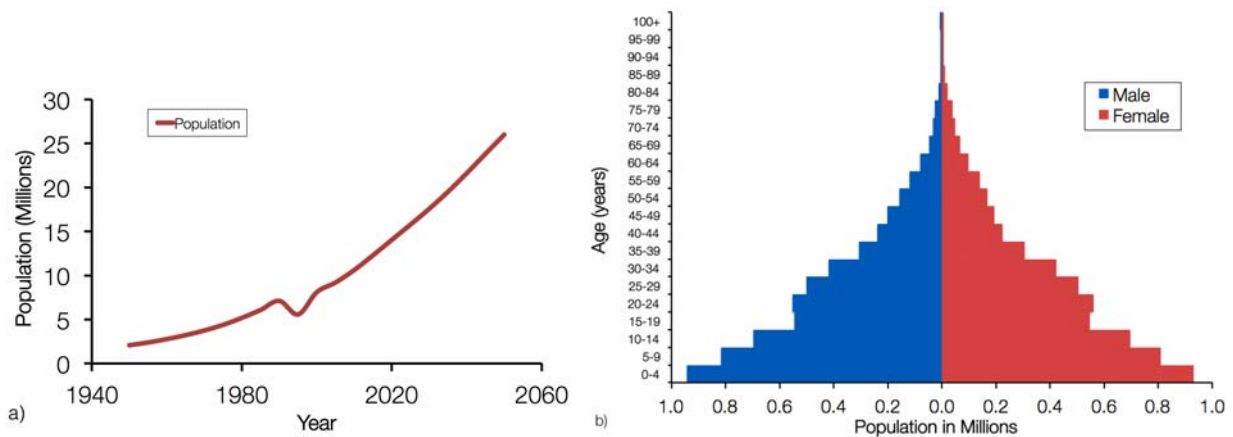


Figure 9: a) Population growth\* and b) population pyramid# of Rwanda

Data Source: \*UN, 2011 and #US Census Bureau International Database, 2011

The Kigali City Master Plan and Rwanda's rural settlement and land consolidation policies address this to some degree but unless secondary urban areas are developed to a level where they can sustain independent economic growth, there is a danger of Kigali becoming a sprawling megacity. Without intervention, Kigali could expand to 5,000km<sup>2</sup>, nearly 20% of Rwanda's land area, putting serious pressure on food production.

The development of slums could result in health problems and increase the incidence of crime. Rwanda therefore needs to carefully plan the growth of its urban areas to ensure that they are sustainable. The transition from a rural to an urban economy will require new skills, technology, and infrastructure. Job creation will be crucial and education will be necessary to build the skilled workforce to fill those jobs. Population growth, together with climate change and oil price spikes, could seriously hinder development in Rwanda and the achievement of Vision 2020 goals.

## 2.3 Future Development

Vision 2020 seeks to transform Rwanda from a subsistence agriculture economy to a knowledge-based society, with high levels of savings and private investment, and thereby reduce the country's dependence on external aid. There are a number of key targets in Vision 2020, notably the aim of reaching middle income status (900 USD per capita) by 2020. The Economic Development and Poverty Reduction Strategy (EDPRS) 2008 to 2012 is the framework for achieving Vision 2020 and the Millennium Development Goals (MDGs). There are three flagship programmes that prioritise public spending and improve sector coordination: Sustainable Growth for Jobs and Exports, Vision 2020 Umurenge Programme (social protection) and Good Governance.

### Business as Usual

When discussing climate change, a country's planned economic growth path is termed Business as Usual (BAU) and it refers to projected GHG emissions without intervention. Rwanda has one of the lowest GHG emissions per capita in the world, estimated at 0.6 tCO<sub>2</sub>e/person compared to a global average of 6.7 tCO<sub>2</sub>e/person, including land use change, in 2005<sup>[4]</sup>. GHG emissions have shown an upward trend, from 2,896Gg in 2003 to 5,793Gg in 2006 and are likely to continue to rise. Rwanda's GHG emissions baseline was set in 2005 in preparation for the Second National Communication (SNC) to the UNFCCC, amounting to 5,010Gg. The aggregate GHG emissions or total CO<sub>2</sub> equivalent (used for measuring global warming potential) were dominated by agriculture while four key sources contribute 91% of aggregate emissions (Figure 10a): N<sub>2</sub>O from agricultural soils (57%), CH<sub>4</sub> from enteric fermentation in domestic livestock (19%), CH<sub>4</sub> from residential energy from fuel combustion (8%) and CO<sub>2</sub> from road vehicles (5%).

CO<sub>2</sub> emissions were dominated by transport and industrial processes (Figure 10b) though CO<sub>2</sub> sequestration made Rwanda a net carbon sink. There are uncertainties in the GHG inventory due to inadequate representation, lack of basic data and application of emissions factors for different conditions. Owing to the rapid development in energy and industry in Rwanda, these figures need to be revisited to account for uncertainties in growth projections, energy intensity and the energy supply mix.

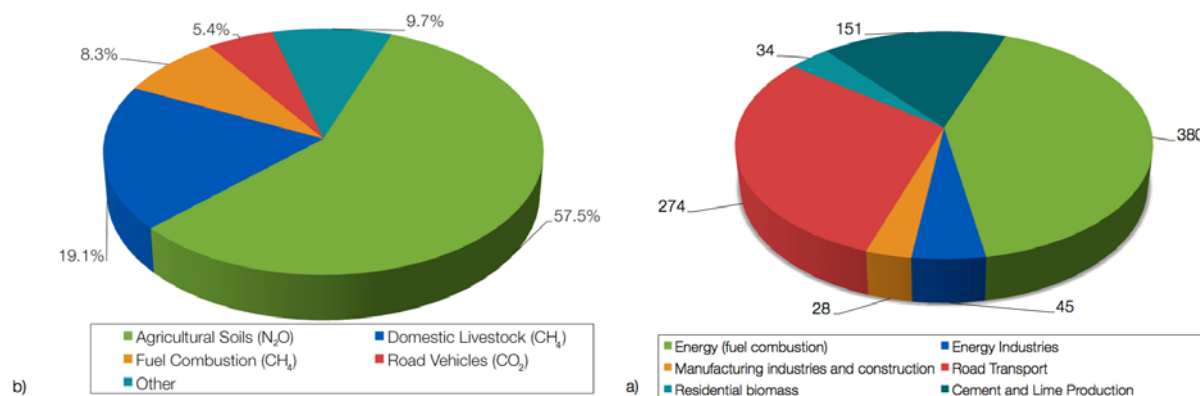


Figure 10: Rwanda's a) key sources of GHG emissions sectors\* and b) CO<sub>2</sub> inventory (in Gg) for 2005

Data Source: GoR, \*the SNC recognises that there are uncertainties in the GHG emissions due to inadequate representation, lack of basic data and application of emissions factors for different conditions.

Growth in Rwanda's economy can come in a number of ways. It is constrained by land availability and natural resources and should therefore focus on what it already has and what areas will provide the most return on investment, whilst preserving ecosystem services to ensure a sustainable economy. Ecotourism and ICT are key opportunities within Rwanda's growing service sector. There is much scope to expand agricultural products both for domestic consumption and export. Mining provides high value exports and there is opportunity for value addition through mineral processing. There is much potential to expand quarrying operations and supply the domestic housing and road construction industry, reducing the cost of materials and boosting the local economy. Opportunities for manufacturing lie in import substitution – providing products that are needed by the local population, rather than for foreign export, particularly for heavy goods due to high associated transport costs. The constraints are reliable electricity and water supply and access to finance, but these will be partly addressed through industrial parks and special economic zones that guarantee basic services and tax exemptions. Rwanda has a large low cost labour force to support new industries though training is required to develop the knowledge and skills.

Rwanda has already taken proactive steps to a more sustainable future. Vision 2020, EDPRS and sector strategies all provide guidance for economic development and poverty reduction. They promote gender equality, equity and sustainable management of natural resources and recognise Rwanda's role in the region. Recent progress has been made in the environmental arena, with Environmental Impact Assessments becoming mandatory for all projects, and environmental indicators being mainstreamed into financial budgeting and planning. Other important steps include setting up a policy and framework for accessing the Adaptation Fund through the establishment of an NIE. Also notable is the increased thrust in the sustainable management of natural resources, mainly land, water, wetlands and reduced deforestation and adequate rural and urban settlements planning. Key achievements in this regard include the National Land Use and Development Master Plan, the National Land Tenure Regularisation Programme, the Kigali City Master Plan, the rehabilitation of degraded ecosystems such as Rugezi and Gishwati, the implementation of nationwide crop intensification based on land consolidation and soils and water control, and domestic renewable energy. These are all positive steps in the right direction, but in order to truly address an uncertain future, climate resilience and low carbon development needs to be mainstreamed into all relevant sectors of the economy.

## A Climate Resilient and Low Carbon Development Path

Rwanda has chosen to embark on a low carbon development pathway. To do this, it needs to reduce its dependence on oil, which has the benefits of supporting energy security, reducing vulnerability to oil price spikes, channeling finances into the local economy, creating jobs and promoting economic development and reducing GHG emissions.

Rwanda is in the fortunate position of having a renewable low carbon energy resource mix which is the foundation for a low carbon economy. Although diesel is currently used for 39% of electricity production, this can be phased out and replaced with geothermal, hydro and solar which are all clean energy sources. Lake Kivu, shared by the DRC and Rwanda, hosts methane gas (mixed with CO<sub>2</sub>) which left unexploited poses a safety risk and if released into the atmosphere, is a potent greenhouse gas. Although using the methane to generate electricity will result in carbon emissions, the benefits of domestic energy security, safety and a possible smaller global warming potential, make this an attractive energy source. Rwanda also hosts vast black peat deposits which are largely unexploited and could contribute to domestic energy security in the short term but with high carbon emissions are not a good long term option. This domestic energy mix will enable all consumers of energy – industry, services and the public – to lower their GHG emissions. More importantly, it will enable Rwanda to provide enough electricity for its growing economy. In addition, Rwanda has access to the East Africa Power Pool, which in the future may provide regional energy security for ten African countries.

The biggest challenge for low carbon development is transport – petroleum products will still have to be imported to supply the needs of the transport sector. Although some work is being done on growing jatropha for biofuels near Akagera National Park in eastern Rwanda, the limited land, growing population and high water requirements for biofuels makes growing biofuels crops a poor option for Rwanda. More innovative and cost-effective solutions could include producing ethanol from municipal solid waste and from methane in Lake Kivu. Oil exploration in Lake Kivu may solve domestic energy security, but will not reduce carbon emissions, and has added complications of the multiple shared energy sources that the lake provides. Until a cleaner, cheaper alternative is available, the focus for transport and energy must be on efficiency and demand reduction. This is a win-win option for domestic and industrial consumers of transport and energy who save on costs while freeing up capacity to extend electricity access across the country and reducing GHG emissions.

Forests, parks and agroforestry can play a role in low carbon development by acting as carbon sinks. By preserving current forests and parks, agroforestry and urban tree planting, Rwanda's growing emissions can be reduced. Forests provide ecosystem services, vital for socio-economic development, and support ecotourism which will continue to contribute to economic growth. Wood will continue to be the largest source of energy in Rwanda in the next few years, but this needs to be managed in order to prevent deforestation. Agroforestry can provide suitable wood fuel while preserving natural forests and parks.

An evaluation of GHG mitigation options, as part of the preparation of the Second National Communication compared the 2005 baseline scenario (Business As Usual - BAU) to a mitigation scenario (Figure 11). A range of activities in energy, agriculture, transport and industry are proposed to reduce GHG emissions. Although there is uncertainty in the data and future economic growth, and the activities need to be revised based on this Strategy, this graph acts as an illustration of what a low carbon development path would look like for Rwanda. This baseline information and emissions reduction potential is important for accessing climate finance.

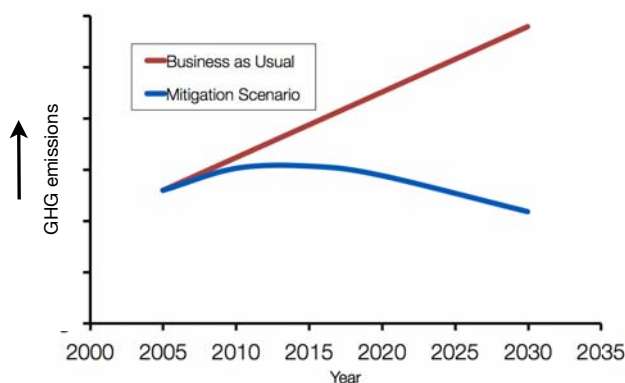


Figure 11: Illustration of projected greenhouse gas emissions for Business-as-Usual versus Mitigation scenario for Rwanda

Data Source: Second National Communication (using LEAP software)

Rwanda also seeks to follow a climate resilient pathway, incorporating adaptation to climate change into policy and planning. In the medium to long term, vulnerability can be reduced through economic development, creating jobs that are less vulnerable to climate change. In the short term, social protection is required to protect the poorest and most vulnerable. Vision 2020 aims to reduce the percentage of the population working in agriculture from 80% to 50% by 2020. However Rwanda needs to produce food to feed its growing population, and many people will continue in agricultural activities. Production per hectare can be increased through more sustainable means and organic waste can be recycled and reused to improve soil fertility, thus reducing dependency on external inputs.

Integrated land use planning and water resource management are fundamental for adapting to climate change and preserving biodiversity and ecosystem services. This includes allocating land to agricultural activities that will be resilient to future changes in climate. Irrigation infrastructure is vital for adapting to changing rainfall patterns, particularly changes in the seasons, and should be designed to optimise water usage. Water efficiency and waste water recycling in both the residential and industrial sectors plays an important role in reducing water demand and costs.

To create climate resilient infrastructure, planned roads, dams and bridges need to be designed with future climate change taken into account, notably flooding and storms. Buildings erected for housing, industry and mining need to be located in less vulnerable sites, without disturbing wetlands and natural forests. Flood and landslide hazard mapping should be performed before construction and regularly updated. Disaster management is essential for adaptation and vulnerability mapping, early warning systems and community based disaster risk reduction are required. Ecotourism should be promoted and forests and natural parks must be protected to preserve Rwanda's biodiversity and ecosystem services.

Rwanda also needs a greater understanding of the actual climate changes that will take place to enable better design and planning of adaptation measures. This is an ongoing process and requires meteorological stations, software and technology, technical expertise, dedicated research and engagement with regional and international centres of excellence. A Centre for Climate Knowledge for Development working with the Rwanda Meteorological Services (RMS), REMA and research institutions, could ensure that climate data is translated into climate knowledge and climate resilient development policies and plans.

Lastly, population growth and good governance are major factors in Rwanda's future development. Female education and empowerment will be crucial in curbing population growth and achieving robust economic development. The development resources, challenges and opportunities discussed in this chapter are summarised in Table 1 and they feed into strategic objectives and programmes of action which will be discussed in the following chapters.

Table 1: Summary of Rwanda's key characteristics, their implications and the climate resilient and low carbon development pathway

<b>Characteristics</b>	<b>Implications</b>	<b>Development path</b>
Limited land but very fertile	Able to achieve food security	Expand crop varieties, local sales and manufactured products and exports
High population density with most people farming on hillside plots	High vulnerability and potential to create rural poor	Employ sustainable intensification of small scale farming and resource recovery and reuse Educate women and girls
Majority of population live in scattered villages, while urban areas are expanding rapidly	High vulnerability to climate Difficult to provide basic services High carbon cities and slums	Climate proof VUP Build passive housing Implement resource recovery and reuse
Landlocked and limited transport network, but part of EAC	High cost of imports Potential for access to markets	Design an integrated robust low carbon transport system Explore import substitution through domestic low carbon industrial growth
High rainfall, though limited water resource management	Currently vulnerable to weather variations Able to achieve water security High occurrence of vector and water-borne diseases	Implement integrated Water Resource Management Expand irrigation infrastructure
Natural beauty – forests, lakes and parks	Able to be a tourist destination	Promote ecotourism with community involvement
Renewable energy resources (geothermal, methane, hydro, solar) though many are shared regionally	Able to achieve energy security and low carbon development of industry and services	Expand the national electricity grid based on renewables thus feeding industry clean energy Install small-scale renewable energy in rural areas
Mineral resources, gemstones and construction materials – though potential is unknown	Potential for foreign exchange earnings Potential for import substitution	Promote sustainable development of the mining and quarrying industry
Small but growing manufacturing/ industry sector	Potential for import substitution of basic goods, taking weight to value ratio into account	Promote sustainable development of industry that supplies domestic needs
Good governance though limited capacity	Access to finance Support services industry	Implement institutional and financial frameworks and capacity building



Strategic Objectives



Programmes of Action  
and Enabling Pillars





## Vision and Objectives



Chapter 2 illustrated Rwanda's potential to embark on a climate resilient low carbon development pathway. This chapter lays out a framework to make it happen. Climate change will fundamentally affect economic development and therefore a long-term vision is required. A vision for 2050 is given along with strategic objectives that together achieve the vision. These objectives are guided by principles already laid out in Vision 2020 and EDPRS. Specific actions are required and 14 Programmes of Action for transforming key sectors of the economy are the core of the Strategy. Enabling Pillars establish the processes and enabling environment required to mobilise the Strategy. Implementation is the crucial next step and a roadmap is given to guide implementation over the next five years, recognising that the Strategy is a first step in a continuous process. These core components form the Strategic Framework illustrated in Figure 12.

### 3.1 A Vision for 2050

Vision 2020 is a visionary document that has guided Rwanda's development over the last decade and contributed to its impressive economic growth and stability. Its goal for Rwanda to be a middle-income country and knowledge based economy by 2020 will reduce vulnerability to climate change and contribute to climate resilience. Although not required to act, Rwanda has already shown its leadership on climate change issues as part of the Climate Vulnerable Forum and the Cartagena Dialogue group. A Vision for 2050 addresses the challenge of climate change and reiterates Rwanda's plan to embrace best practices in this realm. It recognises that in 2050, average temperatures will be higher, impacting on crop yields, health and water resources while rainfall patterns may change, impacting on agriculture, power generation, infrastructure, biodiversity and ecosystem services. The global energy supply and demand and international energy regulations may also be very different, reducing dependence on fossil fuels and associated GHG emissions. Rwanda seeks to be proactive and embark on a development path that is resilient and sustainable over the long term.

**Vision 2050: For Rwanda to be a developed climate-resilient, low-carbon economy by 2050.**

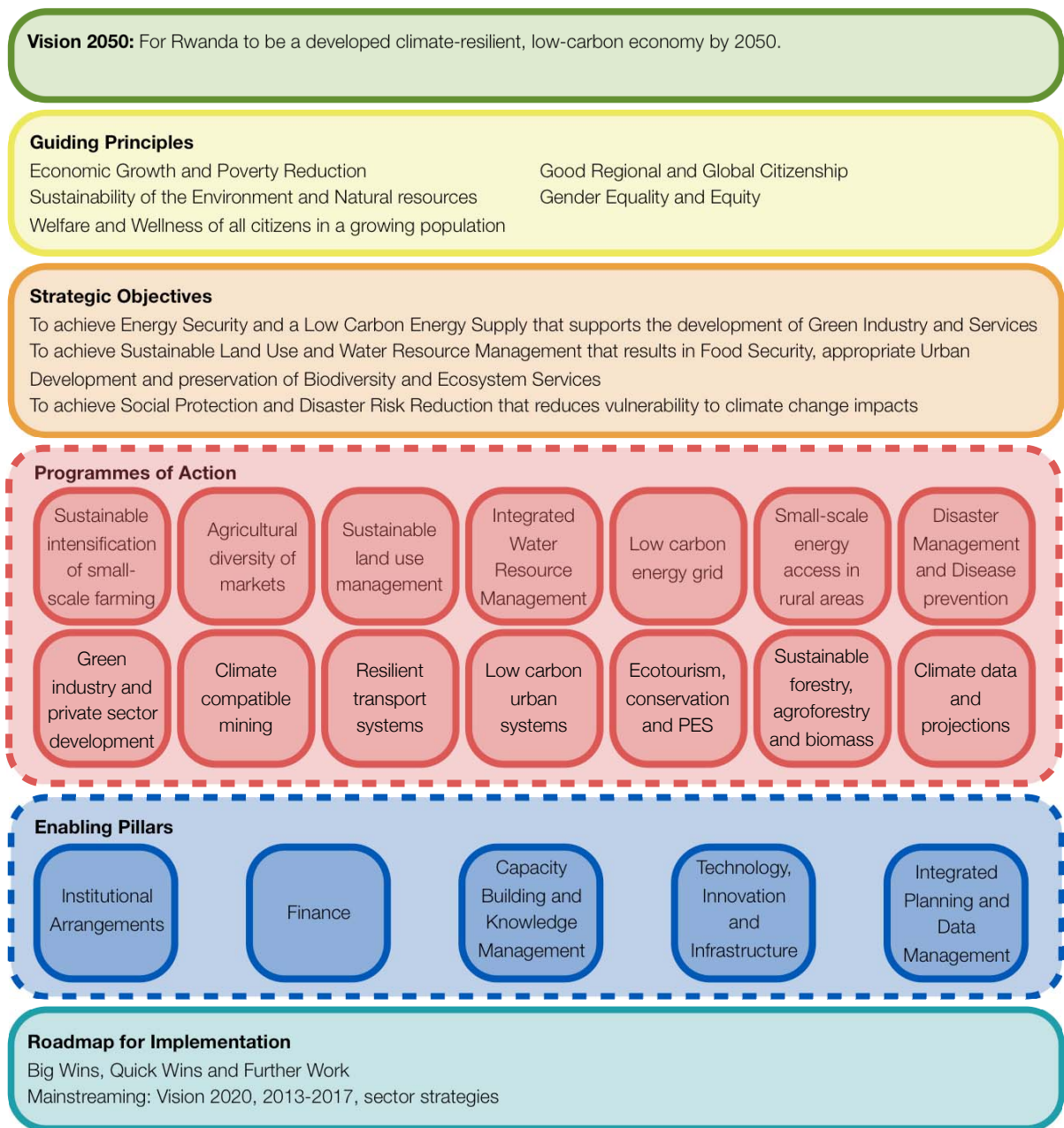


Figure 12: Strategic Framework for Rwanda's National Strategy on Climate Change and Low Carbon Development

Vision 2050 envisages Rwanda as a developed food secure country, with a strong services sector, low unemployment and low levels of poverty. It is a country where agriculture and industry have a minimal negative impact on the environment, operating in a sustainable way, and enabling Rwanda to be self-sufficient regarding basic necessities. By 2050, development will be achieved with low carbon domestic energy resources and practices, reducing Rwanda's contribution climate change while allowing it to be independent on imported oil for power generation. Finally, Rwanda will have the robust local and regional knowledge to be able to respond to changes in the climate, in a position to support other African countries as a regional services hub.

### 3.2 Guiding Principles

The Strategy is guided by a number of principles, already given in Vision 2020 and EDPRS. They ensure that no actions are taken that conflict with decisions already made by the people of Rwanda regarding their future prosperity. They are:

1. Economic Growth and Poverty Reduction
2. Welfare and Wellness of all citizens in a growing population
3. Gender Equality and Equity
4. Sustainability of the Environment and Natural resources
5. Good Regional and Global Citizenship

### 3.3 Strategic Objectives

The Vision for 2050 can be explained by three key strategic objectives discussed below.

**1. To achieve Energy Security and a Low Carbon Energy Supply that supports the development of Green Industry and Services and avoids deforestation**

Rwanda will exploit its clean energy resources to support a low carbon national grid which will enable industry to operate in a low carbon way. The grid will be expanded, enabling development and reducing the demand for wood fuel and charcoal, thus avoiding deforestation. This move to a low carbon economy will reduce vulnerability to oil price spikes and improve energy security.

**2. To achieve Sustainable Land Use and Water Resource Management that results in Food Security, appropriate Urban Development and preservation of Biodiversity and Ecosystem Services**

Mounting pressures on natural resources – land, water and ecosystem services – requires Rwanda to employ sustainable land use planning and integrated water resource management to ensure human well-being. This will involve a new approach to urban planning, rural resettlement and agriculture to ensure food security and to protect ecosystem services vital for sustainable development.

**3. To ensure Social Protection, Improved Health and Disaster Risk Reduction that reduces vulnerability to climate change impacts**

A changing climate will increase the need for social protection, particularly of women whom participate in subsistence agriculture more than men. The Vision 2020 Umurenge Programme – which seeks to create off-farm employment, formalise the economy and to provide effective social protection – becomes even more important in light of climate change. Disaster risk reduction will be mainstreamed to improve the safety and security of livelihoods of the majority of the population.



## Programmes of Action



In order to implement the vision and strategic objectives outlined above, Programmes of Action have been designed to address the most important areas of work that are most likely to succeed and have an impact. They are not exhaustive programmes for each sector however each programme has been derived from robust stakeholder engagement and research into best practice, detailed in the Sector Working Papers (Appendix B), and is informed by current sector strategies and EDPRS. The programmes are summarised in this chapter, but additional information is given at the end of the Strategy. They explain the specific actions that will be taken, highlight the responsible institutions, and give estimates of time, cost, impact on emissions reduction and climate resilience and the multiple sources of climate finance that could fund implementation. Although these programmes can be allocated to specific Ministries to lead on implementation, they are cross-cutting in nature and multiple sectors (Table 2) and stakeholders are involved in each programme, including the private sector and civil society.

Table 2: Sectors involved in the Programmes of Action (*lead in bold*)

Programmes of Action	Sectors												
	Agriculture	Water	Land	Built Environment	Transport	Forestry	Mining	Energy	Industry	Health	Education	Local Government	Disaster Management
1. Sustainable intensification of small scale farming	✓	✓	✓			✓					✓	✓	✓
2. Agricultural diversity for local and export markets	✓	✓	✓		✓			✓	✓		✓		
3. Integrated Water Resource Management and Planning	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓
4. Sustainable Land Use Management and Planning	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	
5. Low carbon mix of power generation for national grid		✓	✓	✓	✓			✓	✓	✓	✓		✓
6. Sustainable small-scale energy installations in rural areas	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓	
7. Green industry and private sector investment	✓	✓	✓	✓	✓		✓	✓	✓		✓		
8. Climate compatible mining		✓	✓		✓		✓	✓	✓		✓	✓	✓
9. Efficient resilient transport systems	✓		✓	✓	✓		✓	✓	✓	✓	✓	✓	
10. Low carbon urban settlements		✓	✓	✓	✓			✓	✓	✓	✓	✓	✓
11. Ecotourism, Conservation and PES Promotion	✓	✓	✓			✓		✓	✓	✓	✓	✓	✓
12. Sustainable forestry, agroforestry and biomass energy	✓	✓	✓			✓		✓	✓	✓	✓	✓	✓
13. Disaster Management and Disease Prevention	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
14. Climate data and projections	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

### **Programme 1: Sustainable Intensification of Agriculture**

The sustainable intensification of agriculture is a key component in building a low carbon and climate resilient agricultural sector. Adaptation, mitigation and development options can be designed and implemented to counter the negative impacts from climate change and reduce the sector's dependency on fossil fuels. Small-scale agriculture can bring wider benefits associated with climate compatible development including food security, improved environmental sanitation, and disaster risk reduction through slope stabilisation and flood mitigation. Terracing and irrigation are already being implemented in Rwanda and will be extended throughout the country. In addition, to build resilience into agricultural ecosystems, Rwanda will

- Mainstream agroecology techniques using spatial plant stacking as in agroforestry, kitchen gardens, nutrient recycling, and water conservation to maximise sustainable food production;
- Utilise resource recovery and reuse through organic waste composting and wastewater irrigation;
- Use fertiliser enriched compost; and
- Mainstream sustainable pest management techniques to control plant parasites and pathogens.

### **Programme 2: Agricultural Diversity in Local and Export Markets**

Rwanda will expand crop varieties, local markets and manufactured products and exports in support of the sustainable intensification and climate resilience of small-scale farming. This multi-faceted initiative will involve diversifying agricultural production and enhancing the agriculture value chain. Improving the agriculture value chain brings multiple benefits as it reduces dependency on external inputs (fertilizers/food/fuel), reduces vulnerability to climate change and builds an agricultural market economy based on added value and import substitution. To become more self-sufficient Rwanda will

- Expand crop varieties for import substitution and climate resilience;
- Add value to those products through processing to meet its own market demand for food stuffs;
- Develop decentralised village-based agricultural processing centres that incorporate low-carbon sources of energy, such as biogas-digesters and solar driers; and
- Develop niche export crops under organic and fair-trade branding.

### **Programme 3: Integrated Water Resource Management and Planning**

Rwanda is endowed with substantial freshwater resources. Regular rainfall patterns and minimal consumption has, until now, not necessitated water storage, water monitoring or irrigation infrastructure. There is a clear gap of observed data and monitoring frameworks for Rwanda's water and climate. The challenges of rapid population growth, increased urbanisation and industry, environmental degradation and pollution are leading to accelerated depletion and degradation of available water resources, while climate change is bringing uncertainty in future supply. In order to reverse this trend and ensure a sustainable water resource for socio-economic development, Rwanda will

- Establish a national integrated water resource management framework that incorporates district and community-based catchment management;
- Develop water resource models, improved meteorological services, water quality testing, and improved hydro-related information management; and
- Develop a National Water Security Plan to employ water storage and harvesting, water conservation practices, efficient irrigation, and other water efficient technologies.

## Programme 4: Integrated Approach to Sustainable Land Use Planning and Management

Land tenure (ownership) security and a robust integrated framework for development planning and sustainable land management are essential for socio-economic development. With land tenure, owners have a responsibility to manage the land in accordance to planning codes, access to equity markets, and the economic incentive to improve the asset. As climate changes, land use may need to change, particularly agriculture. The National Land Use and Development Master Plan provides the platform for this new approach. With increasing and changing demands, Rwanda will

- Employ an integrated approach to planning and sustainable land use management;
- Improve its spatial data by harnessing ICT and GIS (Geographic Information System) technology; and
- Establish a National Information Sharing and Access Policy to guide management of this data.

## Programme 5: Low Carbon Energy Mix Powering the National Grid

Rwanda currently has 95MW capacity for power generation, predominantly from hydropower and oil-fuelled power plants. The government is targeting 1,000MW by 2017 using geothermal power, methane, peat, solar PV and small and large scale hydropower. Increasing the supply, access and stability of electricity in Rwanda is essential for achieving the Millennium Development Goals and maintaining economic growth. The best option for domestic large scale generation is geothermal power, as it is clean, renewable, low cost and independent of other countries. To implement sustainable power generation programme Rwanda will

- Develop a strategy to phase out fossil fuels, utilise Rwanda's domestic energy resources, and increase energy efficiency;
- Establish renewable energy feed-in-tariffs and public-private partnerships to encourage private investment;
- Implement renewable energy guidelines and codes of practice; and
- Develop a medium-term strategy for peat phase out.

## Programme 6: Sustainable Small-scale Energy Installations in Rural Areas

The majority of Rwanda's population does not have access to the electricity grid and is dependent on wood for fuel. There is much potential for off-grid or mini-grid generation from biogas, solar PV and micro-hydropower. This should be utilised to increase access to electricity in rural areas reducing the dependence on wood fuel and supporting economic development. This strategy should be seen as complementary to the grid expansion plans. To increase development of small scale generation in rural areas, Rwanda will

- Encourage private sector involvement through performance-based grants and incentives for consumer finance;
- Maximise energy project potential through high load factors and appropriate maintenance; and
- Build consumer confidence through demonstration and product standards.

### **Programme 7: Green Industry and Private Sector Development**

Rwanda is actively improving the investment climate by improving start-up and operating conditions for business and industry, addressing water and energy requirements, and establishing a Special Economic Zone in Kigali (SEZ) and provincial industrial parks in urban areas to attract foreign investment. The greening of industry is supported by the Rwanda Resource Efficient and Cleaner Production Centre (RRECPC), a proposed Climate Innovation Centre (CIC) and the National Industrial Policy. Support of the private sector is needed to reduce industry emissions and build a local renewable energy sector. In order to transform industry, Rwanda will

- Scale up resource efficiency to reduce energy and water demand, thus reducing emissions and promoting resilience;
- Employ efficient and zero waste technologies, practices and design in Special Economic Zones and provincial industrial parks;
- Establish Climate Innovation Centres to support investment in industries producing green technologies and those adopting green technology; and
- Build carbon trading capacity within the private sector to harness innovative funding opportunities provided by CDM and voluntary carbon markets.

### **Programme 8: Climate Compatible Mining**

The mining industry in Rwanda is undergoing transformation as recent privatisation of concessions and proactive government policy drives its development. The Rwanda Mining Policy has five strategic pillars that support the growth of the mining industry. If this policy is considered 'business as usual' for the next decade, then mining is likely to contribute significantly to energy use, GHG emissions and water use in Rwanda. A sixth strategic pillar – low carbon, climate resilient development – will be added to the Mining Policy with the aim of reducing GHG emissions, improving energy security and water security and reducing vulnerability to floods and landslides. Flood and landslide hazard plans and disaster risk management is needed at mining operations and linked to community disaster management. The government will support the mining industry to

- Implement energy efficiency at operations, through measuring and reporting, setting targets and using efficient technologies;
- Utilise electricity from renewable energy sources, either from the national grid or on-site generation;
- Employ good water management practices on operations, including water efficiency and flood management; and
- Expand the capacity building programme to account for new skills needed in energy and water management.



### Programme 9: Efficient Resilient Transport Systems

The current transport sector is limited to road and air travel and is heavily reliant on imported fossil fuels, making the economy vulnerable to increasingly frequent oil price spikes. Due to the global nature of transport, actions should be integrated with national, regional and global standards. Long-term decisions should incorporate the future impacts of climate change on price, availability and taxes in the global transport sector. To implement an efficient and resilient transport programme, Rwanda will

- Improve vehicle efficiency through vehicle and fuel quality regulations and taxation policies;
- Promote new technologies to reduce transport emissions;
- Increase investment in climate resilient transport infrastructure, particularly roads; and
- Develop efficient operational and knowledge systems to support sustainable development.

### Programme 10: Low Carbon Urban Systems

With increasing numbers of people inhabiting urban areas of Rwanda, particularly Kigali, it is necessary to implement a long-term plan for sustainable urban development. Urban areas need to be efficient users of land through high density buildings, appropriate zoning and mass transit, such as bus rapid transit systems. Buildings should be designed to reduce the demand for energy and water and to support waste recycling. Urban areas should also be attractive to pedestrians and cyclists with trees, parks and public spaces, to promote low carbon transport, improve quality of life and reduce the risk of flooding. This is partly addressed in the Kigali City Master Plan but requires higher density development. To achieve low carbon, climate resilient urban areas, Rwanda will

- Adopt energy and water efficiency standards into building codes;
- Establish an integrated multi-mode urban transport system;
- Employ low carbon urban planning; and
- Fully utilise urban waste as a high-value resource stream.

### Programme 11: Ecotourism, Conservation and Payment for Ecosystem Services Promotion in Protected Areas

Rwanda's location within the centre of the Albertine Rift, a region considered to be the highest in species richness in Africa, makes it ideal for conservation and ecotourism. Ecotourism in envisioned destination management areas is likely to provide high returns on investment. In order to maintain Rwanda's protected areas as key economic assets supporting a climate-resilient services industry, a haven for biodiversity and a source of key ecosystem services, effective protection and sustainable management measures need to be undertaken. Rwanda will

- Maximise business tourism (the largest source of tourism) through strategic conference management;
- Increase the Community Benefit Fund from 5% of tourism revenues and ensure more equal distribution of resources to the poorest income quintiles; and
- Establish participatory Payments for Ecosystem Services (PES) schemes, continuing work in Gishwati and Nyungwe forest.

### **Programme 12: Sustainable Forestry, Agroforestry and Biomass Energy**

To meet energy demands for biomass it is necessary to ensure that supply meets or exceeds demand. Controlled tree planting through afforestation, reforestation, agroforestry and urban tree planting initiatives provides wood for fuel, improves slope stability supports food security and acts as a carbon sink, and can therefore earn carbon credits. To ensure sustainability of these initiatives, Rwanda will

- Promote afforestation/reforestation of designated areas through enhanced germplasm and technical practices in planting and post-planting processes;
- Employ Improved Forest Management for degraded forest resources;
- Formulate a joint strategy for agroforestry between MINIRENA and MINAGRI;
- Mandate licensing of sustainable charcoal production techniques and promote improved cookstoves for efficient and clean wood and charcoal consumptions.

### **Programme 13: Disaster Management and Disease Prevention**

Rwanda's hilly topography and high annual precipitation rates bring high risks from flooding, storms, landslides and vector and water-borne diseases, while other natural disasters include droughts and earthquakes. Over-exploitation of the natural environment such as deforestation and inappropriate farming on steep slopes increases the hazard risk, which may be exacerbated through climate change as an increase in extreme weather events occurs. To develop effective disaster management systems, Rwanda will

- Conduct risk assessments, vulnerability mapping and vector-borne disease surveillance;
- Establish an integrated early-warning system, and disaster response plans;
- Incorporate disaster and disease considerations into land-use, building and infrastructure regulations; and
- Employ community-based disaster risk reduction (DRR) programmes designed around local environmental and economic conditions, to mobilise local capacity in emergency response, and to reduce locally-specific hazards.

### **Programme 14: Climate Data and Projections**

Robust observed climate data and climate projections for Rwanda are crucial to understanding the current and future impacts of climate change and developing scenarios to assess the potential adaptation strategies for Rwanda. The Rwanda Meteorological Service is executing its five-year Strategic Plan to upgrade its network of meteorological stations. In addition Rwanda will

- Arrange additional observations to provide all climate information necessary for future monitoring, climate trend detection, management of climate variability, early warning and disaster management;
- Establish a team to produce and interpret climate change projections for Rwanda, with a focus on disseminating climate model data in a user-friendly format for use by all stakeholders; and
- Develop the capacity in climate science necessary to underpin this work by incorporating climate science into secondary school and university curricula.
- Enhance the use of climate data in disease prevention and mitigation programmes for human health and agricultural crop productivity.

## Enabling Pillars



The Programmes of Action outlined in Chapter 4 would not be possible without Enabling Pillars – ongoing processes that support their implementation. The objective of the pillars is to provide a foundation for current and future actions and will continuously be improved and reviewed. The five enabling pillars are: Institutional Arrangements; Finance; Capacity Building and Knowledge Management; Technology, Innovation and Infrastructure; and Integrated Planning and Data Management.

### Pillar 1: Institutional Arrangements

To implement climate compatible development, it will be critical for Rwanda to create an institutional arrangement that allows for transparent and effective flow of information, knowledge and financial resources. It is more efficient to build upon existing institutional structures and Sector Working Groups (SWGs) using the Sector Wide Approach (SWAp) and the Integrated Development Programme (IDP) offer platforms for implementation. A National Fund for Climate and the Environment (FONERWA) is being established and will play a key role in managing climate funds that flow into Rwanda. The REMA Climate Change Unit is responsible for UNFCCC engagement and documentation while the Rwanda Meteorological Service (RMS) is responsible for providing climate data and projections, the basis for decision-making. RMS under MININFRA is supported by MINAGRI, MIDIMAR and MOH who currently collect data and undertake analysis in their sectors. MINEDUC is working on capacity building in schools and universities and research institutes are investigating some of the challenges facing Rwanda.

Although much work is underway, it could be better coordinated and focused. As a result, there is a need for two new organisational structures – a Centre for Climate Knowledge for Development (CCKD) to translate climate information into policy options for sustainable development in Rwanda, and a Technical Coordinating Committee to lead and facilitate the flow of knowledge between the different organisations as shown in the proposed arrangement in Figure 13. The arrangements represent collaborative mechanisms which bring responsible authorities and stakeholder groups together on a regular basis to discuss, develop and validate policy and strategies.

### Technical Coordinating Committee

This process will be led by the Technical Coordinating Committee which will report back to Ministers for approval on key decisions. It would comprise director generals and department heads from the Rwanda Revenue Authority (RRA), Rwanda Natural Resources Authority (RNRA), the Energy, Water and Sanitation Authority (EWSA), the Rwanda Housing Authority (RHA), the Rwanda Transport Development Agency (RTDA), the Private Sector Federation (PSF), the Rwanda Development Board (RDB), REMA, MIDIMAR, MINEDUC, MOH and MINALOC as well as representatives from civil society, academia, development partners and the private sector.

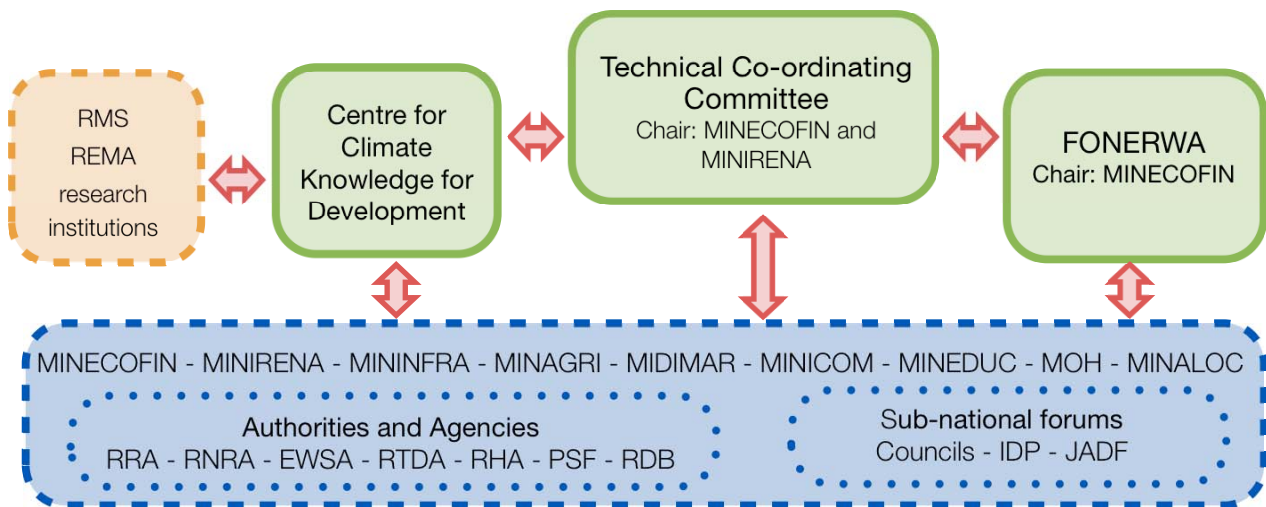


Figure 13: Institutional arrangements for climate-related strategy and policy development

The Technical Coordinating Committee will facilitate the flow of knowledge between the Centre for Climate Knowledge for Development, RMS, REMA Climate Change Unit, academic institutions and the Ministries and their sub-sectors and sub-national committees and forums. The Technical Coordinating Committee will oversee the Technical Committee for FONERWA and for CCKD.

The institutional arrangement will facilitate mainstreaming of climate resilience and low carbon development into Vision 2020, EDPRS, national sector strategies and policies, and budgeting and planning procedures. Mainstreaming into policy and planning is equally important at the sub-national to ensure that local needs are being met and that communities receive incentives for their efforts. This would include District councils, the Integrated Development Programme (IDP), the Joint Action Development Forum (JADF) and Community Development Councils. Participatory action planning should be used to develop local plans so that community voices are heard and have ownership.

### Centre for Climate Knowledge for Development

In order to respond and adapt to climate change, robust climate data and projections are required. But even more important is the ability to translate the information into sector-specific knowledge and policy options for decision makers. This currently does not exist at the level required to achieve the objectives of the Strategy and enable Rwanda to respond to change on an ongoing basis. The building blocks necessary to do this are shown in Figure 14 which shows how they build upon each other. Although the building blocks are being addressed to some degree in Rwanda, greater coordination is required.

RMS is responsible for the station network, data-related activities, seasonal outlooks and climate projections, and has made significant progress in recent years. MINAGRI and the MOH have station networks and MINAGRI produces seasonal outlooks. The Kigali Institute of Science and technology (KIST) and the National University of Rwanda (NUR) are planning to establish geosciences courses and a climate observatory on Mount Karisimbi is planned together with the Common Market for Eastern and Southern Africa (COMESA), which will monitor regional atmospheric GHG constituents and build local capacity, amongst other activities<sup>[14]</sup>. MIDIMAR, RMS and MINALOC are planning on developing early warning systems (EWS) while the REMA Climate Change Unit performs the assessment of climate sensitivities and adaptation and mitigation policy options. A detailed table of current activities and stakeholders and a gap analysis is found in Table 2 in Appendix F.

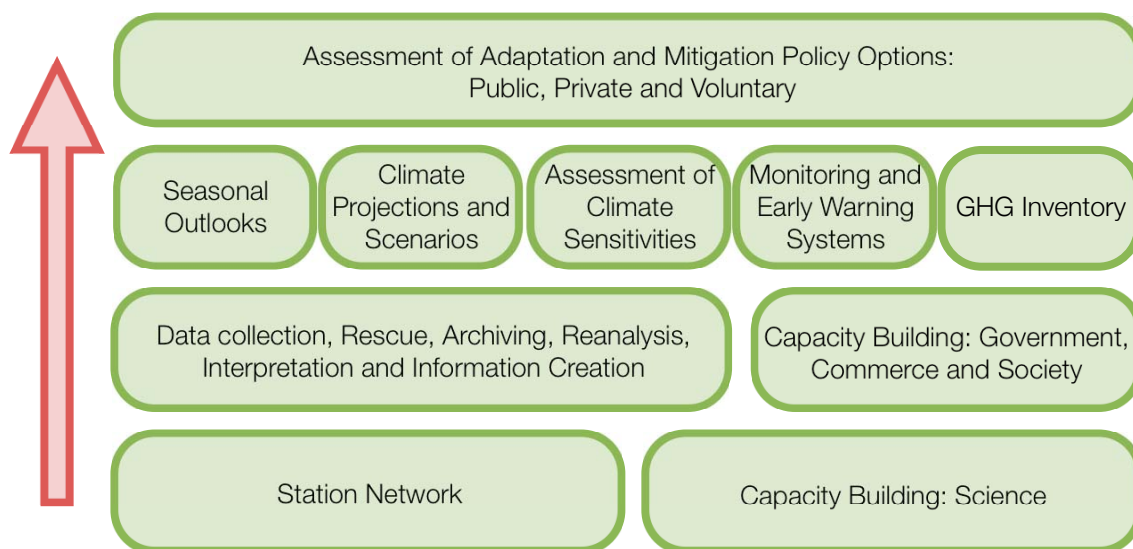


Figure 14: Building blocks of a Centre for Climate Knowledge for Development

A Centre for Climate Knowledge for Development will be established as a focus organisation for interpreting climate information in the forms as required by and appropriate to each climate-sensitive sector. It would be a multi-disciplinary organisation, with expertise covering climate as well as the various sectors and as such its institutional home is yet to be decided. It would work with all the institutions mentioned above, all of whom would perform certain aspects of the building blocks. Together, they would contribute to achieving the objectives of the Strategy and support the ongoing process of policy development. There are a number of ways of establishing the Centre, and further consultation is required before implementation. The ClimDev-Africa programme, expected to be implemented in 2012, will provide funding for activities closely aligned with the vision of the Centre. The detailed justification and explanation of the Centre for Climate Knowledge for Development is found in Appendix F.

The Centre will contribute significantly to the following outcomes:

- An improved understanding of the relationship of climate with the economy, health, environment and society
- Ability to mainstream climate issues into government policy
- Management of an economy more resilient to climate shocks, and therein to manage the consequences of climate variability and climate change
- A centre of excellence for climate science
- Ability to collaborate in and to lead international climate research
- Ability to take prominent roles in international climate and development organisations
- Ability to contribute to international climate policy
- Leadership in the region, including in the interpretation of climate information
- Rwanda's knowledge-based economy is enhanced

## National Fund for Climate and the Environment - FONERWA

FONERWA was provided for in organic law 04/2005 to support REMA. It is now being established with a broader mandate which covers climate and environment, including water, forestry, mining and quarry resources. According to the draft bill, the Management Committee of FONERWA will consist of Permanent Secretaries from MINIRENA, MINICOM, MINAGRI, MINALOC, MININFRA, and MIDIMAR; the Director General from REMA; the Director General of the Rwanda Natural Resource Board; a representative of the Private Sector Federation (PSF); and four representatives of non-governmental organisations operating in the areas of environment, water and forests protection and climate change adaptation and mitigation. FONERWA will begin with a simple design, with a Technical Committee housed in REMA, charged with the day-to-day management of the fund, capitalising the fund through environmental taxes and grants from development partners, mobilising other sources of climate finance, and assisting in carbon accounting. Once established, the Technical Committee will be transferred to MINECOFIN where it can employ more complex financing mechanisms, and eventually access concessional debt financing to increase capital for viable low carbon investments. FONERWA will seek to employ a wide-range of public financing mechanisms, such as performance-based grants, loan guarantees, lines of credit, and public venture capital to create an attractive investment environment for low-carbon activities.

The priorities of the Institutional Pillar are:

- Priority 1.** Establish new institutional arrangements, namely a Technical Coordinating Committee and a Centre for Climate Knowledge for Development
- Priority 2.** Mainstream the Strategy into Vision 2020, EDPRS II, and Sector policies and strategies
- Priority 3.** Mainstream the Strategy into sub-national institutional arrangements, and the Integrated Development Programme, and pilot 'climate smart' villages
- Priority 4.** Develop Local Adaptation Plans of Action and Locally Appropriate Mitigation Actions, and mainstream the Strategy into District Development Plans
- Priority 5.** Develop a common UNFCCC negotiating position with the EAC and LDC and Africa groups

Key responsible stakeholders are: MINIRENA, RNRA, MINALOC, RMS, RNRA, REMA

## Pillar 2: Finance

One of the two biggest challenges Rwanda faces in implementing this Strategy is access to finance. Rwanda has yet to fully exploit the international climate financing opportunities that exist, as shown in figure 15 which lists the climate funds currently, or soon to be, available to each sector. These are detailed in the Rwanda Climate Funds Toolkit in Appendix H which lists all available funds per sector and details the size, mandate, types of finance, project types, decision-making structure, application procedure, status in Rwanda including local contacts, project examples, links and the key contact for each fund. This toolkit needs to be updated on a regular basis as climate finance opportunities will increase substantially over the next decade.

	Agriculture	Built Environment	Disaster Risk Reduction	Climate Risk Reduction	Energy	Forestry	Industry	Land	Mining	Transport	Water
Adaptation Fund											
AfDB Congo Basin Forest Fund											
AfDB Sustainable Energy Fund for Africa											
Africa Enterprise Challenge Fund											
Clean Technology Fund											
Climate Finance Innovation Facility											
ClimDev-Africa Special Fund											
DEG - Deutsche Investitions											
EIB Post-2012 Carbon Credit Fund											
EIB-KfW Carbon Programme II											
Global Climate Change Alliance											
Global Energy Efficiency and Renewable Energy Fund											
Global Environment Facility											
Global Facility for Disaster Risk Reduction and Recovery											
Hatoyama Initiative (Japan)											
International Climate Initiative (Germany)											
International Climate Fund (UK)											
International Development Association											
KfW Development & Climate Finance											
Least Developed Country Fund											
Nordic Climate Facility											
Private Infrastructure Development Group											
Public-Private Infrastructure Advisory Facility											
Seed Capital Assistance Facility											
Special Climate Change Fund											
UNDP Green Commodities Facility											
UNDP/MDG Carbon Facility											
UNEP Renewable Energy Enterprise Development											
World Bank Carbon Facility											
World Bank Catastrophe Risk Management Facility											
World Bank Forest Carbon Partnership Facility											

Figure 15: International climate funds currently available for each sector in Rwanda

The Cancun Agreements at COP16 made significant progress on areas related to climate finance:

- Agreement to establish a Green Climate Fund, and extend USD 30 billion in 'fast start finance' for mitigation and adaptation initiatives in developing countries between 2010 and 2012
- Agreement to secure USD 100 billion per year in long-term financing for developing countries by 2020, from a mix of public and private sources
- Establishment of the Adaptation Committee to promote enhanced action on adaptation in a coherent manner - a draft decision text will be negotiated at COP17
- Establishment of a registry for Nationally Appropriate Mitigation Actions (NAMAs) which consist of a list of mitigation measures and sometimes a GHG emission reduction target

Developing a NAMA for Rwanda may increase climate financing opportunities, and this Strategy would act as the foundation for the NAMA. Any emissions reduction commitments made by Rwanda in the future will need to be against a business-as-usual (BAU) baseline and the economic impacts must first be calculated. Any targets adopted should be contingent on financial and technical support from developed countries. International climate finance is often channelled in an inefficient way through many different and uncoordinated intermediaries that bypass budgetary controls by national governments.

Though significant, the international climate funding flowing into Rwanda will not be sufficient to finance the Strategy. Thus, it will be crucial for the government to secure domestic sources of revenue and leverage private capital for low carbon and adaptation activities. FONERWA will be the centrepiece of Rwanda's climate financing plan, attracting and streamlining climate finance with the Strategy, and leveraging private investment for low carbon initiatives. There is huge potential to attract private investment – both domestic investment and regional and global funds focusing on green economy investments - in many of the programmes of action, as long as these are made commercially viable. To increase viability of low carbon projects, Rwanda will investigate environmental fiscal reforms: taxes to make environmentally damaging behaviour more expensive, and tax exemptions and subsidies to make environmentally beneficial behaviour more attractive. Renewable energy technologies will be exempted from VAT and import duties, and feed-in tariffs will guarantee a market for renewable electricity sold onto the national grid by independent power producers. Kigali's new Green Special Economic Zone will investigate financial and fiscal incentives to companies to comply with voluntary energy efficiency and building standards; and in the long-term a green investment index will be established in RDB to attract climate-friendly foreign direct investment by ranking Rwandan companies' environmental and financial performance. On more risky ventures private capital can team up with Development Finance Institutions (DFIs) such as the European Investment Bank (EIB), the World Bank, the African Development Bank, Belgium's BIO, and Netherlands's FMO.

Low carbon projects will also seek funding from carbon markets, which allow projects that abate GHG emissions to raise funds by selling 'carbon credits'. Mandatory emission reduction credits for Geothermal plants, micro hydro dams, organic composting stations, energy efficient buildings, improved cookstoves, biogas digesters, etc, can generate emission reduction credits to be sold through mandatory/regulated markets such as the Kyoto Protocol's Clean Development Mechanism (CDM). Forestry projects on the other hand, can generate credits to be traded through voluntary markets. The GoR will independently implement several of these projects, and actively promote private implementation of others by extending financial and technical support to 'Implementing Entities'.

In order to promote the preservation of ecosystems by individuals, communities and businesses, Payments for Ecosystem Services (PES) will be expanded beyond the pilot projects in Gishwati and Nyungwe forests. REDD+, which encompasses Reducing Emissions from Deforestation and Forest Degradation (REDD), conservation and enhancement of forest carbon stocks and sustainable management of forests, is the most advanced form of PES. However, Rwanda's limited forest stocks, initial exclusion from the pilot programmes of the UN-REDD Programme and the Forest Investment Programme, significant reduction in deforestation in recent years, makes it less likely to access these funds than other countries.

The priorities for the Finance Pillar are:

**Priority 1.** Operationalise the National Climate and Environment Fund of Rwanda, FONERWA

**Priority 2.** Secure grants from the Green Climate Fund, the Adaptation Fund and other climate funds targeted at LDCs



**Priority 3.** Promote CDM and voluntary carbon projects in Rwanda and push for simplified baseline calculations and monitoring methodologies at UNFCCC negotiations

**Priority 4.** Investigate and employ environmental fiscal reforms, a feed-in tariff, a green investment index, and public financing mechanisms to encourage green consumerism and investment

**Priority 5.** Encourage conservation through Payments for Ecosystem Services (PES) schemes

Key responsible stakeholders are: MINECOFIN, REMA, MINIRENA, MININFRA, EWSA

### **Pillar 3: Capacity Building and Knowledge Management**

Rwanda's constrained human resource capacity is arguably the greatest challenge facing climate compatible development. Many of the programmes of action required to implement the Strategy are knowledge intensive and require new skills across sectors and management levels. Capacity building efforts are instrumental to creating foundations of adaptive management and stakeholders' ability to implement the Strategy. A comprehensive capacity building plan will be developed by the Technical Coordinating Committee as one of the first steps of implementation.

In the short term, key government staff from MINECOFIN, MINIRENA, MINALOC, MININFRA, MINAGRI, MIDIMAR, MINEDUC, MINICOM, MOH, RNRA, EWSA, PSF, RDB, REMA and RMS should undergo capacity building in climate resilient low carbon development. In particular, the members of the Technical Coordinating Committee and the FONERWA technical committee should attend international short courses and seek to build relationships with technical experts in their sectors. To build capacity in specific areas, Rwanda will bring in international experts to work with and train national and sub-national government employees. Rwanda will also send government employees to other countries to receive high quality on-the-job experience and training. Scholarships will be provided for graduate study on international courses in the fields of climatology, meteorology, climate finance, sustainable natural resource management, green engineering, geographical information systems and climate sensitive diseases.

Training and capacity building will also be required for international climate change negotiations and policy development. The new Advocacy Fund set up by DFID in the UK and managed by CDKN aims to support greater engagement by LDCs in the UNFCCC process and could support capacity building efforts in Rwanda in this area.

Actions to build capacity must harness existing efforts as much as possible, in order to promote efficiency of investment in current resources. The Strategic Capacity Building Initiative supports professional development in agriculture, mining, energy and investment through employing international experts in Rwanda and training Rwandan staff at international institutions. There is also a drive to encourage Rwandans living overseas to return, bringing with them their skills and financial support.

The Rwanda Climate Finance Toolkit described under Pillar 2 could provide the basis for a Rwanda Climate Portal, similar to the websites set up by India and South Korea. This would contain information about the Strategy, climate change impacts in Rwanda, climate negotiations, government policies and programmes and ways for citizens to contribute to mitigation and adaptation while reducing their own vulnerability. It would play a key role in public awareness and online communication and will be made possible by the fibre optic network in Rwanda. For those without access to the internet, other forms of communication are important and creative radio programming, demonstration projects, community exchange visits and farmer field schools are all critical for building capacity in rural areas. The Integrated Development Programme (IDP) is an ideal platform for this work as it is already piloting biogas digesters, solar panels, rainwater harvesting and organic waste composting in villages.

In the medium term, these courses will be set up at universities to create a local knowledge base and platform for long-term research. The education framework for Rwanda is shown in Figure 16. The foundation for capacity building is school education as it increases the number of children who can go on to technical or university training. Rwanda has made much progress in this area with 95% enrollment in primary school (2.3 million children), though enrollment in lower secondary school was only 22.6% in 2009. In 2009, half as many students attended technical and vocational education and training (TVET) than university. Although both are very important for Rwanda's development, greater numbers are needed in TVET to support the growing economy. The Rwandan Workforce Development Authority (WDA) is fast-tracking TVET and has proposed a new TVET qualification framework. Demand-driven apprenticeship programmes in partnership with the private sector are a feature of WDA work, and help ensure high-quality trainers. The WDA will be supported and TVET courses expanded to develop skills in energy and water efficiency, renewable energy, agroforestry, passive housing, organic agriculture, waste recycling and drip irrigation.

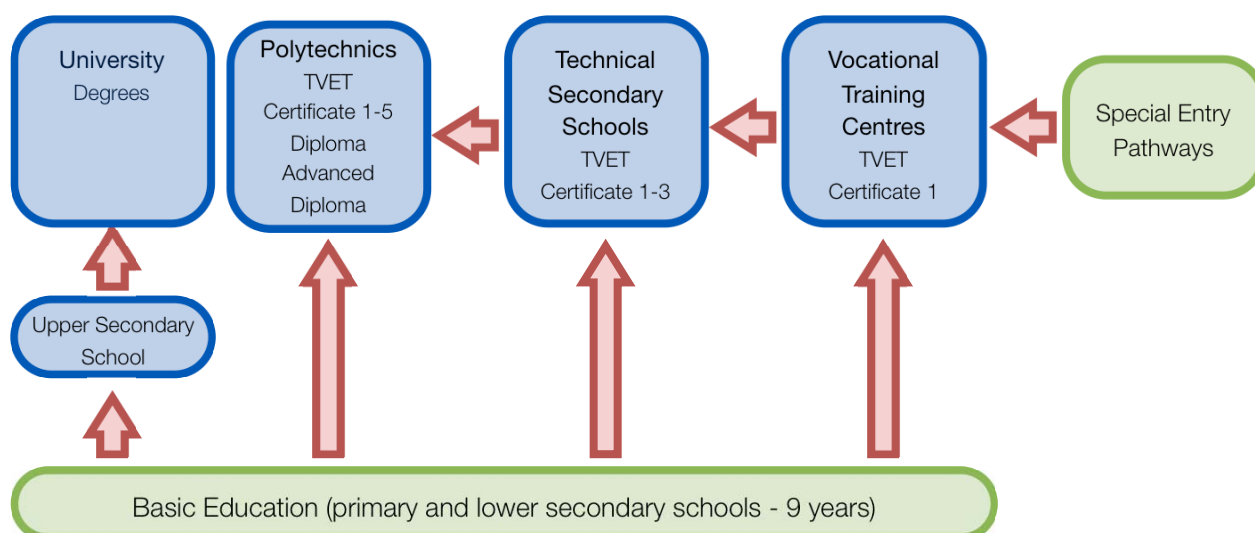


Figure 16: Education framework in Rwanda

In the long term, Rwanda will increase its research and development (R&D) capacity by forming links between government, industry and relevant higher learning and research institutions in Rwanda (KIST, NUR, etc) and abroad. Such links will enable effective research in line with the Strategy and support innovation and locally appropriate solutions. RMS and the Centre for Climate Knowledge for Development will play a key role in this area. Other research centres may be set up to support the growing demand for research and policy development and a brief proposal for an Energy Research Centre for Rwanda is given in Appendix G. In addition, universities will set up courses to cover all the professions required to maintain a climate resilient low carbon economy. This will support the aspiration of Vision 2020 in creating a knowledge-based economy.

The priorities for the Capacity Building and Knowledge Management Pillar are:

- Priority 1.** Improve education by expanding school curricula, tertiary education, technical and vocational training and farmer field schools to address climate resilience and low carbon development

**Priority 2.** Develop capacity within national and sub-national government through exchange programmes, university partnerships, training focal points, professional development and pilot villages

**Priority 3.** Improve knowledge management and public awareness through an online Climate Portal, creative radio programming, short training courses, demonstrations of best practice in communities and community exchange visits

**Priority 4.** Engage in regional and international forums and partnerships on climate and sustainable development topics

**Priority 5.** Ensure adequate education and training is provided for women and girls

Key responsible stakeholders are: MINEDUC, KIST, NUR, WDA, MINAGRI

#### **Pillar 4. Integrated Planning and Data Management**

Climate change is a cross-cutting issue that impacts the economy in the long-term. Integrated planning of multiple sector programmes is crucial due to the constraints facing Rwanda, in land, water, energy and finance. Integrated planning systems will allow the Government of Rwanda to invest in the most efficient way, producing the maximum return on investment while accommodating different sector needs. Equally important is the collection, analysis and application of robust data across sectors. This will allow decisions to be made based on facts and figures and will enable scenario planning. An integrated set of analyses is required to understand the feedbacks and interconnections between land use, ecosystem services, water availability and energy supply going forward under future population scenarios. The institutional arrangements discussed earlier will facilitate integrated planning and data management.

As the population grows, the economy expands into new areas and as the climate changes, land use will need to change. Land tenure security and a robust integrated framework for development planning and sustainable land management are essential for supporting socio-economic development. Land use must be taken into consideration in every programme of action to ensure adaptation is embedded in the long term. The National Land Use and Development Master Plan (NLUDMP) and subsequent District Detail Plans are the foundation for this integration. Strategic Environment Assessments (SEAs) for key Development Zones and ecologically sensitive areas need to be standard practice.

Rwanda needs to develop a National Spatial Data Infrastructure (SDI) to manage the nation's land information resources and to identify the fundamental data sets required to manage land and water resources, monitor land use and environmental change, support economic development, and enable Rwanda to better plan, monitor, and respond to the impacts of climate change. The Rwanda Natural Resources Authority offers an appropriate framework to improve management of natural resource data sets. Other sectors maintain key national data sets that also must be managed, made accessible, and kept up to date. To develop its SDI, Rwanda will establish a National Information Sharing and Access Policy, a National SDI Strategy, a detailed national features map, and ongoing monitoring of land use and environmental change.

Sustainable land management demands integrated analysis of various data sets including land use, zoning, administrative boundaries, roads, population and health, environment, soils and geology, hydrology, and elevation. By harnessing GIS and ICT technologies, Rwanda will enable national government and district offices to avoid uncontrolled development, increased energy demand and emissions, inefficient transport systems, over burdened water and sanitation systems, environmental degradation and loss of biodiversity, food insecurity, health impacts and reduced livelihoods.

The most critical data sets that are required at present are those needed to generate climate models and projections to facilitate adaptation planning. Key variables are temperature, rainfall and rainfall intensity. RMS is currently implementing a five-year Strategic Plan, which includes upgrading the network of meteorological stations. It will be complemented by the Mt Karisimbi climate observatory project. This network will provide climate information necessary for future monitoring, climate trend detection, vulnerability mapping, management of climate variability, early warning and disaster management, and development of a weather index-based crop insurance industry. The information will complement historical data, and update historical records and re-analyses. In addition, MIDIMAR is developing a database of disasters, including from extreme weather events which will complement the work done by RMS.

The priorities for the Integrated Planning and Data Management Pillar are:

- Priority 1.** Identify, record and maintain fundamental integrated data sets according to international standards, particularly for energy and water
- Priority 2.** Develop climate compatible national and district level sector plans integrated with national strategies based on the National Land Use and Development Master Plan
- Priority 3.** Develop a robust forecast of future resource demands and vulnerabilities which are stress tested for future shocks, with applicable warning indicators
- Priority 4.** Develop monitoring, reporting and evaluation systems to improve planning and provide the evidence base to receive climate finance
- Priority 5.** Improve spatial data by harnessing ICT and GIS (Geographic Information System) technology

Key responsible stakeholders are: RNRA Land and Mapping Department, RMS, MIDIMAR, MINALOC, Disaster Management Task Force, MOH

## **Pillar 5: Technology, Innovation and Infrastructure**

The application of, and investment in technology, innovation and infrastructure is vital for development. Rwanda has the opportunity to leapfrog old technologies and destructive development pathways, and build a green economy, resilient to oil prices spikes and a changing climate. The developed world faces a huge challenge as it is locked into high carbon infrastructure, systems and lifestyles. It is very costly to retrofit or replace capital intensive technology and even more difficult to induce behaviour change in citizens across the globe. Infrastructure is expensive, has long lead times to implementation and long life spans and therefore needs to be resilient to future changes in the climate while maximising return on investment. Developing countries have the opportunity to choose to follow a low carbon pathway and one that is climate resilient.

This will be supported by technology transfer, a 'broad set of processes covering the flow of know-how, experience and equipment for mitigating and adapting to climate change amongst different stakeholders'<sup>[15]</sup>. Examples of technology transfer are power generation technology, energy and water efficient technology, early warning systems and soil management. Technology and knowledge can be transferred from developed or developing countries to Rwanda and through the private sector or development partners such as the United Nations Industrial Development Organisation (UNIDO). In 2008 the World Business Council for Sustainable Development (WBCSD) set up the Eco-Patent Commons to provide free access to patents for environmentally beneficial knowledge and technology. This provides a significant opportunity for the private sector in Rwanda.

A Technology Needs Assessment (TNA) for Rwanda is underway with UNEP and Rwanda can apply for technology transfer through the Technology Mechanism agreed at COP16 aimed at boosting global clean technology cooperation. Funding for research and development of new technology, particularly in the areas of agriculture and energy, will be sought and capacity will be developed at universities in Rwanda over the long term. Other channels for technology transfer will be investigated, particularly bilateral arrangements and south-south transfer and collaboration in technology R&D.

Rwanda's Private Sector Federation (PSF) is working to mainstream water and energy efficiency and waste recycling through the Rwanda Resource Efficient and Cleaner Production Centre (RRECPC) set up in 2008. It works closely with industry and has already demonstrated the financial benefits of saving energy and water. A Climate Innovation Centre (CIC) has been proposed for Rwanda to facilitate private sector development and to support small to medium enterprises (SMEs) in providing goods and services for climate resilient low carbon development. CICs are aimed at helping developing countries accelerate the deployment of climate technologies, companies and industries by identifying and analysing support networks, centres of excellence, gaps in institutional capacity and the financial landscape. Both initiatives will be supported and expanded.

The priorities for the Technology, Innovation and Infrastructure Pillar are:

- Priority 1.** Identify and implement applicable technologies through technology transfer to drive efficiency of resource consumption and creation, particularly in energy and water
- Priority 2.** Perform local research and development of applicable technologies for climate resilience and low carbon development, particularly for agriculture
- Priority 3.** Invest in relevant climate resilient infrastructural projects, particularly an all-weather road network and irrigation
- Priority 4.** Develop links to regional and international centres of excellence to benefit from the latest research on climate resilience and low carbon development

Key responsible stakeholders are: MINICOM, MINIRENA, MININFRA, EWSA, RNRA, KIST, PSF, Institute for Scientific and Technological Research (IRST), Rwanda Agricultural Research Institute (ISAR), Industrial Research and Development Agency (IRDA)



## Roadmap to Implementation



This Strategy is the first attempt at plotting a climate resilient and low carbon development pathway. It is the start of a continuous process which is described in the Enabling Pillars and will be implemented through the Programmes of Action. The first step (Figure 17) is to set up the institutional arrangements, namely the Technical Coordinating Committee, FONERWA and the Centre for Climate Knowledge for Development. These government institutions will utilise the Sector Wide Approach and work closely with development partners, civil society, academia and the private sector. Implementation will be impossible without the technical and financial support of these partners.

The Technical Coordinating Committee will be responsible for implementation of the Strategy and facilitate its incorporation into Vision 2020, EDPRS II and sector policies. Further work is then required to perform cost-benefit analysis on the programmes of actions and apply for climate finance for them. This will inform the revision of detailed sector strategies and annual budgets. In parallel, short term capacity building programmes must be initiated and work done to develop a long term plan to provide the support required to implement the Strategy.

Figure 17 illustrates the steps that need to be taken in the coming years to mainstream climate resilience and low carbon development at all levels of government. In order to achieve the 2050 vision, implementation must be an ongoing process (Figure 18) that responds to changes in climate, demographics, economic development, and global energy trends. Decisions need to be based on good data and research provided by government, academia, NGOs, private sector and development partners. This will allow a range of policy options to be considered and short to long term decisions made that benefit all Rwandans. The policies will then be translated into programme design and planning which are also informed by the data and research available and robust economic analysis. Finally projects will be implemented and monitoring and evaluation undertaken with findings then fed back into each step of the process.

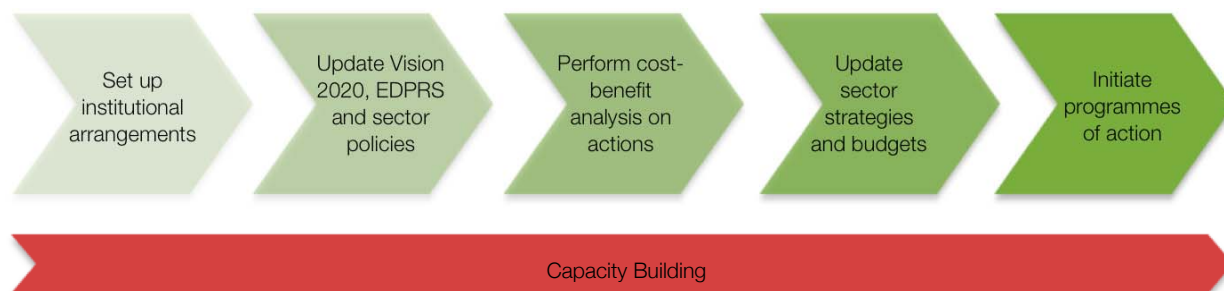


Figure 17: Roadmap to implementation

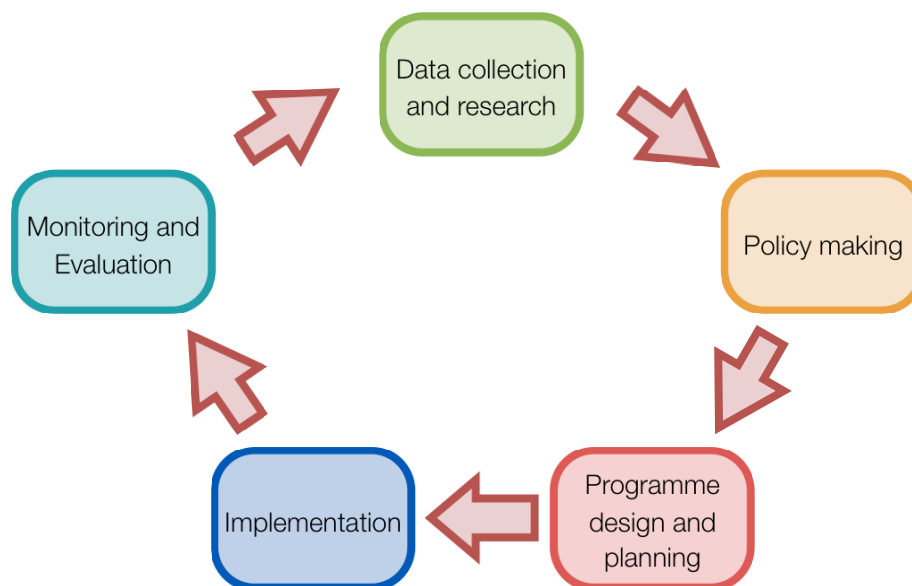


Figure 18: Ongoing process for implementation of climate resilience and low carbon development

## 6.1 Big Wins

Amongst all the recommended actions in the Strategy, there are a few ‘big wins’ that, if implemented, will make a significant impact on mitigation, adaptation and low carbon economic development. These are likely to produce the greatest return on investment for Rwanda as they impact the whole economy in the long term. More details regarding each ‘big win’ are found in the Sector Working Papers in Appendix B. They have been split into low carbon development/mitigation and resilience/adaptation, though there are synergies between them. As the three largest sources of GHG emissions, agriculture, energy and transport are all addressed in the mitigation ‘big wins’, which will enable low carbon development, increase food and energy security and reduce vulnerability to oil price spikes. They would all qualify for climate finance.

### Low Carbon Development / Mitigation

1. **Geothermal power generation:** Geothermal power is a clean, renewable, reliable and large-scale energy resource. There is an estimated potential of up to 700MW of geothermal power in Rwanda and this would exceed domestic electricity demand by 2020 if implemented. It uses known technology and could produce electricity at four times less the cost of diesel generated electricity currently in use in Rwanda. It could replace oil-fuelled power plants which currently supply 38MW of electricity and result in high GHG emissions and are vulnerable to oil price spikes. Geothermal power has near zero emissions, making it eligible for carbon credits. It is a domestic resource, not shared with neighbouring countries like methane in Lake Kivu and hydropower on the Rusizi and Rusumo Rivers, and has relatively small land use impact, unlike peat. Geothermal energy, together with other renewable energy sources, will provide energy security, reduce energy costs and vulnerability to external economic shocks and ultimately promote economic development.



2. **Integrated soil fertility management:** The crop intensification programme in Rwanda currently uses inorganic fertiliser to increase crop yields. These imported fertilisers produce a significant proportion of Rwanda's GHG emissions through soil nitrous oxide (N<sub>2</sub>O) emissions but also through the fertiliser manufacturing process and transportation. Demand for inorganic fertilisers can be reduced by applying an integrated approach to soil fertility and nutrient management, which employs agroecology, resource recovery and reuse, and fertiliser enriched composts. An integrated approach will significantly lower inorganic fertiliser demand, reduce dependence on oil, reduce GHG emissions and increase farm profitability due to reduced input costs for farmers. This will contribute to reducing vulnerability to external shocks. Such approaches also improve soil structure and the water retention capacity of soils, leading to climate resilient agricultural ecosystems and sustainable food security.
3. **High density walkable cities:** The growing population and increasing urbanisation will result in an increase in urban area in Rwanda. If this is not achieved in a high density manner, Rwanda will face unprecedented levels of urban sprawl, partly due to hilly terrain. This forces people to travel greater distances than necessary, with motorised transport resulting in GHG emissions and air pollution. Designing high density cities with corridors for pedestrians and cyclists and green public spaces, would reduce the need for energy intensive transport, improve quality of life and reduce the risk of flooding. Not only will this reduce GHG emissions and oil dependency, but also reduce the burden of transport costs to citizens. It also has adaptation benefits, as reduced urban sprawl limits the development of housing on steep slopes which are vulnerable to flooding and landslides.

### Climate Resilience / Adaptation

1. **Irrigation infrastructure:** Rwanda has high annual rainfall which it has traditionally been able to exploit for seasonal agriculture. However, seasonal agriculture is vulnerable to climate change and population pressure, as even slight changes in rainfall patterns can have significant impacts on crop and livestock production. The uncertainty in the timing of wet seasons makes it difficult for farmers to know when to plant and to harvest to produce a good crop. Irrigation infrastructure gives farmers more control of the water resource and reduces the vulnerability to changing rainfall patterns. It also allows for diversification of crops, such as rice, contributes to efficient land and water usage, and provides water to dry areas. Irrigation infrastructure forms a crucial component of Integrated Water Resource Management as improved watershed management allows for increased water supply and efficiency in other sectors, while also reducing disaster risks through the mitigation of floods and landslides.
2. **Robust road network:** Rwanda, at 0.56km/km<sup>2</sup> has one of the densest road networks in Africa. As the dominant mode of transportation, all sectors – agriculture, mining, industry and services – and therefore the economy relies on this road network. These roads vary in quality, from tarmac highways to dirt tracks. The poor quality roads have a detrimental effect on the economy, contributing to a large proportion of food produce being lost during transit to market. The majority of the network is unprepared for current weather events, let alone future variations due to climate change, making the entire economy vulnerable to flooding and storms. Building and maintaining the roads in a way that is not only suitable for the value of the route, but also resilient to more extreme weather events, will reduce Rwanda's vulnerability and promote economic development, particularly in rural areas.

3. **Centre for Climate Knowledge for Development:** Rwanda is located in equatorial Africa, which lacks sufficient data to produce robust climate projections. Although temperature will rise, the temperature increase is uncertain. Future rainfall patterns are even more uncertain, as annual rainfall could increase or decrease and rainfall intensity may increase. This uncertainty makes it very difficult to plan for future adaptation in Rwanda, which is particularly important for agriculture, water resource management, disaster management and land use planning. A Centre for Climate Knowledge for Development, working with the Rwanda Meteorological Service and research organisations, will contribute significantly to improving climate data and projections and translating them into policy options for decision makers to guide the country onto a climate resilient development path. This is explained more fully in the report of the same name in Appendix F.
4. **Agroforestry:** Rwanda does not have the land available to expand its forests and plantations, yet the majority of the population depends on wood for cooking and will continue to do so until electricity is available and affordable for all. Agroforestry will provide wood for fuel and social protection while avoiding deforestation. Different tree species will be used in agroforestry to provide construction materials as well as livestock fodder and food (fruit and nuts) which improve food security. Agroforestry has multiple additional benefits, namely reduced soil erosion and increased resilience to heavy rains through improved slope stability; water management and nutrient recycling which improve agricultural production; and carbon sequestration. Agroforestry in Rwanda will be guided by latest best practices and research, such as those developed by the World Agroforestry Centre (ICRAF).

## 6.2 Quick Wins

The big wins are large scale economy-wide programmes that will take years to fully implement. There are a number of immediate 'quick wins' that can be implemented to begin addressing the Enabling Pillars. They focus on mainstreaming climate resilience and low carbon development into initiatives that are currently underway.

1. **Institutional Framework:** Use the Integrated Development Programme (IDP) to facilitate implementation of climate resilient low carbon development in rural areas, incorporating the Vision 2020 Umurenge Programme. Sectors are already working together to improve development in rural areas and the Rural Development Task Force can be used to incorporate climate resilience into the IDP.
2. **Finance:** Operationalise the National Fund for Climate and Environment (FONERWA) to facilitate access to international climate finance, especially Fast Start Finance for adaptation. Capacity and finance will be required to make it operational and start channeling climate finance into implementation.
3. **Integrated Planning and Data Management:** Implement regular measuring and reporting of energy use across sectors to develop a GHG emissions profile and future energy requirements. More accurate knowledge of energy demands will enable better short and long term planning of energy resource management. This will also support applications for climate finance which require that GHG emissions are Measurable, Reportable and Verifiable (MRV).
4. **Capacity Building:** Expand Technical and Vocational Educational and Training (TVET) to develop skills needed for the Strategy implementation. The Workforce Development Agency has proposed a TVET qualifications framework which will facilitate the development of new qualifications in areas such as renewable energy, agroforestry and irrigation.

5. **Knowledge Management:** Set up an online Climate Portal to communicate the National Strategy to the public and international community, thereby raising awareness and facilitating knowledge sharing. This has been done successfully by India and South Korea and is particularly important for adaptation as all Rwandans need to take steps to become climate resilient.
6. **Technology:** Use the Strategy to complete the UNEP Technology Needs Assessment already underway to speed up technology transfer for key sectors of the economy, particularly energy, water and agriculture.
7. **Infrastructure:** Implement resource efficient design in the Special Economic Zone (SEZ) in Kigali which is in the first stage of construction. This will include energy efficiency lighting, energy and water metering, wastewater recycling and recycling of other waste products. The SEZ guarantees reliable electricity supply to businesses, and this should be generated from renewable sources.

The roadmap for implementation as outlined above, can be summarised in Figure 19. Details of each Programme of Action are given in at the end of this Strategy and they include a simple timeline which needs to be worked out in more detail. The enabling pillars are ongoing but all need to start with a design phase in early 2012, followed by implementation in 2013 and then operation from then onwards.

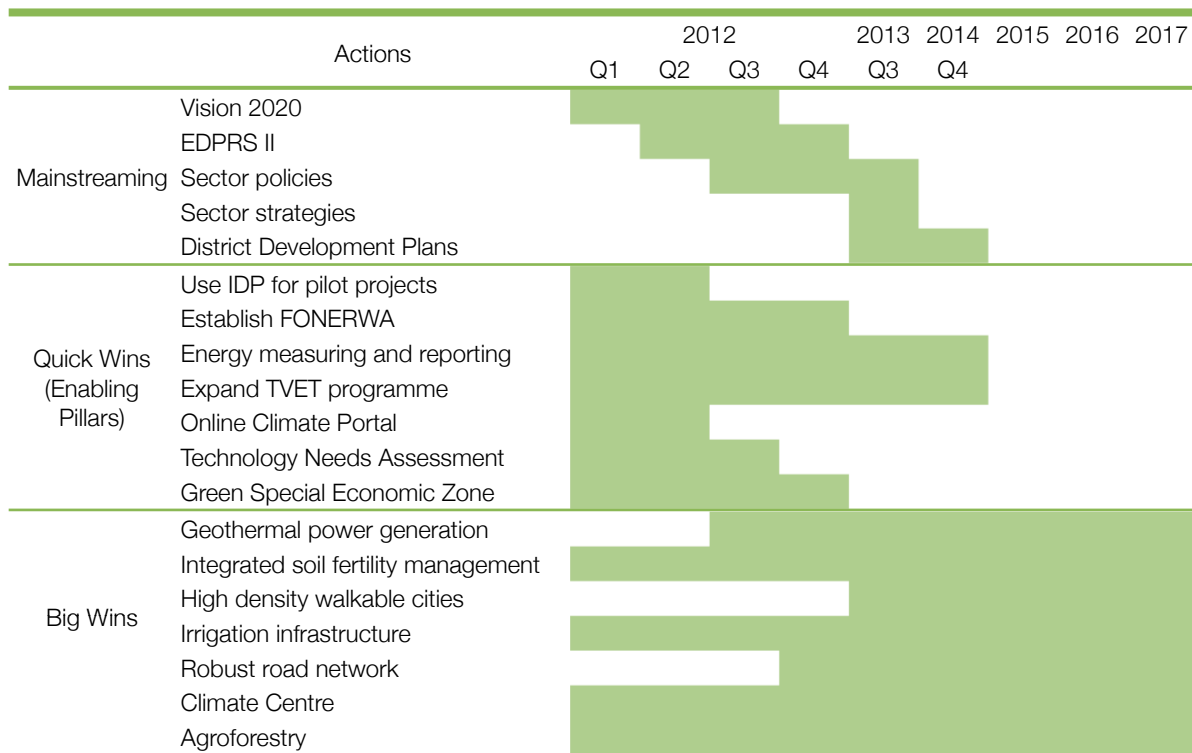


Figure 19: Timeline for mainstreaming climate change into sectors, and implementation of the quick wins and big wins

### 6.3 Further Work

Due to the short timeframe of the development of this Strategy, extra work will be required to develop the Programmes of Action and to explore the issues of health, gender equality, private sector development, economic analyses and future scenarios.

## Health

Infectious human diseases continue to present a significant burden to our public health. Infectious diseases of livestock affect their health and welfare, are themselves important causes of human disease and can threaten food security. These effects occur worldwide, but are disproportionately prevalent in the developing world. A large, but currently unknown, proportion of human and livestock pathogens is influenced by weather or climate and therefore climate change is likely to impact on some of them, possibly exposing human or animal populations to new disease risks. Some diseases may spread but others may retreat in distribution or intensity. The most notable impact of climate change is that higher temperatures permit diseases to occur at higher altitudes. If climate change increases the burden of diseases that are existing major health issues, then we may face exacerbated, major health problems in future that severely test our health services. If, however, climate change mostly affects diseases of only minor importance, while more important infections are refractory to climate change's impacts, then our concerns should be tempered and our health services, may manage to take it in their stride.

The first step in producing a realistic assessment of the impact of climate change on human and animal health in Rwanda is to ask what are the most important diseases in the country? The second step is to ascertain which, if any, of these important diseases have known associations with climate and might be expected, therefore, to be affected by climate change? A desktop study of human and animal health in Rwanda was undertaken as part of this Strategy (Appendix D).

### Animal Health

23 livestock diseases have previously been identified as having highest impact on poor people in East, Southern and Central Africa and affect all major species of livestock and, in many cases, wildlife<sup>[16]</sup>. Nine of these diseases are identified as being sensitive to climate, and hence possibly subject to effects of climate change. The main livestock diseases in Rwanda are bovine tuberculosis, brucellosis, CBPP, FMD, GI helminths, ticks (as ectoparasites), tick-borne diseases and trypanosomiasis<sup>[13]</sup> of these, the last three are likely to be sensitive to climate change.

### Human Health

The Enhanced Infectious Disease (EID) database identified 74 human pathogens known to be present in Rwanda, though only seven are vector borne, the disease-type most sensitive to climate and most likely, therefore, to be affected by climate change. However, it is worth noting that for humans, the majority of the high-impact pathogens present in Rwanda are unlikely to have significant links to climate and, therefore, are unlikely to be susceptible to effects of climate change.

It is imperative to consider the effects of climate change on health in the context of other health drivers (environmental demographic, social and technical change) which may change over similar or shorter time scales. Even if climate change is expected to affect an important disease, its occurrence may be more susceptible to change in other drivers such that, over decadal time scales, the overall impact of climate change is relatively minor. Due to the complexity of the causes of disease, further research on the links between climate change and animal and human health is needed.

The key stakeholder in taking the health programme forward is the Ministry of Health (MOH), supported by the Ministry of Agriculture and Animal Resources (MINAGRI) in the area of animal health.

## Gender Equality

Gender equality is a guiding principle for the Strategy, and a full assessment of how to mainstream gender into the Programmes of Action and Enabling Pillars is necessary to make gender equality a reality. Neither impacts of, nor responses to, climate change are gender-neutral. Gender matters at all levels and scales and in all sectors. Robust analysis is required on gender roles, norms and unequal power relations; risks and opportunities for men, women, boys and girls; resources for developing and implementing gender-sensitive responses; men's and women's needs and preferences; gender-sensitive policy and programme evaluation; and gender-aware and inclusive accountability mechanisms. Gender equality and women's empowerment, the third MDG, is recognised as a condition for the achievement of sustainable development<sup>177</sup>. In Rwanda, it will make a large contribution to addressing the challenge of population growth which impacts on economic growth.

The key stakeholder for mainstreaming gender equality is the Ministry of Gender and Family Promotion (MIGEPROF) which has put in place a National Gender Policy. This policy defines the process of mainstreaming gender needs into all public and private sector policies, programmes, projects and budgets.

## Private Sector Development

The private sector is crucial for economic growth in Rwanda. Further analysis is needed to understand competitiveness and market drivers, particularly for green technologies and renewable energy. Five forces define an industry's structure: competition amongst existing competitors, bargaining power of buyers, bargaining power of suppliers, threat of new entrants and the threat of substitute products or services. Industry structure drives competition and profitability in the medium and long term, though the configuration of the five forces differs by industry<sup>178</sup>. Government policy would benefit from a greater understanding of how the private sector operates in Rwanda and how it can be supported to contribute to low carbon development and climate resilience.

Research was conducted on green businesses in Rwanda during the development of the Strategy. A full report of the findings can be found in Appendix G. The report indicates that private companies cannot only help reduce GHG emissions, but also increase non-farm employment, which was identified in the NAPA as a central measure to adapt to climate change. Although the GoR has implemented a number of policies to promote green investments, more efforts are still needed to overcome existing challenges. Some of the proposed actions in this regard include the following:

- Clearer tax and import duty exemption rules for all efficient energy technology components;
- A government supported microfinance scheme (loan guarantees or grant-per-unit-financed) to help households purchase renewable energy;
- More flexible pricing arrangements for biogas digesters;
- A government-supported low-interest credit line or loan guarantees for renewable energy businesses and installations;
- An increase in the price paid for renewable energy by EWSA to RWF80 or RWF90 per kWh;
- An engineering capacity building programme; and
- Government support for recycling and reuse of economically valuable waste products such as plastics and organic waste for fertilizer and fuel, with an eventual transition to mandatory waste management for households and businesses.

A National Industrial Policy for Rwanda was published in April 2011 by the Ministry of Trade and Industry (MINICOM). It makes three policy statements:

- Government will provide sector-support for existing dynamic clusters to boost domestic production and foster export competitiveness.
- Government will promote future sector with a focus on medium and high-tech industries.
- Government will provide an enabling environment to achieve the above.

The policy is issue-specific and focuses on overcoming barriers to industrialisation and targets key growth clusters. It supports environmental sustainability but it needs to be updated to promote low carbon development and take advantage of the opportunities in climate finance.

The three key stakeholders for private sector development apart from MINICOM are: the Rwanda Development Board (RDB) who provides exporters with trade and market information and investors, advises government of measures to stimulate export trade and acts as a one-stop-shop for investors to reduce the cost of doing business in Rwanda; the Private Sector Federation (PSF) which aims to strengthen the private sector through human capacity building, sourcing sustainable funding, developing member associations and providing dispute arbitration; and the Rwanda Resource Efficient and Cleaner Production Centre (RRECPC) which promotes more efficient use of raw materials, energy and water to ensure a life cycle approach and environmental sustainability.

### Economic Analysis

The Programmes of Action are based on detailed study recorded in the working papers. Although timelines and comparative costs are given, further work is required to quantify, in monetary terms, each of the programmes of action and incorporate them into the macroeconomic and financial projections of the EDPRS and Sector Strategies. Cost-Benefit Analyses (CBAs) should be conducted in an integrated cross-sectoral manner to take into account the costs and benefits of all Rwandan stakeholders. Furthermore, to ensure sustainability of resource consumption, they should account for the costs and benefits that a programme would have on future generations. In order to ensure an optimal distribution of Rwandan resources, CBAs must appraise both market and non-market goods and services. Ecosystem services, including water filtration, water table regulation, erosion mitigation, pollination, pest control and carbon sequestration must be valued. Non-use values, including stakeholders' preferences to preserve a park or protect a species, should be appraised using valuation techniques such as contingent valuation, choice modelling, and revealed preference methods. CBAs that do not account for non-market goods and services are at best incomplete, and at worst, misleading.

CBA will help prioritise the programmes, and develop a timeline for implementation that is both feasible and desirable in light of other macroeconomic goals. The leads and lags between investment in the programmes (building of institutional capacity, economic infrastructure, funding research and other investments) and increases in productivity could have macroeconomic management implications for inflation, balance of payments and unintended resource shifts across sectors. Therefore, it is essential that the various elements of the Strategy be incorporated into economic and financial projections of EDPRS and Sector Strategies. These projections will generate a perspective of the scope for balancing the implementation of the Strategy and other macroeconomic goals of price stability, a viable balance of payments and fiscal sustainability, as well as broad measures of social welfare.

To deal with unavoidable macroeconomic consequences of implementing the Strategy, and ensure time consistency between the implementation of the Strategy and other macroeconomic objectives, the government will need to design a phased implementation plan divided into short-, medium-, and long-term actions. Such a plan will be essential in view of the time needed to build capacity (administrative, technical and logistical), as well as the inevitable challenges of the timing of procurement of external financial resources and essential inputs. For a rough idea of the phased implementation plan, a “timescale to initiation” for each action is included in the programme descriptions.

The cost-benefit analysis must be done across all sectors, with oversight by the Ministry of Finance and Economic Planning (MINECOFIN).

## Future Scenarios

All decisions and plans ‘live’ in the future. Indeed, success in the future relies not on the study of the future but on the success of decisions taken today. The uncertainty of climate change impacts, over the long term, limits the effectiveness of conventional approaches to planning, i.e. forecast-based planning. Forecasting assumes that the future can be predicted, based on a continuation of past and present trends. Forecasting adopts a trend by trend approach and, as such, cannot provide a systemic understanding of the future. Alternative approaches to decision-making under uncertainty that have developed to address the limitations of forecasting in the face of inherent uncertainties include scenarios and visioning. Visioning involves a discursive-analytical and social process that aims to forge a shared sense of the preferred future for a group, organisation or nation. Combined with a backcasting methodology, i.e. working from the future back to the present, the means to achieve progress towards the vision is made concrete through the articulation of a pathway and key milestones.

Scenarios similarly comprise a discursive-analytical and social process but, in contrast to visioning, explore multiple, plausible futures rather than the single, preferred future. Scenarios, in essence, explore where the future might take us. A set of scenarios describes two or more stories of the future context of a group, organisation or nation. Scenarios are purposeful interventions, providing the means to an end, rather than the end, in the form of a set of scenarios (a product/booklet) that are used to achieve some wider purpose (e.g. risk assessment and crisis management, strategic planning, community alignment). Scenarios explore what is beyond the control and direct influence of an organisation. Scenarios provide a method for engaging with uncertainties that manifest in the interplay of macro/exogenous trends. It is important to note that scenarios focus on the context, not the self.

Scenarios have been used for over 50 years to help groups, organisations and nations to think the unthinkable, by revealing and testing deeply-held assumptions about the future that frame today’s issues. Scenarios are not strategy or policy but provide a set of wider conditions that can be used to develop and/or test options. Combining scenarios with visioning provides a robust and more systemic approach to decision-making under uncertainty that is suited to the evidence-based and positivist thrust of governmental policy making and planning. Scenarios and visioning can help organisations avoid the traps of prediction which underpins forecast-based planning and be used to develop early warning systems suited to navigating unpredictable and turbulent changes. With the uncertainties surrounding climate change, as well as the number of regional and global actors and events which will impact the future of Rwanda, the use of scenarios to test and refine the national green growth strategy can help further develop the vision of a thriving nation and inform or test the robustness of the plan. Using a ‘what if’ approach, scenario planning can help identify options for flexibility that will be needed if Rwanda is to be prepared for the variances and challenges presented by climate change.

The key uncertainties for Rwanda that should be used in scenarios are oil price, oil dependency, population growth, urbanisation, temperature increase, rainfall change, energy demand and water demand. Rwanda needs forecasts of energy supply/demand to 2050 with expected shifts in source and associated GHG emissions in order to generate emissions reductions scenarios. Rwanda also needs to account for land and water demand into the future by all sectors and understand the degree of competition for resources between sectors. The Technical Coordinating Committee will be responsible for initiating a future scenarios programme and ensure that all sectors are involved, due to its cross-cutting nature.

## 6.4 Risks to Implementation

This Strategy lays out an ambitious path for development in Rwanda. It aims to contribute to poverty reduction and an improved standard of living for all Rwandans. If all of the Enabling Pillars are put in place, and all the Programmes of Action are implemented, then Rwanda will indeed have a climate resilient low carbon economy by 2050. There are challenges ahead however. The Strategy requires large amounts of finance and human capacity to be implemented. This will require significant support from development partners, civil society and the private sector. As outlined in EDPRS, development of the private sector is crucial for sustainable development in Rwanda and more work needs to be done to encourage foreign direct investment. Capacity building is underway in government but needs to be scaled up to meet the needs of the Strategy. Initially, Rwanda will need technical assistance from the international community, and local staff will need to study and gain work experience abroad until the technical and university courses are up and running in Rwanda. School education and primary health care remain fundamental to development, enabling the creation of a healthy skilled workforce. Rwanda has made much progress in the past decade, but aspires to achieve even more.



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Footnote: CMIP3 output was used by Working Group I of the IPCC in the production of the Fourth Assessment Report (AR4). In running the models different scenarios or 'pathways' of future GHG emissions are used to assess their differing impact on global climate. The scenario used for the results here, 'A1B', can be referred to as a 'medium' emissions scenario; that is, it describes a world with rapid economic and population growth, but with a balance of fossil fuel and renewable energy sources<sup>[8]</sup>. The concentrations of GHGs and associated temperature increase fall towards the middle of the six scenarios; it is used here to give an indication of potential change to Rwanda's climate. The data refer to model grid cells over Rwanda specifically.

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## Detailed Programmes of Action



In order to implement the vision and strategic objectives, Programmes of Action have been designed to address the most important and implementable areas of work. Each programme has been derived from robust stakeholder engagement and research into best practice, which is detailed in the Sector Working Papers (Appendix B). The programmes are summarised in two page briefs in the following pages. The first page explains the specific actions that must be taken and highlights the responsible Ministries and key stakeholders. The second page illustrates (using grey boxes) which strategic objectives are met, which enabling pillars are needed; what key indicators could be used to measure success; an estimate of comparative costs, impact on emissions reduction and climate resilience; an indicative timescale to initiation and programme length; and lists all the potential sources of climate finance that could fund implementation. The most favourable actions are indicated where most of the grey boxes sit on the left hand side of the page. Although these programmes can be allocated to specific Ministries to lead on implementation, they are cross-cutting in nature and multiple sectors are involved in each programme, as shown in table 2.

Table 2: Sectors involved in the Programmes of Action (*lead in bold*)

Programmes of Action	Sectors												
	Agriculture	Water	Land	Built Environment	Transport	Forestry	Mining	Energy	Industry	Health	Education	Local Government	Disaster Management
1. Sustainable intensification of agriculture	✓	✓	✓			✓					✓	✓	✓
2. Agricultural diversity for local and export markets	✓	✓	✓		✓			✓	✓		✓		
3. Integrated Water Resource Management and Planning	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓
4. Sustainable Land Use Management and Planning	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	
5. Low carbon mix of power generation for national grid		✓	✓	✓	✓		✓	✓	✓	✓	✓		✓
6. Sustainable small-scale energy installations in rural areas	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓	
7. Green industry and private sector investment	✓	✓	✓	✓	✓		✓	✓	✓		✓		
8. Climate compatible mining		✓	✓		✓		✓	✓	✓		✓	✓	✓
9. Efficient resilient transport systems	✓		✓	✓	✓		✓	✓	✓	✓	✓	✓	
10. Low carbon urban settlements		✓	✓	✓	✓			✓	✓	✓	✓	✓	✓
11. Ecotourism, Conservation and PES Promotion	✓	✓	✓			✓		✓	✓	✓	✓	✓	✓
12. Sustainable forestry, agroforestry and biomass energy	✓	✓	✓			✓		✓	✓	✓	✓	✓	✓
13. Disaster Management and Disease Prevention	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
14. Climate data and projections	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

## Programme 1: Sustainable Intensification of Agriculture

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### Responsible Stakeholders (lead in bold)

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**MINAGRI, MININFRA, Municipal Authorities, ISAR, Private Sector, NGOs, REMA**

### Summary of Programmes and Actions

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In Rwanda, average farm size is small at 0.7 of a hectare. The sustainable intensification of small-scale agriculture is a key component in building a low carbon and climate resilient agricultural sector. Adaptation, mitigation and agricultural development options can be designed and implemented to counter the negative impacts from climate change and reduce the sectors dependency on fossil-fuels, thus building resilience into agricultural ecosystems. When small-scale production is intensified through agroecology techniques including agroforestry, kitchen gardens, nutrient recycling and water conservation to maximise sustainable food production, the aggregate benefit of small-holdings can be considerable and substantially contribute to national food security. Additional aggregate benefits include improved environmental sanitation, and disaster risk reduction (slope stabilization/flood mitigation) all leading to climate compatible development.

#### *Action 1: Mainstreaming of Agroecology*

Rwanda will mainstream agroecology in the agriculture intensification programme and other natural resource-based livelihood programmers. This action will focus particularly on the Land husbandry, Water harvesting and Hillside irrigation Project (LWH); Integrated Water Resource Management (IWRM) (irrigated rice production); and the One Cow Program to maximise adaptation and mitigation capacity, and build agricultural diversity in current farming systems through an integrated approach to farm design.

#### *Action 2: Resource Recovery and Reuse*

Rwanda will promote recovery and reuse of both organic waste and wastewater. Recycling organic waste is a critical adaptation and mitigation strategy. It improves soil fertility and structure, as compost increases soil water retention and nutrition supply to crops; and it diverts organic waste from waste dumps and landfill sites reducing methane emissions. Wastewater irrigation allows increased food production in urban and peri-urban agriculture during periods of rainfall scarcity. Consequently, urban-regional planning is required to ensure suitable peri-urban areas are identified and maintained as potential agricultural sites for implementation of wastewater irrigation during possible periods of food insecurity due to rainfall scarcity.

#### *Action 3: Fertiliser Enriched Compost*

The agricultural intensification programme in Rwanda is currently dependent on the application of inorganic fertiliser to increase crop yields, although these external inputs produce GHG emissions through the fertiliser manufacturing process and the transportation of fertiliser products. However demand for inorganic fertilisers can be reduced by applying an integrated approach to soil fertility and nutrient management, which employs agroecology, resource recovery and reuse, and fertiliser enriched composts. An integrated approach can significantly lower inorganic fertiliser demand, reduce GHG emissions and increase farm profitability due to reduced input costs for farmers. Such approaches also improve soil structure and the water retention capacity of soils leading to resilient agricultural ecosystems and sustainable food security. Rwanda will promote the use of fertiliser enriched compost. This technique will ensure a more efficient use of inorganic fertilisers, and will add valuable organic matter to soils, which also maximises terrestrial carbon in farm soils.

#### *Action 4: Mainstreaming of "Push-Pull" Strategies (IPM)*

"Push-pull" strategy is a sustainable pest management technique that incorporates a cropping system based on producing multiple crop and fodder yields but which is also designed to control plant parasites and pathogens such as stemborers and striga weed. Rwanda will implement a push-pull system using Napier grass and desmodium legume to manage pests in fields of maize, sorghum, millets and rain-fed rice. "Push-pull" strategies increase maize yield, fix nitrogen into farm soils and provide a continuous supply of cattle fodder from the harvest of Napier grass and desmodium, which improves milk yields of cattle while also reducing methane emission due to improved fodder regimes.



## Strategic Objectives

Energy Security		Food and Water Security	✓	Social Protection and DRR	✓
Low Carbon Development	✓	Protection of Ecosystem	✓	Sustainable Land Use	✓

## Enabling Pillars

Institutional Frameworks	Financial Structures	Capacity Building	Integrated Planning and Data Management	Technology, Research and Infrastructure
✓	✓	✓	✓	✓

## Key Indicators

Action 1: Mainstreaming of Agroecology	% of farms up-taking agroecology technologies
Action 2: Resource Recovery and Reuse	Volume of waste reduction / Compost production
Action 3: Fertiliser Enriched Compost	% of farms applying fertiliser rich compost
Action 4: Mainstreaming of "Push-Pull" Strategies	% of farms up-taking "push-pull" strategies

## Comparative Cost

Action 1: Mainstreaming of Agroecology	Low	Medium	High
Action 2: Resource Recovery and Reuse	Low	Medium	High
Action 3: Fertiliser Enriched Compost	Low	Medium	High
Action 4: Mainstreaming of "Push-Pull" Strategies	Low	Medium	High

## Emissions Reduction

Action 1: Mainstreaming of Agroecology	High	Medium	Low
Action 2: Resource Recovery and Reuse	High	Medium	Low
Action 3: Fertiliser Enriched Compost	High	Medium	Low
Action 4: Mainstreaming of "Push-Pull" Strategies	High	Medium	Low

## Climate Resilience

Action 1: Mainstreaming of Agroecology	High	Medium	Low
Action 2: Resource Recovery and Reuse	High	Medium	Low
Action 3: Fertiliser Enriched Compost	High	Medium	Low
Action 4: Mainstreaming of "Push-Pull" Strategies	High	Medium	Low

## Timescale to Initiation

Action 1: Mainstreaming of Agroecology	Immediate	Short	Medium	Long
Action 2: Resource Recovery and Reuse	Immediate	Short	Medium	Long
Action 3: Fertiliser Enriched Compost	Immediate	Short	Medium	Long
Action 4: Mainstreaming of "Push-Pull" Strategies	Immediate	Short	Medium	Long

## Programme Length

Action 1: Mainstreaming of Agroecology	Ongoing
Action 2: Resource Recovery and Reuse	3 year initiation and development
Action 3: Fertiliser Enriched Compost	Ongoing
Action 4: Mainstreaming of "Push-Pull" Strategies	Ongoing

## Climate Finance Streams

Adaptation Fund - Africa Enterprise Challenge Fund - ClimDev-Africa Special Fund - EIB Post-2012 Carbon Credit Fund - EIB-KfW Carbon Programme II - Global Climate Change Alliance - Global Environmental Facility - Global Facility for Disaster Risk Reduction and Recovery - Hatoyama Initiative - International Climate Initiative - International Climate Fund - International Development Association - KfW Development & Climate Finance - Least Developed Country Fund - Nordic Climate Facility - Public-Private Infrastructure Advisory Facility - Special Climate Change Fund - UNDP Green Commodities Facility - UNDP/MDG Carbon Facility - World Bank Carbon Facility - World Bank Catastrophe Risk Management Facility - Clean Development Mechanism - Voluntary Carbon Markets

## Programme 2: Agricultural Diversity in Local and Export Markets

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Responsible Stakeholders (lead in bold)

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**MINAGRI**, MININFRA, Municipal Authorities, ISAR, Private Sector, NGO's, REMA

### Summary of Programmes and Actions

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Rwanda will expand crop varieties, local markets and manufactured products and exports in support of the sustainable intensification of small-scale farming. This will involve diversifying agricultural production and enhancing the agriculture value chain. Improving the agriculture value chain reduces the sectors dependency on external inputs (fertilizers/food/fuel), while building an agricultural market economy based on added value and import substitution. Rwanda will become more self-sufficient by expanding crop varieties, and will add value to those crops through processing to meet its own market demand. This approach will create employment through the development of small and medium enterprises, thus converting a subsistence-based agriculture sector into a bio-diverse and sustainable agricultural market economy. Other opportunities to add value along the agriculture value chain include the development of niche export crops under organic and fair-trade branding.

#### *Action 1: Expansion of Crop Varieties*

Rwanda will become more self-sufficient by expanding crop varieties to meet its own market demand for food stuffs that are currently imported from regional and international markets. Examples include the introduction of vanilla seeds, apricot saplings, and macadamia plants to the north-central region of Rwanda. Other potential products include under-utilised crops such as the high-yielding fodder crop Russian comfrey, and indigenous African vegetables, which are in high demand and are particularly suited to small-scale farms, as they require low-external-inputs and are resistance to local pest and climatic conditions.

#### *Action 2: Expansion of Local Markets*

In order to meet its own market demand, Rwanda will expand local markets by constructing market infrastructure, including roofed market facilities, serviceable road and transport networks, developing decentralised village-based agricultural processing centres that incorporate low-carbon sources of energy, such as biogas-digesters and solar driers, and decentralised compost plants. This will form a conduit for agricultural-based trade based on less food miles for regionally and internationally imported food products. Strengthening local markets will also build economic resilience in rural areas that is less dependent on linear commodity flows of raw goods leaving rural areas unprocessed and without added value.

#### *Action 3: Expansion of Manufactured Products*

Rwanda will add value to food stuffs through the processing of agricultural products to supply the market demand of a growing population with an increasingly wider demand for processed food items, much of which is currently imported from regional and international suppliers. Processing agricultural products also reduces post-harvest loss due to insufficient storage or cold-chain facilities, particularly with high value and perishable fruits and vegetable crops. Expansion of manufactured products will best be achieved through the development of decentralised village-based agriculture processing centres using a range of appropriate technologies that incorporate low-carbon sources of energy, such as biogas-digesters and solar driers.

#### *Action 4: Expansion of Exports*

To create additional export opportunities, Rwanda will develop niche export crops under organic and fair-trade branding, such as organic and fair-trade tea, coffee and sugar. Such initiatives, including 'Greening the Tea' initiative will increase adaptive capacity while reducing greenhouse gas emissions (mitigation) by addressing not only crop production, but also processing technologies that are currently energy and bio-mass intensive. Developing adaptation capacity in the export crop sector will also increase resilience to future temperature changes which are already impacting on coffee production in Kenya.

## Strategic Objectives

Energy Security		Food and Water Security	✓	Social Protection and DRR	✓
Low Carbon Development	✓	Protection of Ecosystem	✓	Sustainable Land Use	✓

## Enabling Pillars

Institutional Frameworks	Financial Structures	Capacity Building	Integrated Planning and Data Management	Technology, Research and Infrastructure
✓	✓	✓	✓	✓

## Key Indicators

Action 1: Expansion of Crop Varieties	<i>% of farms adopting crops</i>
Action 2: Expansion of Local Markets	<i>No. of markets constructed/national product flows</i>
Action 3: Expansion of Manufactured Products	<i>% of districts with product manufacturing capacity</i>
Action 4: Expansion of Exports	<i>% of agricultural production of niche export crops</i>

## Comparative Cost

Action 1: Expansion of Crop Varieties	Low	Medium	High
Action 2: Expansion of Local Markets	Low	Medium	High
Action 3: Expansion of Manufactured Products	Low	Medium	High
Action 4: Expansion of Exports	Low	Medium	High

## Emissions Reduction

Action 1: Expansion of Crop Varieties	High	Medium	Low
Action 2: Expansion of Local Markets	High	Medium	Low
Action 3: Expansion of Manufactured Products	High	Medium	Low
Action 4: Expansion of Exports	High	Medium	Low

## Climate Resilience

Action 1: Expansion of Crop Varieties	High	Medium	Low
Action 2: Expansion of Local Markets	High	Medium	Low
Action 3: Expansion of Manufactured Products	High	Medium	Low
Action 4: Expansion of Exports	High	Medium	Low

## Timescale to Initiation

Action 1: Expansion of Crop Varieties	Immediate	Short	Medium	Long
Action 2: Expansion of Local Markets	Immediate	Short	Medium	Long
Action 3: Expansion of Manufactured Products	Immediate	Short	Medium	Long
Action 4: Expansion of Exports	Immediate	Short	Medium	Long

## Programme Length

Action 1: Expansion of Crop Varieties	<i>Ongoing</i>
Action 2: Expansion of Local Markets	<i>Ongoing</i>
Action 3: Expansion of Manufactured Products	<i>Ongoing</i>
Action 4: Expansion of Exports	<i>Ongoing</i>

## Climate Finance Streams

Adaptation Fund - Africa Enterprise Challenge Fund - ClimDev Africa Special Fund - DEG – Deutsche Investitions - Global Climate Change Alliance - Global Environmental Facility - Hatoyama Initiative - International Climate Initiative - International Climate Fund - International Development Association - KfW Development & Climate Finance - Least Developed Country Fund - Nordic Climate Facility - Public-Private Infrastructure Advisory Facility - Special Climate Change Fund - UNDP Green Commodities Facility

## Programme 3: Integrated Water Resource Management

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### Responsible Stakeholders (lead in bold)

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**RNRA**, MINIRENA, MININFRA, EWSA, REMA, MINALOC, MOH

### Summary of Programmes and Actions

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Rwanda is endowed with substantial freshwater resources. Regular rainfall patterns and minimal consumption has, until now, not necessitated water storage, irrigation and monitoring. There is a clear gap of observed data and monitoring frameworks for Rwanda's water and climate. The challenges of rapid population growth, increased urbanisation and industry, environmental degradation and pollution are leading to accelerated depletion and degradation of available water resources, while climate change is bringing uncertainty in future supply. Rwanda must consider downstream nations, primarily the beneficiaries of the Kagera basin and riparian states of the Nile. Preserving environmental flows and protecting biodiversity will become increasingly difficult. Establishing a robust Integrated Water Resource Management (IWRM) framework that can better understand current and future abstraction, and better plan for and respond to impacts of climate change is crucial to securing the nation's water resources.

#### *Action 1: Establish National Integrated Water Resource Management (IWRM) framework*

Rwanda will prioritise establishing a robust national framework for Integrated Water Resource Management (IWRM) that establishes clear roles, responsibilities, and decision-making processes for all water-related activities across the relevant sectors for improved coordination. The national framework will be coordinated by the Integrated Water Resources Management Department under the Rwanda Natural Resources Authority. An Inter-Ministerial Council will facilitate participatory mainstreaming processes in water use sectors. The national framework for IWRM will be cascaded down to district and catchment levels. It will include compliance and enforcement, information access policies and custodial arrangements.

#### *Action 2: District and Community Based Catchment Management under National IWRM Framework*

As part of the National Land Use Planning and IWRM framework, Rwanda will integrate management of water resources at the district and community levels, define catchment wide responsibilities, cluster catchment partner-districts according to sub-catchment regions, and improve understanding of water users within districts and catchments. These actions will ensure a common management and service delivery framework. Water User Associations will also be established to ensure responsible and equitable water use at the community level.

#### *Action 3: Understanding the Water Balance: Monitoring, Modeling and Analysis, Information Management*

To allow precise planning of water resources and improved allocation, Rwanda will develop water balances at district and catchment levels, supported by hydrological models, improved rainfall monitoring, a better understanding of agro-meteorology and water quality testing. The important national water datasets will be identified to enable monitoring of the water balance, model abstraction and future demand. Furthermore, assessments will be undertaken of water resources under a range of climate change scenarios.

#### *Action 4: Water security through efficiency and conservation*

Rwanda will establish a comprehensive National Water Security Plan to expand water storage and irrigation infrastructure, rainwater harvesting, water conservation and water efficiency practices. The plan will bring together the national policies and strategies for irrigation, water supply and sanitation, IWRM and energy. Rwanda will investigate available water efficient use and water recycling technologies, and water conservation practices for domestic, industrial and agricultural uses. Rwanda will mainstream water saving technologies and practices into the planning system, EIA/EMPs and building codes.

### Strategic Objectives

Energy Security		Food and Water Security	✓	Social Protection and DRR	✓
Low Carbon Development	✓	Protection of Ecosystem	✓	Sustainable Land Use	✓

### Enabling Pillars

Institutional Frameworks	Financial Structures	Capacity Building	Integrated Planning and Data Management	Technology, Research and Infrastructure
✓	✓	✓	✓	✓

### Key Indicators

Action 1: Establish National IWRM Framework	<i>framework in place</i>
Action 2: Community Water Management	<i>community level framework implemented</i>
Action 3: Understanding the Water Balance	<i>district and catchment water balances in place</i>
Action 4: Water Security	<i>% water efficiency achieved</i>

### Comparative Cost

Action 1: Establish National IWRM Framework	Low	Medium	High
Action 2: Community Water Management	Low	Medium	High
Action 3: Understanding the Water Balance	Low	Medium	High
Action 4: Water Security	Low	Medium	High

### Emissions Reduction

Action 1: Establish National IWRM Framework	High	Medium	Low
Action 2: Community Water Management	High	Medium	Low
Action 3: Understanding the Water Balance	High	Medium	Low
Action 4: Water Security	High	Medium	Low

### Climate Resilience

Action 1: Establish National IWRM Framework	High	Medium	Low
Action 2: Community Water Management	High	Medium	Low
Action 3: Understanding the Water Balance	High	Medium	Low
Action 4: Water Security	High	Medium	Low

### Timescale to Initiation

Action 1: Establish National IWRM Framework	Immediate	Short	Medium	Long
Action 2: Community Water Management	Immediate	Short	Medium	Long
Action 3: Understanding the Water Balance	Immediate	Short	Medium	Long
Action 4: Water Security	Immediate	Short	Medium	Long

### Programme Length

Action 1: Establish National IWRM Framework	<i>1 year initial, 2 years expand role, ongoing</i>
Action 2: Community Water Management	<i>2 years initial phase, ongoing</i>
Action 3: Understanding the Water Balance	<i>2 year initial phase, ongoing</i>
Action 4: Water Security	<i>3 year initial program, ongoing</i>

### Climate Finance Streams

Adaptation Fund - ClimDev-Africa Special Fund - Global Climate Change Alliance - Global Environmental Facility - Global Facility for Disaster Risk Reduction and Recovery - Hatoyama Initiative - International Climate Initiative - International Climate Fund - International Development Association - KfW Development & Climate Finance - Least Developed Country Fund - Nordic Climate Facility - Public-Private Infrastructure Advisory Facility - Special Climate Change Fund

## Programme 4: Integrated Approach to Land Use Planning and Sustainable Land Use Management

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### Responsible Stakeholders (lead in bold)

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**Department of Lands and Mapping** under RNRA, MINIRENA, Land Commissions, Land Bureaux, MINAGRI, MINALOC, MOH

### Summary of Programmes and Actions

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Adapting to climate change and achieving a low carbon growth is contingent on ensuring land tenure security and instigating a robust integrated framework for development planning and sustainable land management. Tenure gives landowners responsibility to manage their land in accordance to planning codes, access to equity markets, and the economic incentive to improve the asset. To achieve these goals, improved land information management is essential.

#### *Action 1: Integrated Approach to Planning and Sustainable Land Use Management*

Competition for land will continue to grow with increasing pressures from agriculture and livestock. Encroachment on sensitive areas will persist until land reforms are completed. Rwanda will implement a rigorous planning and zoning regulatory framework to manage the changing demands on land. The key steps in achieving an integrated framework for land use planning and sustainable land use management will be to promulgate the land use planning law; elaborate the District Detail Plans (DDPs) under the National Land Use and Development Master Plan; provide integrated land use planning decision support; and employ Strategic Environment Assessments (SEAs) for key Development Zones and ecologically sensitive areas.

#### *Action 2: Rwanda Spatial Data Infrastructure: National Land Information Management and Information Sharing and Access Policy*

Rwanda's next priority will be to develop National Spatial Data Infrastructure (SDI). A plan is urgently required to manage the nation's land information resources and to identify the fundamental datasets required to manage land and water resources, monitor land use and environmental change, support economic development, and enable Rwanda to better plan, monitor, and respond to the impacts of climate change. The Rwanda Natural Resources Authority (RNRA) offers an opportunity to spur improved management of natural resource datasets. Other sectors maintain key national data sets that also must be managed, made accessible, and kept up to date. To develop its SDI, Rwanda will establish a National Information Sharing and Access Policy, a National SDI Strategy, a detailed national features map, and ongoing monitoring of land use and environmental change.

#### *Action 3: GIS/ICT Innovation throughout Government, Districts and Implementing Agencies*

Land Use Planning and Sustainable Land Management demands integrated analysis of various datasets including land use, zoning, administrative boundaries, roads, population and health, environment, soils and geology, hydrology, and elevation. By harnessing GIS and ICT technologies, Rwanda will enable national government and district offices to avoid uncontrolled development, increased energy demand and emissions, inefficient transport systems, over burdened water and sanitation systems, environmental degradation and loss of biodiversity, food insecurity, health impacts and reduced livelihoods. In order to foster professionals with the skill sets required to understand and respond to these demands, Rwanda will build a GIS user community, and a District Planning Capacity program. Planning partnerships will be established between national and district government offices to ensure a common service delivery framework. Such technology diffusion will build on the National ICT Plan (NICI III) and advance Government to Government (G2G), Government to Business (G2B), and Business to Business (B2B) ICT components of a knowledge based economy.

### Strategic Objectives

Energy Security	✓	Food and Water Security	✓	Social Protection and DRR	✓
Low Carbon Development	✓	Protection of Ecosystem	✓	Sustainable Land Use	✓

### Enabling Pillars

Institutional Frameworks	Financial Structures	Capacity Building	Integrated Planning and Data Management	Technology, Research and Infrastructure
✓	✓	✓	✓	✓

### Key Indicators

Action 1: Integrated Planning & Land Use Management	<i>Operational Inter-Ministerial Council and National Water Authority</i>
Action 2: Rwanda Spatial Data Infrastructure	<i>Organisational structure populated</i>
Action 3: GIS/ICT Innovation: Central & Local Govt.	<i>Completed Water Balance at national and district levels</i>

### Comparative Cost

Action 1: Integrated Planning & Land Use Management	Low	Medium	High
Action 2: Rwanda Spatial Data Infrastructure	Low	Medium	High
Action 3: GIS/ICT Innovation: Central & Local Govt.	Low	Medium	High

### Emissions Reduction

Action 1: Integrated Planning & Land Use Management	High	Medium	Low
Action 2: Rwanda Spatial Data Infrastructure	High	Medium	Low
Action 3: GIS/ICT Innovation: Central & Local Govt.	High	Medium	Low

### Climate Resilience

Action 1: Integrated Planning & Land Use Management	High	Medium	Low
Action 2: Rwanda Spatial Data Infrastructure	High	Medium	Low
Action 3: GIS/ICT Innovation: Central & Local Govt.	High	Medium	Low

### Timescale to Initiation

Action 1: Integrated Planning & Land Use Management	Immediate	Short	Medium	Long
Action 2: Rwanda Spatial Data Infrastructure	Immediate	Short	Medium	Long
Action 3: GIS/ICT Innovation: Central & Local Govt.	Immediate	Short	Medium	Long

### Programme Length

Action 1: Integrated Planning & Land Use Management	<i>2 years, ongoing</i>
Action 2: Rwanda Spatial Data Infrastructure	<i>1 year, ongoing</i>
Action 3: GIS/ICT Innovation: Central & Local Govt.	<i>1 year pilot districts, 2 years scale up, ongoing</i>

### Climate Finance Streams

Adaptation Fund - ClimDev Africa Special Fund - Global Climate Change Alliance - Global Environmental Fund - Global Facility for Disaster Risk Reduction and Recovery - Hatoyama Initiative - International Climate Initiative - International Development Association - KfW Development & Climate Finance - Least Developed Country Fund - Special Climate Change Fund

## Programme 5: Low Carbon Energy Mix Powering the National Grid

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Responsible Stakeholders (lead in bold)

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**MININFRA**, EWSA, RURA, Private Sector

### Summary of Programmes and Actions

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Increasing the supply, access and stability of electricity in Rwanda is essential for achieving the Millennium Development Goals and maintaining economic growth. Rwanda will implement a programme for sustainable power generation for the national grid based around four implementable actions: a strategy to phase out fossil fuels, incentivising private sector investment in renewable electricity, renewable energy norms and codes of practice, and a long-term strategy to phase out peat.

#### *Action 1: Strategy for Oil-Fuelled Generation Phase Out*

Rwanda will make the most out of its domestic renewable energy potential in order to reduce reliance on imports. Diesel generation of electricity for the national grid will be phased out as soon as possible. Geothermal development will be a national priority, and the level of generation from methane to power will also increase. Total volume of hydropower electricity generation will increase, whilst its overall share of the generation mix will decrease relative to geothermal and methane in order to reduce vulnerability to hydrological risks. Rwanda's peat resource will be utilised as a stopgap measure if delays occur in the development of other resources, and to quickly reduce the share of diesel generation in the energy mix. Regional connections will be developed so that electricity can be both exported and imported where required. Energy efficiency will also be an integral part of the strategy. Policies will be implemented to efficient electrical products, and in the area of power transmission, efficiency will be improved by applying a distributed power structure to the electricity grid to minimise losses by providing power in proximity to its use.

#### *Action 2: Incentivise Private Investment in Renewable Electricity*

Rwanda will provide feed-in tariffs and long-term power purchase agreements (PPAs) to provide a secure investment environment for independent power producers (IPPs) by guaranteeing long-term procurement of the energy produced at a fixed-rate. A law will be passed stating that once the grid is expanded to include an area with private electricity producers, the utility will either purchase the technology outright, or it will begin procuring the electricity via the feed-in tariff. This law will remove the danger facing IPPs that grid extension could undermine their business. International funding will be sought to supplement the feed-in tariff rate while risk financing will be sought and employed to underwrite PPAs. Secure affordable financing for IPPs could be set higher for renewable electricity.

#### *Action 3: Renewable Energy Norms and Codes of Practice*

Most renewable energy technologies in Rwanda are in relatively early stages of development, and norms and codes of practice still need to be developed. Rwanda will implement safety guidelines, rules for compensation of those potentially affected by a project, rules for private sector involvement, maintenance strategies and productive end uses. Implementing these regulations will remove uncertainty for private sector investors and project developers. This initiative could be supported by a Centre of Excellence in Energy Research.

#### *Action 4: Strategy for Peat Phase Out*

Peat is a domestic, cheap and easily exploited source of energy. Rwanda will utilise peat to make up the supply if delays occur in the development of other resources, and to quickly reduce the share of diesel generation in the energy mix. However, there are a number of issues with the use of peat for energy including potential conflict with other land uses, its finite supply, and its negative environmental impacts. Rwanda will exploit other domestic sources of energy to avoid developing a dependence on peat, and once other sources of energy have been sufficiently developed peat will be phased out.



## Strategic Objectives

Energy Security	✓	Food and Water Security	Social Protection and DRR
Low Carbon Development	✓	Protection of Ecosystem	Sustainable Land Use

## Enabling Pillars

Institutional Frameworks	Financial Structures	Capacity Building	Integrated Planning and Data Management	Technology, Research and Infrastructure
✓	✓	✓	✓	✓

## Key Indicators

Action 1: Strategy for Oil-Fuelled Generation Phase Out	% diesel generation mix
Action 2: Incentivise Private Investment in Energy	% electricity generated by IPPs
Action 3: Renewable Energy Codes of Practice	% compliance to codes of practice
Action 4: Strategy for Peat Phase Out	% peat in energy mix

## Comparative Cost

Action 1: Strategy for Oil-Fuelled Generation Phase Out	Low	Medium	High
Action 2: Incentivise Private Investment in Energy	Low	Medium	High
Action 3: Renewable Energy Codes of Practice	Low	Medium	High
Action 4: Strategy for Peat Phase Out	Low	Medium	High

## Emissions Reduction

Action 1: Strategy for Oil-Fuelled Generation Phase Out	High	Medium	Low
Action 2: Incentivise Private Investment in Energy	High	Medium	Low
Action 3: Renewable Energy Codes of Practice	High	Medium	Low
Action 4: Strategy for Peat Phase Out	High	Medium	Low

## Climate Resilience

Action 1: Strategy for Oil-Fuelled Generation Phase Out	High	Medium	Low
Action 2: Incentivise Private Investment in Energy	High	Medium	Low
Action 3: Renewable Energy Codes of Practice	High	Medium	Low
Action 4: Strategy for Peat Phase Out	High	Medium	Low

## Timscale to Initiation

Action 1: Strategy for Oil-Fuelled Generation Phase Out	Immediate	Short	Medium	Long
Action 2: Incentivise Private Investment in Energy	Immediate	Short	Medium	Long
Action 3: Renewable Energy Codes of Practice	Immediate	Short	Medium	Long
Action 4: Strategy for Peat Phase Out	Immediate	Short	Medium	Long

## Programme Length

Action 1: Strategy for Oil-Fuelled Generation Phase Out	Development: 0-2 years, implementation: 2-5 years
Action 2: Incentivise Private Investment in Energy	2-year initiation phase, implementation: ongoing
Action 3: Renewable Energy Codes of Practice	Development: 0-2 years, implementation: ongoing
Action 4: Strategy for Peat Phase Out	Development: 0-2 years, implementation: 2-5 years

## Climate Finance Streams

AfDB Sustainable Energy Fund for Africa - Africa Enterprise Challenge Fund - Africa Infrastructure Investment Fund - Climate Finance Innovation Facility - Clean Technology Fund - ClimDev-Africa Special Fund - DEG - Deutsche Investitions - EIB Post-2012 Carbon Facility - EIB-KfW Carbon Programme II - Global Climate Change Alliance - Global Energy Efficiency and Renewable Energy Fund - Global Environment Facility - Hatoyama Initiative - International Climate Change Initiative - International Climate Fund - International Development Association - KfW Development and Climate Finance - Least Developed Country Fund - Nordic Development Fund - Private Infrastructure Development Group - Public Private Infrastructure Advisory Facility - Seed Capital Assistance Facility - UNDP/MDG Carbon facility - UNEP Renewable Energy Enterprise Development Programme - World Bank Carbon Facility - Clean Development Mechanism

## Programme 6: Sustainable Small Scale Energy Installations in Rural Areas

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Responsible Stakeholders (lead in bold)

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**MININFRA**, EWSA, RURA, Private Sector

### Summary of Programmes and Actions

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Off-grid or mini-grid generation potential should be utilised to increase access to electricity in rural areas. This strategy should be seen as pre-electrification and complementary to the grid expansion plans. Rwanda will increase development of small scale generation in rural areas by encouraging private sector involvement through performance-based grants and incentives for consumer finance; maximising energy project potential through high load factors and appropriate maintenance; and building consumer confidence through demonstration and product standards. The end goal of these actions is a commercially-viable model for rural electrification.

#### *Action 1: Private Sector Involvement*

Private sector involvement can accelerate the diffusion of small scale renewable generation projects into rural areas. Rwanda will encourage private sector involvement in a number of ways. Firstly, it will remove import and VAT taxes on renewable technology components. Secondly, it will set up a grant-per-unit-sold scheme to incentivise private companies to invest in solar products and biogas digesters. Thirdly, in order to overcome the barrier of high up-front costs for consumer, the GoR will encourage credit institutions – banks, microfinance institutions, savings and credit cooperatives (SACCOs) – to extend consumer finance to those that want to purchase renewable energy technologies such as solar home systems and biogas digesters. The GoR will encourage lending through either partial loan guarantee, in which it would assume the risk of a certain percentage of clients defaulting, or a grant-per-unit-financed scheme. Lastly, the GoR will extend loan guarantees to buy down the interest rates of loans for renewable energy enterprises, such as micro hydro engineering companies, mini-grid operators, and solar and biogas retailers. Alternatively, the new Climate and Environment Fund, FONERWA, could extend concessional loans to such enterprises. As mini-grid and off-grid systems have high capital costs, grants should incentivise or require the use of efficient end-use technologies.

#### *Action 2: Maximisation of Energy Project Potential*

Currently, significant generation potential is lost through poor maintenance, or because projects are financially unsustainable. For example, to be financially viable, micro hydro projects must operate with a high load factor. To ensure this high load factor, consideration will be given to productive end-uses of the energy during the planning of future micro hydro programmes. For example, a hydro plant could be developed in tandem with an “anchor consumer” such as a mill, school, or tea plantation that will make up the bulk of the load factor. Once the load factor is guaranteed, it will be then possible to consider construction of a mini-grid. Productive end-use strategies should therefore be the norm. Night-time use for electricity, such as battery charging stations uses, will also be considered. Maintenance strategies are crucial to the success of any energy project. Local technical and managerial capacity will be built, and where a private company is receiving a grant-per-unit-sold, a portion could be made conditional upon the product working after a certain number of years.

#### *Action 3: Build Consumer Confidence*

Creating consumer confidence and awareness in renewable energy technologies is essential to promote uptake, particularly for solar technologies, pico hydro and biogas digesters. Product standards, drawn from established international standards such as those set by the Lighting Africa Initiative, will be implemented to ensure quality. In partnership with the private sector and research institutes such as KIST and CITT, the government will hold marketing events to disseminate information about benefits of renewables and the health and environmental pitfalls of traditional fuels; and will implement demonstration projects to promote consumer awareness and test the suitability of products for specific communities.

## Strategic Objectives

Energy Security	✓	Food and Water Security	Social Protection and DRR	✓
Low Carbon Development	✓	Protection of Ecosystem	Sustainable Land Use	

## Enabling Pillars

Institutional Frameworks	Financial Structures	Capacity Building	Integrated Planning and Data Management	Technology, Research and Infrastructure
✓	✓	✓	✓	✓

## Key Indicators

Action 1: Private Sector Involvement	# and size of private renewable energy enterprises
Action 2: Maximisation of Energy Project Potential	Load factors, failure rates
Action 3: Build Consumer Confidence	Product uptake rates

## Comparative Cost

Action 1: Private Sector Involvement	Low	Medium	High
Action 2: Maximisation of Energy Project Potential	Low	Medium	High
Action 3: Build Consumer Confidence	Low	Medium	High

## Emissions Reduction

Action 1: Private Sector Involvement	High	Medium	Low
Action 2: Maximisation of Energy Project Potential	High	Medium	Low
Action 3: Build Consumer Confidence	High	Medium	Low

## Climate Resilience

Action 1: Private Sector Involvement	High	Medium	Low
Action 2: Maximisation of Energy Project Potential	High	Medium	Low
Action 3: Build Consumer Confidence	High	Medium	Low

## Timscale to Initiation

Action 1: Private Sector Involvement	Immediate	Short	Medium	Long
Action 2: Maximisation of Energy Project Potential	Immediate	Short	Medium	Long
Action 3: Build Consumer Confidence	Immediate	Short	Medium	Long

## Programme Length

Action 1: Private Sector Involvement	Ongoing
Action 2: Maximisation of Energy Project Potential	Development: 0-3 years, implementation: ongoing
Action 3: Build Consumer Confidence	Development: 0-3 years, implementation: ongoing

## Climate Finance Streams

Adaptation Fund - AfDB Sustainable Energy Fund for Africa - Africa Enterprise Challenge Fund - Africa Infrastructure Investment Fund - Climate Finance Innovation Facility - Clean Technology Fund - ClimDev-Africa Special Fund - DEG - Deutsche Investitions - EIB Post-2012 Carbon Facility - EIB-KfW Carbon Programme II - Global Climate Change Alliance - Global Energy Efficiency and Renewable Energy Fund - Global Environment Facility - Hatoyama Initiative - International Climate Change Initiative - International Climate Fund - International Development Association - KfW Development and Climate Finance - Least Developed Country Fund - Nordic Development Fund - Private Infrastructure Development Group - Public Private Infrastructure Advisory Facility - Seed Capital Assistance Facility - UNDP/MDG Carbon facility - UNEP Greening the Tea Initiative - UNEP Renewable Energy Enterprise Development Programme - World Bank Carbon Facility - Clean Development Mechanism- Voluntary Carbon Markets

## Programme 7: Green Industry and Private Sector Development

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### Responsible Stakeholders (lead in bold)

**MINICOM**, Rwanda Development Board (RDB), MININFRA, RNRA, MINIRENA, NLC, OGMR, REMA, MINAGRI, PSF, UNIDO-UNEP, World Bank Group

### Summary of Programmes and Actions

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Rwanda is actively improving its investment climate by improving start-up and operating conditions for business and industry, addressing water and energy requirements, and establishing special economic zones (SEZs) to attract foreign investment. Resource efficient and clean production has been introduced to industry in Rwanda and needs to be scaled up to improve energy and water efficiency, thus reducing emissions and promoting resilience. SEZs should employ energy efficient technologies, water recycling and waste management systems, and low carbon building design. Climate innovation centres (CICs) can promote win-win scenarios by supporting investment in industries producing green technologies and those adopting green technology. infoDev has proposed setting up a CIC in Kigali. Support for the private sector is needed to reduce industry emissions and build a local renewable energy sector.

#### *Action 1: Resource Efficient Industries*

The Rwanda Resource Efficient and Cleaner Production Centre (RRECPC) is a joint project of the Ministry of Trade and Industry (MINICOM) and UNIDO-UNEP housed in the Private Sector Federation. Resource efficiency and cleaner production methods can reduce business risk, directly translate into cost savings, and could promote sector growth. To build efficient industries, Rwanda will establish a framework for reporting energy and water use, setting energy intensity targets, investigating differentiated electricity tariffs that promote off-peak use, and developing guidelines, standards and support for clean production.

#### *Action 2: Greening the Special Economic Zone and provincial industrial parks*

Rwanda is establishing a Special Economic Zone (SEZ), a world-class business and industrial park in Kigali, to attract foreign direct investment. It is also implementing provincial industrial parks in other urban centres. It is timely that a green approach is considered in preparation of the SEZ and industrial parks to encourage energy and water efficiency; green site preparation, industrial and building design; and to investigate waste treatment options. Rwanda will implement a green SEZ to realise 'triple-win' opportunities: cost savings in production and operation, environmental benefits, and climate resilience. These opportunities will help promote investment in the site, incentivise good practice, and attract key industries that will support Rwanda's development of a low carbon green economy.

#### *Action 3: Promoting Green Technologies*

Climate Innovation Centres assist developing countries to accelerate the deployment of low carbon and adaptive technologies, companies and industries. They link green small- and medium- enterprises (SMEs) with support organisations, incubators, centres of excellence, and multilateral programmes; identify institutional and capacity gaps; and explore early stage climate finance opportunities. By hosting a Climate Innovation Centre within the SEZ, Rwanda will benefit from the advisory and support services provided. Beyond these services, technology transfer is crucial to low carbon industrial growth. The government will work with the UNEP-Risoe Technology Transfer Programme to identify priority sectors and technologies specific to Rwanda. The Private Sector Federation will also promote green technology industries by establishing SME and private sector support programmes for technology awareness.

#### *Action 4: Building Carbon Trading Capacity*

The Clean Development Mechanism and voluntary carbon markets offer innovative funding opportunities for the private sector in renewable energy, energy efficiency, low carbon building and transport, forestry, and organic waste management. To fulfill the highly technical requirements, Rwanda will establish a training programme for the private sector, linked to the CIC, on project design, baseline calculations, carbon accounting, and monitoring, reporting and verification.

### Strategic Objectives

Energy Security	✓	Food and Water Security	✓	Social Protection and DRR	
Low Carbon Development	✓	Protection of Ecosystem	✓	Sustainable Land Use	✓

### Enabling Pillars

Institutional Frameworks	Financial Structures	Capacity Building	Integrated Planning and Data Management	Technology, Research and Infrastructure
✓	✓	✓	✓	✓

### Key Indicators

Action 1: Resource Efficient Industries	<i>GHG emissions, water usage</i>
Action 2: Greening the Special Economic Zone	<i>No. of green tech companies started</i>
Action 3: Promoting Green Technologies	<i>No. of new green technologies employed</i>
Action 4: Building Carbon Trading Capacity	<i>No. of carbon projects operational</i>

### Comparative Cost

Action 1: Resource Efficient Industries	Low	Medium	High
Action 2: Greening the Special Economic Zone	Low	Medium	High
Action 3: Promoting Green Technologies	Low	Medium	High
Action 4: Building Carbon Trading Capacity	Low	Medium	High

### Emissions Reduction

Action 1: Resource Efficient Industries	High	Medium	Low
Action 2: Greening the Special Economic Zone	High	Medium	Low
Action 3: Promoting Green Technologies	High	Medium	Low
Action 4: Building Carbon Trading Capacity	High	Medium	Low

### Climate Resilience

Action 1: Resource Efficient Industries	High	Medium	Low
Action 2: Greening the Special Economic Zone	High	Medium	Low
Action 3: Promoting Green Technologies	High	Medium	Low
Action 4: Building Carbon Trading Capacity	High	Medium	Low

### Timscale to Initiation

Action 1: Resource Efficient Industries	Immediate	Short	Medium	Long
Action 2: Greening the Special Economic Zone	Immediate	Short	Medium	Long
Action 3: Promoting Green Technologies	Immediate	Short	Medium	Long
Action 4: Building Carbon Trading Capacity	Immediate	Short	Medium	Long

### Programme Length

Action 1: Resource Efficient Industries	<i>2 years, ongoing</i>
Action 2: Greening the Special Economic Zone	<i>1 year, ongoing</i>
Action 3: Promoting Green Technologies	<i>1 years, 2 years expanding new sites, ongoing</i>
Action 4: Building Carbon Trading Capacity	<i>Ongoing</i>

### Climate Finance Streams

Africa Enterprise Challenge Fund - Clean Technology Fund - Climate Finance Innovation Facility - DEG – Deutsche Investitions - EIB Post-2012 Carbon Credit Fund - EIB-KfW Carbon Programme II - Global Energy Efficiency and Renewable Energy Fund - Hatoyama Initiative - International Climate Initiative - ILO Coop Challenge Fund - International Development Association - KfW Development & Climate Finance - Nordic Climate Facility - Private Infrastructure Development Group - Public-Private Infrastructure Advisory Facility - Seed Capital Assistance Facility - UNDP Green Commodities Facility - UNDP/MDG Carbon Facility - UNDP Renewable Energy Enterprise Development - World Bank Carbon Facility - Clean Development Mechanism - Voluntary Carbon Markets

## Programme 8: Climate Compatible Mining

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### Responsible Stakeholders (lead in bold)

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**MINIRENA**, RNRA, private sector, KIST, PSF, MININFRA, EWSA, FECOMIRWA (federation of cooperatives)

### Summary of Programmes and Actions

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The Rwanda Mining Policy has five strategic pillars that support the growth of the mining industry. If this policy is considered ‘business as usual’ for the next decade, then mining is likely to contribute significantly to energy use, GHG emissions and water use in Rwanda. A sixth strategic pillar – low carbon, climate resilient development – will be added to the Mining Policy with the aim of reducing GHG emissions and improving energy security and water security through energy efficiency, renewable energy, good water management practices and capacity building.

#### *Action 1: Energy Efficiency*

Energy efficiency reduces operating costs and therefore is an attractive approach for the private sector. Rwanda’s first step to improving efficient energy use will be to start measuring and reporting energy usage by source on a monthly basis. Measurements can also be used to calculate GHG emissions for the industry, and will help with national energy supply planning. Once a baseline is determined, Rwanda will set energy intensity reduction targets. Energy efficient technology will be implemented where financially viable, supported by the UNEP-Risoe Technology Transfer Programme. Electricity tariffs could also be negotiated with the private sector to incentivise off-peak use.

#### *Action 2: Renewable Energy*

Electricity is usually the largest source of GHG emissions in mining. If it can be sourced from clean renewable energy, then the industry can transition to low carbon. Rwanda is developing 900MW of large-scale geothermal, hydro and methane, to phase out oil and become energy secure. Mining operations using electricity from the national grid will therefore become low carbon. Mining operations could also install on-site electricity generation such as solar PV and micro-hydro. These technologies have high upfront capital costs, but provide greater reliability, essential for large operations, and reduce operating costs.

#### *Action 3: Water Management*

Good water management reduces water demand and improves water quality which contributes to water security in the catchment where the mining operation is located. It can reduce energy use, and therefore GHG emissions, required for pumping water around an operation. Rwanda’s first step to good water management will be to start measuring and reporting water inputs by source, usage and discharge on a monthly basis. These measurements will form the basis for a site water balance and can contribute to district and national water supply planning. Once a baseline is determined, water efficiency measures will be implemented. These include using water efficient technology and technology transfer, supported by the UNEP-Risoe Technology Transfer Programme. Grey water could also be reused, although water treatment is required to provide potable water and to process water before discharge to rivers. Another important aspect of water management is risk reduction for flooding, which includes hazard mapping, drainage and pumping, early warning systems and site design. This should be done with the local community and government.

#### *Action 4: Capacity Building*

The Mining Policy already addresses the need for capacity building in the mining sector and technical assistance is underway. Rwanda will expand this programme to cover climate change impacts and low carbon development. Engineering courses are required, and mining-specific needs will be addressed with education and training. Mining companies can implement simple employee awareness programmes. The GoR will immediately join the Intergovernmental Forum on Mining, Minerals, Metals and Sustainable Development (IGF) to learn from other countries. It should further investigate setting up a regional forum for Mining and Metallurgy to foster capacity building in the region.

## Strategic Objectives

Energy Security	✓	Food and Water Security	✓	Social Protection and DRR	
Low Carbon Development	✓	Protection of Ecosystem		Sustainable Land Use	✓

## Enabling Pillars

Institutional Frameworks	Financial Structures	Capacity Building	Integrated Planning and Data Management	Technology, Research and Infrastructure
✓	✓	✓	✓	✓

## Key Indicators

Action 1: Energy Efficiency	<i>GHG emissions reduction from 2013 baseline</i>
Action 2: Renewable Energy	<i>GHG emissions reduction from 2013 baseline</i>
Action 3: Water Management	<i>Reduction in water usage in MI from 2013 baseline</i>
Action 4: Capacity Building	<i>Number of personnel completed training courses</i>

## Comparative Cost

Action 1: Energy Efficiency	Low	Medium	High
Action 2: Renewable Energy	Low	Medium	High
Action 3: Water Management	Low	Medium	High
Action 4: Capacity Building	Low	Medium	High

## Emissions Reduction

Action 1: Energy Efficiency	High	Medium	Low
Action 2: Renewable Energy	High	Medium	Low
Action 3: Water Management	High	Medium	Low
Action 4: Capacity Building	High	Medium	Low

## Climate Resilience

Action 1: Energy Efficiency	High	Medium	Low
Action 2: Renewable Energy	High	Medium	Low
Action 3: Water Management	High	Medium	Low
Action 4: Capacity Building	High	Medium	Low

## Timescale to Initiation

Action 1: Energy Efficiency	Immediate	Short	Medium	Long
Action 2: Renewable Energy	Immediate	Short	Medium	Long
Action 3: Water Management	Immediate	Short	Medium	Long
Action 4: Capacity Building	Immediate	Short	Medium	Long

## Programme Length

Action 1: Energy Efficiency	<i>2 years, ongoing</i>
Action 2: Renewable Energy	<i>5 years</i>
Action 3: Water Management	<i>3 years, ongoing</i>
Action 4: Capacity Building	<i>2 years, ongoing</i>

## Climate Finance Streams

Africa Enterprise Challenge Fund - DEF – Deutsche Investitions - EIB Post-2012 Carbon Credit Fund - EIB-KfW Carbon Programme II - Private Infrastructure Development Group - Public-Private Infrastructure Advisory Facility - UNDP/MDG Carbon Facility - World Bank Carbon Facility - Clean Development Mechanism

## Programme 9: Efficient Resilient Transport Systems

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### Responsible Stakeholders (lead in bold)

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**MININFRA**, RTDA, Operators

### Summary of Programmes and Actions

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Transport is a key sector, both in terms of economic development and climate change impacts. With the current transport sector heavily reliant on imported fossil fuels, Rwanda's economy is susceptible to increasingly frequent oil price spikes. Due to the global nature of transport, actions should be integrated with national, regional and global standards. Rwanda will implement a transport programme based around four key actions. It will improve the efficiency of internal combustion engine (ICE) vehicles by applying and tightening vehicle and fuel quality regulations; raise awareness of new technology; increase investment in climate resilient infrastructure; and develop efficient operational and knowledge systems.

#### *Action 1: Improving the efficiency of ICE Vehicles*

Although ICE vehicles are the dominant mode of transportation globally, and will be for the foreseeable future, they are dependent on a high carbon and expensive commodity that suffers from reducing availability. For both environmental and economic reasons, the use of oil must be minimised. With little ability to influence the development of efficient vehicles, the GoR will take an operational approach. It will apply and tighten vehicle regulation, based around annual testing, as a method to ensure current fleet efficiency and safety. Regulation will take a transitional approach, with the application of basic standards at first and increasingly tight and scrutinised standards as fleet improvement progresses. Similar regulations will be enforced on new vehicles and fuel quality. The available policy levers will be carefully considered to facilitate this action.

#### *Action 2: Awareness of new technology*

As mentioned, a major obstacle for Rwanda in developing low carbon transport systems is its limited ability to influence the development and implementation of new technologies. However, Rwanda will undertake studies in preparation for utilisation of suitable new technologies as they are developed. These studies will centre on assessing the suitability of a given technology to the characteristics of Rwanda, indicating the actions required for application, as well as identifying flags in technology development that will result in an action being required by the Government of Rwanda. Studies should take a holistic approach, including not only climate change impacts, but also socio-economic factors and other externalities.

#### *Action 3: Investment in infrastructure*

The quality of transport infrastructure not only affects the efficiency of the transport system, but also its resilience to climatic impacts. Improved infrastructure, such as road surface, both increases efficiency and improves resilience to climatic events. Diversified infrastructure, including inter-modal competition and multiple routes, improves both the efficiency of the system and the robustness of the transport network by reducing the reliance on a single transport mode or route. Rwanda will continue to strengthen the Rwanda Transport Development Agency (RTDA). It will also develop a formula for defining where, in a multimodal system, investment should be directed. Studies will take into account climate impacts and resilience, as well as current socio-economic considerations. The process has already been initiated with the implementation of the Dar-es-Salaam to Kigali Railway project.

#### *Action 4: Developing efficient operational systems*

Whilst Rwanda's main focus will be on physical solutions, such as vehicles and infrastructure, many knowledge systems must also be considered. Demand management and logistical solutions will be investigated in the short term to identify the benefits and inform the need for application. Traffic flow management will be integrated into the planning structure of urban areas, while intelligent transport systems will be considered as a long term option. A detailed study will be conducted covering potential costs and benefits of each option, and an implementation plan with flags indicating when a relevant policy should be applied.



## Strategic Objectives

Energy Security	✓	Food and Water Security	✓	Social Protection and DRR	✓
Low Carbon Development	✓	Protection of Ecosystem	✓	Sustainable Land Use	

## Enabling Pillars

Institutional Frameworks	Financial Structures	Capacity Building	Integrated Planning and Data Management	Technology, Research and Infrastructure
✓	✓	✓	✓	✓

## Key Indicators

Action 1: Improving the efficiency of ICE Vehicles	<i>Reduction in emissions per km</i>
Action 2: Awareness of new technology	<i>Action flags</i>
Action 3: Investment in infrastructure	<i>% km per mode</i>
Action 4: Developing efficient operational systems	<i>Reduction in emissions per km</i>

## Comparative Cost

Action 1: Improving the efficiency of ICE Vehicles	Low	Medium	High
Action 2: Awareness of new technology	Low	Medium	High
Action 3: Investment in infrastructure	Low	Medium	High
Action 4: Developing efficient operational systems	Low	Medium	High

## Emissions Reduction

Action 1: Improving the efficiency of ICE Vehicles	High	Medium	Low
Action 2: Awareness of new technology	High	Medium	Low
Action 3: Investment in infrastructure	High	Medium	Low
Action 4: Developing efficient operational systems	High	Medium	Low

## Climate Resilience

Action 1: Improving the efficiency of ICE Vehicles	High	Medium	Low
Action 2: Awareness of new technology	High	Medium	Low
Action 3: Investment in infrastructure	High	Medium	Low
Action 4: Developing efficient operational systems	High	Medium	Low

## Timescale to Initiation

Action 1: Improving the efficiency of ICE Vehicles	Immediate	Short	Medium	Long
Action 2: Awareness of new technology	Immediate	Short	Medium	Long
Action 3: Investment in infrastructure	Immediate	Short	Medium	Long
Action 4: Developing efficient operational systems	Immediate	Short	Medium	Long

## Programme Length

Action 1: Improving the efficiency of ICE Vehicles	<i>Initial 2 year feasibility study, followed by transitional implementation then ongoing</i>
Action 2: Awareness of new technology	<i>Year long studies in various technologies, activities required when action flags are indicated</i>
Action 3: Investment in infrastructure	<i>Ongoing</i>
Action 4: Developing efficient operational systems	<i>Ongoing</i>

## Climate Finance Streams

Adaptation Fund - Africa Enterprise Challenge Fund - Clean Technology Fund - DEG – Deutsche Investitions - Global Climate Change Alliance - Global Environment Facility - Global Facility for Disaster Risk Reduction and Recovery - Hatoyama Initiative - International Climate Initiative - International Climate Fund - International Development Association - KfW Development & Climate Finance - Nordic Climate Facility - Private Infrastructure Development Group - Public-Private Infrastructure Advisory Facility

## Programme 10: Low Carbon Urban Systems

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### Responsible Stakeholders (lead in bold)

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**MININFRA**, RHA, KCC, Real Estate Developers, Private Sector

### Summary of Programmes and Actions

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With increasing numbers of people inhabiting urban areas of Rwanda, particularly Kigali, it is necessary to implement a long-term plan for urban areas, to ensure that they are low-carbon and therefore sustainable. To achieve this, Rwanda will adopt energy and water efficiency standards into building codes; establish an integrated multi-mode urban transport system; employ low carbon urban planning; and fully utilise urban waste as a resource stream.

#### *Action 1: Low energy buildings and services*

The implementation of low energy standards in buildings and services in Rwanda could result in an 80% reduction in energy use over current global practice. Efficient systems often have higher upfront costs that can be rapidly recovered when compared to more inefficient systems. Rwanda will adopt a national low energy building standard, enshrined in the building codes, to produce the necessary behaviour change in the industry, without costly intervention in the sector by the state. These standards will be built around systems, such as passive housing principles that are technically appropriate, have minimal upfront costs, and little or no operational costs. Such systems take advantage of direct solar gain for heating, insulation and thermal capacity for temperature regulation and shading and ventilation for cooling. The recovery of grey water and rainwater should also be inserted into the building codes to support water efficiency and conservation. The goods and services used within buildings will also be regulated. Efficient technologies, such as solar hot water and distributed power generation, will be championed over inefficient systems such as electric immersion heaters.

#### *Action 2: Integrated Multi-mode Urban Transport*

The adoption of urban transport systems will not only reduce carbon emissions, but lower barriers to access for transport, increasing the mobility of the population and thus opportunities for economic development. It is crucial that transport networks are heavily linked to urban planning through transit orientated developments to maximise the level of access to costly infrastructure. Rwanda will implement a multi-mode approach to prevent dependencies on a single mode, and to offer the greatest range of opportunities to the population.

#### *Action 3: Urban Planning*

High density clusters consist of mixed use, co-located urban systems, centred on local services. They promote 'walk-able' lifestyles, reducing the need for transport, and therefore energy consumption. Walk-able lifestyles, enabled by access to local, neighbourhood services and an attractive public realm (parks, squares, pathways) also have health benefits through increased exercise and social impacts through increased community interaction. Rwanda will implement distributed urban centres, clustered around services, such as education and distributed energy generation. They will be well linked by mass transit both to each other and to the central business district. Preventing construction on unsuitable sites, such as flood plains and steep slopes, will increase the resilience to climate change of urban areas. These policies are already enshrined in the Kigali Conceptual Master-plan, which will form the basis for a national urban development plan that will lay out the key criteria for developments of all sizes across Rwanda.

#### *Action 4: Utilisation of the Waste Stream*

Rwanda is failing to take advantage of a highly valuable resource: its municipal, agricultural and industrial waste. Various low cost value-adding activities, such as composting or reuse and recycling, can turn formerly low value goods into high value resources. Rwanda will apply these processes to not only develop another resource stream, enabling entrepreneurship and economic development, but also to lower the inputs required by its systems, thus reducing the energy requirement and therefore urban systems climate impact.

## Strategic Objectives

Energy Security	✓	Food and Water Security	✓	Social Protection and DRR	✓
Low Carbon Development	✓	Protection of Ecosystem	✓	Sustainable Land Use	✓

## Enabling Pillars

Institutional Frameworks	Financial Structures	Capacity Building	Integrated Planning and Data Management	Technology, Research and Infrastructure
✓	✓	✓	✓	✓

## Key Indicators

Action 1: Low energy buildings and services	<i>Per Capita Energy Use</i>
Action 2: Integrated Multi-mode Urban Transport	<i>% Passenger Km by mode</i>
Action 3: Urban Planning	<i>Urban area per capita</i>
Action 4: Utilisation of the Waste Stream	<i>Reduction in mass of landfill</i>

## Comparative Cost

Action 1: Low energy buildings and services	Low	Medium	High
Action 2: Integrated Multi-mode Urban Transport	Low	Medium	High
Action 3: Urban Planning	Low	Medium	High
Action 4: Utilisation of the Waste Stream	Low	Medium	High

## Emissions Reduction

Action 1: Low energy buildings and services	High	Medium	Low
Action 2: Integrated Multi-mode Urban Transport	High	Medium	Low
Action 3: Urban Planning	High	Medium	Low
Action 4: Utilisation of the Waste Stream	High	Medium	Low

## Climate Resilience

Action 1: Low energy buildings and services	High	Medium	Low
Action 2: Integrated Multi-mode Urban Transport	High	Medium	Low
Action 3: Urban Planning	High	Medium	Low
Action 4: Utilisation of the Waste Stream	High	Medium	Low

## Timscale to Initiation

Action 1: Low energy buildings and services	Immediate	Short	Medium	Long
Action 2: Integrated Multi-mode Urban Transport	Immediate	Short	Medium	Long
Action 3: Urban Planning	Immediate	Short	Medium	Long
Action 4: Utilisation of the Waste Stream	Immediate	Short	Medium	Long

## Programme Length

Action 1: Low energy buildings and services	<i>Ongoing</i>
Action 2: Integrated Multi-mode Urban Transport	<i>2-year initiation phase, 5+ year construction then ongoing operation and development</i>
Action 3: Urban Planning	<i>Ongoing</i>
Action 4: Utilisation of the Waste Stream	<i>3 year initiation and development</i>

## Climate Finance Streams

Adaptation Fund - Africa Enterprise Challenge Fund - Clean Technology Fund - DEG – Deutsche Investitions - EIB Post-2012 Carbon Credit Fund - EIB-KfW Carbon Programme II - Global Climate Change Alliance - Global Energy Efficiency and Renewable Energy Fund - Global Environment Facility - Global Facility for Disaster Risk Reduction and Recovery - Hatoyama Initiative - International Climate Initiative - International Climate Fund - International Development Association - KfW Development & Climate Finance - Nordic Climate Facility - Private Infrastructure Development Group - Public-Private Infrastructure Advisory Facility - Seed Capital Assistance Facility - Special Climate Change Fund - UNDP/MDG Carbon Facility - World Bank Carbon Facility - Clean Development Mechanism - Voluntary Carbon Markets

## Programme 11: Ecotourism, Conservation and Payments for Ecosystem Services

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### Responsible Stakeholders (lead in bold)

**MINIRENA, RNRA, REMA, MINICOM, RDB, MINALOC, Civil Society, DPs**

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### Summary of Programmes and Actions

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Rwanda's location within the centre of the Albertine Rift, a region considered to be the highest in species richness in Africa, makes it ideal for conservation and ecotourism. Tourism represents Rwanda's top foreign exchange earner, earning USD 202 million in 2008. Based on projected growth targets, tourism revenues are anticipated to more than double by 2020 to USD 627 million. Ecotourism in envisioned destination management areas (DMAs) is likely to provide high returns on investment. In order to maintain Rwanda's protected areas as key economic assets supporting a climate-resilient services industry, havens for biodiversity, and sources of vital ecosystem services, effective protection and sustainable management measures must be undertaken.

#### *Action 1: Business tourism through strategic conference management*

Business travellers make up an estimated 75% of tourists in Rwanda. The majority of tourism revenues come from park entrance fees. Rwanda will promote business conferences beyond the current "high season" in efforts to maximise the distribution and volume of business travellers throughout the year. These efforts will increase the bed occupancy rate of available hotels and lodges within Kigali, and subsequent visitation to surrounding DMAs, including Volcanoes National Park (VNP), Nyungwe forest and Akagera National Park.

#### *Action 2: Community-based ecotourism*

The primary threats to Rwanda's tourism assets are linked to population pressure, unsustainable resource use and endemic poverty. These are drivers of degradation surrounding park boundaries, threatening the long-term sustainability and viability of ecotourism destinations. Households' use of parks is often linked to seasonal stresses in the dry season, or "hungry gap", when poor households look for bush meat, water and other non-timber forest products as sources of subsistence or income. Despite the existence of a government run community-benefit scheme derived from 5% of tourism revenues, insufficient resources are obtained by the poorest households. Households across all income groups receive an average of only USD 0.36 per person per year in the case of VNP, and written application requirements act as a barrier to access the funds. Rwanda will increase the proportion of tourism revenues flowing into the community fund from 5% to 10%, and will review application procedures and awareness to ensure participation in communities adjacent to parks.

#### *Action 3: Participatory Payments for Ecosystem Services (PES)*

In order to ensure the productive use of community benefit funds for sustainable park management, Rwanda will promote close ownership, participation and technical support of local communities. Future schemes of high potential include community engagement in standalone or bundled PES schemes (carbon, biodiversity, water) through private, public or public-private operators. Promising projects include PES schemes with tea factories compensating forest-adjacent communities for water filtration services provided by protected areas (e.g. Nyungwe); and PES schemes to promote rehabilitation of degraded areas such as Gishwati forest. In addition, engagement of community conservation wardens, women's and youth groups at the cell-level, along with incorporation of community participation targets within performance contracts of District Mayors, represent actions with high potential for ensuring PES scheme success and long-term sustainability.

## Strategic Objectives

Energy Security		Food and Water Security	✓	Social Protection and DRR	✓
Low Carbon Development	✓	Protection of Ecosystem	✓	Sustainable Land Use	✓

## Enabling Pillars

Institutional Frameworks	Financial Structures	Capacity Building	Integrated Planning and Data Management	Technology, Research and Infrastructure
✓	✓	✓	✓	✓

## Key Indicators

Action 1: Strategic Conference Management	% Total annual/monthly utilisation of capacity
Action 2: Community-based Ecotourism	% Lower income quintiles households reached
Action 3: Participatory PES	Scheme number; total transactions & area coverage

## Comparative Cost

Action 1: Strategic Conference Management	Low	Medium	High
Action 2: Community-based Ecotourism	Low	Medium	High
Action 3: Participatory PES	Low	Medium	High

## Emissions Reduction

Action 1: Strategic Conference Management	High	Medium	Low
Action 2: Community-based Ecotourism	High	Medium	Low
Action 3: Participatory PES	High	Medium	Low

## Climate Resilience

Action 1: Strategic Conference Management	High	Medium	Low
Action 2: Community-based Ecotourism	High	Medium	Low
Action 3: Participatory PES	High	Medium	Low

## Timescale to Initiation

Action 1: Strategic Conference Management	Immediate	Short	Medium	Long
Action 2: Community-based Ecotourism	Immediate	Short	Medium	Long
Action 3: Participatory PES	Immediate	Short	Medium	Long

## Programme Length

Action 1: Strategic Conference Management	1 year
Action 2: Community-based Ecotourism	6 months
Action 3: Participatory PES	4 years

## Climate Finance Streams

Adaptation Fund - AfDB Congo Basin Forest Fund - Africa Enterprise Challenge Fund - ClimDev-Africa Special Fund - DEG - Global Climate Change Alliance - Global Environmental Facility - Special Climate Change Fund - Hatoyama Initiative - International Climate Initiative - International Climate Fund - International Development Association - KfW Development & Climate Finance - Nordic Climate Facility - Special Climate Change Fund - World Bank BioCarbon Fund - Forest Carbon Partnership Facility - Voluntary Carbon Markets

## Programme 12: Sustainable Forestry, Agroforestry and Biomass Energy

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### Responsible Stakeholders (lead in bold)

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**MINIRENA, RNRA**, REMA, MINAGRI, MININFRA, ISAR, MINALOC, private sector

### Summary of Programmes and Actions

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To meet energy demands for biomass it is necessary to ensure that supply meets or exceeds demand. Controlled tree planting through afforestation, reforestation, agroforestry and urban tree planting initiatives provides wood for fuel, improves slope stability, supports food security and acts as a carbon sink. To ensure sustainability of these initiatives, Rwanda will undertake the following actions, all of which are eligible for carbon credits.

*Action 1: Promotion of Afforestation/Reforestation (A/R) through enhanced germplasm and technical practices in the planting and post-planting process*

A key challenge to the success of Rwanda's tree planting efforts is the use of genetically poor-quality germplasm, combined with planting at inappropriate times (e.g. during dry season) and lack of post-planting care. Improving these elements of Rwanda's forestry programme will greatly enhance the success, and visible results, of Rwanda's A/R efforts. Mixed-species approaches are recommended for achieving both mitigation objectives, as well as the adaptation benefits of ecosystem resilience and biodiversity. Carbon credits can be attained for A/R activities on both voluntary and compliance markets.

*Action 2: Improved Forest Management (IFM) for degraded forest resources*

Land scarcity is a primary constraint to the expansion of Rwanda's forest resources. Efforts to maximise the productivity of Rwanda's many degraded forest plantations present an opportunity to increase biomass supply without converting additional land. The degraded pine buffer zone surrounding Nyungwe National Park illustrates the need (and economic benefit) to rehabilitate degraded forests. Voluntary carbon credits (e.g. through the VCS standard) can be obtained for IFM.

*Action 3: Joint formulation and implementation of Agroforestry by MINIRENA/MINAGRI*

Agroforestry systems have significant potential for contributing to objectives of poverty alleviation through income generation and diversification; biodiversity, energy and water security; and sequestration of carbon by increasing above and below-ground sinks. In order to achieve the 85% agroforestry component of the Vision 2020 national tree coverage target of 30%, Rwanda needs to redouble efforts towards agroforestry promotion. Formulation of a joint strategy between MINIRENA and MINAGRI, in partnership with ISAR is a critical first step. Best practice in agroforestry is well established in Rwanda (e.g. Vi-Life, IFDC) and voluntary carbon credits can be obtained and channelled as direct incentives to smallholders.

*Action 4: Licensing of sustainable charcoal production techniques & promotion of Improved Cookstoves (ICS) for efficient and clean wood and charcoal consumption*

Rwanda's charcoal sector is an estimated 5% of national GDP, and supplies the majority of urban households' energy needs. Fuelwood (and crop residues) supply the majority of rural households' energy needs. Promotion of more efficient and clean-burning ICS, and formalisation of the charcoal supply chain through licensing (for improved carbonisation) present opportunities to reduce biomass demand, and offset negative environmental and health impacts. Carbon credits for ICS have high potential in Rwanda through both voluntary and compliance markets – with credits likely exceeding the purchasing price of ICS.

## Strategic Objectives

Energy Security	Food and Water Security	✓	Social Protection and DRR	✓
Low Carbon Development	Protection of Ecosystem	✓	Sustainable Land Use	✓

## Enabling Pillars

Institutional Frameworks	Financial Structures	Capacity Building	Integrated Planning and Data Management	Technology, Research and Infrastructure
✓	✓	✓	✓	✓

## Key Indicators

Action 1: Improved Afforestation/Reforestation	<i>Survival rates and area coverage of trees planted</i>
Action 2: Improved Forest Management	<i>% degraded forests rehabilitated; yields</i>
Action 3: Joint Agroforestry Strategy	<i>Biomass energy security of smallholder households</i>
Action 4: ICS promotion and charcoal licensing	<i>% Dissemination and use of ICS</i>

## Comparative Cost

Action 1: Improved Afforestation/Reforestation	Low	Medium	High
Action 2: Improved Forest Management	Low	Medium	High
Action 3: Joint Agroforestry Strategy	Low	Medium	High
Action 4: ICS promotion and charcoal licensing	Low	Medium	High

## Emissions Reduction

Action 1: Improved Afforestation/Reforestation	High	Medium	Low
Action 2: Improved Forest Management	High	Medium	Low
Action 3: Joint Agroforestry Strategy	High	Medium	Low
Action 4: ICS promotion and charcoal licensing	High	Medium	Low

## Climate Resilience

Action 1: Improved Afforestation/Reforestation	High	Medium	Low
Action 2: Improved Forest Management	High	Medium	Low
Action 3: Joint Agroforestry Strategy	High	Medium	Low
Action 4: ICS promotion and charcoal licensing	High	Medium	Low

## Timescale to Initiation

Action 1: Improved Afforestation/Reforestation	Immediate	Short	Medium	Long
Action 2: Improved Forest Management	Immediate	Short	Medium	Long
Action 3: Joint Agroforestry Strategy	Immediate	Short	Medium	Long
Action 4: ICS promotion and charcoal licensing	Immediate	Short	Medium	Long

## Programme Length

Action 1: Improved Afforestation/Reforestation	5 years
Action 2: Improved Forest Management	5 years
Action 3: Joint Agroforestry Strategy	1 year
Action 4: ICS promotion and charcoal licensing	1 to 5 years

## Climate Finance Streams

Adaptation Fund - AfDB Congo Basin Forest Fund - Africa Enterprise Challenge Fund - ClimDev-Africa Special Fund - DEG - Deutsche Investitions - EIB Post-2012 Carbon Credit Fund - Global Climate Change Alliance - Global Environmental Facility - Special Climate Change Fund - Hatoyama Initiative - International Climate Initiative - International Climate Fund - International Development Association - KfW Development & Climate Finance - Nordic Climate Facility - Special Climate Change Fund - World Bank BioCarbon Fund - Forest Carbon Partnership Facility - Clean Development Mechanism - Voluntary Carbon Markets

## Programme 13: Disaster Management and Disease Prevention

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### Responsible Stakeholders (lead in bold)

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**MIDIMAR, MINALOC, MOH**, Rwanda Meteorological Service, District and Sub-District authorities, MINAGRI, Disaster Management Task Force

### Summary of Programmes and Actions

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Rwanda is vulnerable to a range of disasters and emergency situations. The hilly topography and high annual precipitation rates bring high risks from flooding, storms, landslides and vector-borne disease, while other natural disasters include droughts and earthquakes, all of which can directly impact on health and food security. Over-exploitation of the natural environment such as deforestation and inappropriate farming on steep slopes increases the hazard risk, which may be exacerbated through climate change as an increase in extreme weather patterns occurs. There is a requirement for contingency planning to deal with incidents such as disease outbreaks, hydro-dam failures, refugee movements and environmental contamination.

#### *Action 1: Risk Assessment and Vulnerability Mapping*

Rwanda will conduct risk assessments and vulnerability mapping to develop effective disaster management systems. This will include health impact assessments for water-related infrastructure projects such as dams and irrigation where disease may spread. Timely risk assessment is crucial to disaster prevention as it enables disaster preparedness planning and mitigation activities, such as the protection of fragile ecological zones including steep slopes and flood prone areas like wetlands. Vulnerability mapping will build planning capacity and allow for rapid response and resource allocation based on sector activity and geographical prioritization of risk and vulnerability.

#### *Action 2: Integrated Early-Warning System*

An early-warning system (EWS) for Rwanda has been proposed and the Rwandan Meteorological Service (RMS) has produced an initial scoping report. There are also a number of regional warning systems, for example, relating to food security, famine and malaria. Rwanda will develop an EWS alongside these existing systems in order to foster complementary systems and avoid duplication. The EWS will require the development of environmental monitoring and data collection tools to understand thresholds and triggers for disasters and emergencies. This action will be conducted in partnership with RMS.

#### *Action 3: Disaster Mitigation, Preparedness and Response Planning*

The impacts of disasters in terms of loss of human life and economic losses can be greatly reduced through disaster preparedness and response planning. Such approaches require effective communication across the ministries and local government to ensure each sector has appropriate contingency plans in place to deal with a range of hazards. Rwanda will implement contingency plans to address disaster mitigation, e.g. laws governing settlement planning and building regulations to enforce safe construction and reduced risk from storm and flood damage; disaster preparedness, e.g. early warning systems; and disaster response, e.g. action plans for communicable disease outbreaks such as cholera. It will also continue to support pilot projects of weather index-based crop insurance to address the risk of drought.

#### *Action 4: Community-Based Disaster Risk Reduction*

DRR consists of a wide-range of activities that aim to both reduce the socio-economic vulnerabilities to disasters, and deal with hazards, environmental and otherwise, which result in disaster and emergency situations. Such programmes require effective community mobilization and participation in order to build local capacity in risk reduction and in disaster response. Rwanda will implement the following community-based DRR activities: improved farming techniques that mitigate flood and landslide impacts; first aid training; and environmental and public health awareness for disease prevention, particularly following flood and storm episodes when the spread of water-borne disease is high.



## Strategic Objectives

Energy Security	Food and Water Security	✓	Social Protection and DRR	✓
Low Carbon Development	Protection of Ecosystem	✓	Sustainable Land Use	✓

## Enabling Pillars

Institutional Frameworks	Financial Structures	Capacity Building	Integrated Planning and Data Management	Technology, Research and Infrastructure
✓	✓	✓	✓	✓

## Key Indicators

Action 1: Risk Assessment and Vulnerability Mapping	<i>Number of produced vulnerability maps</i>
Action 2: Integrated Early-Warning System	<i>% coverage by early warning system</i>
Action 3: Disaster Planning	<i>District training exercise in emergency plans</i>
Action 4: Community-Based Disaster Risk Reduction	<i>% local government units participating</i>

## Comparative Cost

Action 1: Risk Assessment and Vulnerability Mapping	Low	Medium	High
Action 2: Integrated Early-Warning System	Low	Medium	High
Action 3: Disaster Planning	Low	Medium	High
Action 4: Community-Based Disaster Risk Reduction	Low	Medium	High

## Emissions Reduction

Action 1: Risk Assessment and Vulnerability Mapping	High	Medium	Low
Action 2: Integrated Early-Warning System	High	Medium	Low
Action 3: Disaster Planning	High	Medium	Low
Action 4: Community-Based Disaster Risk Reduction	High	Medium	Low

## Climate Resilience

Action 1: Risk Assessment and Vulnerability Mapping	High	Medium	Low
Action 2: Integrated Early-Warning System	High	Medium	Low
Action 3: Disaster Planning	High	Medium	Low
Action 4: Community-Based Disaster Risk Reduction	High	Medium	Low

## Timescale to Initiation

Action 1: Risk Assessment and Vulnerability Mapping	Immediate	Short	Medium	Long
Action 2: Integrated Early-Warning System	Immediate	Short	Medium	Long
Action 3: Disaster Planning	Immediate	Short	Medium	Long
Action 4: Community-Based Disaster Risk Reduction	Immediate	Short	Medium	Long

## Programme Length

Action 1: Risk Assessment and Vulnerability Mapping	<i>2 years initially, updated on an ongoing basis</i>
Action 2: Integrated Early-Warning System	<i>5 years</i>
Action 3: Disaster Planning	<i>2 years initially, updated on an ongoing basis</i>
Action 4: Community-Based Disaster Risk Reduction	<i>2 years</i>

## Climate Finance Streams

Adaptation Fund - ClimDev Africa Special Fund - Global Climate Change Alliance - Global Environment Facility - Global Facility for Disaster Risk Reduction and Recovery - Hatoyama Initiative - International Climate Initiative - International Climate Fund - KfW Development & Climate Finance - Least Developed Country Fund - Nordic Climate Facility - Special Climate Change Fund - World Bank Catastrophe Risk Management Facility

## Programme 14: Climate Data and Projections

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### Responsible Stakeholders (lead in bold)

**RMS, MIDIMAR, MINALOC, MININFRA, MOH**, research organisations, District and Sub-District authorities

### Summary of Programmes and Actions

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Robust observed climate data and climate projections for Rwanda are crucial to understand the future impacts of climate change, and to develop scenarios to assess the potential futures of Rwanda. Developing capacity in climate science is necessary to underpin this work, as highlighted in the actions identified below.

#### *Action 1: Enhancing Climate Data Collection*

The recording and collection of climate data is predominantly the responsibility of RMS, with other stations held by MINAGRI and MOH. RMS is currently implementing a 5-year Strategic Plan, which includes investment into upgrading their network of meteorological stations. However, this network upgrade may not provide the spatial density of information required for climate studies and for adaptation. Therefore, Rwanda will conduct an assessment of all existing and planned weather and climate data sources, in context of the requirements for climate studies and for early warning systems. Required additional observations will be arranged – to appropriate international standards – in collaboration with RMS and other relevant partners. This network will provide all climate information necessary for future monitoring, climate trend detection, management of climate variability, early warning and disaster management, and development of a weather index-based crop insurance industry. The information will complement historical data, and update historical records and re-analyses.

#### *Action 2: Production of Climate Change Projections for Rwanda*

A team will be established to undertake processing and interpretation of climate model outputs for Rwanda. By using existing data, this action can be initiated quickly. Two example programmes with suitable data for Rwanda include General Circulation Models (GCMs) and Regional Climate Models (RCMs): CORDEX (COordinated Regional climate Downscaling Experiment) is an international collaboration to produce downscaled climate model information on a regional and national basis across the whole world, and will be released shortly. The focus will be on supporting vulnerability mapping in Rwanda, and on processing climate model data in a user-friendly format so that it can be utilised by stakeholders in other sectors. Data will be made available in a common format (Excel files, text files, etc), and both technical and non-technical reports on projections will be produced.

#### *Action 3: Coordinating Capacity Building in Climate Science*

Building skills and expertise in climate science must be underpinned by appropriately trained staff. While capacity exists in RMS and REMA, the long-term development of climate expertise in Rwanda requires a coordinated approach to bring through a generation of climate scientists and experts in adaptation and climate policy. Developments are being made by REMA in secondary schools, and by KIST and NUR at university level. The GoR will undertake a study to identify further needs for integrating climate science in schools, and ways of encouraging links between academia and Rwandan institutions, such as RMS and REMA, for collaboration on research and implementation of work experience placements.

#### *Action 4: Enhance the Use of Climate Data in Disease Prevention and Mitigation Programmes*

Current programmes on human disease surveillance and prevention at the Ministry of Health will benefit from climate data and projections. Research will be done on the impacts of temperature increases on vector-borne diseases and mapping will be done to highlight high risk areas for malnutrition and water-borne diseases from droughts and floods. Temperature increases may affect agricultural crop productivity and the spread of crop disease and research will be done in this area.

## Strategic Objectives

Energy Security	Food and Water Security	✓	Social Protection and DRR	✓
Low Carbon Development	Protection of Ecosystem	✓	Sustainable Land Use	✓

## Enabling Pillars

Institutional Frameworks	Financial Structures	Capacity Building	Integrated Planning and Data Management	Technology, Research and Infrastructure
✓	✓	✓	✓	✓

## Key Indicators

Action 1: Enhancing Climate Data Collection	<i>appropriate station network</i>
Action 2: Production of Climate Change Projections	<i>Initial completed set of projections for Rwanda</i>
Action 3: Coordinating Capacity Building	<i>Completed assessment of needs; establishment of proposed programmes at NUR and KIST.</i>
Action 4: Climate Data for Disease Research	<i>Academic papers; disease prevalence</i>

## Comparative Cost

Action 1: Enhancing Climate Data Collection	Low	Medium	High
Action 2: Production of Climate Change Projections	Low	Medium	High
Action 3: Coordinating Capacity Building	Low	Medium	High
Action 4: Climate Data for Disease Research	Low	Medium	High

## Emissions Reduction

Action 1: Enhancing Climate Data Collection	High	Medium	Low
Action 2: Production of Climate Change Projections	High	Medium	Low
Action 3: Coordinating Capacity Building	High	Medium	Low
Action 4: Climate Data for Disease Research	High	Medium	Low

## Climate Resilience

Action 1: Enhancing Climate Data Collection	High	Medium	Low
Action 2: Production of Climate Change Projections	High	Medium	Low
Action 3: Coordinating Capacity Building	High	Medium	Low
Action 4: Climate Data for Disease Research	High	Medium	Low

## Timescale to Initiation

Action 1: Enhancing Climate Data Collection	Immediate	Short	Medium	Long
Action 2: Production of Climate Change Projections	Immediate	Short	Medium	Long
Action 3: Coordinating Capacity Building	Immediate	Short	Medium	Long
Action 4: Climate Data for Disease Research	Immediate	Short	Medium	Long

## Programme Length

Action 1: Enhancing Climate Data Collection	<i>2-5 years</i>
Action 2: Production of Climate Change Projections	<i>6 months initially, updated on an ongoing basis</i>
Action 3: Coordinating Capacity Building	<i>6 months initially, updated on an ongoing basis</i>
Action 4: Climate Data for Disease Research	<i>3 years</i>

## Climate Finance Streams

Adaptation Fund - ClimDev Africa Special Fund - Global Climate Change Alliance - Global Facility for Disaster Risk Reduction and Recover - Hatoyama Initiative - International Climate Initiative - Least Developed Country Fund - Nordic Climate Facility - Special Climate Change Fund - World Bank Catastrophe Risk Management Facility

