FINAL REPORT

STRATEGIC ENVIRONMENTAL ASSESSMENT OF THE ENERGY SECTOR POLICY IN RWANDA

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We would also especially like to express our thanks to the stakeholders interviewed during the scoping and SEA period (see the list presented in **Annex 1** and **2 of the Administrative Annexes,** bound in a separate volume).

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Administrative Annexes
(bound in a separate Volume)

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Acronyms

ACP	African, Caribbean and Pacific Countries
ADF	African Development Foundation
AFC	Agricultural Finance Corporation
AIDS	Acquired Immune Deficiency Syndrome
AMS	Agricultural Management System
APSF	Above the Ground Petrol Storage Facilities
ASAL	Arid and Semi-arid Land
Bcm	Billion cubic meter
BEST	Biomass Energy Strategy
BTC	Belgian Development Corporation
CDM	Clean Development Mechanism
CET	Common External Tariff
CFL	Compact Fluorescent Lamp
COMESA	Common Market for Eastern and Southern Africa
CSR	Corporate Social Responsibility
CSP	Country Strategy Paper
CSS	Customer Satisfaction Surveys
CU	Customs Union
DWO	District Water Offices
DRC	Democratic Republic of the Congo
EAC	East African Community
EARP	Electricity Access Rollout Program
EBA	Everything-But-Arms
EC	European Commission
EC-MAS	EC Multiannual Adaptation Strategy
EDPRS	Economic Development and Poverty Reduction Strategy
EDCL	Energy Development Corporation Ltd (
EIA	Environmental Impact Assessment
EIB	European Investment Bank
EMMP	Environmental Management and Monitoring Plan
ERW	Early Warning System
ESSP	Energy sector strategic plan
ESIA	Environmental and Social Impact Assessment
EU	European Union
EUCL	Electricity Utility Corporation Ltd
EWSA	Energy Water and Sanitation Authority*
FAO	Food and Agriculture Organization of the United Nations
FSNP	Food Security and Nutrition Policy

GDP	Gross Domestic Product
GHG	Green House Gases
GIS	Geographic Information System
GIZ	German International Cooperation Agency
GoR	Government of Rwanda
Ha	Hectare
HFO	Heavy Fuel Oil
HIV	Human Immunodeficiency Virus
HMPA	High and medium potential areas
IAIA	International Association for Impact Assessment
ICC	Inter-Ministerial Coordination Committee (Agriculture & related sectors)
ICS	Improved Cooking Stoves
ICT	Information and Communication Technology
IEC	Independent Expert Commission (SEAs with transboundary impacts)
IPP	Independent Power Producers
ISO	International Organisation for Standardization
IWRM	Integrated Water Resource Management
IWUAs	Irrigation Water Users Associations
kWh	Kilowatt hour
LA	Local Authorities
LAC	Limits of Acceptable Change
LATF	Local Authority Transfer Fund
LBDA	Lake Basin Development Authority
LDC	Least Developed Country
LRA	Land Reclamation Authority (also County LRC and Local Community LRC)
LVBC / LVEMP	Lake Victoria Basin Commission Lake Victoria Environmental Management Plan
LPG	Liquefied Petroleum Gas
MCI	Millennium Cities Initiative
MDG	Millennium Development Goals
MEA	Multilateral Environment Agreements (e.g., Agenda 21, Montreal Protocol, Basel Protocol, Stockholm Convention, Kyoto, and CITES)
MINAGRI	Ministry of Agriculture and Animal Resources
MINALOC	Ministry of Local Government and Social Affairs
MINECOFIN	Ministry of Finance and Economic Planning
MINICOM	Ministry of Commerce

MININFRA	Ministry of Infrastructure
MINIRENA	Ministry of Natural Resources
M&E	Monitoring and Evaluation
MIP	Multi-annual Indicative Programme
MoU	Memorandum of Understanding
MT	Metric Tonne
MTEF	Medium Term Expenditure Framework
MTER	Mid Term Evaluation and Review
MTP	Medium Term Plan
MW	Mega Watt
MWh	Mega Watt Hour
NCBS	National Capacity Building Secretariat
NDBP	National Domestic Biogas Programme
NEPAD	New Partnership for Africa's Development (2002)
NICA	National Standards Inspectorate, Competition, and Consumer Protection Authority
NTB	Non-Tariff Barriers
NWP	National Water Policy
OTE	Overall Time Efficiency
PES	Payment for Environmental Services
PESTLE	Political, Economic, Social, Technological, Legal and Environment
PPA	Power Purchase Agreement
PPP	Public-Private Partnership
PPP	Policy, Plan, or Program
PS	Permanent Secretary
PSF	Private Sector Federation
PV	Photovoltaic
RBS / RSB**	Rwanda Bureau of Standards/ now Rwanda Standards Board
REC	Rwanda Energy Company
RECO	Rwanda Electricity Corporation
REFIT	Renewable Energy Feed in Tariff
REG	Rwanda Energy Group
REMA	Rwanda Environment Management Authority
RWASCO	Rwanda Water and Sanitation Corporation
SACCos	Savings and Credit Cooperatives
SEA	Strategic Environmental Assessment
SMART	Specific, Measurable, Attainable, Realistic, Timed
SME	Small and Medium Scale Enterprise
SOE	State of the Environment Report
SWAp	Sector Wide Approach
SWG	Sector Working Group

STI	Science, Technology and Innovation
SWOT	Strengths, Weaknesses, Opportunities and Threats
TAC	Technical Advisory Committee
TNA	Training Needs Assessment
ToR	Terms of Reference
UERP	Urgent Electricity Rehabilitation Project
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UN-Habitat	United Nations Human Settlements Programme
USA	United States of America
VAT	Value Added Tax
WASAC	Water and Sanitation Corporation
WTO	World Trade Organisation

*EWSA was replaced by REG and WASAC in July 2014
**RSB was established via the Official Gazette no 30 29/7 2013.

1 Executive Summary

The Government of Rwanda (GoR) and key stakeholders are preparing the National Energy Policy and Strategic Plan with financial support from several development partners.

The EU delegation in Kigali has commissioned a Strategic Environmental Assessment (SEA) of the Energy Sector Policy. It is anticipated that the SEA findings will be integrated in the Energy Policy. This SEA Draft Final Report presents the results of the main reporting period after the scoping phase (July - October 2014).

The analysis of the Sector Policy and Strategic Plan has mainly been based on assessment of the two Key documents of the Energy Sector, namely:

- The *National Energy Policy* (version Sept. 2, 2014), (NEP)
- *Energy Sector Strategic Plan (2013/2017)* (version Sept. 16, 2014); (ESSP)
  as well as earlier Drafts of the same documents

An overview of the Energy Sector is discussed in **section 3.1.1** The NEP, the Energy Sector Policy is presented and analysed in **section 3.1.2.** The Policy is based on the following principles:

1. demonstrating resolve for transparent and effective governance through sustainable reform of the sector that produce measureable improvements in service delivery and operational efficiencies;
2. improving the ease of doing business and reducing barriers to private sector investment in energy generation, supply, and distribution; and
3. enhancing institutional, organizational, and human capacities as well as the legal and regulatory framework fundamental to a more stable, progressive sector.

While the Energy Sector Strategic Plan, ESSP, described in **section 3.1.3**, and National Energy Policy are mutually reinforcing, the latter provides high-level direction on the longer-term goals, priorities, and approaches needed in the sector. In this way, the energy policy directives support the development of harmonized implementation strategies and action plans that are clear, well-coordinated, and aligned to the Economic Development and Poverty Reduction Strategy, EPDRS-II and National Energy Policy goals. In general, the policy is the main mechanism to shape the scope, ways, and means that subsequent actions shall be taken in support of the policy. The ESSP then describes the challenges and proposed solutions for to meet with the Policy, and these actions are assessed in this SEA.

Section 3.3, The Policy, Legal, and Institutional Framework, discusses the relevant framework for the energy sector and for the Strategic Environmental Assessment.

Chapter 4 describes the general approach for the assignment**.** **Chapter 5** shows the environmental baseline and trends, while **Chapter 6** discusses the impacts of climate change and variability. **Chapter 7** is an assessment of the environmental risks connected to the sector.

Chapter 8 comprises the **main** analysis of the NEP and **Chapter 9** of the ESSP including compatibility analysis against the key environmental issues and concerns studied in detail during the Detailed SEA as follows:

Biological Objectives:

Reverse deforestation; reduce pressure on forests; Prevent loss of wetlands & associated ecosystem services; Protect natural areas; protect biodiversity

Physical objectives

Minimize land take, land degradation and soil erosion; Minimize impact on hydrological system; Support Integrated Water Resource Management; Reduce pollution.

Social Cultural objectives

Promote water and food security; Promote gender equality and equity; Reduce poverty; Improve alternative livelihoods; Support welfare and health for all.

Energy objectives:
Provide clean, affordable, reliable, secure, renewable, efficient, indigenous sustainable energy; Minimize economic costs of the energy sector; Provide a low carbon energy supply; Reduce demand for wood fuel and charcoal.

Economic objectives:
Support economic growth; Increase employment opportunities; Support green growth / cleaner production / EE; Support private sector development; Support other sectors to be more sustainable.

Institutional objectives:
Strengthen institutional coordination & compliance with government regulations; Strengthen management & monitoring capacity; Promote a culture of 'maintenance'

The analysis of the NEP and ESSP against these environmental objective results in a set of priority recommendations in **Chapter 10**, which are repeated in full below, to facilitate that the executive summary is printed as a stand-alone document. The recommendations are valid to highlight important aspects to be included both in the NEP and the ESSP. Some of the recommendations provided in the Draft Final Report has been removed, since they were taken care of in the NEP and ESSP submitted to the Cabinet. As a response to the stakeholder workshop on 3 December 2014 an attempt to propose implementation responsibilities has been added to the recommendations.

Priority	Recommendations	Proposed responsibility
General Recommendations		
1	Ensure that measures to minimize demand through energy efficiency and timely maintenance are broadly being applied, before considering generation;	MININFRA and its authorities/companies
1	Avoid environmentally protected areas, when siting energy installations; apply environmental best practises in sensitive areas	Project developer, to be monitored / supervised by REMA
1	Integrate environmental criteria into the site and route-selection process;	Project developer, to be monitored / supervised by REMA
1	Integrate extra robustness into the design of energy infrastructure to cope with climate change and variability;	Project developer, to be monitored / supervised by REMA
2	Develop an energy sector land use plan (to reduce land use competition and to clarify where to locate generation and transmission/distribution infrastructure);	MININFRA in collaboration with REMA MINIRENA, and RNRA
3	Enforcing public participation in assessment of energy development projects	Project developer, to be supervised by REMA
3	Provide environmental awards to energy producers with 'good environmental performance'	MININFRA / REMA
Institutional capacity		
1	Designate environmental officers / environmental focal points within the REG (at national and sub-national level);	MININFRA / REG
2	Establish an institutional framework that can mobilize, co-ordinate and facilitate private and public initiatives for renewable energy/technologies usage in rural areas.	MININFRA in collaboration with Rwanda Development Board and Rwanda Private Sector

Priority	Recommendations	Proposed responsibility
		Federation
2	Ensure that all findings related to energy, integrated planning, and environmental management have excellent executive summaries that highlight core messages (to avoid an increase in coordination and sector-governance tasks)	Project Developers
Capacity development: Environmental Training		
2	Provide capacity development and awareness raising in energy-and-environmental management to the government, to the private sector, to investors, to local enterprises, and provide capacity development at decentralized level;	REMA in collaboration with training institutions
2	Integrate an adequate environmental curriculum into the energy sector's capacity development program (government).	MINEDUC in collaboration with Rwanda Education Board and REMA
Capacity development: Guidance and Standards		
1	Provide clear environmental requirements and standards for energy projects to ensure a level playing field between competing parties;	MININFRA, MINIRENA / REMA / RSB
2	Develop simplified but comprehensive ESIA guidance for the streamlined investment processes and for the ESIA of off-grid installations (this could take the form of an ESIA class assessment, e.g. one 'class' ESIA to cover a number of mini hydro grids);	REMA
2	Establish a greenhouse gas (GHG) inventory in the energy sector, introducing and implementing the ISO 14000 standards for environmental management in energy companies.	MININFRA in collaboration with MINIRENA, REMA and RSB
2	Integrate *environmental* standards into technology standards.	REMA and RSB
EIA, SEA, energy-and environment audits, CBA, and other economic instruments		
1	Conduct cumulative impact assessments, especially on watersheds that have a number of small energy projects;	REMA to summarise from project developers
1	Prioritize building capacity to conduct energy-***and-environment*** audits;	REMA in collaboration with Training institutions
1	In addition to conducting audits targeting commercial and industrial energy users, conduct energy-***and-environment*** audits of government installations;	Trained and certified energy and environment auditors. Audit reports to be reviewed and approved by REMA
2	Strengthen capacity to conduct ESIA at decentralized level, through ESIA training;	REMA and training institutions
2	Conduct an SEA on Rwanda's wetland habitats, especially bogs, to minimize impacts of peat-for-energy exploitation (this assumes that the *Peat Strategy and Action Plan* did not sufficiently integrate environmental considerations);	MININFRA in collaboration with REMA and REG
2	Explicitly outline and make transparent how trade-offs between costs, carbon intensity, diversification, security… will be decided while optimizing the power mix (e.g., use environmental CBA or environmental	MININFRA in collaboration with REG and REMA

Priority	Recommendations	Proposed responsibility
	valuation methods);	
3	Evaluate and apply other relevant economic instruments for the environmental management of the energy sector: e.g., carbon tax, user charges, and/or effluent charges.	MININFRA in collaboration with MINIRENA and REMA
Gender		
1	Incorporate gender impact assessment into existing tools (e.g., into EIA and technology assessments); develop the related guidance.	REMA
Data, Monitoring, and Research		
1	Compile, analyse, and maintain energy–environment data and monitoring data;	REMA and REG
1	Integrate the environmental monitoring data into the energy sector's information management system (project level data and national-level data);	REMA and REG will feed in data to IMS open for nominated users.
2	Develop environmental management & monitoring capacity at national and decentralized level;	REMA and project developers
2	Explicitly support some high-priority energy–environment *research* projects;	REMA and Research institutions
3	Publish and disseminate the energy–environment *research* findings in a user-friendly format.	REMA and Research institutions
Budgets		
1	Ensure that specific and adequate mainstreaming budgets are included in energy project contracts and in the budgets of government departments responsible for mainstreaming energy and environment.	REG /REMA / MININFRA / MINIRENA
Tender processes		
1	Highlight environmental management requirements at time of tender [e.g., clean development mechanisms, cleaner production (and waste minimization); *corporate social responsibility*; ISO/EMS certification; availability of environmental management budget];	REG / Financiers
1	Ensure that environmental qualifications, environmental criteria, and good environmental performance are included in the tender evaluation criteria of energy projects;	REG / Financiers
1	Ensure that the financial bids show an adequate budget for environmental management.	REG / Financiers
Licensing processes		
2	Integrate environmental criteria into the licensing procedure and approval process;	RURA in collaboration with REMA
2	Approve/renew energy licenses under the condition that the energy generation: ▪ Currently complies with environmental standards (to be verified by REMA and RSB); ▪ Has adopted new, cleaner technology, shows an adequate environmental management system (EMS/ISO), and has sufficient waste treatment capacity.	RURA in collaboration with REMA
Biomass, Charcoal, and ICS		
1	Allocate a lot more budget to the biomass sector (biomass currently has 1% of the budget, whereas it supplies about 90% of energy needs);	MININFRA in collaboration with MINECOFIN and

Priority	Recommendations	Proposed responsibility
		MINALOC (Districts)
1	Routinely review ICS technology standards to keep abreast of best practicable environmental technology standards and emerging cleaner technologies (in particular, focus on quality standards that can achieve health improvements).	MININFRA in collaboration with RSB
2	Develop alternative livelihood programs for the informal charcoalers;	MINALOC in collaboration with MINIRENA
2	Develop an explicit charcoal exit strategy and action plan (or charcoal reduction strategy and action plan), with explicit benchmarks, targets, and timelines;	MININFRA in collaboration with MINIRENA
2	Develop a novelty support to the biogas sector, specifically for institutions, including the environmental aspects;	MININFRA in collaboration with REG and districts
Petroleum Sector		
1	Minimize the use of fossil fuels to comply with green-growth imperative (e.g., focus on sustainable road and air transport sector); o Integrate and enforce high *environmental* fuel quality standards for all petroleum products, including the fuels used by road, aviation, and rail sectors (e.g., low sulphur) and the fuel used for thermal generation.	MININFRA in collaboration with REMA and RSB
Regional Issues		
1	Apply high *environmental* standards and 'green procurement' criteria to all petroleum products (domestic, regional, and global petroleum products) and to the related transportation infrastructure (e.g., pipeline, rail, transportation routes);	Regional institutions (EAC, COMESA, etc.)
1	Ensure that neighbouring countries are informed of energy development projects that has regional impact	REG / MININFRA
2	Monitor the environmental performance of regional projects;	REMA in collaboration other regional environmental management agencies
2	Ensure that Rwanda's environmental standards match or exceed regional standards.	REMA/ RSB
Transportation Sector		
2	Develop regulations and codes for a sustainable transport system (road, air, rail, and pipeline transport) (e.g., assess the relevance of traffic management measures in urban centres and other sustainable transport measures).	MININFRA
Water		
1	Develop water-sharing agreements with other stakeholders, in areas prone to floods and drought;	MINIRENA
1	Store water or provide irrigation for plantations in areas prone to floods and drought;	Project developer
2	Store water for hydropower, in areas prone to floods and droughts;	Project developer
2	Include 'water scarcity' and 'value of water to be consumed' into feasibility studies;	Project developer
2	Adjust the hydropower plans to reflect water scarcity and the cost of water.	Project developer

2 Introduction and Scope

The Government of Rwanda (GoR) and key stakeholders are implementing the Energy Policy and the Energy Sector Strategic Plan 2013/2017 with financial support from the European Union (EU) and other development partners.

The EU has commissioned a Strategic Environmental Assessment (SEA) of the energy sector policy in Rwanda. According to the ToR, the specific objectives of this SEA are to:

- Describe, identify and assess the likely significant effects on the environment of implementing the energy policies from MININFRA, as well as the most important environmental and natural resource-related constraints bearing on the implementation of any related programmes.
- Provide decision-makers of the GoR, the EU and other Development Partners (DPs) in Rwanda with relevant information (quantitative and qualitative) to assess the adequacy of environmental considerations when supporting the implementation of the Energy Sector Strategic Plan/Policy.
- Assess the degree to which the EU's planned Energy SRC programme addresses the major environmental sustainability challenges in the energy sector and provide recommendations at strategic level on how potential negative effects can be minimized and how positive effects can be optimized.

The SEA was implemented in three phases:

- A scoping phase (May–June 2014);
- A more detailed study phase, extended to October 2014, given that multiple versions of the policy and the plan were received. In the end, the SEA was conducted on the 2014 draft energy policy (version Sept. 2) and the 2014 ESSP (version Sept. 16);
- A review and finalization phase (November – December 2014).

The scoping workshop was held June 10, 2014, concurrent with Validation Workshop of the Draft Energy Policy.

This *Draft SEA Report* submitted on October 25, 2014 presented the results of the August – October studies and evaluations.

The Draft SEA Workshop to discuss the findings was executed on December 3, 2014, thereafter a comments period until December 17 was allocated. The current **Final Report** incorporates comments during the workshop and written comments received until 17 December.

3 Background

Chapter 3 provides:

- The sector programme justification and purpose:
  - An overview of the energy sector;
  - A description of the *National Energy Policy* (version Sept. 2, 2014),
  - A description of the *Energy Sector Strategic Plan (2013/2017)* (version Sept. 16, 2014);
- The list of alternatives that was studied in more detail; and
- The policy, institutional, and legal framework for the energy sector.

3.1 Sector Programme Justification and Purpose

3.1.1 Overview of Energy Sector and its Sub-sectors[1]

Sustainable environmental, social, and economic development necessitates having sufficient energy services for basic human needs and for productive processes. The energy services need to be secure, affordable, and environmentally friendly.

The main consumers of energy in Rwanda are households (91%) (mainly in the form of wood/charcoal), transport sector (4%), industry (3%), and public services (2%) (see **Figure 3.1**).

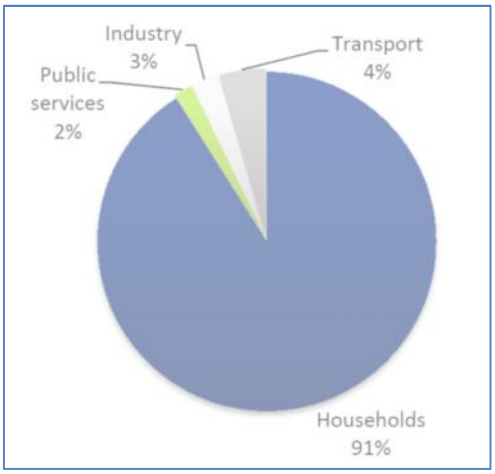


Figure 3.1: Energy Consumption by Sector (2009)

Source: ESSP 2014, v. Sept. 16.

Biomass represents about 90% of all energy consumed, which is principally used for cooking [firewood: 86%; charcoal: 11%; crop waste: 2%, and other fuel (1%)]. In 2012, electricity represented about 4% of the primary energy consumed in Rwanda.

Households consume most of the electricity (51%, mainly for lighting), followed by industry (42%, mainly for motor drivers and lighting), and the public sector (6%, for buildings, street lighting, and water pumping). In July 2014, the electric utility had about 450,775 household customers and 170 industrial customers (2014 ESSP). **Figure 3.2** summarizes Rwanda's electricity consumption by overarching sector.

[1] *Chapter 3.1.1 was researched and developed by Louise Grenier.*

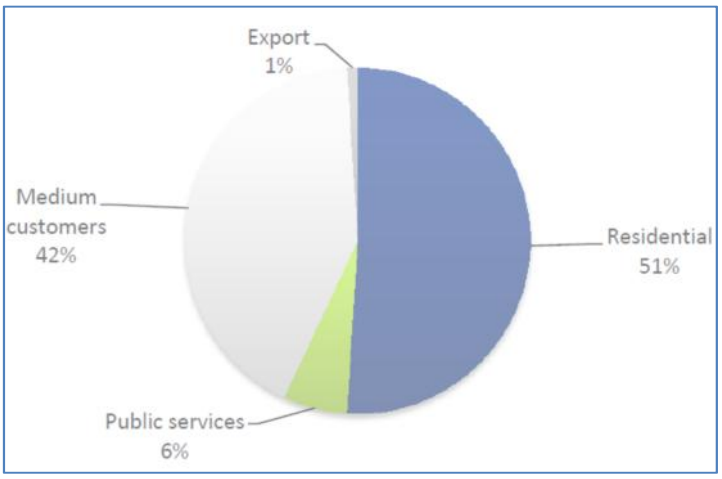


Figure 3.2: Rwanda's Electricity Consumption by Overarching Sector (2012)

Source: 2014 ESSP.

Electricity production in Rwanda has been mostly dependent on hydropower since about 1962. Of note, Rwanda had acute electricity supply shortages, leading to significant load shedding during 2004–2006. Its installed hydropower generation capacity was constrained by a drought, which lead to a drawdown of the reservoirs. The same drought affected Kenya, Tanzania, and Uganda, so access to regional electricity was also constrained at that time[2]. As a coping measure, Rwanda was forced to switch/add some expensive thermal generation.

Rwanda has very low per capita electricity consumption, about 42 kWh/year/capita compared to 478 kWh in sub-Saharan Africa and 1,200 kWh for developing countries as a whole. Rwanda is densely populated, but it has some of the lowest electricity access rates in Africa, with only 20% of households connected to the grid (about 1% of the rural population uses electricity). A lack of energy is a key constraint to economic development. Current demand exceeds supply, especially during peak hours. (ESSP 2014; World Bank 2012).

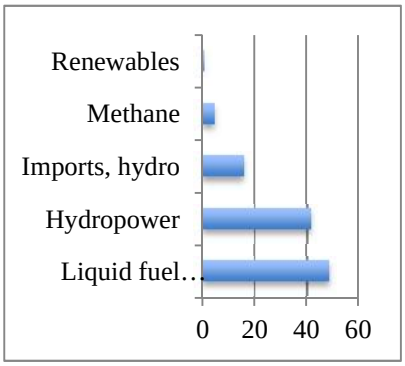
The price of electricity in Rwanda is high for Eastern Africa, at 123 RwF/kWh (0.20 USD) (or about 50% higher than the average tariff in East Africa) (2014 ESSP). The high costs are generally due to high world oil prices, high inland transport costs for petroleum, and various duties and taxes that result in retail prices that are about 100% higher than acquisition costs for petroleum products (World Bank 2012).

Table 3.1 summarizes Rwanda's generation capacity: ***Domestic*** hydropower accounts for 38%, hydropower imports account for about 14% (hydropower total: 52%), and petroleum plants, 44%. (See the sub-sections below to obtain generation capacity updates from 2013 and 2014).

[2] *Source*: Karisimbi EIA Executive Summary, 2013.

Table 3.1. Installed Energy Capacity in Rwanda (2012)

Energy Generation	MWe
Liquid fuel (diesel) (own & rental)	48.3
Hydropower	41.2
Imports, hydropower	15.5
Methane	4.2
Renewables	0.3
Total	**109.4**



Source: EWSA presentation, 2012.

Energy demand is growing rapidly due to population growth *and* due to economic growth[3]. The demand projection for electricity for 2017 is for 470 MW, and with a 15% reserve margin, this is 563 MW (World Bank 2012). The GoR aims to increase access to electricity and to diversify the country's energy sources. A more diverse portfolio of energy sources could help reduce the economy's vulnerability to price volatility and could redirect foreign exchange away from energy imports.

To provide a sufficient context for this SEA study, a brief overview of Rwanda's key energy resources[4] is provided below.

Biomass

Wood and Charcoal

Rwanda's energy mix is dominated by biomass, which accounts for about 84 to 86% of primary energy use (and for up to 94% of energy needs in rural areas). According to Munyehirwe (2013), this biomass comprises wood (57%), charcoal (23%), and crop residues and peat (5%). [Petroleum products and electricity account for 11% and 3-4% respectively]. **Figure 3.3** summarizes Rwanda's energy mix.

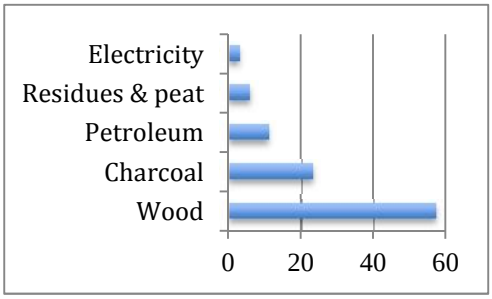


Figure 3.3: Rwanda's Energy Mix
Source: Munyehirwe 2013

The *Second National Communication under the UNFCC* states that this energy from biomass equates to about 0.48 kg/person/day of wood charcoal,

[3] Rwanda's industrial sector is still small, contributing 16% of GDP in 2012. Rwanda's manufacturing sector produces some import substitutes for internal consumption. The larger enterprises produce beer, soft drinks, cigarettes, hoes, wheelbarrows, soap, mattresses, plastic pipe, roofing materials, and bottled water. Other products include agricultural products, small-scale beverages, soap, furniture, shoes, cement, plastic goods, textiles and cigarettes.

[4] N.B. Depending on the source of the information, the resource assessments can vary substantially from one reference to another; this generally indicates the need for more detailed resource assessments. For the purpose of this study, consider all quantitative assessments as indicative.

1.45 kg/person/day of firewood, and 0.24 kg/person/day of agricultural residues. Households, community institutions, and industries (e.g., restaurants, schools, prisons, military barracks and tea factories) are the main biomass users. In 2009, this consumption resulted in a biomass deficit of about 7,000,000 m^3/year, which is an over-exploitation of timber resources that is leading to deforestation and the use of agricultural residues that should be used to maintain soil fertility. [Using other units, the 2014 ESSP cites that there was a 750,000 tonne (BEST report) or 870,000 tonne (citing the WISDOM report) woody biomass deficit in 2009]. Wood consumption (fuel wood, charcoal, and for industries) increased from 4,991,063 in 2005 to 5,959,955 tons in 2010 (20% increase) (Yearbook 2012). Furthermore, in spite of efforts to disseminate improved cookstoves (ICS), domestic and institutional biogas installations, and better charcoaling techniques, there remains a significant biomass deficit (as of 2012).
Fuel wood for use in rural areas and wood for urban charcoal account for most of this wood consumption (see **Figure 3.4**).

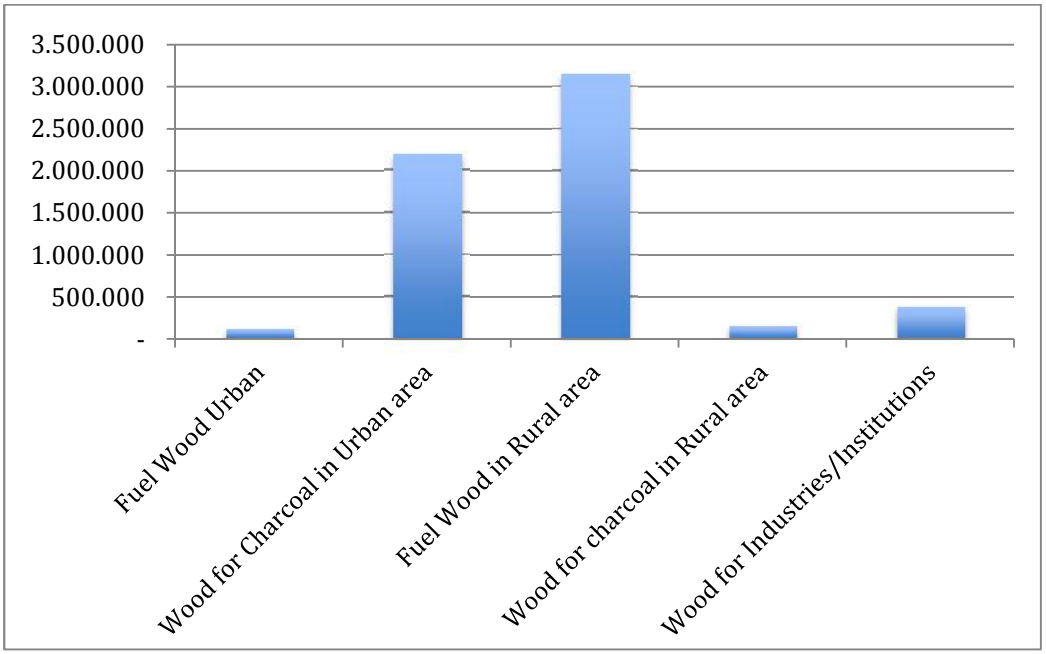


Figure 3.4: Consumption of Wood in 2010 (in tons) for Various Uses

Source: Table 5.1.1, of Yearbook 2012, NISR.

Over 80% of the country's firewood and charcoal comes from private Eucalyptus plantations and other small-scale agro forestry programs. Charcoal is said to have contributed to deforestation in the past, but land clearing for agriculture, housing, and tea plantations are considered to have resulted in more forest destruction than charcoal demand. It is estimated that most of Rwanda's charcoal is now made from planted trees (and only a small amount comes from natural forests).

Biomass is a source of income and labour, with charcoal and firewood were worth about USD 122 million (5% of the GDP) in 2007. Although most farmers set aside a small part of their land for Eucalyptus trees (for charcoal making and for their own wood requirements), it is argued that charcoal producers only earn a small share of the overall value-added, with the charcoal trade dominated by a small number of powerful entrepreneurs. Government and other institutions have supported tree plantations and improved charcoaling techniques, but the World Bank 2012 report argues that this has mainly benefitted traders, and less so the charcoal producers.

Government has various programs to address the biomass and deforestation issues, including: public sector forestry programs, licensing schemes for tree harvesting, strict tree harvesting regulations (for public and private trees), and diversifying away from traditional wood fuel to other forms of biomass (e.g., papyrus, rice and coffee husks, and biogas).

Government efforts are focused on increasing wood production. Overall, the measures help to reduce deforestation and Rwanda is considered a country where the relationship between charcoal consumption and deforestation no longer exists (ESSP 2014).

Currently, biomass energy is mainly used for cooking and for boiler fuel (ESSP 2014).
Biomass covers about 98% of the cooking needs, comprising firewood 82%; charcoal 13%; grass/leaves 3%; and other 2%. The average household uses around 1.8 tonnes of firewood each year to cook with a traditional stove (cited in 2014 ESSP). There are significant differences in the use of wood and charcoal when urban use is compared to rural use (see **Figure 3.5**).

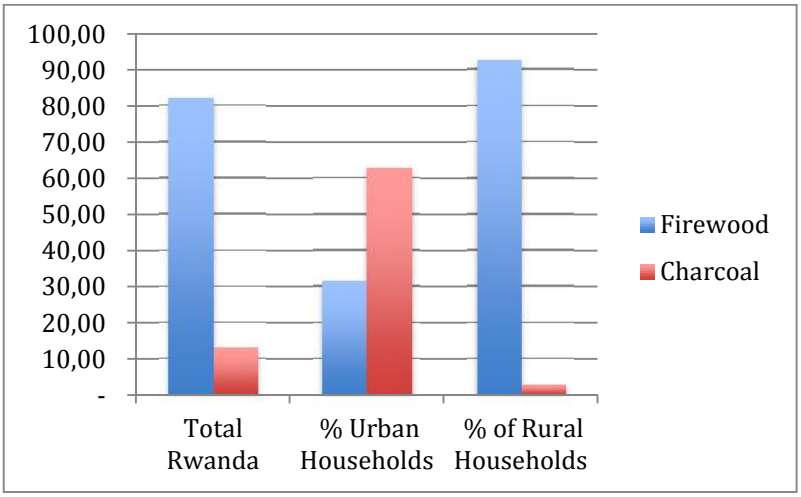


Figure 3.5: Main Source of Cooking Energy

Source: Fourth Population and Housing Census, Rwanda, 2012, Final Results Publication Tables, NISR 2014.

Charcoal is regarded as the preferred cooking fuel for urban households. Trends elsewhere in Africa show that charcoal use increases with urbanization, and will tend to replace wood over time (LPG and electricity are less likely to do so, given the expense) (2014 ESSP).

According to the World Bank (2012), there is currently no clear fuel alternative that can provide the same service as charcoal at a similar price. The World Bank study cites the example of switching to kerosene (the next best and least expensive alternative): if all households adopted kerosene for cooking, kerosene imports would surge from 20,000 in 2007 to 120,000 tonnes/year. However, this same study highlights that the charcoal sub-sector is not the best choice for a low-carbon growth economy.

Cookstoves and Biomass
Rwanda's population increased from 8 to 10.5 million between 2002 and 2012, with population density increasing from 321 to 416 persons/km^2. Population growth increased demand for cooking energy and reduced the space to produce biomass energy (Munyehirwe 2013). Government has been running a program on improved cooking stoves (ICS) since the 1980s, with 60% household penetration. The private sector is also distributing cooks stoves, with some being three times more efficient than the traditional 3-stone stove, reducing biomass consumption by 68 to 94% (2014 ESSP).

In the recent period, a consultancy firm was hired to construct 15 ICS production units in 15 Districts, and construction is ongoing. In the July 2013 to May 2014 period, about 114,3769 ICSs were produced and disseminated (*Forward Looking Energy Joint Sector Report 2014/2015*).

It should be noted that the energy efficiency, environmental performance (e.g., emissions, including CO_2 emissions), and health-impact-reduction performance of the various ICS models varies greatly, with some ICS models not really providing any

significant improvements, especially in terms of reducing health impacts (World Bank 2014).

Biogas

Institutional Biogas Program

In 2008, GOR announced a policy to introduce biogas digesters in all boarding schools (about 600 schools), large health centres, and institutions with canteens to reduce the consumption of firewood[5]. The program started in 2010 with school installations. To date, the institutional biogas program has installed about 68 biogas digesters; this has improved hygiene and reduced firewood consumption in some institutions by up to 50%. In the July 2013 to May 2014 period, institutional biogas digesters were being constructed in Musanze and Ngoma prisons, and at the Gikondo transit centre.

Domestic Biogas Program

About 120,000 households have dairy cows that are kept under zero grazing conditions (to reduce soil erosion and also due to lack of grazing areas); There is a government program to increase the number of families with dairy cows. The domestic biogas program targets households that have cattle. Under the 2007–2011 *National Domestic Biogas Programme* (NDBP), about 1,700 household biogas digesters were constructed and over 200 masons were trained. In the July 2013 to May 2014 period (NDBP II), 857 domestic biogas digesters were installed[6]. To date, the NBDP has disseminated the digesters through 50% government subsidy and use of microfinance. The targeting of the subsidy and the amount of subsidy is being revised to better meet program objectives.

It is noted that there are new emerging (possibly better performing) biogas technologies that require assessment.

Biofuels

Although Rwanda's land shortage limits the likelihood that it will grow its own domestic biocrops for biofuels, there is some ongoing research on biofuels and there is some interest at the regional level.

Biomass and Power Generation

Although there is some interest in small-scale power generation using agricultural residues (e.g., bagasse or risk husks), biomass briquettes, charcoal dust, landfill gas, wastewater effluent, and municipal solid waste, more detailed assessments are needed to assess the power generation potential.

Electricity

Geothermal

Geothermal is considered a low-cost, clean, reliable, secure, sustainable option for electricity generation and other energy needs (e.g., direct use). Geothermal power does have some high upfront capital costs (especially relating to feasibility and resource assessment). Rwanda's main fields are: *Karisimbi*; *Gisenyi; Kinigi*; and *Bugarama.* It should be noted that the preliminary results from the Karisimbi exploration drilling were disappointing, with the results suggesting that there are no significant commercial resources available at that prospect. Rwanda very much needs a more robust resource assessment of its geothermal resources (especially on Kinigi, Gisenyi, and Bugarama); this will require more upstream studies and the completion of a geothermal master plan (expected Q1 2015) [7].

[5] *Source:* https://energypedia.info/wiki/Rwanda_Energy_Situation and *Forward Looking Energy Joint Sector Report 2014/15.*

[6] N.B. The *Forward Looking Energy Joint Sector Report 2014/2015, p.11* lists the baseline for domestic biogas digesters at 4,100 for end of May 2014; given the figures for 2007–2011 and for July 2013 to May 2014, this implies that about 1,543 domestic biogas were installed from about July 2011 to June 2013. The ambitious target for 2014/15 is to install 3,500 new domestic biogas installations.

[7] Source: *Geothermal Sub-sector Presentation,* at the Draft Energy Policy Validation Workshop, June 10, 2014.

Methane

Rwanda has some methane resources that could be extracted from underground mining seams, but most notable is that Lake Kivu has an estimated methane gas reservoir of 55 bcm. The estimated potential power production is 700 MW, which would need to be shared equally with DRC (each obtaining 350 MW). Lake Kivu also produces about 150 to 250 million m^3 of CH_4 annually (2014 ESSP). As the Lake could potentially release a large quantity of this methane in a sudden manner (as what happened at Lake Nyos, Cameroun, in 1986), extracting this methane should make the nearby communities safer.

The primary anticipated end use of the methane resource is to generate electricity. Additional feasibility studies are looking into direct use of methane gas in heating applications and for fertilizer and petrochemical production. The following entities currently use the Lake Kivu methane: Bralirwa Brewery: 5,000 m^3/day; Rwanda Energy Company (REC): 3.6 MW; and Kibuye Power (KP1): operates at 1.5 MW since 2007, but has plans to scale up. KivuWatt I is expected to be operational by November 2014 (25 MW of grid electricity) [8]. KivuWatt 1 has a PPA with EWSA for an additional 25 MW.

Peat

In a study from 1993, Rwanda identified about 40,000 ha of peat bogs of varying quality, with a potential power production capacity of 300 MW (the 2014 ESSP says 50,000 ha of peat). Peat sites are in: Akanyaru, Bahimba, Bisika, Cyato, Cyabararika, Gasaka, Gihitasi, Gishoma, Kageyo, Kaguhu, Mashoza, Mashya, Murago, Nyabigongo, Nyirabirande, Rucahabi, Rugeramigozi, Rwabusoro, and Rwuya.

Peat is currently being used for energy production by PEC (Peat Energy Company) (supplies 2,000 tons per month to a cement plant; the plant is to be expanded in 2014[9]) and RAS (Rwanda Auto Service) (supplies small amounts of peat to prisons, schools, and other institutions for cooking). There are a number of projects under implementation, such as Gishoma[10] Peat-to-Power (15 MW) (2014) and Hakan (100 MW) (2017). EWSA (now REG) undertook a more detailed assessment of peat resources in 2013/14, as it was viewed critically important to have a national overview of peat resources to ensure sustainable use. (N.B. This peat assessment was not available at the time of this study).

Wind

There is little wind energy potential in Rwanda (although there is some moderate potential in Eastern Province). Nevertheless, MININFRA is proceeding with some detailed assessments to verify whether wind power could have some niche contributions to the country's energy needs (e.g., windmills or water pumping for agricultural and institutional needs).

Solar

Rwanda has a moderate source of solar energy (mostly in Eastern province), given an average solar radiation of 4.3–5.2 kWh/m^2/day (2014 ESSP). There is some experience with solar power (e.g., the 250 kW Kigali solar project). Other existing or approved on-grid solar projects include[11]: Ngoma Solar Power Station: 22.4 MW (2011); Rwamagana / GIGAWATT

[8] According to the *Forward Looking Energy Joint Sector Report 2014/2015*, as of June 2014, the overall progress of the KivuWatt pipe welding was 80% and the progress of the gas-extraction facility / barge was about 70%. KivuWatt was planning to start testing and commissioning by the end of July 2014; COD was estimated for November 2014.

[9] The *Forward Looking Energy Joint Sector Report 2014/2015* highlights that EWSA and PEC signed an interim peat supply agreement in May 2014 to supply 20,0000 tons by end of August 2014 for testing and commissioning of the plant.

[10] The *Forward Looking Energy Joint Sector Report 2014/2015* states that the civil works for Gishoma Peat are 53% completed, whereas the installation of equipment is at 37%. The construction will be completed by end of October 2014.

[11] *Source*: Newspaper: *The New Times,* May 16, 2014. *Additional on-grid and off-grid solar systems are planned.*

Solar Power Station: 8.5 MW (2014, 2015 listed in ESSP)[12]; and Kayonza Solar Power Station: 10 MW (2016). (*N.B. The ESSP lists a different set of solar projects*).

The *SolaRwanda* solar-water-heater (SWH) project has aimed to establish a SWH market through promotion and financial incentives. The target is to distribute 12,000 units by 2015, saving about 23,000 MWh per year. Only about 800 units have been distributed, due to supply and incentive issues (2014 ESSP).

In addition, 500 households were electrified by solar PV (solar kits by Government of China and Mobisol) (Joint Sector Report 2014). *And*, donor supported programs have reached more than 150 remote rural schools, with 1.7 kW solar equipment; an additional 300 schools and 46 health centres are targeted. Solar lantern kits of 5 W were distributed to 1500 households (15 rural settlements); and 400 solar kits of 300 W were installed in 4 rural settlements (2014 ESSP).

Although there is good interest from the private sector in on-grid solar power development, this is limited by the technical capacity of the grid. Hence, solar power will only be added as / when the grid is reinforced (2014 ESSP).

Lighting

Figure 3.6 shows kerosene remains the main source of lighting for households overall (about 40%). About 17% of Rwanda's electricity is used for household lighting (67% in urban areas, and only 6% in rural areas).

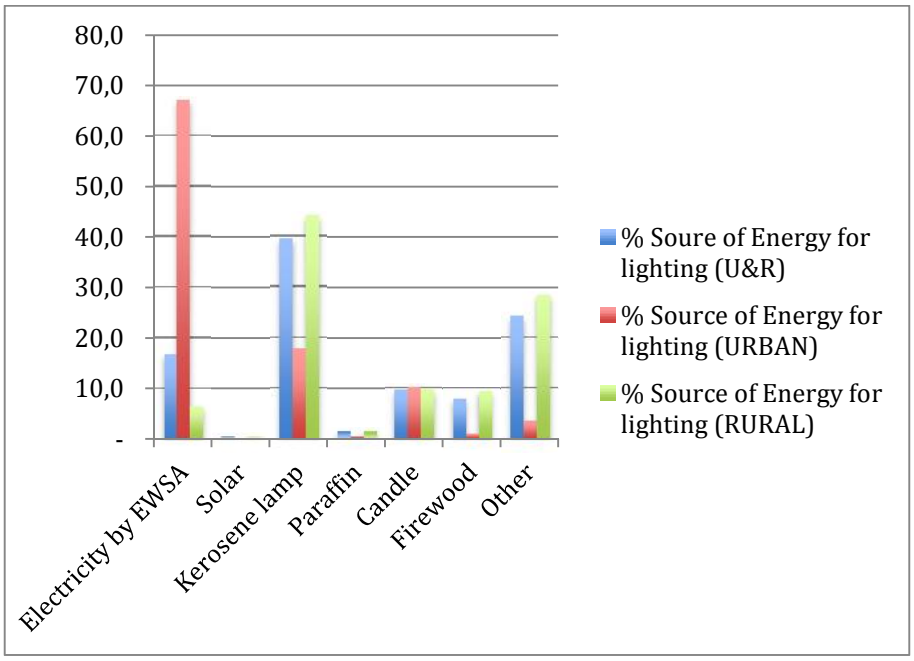


Figure 3.6: Source of Lighting in Urban and Rural Households (2012)

Source: Fourth Population and Housing Census, Rwanda, 2012, Final Results Publication Tables, NISR 2014.

A *compact fluorescent light* (CFL) distribution program was conducted in 2007; 400,000 CFLs were sold to the 95,000 existing customers and 400,000 CFLs were provided to 80,000 new customers as part of a '*welcome pack*'. It was estimated that 54 GWh were saved / per year, as well as 260,000 t CO_2e. In terms of street lighting, a pilot project in Kigali replaced high-pressure sodium (HPS) street lamps with LEDs. This resulted in a 60% reduction of power consumption from the baseline, but further analysis is needed before replication (ESSP 2014).

[12] According to the *Forward Looking Energy Joint Sector Report 2014/2015*, the PPA and Concession Agreement for GIGAWATT (8.5 MW) was signed in 2013; the financial arrangement was agreed in Jan. 2014; RURA granted a generation licence in Feb. 2014; and construction activities began in May 2014.

Hydropower

Rwanda's topography is seen as very suitable for medium- to high-head pico- and micro-hydro *run-of-river* schemes. According to AfDB (2013), the hydropower potential is 313 MW (comprising 130 MW of domestic hydro and 183 MW of regional hydro resources) (the 2014 ESSP says up to 400 MW). Small and medium-size *domestic* hydropower could provide an additional 77.2 MW of potential capacity. In 2012, the following sites provided about 40 MW of operational domestic capacity: Ntaruka, Mukungwa, Gihira, Gisenyi, Rukarara, and mini/micro hydro (accounting for about 4.5 MW of operational capacity). Although scattered across many locations, mini/micro hydro could provide an additional 8 MW of potential capacity (2014 ESSP).

The joint regional hydropower resources that are under consideration include:

- *Rusizi on the border with DRC:* The first two phases of Rusizi are operational providing 15.5 MW. Rusizi III (48 MW) and Rusizi IV (98 MW) are under active consideration;
- *Rusumo Falls on the border with Tanzania:* This location could provide about 80 MW as a runoff river scheme; it is currently under implementation under the *Nile Equatorial Lakes Subsidiary Action Programme*, NELSAP.

Although different information sources provide different sums and different lists of hydropower installations, **Tables 3.2 – 3.3** provide a reasonable overview of the hydropower installations and the installations under construction in 2012 [13]. A more detailed resource mapping for the hydropower sector is needed, and could take a spatial river basin approach to minimize environmental impacts. For instance, a 2014 study on the Akanyaru River Basin identified 11 domestic sites and 3 shared sites with Burundi that could be developed for 25 MW (2014 ESSP).

Table 3.2: Existing Installed Hydropower Capacity as of January 2012

Category	Name	Installed Capacity (MW)	Available Capacity (MW)	Remarks
On-grid Hydropower	Ntaruka	11.25	10	Public
	Mukungwa	12	11	Public
	Gihira	1.8	1.8	Public, Rehab
	Gisenyi	1.2	0.6	Public, Rehab
	Rukarara	9	9	Public
	Rugezi	2.2	2	Public
	Nkora, Keya, Cymbili	3.2	2	Public
	Murunda (REPRO)	0.1	0.1	Private
Imported / shared Hydropower	Rusizi I (SNEL)	3.5	3.5	Public
	Rusizi II (SINELAC)	12	11	Public
Off-grid Micro Hydropower	Nyamyotsi I	0.1	0.1	Public
	Mutobo	0.2	0.2	Public
	Agatobwe	0.2	0.2	Public
	Nyamyotsi II	0.1	0.1	Public
	Rushaki	0.04	0.04	Private
TOTAL		**57.21**	**51.64**	

[13] The *Forward Looking Energy Joint Sector Report 2014/2015* (submitted in June 2014) highlights that the *total* electricity generation capacity increased from 110 MW in June 2013 to 115.2 MW by June 2014. The additional 5.2 MW capacity comes from Janja, Nyirabuhombohombo, Rukarara II, and Giciye Micro hydropower plants, all projects that were listed in **Table 3.3** as *Hydropower under construction in 2012*. This same report states that the civil works for Nyabarongo I (28 MW) are 98.8% completed, and that the 2 turbines are scheduled for commission in July 2014.

This report also highlights that 38 feasibility studies for micro hydropower sites in Western Province (about 10 MW in all) were undertaken by *Fichtner and Studio Galli* and that the feasibility study of Nyabarongo II (a multipurpose project) was currently being done by *Feedback Infra*.

Source: Presentation by Yves Muyange, former DG, EWSA: *Hydropower in Rwanda: Ongoing Initiatives & New Investment Opportunities.* 2012?

Table 3.3: Hydropower under Construction in 2012

No.	Hydropower Site	Installed Capacity (MW)	Developer	Mode of implementation
1	Nyabarongo I	28	GoR	Public
2	Mukungwa II	2.5	GoR	Public
3	Nyirabuhombohombo	0.5	GoR	Public
4	Gashashi	0.2	GoR	Public
5	Nyabahanga	0.2	GoR	Public
6	Janga	0.4	GoR	Public
7	Nshili	0.4	GoR	Public
8	Rukarara II	2	GoR	Public
9	Rubagabaga	0.314	Calimax	PPP
10	Musarara	0.438	SOGEMR	PPP
11	Giciye	4.0	RMT	PPP
12	Mazimeru	0.5	ENNY	Private
13	**Total**	**44.132**		

Source: Presentation by Yves Muyange, former DG, EWSA: *Hydropower in Rwanda: Ongoing Initiatives & New Investment Opportunities.* 2012?
Note: The 'highlight' indicates that the electricity project was operational by June 2014. See relevant footnote on previous page.

Electricity Transmission and Distribution

The *Electricity Access Rollout Program* (EARP I and now EARP II, 2012–2017) is the main program focused on connecting people to the electricity grid. The target for EARP II is to increase electricity access rate to 70% by 2017 (using grid and off-grid solutions) and to connect 100% of the health centres, schools, and main administrative offices. The revised *Electrification Plan* emphasizes connecting productive centres, including industrial parks, and other productive consumers (e.g., tea factories, mining plants, irrigation, market centres, craft production centres, and water pumping stations) [14]

Petroleum

Rwanda currently depends completely on fuel imports (the main product imports are diesel, petrol, oil, kerosene, and natural gas) (see **Table 3.4**). Petroleum is currently transported by road from Kenya (16%) and Tanzania (84%). There are plans to extend the Nairobi–Eldoret petroleum pipeline to Kampala and Kigali[15] and to transport petroleum from Tanzania to Kigali by rail.

[14] The *Forward Looking Energy Joint Sector Report 2014/2015* highlights that in the July 2013 to June 2014 period, the national electricity grid was extended with 27 km of HV lines (Nyabarongo–Kilinda), 214 km of MV lines, and 385 km of LV lines. The total number of connections to the national grid increased from 364,409 in June 2013 to 429,051 in May 2014 (i.e., the additional 64,642 connections was below the target of 90,000 additional connections). Regarding interconnections projects, the preliminary survey work, aerial survey, and preliminary engineering designs were completed for the Rwanda–Uganda project; the contractors for the Rwanda–DRC transmission line and substations are mobilized and work is being done on the engineering designs.

[15] According to the *Forward Looking Energy Joint Sector Report 2014/2015*, the contract for the feasibility study on the Kampala–Kigali oil pipeline was signed in January 2014; the engineering design, and economic and environmental study are currently being carried out.

Table 3.4: Petroleum Products Imports (litres) in 2011

Product	Annual Consumption (litres)
Petrol	82,263,817
Diesel (Gasoil)	***121,937,405***
Illuminating kerosene	15,222,724
Heavy fuel oils	33,666,910
Jet A-1	12,454,649
Total	**265,545,505**

Source: MINICOM: Downstream Petroleum Policy, 2012.

There are currently 20 active oil-marketing companies in Rwanda, but no national oil company.

There was a 16% increase in petroleum consumption between 2000 and 2012 (NEP 2014). Rwanda consumes about 5,300 barrels of petroleum per day (World Bank 2012). **Figure 3.7** shows the consumption of petroleum products for 2012 and 2013. Diesel and petrol comprise the dominant petroleum imports.

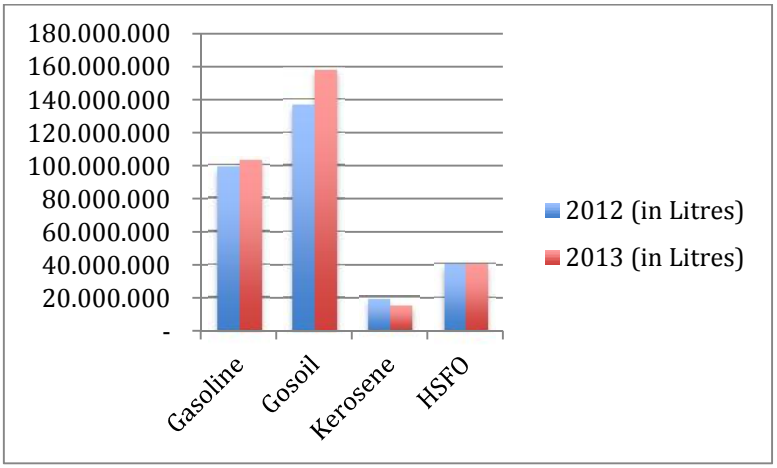


Figure 3.7: Consumption of Various Fuel Types in 2012 and 2013

Source: Data received May 19, 2014 from Ms. Francoise MUKAKALISA, Petroleum downstream. EWSA.

A lot of diesel is used to generate electricity. Petrol, on the other hand, is mainly used in transportation. The demand for petroleum overall is forecast to match the GDP growth rate and petroleum imports are expected to increase at about 10% per year over the next 20 years, as the fleet of vehicles and the population increase. The import of jet fuel is projected to grow even faster (15%), in line with positioning Rwanda as a preferred regional air traffic hub in the future. The diesel import is expected to gradually decline as more indigenous forms of power generation come on line. (See **Table 3.5**).

Table 3.5: Demand Projection for Petroleum Products (m^3)

Year	Annual consumption (petrol, diesel, kerosene, and fuel oil)	Annual Consumption (Jet-fuel)
2010	205,908	13,200
2012	258.291	17,457
2015	362,880	26,549
2017	**455,197**	**35,112**
2020	**639,519**	**53,401**

Source: MINICOM (Downstream Petroleum Policy, 2012)

Figure 3.8 shows the increasing number of registered vehicles.

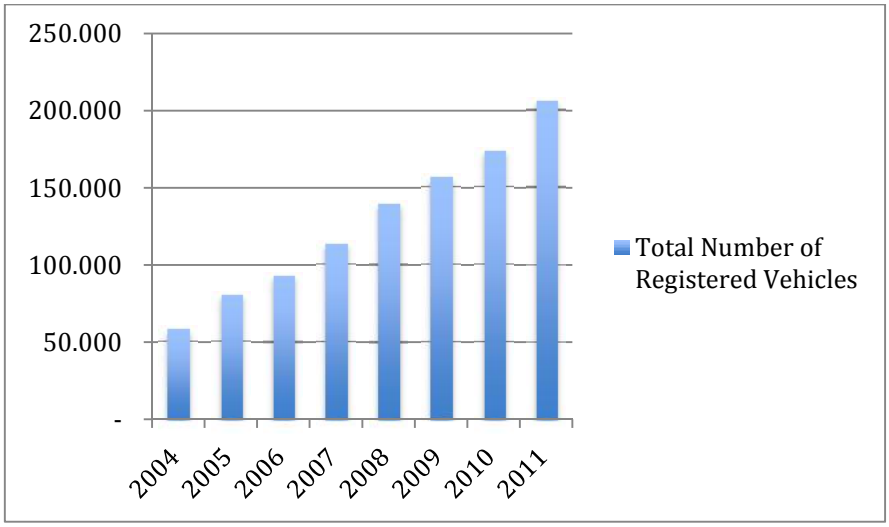


Figure 3.8: Total Number of Registered Vehicles

Source: Fourth Population and Housing Census, Rwanda, 2012, Final Results Publication tables, NISR 2014.

There were 4 thermal power plants in operation in 2013: Jabana 1 (LFO); Jabana II (LFO and HFO); (Rental) Aggreko Gikondo (LFO), and Aggreko Mukungwa (LFO)[16]. **Figure 3.9** shows the increasing consumption of Light Fuel Oil (LFO) and Heavy Fuel Oil (HFO) at all thermal plants over time.

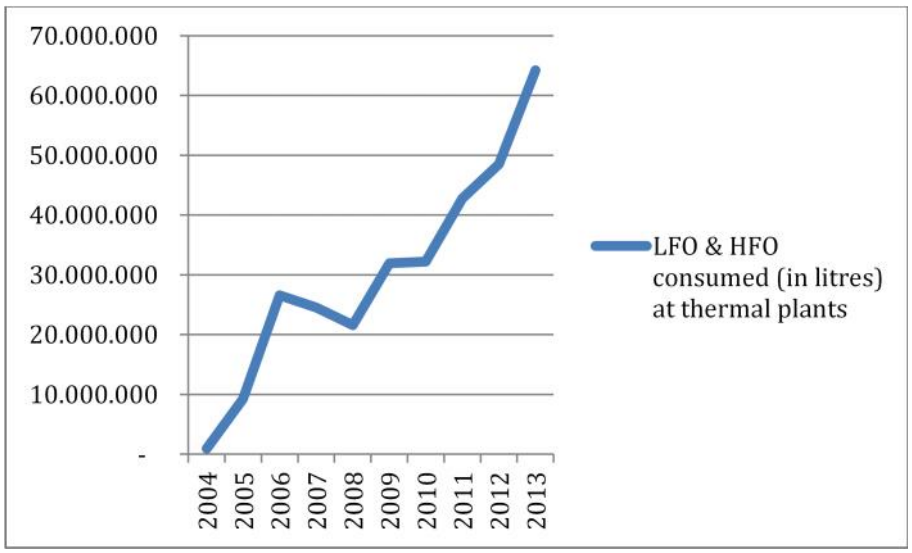


Figure 3.9: LFO & HFO Consumed at Thermal Plants from 2004 to 2012

Source: Data received May 19, 2014 from Ms. Francoise MUKAKALISA, Petroleum downstream. EWSA.

[16] According to the *Forward Looking Energy Joint Sector Report 2014/2015, p.11* there is a feasibility study and construction of a 50 MW HFO Power Plant (CIMERWA and KSEZ) in the 2014/2015 period.

The GOR maintains strategic fuel reserves at Gatsata, Kabuye, Rwabuye, and Bigowe and it leases its Gatsata petroleum depot to the oil companies for their own import requirements. The current storage capacity of 30 million litres would cover about 1.5 months of consumption[17]**.** Given the latter, the supply of petroleum is considered insecure and the price unstable, as was experienced in 2010, when high oil prices and political instability affected petroleum imports. The current total storage capacity of 25.1 million litres of both petrol and diesel would last about 43 days. The GOR plans to significantly increase its storage capacity.

The legal and regulatory framework for petroleum needs to be strengthened. Rwanda is doing some petroleum exploration on Lake Kivu. The downstream petroleum sub-sector has seen a proliferation of sub-standard fuel dispensing facilities and some cases of adulteration of fuel products. The current challenge is to manage and promote rational, efficient, and cost-effective use of the imported petroleum products.

LPG market

LPG is another imported petroleum product, considered to have a volatile price. Its use in Rwanda is still limited, but growing. LPG imports increased from 650 to 1,300 tons per year from 2009 to 2012 (i.e., rising 25% annually between 2009 and 2012) (2014 ESSP). In 2012, there were 6 importers and the LPG storage capacity was 186 tons, corresponding to a 1.7-month reserve. GoR attempted to stimulate the uptake of LGP by removing the VAT on LPG in June 2010, but this effort was overshadowed by a concurrent increase in the international cost for LPG and the devaluation of the Rwandan Franc. According to Munyehirwe (2013), factors that could enhance the uptake of LPG include reducing the cost and increasing the public's awareness of the benefits and safety of using LPG. Of note, the 2014 energy policy and ESSP do not have specific targets for LPG penetration, investment, construction of storage facilities, and strategies to deal with emerging issues (e.g., quality of cylinders). To date, there is no comparative study on the socio-economic impacts of using LPG for cooking vs. using local biomass. Nevertheless, it is quite clear that the target consumer for LPG is the urban and peri-urban charcoal user.

3.1.2 Description of National Energy Policy, Draft 3.8 (Sept. 2, 2014)

[18] This SEA consultancy was initiated at the end of April 2014. As of September 18, 2014, the Consultants had received three (3) drafts of the energy policy: drafts 2.5, 3.5, and 3.8. As an *ex post* SEA model (as per TOR) is a sequential assessment, *it should be emphasized that a clear description of the object of the assessment (i.e., the energy policy) was needed to conduct all subsequent SEA procedures and exercises.* **Technical Annex 1** presents a discussion on the evolution of the NEP from version 2.5 to 3.8.

NEP 3.8 is described below by listing the main policy goals, objectives, and statements. The presentation follows the NEP structure, as follows:

General Goals and Policies:

- Vision and Overarching Policy Goals;
- General Policy Principles and Priorities;
- Policies on Promoting Private Sector Participation;
- Cross-cutting Energy Policies.

Energy Policy Principles for the Energy Sub-sectors:

- Electricity Sub-sector Policy Objectives;
- Additional Policy Objectives for Electricity Sub-sector;
- Rural/Electricity Access Sub-sector Policy Objectives;
- Energy Efficiency and Demand-Side Management Sub-sector Policy Objectives;

[17] According to the *Forward Looking Energy Joint Sector Report 2014/2015*, two new fuel depots are currently under construction: a) 32-million litre depot by *Societe Petroliere* at Rusororo (with 16 million litres in Phase 1); b) 19 million litre depot at Jabana by OILCOM. A contract was also signed between EWSA and EXERT ENGINEERING GROUP to rehabilitate the Rwabuye fuel storage

[18] *Chapter 3.1.2 was researched and developed by Louise Grenier.*

- Biomass Sub-sector Policy Objectives;
- Petroleum Sub-sector Policy Objectives.

General Goals and Policies of the NEP

Vision and Overarching Policy Goals

The overall goal of *National Energy Policy 3.8* is to '*ensure that all residents and industries can access energy products and services that are sufficient, reliable, affordable, and sustainable*'. The core objectives are:

1) Increase the supply of power generation in line with expected demand;
2) Create an enabling environment for increased private sector participation in energy supply and service provision;
3) Encourage and incentivize more rational, efficient use of energy in public institutions, and amongst industrial and household end-users;
4) Ensure the sustainability of energy exploration, extraction, supply, and consumption so as to prevent damage to the environment and habitats;
5) Promote safe, efficient, and competitive production, procurement, transportation, and distribution of energy.

General Policy Principles and Priorities

The general policy principles and priorities address several high-level concerns, from integrated planning, gender, decentralization, and subsidies. The policy objectives are:

1) Promote integrated planning and streamline sector governance;
2) Mainstream gender-based equity, environmental sustainability, and climate concerns into energy planning and sector strategies;
3) Boost national ownership of the vision and build decentralized implementation capacity;
4) Promote value-for-money and increased market competition in energy development;
5) Transition away from indiscriminate subsidies toward 'smart' subsidies aligned to social protection principles.

Policies on Promoting Private Sector Participation

The general *intent* is to streamline the project approval processes and facilitate private sector investment, including a focus on local enterprises. The policy objectives are:

1) Streamline investment promotion processes for IPPs;
2) Extend and expand investment incentives to private investors[19];
3) De-risk investments through upstream resource assessments and pre-feasibility studies[20];
4) Accelerate and facilitate energy sector Public–Private Partnerships (PPPs):
5) Empower more local enterprises to engage in energy sector deals and accelerate the introduction of more competition in energy service provision[21].

Cross-cutting Energy Policies

The cross-cutting policy objectives focus on capacity development ***and*** regional integration, as listed below:

1) Enhance human, organizational and institutional capacity;
2) Promote and accelerate regional energy sector integration;
3) Improve energy data collection and statistics;
4) (Improve) Energy technology standards, and related compliance and enforcement;
5) (Support) Research, development, and technological innovation;
6) (Improve) Energy security and disaster mitigation.

Energy Policy Principles for Energy Subsectors

Electricity Sub-sector Policy Main Policy Objectives

The policy objectives and measures for the electricity sub-sector are:

[19] For example: Government could fund access roads.
[20] For example: Government will invest in better energy resource assessments and resource mapping.
[21] An example given is to ensure that the *local content* requirement is incorporated into concession agreements.

1) Revise and upgrade the existing policy, legal, and regulatory, institutional, and financial frameworks to support the rapid development of the electricity industry;
2) Meet projected demand expected to exceed 400 MW by the end of 2018[22] by diversifying resources over time and increasing the share of clean power generation in the total generation mix over time;
3) Align investment planning and funding mobilization more closely to a power sector master plan informed by the ESSP, a least-cost power development plan, and electricity sub-sector action plans;
4) Enhance regional cooperation and trade in electricity, including investment in transmission network development, to further improve security of supply;
5) Streamline IPP processes and fast track project delivery by securing long-term funding for planned projects through a medium-term budget expenditure framework, revising and expanding the existing Renewable Energy Feed-in Tariff regime, developing new information management systems to streamline steps and procedures, and building greater capacity in planning, procurement, and negotiating power transactions.

Additional Policy Objectives for Electricity sub-sector

These are some additional policy objectives for the electricity sub-sector, especially detailing aspects related to economic efficiency, as follows:

1) Increase accountability and cost efficiencies by power sector restructuring[23];
2) Transition to cost-reflective yet affordable electricity tariff;
3) Develop the national electrical power system to serve growing demand in an economically efficient way and to reduce technical and non-technical losses;
4) Optimize the power mix to reduce long-run cost of service, diversify energy generation technologies, and gradually reduce the carbon-intensity of the grid;
5) Enhance private sector engagement and the attractiveness of exploiting domestic energy resources for power generation;
6) Facilitate autonomous power generation through updated policy guidelines, streamlined licensing, and regulatory reforms.

Rural/Electricity Access Sub-Sector

The main policy objective for this sub-sector is to enhance access to sustainable, modern energy for all Rwandans. The target is 70% electricity access by 2018. The Sept. 16 version of the policy places greater focus on detailing the approach for grid- ***and*** off-grid electricity. Measures to simplify the licensing for off-grid solutions are expected to attract the private sector. There will be a *Rural Energy Agency* by 2018. The policy statements for the Rural/Electricity Access sub-sector are:

1) Restructure energy access and related electricity connection planning and policies;
2) Ensure universal access to electricity in all schools and health clinics by 2018[24];
3) Pilot innovative partnerships to increase rural access to appropriate off-grid solutions;
4) Introduce greater competition and flexibility in off-grid service provision;
5) Introduce short and long-term institutional reforms to increase sector coordination, accountability, and delivery effectiveness[25].

Energy Efficiency and Demand-Side Management Sub-sector

The policy objective of the energy efficiency and demand-side management sub-sector is to

[22] ESSP version Sept. 16, 2014 inserts at this point: *with generation of 563 MW, to account for a reserve margin and system losses.*…into the policy statement. **N.B. It is unusual for a lower-hierarchy instrument (a plan) to modify in any way a higher-level instrument (a policy), and this will have to be harmonized in the final versions.**

[23] There will be an *energy **and** a water* company. The energy company, the *Rwanda Energy Group* (REG), will comprise two companies under one CEO: *Electricity Utility Corporation Limited* and an *Energy Development Corporation Limited.*; each entity will have clear roles and responsibilities.

[24] In Feb. 2014, 90% of health centres, 41% of primary- and 66% of secondary-schools had access to electricity. The policy objective is for universal access in primary ***and*** secondary schools and health centres by 2018.

[25] All major off-grid projects will be put under the EARP Program. By the end of EARP Phase II (2019), rural activities (on- and off-grid) will be under a semi-autonomous *Rural Energy Agency*.

curb unbridled growth in energy consumption and to support the green economy vision. The aim is to gradually decouple economic growth from energy consumption and to manage/reduce peak demand load, which tends to drive the need for more 'generation' capacity. The policy statements are:

1) Adopt new laws, regulations, and codes that mandate energy efficiency measures;
2) Restructure electricity tariff methodology to incentivize efficiency[26];
3) Establish a demand-side management program *within the Utility company to oversee implementation of relevant energy efficiency, conservation, and DSM programs* [27];
4) Encourage and incentivize energy audits among commercial and industrial end-users;
5) Develop a *regional* standards and labelling scheme for common appliances[28];
6) Promote and remove barriers to the implementation of priority efficient lighting initiatives *through bulk procurement, social marketing campaigns, and targeted subsidies for retrofit* [29];
7) *Devise and implement* 'green' procurement guidelines and strategies[30].

Biomass Sub-sector Policy

The policy objective for the biomass sub-sector is to facilitate fuel switching *from traditional biomass energy carriers* ***towards modern biomass energy technologies*** and cleaner fuel alternatives to reduce ***non-renewable fuel wood consumption*** and related social, health, and environmental costs. The discussion is still focused on LPG and biogas, but adding 'modern' biomass to the discussion allows for innovations such as biomass pellets. In general, this section has policy objectives to improve the efficiency of producing biomass energy fuels and to reduce energy consumption through ICS. The policy statements are:

1) Consolidate institutional mandates[31] and strengthen decentralized policy implementation;
2) *Formalize charcoal production and supply to facilitate more effective regulatory control and mainstream improved harvesting and carbonization techniques* [32]*;*
3) Increase access to cleaner cooking technologies by promoting technology standards, introducing fiscal reforms, and piloting new market transformation activities[33]);
4) Develop a harmonized policy and regionally-integrated market for sustainable liquid biofuels [34].

[26] N.B. '*Demand charges*', which are based on the kW consumed, will replace *time-of-use* charges.

[27] This section highlights that a demand-side management program ***or*** unit will be established to implement and monitor related programs. This section also highlights how EWSA will need to upgrade its water pumping stations, as most water pumps are currently energy inefficient. N.B. ESSP Sept 16, 2014 replaces the *italic* text with: ***within the new EUCL***.

[28] ESSP Sept. 16, 2014 modifies the text *italics* to: *Develop* ***and adopt an EAC-wide*** *energy standards and labelling scheme for common household appliances.*

[29] ESSP Sept. 16, 2014 deletes the text in *italics*

[30] RPPA, REMA, and MININFRA shall collaborate to develop clear energy efficiency criteria and guidelines that can be incorporated into sustainable procurement policies and processes (e.g., into the tenders for IT, servers, computers, printers, and copiers). ESSP Sept. 16, 2014 modifies this statement to: ***Institutionalize 'green'*** public procurement guidelines and strategies ***focused on equipment with a high-energy footprint***.

[31] NEP 3.8 explicitly says that the institutional responsibility for ICS and for promoting sustainable production of charcoal should be under MINIRENA. EWSA charcoal and ICS expertise should be transferred to MINIRENA.

[32] ESSP Sept.16, 2014 lists this objective as: ***Improve regulatory oversight over the charcoal sector and mainstream more efficient harvesting and carbonization technique.***

[33] The NEP lists these various measures / actions / plans focused on cleaner cooking and biomass energy:

- Green fiscal reforms*;
- Social marketing / behavioral change models and partnerships with financial institutions**;
- Updated national clean cooking technology standards and a strengthening of decentralized implementation***;
- Promoting 'green' charcoal substitutes;
- Improving Liquefied Petroleum Gas (LPG) market and distribution infrastructure;

* For example, apply VAT / tax on charcoal sales and kerosene, while at the same time applying social marketing to increase LPG sales.
** A focus on social marketing & behavioural change is needed, given that biomass is often collected for free.
*** This section highlights the need to review the effectiveness and impact of current *ICS* and *biogas* programs to capture lessons learnt about public subsidies, technology standards, and integrating maintenance costs.

Petroleum Sub-sector Policy

Given that the petroleum sub-sector has issues with supply, quality, storage capacity, and price volatility, the main policy objective is to *ensure safe, sufficient, reliable, sustainable, and affordable supply of petroleum and LPG*. The policy statements are:

1) Enhance the attractiveness of Rwanda as an investment destination for upstream oil and gas exploration and development [35];
2) Accelerate regional cooperation and strategic infrastructure development, including new refining, pipeline transportation, and railway infrastructure;
3) Institute a more effective public–private hybrid model for maintaining strategic petroleum product reserves;
4) Enhance the effectiveness of price stabilization mechanisms [36];
5) Improve data collection and enforce fuel quality standards through greater checks;
6) Define clear institutional mandates [37];
7) Implement market transformation activities for Liquefied Petroleum Gas (LPG) [38].

NEP Implementation Plan and Monitoring System

According to NEP 3.8, the preferred option to oversee policy implementation is to establish a national *Energy Policy and Integrated Planning Steering Committee* chaired by MININFRA, with representatives from MINICOM, MINECOFIN, PMO, REG, REB, RURA, MINIRENA, RBS/RSB, and private sector chambers. *Of note, the NEP monitoring plan does not strictly follow the sequence of the policy statements nor the actions described under the policy statements. This will make monitoring difficult.*

[34] The text addresses the need to update the 2008 IRST draft policy to promote bio-diesel exploration, production, and use in Rwanda.

[35] The National Petroleum Exploration and Production Policy has 5 pillars:

- Prove and quantify Rwanda's national resources (using an approach based on data);
- Develop a clearer approach and institutional framework for petroleum exploration activities and production sharing agreements;
- Increase the transparency of the legal and regulatory framework, including creating a clear, efficient system for exploration and production licensing;
- Develop a set of technical standards and environmental management protocols to ensure that activities do not compromise health, safety, or the environment;
- Adopt other necessary measures needed to support a more conducive business and investment climate, including opening up the market to greater competition, having clearly defined investment incentive schemes in place, and streamlining procedures for resource exploration and joint ventures.

[36] One example given was to expand the bulk purchasing agreements for petroleum products to all EAC countries (e.g., from only Kenya to also include Tanzania).

[37] This section recommends that the regulations/responsibility for downstream activities (currently under MINICOM) and petroleum infrastructure (currently under MININFRA) be placed in MINICOM. An alternative could also be to establish a *Ministry of Oil and Gas* for the sub-sector.

[38] Measures to implement market transformation activities for the LPG market include:

- Develop an action plan, including a more robust market assessment and marketing and behavioural change campaign, to increase market uptake in urban areas, with measures to incentivize LPG (e.g., levy VAT on charcoal);
- Track market growth and penetration rates;
- Assist local importers to bulk purchase and to have storage facilities;
- Assist pooling of LPG assets and coordination of purchasing via consortia;
- Conduct training in production and assembly of LPG low cost stoves.

3.1.3 Description of the Energy Sector Strategic Plan (2013/2017), Draft Sept. 16, 2014

[39] This SEA consultancy focused until the end of the scoping period on ESSP draft 2012, as that was the version of the plan available in that period. The Consultant received three other drafts of the ESSP during the detailed study period: *Draft 3.1* (Aug. 8); *Draft Sept. 2*; and *Draft Sept. 16*. Given that an *ex post* SEA model (as per TOR) is a sequential assessment, *it should be emphasized that a clear description of the object of the assessment (i.e., the ESSP) was needed before the Consultant could proceed to all subsequent SEA steps and exercises.* ESSP Draft. Sept. 16 is described below.

The objective of the *2014 Energy Sector Strategic Plan (ESSP)* [40] is to achieve the targets under the EPDRS–II for the energy sector and to ensure that the delivery conforms to the 2014 *NEP* [41]. The ESSP is regarded as a detailed action plan to implement the 2014 NEP and to reach the medium-term targets of the EPDRS–II [42].

The ESSP implementation budget is USD 4 billion: 1.1 billion from government / DP and 2.9 billion (or 72%) from private investments. Some 81% of the budget is for the electricity sub-sector, of which 2/3 is for generation and transmission and 1/3 is for access and off-grid electrification. About 18% of the budget is for petroleum activities (89% of which is to fund the regional pipeline). The biomass sub-sector is allocated 1% of the budget, mainly to cover biogas subsidies.

The 2014 ESSP and the 2014 NEP generally cover the same topics, but in a slightly different sequence. The text below summarizes the *challenges, targets* (where relevant), and related *actions* associated with each topic, using the ESSP document sequence, as follows:

- Electricity sub-sector;
- Electricity access;
- Energy efficiency and demand-side management;
- Biomass sub-sector;
- Petroleum sub-sector;
- Private sector engagement;
- Contributions to EDPRS 2 thematic areas (~ NEP's *cross-cutting issues* section).

Electricity sub-sector

The ESSP lists the following electricity sub-sector *challenges*: financial sustainability of network investments; financial sustainability of the generation investment; capacity to deliver the electricity infrastructure; system losses; and timely maintenance and servicing of electric power infrastructure. The related ESSP *actions* are listed, and then detailed below:

1) Restructure and corporatize EWSA;

[39] *Chapter 3.1.3 was researched and developed by Louise Grenier.*

[40] In this document, '*2014 Energy Sector Strategic Plan (ESSP)'*, or '2014 ESSP' refers to version Sept. 16, 2014.

[41] The 20*14 NEP* means *National Energy Policy* version 3.8 (Sept.2, 2014).

[42] The EPDRS–II targets:

- Increase the electric power system equivalent installed capacity to 563 MW;
- Increase household access to grid electricity to 48% and to off-grid, to 22% (=70%);
- Achieve savings from energy efficiency measures up to 10% per annum through demand-side measures and 8% through grid-loss reduction (2013 baseline);
- Reduce carbon intensity of the grid by 10% by 2018 and 25% by 2025 (2013 baseline);
- Ensure that 80% of all households employ clean cooking energy technologies;
- Realize all EAC regional integration policy priorities for energy sector.

2) Transition to a cost reflective tariff:
3) (Balance) demand/supply and security of supply:
4) (Develop the) power system: electricity generation and transmission roadmap;
5) (Develop) regional trade.

1) Restructure and corporatize EWSA

EWSA will be split into two corporations: *Rwanda Energy Group (REG)* and *Water Sanitation Corporation Ltd (WASAC Ltd)*. REG is to be organized in two subsidiaries, the *Electricity Utility Corporation Ltd (EUCL)* and *Energy Development Corporation Ltd (EDCL)*.

2) Transition to a cost reflective tariff

These *actions* are anticipated during the *transition to a cost reflective tariff:*

- Eliminate indiscriminate subsidies to all consumers and define '*smart subsidies*';
- (RURA to) Review the tariff structure in 2014/15, differentiating residential from non-residential users, and provide support to low income customers based on *ability-to-pay*;
- Establish a tariff regime for households and industry based on end users' voltage requirement (i.e., medium vs. low voltage customers);
- Remove the 'metering' charges and apply 'standing fees' to all medium voltage customers;
- Remove the 'time of use' tariff regime and apply 'demand' charges per kW consumed to the medium-voltage customers (the charges should reflect peak load demand).

3) (Balance) demand/supply and security of supply

The ESSP cautions that electricity-infrastructure investments must be in line with demand to set the right balance between maintaining a reliable supply of electricity and making electricity affordable enough to drive economic development. *Reducing power losses* from the current 23% to 15% and having a 15% *reserve power* are priorities, in addition to the following ***actions***:

- ***(Forecast) the baseline demand:*** The ESSP has four (4) preliminary projection scenarios: *likely* demand scenario (where 50% of the large user projects materialize) under two options: the 35% and 48% on-grid connection level; ***and*** an *ambitious* demand scenario (100% of the large user projects materialize) under 2 options: the 35% and 48% on-grid connection level. Under an *ambitious* demand scenario ***and*** a program of 48% on-grid connection level, 563 MW are needed by 2017/18 [43].

- ***Optimize the power mix:*** To optimize the power mix (i.e., to reduce costs and the carbon-intensity and to find the right balance between domestic energy resources, imports, energy supply security, and expected demand), these *actions* are planned:
  - Optimize exploitation of domestic energy resources;
  - Increase net imports in line with security of supply limits and upon concluding advantageous trade agreements;
  - Reduce the carbon intensity by 10% by 2018 and by 25% by 2025 [44];
  - In the short term, prioritize domestic geothermal [45], peat [46], and methane gas for base load applications over hydro imports and petroleum generation sources;
  - Pursue indigenous energy resources as long as the sources are sustainable, affordable, and reliable compared to imports (e.g., solar power);
  - Phase-out expensive petroleum-based *rental* capacity; maintain utility-owned plants to cover peak demand *or* to use as a power reserve.

- ***(Develop the) Least Cost Power Development Plan (LCPDP)***: The LCPDP will be developed by end 2014, and will be updated yearly. Related ***actions*** are:
  - Maximize the use of indigenous energy resources to the extent that energy remains affordable/sustainable/reliable when compared to energy imports;

[43] The demand forecast will be updated once the *Least Cost Power Development Plan* is ready.
[44] At time of writing, the carbon intensity was 0.504 tons of CO_2/MWh.
[45] N.B. The 2014 NEP no longer includes geothermal in the list of sources for the planned period.
[46] The NEP also emphasizes to exercise caution when using peat resources.

- Project electricity *demand* over a 20-year horizon (with yearly updates);
- Produce an annual report on *security of supply*;
- Expand the existing transmission network;
- Only implement projects that are environmentally and socially sustainable;
- Integrate the SEA and other sustainability assessments into the LCPDP.

▪ ***(Develop the) power system*: *the electricity generation and transmission roadmap***
  o ***(Invest in) generation:*** Deliver 563 MW by 2017/18 (about $ 1.6 billion [47]);
  The ESSP lists the projects, timing, and costs to deliver the 593 MW (starting with 119.6 MW in 2013/14; adding 473.5 MW in 2014–2018) [48], see **Figure 3.10** and **Table 3.6**.

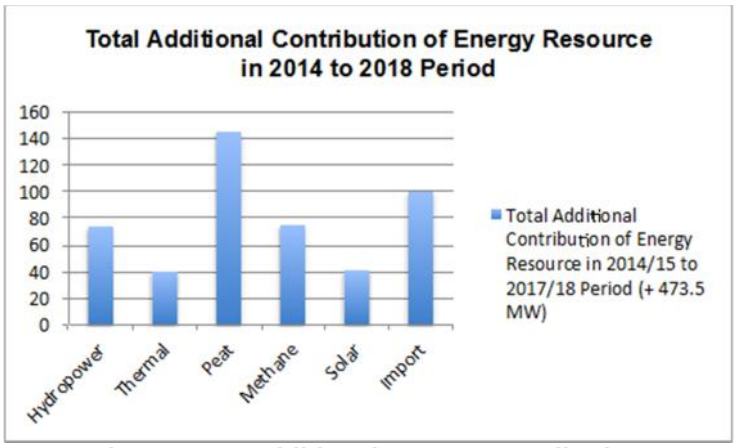


Figure 3.10: Additional Energy Contribution
Source: Analysis of ESSP v. Sept. 16, 2014, Table 9.

Table 3.6: ESSP Electricity Generation Projects for 2015 to 2018

[47] These resources can be combined to deliver 593 MW by 2017/18:
Hydropower: 400 MW (250 MW domestic; 150 MW regional; for base load);
Methane: 350 MW (Rwanda's share) (for base load);
Peat: 700 MW (40,000ha of peat bog) (flexible, including for peak load);
Geothermal: To be determined (for base load) (see previous footnote on geothermal;
Solar energy: On-grid solar power development is currently limited by the technical capacity of the grid;
HFO or diesel: Evening peak demand.

[48] Implementing the current project pipeline will generate 590 MW in capacity by 2017/18, higher than the 563 MW projected requirement. This is to deal with shortfalls due to various types of potential delays.

Generation Option	Project	MW	Year	Sub-total
Hydropower	Mushishito HPP (RukararaV)	2 + 3 MW	2015	
	Nyabarongo I	28 MW	2015	
	Mukungwa I	-12 MW	2015	
	Mukungwa I	12 MW	2016	
	Ntaruka B HPP	5 MW	2018	
	Micro hydro (IPPS)	10 MW 6 MW 4 MW	2016 2017 2018	
	Micro Hydro (REFIT)	5 MW 10 MW	2017 2018	
				73 MW
Import	Interconnection	40 MW	2016	
	Interconnection	20 MW	2017	
	Interconnection	40 MW	2018	
				100 MW
Methane	Kivu Watt I	25 MW	2015	
	Additional PPA	50 MW	2018	
				75 MW
Peat	Gishoma Peat	15 MW	2015	
	Hakan Peat	80 MW	2017	
	Akanyaru Peat	50 MW	2018	
				145 MW
Solar	Rwamagana Solar	8.5 MW	2015	
	Rwinkwavu Solar	10 MW	2016	
	Nyagatare	10 MW	2017	
	Solar REFIT	12 MW	2018	
				40.5 MW
Thermal	Rental	4 MW	2015	
	KSEZ HFO	40 MW	2017	
	Rental	-24 MW	2017	
	KSEZ HFO	10 MW	2018	
	Additional HFO	10 MW	2018	
				40 MW
Total of Roadmap				***473.5***
Existing (2014)				***119.6***
TOTAL by 2018				***593.1***

- ***(Match) generation with demand*** [49]***;***

- ***(Undertake) feasibility studies and the related technology roadmaps***
  Hydropower: *Complete*:
  - Feasibility work on the large regional projects;
  - Feasibility studies on domestic hydro resources, once the 2015/16 *Hydropower Master Plan* is completed;

  Methane: *Conduct*:
  - Various pre-feasibility studies to identify the range of opportunities for investors (e.g., differently-sized projects; different technologies);

  Peat: *Define:*

[49] The energy roadmap can fulfil the generation needs under an ambitious requirement scenario **and** 48% on-grid connections, ***even without geothermal*.** It assumes that a large amount of peat generation will come on line in 2017 and 2018. In the *short term* (2015/16), small hydro and HFO plants will be needed to meet peak demand.

- A *Peat Energy Strategy Action Plan* to assess economic, social, and environmental aspects and develop private sector participation;
- Government to fund: peat development capability; feasibility studies on 4 bogs; and resource inventory

Geothermal:

- Continue geo-scientific surface studies in Gisenyi and Bugarama;
- Consider further uses of geothermal energy (e.g., industrial heating);

Other:

- Develop the relevant technology standards (RBS/RSB) & environmental guidelines (REMA).

o ***(Refine) the REFIT mechanism***

- Draft standardized PPAs to include in the regulation so that the rules / price for the off-take of electricity are known in advance;
- Adjust the tariff schedule for hydropower REFIT upward so that only economically viable projects are procured;
- Include a 'catch-all' bioenergy category (based on an *avoided-cost approach*');
- Expand the range of clean energy sources covered by the REFIT mechanism beyond hydropower (e.g., add grid solar & bio-energy).

o ***(Encourage) autonomous generation***

- Encourage the development of dedicated power plants via *simplified* regulations, licensing, and approaches for autonomous generation;
- Investigate systems to integrate solar energy & net metering arrangements.

o ***(Construct) transmission infrastructure***

To accommodate the increase in generation:

- Develop 25 transmission lines (~1,064 km);
- Develop 20 sub-station projects.

4) (Support) regional trade

- Participate in the EAC/EAPP technical meetings & promote regional integration;
- Develop the necessary standards, procedures, agreements, tariffs, regulations, capacity to manage the interconnected system (i.e., build interconnected lines; negotiate equitable commercial arrangements; establish operational guidelines for the synchronized systems; harmonize the grid codes; create the institutional and regulatory arrangements; develop the capacity to manage the system; and, complete the action plan to operationalize energy imports);
- Complete the following key projects:
  - Mbarara – Mirana, 220 kV double circuit; April 2015;
  - Mirana – Shango, 220 kV double circuits; June 2015;
  - Lessos (Kenya) – Tororo (Uganda): 400 kV; Dec. 2016;
  - Masaka – Mbarara (Uganda): 400 kV; under discussion; Dec. 2016;
  - Gilgel Gibe III (Ethiopia) – Suswa (Kenya), high voltage direct current, Dec. 2017;
- Assess the role and economic impact of the various import sources in relation to the LCPDP;
- Import from Uganda & Kenya by 2016 and import from Ethiopia, by 2018.

Electricity Access Sub-sector

The *challenges* with respect to electricity access include: financial sustainability of network investments; coordination between the distribution plans and the generation plans; sustainability of off-grid solutions (e.g., preventative maintenance system); terrain and settlement patterns (scattered settlements increase the costs); and access to finance for energy access (especially relevant to off-grid connections).

The 2014 ESSP prioritizes large and productive users; schools and hospitals; small and medium enterprises (SMEs); and lastly, households. The 2018 *targets* are to: provide up to 230 MW of power to *productive* end users (e.g. mining, industry, special economic zones, tea factories, and irrigation) (*outside the scope of EARP*); provide 100% of *schools* and *hospitals* with access to electricity by 2018 using on-grid and off-grid solutions, and provide 70% of *households*: on-grid (48%) & off-grid (22%) (*under EARP*).

1) Implement actions that are outside the scope of the EARP (~productive users)

- Realize better coordination and integrated planning over investments and implementation strategies for energy access and electrification (overseen by MININFRA as part of the SE*4*ALL *Action Plan* and by the proposed inter-agency *National Energy Policy and Integrated Planning Steering Committee*);
- Reprioritize target groups for on-grid electrification access;
- Increase financial sustainability of network investments (e.g., by increasing the industrial and commercial use of electricity);
- (EUCL to) develop a 3-year On-grid Electrification Plan that reflects the policies and the LCPDP to incentivise industrial investment.

2) Implement other activities contributing to access (*Beyond EARP*)

- Develop a stand-alone *Off-grid Action Plan* that makes private sector engagement a core focus of the implementation and procurement approach;
- Further develop institutions to increase coordination, effectiveness and accountability (e.g., by 2018/19, there will be a *Rural Energy Agency*);
- Pilot innovative partnerships to increase rural access to electricity (e.g., innovative PPPs; use of climate financing such as FONERWA);
- Implement fiscal reform for peri-urban / urban households to reduce consumption of kerosene and to increase alternative solar technology;
- Increase competition and flexibility in off-grid provision by simplifying licensing and stimulating (off-grid) small-scale power distributors (SPDs);
- Facilitate private sector off-grid activities (i.e., develop an off-grid strategy and a regulatory environment that is conducive for the private sector);
- (Implement various) specific off-grid technologies (e.g., solar installations)[50].

3) Implement the *Electricity Access Rollout Program (EARP)*

Schools and hospitals:

- Conduct feasibility studies to ensure value-for-money (schools and hospitals, and other public services);
- Deliver on the 70% electricity access target:
  On-grid households:
  - Connect an additional 669,000 households from July 2014 to 2017/18 to reach the 48% on-grid target;
  - Buy equipment in bulk;
  - Encourage local and regional companies to participate;
  - Install about 362,000 direct connections to reach the 48% target;
  - Connect an additional 396,000 through relocation and fill-ins;

  *Off-grid households***:** *MININFRA to:*
  - Develop an Action Plan to implement and manage off-grid solutions;
  - Hire an off-grid expert to manage the programs;
  - Collaborate with RURA to develop an enabling legal and regulatory framework to encourage the private sector into rural service provision;
  - Develop appropriate PPPs;
  - EARP to harmonize with EARP II off-grid plans to reach the 22% off-grid target.

[50] The private sector can deliver some household solar systems for $50 to 200. Other relevant off-grid technologies include off-grid hydro projects, such as mini-grids, solar-wind & solar-diesel hybrid systems, efficient diesel generators for independent generation, and stand-alone or mini-grid biogas, and possibly.

Energy Efficiency (EE) and Demand-side Management (DSM)

The *challenges* with respect to energy efficiency and demand-side management are: limited institutional experience (and no specific EE strategy yet); high degree of system losses; and barriers to uptake, including high up-front cost (e.g., limited financial mechanisms or awareness to encourage EE or DSM). The *targets* are to increase energy efficiency by up to 10% though demand-side measures and by an additional 8% through grid-loss reduction by 2018 (2013 baseline).

The 2014 ESSP *actions* to address EE and DSM are:

1) (Implement the) grid loss reduction (from 23% to 15%);
2) (Develop) new laws, regulations, and codes (and programs):
   - Develop and adopt an *Energy Efficient Strategy and Law* (and other mechanisms, e.g. solar water heater regulation);
   - (Implement) energy efficiency programs (e.g., new connections will have CFLs);
   - (Require EE design in new) buildings (green building and green architecture);
   - (Promote EE in the) Public Sector (e.g., adopt EE code for street lighting; replace inefficient pumps);
   - (Adopt) EAC-wide energy-standards-and-labelling scheme (for appliances);
3) (Establish) a dedicated demand-side management unit in the Utility;
4) (Encourage and incentivize) energy audits (e.g., EE finance facility to do 50/50 cost split and retrofits for industry);
5) (Institutionalize) green procurement guidelines.

Biomass Sub-sector

The *challenges* within the biomass sub-sector include deforestation and low availability of alternatives [51]; deadly smoke and emissions from cooking fuels [52]; and lack of clear ownership [53]. The 2018 *targets* include: 80% of households employ cleaner cooking energy technologies by 2018; 80% of households using improved cook stoves; 3,500 domestic- and 15 institutional-biogas digesters distributed annually; in charcoal yields (2009 baseline) are increased by 30%; and, consumption of traditional energy biomass is dramatically reduced.

The ESSP *actions* to address the biomass sub-sector challenges are to:

1) Introduce enabling frameworks to promote alternative clean cooking carriers and technologies (e.g., biogas, LPG, peat briquettes); develop a new strategy / action plan that will identify appropriate technologies; (i.e., for different types of households and geographical locations within a biomass strategy);
2) Decentralize the biomass schemes (e.g., decentralize decision making to accelerate delivery and promote ownership; incorporate the delivery of alternative energy into the Districts' annual performance contract);

ICS

3) Promote improved charcoal and wood stoves (e.g., training on modern ICS);
4) (Provide) technical support on the choice of stove models (e.g., provide technical guidance on the most fuel-efficient cook stoves; continue to promote the 'rondereza[54]' oven; and leverage carbon finance to provide additional financing);

Charcoal

[51] Alternatives to fuel wood are expensive and can be difficult to obtain (e.g., LPG).
[52] 5,680 deaths a year in Rwanda are related to household air pollutants (cited in 2014 ESSP).
[53] According to the ESSP, there is a lack institutional accountability, some responsibility overlap, and coordination failure in the biomass sub-sector (e.g., biogas program). The centralized dissemination of biogas digesters and cooking stoves has yielded less than expected results.
[54] Common name for economizing stove

5) (Further) formalize the charcoal supply chain;
6) Simplify the licensing scheme for charcoalers (e.g., apply a decentralized licensing system to foster more transparent and sustainable wood harvesting; explicitly require tree harvesting / replacement in the public domain);
7) Train charcoaling professionals (e.g., improve via training charcoaling techniques to improve efficiency from 12% to 15% by 2015; improve the charcoal supply chain; also promote energy conservation measures through use of carbonised charcoal or hydraulic charcoal among large non-domestic users of wood and charcoal, e.g., brick makers);

Biogas

8) (Revise the) biogas subsidies (e.g., restructure biogas subsidies based on a detailed economic analysis; develop strategies on end-user financing);
9) Disseminate via the NDBP II some 3,500 household biogas digesters (i.e., an additional 18,000 by 2018) and 15 institutional biogas digesters per year (e.g., for schools, hospitals, and prisons); the EDLC to continue to give technical assistance for the installation, use, and maintenance of biogas digesters; upgrade existing standards for biogas technologies and develop new standards for emerging technologies; and conduct a feasibility study to evaluate the relative merits of the new and existing technologies;

Other fuels

10) (Supply) alternative fuels:
    - *Briquettes***:** Explore the possibility of large scale and commercial use of peat briquettes for cooking or boiler fuel; Explore the use of briquettes made from charcoal dust, peat, papyrus, or other waste such as rice or maize husks, or coffee grounds to replace wood and charcoal for cooking and heating;
    - *Liquefied petroleum gas (LPG):* Explore other measures to promote the use of LPG (e.g., bulk purchasing and storage facilities);
      Liquid Biofuels: Develop a market for sustainable [55] liquid biofuels for the transport and agro-processing sectors; promote regional approaches to develop supply chains and distribution channels;
11) Develop a national clean cooking database *(this is listed in the implementation plan, but not in the text per se of the ESSP*).

Petroleum Sub-sector

The high level *target* for the petroleum sub-sector is to hold a *3-month fuel reserve*. The main *challenges* are volatile prices, high costs and uncertain product quality, fragmentation of institutional mandates and regulatory responsibilities (e.g., between MININFRA, MINICOM, MINIRENA, and other stakeholders), and insufficient infrastructure (e.g., storage). The ESSP *actions* to address the challenges of the petroleum sub-sector are categorized as *upstream, midstream, and downstream*, as outlined below.

Upstream petroleum [56]:

- Implement the 2013 *National Petroleum Exploration and Production Policy*;
- Liberalize the issuance of exploration licenses;
- Increase TVETs' capacity to provide training in the production and /or assembly of LPG low-cost stoves, in line with increased demand.

[55] The 2014 NEP revised this statement to***: Developing a harmonized policy and regionally-integrated market for sustainable liquid biofuels.***

[56] *Upstream petroleum* relates to the exploration and production of petroleum, and the supporting infrastructure.

Midstream petroleum [57]:

- Jointly invest in the Hoima regional refinery project and in other multi-national investments, including bio-diesel blending facilities;
- Develop interconnected transport infrastructure to provide faster, more reliable supplies of petroleum and LPG;
- Assist / incentivize private investors and local importers to purchase in bulk;
- Assist / incentivize retailors, wholesale fuel distributers, and local importers to invest in storage and distribution facilities to reduce the LPG price.

Downstream petroleum [58]:

- (Regulator to) set and enforce standards for all downstream petroleum products;
- Conclude bulk-purchasing agreements for petroleum products with the EAC countries, starting with Tanzania;
- Adopt an appropriate domestic fuel-pricing methodology;
- Encourage/mandate large fuel consumers to enter fuel-hedging arrangements;
- Adopt regulations to mandate that data on the trade, sale, and strategic stores of petroleum products be submitted to the regulator;
- Track the market growth and penetration rates of LPG through surveys;
- To increase the uptake of LPG, implement a social marketing / behavioural change campaign targeting urban, middle-class households.

Infrastructure:

- Complete the feasibility study for the Hoima, Uganda, and Kigali pipeline [59].

Private Sector Engagement

To implement the ESSP, Government needs to attract private investors and to streamline investment processes. *Challenges* with respect to the private sector have included passive reactions to expressions of interest, the occurrence of unplanned negotiations before having feasibility studies, and the evaluation of investments against an optimized energy portfolio. In addition to clarifying the rules and modalities for Public–Private Partnerships (PPPs), the ESSP *actions* to address private sector challenges are listed below

- De-risk investments by financing upstream resource assessments and pre-feasibility studies;
- Establish a *Rwandan Energy Development Fund (REDF)* by end of 2015/16 (under MINECOFIN) to streamline access to early-stage project finance (e.g., to fund feasibility studies);
- Streamline investment promotion processes for IPPs (i.e., simplify);
- Empower local enterprises to engage in energy sector deals and introduce more competitive, transparent approaches to service provision (i.e., new procurement guidelines with templates will be developed; competitive bidding is the default option);
- Extend and expand investment incentives to private investors (e.g., provide access roads with reimbursement at a later date).

[57] There is no mention of 'mid-stream' petroleum sector in the 2014 NEP. *Midstream* refers to the transport, storage, and wholesale marketing of petroleum.

[58] *Downstream petroleum* refers to the refining, processing, marketing, and distribution of petroleum products.

[59] A new oil refinery is to be completed in Uganda by 2018.

EDPRS II and Cross Cutting Themes

The ESSP *actions* to contribute to the EDPRS–II and cross-cutting themes [60] include: *capacity building*; *environmental conservation, risk mitigation, and green growth*; and *regional integration*, as summarized below.

Capacity building

- *Human resource development:* transfer knowledge to local counterparts through the *Strategic Capacity Building Initiative*, SCBI[61];
- *Institutional capacity development*: develop clear policies/guidelines on training needs and priorities and internships; develop opportunities for staff exchanges or rotations; each energy-sector institution will have a clear focal point tasked with delivering on capacity building targets;
- *Monitoring and Reporting Systems*[62] .

Environmental conservation, risk mitigation, and green growth

- Enact legislation that requires green design, solar water heating systems, and natural lighting (etc.) to comply with the commitment to low-carbon development;
- Implement measures to mitigate climate change impacts and to protect the environment; the measures should:
  - Reduce reliance on traditional biomass energy from 85% to 50% by 2018;
  - Focus on local and *renewable*[63] energy sources to replace expensive and higher polluting diesel fuels (e.g., domestic geothermal, methane gas, and solar resources);
  - Increase energy efficiency through energy efficient devices;
  - Ensure that all power projects conduct EIA;
  - Develop a *Disaster Recovery Plan* for each energy investment;
  - Mainstream disaster prevention and environment, health, and safety (EHS) into operational policies; address petroleum industry EHS risks through international best practices and use of high standard equipment (e.g., risks include fire outbreaks and oil spills).

Regional Integration

- Participate in the formulation of the *Regional Energy Master Plans*, the *Common Market for East and Southern Africa*, and in the regional strategies or projects for

[60] The 2014 NEP addresses '*mainstreaming cross-cutting issues'*, whereas the 2014 ESSP covers '*EDPRS II & Cross-cutting Themes'*.

[61] Capacity gaps identified among energy sector staff include procurement, project management, and contract management skills. (There is no mention of environmental management skills).

[62] Although '*monitoring and reporting systems*' are not explicitly listed under '*capacity building*' in the ESSP, this is a good place to address the topic, given that achieving the new targets requires new databases, and these actions:

- Set up a dedicated M&E Unit for the energy sector at the Energy Utility;
- Expand the Utility's MIS to cope with the new datasets;
- Integrate the Utility's Management Information System (MIS) at all levels;
- Ensure that MININFRA IT system can cope with centralized data sharing and also host a light version of the Utility's MIS to better exchange information;
- REG to send updates and project information to the SWAP Secretariat;
- The Secretariat to serve as a portal of information and coordinator;
- Develop the new databases (e.g., off-grid database; investment-tracking system);
- Conduct training on how to manage the monitoring systems.

[63] The 2014 NEP (Sept. 2, 2014 version) now refers to *clean* energy sources, rather than *renewables.* As mentioned previously, the 2014 NEP no longer lists 'geothermal' for the plan period.

petroleum products and electricity (including EAPP and NELSAP);
- Explore/develop Lake Kivu's methane gas with the DRC;
- Develop regional interconnections to export/import from other countries;
- Participate in the *Regional Strategy on scaling up access to Modern Energy Services in EAC* (e.g., to provide access to modern cooking practices for 50% of the population currently using traditional cooking fuel);
- Participate in the *EAC Regional Cross-border Electrification Policy and Model Power Supply Agreement* (i.e., this allows consumers to benefit from resources across the border that are nearer than domestic alternatives);
- Participate in *Eastern Africa Power Pool (EAPP)* and *East African Community (EAC)* (where power generation and interconnections are identified at the level of a Master Plan, and the aim to facilitate the integrated development and operations of the power systems of EAPP and EAC countries).

ESSP Implementation Plan and Monitoring System
N.B. The ESSP Implementation Plan and Monitoring system not strictly follow all the actions described in the text. This will make monitoring difficult.

3.2 Alternatives

During the Scoping period three main alternatives under various climate scenarios were discussed. An initial assessment of these scenarios gave an utterly complex matrix which would not give clarity to the evaluation of the ESSP. Thus, due to their complexity and the number of revised ESSP draft during the period June to September 2014 the Consultant decided to adapt his development scenarios to the ESSP 2014 ambitious scenario which are assessed against the below environmental objectives, specified as:

Biological Objectives:
Reverse deforestation; reduce pressure on forests; Prevent loss of wetlands & associated ecosystem services; Protect natural areas; protect biodiversity
Physical objectives
Minimize land take, land degradation and soil erosion; Minimize impact on hydrological system; Support Integrated Water Resource Management; Reduce pollution.
Social Cultural objectives
Promote water and food security; Promote gender equality and equity; Reduce poverty; Improve alternative livelihoods; Support welfare and health for all.
Energy objectives:
Provide clean, affordable, reliable, secure, renewable, efficient, indigenous sustainable energy; Minimize economic costs of the energy sector; Provide a low carbon energy supply; Reduce demand for wood fuel and charcoal.
Economic objectives:
Support economic growth; Increase employment opportunities; Support green growth / cleaner production / EE; Support private sector development; Support other sectors to be more sustainable.
Institutional objectives:
Strengthen institutional coordination & compliance with government regulations; Strengthen management & monitoring capacity; Promote a culture of 'maintenance'

Details of the ESSP assessment is presented in **Chapter 9.**

3.3 Policy, Institutional, and Legal Framework for the Energy Sector

Section 3.3 [64] briefly reviews the general policy framework (Rwanda and EC), introduces the key institutions of the energy sector (as well as the main responsibilities), introduces the environmental legal framework, and lastly, provides a comprehensive summary of the policy, institutional, and legal framework of the energy sector.

3.3.1 Overall Policy Framework

All sectors, including the energy sector, must contribute to the implementation of the national policy framework. Key documents include the 2003 Constitution, Vision 2020, EDPRS II, and the Green Growth and Climate Resilience Strategy.

3.3.2 European Commission Environment-and-Climate-Change Policy Framework and Requirements

Based on the 2009 *Guidelines on the Integration of Environment and Climate Change in Development Cooperation*[65], it is the EC's policy to mainstream the environment (including climate variability and climate change aspects) into development cooperation. The specific objectives are to:

- Identify / avoid harmful direct / indirect environmental impacts of its programmes;
- Recognise and realise opportunities to enhance environmental conditions;
- Promote improved environmental dialogue with partner countries;
- Identify potential programme risks by assessing exposure, sensitivity, and response capacities to deal with climate variability and change.

The EC has a high-level commitment to *environmental sustainability.* It is noted that 'climate', as an integral part of the 'environment', interacts with existing environmental trends and will tend to intensify existing pressures. The EC therefore advocates *robust* responses to climate change. Other fundamental objectives of EC environment policy include to:

- Minimize security and potential conflict with regards to the access and management of natural resources;
- Eradicate poverty;
- Address gender issues;
- Protect the environment and sustainably manage natural resources;
- Implement the Multilateral Environmental Agreements (e.g., Rio conventions and Millennium Development Goals, *MDGs*).

As outlined in the 2009 guidelines, the EC integrates environment through the use of specific programming and project tools [most relevant here is using SEA for *Sector Policy Support Programmes* (SPSP) and EIA for any project support]. During the *identification* phase of the SPSP*,* sector policies/programmes are screened to identify those that could have significant environmental impacts and/or those that have environmental and climate constraints. The screening outcome in the case for Rwanda's energy policy and energy plan was a decision to conduct an SEA. The 2009 EC guidelines provide a template for the SEA study, which was used to develop the ToRs for this SEA. It is expected that this SEA will integrate environment and climate aspects into the 2014 energy policy and ESSP, and also therefore integrate environment and climate aspects into the SRC programme identification, formulation, implementation, programme monitoring, and evaluation[66]**.**

[64] *Chapter 3.3 was researched and developed by Louise Grenier.*

[65] The *2009 Guidelines on the Integration of Environment and Climate Change Development Cooperation* **replace** the *2007 Environment Integration Handbook for EC Development Co-operation.*

[66] Of note, the actual SRC was under formulation during the timeframe of this SEA consultancy; there was no draft SRC and therefore it could not be directly assessed using the SEA tool; this SEA focused on the 2014 Energy Policy and 2014 ESSP.

3.3.3 Institutional Framework

Table 3.7 lists the key energy-sector institutions, as well as the main responsibilities (in alphabetical order).

Table 3.7: Key Institutions of the Energy Sector

Institution	Main Responsibility
Civil society	Civil society supports the implementation of energy policies and programs, and undertakes policy advocacy, civic education, and community empowerment. It can promote sustainable energy resources, service delivery, renewable and cleaner energy technologies, and local entrepreneurship.
Energy SWAP and Secretariat	The eSWAP conducts inter-sectoral and intra-governmental coordination, to harmonize processes, procedures, and policies and to better coordinate external assistance; eSWAP also monitors the implementation of energy programs and policies (Ministries of Finance and Energy, and Development Partners).
Energy SWG	The Energy Sector Wide Group is a forum where government meets development partners to discuss matters influencing the sector; it approves long-term plans and policy measures; the SWG convenes the Joint Sector Reviews.
EWSA *(reorganized, as shown in grey below)*	The Energy, Water and Sanitation Authority translates energy sector policies and programs into tangible projects to achieve the government vision in the energy, water, and sanitation sectors.
REG	The Rwanda Energy Group (REG) will translate energy sector policies and programs into tangible projects to achieve the government vision in the sector and to efficiently operate and maintain Rwanda's power system. The REG comprises the *Electricity Utility Company Ltd (EUCL)* and the *Electricity Development Company Ltd (EDCL),* both reporting to a CEO and an independent board. (The *Water and Sanitation* Company will also be an autonomous company with its own CEO & Board).
EUCL	The *Electricity Utility Company Ltd* will be responsible for: • Planning the transmission and distribution grid in areas already reached by electrification; • Generation, bulk transmission, and distribution and retailing functions on a commercial basis; • Promoting energy efficiency and demand side management; • Operation of the systems; • Serving as Secretariat for the Grid Code Advisor Committee.
EDCL	The *Electricity Development Company Ltd* will be responsible for: • Exploring and assessing new energy resources; • Developing / planning of primary energies (generation & transmission projects); • Developing the *Least Cost Power Development Plan*; • Definition/updating of the overall power system master plan, based on the *Least Cost Power Development Plan*; • Planning and development of electricity access; • Developing social energy projects; • Execution of the generation and electrification projects (and then handover of the assets to the EUCL at time of commissioning); • In collaboration with MININFRA, negotiation of PPAs with neighbouring countries for long-term import of electricity.
Financial institutions and development partners	The financial institutions and development partners provide access to credit and financial services; finance institutions (e.g., MIGA and KFW) could offer guarantees and risk insurance; development partners can support feasibility work and technology and knowledge transfer.
FONERWA	The *Rwanda National Climate and Environment Fund* will serve as the primary mechanism through which Rwanda mobilizes, programs, and disburses international and national extra-budgetary environment-and-climate finance.

IRDA	The Industrial Research and Development Agency facilitates the transfer of innovative technologies, carrying out industrial research to promote development.
Local Government	Local Governments are responsible for the development of their District and for maintaining District infrastructure (i.e., responsible for decentralized service delivery and approval of local Development Plans).
MIDIMAR	Ministry of Disaster Management and Emergency Response works to improve capacity to manage disaster risks; it develops emergency systems to respond to disaster, including disasters involving energy projects.
MIGEPROF	Ministry of Gender and Family Promotion (Gender Monitoring Office) monitors progress and compliance with mainstreaming gender-based equity into the energy policy.
MINALOC	The Ministry of Local Government promotes decentralized basic services delivery (e.g., cook stoves, biogas digesters, and portable solar lamps).
MINEAC	Ministry of East African Community is a coordinating body for EAC and Rwandan priorities within EAC protocols, treaties, and strategies.
MINECOFIN	The Ministry of Finance and Economic Planning is responsible for budgets, financial laws and regulations, tax law and regulations, and public procurement regulations. It provides sovereign guarantees for strategic investment projects and IPPs; it will support feasibility studies (e.g., resource assessments).
MINEDUC	The Ministry of Education builds the competency and human resources for sector development. It ensures that the TVETs address skill shortages in the energy sector.
MINICOM	The Ministry of Commerce (Trade and Industry) has a number of key policies and strategies to support the development of the industrial sector and export markets; it is responsible for the development and oversight of the downstream petroleum sub-sector.
MININFRA	The Ministry of Infrastructure is responsible for the legal and institutional framework for the energy, water and sanitation, transport, urban development, and meteorology sectors. It develops energy policy and strategy, monitors and evaluates projects, and implements programs. The Ministry also sets the legal framework, prepares budgets, mobilizes resources (together with MINECOFIN), and provides political oversight.
MINIRENA	The Ministry of Natural Resources is responsible for the legal and institutional framework for lands, water, environment, forestry, and mining sectors; it is responsible for ensuring the sustainability of natural resources exploitation and for compliance with environmental policy and law.
RBS *(split into RSB and NICA; NICA is shown in grey below)*	The Rwanda Bureau of Standards, now Standards Board, undertakes all activities pertaining to the development of national standards (e.g., standards for biogas digesters and solar appliances), quality assurance, and metrology in the country.
NICA	The National Standards Inspectorate, Competition, and Consumer Protection Authority *will*: advise government on competition, consumer protection, and project quality; monitor the implementation of trade laws; educate on consumer protection rights and principles; and inspect quality standards (e.g., petroleum storage and distribution facilities). *The roles of RSB and NICA need to be more clearly delineated (especially within downstream petroleum).*
RDB	The Rwanda Development Board has a lead role in investment mobilization and promotion for the energy sector, acting as a gateway and facilitator. It promotes private sector participation and facilitates foreign direct investment. It issues the EIA, when required.
REMA	Rwanda Environment Management Authority applies the *Organic Law on Environment* and prepares environmental regulations and guidelines e.g., for EIA, SEA, environmental monitoring and permitting, & climate change mitigation and adaptation. It has the mandate to implement environmental policy and also acts as MINERENA's think tank.
Research and educational institutions	The research and educational institutions help develop the skills and knowledge needed to implement the energy policy and strategy by supporting related research and capacity building.

RNRA	The Rwanda Natural Resources Authority is an autonomous authority responsible for the management of Rwanda's natural resources (including hydrological resources, such as land and peat reserves).
RTDA	Rwanda Transport Development Agency (under MININFRA) manages the transport sector (including planning of access roads for energy projects and the rail project from Dar es Salaam).
RURA	The Rwanda Utilities Regulatory Authority is responsible for licensing and regulations in the energy, water and sanitation, transport, and communications sectors; it ensures consumer protection and financial sustainability of public utilities; it updates the electric grid code and ensures quality of the service standards for electric power; it reviews tariff structures.

3.3.4 Environmental Legal Framework

The important energy–environment interactions are managed through an environmental management framework spanning from the 2003 National Environment Policy, to EIA regulation, and to EIA and SEA guidance, to various strategies and plans to manage biodiversity, wetlands, fisheries, land, and forestry issues. **Table 3.8** provides a comprehensive summary of key environment management policies in Rwanda

3.3.5 Comprehensive Summary of the Policy, Institutional, Legal, and Planning Framework for the Energy Sector

The energy sector has an evolving policy/institutional/legal framework. The framework is evolving at all levels, including at the level of each sub-sector (i.e., electricity, petroleum, geothermal, peat, biomass, and the inter-regional level). **Table 3.8** provides a comprehensive summary of the energy sector framework, with some summary descriptions of key documents, as of August 2014.

Table 3.8: Policy, Institutional, and Legal Framework for the Energy Sector

Institution	Policy, Legal, and Planning Framework	Relevant Description
NATIONAL		
GOR	▪ Constitution of the Republic of Rwanda (2003).	▪ Entitles every citizen to a healthy and satisfying environment; ▪ Obliges every person to protect, safeguard, and promote the environment.
GOR	▪ Rwanda Vision 2020 (issued in 2000).	▪ Institutes the principle of precaution to mitigate the negative effects caused to the environment by the socio-economic activities; ▪ Adopts the polluter-pays principle, as well as preventative and penal measures; ▪ Promotes environmental conservation and sustainable natural resources management; *Relevant Targets for 2020:* ▪ Middle income country by 2020 (from USD 220 in 2000 to USD 900); ▪ Poverty rate reduced from 60% in 2000 to 30%; ▪ 35% of population connected to electricity; ▪ Decrease consumption of wood to 50% of national energy consumption; ▪ Forest cover to reach 30%; ▪ Protection rate against erosion to rise from 20% in 2000 to 90% in 2020.

Institution	Policy, Legal, and Planning Framework	Relevant Description
GOR	▪ Economic Development and Poverty Reduction Strategy 2013–2018 (EDPRS).	▪ Focuses on economic growth, but also prioritizes the environment to achieve Vision 2020 and the MDGs; ▪ Aims to eradicate extreme poverty; ▪ Aims to improve governance; ▪ Aims for sustainable growth for jobs and exports (and for a competitive Rwandan business environment); ▪ Empowers citizens to participate in development.
GOR	▪ Green Growth and Climate Resilience Strategy 2012.	▪ Promotes: sustainable intensification and diversification of agriculture; sustainable land use management; Integrated Water Resource Management; low-carbon energy grid; small-scale energy for rural areas; disaster management, green industry, and private sector development; climate-compatible mining; resilient transport systems; low-carbon urban systems; ecotourism; sustainable forestry; and agroforestry and biomass; ▪ Provides for a *Green Economy Inter-ministerial Steering Committee*.
ENERGY		
MININFRA	▪ Energy Sector Strategic Plan 2013–2018 (version Sept. 2, 2014).	▪ As described in **3.1.3**
AfDB	▪ Rwanda Energy Sector Review and Action Plan 2013 (AfDB).	▪ Provides an *accelerated* and a *delayed* programme for installing energy capacity.
EU	▪ TORs for *Rwanda – Sector Diagnostic, Identification, and Formulation of an EU Energy Programme under 11th EDF.*	▪ This SEA will provide inputs to the EU programme.
RDB	▪ Investment Code 2014.	▪ Provides high-level guidance on the development of the energy sector, in a manner that fulfils the EDPRS II; ▪ Promotes greater investment and private sector engagement in the energy sector.
MININFRA	▪ Draft Energy Policy 2014 (version Sept. 2, 2014).	▪ As described in **3.1.2**
MININFRA	▪ MININFRA & Gender Monitoring office.	
	▪ Law on Public-Private Partnerships (draft 2014) (PPP Law 2014).	▪ Will provide the legal framework for the implementation and management of PPPs, clarifying the rules of engagement and procurement for the public and private partnerships.
MININFRA	▪ Least Cost Power Development Plan 2014 (end)	▪ Will compare domestic & regional priority projects.
MININFRA, MINIJUST, Law Reform Commission	▪ National Energy Law (consolidating all existing legislation: 2015/2016).	▪ (To be developed) ▪ Formulates an umbrella law for the energy sector/
ELECTRICITY		
EWSA	▪ Law Establishing EWSA 2010; ▪ Law No 97 / 2013 Repealing EWSA.	▪ Establishes EWSA by merging RECO and RWASCO into EWSA; ▪ Repeals EWSA, separating the electric power utility from the water and sanitation utility.
RURA	▪ Law No 39 / 2001 on *Establishing and Determining the Mandate of the Rwanda Utilities Regulatory Authority* (RURA); ▪ Revisions to Law 39, in Law No 09/2013.	▪ Determines RURA's mission, powers, organization, and functioning; ▪ The 2013 revision mandates RURA to regulate electronic technologies, renewable and non-renewable energy, industrial gases, pipelines, and storage facilities; it also mandates RURA to regulate tariffs.
RURA	▪ Electricity Act 2011.	▪ Covers the market set up, and the licensing

Institution	Policy, Legal, and Planning Framework	Relevant Description
		regime for production, transmission, distribution, and trading of power; ▪ Provides tariff principles. N.B. Articles 12 and 25 need revision to clarify the boundary between concession agreements by MININFRA and operating licenses by RURA. At the moment, the law requires to issue a generation license within 60 days of being granted a concession (this is not practical, given that the RURA regulation says to issue the license after an EIA and PPA agreement). Also need to clarify framework for autonomous generation and net-metering investments.
RURA	▪ Regulation No 002/2012 on *Electrical Installations*.	▪ Covers the requirements for undertaking any electrical installation; ▪ Aims to protect all parties from hazards.
RURA	▪ Regulation No 002/2013 on *Electricity Licensing*.	N.B. RURA issues permits and certificates to electrical operators to satisfy the licensing requirements of the Electricity Law 2011. This 2013 regulation: ▪ Establishes a framework to undertake electricity activities for the orderly development of supply operations; ▪ Outlines the different categories of licenses (e.g., production, transmission, or international trade licenses); ▪ Does not govern concession licenses/agreements.
RURA	▪ RURA's *Rwandan Grid Code* 2013.	▪ Establishes rules & procedures for the good use of the interconnected power system to conform with the *Grid Code* and licensing requirements; ▪ Includes technical guidelines.
RURA (also MININFFRA, EWSA)	▪ *Renewable Energy Feed-in Tariff* (year?); ▪ Reviewed in 2013 to align tariffs to market; ▪ Update to standardize PPA under REFIT (RURA, EWSA, & MININFRA)?	▪ Based on Law No 9/2013, mandates RURA to establish and regulate electricity tariffs (with EWSA).
	Secondary regulations for the electricity sector concerning *Simplified Licenses for Off-grid Providers and Related Technical Specifications* (end of 2014?)	
MININFRA (&EWSA)	▪ Energy Efficiency Law **(**Draft 2014**).**	
RBS/RSB, MININFRA, RURA, REMA, MINELOC, MINEDUC, NCA, RHA, MINIREMA	▪ Various guidelines related to electricity, biogas, building codes, and mainstreaming climate change.	▪ Various power standards including: Electrical wiring of premises 2011; Power installation exceeding 1 kV; ▪ Minimum Energy Performance Standards (year?); ▪ Guidelines for Solar Water Heaters Installation 2012; ▪ Guidelines Promoting Energy Efficiency 2013; ▪ National Technology Standard on Biogas Digesters / Guidelines for biogas digesters 2014?; ▪ Guidelines on mainstreaming climate change in energy infrastructure & accessing climate finance 2014?; ▪ Green Building Codes & Standards (RHA 2014?);
PETROLEUM		
Ministry of Trade and Industry (with MININFRA, RURA, RBS/RSB, REMA, Rwanda Revenue Authority)	▪ 2012 National Petroleum Downstream Policy.	▪ Aims to achieve a consistent and cost-effective supply and distribution of petroleum products in compliance with industry standards; ▪ Protects consumers and ensures safety and environmental protection; ▪ Covers transportation of crude and refined products, refining, distribution, marketing, & storage;

Institution	Policy, Legal, and Planning Framework	Relevant Description
		▪ Establishes strategic reserves, and improves storage capacity and storage security (a 150 million litre reserve by 2017); ▪ Adheres to product standards; ▪ Manages the downstream petroleum sub-sector.
	▪ Law No 85/2013, Law on Petroleum Trade.	▪ Governs and regulates the trade of petroleum and petroleum products in Rwanda, including LPG; ▪ Applies to the selling, import, export, transport, processing, facilities, & distribution of products.
MINIRENA	▪ National Petroleum Exploration and Production Policy 2013; ▪ Petroleum (Exploration and Production) Law (2014) DRAFT?	▪ Mandates MINIRENA to review applications for petroleum rights, and to renew or revoke petroleum exploration and production licenses. N.B. Cabinet approves the award of licenses.
	▪ Law on Mining and Quarry Exploitation, 2008.	
RURA	▪ Regulations for pipelines (Draft).	
RURA	▪ *Liquefied Petroleum Gas Regulations* No. 5, 2012; ▪ LPG Standards and Regulations.	▪ Regulates the import, transport, construction, storage, distribution, and trade of LPG. N.B. Licensing began in June 2013. Various standards regulate the vehicles that are used to import LPG and the cylinders that are used to store LPG.
RURA (and stakeholders)	▪ Petrol Station Regulations (2011).	▪ Regulates the safety of petrol stations and the construction of new stations; ▪ Provides minimum specifications for a number of petrol station features e.g., underground storage and wastewater drainage.
RURA	▪ Aboveground Storage Facility Regulations No 6/2012.	▪ Determines the modalities to construct and manage petroleum storage facilities; ▪ Mandates RURA to issue the permits.
MINALOC, MINICOM, MINIFRA, RBS/RSB, REMA	▪ Regulations on: o Petroleum product quality standards; o Construction of petroleum storage facilities (***status/dates?).***	
MINICOM	Other regulations are relevant, such as the Rwanda Revenue Authority and the APSF regulations concerning the taxation, labelling, and safe storage and disposal of hazardous substances during operation of aboveground storage facilities.	
MININFRA	▪ Gas Law **(draft)** 2014	
GEOTHERMAL		
MININFRA **(**also EWSA, MINREMA, RURA, MINALOC)	▪ Geothermal Resources Law (draft) (2014)?	
PEAT		
	▪ An updated *National Peat Inventory;* ▪ A Peat Development Strategy and Action Plan (to be developed).	▪ EWSA tendered this inventory work in June 2014.
BIOMASS		
EWSA	▪ *Biomass Energy for Sustainable Development.* White paper (date?).	
	▪ Biomass Energy Strategy (2009).	
EWSA	▪ Regulations on Charcoal Harvesting (date?)	
	▪ 2002 Presidential Decree No 95/01 Regulating general traffic police and road traffic (related to charcoal transport),	
	Dissemination of Improved Carbonization Techniques and Reorganization of Charcoal Supply Chain in Rwanda Project (2010–2011) by CAMCO. Global Environment Facility (GEF) Sustainable Energy Development Project (SEDP) has a sub-component on charcoal; NGOs are also working on the Charcoal Value Chain (CVC) (e.g., CARE Rwanda, IFDC,	

Institution	Policy, Legal, and Planning Framework	Relevant Description
	and Vi-Life).	
EWSA	▪ Guidelines on the Construction of Cook Stoves (informal).	
	▪ Law No 21/2006 Establishing the Customs System; ▪ No 25/2010 Law modifying Law No 06/2001 on the code of value added tax, including energy supplies.	▪ Lists the equipment or instruments used for conservation or protection of the environment that are exempt from VAT / import taxes (its unclear whether this applies to ICS).
EWSA	▪ 2012 *Technical Guidelines on Construction of Fixed Dome Domestic Biogas Digesters.*	▪ Covers the responsibilities related to constructing a biogas plant; ▪ Provides guidance to determine plant size, average daily feedstock, plant design, and gas production.
GLOBAL & REGIONAL LEVEL ENERGY PLANS AND PROGRAMS		
UN	▪ United Nations Sustainable Energy for All Initiative (SE4ALL).	▪ Aims for universal access to clean energy by 2030; ▪ Provides goals on access, efficiency, and renewable energy.
	▪ (Regional program) *Global Sustainable Electricity Partnership, Eskom, and Duke Energy*.	▪ Provides an electrification roadmap to give 500 million people access to energy by 2025 (100 million connections).
NEPAD	▪ New Partnership for Africa's Development, 2002 (NEPAD).	▪ Increases access to reliable and affordable energy supply for 35% of the population by 2015 and access to modern energy for cooking to 50% of the population.
EAC	▪ East African Community (EAC) *Regional Power System Master Plan*; ▪ *Regional Strategy on Scaling up Access to Modern Energy Services*; ▪ *Regional Energy Access Strategy* (adopted by EAC Council of Ministers).	▪ Requires a monitoring and evaluation framework; ▪ (The strategy) Promotes access to modern cooking energy for 50% of biomass users; access to reliable electricity for all urban and peri-urban poor; access to energy to schools, clinics, hospitals, and community centres; access to power for productive use for all.
ENVIRONMENT		
MINIRENA	▪ National Environment Policy 2003.	▪ Improves health and promotes socio-economic development through the sustainable management and use of natural resources and the environment; ▪ Conserves and restores ecosystems and national biodiversity and optimizes sustainable use of natural resources for sustainable and fair development.
	▪ Law No 04/2005: *Organic Law on Environment* (2005) *(on protection, conservation, and promotion of the environment)*.	▪ Conserves the environment, people, and habitats; ▪ Promotes social welfare, considering equal distribution of the existing wealth; ▪ Promotes equal rights to resources to the present and future generations; ▪ Guarantees Rwandans sustainable development; ▪ Stipulates the modalities of protecting, safeguarding, and promoting the environment; ▪ Establishes responsibilities for soil erosion and pollution control; ▪ Establishes responsibilities for environmental management at the local level; ▪ Regulates the EIA process (covers the EIA of plans and policies and hence encompasses SEA); ▪ Stipulates that industries that import equipment that assists with eliminating or reducing atmospheric carbon dioxide and chlorofluorocarbons and those which

Institution	Policy, Legal, and Planning Framework	Relevant Description
		manufacture equipment that reduce pollution are subject to a reduction of customs duty on the equipment.
	▪ Law No 04/2005: *Organic Law on Environment* (2005) *(on the use and management of land)*.	▪ Determines the use and management of land in Rwanda and principles for land rights; ▪ Recognizes private ownership (customary and legal) of most hillside areas. N.B. Previously, all land belonged to the State; it was illegal to buy/sell land and those who were expropriated were compensated for lost assets at a fixed rate (there were serious shortcomings in the process).
	▪ Resettlement Policy Framework / Resettlement Action Plan.	
REMA	▪ Guidelines and Procedure for Environmental Impact Assessment 2006.	▪ Operationalizes the *Organic Law* to make EIA mandatory for all development projects.
	▪ Ministerial Order No 003/2008 relating to the requirements and procedure for EIA.	▪ Determines the EIA requirements and procedures; ▪ Stipulates that the TORs will be submitted to the developer 30 days after receiving the project brief.
REMA	▪ General Guidelines and Procedures for Strategic Environmental Assessment 2010.	▪ Operationalizes the *Organic Law* for the SEA of policies/programs that may affect the environment.
MINIRENA	▪ Ministerial Order on the use of substances that may cause climate change.	
MINIRENA	▪ Law establishing the *National Fund for Environment and Climate Change* (FONERWA) (2012).	N.B. The FONERWA may become an accredited national climate-financing instrument capable of accessing international climate finance.
	▪ National Adaptation Programmes of Action (NAPA) 2006.	▪ Evaluates vulnerabilities to climate change considering socio-economic aspects and land use that exacerbate these vulnerabilities; ▪ Identifies the most vulnerable groups of population, regions, and sectors; ▪ Determines priority adaptation options; ▪ Selects urgent and immediate activities and projects to be implemented; ▪ Includes projects focused on: erosion and flood control; climate information and early warning systems; water storage; drinking water, sanitation, and alternative energy; wood substitution strategy.
	▪ Nationally Appropriate Mitigation Actions (NAMAs).	▪ Could finance mitigation/adaptation in Rwanda after 2012 (supported & credited NAMAs).
	▪ Rwanda Biodiversity Policy 2011.	▪ Refers to commitments to the *International Convention on Biological Diversity*; ▪ Provides the legal/institutional framework for biodiversity conservation & management in Rwanda.
	▪ National Strategy and Action Plan for the Conservation of Biodiversity 2003.	▪ Develops strategies, plans, or programs for the conservation & sustainable use of biodiversity; ▪ Integrates the conservation and sustainable use of biological diversity into relevant sectoral and cross-sectoral plans, programs, and policies.
	▪ National Policy on Soil and Water Conservation.	
	▪ Soil Erosion Law (& Ministerial guidelines to implement the soil erosion law).	
	▪ Effluent standards.	▪ REMA to issue effluent standards;

Institution	Policy, Legal, and Planning Framework	Relevant Description
		▪ IFC, WB, WHO, and EAC standards are in use.
	▪ Environmental Profile Rwanda. EC 2006; ▪ Rwanda State of Environment Outlook, REMA. 2009; ▪ Atlas of Rwanda's Changing Environment: Implications for Climate Change Resilience. 2011.	
WATER RESOURCES AND WETLANDS		
	▪ National Policy on Water and Sanitation 2004.	▪ Provides for inventory & integrated management of water resources & watershed protection; ▪ Expands water supply & sanitation infrastructure to increase access to potable water, & water for livestock and agricultural production; ▪ Provides for water resources governance, including decentralization, community participation, privatization, and capacity building. N.B. Policy implementation is hampered by lack of a strong legal framework and weak capacities.
	▪ Fisheries Law 2008.	▪ Governs 3 types of fishing: sport, commercial, and scientific fishing (to advance knowledge).
	▪ The Water Law N°62/2008.	
	▪ National Policy for Water Resource Management 2012.	▪ Governed by the *Water and Sanitation Policy* 2004; formulated for water resource management.
AGRICULTURE AND LAND		
	▪ National Land Policy 2004.	▪ Stipulates the land administration / tenure system; ▪ Allows land to be registered and transferred; ▪ Allows investment in land.
	▪ National Land Law, No 08/2005.	▪ Determines the use & management of land.
	▪ Rwanda Agricultural Policy, 2008.	
MINAGRI	▪ National Action Programmes (NAP) to implement *United Nations Convention to Combat Desertification (UNCCD).*	▪ Reinforces capacities of local stakeholders and partners for sustainable development and the rational use of natural resources; ▪ Rehabilitates areas affected by desertification and land degradation; ▪ Improves the enforcement of laws & formulates new laws to manage natural resources; ▪ Identifies and adopts alternatives to reduce natural resource degradation; ▪ Includes projects on management of forests, water, non-wood energy sources, & rational land use; ▪ Funded by FONERWA.
	▪ Presidential Order No 54/01/2006 on *Land Commissions*.	▪ Determines the structure, responsibilities, and composition of the Land Commissions.
	▪ Land Expropriation Law No 18/2007.	▪ Determines the procedures for land expropriation.
DECENTRALIZATION		
	▪ National Policy on Decentralization 2006; ▪ Amendments to the Law determining the organization and functioning of the District (08/2006)?	▪ Makes districts/towns responsible for agriculture, livestock, forests, and ***the implementation of environmental policies / programs*** for environmental protection at the local level; ▪ Orders districts, sectors, and cells to include environmental officers in the organogram to implement district-level environmental activities. ▪ (Need to) Empower districts to manage public lighting assets and to pay for the maintenance

Institution	Policy, Legal, and Planning Framework	Relevant Description
		and running costs.
FORESTRY		
	▪ The Law on Forestry No 47/1988.	
	▪ Instruction No 01/2003.	▪ Bans the cutting of trees before maturity; ▪ Requires a permit from the district mayor to cut trees.
	▪ Instruction No 0001/2004.	▪ Bans the use of fuel wood to make bricks and tiles.
	▪ Instruction No 001/2006.	▪ Requires authorizations to cut/transport mature trees.
	▪ National Forestry Policy 2004.	▪ Establishes the *Provincial Forest Commission* to oversee forestry activities to meet needs for wood and other forest products on a sustainable basis; ▪ Sets a forest-cover target of at least 30%; ▪ Sets a target to have at least 85% of the farmland under agro-forestry by 2020.
	▪ Draft 2009 Forest Policy.	
GENDER		
	▪ National Gender Policy	
HEALTH & LABOUR		
	▪ Rwanda Health Sector Policy, 2005.	
	▪ Environmental Health Policy.	
	▪ N°13/2009 of 27/05/2009 Law regulating labour (& health and safety) in Rwanda.	
EU FRAMEWORK FOR ENVIRONMENT		
▪ *Guidelines on the Integration of Environment and Climate Change in Development Cooperation*, Europe AID 2009, ***replacing:*** *Environmental Integration Handbook for EC Development Co-operation. European Commission. 2007.*		
▪ *Increasing the impact of EU Development Policy: an Agenda for Change*.		
▪ EC Cooperation: *Responding to Climate Change, Sector Script for Energy Supply* version July 2009.		
VARIOUS MULTILATERAL AGREEMENTS FOR ENVIRONMENT		
▪ Nile Basin Initiative, Common Market for Eastern and Southern Africa (COMESA), the Lake Victoria Biodiversity Programme, and the New Partnership for Africa's Economic Development (NEPAD).		
▪ East African Community Climate Change Policy and its updates.		
▪ Convention on Biological Diversity 1992; approved by Presidential Order No 017/01 in 1995.		
▪ The CARTAGENA Protocol to the Convention on Biological Biodiversity 2000; ratified by Law No 38/2003 in 2003.		
▪ The United Nations Framework Convention on Climate Change 1992; approved by Presidential Order No 021/01 in 1995.		
▪ The KYOTO Protocol to the Framework on Climate Change 1998; ratified by Law No 36/2003 in 2003.		
▪ United Nations Convention on Desertification 1995; ratified in 1998.		
▪ The RAMSAR International Convention 1971 on Wetlands of International Importance; ratified by Law No 37/2003 in 2003.		
▪ Vienna Convention for the Protection of the Ozone Layer 2001.		
▪ The STOCKHOLM Convention on Persistent Organic Pollutants 2001; approved by Presidential Order No 78/01 in 2002.		
▪ Convention on the Conservation of Migratory Species of Wild Animals 2003.		
▪ The ROTTERDAM International Convention on the Establishment of the International Procedures Agreed by States on Commercial Transactions of Agricultural Pesticides and Other Poisonous Products 1998; Presidential Order No 28/01 in 2003.		
▪ The BASEL Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal (1989); Presidential Order No 29/01 in 2003.		
▪ The MONTREAL International Convention on Substances that Deplete the Ozone Layer (1990, 1992, 1997, 1999); Presidential Order No 30/01 in 2003.		
▪ The BONN Convention (1979) on Conservation of Migratory Species of Wild Animals; ratified by Law No 35/2003 in 2003.		
▪ The WASHINGTON Agreement (1973) on International Trade in Endangered Species of Wild Flora and Fauna; Presidential Order No 211 in 1980.		

Summary list of new legislative and regulatory texts to be enacted shortly after the approval of the 2014 NEP		
Laws		
MININFRA	▪ National Energy Law consolidating all existing legislation	▪ First draft available end of FY 2015/16
MININFRA	▪ Geothermal Resources Law	▪ Adoption following approval of NEP and the geothermal sub-sector action plan
MINICOM	▪ Gas Law ensuring adequate coverage of all gas types and special issues	▪ Immediate adoption following approval of the NEP
MININFRA	▪ Energy Efficiency & Conservation Law	▪ First draft circulated to Cabinet Jan 2015
Regulations		
RURA	▪ Revised renewable energy feed-in tariff (RE-FIT) regulations	▪ Expected adoption immediately following the approval of NEP
RURA	▪ Regulations concerning simplified licenses for off-grid providers & related technical specifications	▪ Adoption by end of 2014
MINALOC	▪ Ministerial Order on Public Street Lighting	▪ First draft Circulated to Cabinet end 2014
RURA	▪ Secondary regulations on downstream petroleum activities incl. enforcement of product quality standards and strategic reserve requirements	▪ Expected adoption immediately following approval of downstream petroleum policy
MININFRA / ABAKIR	▪ Domestication and national regulations to domesticate management prescriptions (MPs) and other international guidelines concerning Lake Kivu gas extraction	▪ Elaborate and gazette by end of 2014
MINIRENA	▪ Secondary Regulations under Environment Law on climate finance	▪ First draft circulated to Cabinet beginning of FY 2015/16
Technical Guidelines, Codes & Standards		
RBS/RSB	▪ National Technology Standard on Biogas Digesters	▪ Elaborate and gazette by end of 2014
RBS/RSB	▪ Updated National ICS Standard	▪ Elaborate and gazette by end of 2015
RHA	▪ Green Building Codes and Standards, incl. Mandatory Solar Water Heater requirements	▪ Elaborate and gazette by end of 2014
MINIRENA	▪ Guidelines on applicability of Water Resources Licenses under Water Law to Hydropower Projects	▪ Elaborate and gazette by end of 2014

4 Approach and Methodology

Chapter 4 reviews the general approach used to conduct this SEA. It also reviews the approach, methodology, and results of the scoping period and of the detailed study period. Lastly, Chapter 4 outlines the geographical focus of the SEA and the assumptions, uncertainties, and constraints related to this SEA exercise.

4.1 General approach

This SEA was organized in three phases: a scoping phase (May/June 2014), a more detailed study phase (July to October 2014), and a review phase (November -December 2014). The approach, methodology, and results associated with each phase are briefly discussed below.

The general approach for the assignment was to identify the major stakeholders and background documents pertinent to the energy and environment sectors, to interview the major stakeholders, and to visit some relevant sites for energy generation to assess some site-specific environmental impacts and concerns.

The collected information was analysed to develop a good understanding of the planning process for the NEP and ESSP and to subsequently systematically assess the impacts of the energy policy and plan. The NEP and the ESSP were assessed against the below 24 SEA objectives in sequential stages, different for the two documents, the ESSP in more details, since the plan proposes more detailed interventions and actions than the Policy. The analysis of the NEP is based on a compatibility approach while the ESSP analysis was based on a spatial approach, since the proposed actions of the ESSP mainly comprises spatial impacts. The details of the methodology and outputs are shown in **Chapter 8 and 9.**

4.2 Scoping-Period Approach, Methodology, and Results

The SEA scoping period relied heavily on scoping-period field interviews and field observations, the scoping workshop (concurrent with the June 10, 2014 Draft Energy Policy validation workshop), and stakeholder review comments on the draft scoping report. The main activities and outputs of the scoping period included:

- Described the ESSP (version 2012) and Draft Energy policy (version 2.5);
- Conducted 26 interviews / field visits;
- Identified stakeholders through stakeholders interviews & literature review;
- Outlined in a preliminary manner the institutional, policy, & legal framework;
- Identified the data needs, methodology for the detailed study, and the 24 strategic environmental objectives for the evaluation framework[67]. The 24 SEA objectives for the evaluation framework are:

BIOLOGICAL

1. Reverse deforestation; reduce pressure on forests;
2. Prevent loss of wetlands and associated ecosystem services;
3. Protect natural areas; protect biodiversity;

PHYSICAL

4. Minimize land take, land degradation, and soil erosion;
5. Minimize impact on hydrological system / Support *Integrated Water Resource Management;*
6. Reduce pollution;

[67] The SEA objectives are based on an analysis of: the ESSP (version 2012), the 2014 draft energy policy (version 2.5), the Green Growth and Climate Resilience, the EDPRS II, the 2006 Environment Profile of Rwanda, the 2009 State of the Environment Report, and the 2011 Atlas of Rwanda's Changing Environment, the scoping-period stakeholder interviews, and field-trip observations. (See the Scoping report in Annex 1-2 for the list of interviews, field trips, and other scoping-period details). *The final* list of SEA objectives was presented to scoping-workshop stakeholders

CLIMATE

7. Promote adaptation to climate change / Build climate resilient assets;
8. Improve capacity to manage disaster risks (especially floods, droughts, and land slides);

SOCIAL

9. Promote water and food security;
10. Promote gender equality and equity;
11. Reduce poverty; create alternative livelihoods / improve livelihoods;
12. Support welfare and health for all;

ENERGY

13. Provide clean, affordable, reliable, secure, renewable, efficient, indigenous sustainable energy;
14. Minimize economic costs of the energy sector (i.e., consider the financial and the environmental and social costs / provide least-cost energy);
15. Provide a low-carbon energy supply;
16. Reduce demand for wood fuel and charcoal;

ECONOMIC

17. Support economic growth;
18. Increase employment opportunities (including jobs for youth and women);
19. Support green growth / green industry / cleaner production / energy efficiency;
20. Support private sector development;
21. Support other sectors to be more sustainable (e.g., tourism, agriculture, fisheries, mining, forestry, transport, waste management, housing, urban development, and/or rural development);

INSTITUTIONAL AND CAPACITY

22. Strengthen institutional coordination and compliance with government regulations (between energy sector, agriculture, environment, urban planning, transport, forestry, and rural development);
23. Strengthen management and monitoring capacity (public administration, private, and civil society capacity);
24. Promote a culture of 'maintenance'.

- Proposed three alternatives to be analysed during the detailed study (revised to two alternatives for the ESSP as outlined in **Section 3.2**);
- Prepared the Draft Scoping Report and conducted a scoping workshop (June 10, 2014). (The Draft Scoping Report was submitted as a separate volume).

4.3 Detailed SEA Study Approach, Methodology, and Results

The main activities and results of the detailed study phase include:

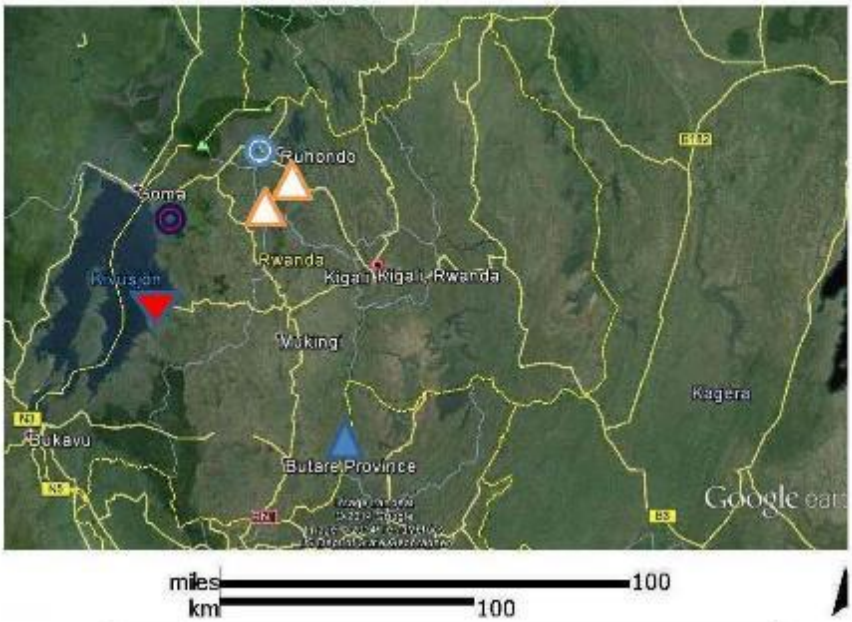
- Revised and further developed the overview description of the energy sector;
- Reviewed and analysed two more drafts of the NEP (versions 3.5 & 3.8);
- Re-wrote the NEP description twice (for version 3.5 & 3.8);
- Reviewed & analysed three more versions of the ESSP (Drafts 3.1, & Sept. 2 & 16);
- Re-wrote the ESSP description three times (Drafts 3.1, & Sept. 2 & 16);
- Revised and further developed the policy, institutional, and legal framework based on the revised NEP and ESSP, and based on further document analysis;
- Revised the SEA impact assessment methodology, to match with the last developments of the NEP and the ESSP after review of all drafts;
- Collected and analysed baseline data (in line with some of the data needs identified during the scoping period);
- Identified trends, opportunities, and constraints, based on data analysis;
- Redesigned some of the SEA tools, based on the 3rd version of the NEP and the 4th version of the ESSP (e.g., re-designed and re-developed the matrices for the compatibility analysis, and qualitative impact assessment);
- Conducted various analyses using specifically-designed matrices (e.g.
    a. (Preliminary) Compatibility analysis of the objectives of the ESSP 2012 vs. the objectives of 2003 Environmental Policy;
    b. Detailed content analysis of NEP 2.5 statements;
    c. Compatibility analysis (compatibility of the NEP objectives and the SEA objectives);
    d. Qualitative impact analysis (to analyze the biophysical, socio-cultural, socio-economic, and institutional impacts of the ambitious ESSP development alternative and a zero alternative;
- Identified mitigation measures, indicators, and recommendations for the NEP, based on the analyses conducted on the NEP;
- Identified mitigation measures, indicators, and recommendations for the ESSP, based on the analyses conducted on the ESSP;
- Developed and distributed the Draft SEA Report based on a synthesis of all the above (until 25 October 2014);
- Conducted the Draft SEA workshop on December 3 2014; (see **Administrative** A**nnex 2** for the Draft-SEA-workshop-participants list);

4.4 Draft SEA Report Review Phase and Final SEA Report

The draft SEA review period was from October 25 to December 17, 2014.The Draft SEA report was revised and finalized based on workshop comments and the comments received during the SEA review period. The Final SEA Report was submitted on 15 January, 2015.

4.5 General Geographical Scope

Rwanda's energy resources are mostly located in the western and south-western part of Rwanda, although the peat resources are mainly located in the Akanyaru Valley on the border to Burundi. Hydropower resources are scattered all over the country. This SEA focused predominantly on the relevant regions, see **Figure 4.1** and **4.2**.



Legend		
Energy source	Location	Map Symbol
Oil fuelled Thermal Plant	Jabana II central thermic, Kigali	
Volcanos region, agroforestry, fuelwood and biomass projects	Kibundi, Ruhundo, Musanze	
Mukungwa & Ntaruka Hydropower.	Musanze	
Visit to Kinigi Geothermal Drilling Site	Musanze	
Akanyaru Peat Production and Power Plant	Akanyaru Valley	
Rubona (Gisenyi) Methane Gas Extraction for BRALIRWA (Rubavu)	Gisenyi and Rubavu	
Gihira Hydropower station, Turambe		
KivuWatt Methane Project, Karongi	Kivu Lake	

Figure 4.1: General Geographical Focus of the SEA

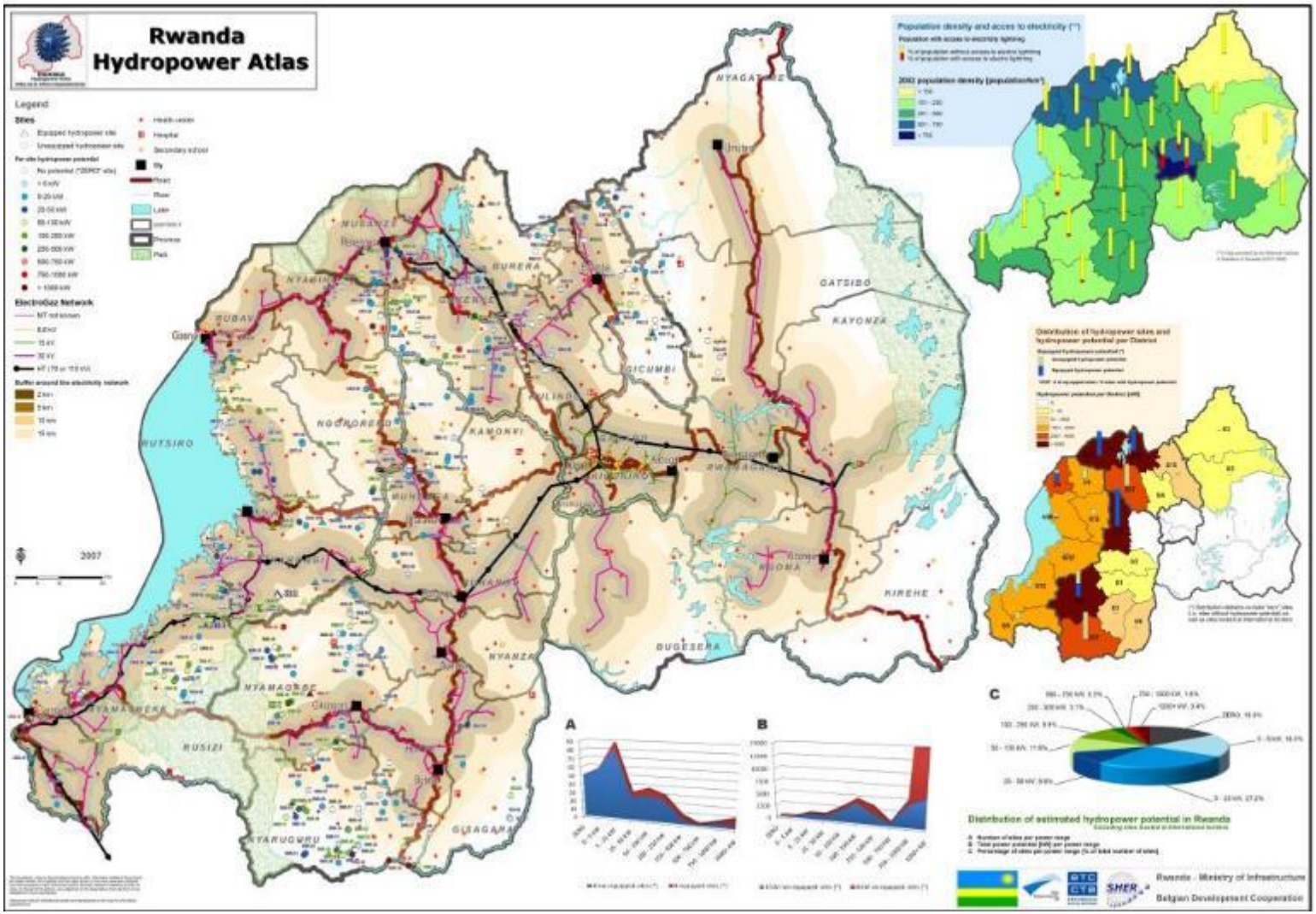


Figure 4.2: Hydropower Resources (Source EWSA Hydropower Atlas)

4.6 Assumptions, uncertainties and constraints

Assumptions

- That the baseline and collected information is reasonably and correct and that the consultants were able to sufficiently validate the information by cross checking with other sources; the two main sources being the NEP and the ESSP.

Uncertainties

There is uncertainty regarding:

- Specifically the ESSP notes a multitude of challenges, but also highlights the proposed solutions to meet with the challenges. Likewise, in this report the implementation schedules of the investment projects for power generation show a tendency of delays, thus the prognosis on meeting the demand is one of the major risks of the ESSP.

Constraints related to conducting this particular SEA

- The ToRs for this SEA were modelled after a much simpler energy-sector country situation. The Rwanda energy sector is complex, covering numerous sub-sectors;
- The ToR were modelled after a simple ex-post SEA exercise and methodology developed during scoping was designed based on a simple ex-post model; in reality, the energy policy and ESSP were under formulation during the whole SEA process; the Consultant had to contend with and assess 3 drafts of the energy policy and 4 drafts of the ESSP; the Consultant had to re-write aspects of Chapter many times (and even at that, more drafts of the policy and plan were expected in the October period). The contract extension only foresaw one additional draft for the policy and one additional draft for the plan;
- Given the complexity of the SEA and the fact that it deals with 2 strategic documents (a policy and a plan) and not the typical situation where an SEA is focused on **one** strategic document), the body of the report is rather long, about 180 pages;
- Quantitative data were available, at times to a limited extent; and the study also relied on qualitative and descriptive assessments, and stakeholder inputs;
- The number of stakeholders was high, and dispersed across the country and across the different sub-sectors.

Thus, the main constraining factor for the assignment is the parallel development of the Energy Policy and ESSP. The ToR of the SEA perceived an ex poste assessment of the Policy and the ESSP, but successive Drafts have been used for the preparation and updating of this report. Thus, this report is based on the versions that were made available to the Consultant on 3 and 16 September 2014, complemented with inputs during the Draft Final workshop and comments until 17 December 2014.

5 Environmental Baseline and Trend Analysis

This section examines the state of the natural environmental inventory in Rwanda, describes protected areas, and discusses current uses and trends of environmental products and services.
The emphasis is on biodiversity and tropical forests, but other sectors of the environment such as watersheds and wetland ecosystems, land use (primarily agricultural uses), and energy figure into the discussion.

5.1. Topography

Rwanda's relief can be divided into four broad categories: the Congo-Nile Ridge, the Central Plateau, the lowlands of the East and the Bugarama plains. **Figure 5.1** contains a three dimensional visualization of Rwanda's relief.

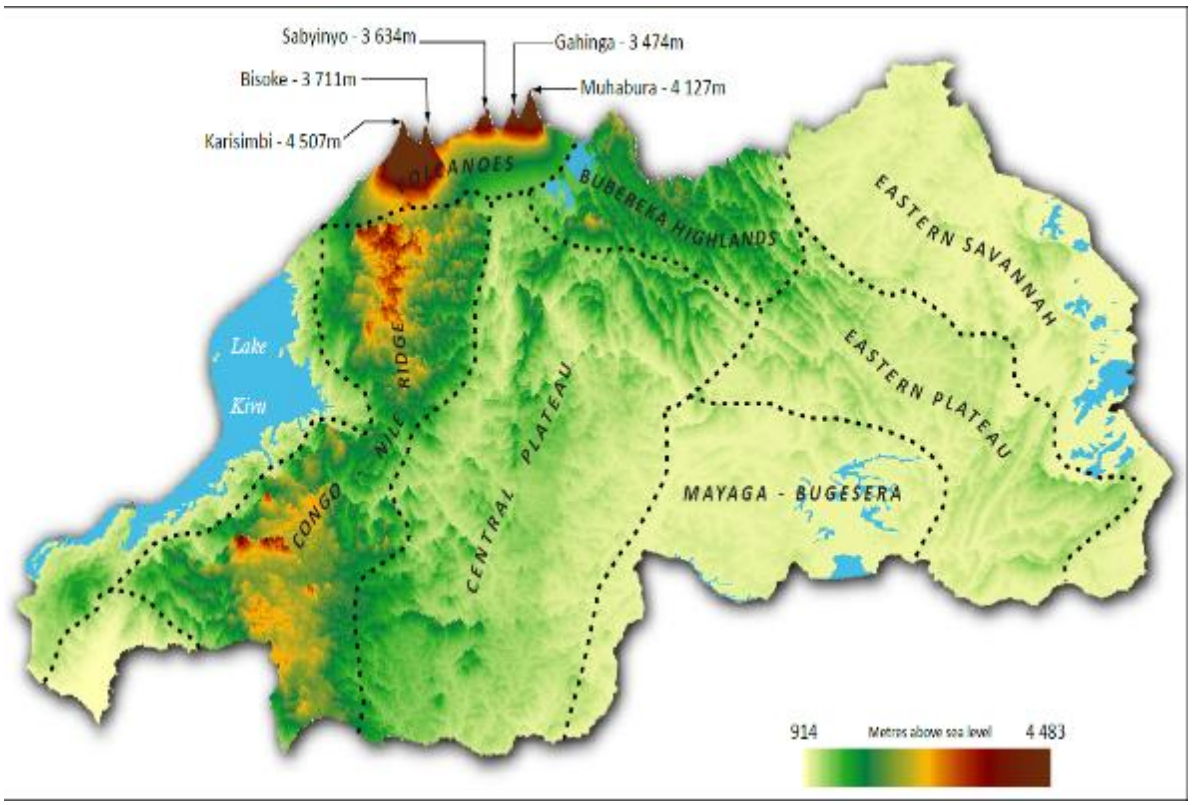


Figure 5.1: Visualization of Rwanda's relief showing the major topographic subdivision

The Congo-Nile Ridge is dominated by eight giant volcanoes namely Nyamuragira, Nyiragongo, Mikeno, Karisimbi, Bisoke, Sabyinyo, Gahinga and Muhabura (Mehta and Katee 2005). The tallest of these Virunga volcanoes and indeed the highest point in the country is Mount Karisimbi, whose summit elevation is 4 507 m above sea level. The altitude of the Central Plateau ranges between 2 000-1 500 m. The plateau's relief largely consists of steep hills separated by valleys that plunge by depths of between 15-50 m. Owing to the ridge and the plateau's rugged mountainous relief, Rwanda is fondly referred to as 'the land of a thousand hills.'

The eastern lowlands are dominated by a depressed relief, whose altitude undulates between 1 500 m at its highest elevation and 1 100 m at its lowest. The Bugarama Plains located in the south west of Rwanda have an altitude of 900 m and are part of the Great Rift Valley.

TRENDS:

- ✓ In general, the Rwanda's topography and local climate is highly sensitive to climate change as the steep, over-cultivated hills and high rainfall give rise to high levels of run-off, erosion and flooding during intense rainfall events that have become more prevalent in the last decade especially in North-Western regions of the country.

- ✓ In addition, the high dependence on biomass fuels further contributes to deforestation and erosion of the hilly landscape.

5.2. Climate

Even though Rwanda is entirely situated within the equatorial zone, it enjoys a moderate tropical climate due to its high altitude, and temperatures average 20°C. Rainfall follows a bimodal cycle although it is generally abundant throughout the year, **Figure 5.2** demonstrates the annual average precipitation.

Figure 5.2: Average annual precipitation (mm)

In higher regions of the Congo-Nile divide, temperatures vary between 15°C and 17°C although they are on an upward trend as shown in **Figure 5.3**. The volcanoes region has lower temperatures which can dip to as low as 0°C in some areas. In the intermediary altitude zones, temperatures vary between 19°C to 29°C with an average rainfall of about 1000 mm per year. Rainfall here is however less regular, leading to frequent dry spells (RoR/MINITERE 2005).

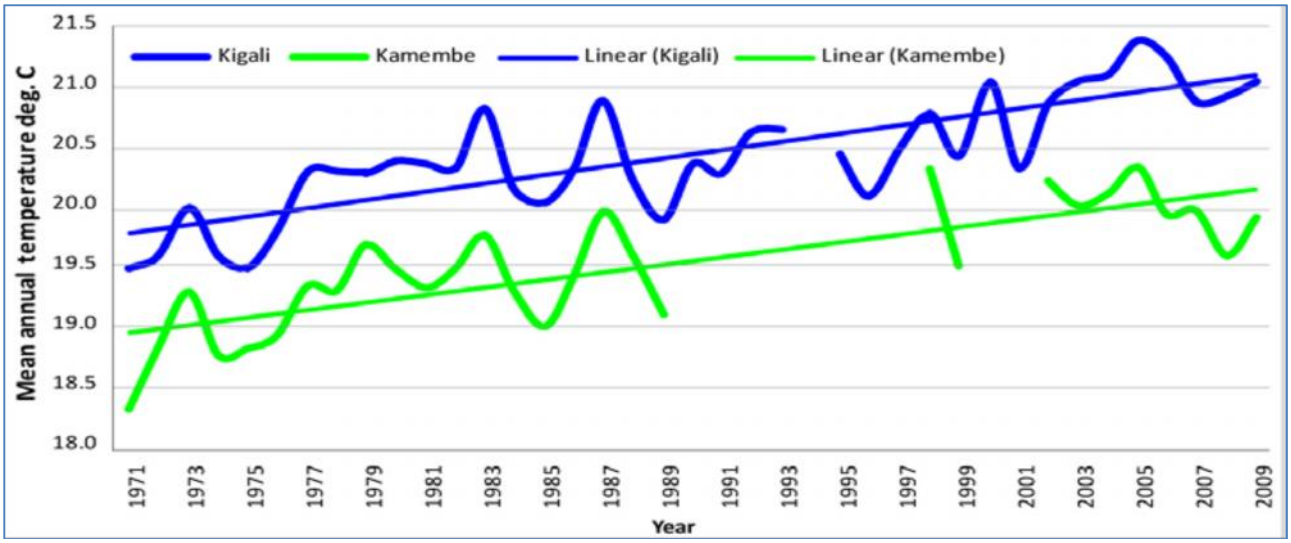


Figure 5.3: Mean annual temperatures in Kigali and Kamembe (1971 – 2009).

In the low altitude zones in the east and south east of the country, temperatures tend to be higher and can top 30°C mostly in February, July and August. In fact, the highest temperature ever recorded was 32.8°C registered at Karama Plateau station in south eastern Rwanda on September 4, 1980 (RoR and EU 2006). Temperature variations are comparatively more pronounced in the rest of the country. In addition, rainfall is less abundant in these other regions and ranges between 700 to 970 mm per year, considerably less than that received in the volcanoes region. Therefore, Rwanda's climatic conditions and the attendant vulnerabilities to climate change vary spatially and temporally.

CLIMATE TRENDS

- ✓ Recent analysis of rainfall trends for Rwanda show that rainy seasons are tending to become shorter with higher intensity leading to decreases in agricultural production and events such as droughts in dry areas and floods or landslides in areas experiencing heavy rains.

- ✓ According to Rwanda's Second National Communication, monthly and annual total rainfalls recorded between 2004 and 2010 were generally lower than the average recorded between 1961 and 1990. Moreover, rainfall in April, the month with the highest rainfall, has dramatically reduced (27%, 48%, 88%, 70% and 52% of the average rainfall recorded for this month between 1961 and 1990 respectively in 2000, 2001, 2002, 2003 and 2005).

- ✓ The average number of rainfall days per year has also declined from 146 between 1971 and 1990 to 131 days between 1991-2009. Similarly, the monthly average rainfall totals decreased between1991 and 2009. This is also confirmed by the annual average rainfall totals which decreased from 1020mm to 920mm. On average, the annual total number of rainfall days decreased from 148 days to 124 days between 1971 and 2009.

- ✓ Rising temperatures have also been observed. The monthly average increased from 19.8°C in 1971 to 21.0°C in 2009, an unprecedented rise of 1.2°C in just 39 years

5.3. Watersheds and Wetland Ecosystems

5.3.1. Watersheds

Rwanda is endowed with abundant water resources distributed in a very dense hydrological network consisting of 101 lakes covering 149,487 ha, 860 marshlands covering a total surface of 278 536 ha and 861 rivers with a combined length of 6 462 km (REMA, 2008) as is displayed in **Figure 5.4** below.

The country is split into two hydrographical basins by a landmark line of waters known as the Congo-Nile divide that runs from the north to the south of the country. The Congo-Nile divide is roughly perpendicular to the volcanoes line which serves as a natural barrier to the catchment basins of Rwanda, North Kivu and those of southwest Uganda (Harper and others, 2008).

To the east of Congo-Nile divide lies the Nile basin which covers 67% of the total national territory and drains 90 per cent of Rwandan waters through two main rivers. These are the Nyabarongo and Akagera (Harding, 2009). The latter is the main tributary of Lake Victoria with an average flow of 256 m^3/s and is considered to be the main source of the White Nile.

The White Nile and the Blue Nile are the main tributaries of the 6 695 km Nile River, the world's longest watercourse.

The Rwandan portion of the Nile basin includes many small lakes such as Bulera, Ruhondo, Cyohoha South, Mugesera, Muhazi, Rwampanga, Mihindi and Mirayi. These lakes are mostly shallow (with depths of between 5 and 7 m) except Lakes Bulera and Ruhondo which are 50 to 70 m deep (RoR/MINITERE, 2005).

The Congo basin is situated to the west of the Congo-Nile divide. Although it covers the remaining 33 per cent of Rwandan territory, it only drains 10 per cent of the country's water resources. The basin comprises Lake Kivu and some smaller rivers such as Sebeya, Koko, Rubyiro, Ruhwa and Rusizi. Lake Kivu is itself shared with the DRC and covers an area of 102 800 ha within Rwanda alone.

Average flows through hydrological stations are 73 m^3/s (Nyabarongo at Kigali), 100 m^3/s (Nyabarongo at Kanzenze), 232 m^3/s (Akagera at Rusumo) and 256 m^3/s (Akagera at Kagitumba). During high waters, there is a serious risk of flooding (RoR/ MINITERE 2005), a risk that is likely to increase by climate change unless effective mitigative and adaptive mechanisms are formulated.

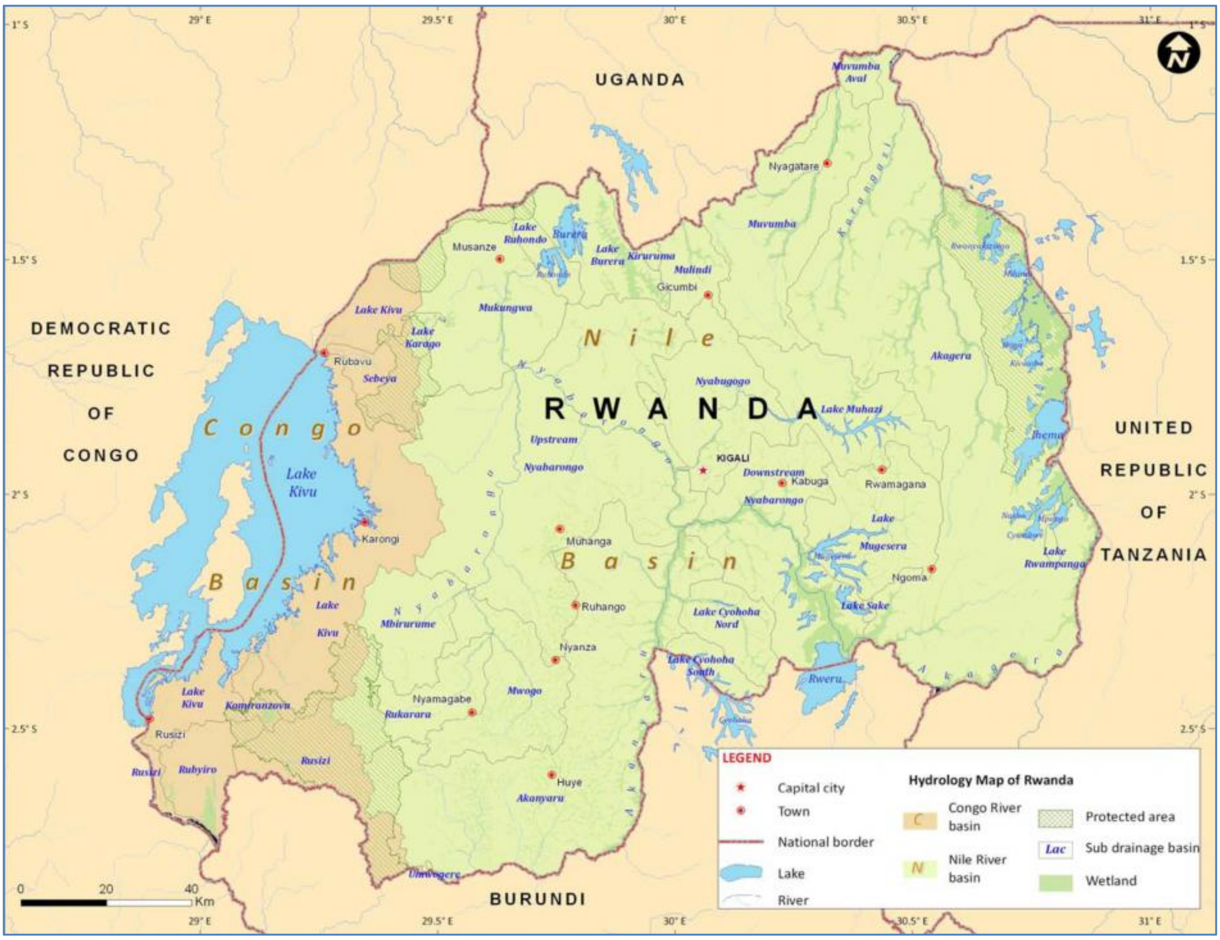


Figure 5.4: Rwanda's hydrological network

Given that the availability and quality of water resources are primarily influenced by rainfall and evapotranspiration, climate change is bound to affect Rwanda's hydrological processes and cycle and ultimately, its hydrological profile. To address water management and access issues, Rwanda is incrementally implementing the concept of Integrated Water Resource Management (IWRM) in order to strike a sustainable balance between abstraction and regeneration levels and to vigorously respond to the impacts of climate change that threaten to jeopardize Rwandans' access to water.

TRENDS:

- ✓ Overall Rwanda is believed to have sufficient water resources characterized by a good hydrological network and 101 lakes and 860 wetlands covering 16% of the surface area of Rwanda, a lowering of water tables as well as impacts of reduced water flows have been observed especially , but not only, in Eastern Rwanda. These impacts are at least partially attributed to climate changes stresses (other drivers are related to non-climatic causes such as sub-optimal water resources and watershed management), which limits water availability.

- ✓ Rainfall variability impacts overall on hydrological flow and water storage and availability, leading to more floods and dry spells while ground water recharge diminishes.

5.3.2. Wetland Ecosystems

Rwanda's wetlands are extremely important. They act as a buffer in flood or overflow plains, reducing maximal flow rates during the rainy season and maintaining relatively high flow rates during the dry season.

Natural vegetation covers 41% of the marshes while 53% is covered by fields and 6 per cent lies fallow. The marshlands are complemented by 101 lakes which collectively cover and area of 149 487 ha and 861 rivers with a combined length of 6 462 km (REMA 2009). The best known of Rwanda's wetlands is the Rugezi-Bulera-Ruhondo wetland complex which was designated by Ramsar as a wetland of international importance in December 2005.

The wetlands' aquatic vegetation which in Rwanda mostly consists of Typha, Papyrus, Miscanthus and Cyperus, slows the flow of water, cushioning landscapes from top soil erosion and rivers and lakes from flooding during heavy rainfall. Equally important, because they serve as terrestrial carbon reservoirs, they help to stabilize the climate and attenuate climate change (Mitra and others 2005).

TRENDS

- ✓ With more than 104 flower species, wetlands and aquatic ecosystems are rich in biodiversity but some lakes such as Kivu, Bulera and Ruhondo are poor in macrophyts (MINITERE, 2003a).

- ✓ The richest wetlands in term of biodiversity are Akagera and associated lakes, Akanyaru-Nyabarongo and associated lakes, Kamiranzovu (part of Nyungwe National Park) and Rugezi marshlands which is a Ramsar site (MINIRENA, 2008). Crocodiles, varans and snakes are also well represented in lakes and marshlands of Akanyaru complex, while wetlands around Nyabarongo and Akagera National Park are especially rich in fauna.

- ✓ The country's wetlands are legally protected: by (1) Organic Law N° 04/2005 determining the modalities of protection, conservation and promotion of the environment, (2) Ramsar Convention, 2003, (3) Ministerial Order N° 008/16.01 dated October 13, 2010 establishing the list of Rwanda's swamps, their geographic limits and regulating their management and use,

- ✓ Despite their important role and the strict legal regime, Rwanda's wetlands continue to be lost to fallow fields, afforestation, pisciculture (fish-farming), human settlement and to agriculture.

5.4. Forest and protected area

5.4.1. Introduction

Forests provide ecosystem services and products such as protection of water catchments, regulation of water flow, influencing climate, protection against soil erosion, water purification, food, wood for fuel and construction, tourism, non-timber forest products including medicine plants, honey and handcrafts. The role of forests in preserving ecological balance is particularly important in Rwanda. They contribute greatly to watershed protection against erosion, thus making agriculture viable and covering the daily basic needs for wood for more than 96 per cent of the country's population.

5.4.2. Status of Forestry Resources in Rwanda

Rwanda forests and woodlands can be classified into four categories: the natural forests of the Congo Nile Ridge comprised with Nyungwe national park Gishwati, and Mukura; the natural forests of the Volcanoes national park; the natural forests in the savannah and gallery-forest of the Akagera national park and remnants of gallery-forests and savannahs of Bugesera, Gisaka and Umutara; and forest plantations dominated by exotic species (*Eucalyptus sp, Pinus sp, Grevillea robusta*) and trees scattered on farmlands (agroforestry) and along anti-erosion ditches.

Statistical information on forest cover in Rwanda is varied and contradicting figures are reported by several authors, mainly because no thorough forest inventory has ever been

carried out in the country (SSEE & ROR, 2011; ROR, 2010; FAO, 2002, 2005, 2010; GTZ, 2008; etc.).

The first national forest inventory was carried out in 2007 by Agricultural Research Institute of Rwanda (ISAR) and Centre for Geographic Information Systems of the National University of Rwanda (CGIS-NUR) and involved only forest areas larger than 0.5 ha due to relatively low resolution of the satellite images used [Landsat (30 m), Aster (15 m) and SPOT (10-20 m)] and financial constraints (MINIRENA/CGIS-NUR, 2007).

This inventory was therefore incomplete because it left out smaller woodlots (< 0.5 ha). In a recent study, FAO (2010) reported that small woodlots and tree resources outside forest (TROF) cover around 6.6% of the country's land area. The forest mapping also considered only forested areas with more than 10% crown cover and tree height greater than 7 m (MINIRENA/CGIS-NUR, 2007). The following table shows the forest cover areas as mapped by CGIS-NUR in 2007 and **Figure 5.5** illustrates the forest cover map (> 0.5 ha; 10% crown cover with trees greater than 7 m height) of Rwanda in 2007.

Figure 5.5: Rwanda's forest cover

Table 5.1 indicates the forest cover areas in 2007 (by forest class)

Table 5.1: Forest cover areas in 2007 (> 0.5 ha; 10% crown cover, > 7 m height)

Forest Classes	Area in ha (rounded to nearest 100 ha)
(i) Natural forests	
Bamboo forest	4,400
Degraded natural forest	38,000
Humid natural forest	79,800
Savannah	3,700
Sub-total	125,900
(ii) Plantations	

Eucalypts plantations	63,600
Young plantations and coppice	39,200
Pine plantation	12,100
Sub-total	114,900
Total	**240,800**

There are no large size private or commercial forest plantations in Rwanda. However there are several small private plantations scattered throughout the country which are owned by farmers and institutions such as private companies (mainly tea factories), religious and education institutions. According to Biomass Energy Strategy (BEST) survey, 89% of traded wood in Rwanda comes from forest plantations of less than 2 ha (GTZ, 2008).

Taking into account the areas classified as protected areas but which did not satisfy the definition of a forest in the 2007 forest inventory, the tree resources outside forests and woodlots below 0.5 ha (estimated by FAO in 2010 to cover 6.6% of the country's total area), and the recent forest plantations established by the PAFOR and PAREF projects, which were not inventoried earlier (most recent satellite images used was dated early 2005), the overall forested areas in Rwanda by 2010 are as shown in **Table 5.2:**

Table 5.2: Overall forest areas in 2010

Forest classes	**Area in ha (rounded to nearest 100 ha)**
(i) Protected areas	
Akagera National Park	108 500
Nyungwe National Park	97 000
Volcano National Park	16 000
Gishwati Forest Reserve	1 000
Mukura Forest Reserve	1 600
Sub-total	224 000
(ii) Plantations	
Eucalypts plantations	63 600
Young plantations and coppice (mainly Eucalyptus spp. and Acacia spp.)	62 700
Softwood plantation (Pinus spp., Cupressus spp. and Callitris spp.)	12 100
Woodlots and tree resources outside forests (Eucalyptus spp., Grevillea spp., Pinus spp., Cupressus spp.; Callitris spp., Acacia spp., Alnus spp., Casuarina spp.)	162 800
Sub-total	301 500
Total	**525 500**

The dominant softwood timber species is *Pinus patula*. However, there are a few plantations with other *Pinus* species such as *Pinus oocarpa, P. radiata, P. elliottii and P. kesiya*. The other softwood timber species (but also for household fencing) that was abundant before the attack by *Cinara cupressii* aphids in 1988 is *Cupressus lusitanica*.

Other exotic species frequently found either in pure or mixed plantations and agroforestry include: *Acacia melanoxylon* (most abundant in plantation), *Callitris robusta, Grevillea robusta* (mainly in agroforestry), *Casuarina equisetifolia, Cedrela serrata, Alnus acuminata, Maesopsis eminii, Acacia mearnsii* and recently in agroforestry systems *Senna spectabilis, Senna siamea, Leucaena leucocephala, Croton megalocarpus* and *Calliandra callothyrsus*.
Some of the indigenous species in plantations include *Entandrophragma excelsum, Podocarpus falcatus, Markhamia lutea (or platicalyx), Symphonia globulifera, Polyscias fulva* and *Prunus africana*.

TRENDS

- Rwanda's forests continue to be under threat from various human drivers such as agriculture, human settlement, illegal logging, charcoal production, bush fires, and

climate change. Statistics show that natural vegetation, including forests, plummeted by 59.4% from 6340 km^2 in 1960 to 2575 km^2 in 2010. Akagera National Park's forest cover plunged by 53% from 2410 km^2 in 1999 to 1121 km^2 in 2010, see **Figure 5.6.** This was largely because a large portion was used to resettle returning Rwandans who had lived as refugees mostly in neighbouring countries for over 3 decades (Havugimana, 2009).

- The gallery forests of eastern Rwanda tumbled from 2410 km^2 in 1980 to 250 km^2 in 1996. Designated hunting zones that included specified belts of natural forest were gradually reduced by 300 km^2 (47%) over a 30-year period from 640 km^2 in 1960 to 340 km^2 in 1990.

- The Volcanoes National Park lost mostly natural bamboo forest estimated at 180 km^2 (53 per cent) with the forested cover falling from 340 km^2 in 1960 to 160 km^2 in 1970. Gishwati lost an estimated 192 km^2 of forest with the forested area falling from 280 km^2 in 1960 to 88 km^2 in 1990. An additional 75 km^2 was lost between 1990 and 1996 leaving only a dismal patch of 13 km^2 (Chadri and Plumptre 2003). The isolated Mukura natural forest was reduced from an already low base of 30 km^2 in 1960 to 21 km^2 in 1980 while an additional 12 km^2 was deforested between 1996 and 1999 (USAID Rwanda 2004).

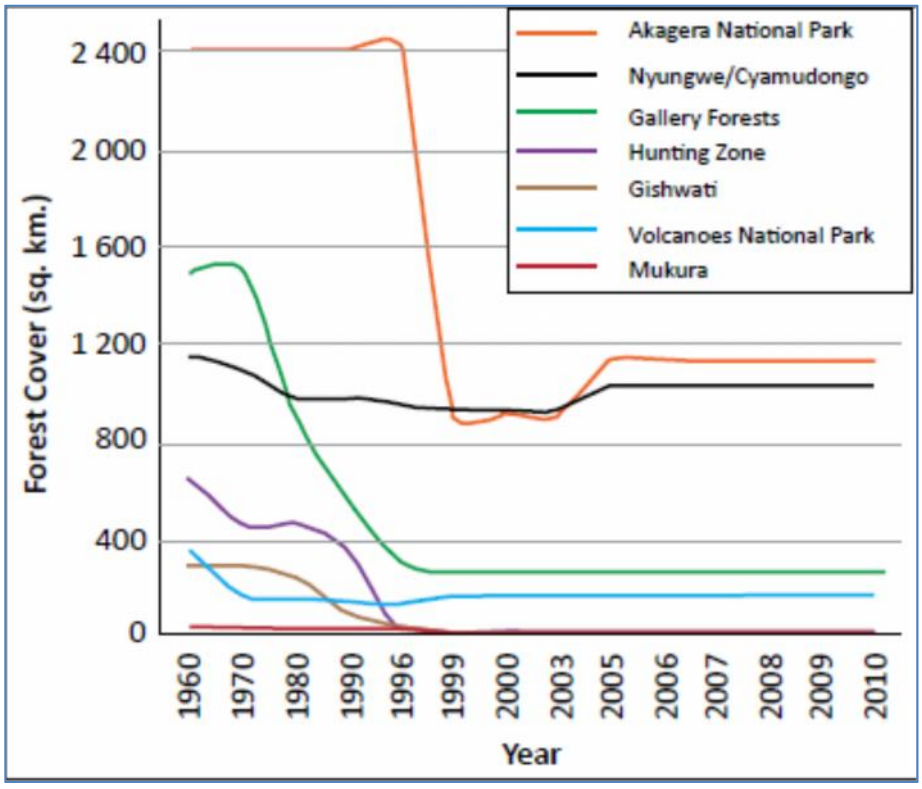


Figure 5.6: Trends in natural forest cover

- Forest fires were frequent in Rwanda until stringent measures were taken against bush fires in the late 1970s. Thus, the occurrence of fires was considerably reduced in the 1980s but dramatically resurged during the war of the mid -1990s. There is no statistics on areas and species affected, but ROR (2004) reported that 6 130 ha, 2 658 and 4 344 ha of forests, respectively, were destroyed by fires in 2000, 2001 and 2002. However, in recent years, no fires are reported in forested areas except in the dry Akagera National Park. No statistics on forest extent and species affected were available for the period 2005-2009.

- The vision 2020, targets the country to have 30% forest cover by the year 2020 while agroforestry systems should cover 85% of cultivated areas. Therefore, in order to achieve this target, the new forestry policy targets to expand forest plantation area between 2010 and 2020 with 350 000 ha (ROR, 2010). However, in the context of land scarcity, this target is far too ambitious, unless alternative sources of livelihood are created to provide out of farm jobs, thereby enabling farmers to use significant areas of farmland for afforestation.

- Generally, due to population pressure and the resulting shortage of arable land, there is practically no land remaining for forest plantation expansion. Only marginal areas and protection areas which are not forested are normally considered as afforestation sites in the country. Such sites include buffer zones to natural forests and national parks, bands for protection of rivers and lakes, and roadsides. These sites need to be planted with appropriate species to avoid negative impact on soils, water, hydrology, fauna and flora.

- Harvesting regulations are prescribed in the licenses issued by the forestry services to those who want to harvest forest plantations. All natural forests are protected and therefore no harvesting takes place there. Local governments are allowed to issue harvesting licenses only for forest plantations or woodlots up to 1 ha. Beyond this size, it is Rwanda Natural Resources Authority (RNRA), Department of forestry which issues harvesting license. No one is allowed to harvest even woodlots without a harvesting license.

5.5. Biodiversity

5.5.1. Introduction

Biodiversity can be defined as the variability of life expressed at the ecosystem, species and genetic levels. It provides a large number of goods and services that sustain our lives.

Biodiversity is the combination of life forms and their interactions with each other and with the rest of the environment that has made the earth a uniquely habitable place for humans. The biodiversity we see today is the fruit of billions of years of evolution, shaped by natural processes and, increasingly, by the influence of humans.

Although Rwanda is a small country, it has a remarkable variety of ecosystems and of flora and fauna. Its location at the heart of the Albertine Rift eco-region in the western arm of the Africa's Rift Valley is a contributory factor. This region is one of Africa's most biologically diverse regions. It is home to some 40 per cent of the continent's mammal species (402 species), a huge diversity of birds (1,061 species), reptiles and amphibians (293 species), and higher plants (5,793 species) (Chemonics International Inc. 2003, MINITERE 2005).

5.5.2. Ecosystem and habitats

The Albertine Rift is considered to have the highest species richness in Africa. It is considered a biodiversity hotspot containing more endemic mammals, birds, butterflies, fish and amphibians than anywhere else in Africa. Habitats supporting such an array of biodiversity are very varied. Being at the heart of the Albertine Rift, Rwanda's habitats are equally varied, ranging from afro-montane ecosystems in the northern and western regions to lowland forests, savannah woodlands and savannah grasslands in the southern and eastern regions. There are other habitats around volcanic hot springs and old lava flows, especially in the northern and western part of the country. Rwanda also has several lakes and wetlands which are rich in different species. Though not yet well surveyed, all these ecosystems host a rich variety of fauna and flora and micro-organisms.

Besides these natural ecosystems, as an agrarian country, Rwanda agro-ecosystems comprise cultivated land, agro-pastoral areas, grassland, grazing and fallow land (MINITERE 2003a).

5.5.3. Species Diversity

Flora

Rwanda harbours very diverse flora due to a considerable geo-diversity and a climatic gradient from west to east. The number of vascular plants is estimated at around 3000 species originating from the different bio-geographical regions (Fischer and Killmann 2008).

Rwanda constitutes the eastern limit for plants from the Guineo-Congolian region. An example of these plants is the *Thonningia sanguinea (*Balanophoraceae), widespread in Western and Central Africa. It is only found in the Cyamudongo forest in western Rwanda. Plants from the afromontane region are confined to higher altitudes, such as the orchid *Disi robusta* found in Nyungwe forest. The Eastern African savannah elements comprise the Zambezi floral region, and most these plants are found in the Akagera National Park and its surroundings (Fischer and Killmann 2008).

About 280 species of flowering plants from Rwanda are considered to be endemic to the Albertine Rift. Of these endemic species, about 20 are restricted to Rwanda, 50 species confined to Rwanda and Eastern Congo and 20 species found only in Rwanda and Burundi. Twenty one species are found additionally in the forests of western Uganda, eastern Congo, Rwanda and Burundi. Examples of these distribution types are *Impatiens bequaertii* (Balsaminacea)*, Impatiens mildbraedii* (Balsaminacea)*, Monathotaxis orophila* (Annonaceaa*) or Liparis harketii* (Orchidaceae) (Fischer and Killmann 2008).

Rwanda has 56 local endemic flowering plants, out of which 47 are confined to Nyungwe National Park (including Cyamudongo forest). Examples of these plants are the recently discovered species *Impatiens nyungwensis* Eb.Fisch., Detchuvi & Ntaganda, (Balsaminaceae*) Afromomum wuertii* Dhetchuvi & Eb. Fisc (Zingiberaceas), *Diaphananthe delepierreana* Lebel & Geerinck (Orchidaceae) and *Ypsilopus liae* Delpierre and Lebel (Orchidaceae) all endemic to Nyungwe National Park (Fischer and Killmann 2008). The number of these newly discovered species shows that the number of plant species found in Rwanda is far from being totally known.

The afro-montane ecosystems comprised of the Volcanoes and Nyungwe National Parks, Gishwati and Mukura Natural Forests, and other small forests found at the Congo-Nile Ridge, is varied and rich in plant species.

The biodiversity in the lowlands of the eastern part of Rwanda comprises mainly savannah with grasses, bushes and trees, mountain rainforests in the Akagera National Park and gallery forests in the eastern part of Rwanda. Gallery forest around lakes and other water bodies are mainly found in the Akagera complex, where they cover almost 163 hectares (Twarabamenye and Gapusi 2000 in MINITERE 2003a). The flora of these forests comprise 66 species including *Acacia kirkii, Acaccia polycantha, Acacia sieberana, Albizia gummifera, Cordia Africana, Crotonmacrostachis, Dombeya burgessia, Dombeta kirkii, Erythria absysniica, Newtonia buchananii* and *Techlea nobilis.* There are also some rare or threatened species such as *Impantiens irvingii, Markhamia lutea, Eulophia guineensis* and *Pterygota mildbraedii,* considered a fossil plant (MINAGRI 1998).

Most of the plant species found in these forests are used in traditional medicine and some plants reveal important biochemical extracts. This is the case with *Blighia unijugata, Grewia forbesi, Rhus vulgaris, Pterygota mildbraedii* and *Ficus* species (MINITERE 2003a).

With more than 104 flower species, wetlands and aquatic ecosystems are also rich in biodiversity. Some lakes such as Kivu, Bulera and Ruhondo are poor in macrophytes (MINITERE 2003a).

About 50 species of plankton are found in these ecosystems distributed in the following families: *Chlorophyceae, Cynaphyceae, Pyraphytes, Bacillariophyceae, Cynophyceae,*

Pyrophytes, Euglenophyceae, and *Diatomophyceae.* There are reports of colonization of *Nymphea nouchalii* and *Nymphea lotus* in the lakes of the eastern region. The Water hyacinth (*Eicchornia crassipes*) presents a big threat to the biodiversity of these lakes.

The flora is dominated by *Cyperus papyrus*. Some of these lakes are associated with gallery forests with the dominating species being those of the genus' *Phoenix, Bridelia, Ficus, Aeschynomene* and *Echinochloa.* Ferns are also found and in some places there are *Echinochloa pyaramidalis.*

The agro-ecosystems have food crops species like *Sorghum*, *Phaseolus vulgaris, Eulisine corocan, Colocasia antigonum, Zea mays, Oryza sativa, Triticum sp., Hordeum vulgare, Pisum sativum, Soja hispada, Arachis hypogea, Ipomea durcis*, Irish potatoes, *Manihot esculenta* and the banana (*Musa*).
There are also commercial crops like coffee, tea and pyrethrum. The agricultural production systems also accommodate many related wild species, the most common being *Eragrostis sp., Bidens pilosa, Digitaria sp., Conyza sumatrensis, Cyperus sp.*

There are also plant forage crops including *Tripsacum laxum, Setaria sp, Desmodeum sp. Pennisetum purpureum, Mucuna pruriensis, Cajanus cajan Calliandra calothyris, Leucaena diverifolia,* and *Sesbania sesban* (MINITERE 2003a).

Tree species found in Rwanda include *Ficus thoningii, Euphorbia tirucalli, Erythrina abyssinica, Verminia amygdalena, Dracaena afromontana,* among others.

Fauna
Rwanda shelters 151 different types of mammal species, eleven of which are currently threatened and none of which are endemic. Among them are the primates (14 to 16), with half of the remaining world population of mountain gorillas (*Gorilla gorilla berengei*). The gorillas are found in the Volcanoes National Park. Others includes the owl-faced monkey (*Cercopithecus hamlyni*), the mountain monkey (*Cercopithecus hoesti*) in Nyungwe, the Chimpanzee (*Pan troglodytes*) in Nyungwe and Gishwati, and the Golden monkey (*Cercopithecus mitis kandti*) found in Volcanoes National Park.

There are also 15 species of antelope, and a wide diversity of species such as buffalo, zebra, warthog, baboon, elephant, hippopotamus, crocodile, tortoise and rare species such as the giant pangolin (Chemonics International Inc. 2003, MINITERE 2005).

Rwanda is one of the top birding countries with 670 different birds having been recorded. Four of species of birds in Rwanda are threatened with extinction: the shoebill (*Balaeniceps rex)* found in Akagera; Grauer's rush warbler (*Bradyptrus graueri*) found in Volcanoes National Park in Nyungwe and in the swamps of Rugezi; the Kungwe apalis (*Apalis argentea*) found in Nyungwe; and the African or Congo barn owl (*Phodilus prigoginei*) found along Lake Kivu (Chemonics International Inc. 2003).

Animal races bred in Rwanda are mixed with native and non-native races. These include cattle (*Ankole, Sahiwal, Frison, Alps brown* and the *Australian Milk Zebu*), goat (*Alpine* and *Anglonubian*), sheep (*Karakul, Merinos* and *Dorper*), pig (*Large white* and *Landrace, Piétrain*), poultry (*Leghorn, Rhodes Island Red, Derco, Sykes* and *Anak*), fish (*Tilapia* and *Clarias*) (MINITERE 2003 a).

Fish species found in aquatic ecosystems comprise *Haplohcromis, Synodontis*, *Barbus, Labeo*, *Tilapiines*, and *Clarias* species. *Raimas moorei* and *Limnothrissa miodon* were introduced into Lake Kivu at the end of the 1950s (MINITERE 2003a).

5.5.4. Status of biodiversity conservation

This rich biodiversity is mainly conserved in protected areas (three national parks, natural forests, wetlands). These cover almost 10 per cent of the national territory while the rest of the country is densely populated.

- ***The Volcanoes National Park*** is home to about 30 per cent of the global population of Mountain Gorilla (*Gorilla gorilla beringei*). It has other 115 mammals' species, including the golden monkey (*Cercopithecus mitis kandti),* elephants, buffaloes, 187 bird species, 27 species of reptiles and amphibians and 33 arthropod species. CITES consider *Rana anolensis*, *Chameleo rudi* and *Leptosiaphos grauer* endangered (MINAGRI 1998, Chemonics International Inc. 2003). It has also 245 plants, 17 of which are threatened; and 13 species of orchids including *Disa starsii, Polystachya kermessia, Calanthes sylvatica, Chamaengis sarcophylla, Cyrtorchis arcuata, Habenaria praestans, Stolzia cupuligera, Eulophia horsfallii,* among others (Chemonics International Inc. 2003).

- ***Nyungwe National Park*** has 75 species of mammals, including 13 species of primates with some on the IUCN Red list such as the Eastern Chimpanzee (*Pan troglodytes schweinfurthii*), owl-faced guenons, (*Cercopithecus hamlyni*) and the Angolan Colobus monkey (*Colobus angolensis ruwenzorii*). The national park is also considered an African Important Bird Area (IBA) with 285 bird species comprising 25 endemic to the Albertine Rift (Plumptre *et. al.* 2002, Fischer and Killmann 2008). Of the 1,200 plant species inventoried in the Nyungwe National Park - 265 species were trees and shrubs and of these 24 are endemic to the Albertine Rift. Among the plant species in the park, 5 species of trees and 6 species of grass are endemic to the park. These include *Oricia renieri*, *Pentadesma reyndersii*, *Pavetta troupinii*, *Psychotria palustris* and *Tarenna rwandensis.* The flora of the park also comprises 148 species of orchids, of which 19 are endemic *(*MINITERE 2005*)*. The following species of orchids found on the CITES list are also found in the park: *Diaphananthe biloba, Disa eminii, Disperis kilimanjarica, Euggelingia ligulifolia, Eulophia horsfallii, Polystachya fabriana, Polystachya hastate* and *Tridactyle anthomaniaca (*MINITERE 2005*)*.

- The wildlife in the ***Akagera National Park*** comprises 90 species of mammals, 530 bird species and 35 fish species. The most threatened species are rhinoceros, large carnivores, particularly lions. Many species in the Akagera National Park are protected by the CITES convention such as *Loxodonta africana* (African elephant), *Sincerus caffer* (buffalo), *Panthera leo* (leopard) and *Tragelaphus spekii* (sitatunga). (MINITERE 2003a, MINITERE 2005). The flora of the Akagera National Park is diverse and 6 species of orchids are recorded. The grass savanna is dominated by *Themeda triandra* and *Hyparrhenia* sp. accompanied with normal species like *Sporobolus pyramidalis* and *Botriochloa insculpta*. Acacias are the most trees found in the forest savannah, and the following species are recorded: *Acacia senegal, A. Sieberiana, A. polyacantha campylacantha, A.gerardii* and *A. brevispica*. Species of *Combretum* are also found in the park (MINITERE 2005).

- **Gishwati forest** includes species such as *Pan troglodytes schewinfurthii, Colobus angolensis ruwenzorii, Potamochoerus porcus, Cephalophus nigrifons, Dendrohyrax arboreus, Felis serval* and *Felis aurata* (MINAGRI, 2002 in Munanura *et. al*, 2006). The Tree squirrel (*Funisciurus pyrrhopus*), Rwenzori sun squirrel (*Heliosciurus ruwenzori*), Ground hog (*Thryonomys swinderianus*) and the jackal species (*Canus spp.)* are found in Mukura forest. Makura is also rich in birds with 59 species recorded, among them 7 Albertine Rift endemic species: *Tauraco johnstoni, Apalis personata, Apalis Ruwenzori, Cynnyris regia, Zoothera tanganjicae, Bradypterus graueri* and *Parus fasciiventer (*Munanura *et. al*. 2006).

- ***Rugezi wetland*** is habitat to an endangered bird and hosts 60 per cent of the global population of Grauer's swap-warbler (*Bradypterus graueri*). It is also habitat to 19 bird species, including two species of *Threskiornithidae,* protected by CITES. Apart from *Clarias liocephalus* and *Haplochromis sp*., the wetland is not rich in fish species. A low number of mammals are also identified: several species of Muridae, *Tragelaphus spekei* and *Aonyx capensis*. (MINITERE 2003a). The orchid *Disa stairsii*, a specie protected by CITES is also found in Rugezi wetland (MINITERE 2003b).

Trends and threats to Rwanda biodiversity

- ✓ With the highest population density in Africa, coupled with its dependence on agriculture, the major threats to the biodiversity and genetic resources in Rwanda are mainly linked to population pressure and the problem of land scarcity. Other threats to the biodiversity are linked to human activities such as loss of habitat by conversion of natural habitats, mining, agriculture and the introduction of alien species. Meanwhile, recent programmes and initiatives of afforestation, soil erosion prevention and wetlands protection will contribute to Rwanda biodiversity protection.

- ✓ Rwanda has set up strategies to improve Rwanda's biodiversity like:
  - Improvement of the policy, legislation and institutional framework for biodiversity conservation.
  - Improvement of the biodiversity knowledge base

5.6. Agriculture and Farming Systems

Agricultural sector has historically been the backbone of the Rwandan economy. In addition to its contribution to GDP, the sector typically generates about 90% of employment (especially for women), about 70% of export revenues and about 90% of national food needed. This gives the sector much strength as the driver of economic power in the country.

Although Rwanda aims to become a service-led economy, the agricultural sector is expected to keep contributing significantly to the country's long term development process as shown in **Figure 5.7.**

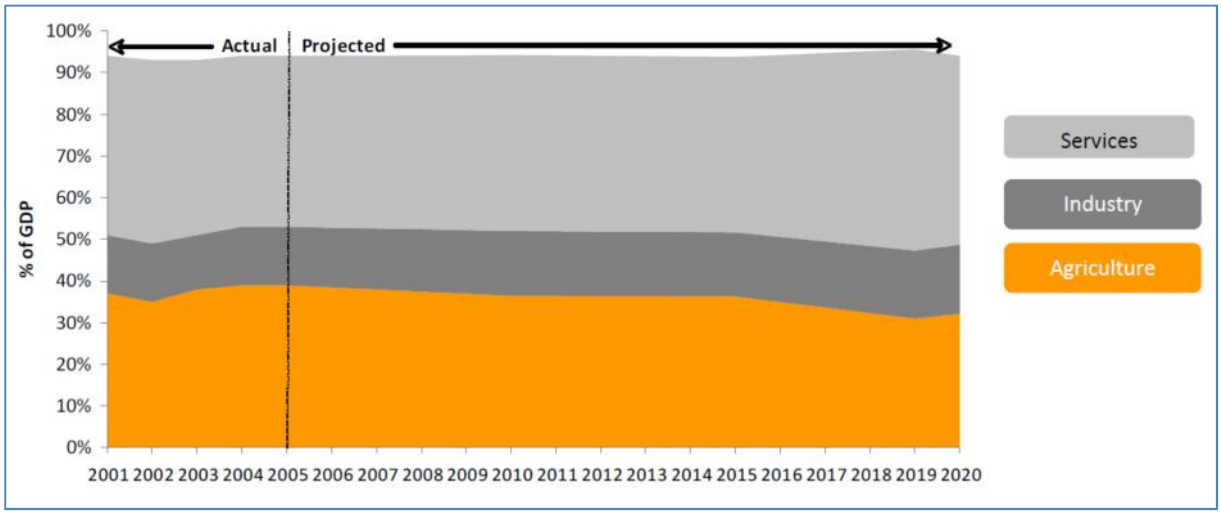


Figure 5.7: Projected Sectoral Proportion of GDP, 2001-2020

Because so many livelihoods depend on agriculture, factors linked to agriculture such as lack of adequate land or non-productive soils are widely seen as a major cause of poverty and hindrance to economic development.

The main food crops are bananas, beans, sorghum, sweet potatoes, Irish potatoes, cassava, maize, and rice. Vegetable crops are mainly tomatoes, cabbages, and peas. Crop yields are generally low, but the agro-diversity present in Rwanda is greater than in many other parts of Africa. Commercial crops such as coffee, tea, pyrethrum, and cut flowers also provide important cover and protection functions.

Animal husbandry, especially cattle raising, is an important component of the farming systems in the country. The main areas are the eastern province and southern province. The use of animal manure from cattle and other livestock figures prominently into the farming systems and are important for fallow (when there is that opportunity) and for returning nutrients to soils that become exhausted due to the cultivation intensity.

TRENDS

- ✓ For the most part, agriculture lands do have a fairly continuous cover, and crop rotation is widely practiced. Without it, the soils would produce even less, and the steep slopes would erode more quickly and more severely than they do today.

- ✓ Over-cultivation, rather than erosion, appears to be a main factor in declining soil fertility (IISD, 2005) and agricultural productivity.

- ✓ Rwanda has recently embarked on a nationwide program to improve and retain its agricultural soils through an active terracing campaign and trees planting

5.7. Land management and agricultural practices

5.7.1. Land use

Land is one of the three main factors of production and its finite nature makes it a very valuable natural resource. Use and management need to be carried out in a sustainable and rational manner.

Rwanda is a small country with total arable land of about 1.4 million ha. In addition, lands in Rwanda are used for pasture or exploited as arable marshlands. **Figure 5.8** gives an overview of the development of land use between 1990 and 2002. This suggests that land is being farmed intensively and Rwanda cannot afford to let any land lie fallow.

Given a growing population combined with strong reliance on agriculture, it is clear that land is one of the scarcest resources in Rwanda. The EICV collects detailed data on land use and the agricultural activities of Rwandan households.

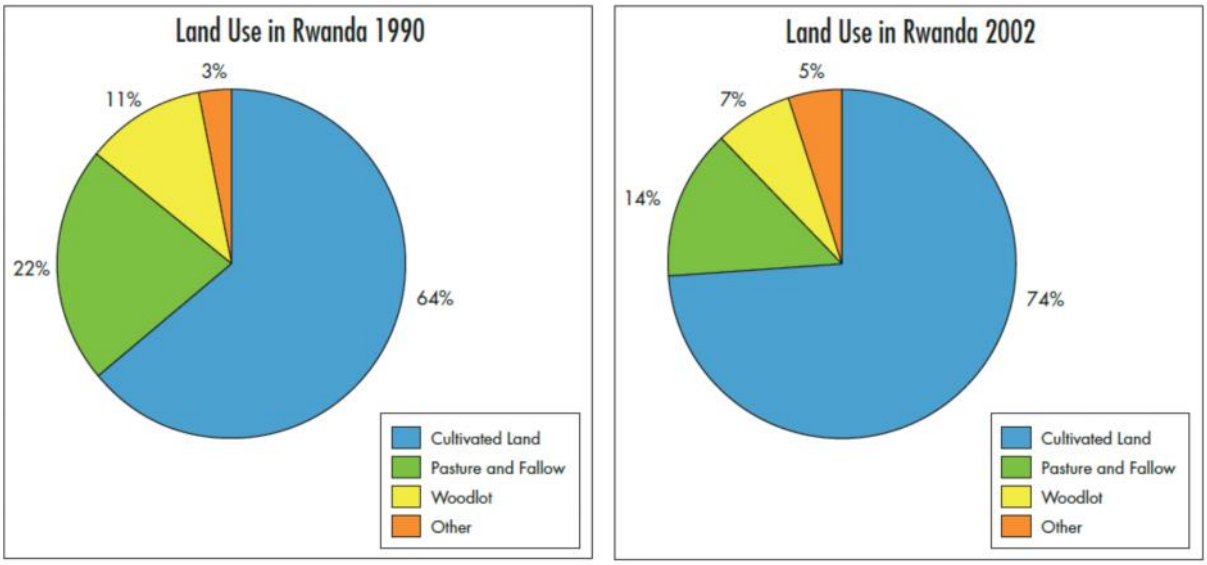


Figure 5.8: Changes in land use over time[68]

[68] Source: Mpyisi et al. 2003, cited in REMA/UNEP 2009

5.7.2. Land distribution

The vast majority of Rwandan households cultivate some amount of land, and most of them are directly reliant on agriculture as their main or only source of income, especially in rural areas.

The average area cultivated per rural household is only 0.6 ha. FAO estimates that on average a Rwandan household requires at least 0.9ha to conduct sustainable agriculture. However, only 17% of rural households cultivate 0.9ha or more in Rwanda. This is also shown in **Figure 5.9**, which illustrates that the majority of households across all provinces cultivate less than 0.9ha, or even less than 0.3ha.

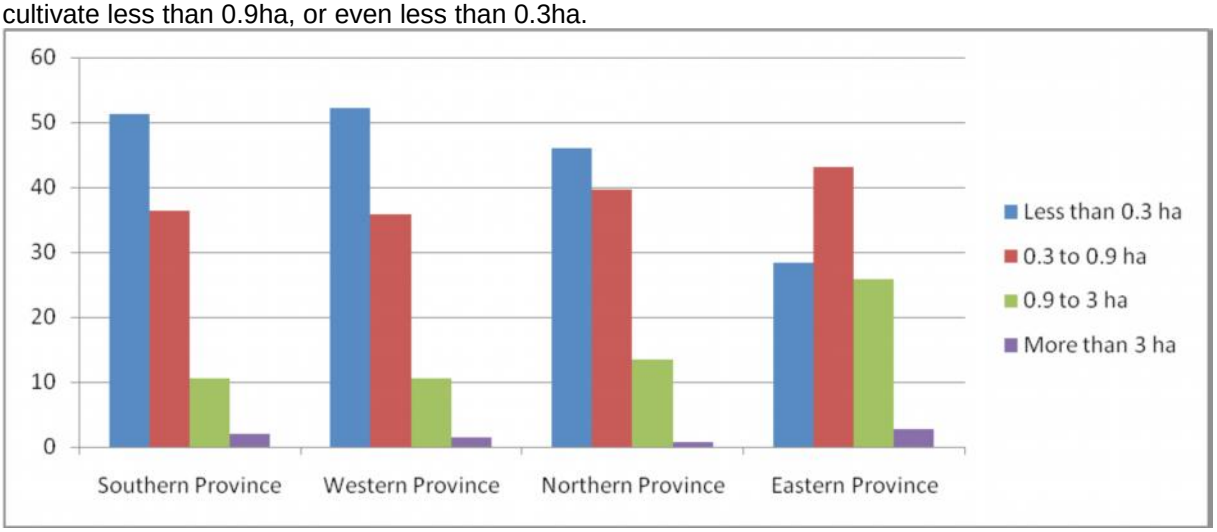


Figure 5.9: Distribution of total HH land in rural areas, EICV3

With a growing population, land availability is becoming even scarcer over time. As illustrated in **Figure 5.10**, the average size of land cultivated per rural household has decreased in five years in all provinces except the Southern Province, where it was already lowest out of all provinces five years ago.

The important point to note here is that, in provinces other than the Southern Province, land cultivated per household has reduced between surveys, but it is now on average around 0.5ha across all provinces except Eastern Province – exactly the level at which no further reduction was observed in the Southern Province over the last five years.

If the interpretation holds that below this level no further land sharing is possible, Rwanda might see a lot more young individuals without access to land in the Southern, Western and Northern provinces in the coming years. This possibility is further supported by the fact that the proportion of households cultivating less than 0.3ha has not changed much between the surveys, suggesting that there is a minimum amount of land under which no further sharing is possible if households wish to sustain themselves through agriculture.

It is of course clear that all data on land must be interpreted carefully in the light of the various government programmes of land consolidation, rehabilitation and registration that have been implemented over the past years.

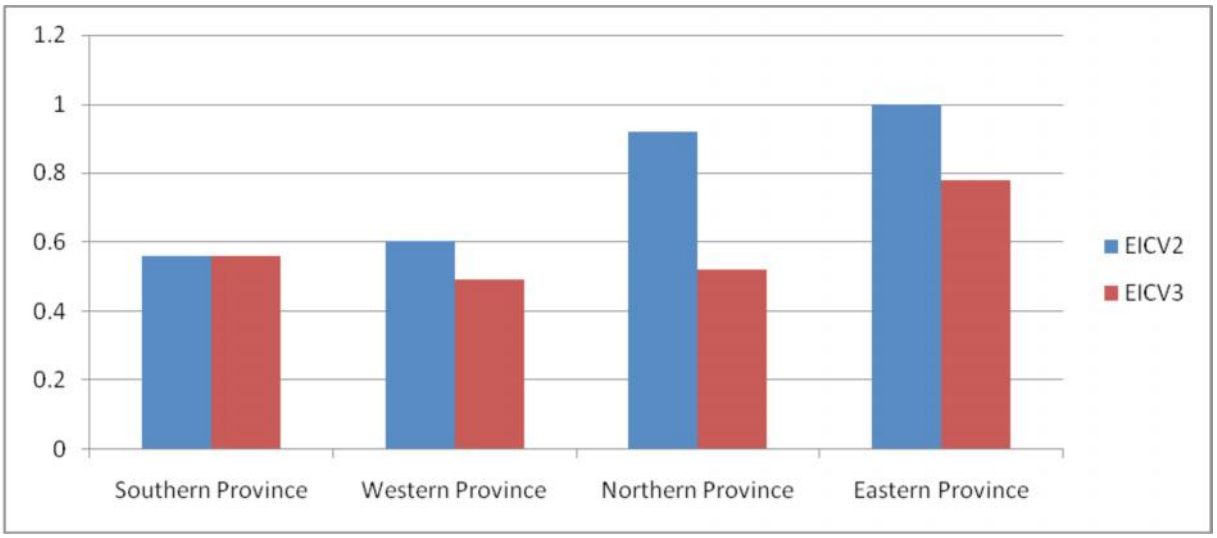


Figure 5.10: Changes in average land cultivated in rural areas (ha per HH) between EICV2 (2007) and EICV3 (2012)

5.7.3. Agricultural practices

Sustainable use of land is one that allows a family to derive good yields from their agricultural activity but does not degrade soil quality and thereby ensures the usability of lands for many generations to come.

Use of fertilisers is an important issue in this respect, because it allows a more efficient use of the scarce land resources but can also pose a threat of soil degradation if used incorrectly.
The Government of Rwanda has decided to subsidise fertiliser use. Data from the EICV shows that the percentage of cultivating households using chemical fertiliser has increased strongly from 11 to 29%. Use of organic fertiliser has also increased slightly.

Trends and Key Environmental Issues associated with the agricultural sector

- ✓ The hilly geography of Rwanda has led to extensive soil degradation and soil erosion. About 40% of Rwanda's land is classified by the FAO as having a high risk of erosion and about 37% is estimated to require soil retention measures before cultivation. Only 23% of the country's lands is not prone to erosion. Soil erosion control is therefore considered an important factor in ensuring Rwanda's economic development.

- ✓ The main environmental threat to Rwanda's farming systems is erosion, stemming from the fact that most agriculture is done on slopes so steep that they occasionally approach 100 percent. MINAGRI sources indicate that around 37 percent of the land in Rwanda needs to be managed before being cultivated, and overall, an estimated 39.1 percent of the land has a high erosion risk. Steep hillsides are likely to erode whenever protective vegetative covering is removed or the surface is disturbed; the hillsides typically suffer the least erosion in their natural state as forests or grassland. Regularly disturbing the soil and leaving large portions of it without protective covering — as happens with agricultural row crops — promotes erosion. Estimates of soil loss from cropped hillsides vary, but may be as much as 80 to 100 m^3 per ha per year. The erosion has an indirect impact on the hydropower as this lead to the sedimentation of main rivers especially during rainy season

- ✓ High population density on the limited land resource is putting pressure on agricultural productivity. This has led to land fragmentation and reduction of farm sizes, continued intensive cultivation of land with no fallow and soil erosion, over cultivation without restoration of soil nutrients, weak extension and research services

and increased vulnerability to climatic shocks like drought or heavy rains. The use of fertilizers and agricultural chemicals has polluted water; and agricultural activities and general mismanagement of the wetlands have further degraded and destroyed them.

- ✓ Overgrazing and bush fires have been the greatest culprit for reduction of biodiversity as they result in the extermination of the most grazed species as well as pyrophlitic (fire-resistant) species with low bromalytic (nutritive) such as *Erogrostics*, *Sporobolus* and *Digitalia* (Twagiramungu 2006). In this respect, the One Cow per Family (*Gira Inka*) programme has been effective in promoting improved cow breeds among Rwandans not only to improve nutrition and income through milk production and sales, but also to provide organic manure to improve crop production. This system has been extended to other animals such as goats.

5.8. Energy Resources

Rwanda has considerable opportunities for energy development: from hydro sources, methane gas, solar, geothermal and peat deposits.

Most of these energy sources have not been fully exploited. As such, wood is still the major source of energy for 94 per cent of the population and imported petroleum products consume more than 40 per cent of foreign exchange (SoE, REMA, 2009).

Energy is a key component of the economy. It is thus recognised that the current inadequate and expensive energy supply constitutes a limiting factor to sustainable development.

Rwanda's Vision 2020 emphasizes the need for economic growth, private investment and economic transformation supported by a reliable and affordable energy supply as a key factor for the development process. To achieve this transformation, the country will need to increase energy production and diversify into alternative energy sources.

The Vision 2020 energy target is to have at least 35 per cent of the population connected to electricity (up from the current 6 per cent) and to reduce the rate of wood use in national energy consumption from the current 94 to 50 per cent (ROR 2000). Additionally, the PRSP aims to ensure a energy consumption growth rate of nearly 10 per cent per year, and a rural electrification rate of 30 per cent giving electricity access to 35 per cent of the population by 2020 (ROR 2007).

Biomass is the main source of energy in Rwanda. It is used in the form of firewood, charcoal or agricultural residues mainly for cooking purposes in Rwandan households, and also in some industries (MININFRA 2008a). In the rural areas, biomass meets up to 94 per cent of national needs; with the balance being met by other options such as kerosene, diesel, dry cells, grid and non-grid electricity, biogas, solar, wind and other renewable energies.

Although fuel wood consumption is expected to increase in the short-term, the long-term strategy of the EDPRS is to reduce fuel wood consumption from 94 to 50 per cent by the end of 2020

<u>Trends and environmental related issues</u>

- ✓ With a continuous Rwandan population growth, urbanization, industrialization and the Rwanda development in general, it is expected that energy demand will continue to increase and sustainable measures need to be taken at national level in order to address this issue.

- ✓ All stages of energy resources exploitation, production, conversion, transportation, storage and end-use can have negative impact on the environment. Health, safety and environmental consequences of energy production and utilisation are a major concern e.g. uncontrolled use of wood-fuel puts pressure on forests and leads to erosion, desertification, and contributes to carbon-dioxide emission. There is a need to ensure that energy development projects and programmes are subjected to

Environmental Impact Assessments (EIAs) and to strengthen co-operation in national, regional and international energy programmes aimed at mitigating environmental impacts of energy.

5.9. Demography

Rwanda has a fast-growing population which totaled 10.515.973 people in 2012. It is obvious that population growth is contributing to environmental degradation, putting increased pressure on the assimilative capacity of the environment. **Table 5.3** indicates the evolution of the size and spatial distribution of the population between 1978 and 2012.

Table 5.3: Evolution of the size and spatial distribution of the population 1978-2012.

Population size and Growth rate by date	**Sex**		
	Both sexes	**Male**	**Female**
Population size			
1978	4.831.527	2.363.177	2.468.350
1991	7.157.551	3.488.612	3.668.939
2002	8.128.553	3.879.448	4.249.105
2012	10.515.973	5.064.868	5.451.105
Average annual growth rate (%)			
1978-1991	3,1	3	3,1
1991-2002	1,2	1	1,3
2002-2012	2,6	2,7	2,5
1978-2012	2,3	2,3	2,4

Rwanda has one of the highest population densities in Africa with 414 inhabitants per square kilometer. By Province, Kigali City is the most densely populated with 1,552 inhabitants per square kilometre, followed by the Northern Province with 527 inhabitants per square kilometre. The Eastern Province is the less densely populated Province with 274 inhabitants per square kilometre.

Population density is high in all Districts but varies tremendously from one District to another. The least densely populated Districts are found in the Eastern Province (178 in Kayonza, 280 in Bugesera). The most densely populated Districts are the Kigali City's ones: Nyarugenge (2,124), Kicukiro (1,911) and Gasabo (1,234). Rubavu in the Western Province has the highest population density outside Kigali City with 1,039 inhabitants per square kilometre.

The population density which was already high in 1978 (183 inhabitants per square kilometre) has more than doubled in 34 years, reaching 414 inhabitants per square kilometre in 2012, see **Figure 5.11**. It was in 272 in 1991 and 321 in 2002.

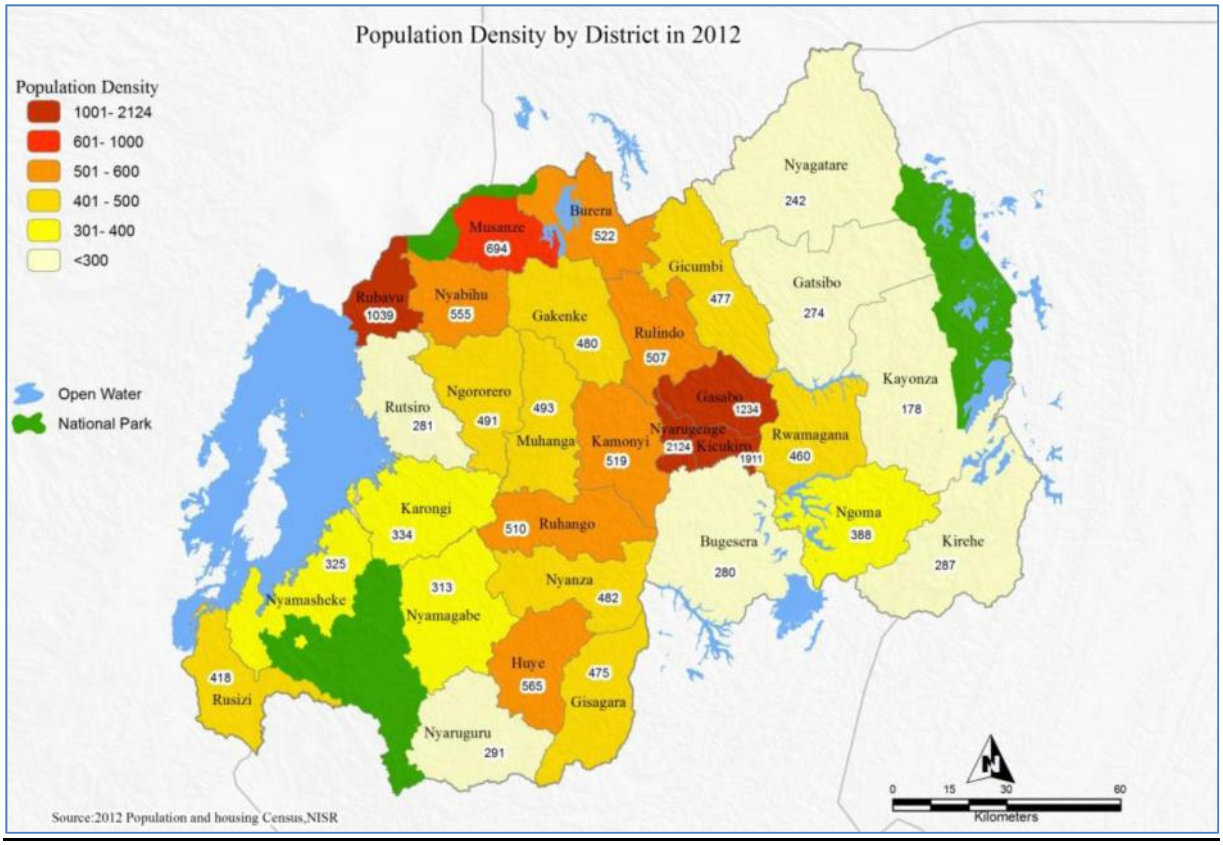


Figure 5.11: Population Density of Rwanda by District in 2012

The density of the population of Rwanda will continue to grow regardless of the measures currently taken to mitigate its evolution. The current density of 414 inhabitants per square km (in mid-year 2012) is already one of the highest in Africa.

Table 5.4 shows a prognosis of the population increase.

Table 5.4: Evolution of the population density 2012-2032 by area of residence according to the medium projections scenario

Projection years	Total Population		Urban Population		Rural Population	
	Population (in millions)	Density (Inhabitants /Sq km)	Population (in millions)	Density (Inhabitants /Sq km)	Population (in millions)	Density (Inhabitants /Sq km)
2012	10.5	414	1.7	1,871	8.8	359
2013	10.7	424	1.8	1,992	8.9	365
2014	11.0	434	2.0	2,120	9.0	370
2015	11.3	445	2.1	2,253	9.2	376
2016	11.5	456	2.2	2,392	9.3	382
2017	11.8	467	2.3	2,535	9.5	388
2018	12.1	478	2.5	2,683	9.6	394
2019	12.4	489	2.6	2,837	9.7	400
2020	12.7	500	2.8	2,995	9.9	406
2021	13.0	512	2.9	3,159	10.0	411
2022	13.3	524	3.1	3,328	10.2	417
2023	13.6	535	3.2	3,502	10.3	423
2024	13.9	547	3.4	3,681	10.4	428
2025	14.2	559	3.6	3,866	10.6	434
2026	14.5	572	3.8	4,055	10.7	439
2027	14.8	584	3.9	4,250	10.8	445
2028	15.1	596	4.1	4,449	11.0	450
2029	15.4	608	4.3	4,654	11.1	455
2030	15.7	621	4.5	4,862	11.2	460
2031	16.0	633	4.7	5,075	11.3	464
2032	16.3	645	4.9	5,292	11.4	469

TRENDS

- ✓ The Rwandan population has regularly increased over time, doubling between 1978 (4.8 million) and 2012 (10.5 million).
- ✓ The increase was steady between 1978 and 1991 and between 2002 and 2012 as reflected by the respective average annual growth rates of 3.1% and 2.6%. In contrast the population growth was slow between 1991 and 2002 (1.2% annually), reflecting the high death toll of the 1990 war and the 1994 Tutsi genocide.
- ✓ In addition to the overall population growth, population density is a crucial indicator in relation to the environment. Rwanda has one of the highest population densities in Africa with 415 inhabitants per square kilometre.
- ✓ By Province, Kigali City is the most densely populated with 1,552 inhabitants per square kilometre, followed by the Northern Province with 527 inhabitants per square kilometre. The Eastern Province is the less densely populated Province with 274 inhabitants per square kilometre.
- ✓ The current density levels are already regarded as a major driver of internal migration as well as stress to the physical environment and the density will continue to further increase.
- ✓ The population of Rwanda is projected to continue to grow as it is shown in the table above.
- ✓ These figures show that the Rwandan population pressure on the natural resources (including energy resources) will continue to increase with the time.

5.10. Housing and Urbanization

The most common type of habitat in Rwanda is the clustered rural settlement (known as Umudugudu). Overall 46.5% of the private households are of that type. It is followed by

dispersed/isolated housing (34%) and spontaneous/squatter housing (14%). **Figure 5.12** shows the typical housing in rural and urban areas.

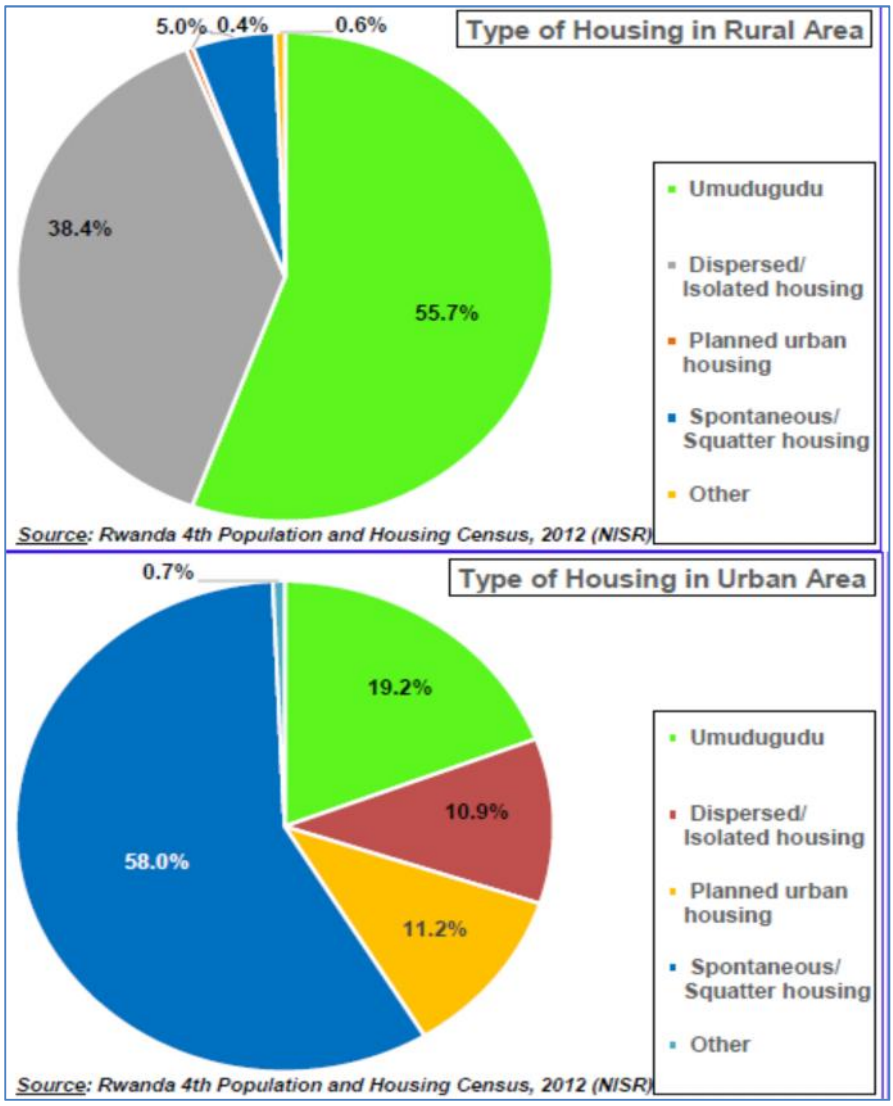


Figure 5.12: Types of housing in rural and urban area

The type of habitat varies a lot across Provinces. The clustered rural settlement is more prevalent in the Eastern Province (76%) with more than 90% of the housing being of that type in the Districts of Ngoma (91%) and Kirehe (98%). It is least common in Kigali City (2.5%). The dispersed/isolated housing is more frequently found in the Western Province (47.5%) and rarer in the Eastern Province (15%). As for the spontaneous/squatter housing, it is more common in Kigali City (66%) and rarer in the Northern Province (5.4%).

The type of habitat varies according to the area of residence. The spontaneous/squatter housing is more common in urban areas (58%) with percentages slightly exceeding 10% for clustered rural settlement (17%), planned urban housing (11%) and dispersed/isolated housing (11%). Rural areas are dominated by clustered rural settlement (53%) and dispersed/isolated housing (38%).

TRENDS

- ✓ During these last years, there has been an important development in Rwanda housing (in both rural and urban area).
- ✓ The current development is in line with the National Human Settlement Policy in Rwanda. The development objective of the human settlement policy, both in urban and rural areas, implies the integration of the human settlement sector, complete control and good management of the land, which is a scarce resource, and rational restructuring of available resources with a view to preserving the major balance of nature.
- ✓ The promotion of grouped settlements; "i*midugudu*" in the country is facilitating other infrastructure services: Electricity connection, access to clean water, education and health.

5.11. Water, Sanitation and Energy in the Housing Units

5.11.1. Water

In Rwanda 72% of the private households use water from improved sources (Internal pipe-born water, protected spring/well) vs. 27% resorting to unimproved sources (Unprotected spring/well, other).

At the Province level, the proportion of the private households using water from improved sources is higher in Kigali City (89%), in the North (77%) and in the South (76%). It is the lowest in the Eastern Province (59%).

Variation by District is associated with the level of urbanization. Access to improved sources of water are better in most urbanized Districts (in Kigali City for instance) and poorer in the most rural Districts (in the East for instance).

The proportions of water supply sources in urban and rural areas are shown in **Figure 5.13**

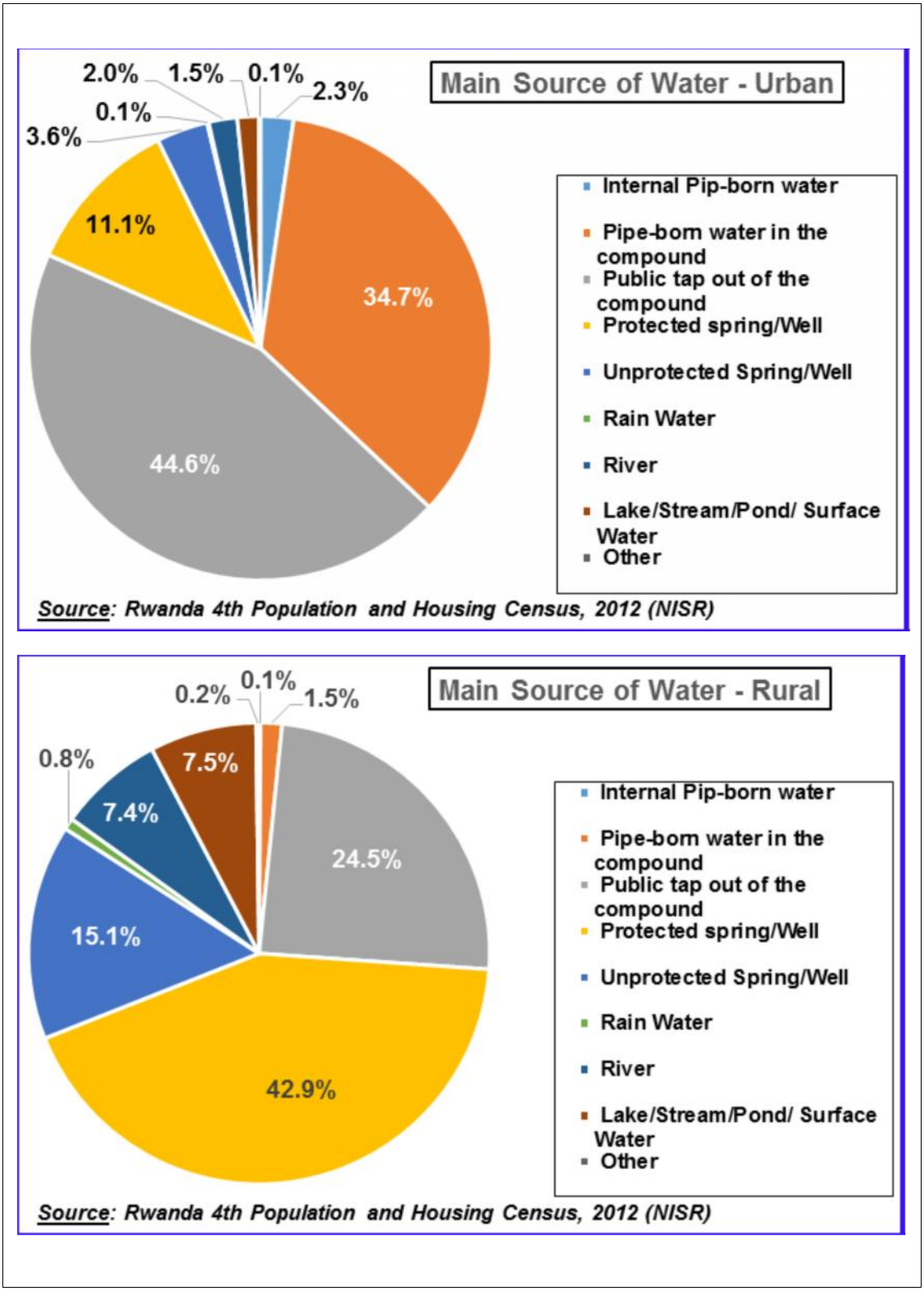


Figure 5.13: Main sources of water in urban and rural areas

The main source of water used by the private households varies according to the area of residence. In urban areas, the main sources of water supply are the public tap out of the compound (45%), the pipe-born water in the compound (35%) and the protected spring/well

(11%). In rural areas, the main sources of water supply are the protected spring/well (43%), the public tap out of the compound (25%) and the unprotected spring/well (15%).

5.11.2. Sanitation

At the national level the main types of toilet facility used by the private households are private pit latrine (82%) and shared pit latrine (12%). Only 0.8% of the households are equipped with flush toilet/WC system. **Figure 5.14** shows the proportions in urban and rural areas.

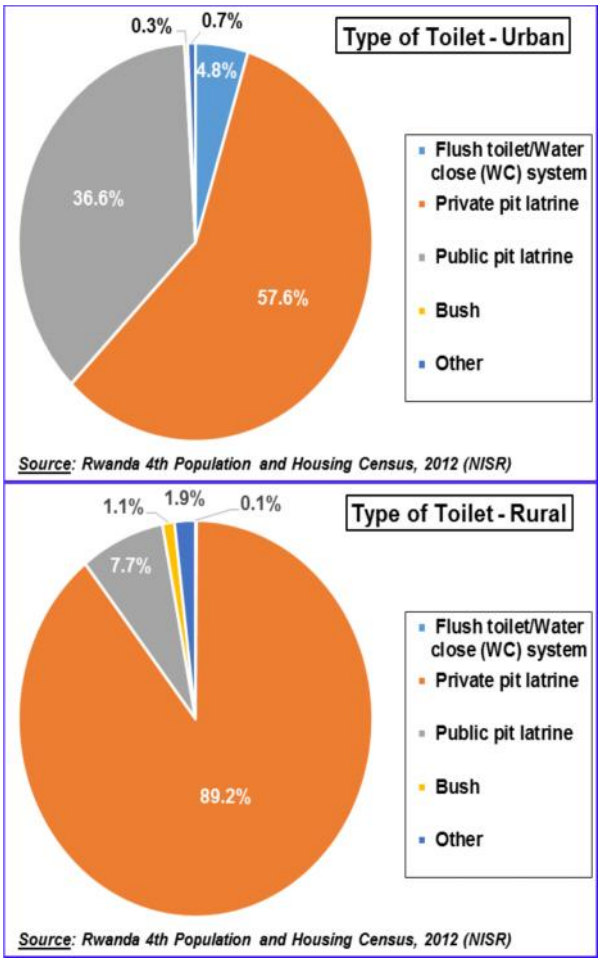


Figure 5.14: Distribution of the private households by type of toilet facility by area of residence

At the Province level, the proportion of households using private pit latrines is the highest in all provinces of the country. It is 50% in Kigali City and varies between 84% and 91% for all other Provinces. In Kigali City the proportion of households using shared pit latrines is the highest (41%) as compared to other Provinces where it varies between 5% and 10% only.

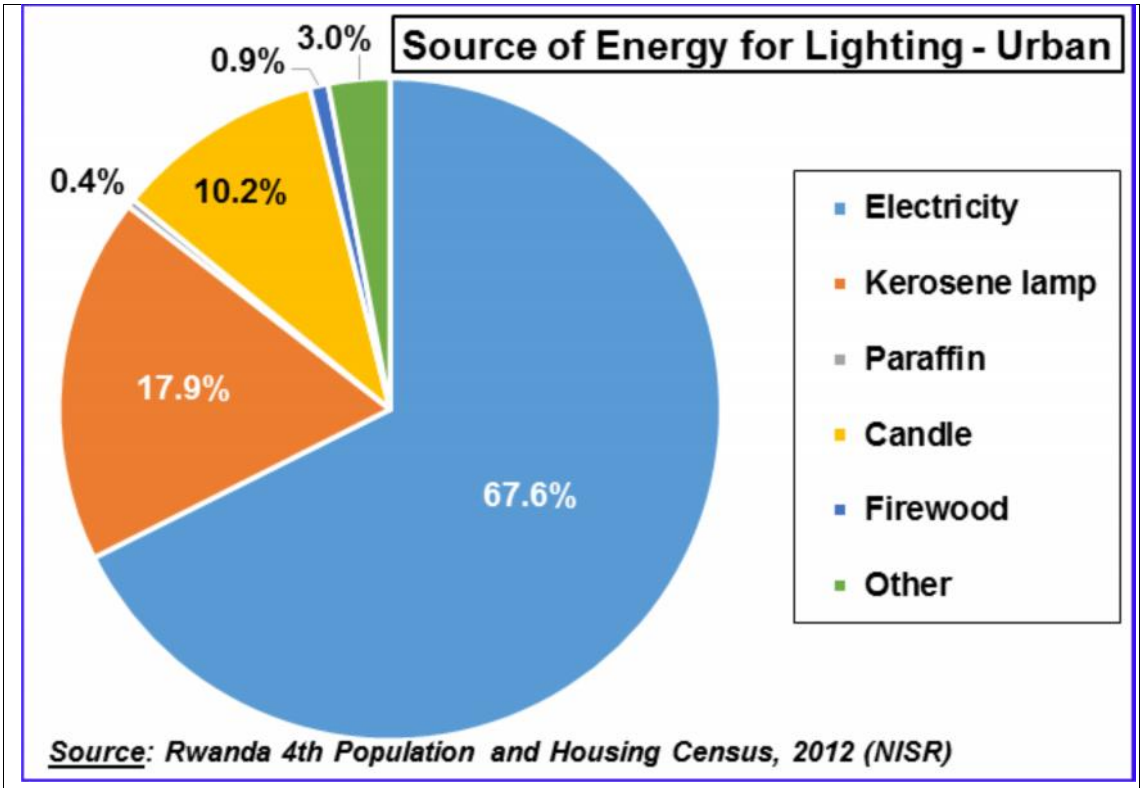
The type of toilet facility used in the private households varies according to the area of residence. In urban areas, the most used types of toilet are private pit latrine (58%) and shared pit latrine (37%). In rural areas, the main type of toilet used is the private pit latrine (89%) and to a lesser extent the shared pit latrine (8%).

5.11.3. Energy

In Rwanda the main sources of energy for lighting used by the households are kerosene lamp (40%), electricity (17.4%), candle (10%) and firewood (8%). However a high percentage of the households (24%) use an unspecified source of energy for their lighting. **Figure 5.15** illustrates the difference between urban and rural energy use.

At the province level, the percentage of the private households that use kerosene lamp for lighting is higher in Eastern (53%) and Southern Province (47%), and lowest in Kigali City (16%). The percentage using electricity for lighting is higher in Kigali City (67%) than in other provinces where it varies between 8% (in the South) and 13% (in the East).

The percentage of the private households using firewood for lighting is higher in the Southern Province (11%), especially in the Districts of Nyaruguru (35%) and Nyamagabe (23%); and in Western Province (17%), especially in the Districts of Ngororero (27%), Rutsiro (24%) and Nyabihu (23%).



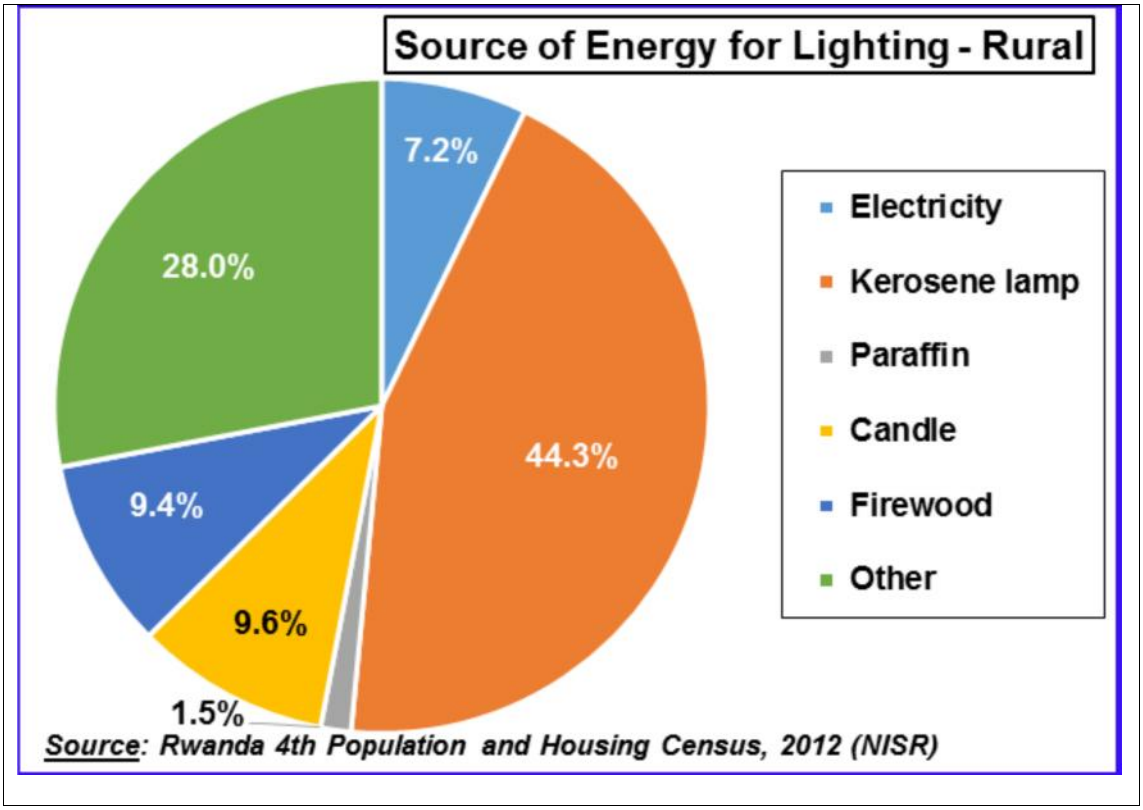


Figure 5.15: Source of energy for lighting in urban and rural area

The sources of energy for lighting vary by area of residence. In urban areas, the main sources of energy for lighting are electricity (68%), kerosene lamp (18%) and candle (10%). In rural areas, the main sources of energy for lighting are kerosene lamp (44%) and other unspecified sources (28%). Other sources of energy are used by non-negligible percentages of the rural households: candle (10%), firewood (9%) and electricity (7%).

At the national level the main sources of energy for cooking used by the private households are firewood (82%) and charcoal (13%), and to a lesser extent grass/leaves (3%). **Figure 5.16** illustrates the different cooking energy sources in rural and urban areas.

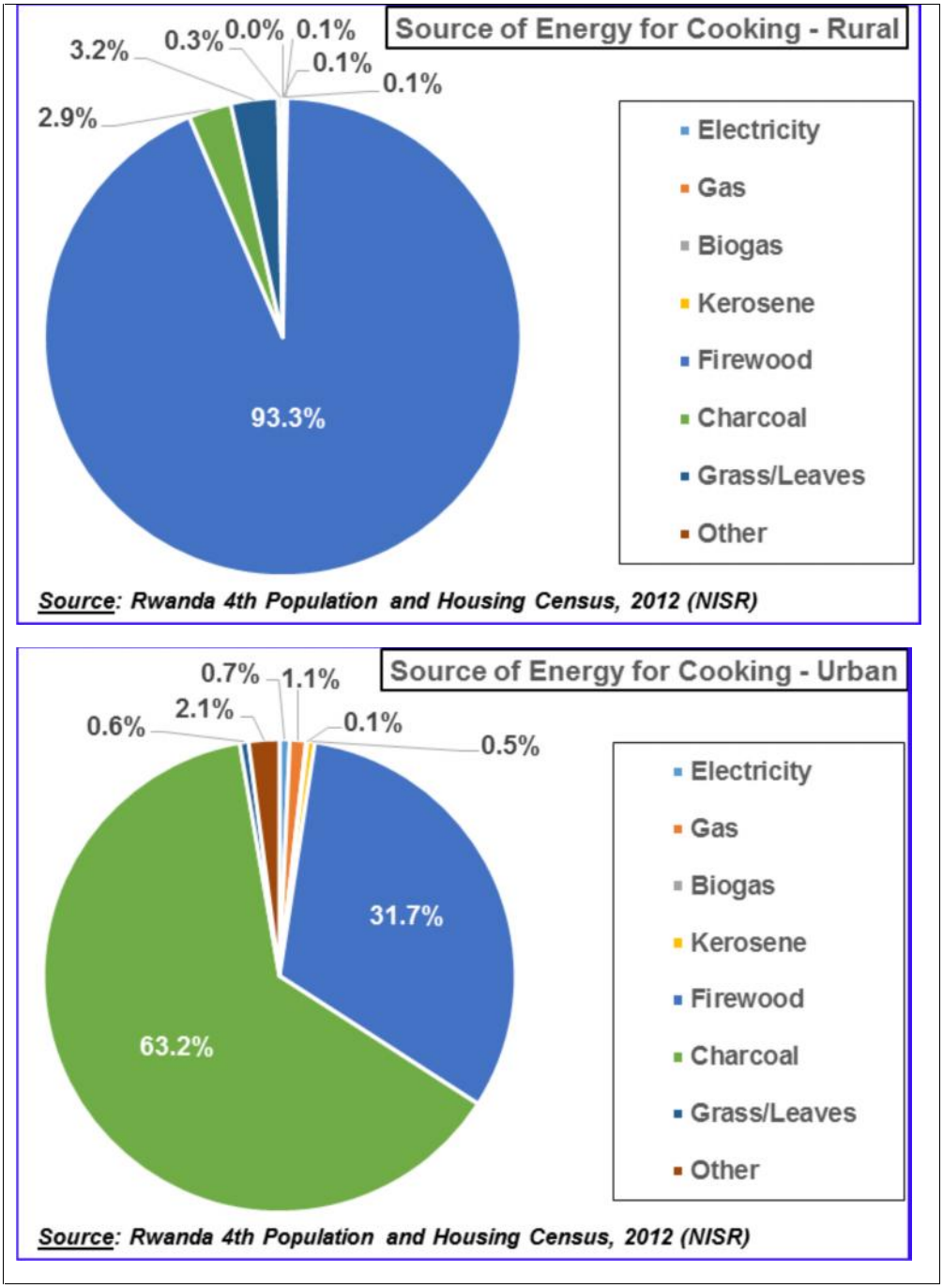


Figure 5.16: Main source of energy for cooking in rural and urban area

At the Province level, the percentage of private households using firewood for cooking is higher in all provinces of the country with proportions varying between 88% (in the Northern Province) and 92% (in the Southern Province). It reaches its lowest level in Kigali City (27%). The percentage of the private households using charcoal for cooking is higher in Kigali City (67%) than in the other Provinces where it varies between 5% (in the Southern, Northern and Eastern Provinces) and 8% (in the Western Province). There are significant percentage of private households using grass/leaves for cooking, especially in the Districts of Burera (13%), Gicumbi and Gatsibo (6% respectively) and Rulindo (5%).

The main sources of energy used by the private households for cooking vary by area of residence. In urban areas, private households use more charcoal (63%) and firewood (32%). In rural areas, households use mainly firewood (93%) for cooking.

At the national level, one third of the households (34%) have and use energy-saving stove. Possession and use of energy-saving stove is much more common in rural areas (37%) than in urban areas (19%).

Male-headed households use slightly more energy-saving stoves than female-headed ones (35% vs. 32%).

Use of energy-saving stove varies a lot by Province; from 10% of the households in Kigali City to 42 in the West. The percentage is similar in the three remaining Provinces (33% to 37%).

Within the Provinces, the use of energy-saving stove varies a lot by area of residence and slightly by the sex of the household head as at the national level.

The variation by District is linked to the level of urbanization of the Districts; the less urbanized the Districts are, the higher is the percentage of their households using energy-saving stoves.

TRENDS

- ✓ According to the latest Integrated Household Living Conditions Survey, EICV3 report, the proportion of Rwandan households using surface water (rivers or lakes) as drinking water has decreased from 18% to 12% over last five years. Rural households can now reach an improved water source more quickly than they could five years ago. However, EICV3 also stressed that even though significant progress has been made, there is a clear trend that fewer households receive their water for free when compared to five years earlier.
- ✓ The overall cost of abstracting, cleaning and delivering clean water to the population is increasing, raising concerns for future access especially by the poor.
- ✓ Rwanda is accelerating efforts to further improve access to safe water and basic sanitation. Rwanda's target is to provide safe drinking water to 100% of its population by the year 2017.

- ✓ Firewood is still the fuel used for cooking by the vast majority of the rural population (93%). In the cities, charcoal is used by 63.2% of households, followed by firewood (31.7%). While rural households have not changed the fuels they use for cooking in the last five years, a slow trend can be observed in the cities away from firewood and toward charcoal.
- ✓ The percentage of households connected to electricity has increased substantially over the last five years, especially in the cities (23% to 46%). Green' energy sources such as solar power or biogas play a negligible role in household energy use in Rwanda.

- ✓ Private ownership of motorised vehicles is another source of demand for fuels, but this is still very low in Rwanda. Commercial/industrial use of fuels constitutes a further source of energy demand, and this will increase in the coming years.

5.12. Education

5.12.1. Highest level of education

Results from the RPHC4 show that about 57% of the resident population aged three and above, had attended primary school, 12% had attended either post-primary or secondary school and about 2% had tertiary education. While about 26% of the resident population had never attended school, a comparison of the RPHC4 results with previous censuses indicates that the general picture of access to education is improving in Rwanda, in terms of expanding it as well as reducing disparities at the sub-national level, most notably gender disparities. The percentage of the population aged seven and above who had never attended school decreased from 61% in 1978 to 19% in 2012.

In the same period, the percentage of the population aged seven and above with higher levels of education (post-primary, secondary and university) also increased from about 3% in 1978 to about 16%.

The gender gap has been diminishing consistently. For instance, among those with no education, the gender gap stood at 17% (70% among females and 53% among males) in 1978 as compared to just 7% (22% among females and 15% among males) in 2012. Similarly, among those who had attended primary school, the gender gap stood, in 1978, at 17% (45% among males and 28% among females) compared to just 4 % (66% among males and 62% among females) in 2012.

5.12.2. Current school attendance

Across all of Rwanda, a total of 3.42 million people aged three and above were attending school. This represents about 36% of the resident population aged three and above, estimated at 9.62 million. Among this population, 1.72 million were females.

About 4.36 million people of the resident population are between three and 18 years of age, the official age range to attend school (from pre-school to the secondary level). This represents about 45% of the resident population aged three and above.
About 29% of the 1.28 million children aged between three and six was attending a pre-school programme. Pre-school attendance is more common in urban areas (about 44%) than in rural areas (about 28%) with the chances of receiving such service increasing almost two-fold from rural to urban areas.

About 93% of the 1.71 million people aged between seven and 12, the official age for primary school, was, at the time of the Census, attending school. The data also show that for this population, both urban/rural and male/female disparities are virtually non-existent.

About 74% of the 1.37 million people aged between 13 and 18, eligible to attend secondary school, was attending school at the time of the 2012 Census. About one out of every four children aged 13–18 has attended school at some point but no longer attending for some reason. While No longer attending cases were also observed among the primary school-age population, this proportion is by far more significant (about 20 times higher) for the secondary school-age population.

The Net Attendance Rate (NAR) in primary school is 88% at the national level. This is slightly higher in urban areas (about 91%) than in rural areas (about 88%) and among females (about 89%) than among males (about 87%). The Gender Parity Index (GPI), a measure of gender disparity, is close to 1, revealing that boys and girls have equitable access to primary school. The Gross Attendance Rate (GAR), at about 139, exceeds 100, revealing that the population under seven or over 12 currently attending primary school represents about 51% of the primary school-age population.

The NAR in secondary school is 22% at the national level. However, when areas of residence are considered, this doubles (two out of five) in urban areas. The GPI for urban areas of 1.01 shows that males and females have equal access to secondary school but this is not the case in rural areas. The GPI for rural areas, at 1.24, shows a 25-fold gap between males and females. The GAR in secondary school is 42%.

The School Life Expectancy (SLE), a composite measure that indicates the total number of years of school a person of a given age can expect to have in the future, is 11. This indicates that an average seven-year-old child starting school at this point in time is expected to stay for about 11 years in the education system.

5.12.3. Literacy

About 68% of the population aged 15 and above is able to read, write and understand in at least one language. About 49% is literate in Kinyarwanda only. 7% of this population is literate in both Kinyarwanda and English while about 6% is literate in Kinyarwanda, English and French. Overall, adult literacy rates are higher among urban residents (about 82% in urban areas versus 65% in rural areas) as well as among males (about 72% among males versus 65% among females).

6 Current and expected effects of climate change on the energy sector

6.1. Climatic Trends and Variability

Rwanda coordinates indicate that this country is entirely situated in the equatorial zone. Its higher altitude between 900 and 4,500 m above sea level moderates its temperatures and accounts for its temperate climate in classification.

An analysis of the total monthly and annual rainfall at Kigali Airport station for the period from 1961 to 1990 shows a clear downward trend as compared to previous years. The annual total average of rainfall which was of 1040 mm in 1961 has decreased to 960 mm in 2006. This means a decrease of 80 mm during the past 46 years.

Indeed, the monthly and annual total rainfalls recorded during the last six years are generally lower than the average of 1961 to 1990. Particularly, April, the month with the highest rainfalls has been recorded as having the rainfall equivalent to 27%, 48%, 88%, 70% and 52% respectively in 2000, 2001, 2002, 2003 and 2005.

It should be mentioned, however, that the months of July, September, November and December have had higher rainfalls than normal with the percentages respectively of 1441% (in 2001), 189% (in 2003), 165% (in 2006) and 153% (in 2006). It can be noted that these excessive rainfalls are not equally distributed across months; they may take place in less than four days and sometimes in one day and are therefore followed by floods and landslides.

The analysis of the average annual temperatures of Kigali Airport Station (1971-2007) and of Kamembe (south-West of Rwanda) shows a clear increasing tendency in rainfalls and temperatures (Figure-1). In fact, it can be observed in the case of Kigali Airport for instance that the average value was 19.8°C in 1971 and 21.0°C in 2009. This reveals an increase of 1.2°C in 39 years.

This temperature increase of 1.2°C in 39 years is remarkable in as much as it exceeds the one caused by global warming estimated at 0.8°C in 150 years. A similar situation is equally noticed at Kamembe Airport station. This seems to confirm the findings of the fourth IPCC report (IPCC, 4th Assessment Report, WG I, Ch.11: Regional projections; J.H. Christensen et al.) according to which the warming of the African continent could exceed that of the global warming of the planet.

In brief, recent testimony on climate change in Rwanda indicates that:

- Temperature increased with high frequency of warm days exceeding 30°C; this is likely to impact on increase of malaria and other diseases related to warm weather;
- The number of annual rain days decreased and this is likely to impact negatively on agricultural productivity as crops requires the quantity of water within the given number of days;
- At the same time the frequency of torrential rain increased with daily rainfall quantity sometimes exceeding the average monthly rainfall; this is natural disasters causing floods including soil erosion;
- The number of dry spells during rainy season increased affecting poor performance of crops;
- In most cases we are observing late onset of rainfall and/or early rainfall cessation during rainy season and this also affect poor performance of agriculture productivity.

6.2. Temperatures and precipitations projection

According to climate scenarios A1F1, A2, B1 and B2 the temperature is expected to increase gradually in Rwanda during the 21st century (Ruosteenoja et al., 2003) The increase

expected is from 0.75 to 3.25°C during the shorter dry season (December to February) and from 1 to 3.25°C during the longer dry season (June-August).

Climate projections for Rwanda reveal a warmer climate with a likely increase in rainfall, though some of the models do project a decrease.

The median projections for precipitation are small (around 7% by the 2080s) compared to interannual variability. Projections for seasons show increases in rainfall for all seasons, with the larger changes projected for the two rainy seasons. However, the median changes are also found to be relatively small compared to interannual variability.

In brief, the analysis of projections for Rwanda's climate through the 21st century indicates a trend towards a warmer, wetter climate. Increases in mean temperature are projected under all models and all emissions scenarios, while the majority of models also indicate increases in annual rainfall totals, though a few show small reductions. The increases in rainfall are generally small relative to the interannual variability currently experienced in Rwanda.

Analysis of daily data for Butare specifically suggests an increase in the frequency of days that would be characterised as 'Hot' in the current climate. The projected changes to heavy rainfall events are less conclusive, with daily data for Butare showing little change for the 2050s or 2090s, while other published research using CMIP3 data has found increases in heavy rainfall for Rwanda. This reflects the uncertainty in projections for heavy rainfall in climate models (*Smith School of Enterprise and the Environment, University of Oxford, 2011 Rwanda's Climate: Observations and Projections)*

Table 6.1 summarizes climate impacts and consequences that the country has experienced (NAPA Report, 2006).

Table 6.1: Climate impacts in Rwanda (Source, NAPA Report, 2006)

Climate hazards	Vulnerable regions	Consequences on most affected sectors
Increase of temperature, prolonged droughts and high evapotranspiration	Swamp complexity of Akagera river Akagera Park Rugezi swamp	**Water resources**: • Low river flow and disturbance of hydraulic cycle • Low water level of lakes and rivers: • Drying u of water sources • Loss of aquatic ecosystems (hippopotamus deaths due to drying of Gabiro akagera valley in the Akagera National Park during la nina 1999-2000)
	Bioclimatic region of East and Southeast and some zones of central plateau (Umutara, Kibungo, Bugesera, Mayaga-Gitarama)	**Land Ecosystem and Agriculture:** • Decrease of banana production • Decrease in cereal and leguminous production, • Favorable conditions to parasites (caterpillar on sweet potatoes and beans, • Pastures without perpetual water or from irrigation become threatened and extinct
		Food security: • Fluctuation in the production, risk of food insecurity and favorable conditions to famine
	E.g. the 6 hydroelectric stations: Ntaruka, Mukungwa, Gihira and Gisenyi, Rusizi I and Rusizi II	**Hydroelectric and wood energy:** • Reduction of hydroelectricity production • Limited forest resources and exposed to direct and indirect drought effects (bush fire) • Low production of wood resources
Heavy rains, floods, frequent landslides	Riverside regions of Akagera, Akanyaru and Nyabarongo rivers	**Health:** • Proliferation of mosquitoes and diseases of water-borne origin, • Loss of animal and human lives
	High altitude regions of West, South-West, North, Centre and Congo Nil crater foothills (Budaha, Ndiza and Buberuka highlands)	**Agriculture:** • Erosion becomes an important factor for low agricultural production and food insecurity. • Crops destruction risks and high silting-up

Climate hazards	Vulnerable regions	Consequences on most affected sectors
	High mountainous region , Congo Nil crater regions, valleys and shallows	**Infrastructure:** • Destruction of anti-erosive systems, destruction of economic infrastructures (roads, bridges, schools, hospitals, etc,)
		Economy: • Reduction of production and GDP • Reduction of rural population revenue • Increase of foodstuff cost
	Hydroelectric stations: e.g. Ntaruka, Mukungwa, Gihira and Gisenyi, Rusizi I and Rusizi II	**Hydroelectricity:** • Low hydroelectricity production, which may affect all HP plants in the country
	Protected zones: National parks, cultivated lands, Affluents and swamps: Nyabarongo, Rugezi, Akagera and Mukungwa rivers	**Ecosystems:** • Problems related to water pollution and invasion of aquatic pollutant plants, • Loss of soil fertility by leaching of arable lands: increase of sediments on arable land at the outlets of slopes, • Local risk of landslides • Soil erosion and degradation, • River, lake and reservoir sedimentation

6.3. Expected effects of Climate change on the energy sector

Climate change may affect all energy sub-sector: biomass, hydropower, peat, petroleum, methane gas and agricultural, forest and urban wastes.

6.3.1. Biomass

Biomass energy will remain dominant for cooking, other household uses and small scale industries. In this regard it is imperative that forests and woodlots be more productively managed and charcoal more efficiently produced. Failure in this realm could result in accelerated deforestation as the demand for energy due to the increasing population.

Climate Change issues and vulnerability for biomass/fuel wood will include:

- Prolonged droughts may affect regeneration potentials and growth rates of some wood fuel species and also the planting of trees, thus affecting supply.
- Inefficient use and conversion promotes production of Green House Gases. Although the complete combustion of biomass produces little more than just CO_2 and water, charcoal making involves combustion of the biomass in circumstances of limited oxygen and this diverts substantial amounts of biomass carbon into products of incomplete combustion (PIC). PIC, which include CO, CH_4, HC, are more dangerous greenhouse gases compared to CO_2 because, once emitted, there are no known processes yet that can re-absorb them from the atmosphere.

6.3.2. Hydro Power Electricity

According to AfDB (2013), the hydropower potential is estimated at 313 MW (comprising 130 MW of domestic hydro and 183 MW of regional hydro resources) (the draft environment policy 2014 says 500 MW). Small and medium-size *domestic* hydropower could provide an additional 77.2 MW of potential capacity, but it presently provides about 39.7 MW of operational capacity in the following sites: Ntaruka, Mukungwa, Gihira, Gisenyi, Rukarara and Nyabarongo. Mini/ micro hydro provides 4.5 MW of operational capacity, and, although scattered across many locations, mini/micro hydro could provide an additional 8 MW of potential capacity.

Climate Change issues and vulnerability may be described as follow:

- Between the years 2004 and 2005, prolonged droughts, a result of Climate Change, reduced the water levels significantly both in the rivers and the Lakes. This affected power generation forcing states in the Lake Victoria Basin to increase thermal electricity generation, with its accompanying negative environment effects and high cost per unit, to meet the electricity needs. Hydropower generation, the dominant modern energy source in the country, is likely to be the most directly affected by Climate Change because; it is sensitive to the amount, timing and geographical pattern of precipitation and temperature. However, changes in precipitation are difficult to project at the regional scale, which means that Climate Change will affect hydropower either positively or negatively, depending on the region (UNEP, Undated and Kull, 2006). Without alternative means of environmentally clean modern energy provision, thermal power generation is likely to increase in the region and thus aggravate Climate Change effects.
- Climate Change also is likely to affect the infrastructure for electricity generation, transmission and distribution. The transmission systems of electric utilities may experience a higher rate of failure, with attendant costs. This phenomenon, could affect energy security and economic development activities. It is important therefore, that planning and implementation of sustainable development programmes in the country integrates energy adaptation measures to Climate Change.

6.3.3. Peat

Rwanda disposes of high burning power peat reserves estimated at 13.5 billion cubic meters cubic meters. The biggest reserve sites are located at Gishoma (western region), with an estimated reserve of 10 billion cubic meters, and at Akanyaru (southern province), disposing of approximately 1.5 billion cubic meters.

According IPC (Intergovernmental Panel on Climate Change, peat is considered to be a fuel in its own class, residing between fossil fuels and biofuels. Peat Combustion is associated with a carbon dioxide emission factor of 106 g CO_2 /MJ.

Drought causes peat to release far more carbon dioxide into the atmosphere than has previously been realised. Increased frequency and severity of drought as a result of climate change may lead to the peat drying out and releasing vast stores of carbon dioxide (CO_2) into the atmosphere. As well as contributing further to climate change, as CO_2 is one of the 'greenhouse gasses', the loss of carbon from the peat has other consequences. Dissolved organic carbon in the water as a result of this process, could adversely affect the quality of drinking water. The increase of dissolved organic carbon in the water is likely to bring extra problems and expense to the water supply industry because it interferes with the treatment process.

6.3.4. Petroleum

Rwanda's policy on Petroleum has two main elements – an upstream component, currently concerned with exploration for possible petroleum resources, and a downstream component that relates to the importation of refined products.

The consumption of petroleum products (all imported), is clearly increasing with the rising number of vehicles, particularly since 2005, the year when electricity began to be produced from thermal power plants. However, the transport sector remains the main fuel consumer.

A key sub policy of the energy policy for the management of the petroleum sector that is relevant to addressing Climate Change adaptation and vulnerability, is sub policy number three; "***Enhance environmental protection, health and safety by establishing adequate standards and ensuring that these are adhered to".*** These should include mitigation measures like establishing carbon sinks (Tree planting) and adaptation measures like efficient utilisation technologies and alternative renewable fuels (Bio energy).

6.3.5. Methane Gas

The Rwanda Development Board (RDB) estimated the methane Gas reserves to be about 55 billion m^3 of usable methane gas found at the bottom of Lake Kivu, at a depth of 250 m. The feasibility of large scale methane gas exploitation from Lake Kivu is well established. The pilot plant built in 1963 has perfectly demonstrated the technical and commercial viability of gas exploitation from the lake.

Natural gas is of interest for climate change mitigation both for its potential role as a low-carbon substitute for other fossil fuels, and for the direct warming effect of un-combusted methane. As a fuel, natural gas is less carbon-intensive than liquid fuels and coal, and may offer low-cost, near-term opportunities for CO_2 abatement in many sectors. Steam reforming of natural gas is also the least-cost technology for production of hydrogen, which may one day be an important part of the energy system. However, un-combusted methane that escapes to the atmosphere is a potent greenhouse gas, having 25 times the global warming potential of an equivalent mass of CO_2.

Therefore, while using natural gas in place of alternative fuels may mitigate climate change, it can also make the problem worse if gas is released un-combusted to the atmosphere.

Inefficient use of natural gas aggravates Climate Change. Promoting efficient utilisation technologies and the planting of trees therefore is imperative for mitigating the effects of utilising fossil fuels. In addition promote the use of alternative renewable fuels like biogas.

6.3.6. Agricultural, Forest and Urban Wastes

In the rural areas, agro and forest waste form part of a significant source of energy. Agriculture crop residues include biomass materials, primarily stalks and leaves that are not harvested or removed from fields in commercial use.

Climate change may affect agricultural and forest production. This has a direct impact on the available waste for energy. Biogas production highly depends on water availability and therefore, changes in the water supply due to prolonged draughts or flooding, can affect biogas production in household biogas units.

Residential, commercial, and institutional post-consumer waste contains a significant proportion of plant-derived organic material that constitutes a renewable energy resource. Waste paper, cardboard, wood waste and yard waste are examples of biomass resources in urban waste. These wastes are dumped in designated areas. The garbage dumps in the urban areas are however major sources of CH_4 a worse GHG than CO_2. As a mitigation measure at the global level, and an adaptation measure at the household level, garbage dumps could be designed as landfills to capture the Landfill gas (CH_4) as an alternative energy source for domestic and industrial application.

7 Environment related risks, constraints and opportunities of Rwanda energy sector programme

Chapter 7 describes without classification the environmental and climate risks and opportunities from a broad perspective, including population and economic growth, physical impacts and exploitation of natural resources and impacts of climate change. In Chapter 8 and 9 the impacts are detailed, evaluated and classified in a systematic manner.

7.1. Population growth and over-exploitation of natural resources

The key environmental related effects of the population growth are land degradation, deforestation, wetland and biodiversity loss. About 40% of land is classified by FAO as high erosion risk with about 37% requiring soil retention measures before cultivation. Nutrients and eroded soil reach Lake Victoria primarily through River Kagera that accounts for 1/3 of the river inflow in the lake.

Rapidly growing urban areas are also creating problems of waste management, air and water pollution.

Another downstream effect is reduced potential for Rwandan hydropower generation due to siltation (reduced water storage) and lower water levels. This is an important effect of the Rwanda energy sector programme.

Key causes: Land scarcity, population pressure, poverty and lack of alternative livelihood options are main causes for unsustainable use of natural resources: Fallow periods have been drastically reduced and marginal lands, steep hills and wetlands have been encroached in search for agricultural lands and fuel wood.

Poorly planned urban settlements and massive urbanisation raise significant challenges for human wellbeing due to insufficient access to basic services for water, sanitation and waste.

Opportunities:
Improved management of natural resources are seen in key planning documents like Vision 2020 and the National Strategy for Green growth and climate resilience as a means to increase agricultural productivity, improve food security, reduce dependence on oil imports and adapt to climate change.

The potential for exploitation of renewable energy, not least from geothermal sources is significant. Efforts to reduce water and air pollution can also improve employability and reduce health expenditures. Eco tourism is highlighted as an opportunity to increase foreign investments and expansion of a sector that is expected to more than double up to 2020.

7.2. Assessment of the current official target on the country urbanization

The target in terms of urbanization in the Revised Vision 2020 is an urban population of 35% by 2020. Table 7.1 is a simulation of what would be the size of the urban population between 2012 and 2020 based on the Vision 2020 target.

According to **Table 7.1,** the size of the urban population in 2020 will be 2.5 times greater than its current size. It will increase from 1.7 million in 2012 to 4.4 million by 2020, regardless of the projection scenarios.
Such a rapid increase in a relatively short period of time means that huge investments in terms of infrastructure would be required to accommodate 2.7 million more urban dwellers, which would be hard to achieve.

Table 7.1: Urban population between 2012 and 2020 based on the Vision 2020 target

Projections year	High Scenario		Medium Scenario		Low Scenario		Urbanization rate (%)
	Total population	Urban population	Total population	Urban population	Total population	Urban population	
2012	10,482,641	1,732,175	10,482,641	1,732,175	10,482,641	1,732,175	16.5
2013	10,724,489	2,017,544	10,725,541	2,017,742	10,726,937	2,018,005	18.8
2014	10,969,957	2,317,403	10,973,254	2,318,100	10,977,519	2,319,001	21.1
2015	11,218,267	2,629,281	11,225,190	2,630,904	11,233,876	2,632,940	23.4
2016	11,468,792	2,953,214	11,480,788	2,956,303	11,495,533	2,960,100	25.8
2017	11,720,998	3,289,205	11,739,594	3,294,424	11,762,121	3,300,745	28.1
2018	11,974,372	3,637,215	12,001,136	3,645,345	12,033,251	3,655,100	30.4
2019	12,228,393	3,997,156	12,264,898	4,009,088	12,308,488	4,023,337	32.7
2020	12,482,323	4,368,813	12,530,458	4,385,660	12,587,498	4,405,624	35.0
% increase between 2012 and 2020	19.1	152.2	19.5	153.2	20.1	154.3	

7.1.1 Environmental impacts of Rwandan Urbanisation and Human settlements and sustainable energy use in urban centres

The impact of humans on environmental degradation can be mitigated by modern technologies, but equally so by simple behavioral patterns such as the proper treatment of waste or use of sustainable fuels.

Traditionally, rural habitat in Rwanda has been made up of scattered and isolated dwellings. Such settlements make it difficult to develop accessible rural infrastructure and provide basic services for sustainable use of natural resources especially energy resources. In addition, recent years have seen the emergence of unplanned residential areas in urban centres, which mostly display a strong lack of infrastructural planning. Furthermore, the aftermath of the genocide required interventions in human settlements including ad hoc construction of camps or temporary housing schemes.
All these factors complicate the development of environmentally sustainable forms of human settlement. One example is the fact that Kigali has no system of sewers or a central treatment facility for sewage. Likewise, rubbish collection services reach less than half of urban households.

However, the data show a clear trend away from the traditional isolated habitat towards *Imidugudu* or other clustered forms of habitat, which is in line with national policy. **Figure 7.1** shows that the proportion of households living in isolated rural dwellings has decreased strongly between 2005/06 and 2010/11.

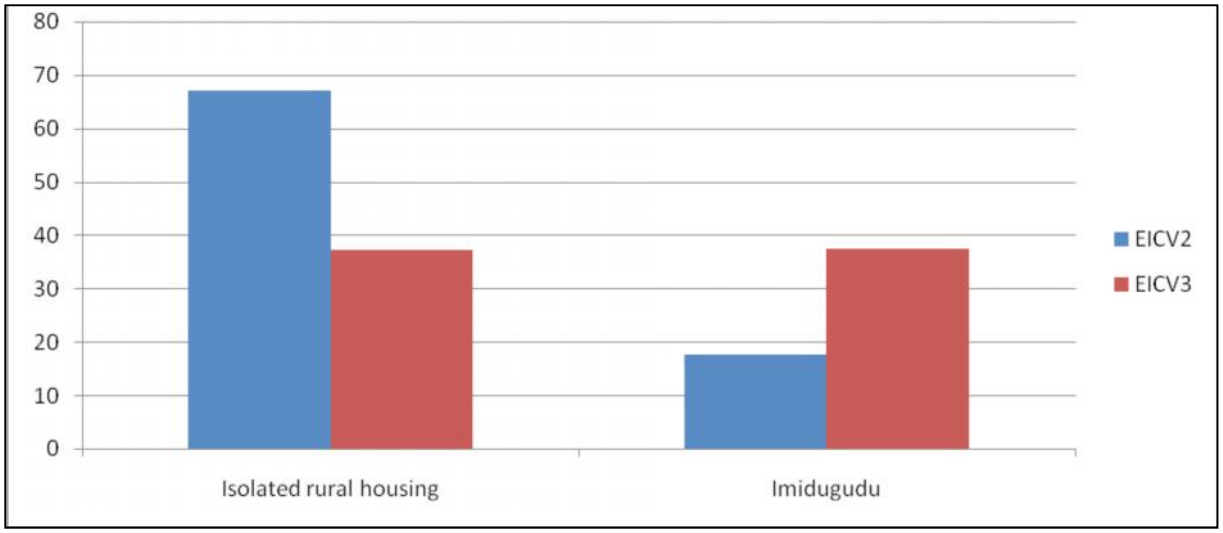


Figure 7.1 Change in specific habitat types

Sustainable energy use

The use of energy is essential in urban centres for transportation, industrial production, and household and office activities. Current dependence in most urban centres on non-renewable energy sources can lead to climate change, air pollution and consequent environmental and human health problems, and may represent a serious threat to sustainable development. Sustainable energy production and use can be enhanced by encouraging energy efficiency, by such means as pricing policies, fuel switching, alternative energy, mass transit and public awareness. Human settlements and energy policies should be actively coordinated.

Possible Actions
In order to promote efficient and sustainable energy use, Government at the appropriate levels, in partnership with the private sector, non-governmental organizations, community-based organizations and consumer groups, should, as appropriate:

a. Promote urban and rural planning and design solutions that are conducive to the efficient use of energy and that pay due attention to end users and their attitudes and practices;
b. Introduce appropriate measures to promote the use of renewable and safe sources of energy and to improve the efficiency of energy use in human settlements, while ensuring that people living in poverty and their families are not disadvantaged;
c. Promote energy-efficient systems, for example, by introducing or supporting innovative energy-efficient measures in the generation, distribution and use of energy, such as combined heating and cooling systems that utilize waste heat recovery, and co-generation of heating and electricity;
d. Encourage research, development and use of non-motorized or low-energy transport systems and the use of renewable energy sources and technologies, such as solar, wind and biomass energy.

7.3. Hydrological effects from peat harvesting and large water storages (dams) construction

Potential hydrological effects of peat harvesting include alteration or disruption of surface water flow patterns and changes in groundwater elevations. Effluents produced from the drainage of the wetland will often contain a high level of suspended solids.

Dams constructed in the upper reaches of a river system is used to regulate the flow downstream for the benefit of downstream users. If not properly designed the dams may pose a risk for accidental releases of storm and flood water, and dam failures.

7.5 Other Physical Impacts

All development projects including the energy sector will generate a physical environmental impact, which is obvious for all generation projects in the biomass, petroleum, peat, hydropower, solar and also electricity transmission subsectors.

All such projects will increase environmental pollution load to a great extent; change in the view of landscape and in biodiversity; as well as social implications including land acquisition and expropriation.

7.6. Occupational Health & Safety Risks

There will be occupational health and safety risks from the implementation of Rwanda energy sector plan and their significance will depend on the nature and type of activity under the ESSP.

7.7. Climate Change and Variability

The energy sector is vulnerable to changes in climate in a variety of ways. The effects largely impact the energy infrastructure, particularly through extreme events such as floods and droughts.

The flood events can affect thermal power stations in particular placed near to rivers in order to use the water for cooling. Extreme events can also effect the transportation of fuel to the thermal power stations. Likewise, hydroelectric plants are sensitive to flooding and the design criteria for dams and hydropower stations need to be revisited. Reduced precipitation and extended droughts will have a direct impact on the hydropower generation capacity.

Given the current high level of hydropower in the electricity generation mix, the sector is vulnerable to the negative effects of future changes in rainfall and river flow patterns resulting from climate change.

Although these changes are at present not yet determined, Rwanda already experiences hydrological variability which results in periodic floods and droughts. These can affect the ability of hydropower stations to work at full capacity. In addition, the growing population is likely to require larger amounts of water, and future land use patterns are likely to have an impact on hydropower potential.

Around 45% of the electricity generation mix is from diesel or heavy fuel oil generators. 100% of the diesel and heavy fuel oil is imported. This dependence on imported diesel and heavy fuel oil ties electricity generation and the Rwandan economy to the price of oil. This is undesirable given the volatility and increasing price of the commodity.

Furthermore, the high price of oil means that electricity generated is very costly and must be subsidised by the government in order to make it accessible to consumers. An additional factor related to the dependence on imported diesel and heavy fuel oil in the energy mix is the effect that this has upon Rwanda’s trade deficit.

Due to the importance of electricity and other uses of petroleum, i.e. transport, for the Rwandan economy and its development imported diesel and heavy fuel oil have a priority call on foreign currency. An increasing dependence on imported energy will limit the availability of foreign currency for the rest of the economy. In addition, when oil price spikes occur, the amount of foreign currency needed to sustain levels of oil imports will increase dramatically impacting on other sectors of the economy. Developing energy from indigenous sources of primary energy can reduce the foreign reserve requirements of the energy sector however if equipment, spare parts and technical input are required from foreign sources there will still be some demand for the foreign exchange reserve.

7.8. Identification and evaluation of impacts in terms of vulnerability to climate risks

For the energy sector, the identification and evaluation of impacts in terms of vulnerability to climatic risks have be done by trying to respond to the following questions for each energy sub-sectors; Petroleum, Biomass, Hydropower and Peat.

1. How has Climate Change affected the energy sector in Rwanda?

2. What are the major Climate Change issues and concerns in the energy sector?

3. What are the specific issues for mitigation and adaptation?

4. What are the potential barriers to Climate Change adaptation and mitigation?

5. What are the likely trends?

Table 7.2 gives a summary of climate change/vulnerability issues and proposed adaptation and mitigation measures

Table 7.2: Summary of Climate Change/Vulnerability Issues and Adaptation and Mitigation Measures

Energy sub-sector	Climate Change Impacts and Vulnerability Issues	Potential Adaptation Measures	Potential Mitigation Measures
Hydro Power	• Prolonged droughts, which were a result of Climate Change, reduced the water levels significantly both in the rivers and the Lakes. This affected power generation forcing the government to increase thermal electricity generation, with its accompanying negative environment effects and high cost per unit of power. • Climate Change also is likely to affect infrastructure for energy production, transmission and distribution. The transmission systems of electric utilities may experience a higher rate of failure, with connected costs. This phenomenon, will greatly affect energy security and economic development activities.	• Restoration and sustainable management of watersheds, • Integrate Climate Change considerations into the design, management and operation of Rwanda's hydroelectric power plants; • Promote the integration of vulnerability and adaptation to Climate Change into energy and sustainable development plans and processes in Rwanda. • Develop and promote environmentally friendly alternative energy sources like Biomass gasification technologies for power generation and solar power for lighting and refrigeration. • Replacing incandescent bulbs with low energy consumption • Set and enforce design standards for the hydro power infrastructure to cater for the effects of climate change and variability.	• Promote efficient practices in the utilisation of hydropower • Promote tree planting activities, • Optimise the utilisation of naturally generated Methane for energy through biogas technology
Biomass	• Prolonged droughts may affect regeneration potentials and growth rates of some wood fuel species and may also affect the planting of trees, thus affecting supply, • Fuel wood products will be more expensive	• Efficient conversion technologies like improved charcoal production kilns and retorts, • Biomass gasification technologies for heat and power production, • Improving biomass fuel management and utilisation practices e.g. improved cook stoves	• Promote profitable Tree planting for fuel wood production • Set standards for Biomass energy production and sales to facilitate monitoring and enforcement of sustainable practices. • Set standards and conditions for land use.

Energy sub-sector	Climate Change Impacts and Vulnerability Issues	Potential Adaptation Measures	Potential Mitigation Measures
Peat	• When peat-lands are drained and developed, they stop absorbing carbon dioxide, • Also, the emissions of methane, which is a worse gas than CO_2 in causing Climate Change, ceases. • When peat is harvested and used as a fuel the stored carbon is released back into the atmosphere as carbon dioxide.	• Set standards and conditions for land use, discharges and emissions.	• In the post production phase, the cutaway peat-lands can be reclaimed for forestry, or restored to wetlands, and once again become carbon sinks. • Promote efficient peat energy utilisation technologies like gasification technologies
Petroleum	• Unreliability of fuel supplies due to affected roads as a result of climate related disruptions.	• Efficient utilisation technologies • Application of affordable alternative renewable fuels (Bio-energy) • Construction of storage facilities • Store fuel according to its origin of import or according to the quality required by Rwanda Bureau of Standards and Rwanda Environment Management Authority	• Set and enforce a strict code of standards for procurement and storage • Establishing carbon sinks (Tree planting) • Develop and or improve distribution infrastructure
Natural Gas	• Unreliability of fuel supplies due to affected roads as a result of climate related disruptions.	• Promoting efficient conversion and utilisation technologies • Promotion of alternative renewable fuels like biogas	• Promotion of tree planting

8 Impact identification, evaluation and analysis of alternatives of the NEP

The assessment of the NEP 3.8 and the ESSP, version Sept.16, 2014 has been made according to different methods, comparing the two documents' earlier versions, and the latest version with established SEA objectives in evaluation matrices as presented below

8.1 Impact Assessment of the NEP 3.8, Proposed Mitigation Measures with Indicators, and Recommendations

The *environmental* [69] impact assessment on the National Energy Policy (NEP) comprised three main exercises: 1. *General impact assessment;* 2. *Preliminary SEA impact assessment* (June 18, 2014); and 3. *Compatibility analysis*. [70] These methods are standard evaluation tools for SEA of policy and planning documents.

The text below summarizes the findings of the three analyses. There is some overlap in the results of the analyses, but **Table 8.2** summarizes and consolidates all the potential impacts and mitigation & optimizing measures stemming from the three analyses, relevant to the NEP.

N.B. The analyses in this section are on the NEP (ONLY). Some aspects that are further treated or actually well mitigated in the ESSP are not 'visible' in this assessment. However, after integrating the ESSP assessment the recommendations are valid for both documents.

8.1.1 General Impact Assessment

The EC has an energy-sector script [71], which highlights that climate change may affect energy supply through a range of biophysical and socio-economic impacts. The predominant effects / impacts are:

- Change in temperature, rainfall, and/or cloud-cover pattern;
- Increase in extreme weather events / natural disasters (e.g., droughts, floods, storms, fires, and landslides);
- Change in hydrological flows (e.g., irregular and overall reduced water flows);
- Reduced availability of energy / reduced capacity to transform primary sources into useable energy (e.g., through damage to infrastructure; irregular stream flows that limit ability to generate hydropower; decreased availability of water for the thermal-plant cooling towers);
- Damage to transmission and distribution infrastructure;
- Increased power transmission losses (because of higher ambient temperatures);
- Disruption to the energy-transport infrastructure (e.g., road or pipeline damage);
- Reduced yields of energy crops, including the yield from fuelwood plantations;
- Reduced or enhanced solar power production (depending on cloud cover pattern).

Altogether, the biophysical and socio-economic could result in economic and social disruption (e.g., loss of livelihoods), increased probability and intensity of conflicts, and possibly some human migration. Given the above, the sector script emphasizes that a country's energy mix should be guided by technological, economic, as well as strategic considerations.

[69] *Note that when the term 'environment' is used, it refers to the broad definition of environment, which comprises the biological, physical, climate, and socio-cultural (including gender) components.*

[70] Louise Grenier completed the three NEP analyses, the NEP mitigation and optimizing table, and the NEP recommendations.

[71] *EC Cooperation: Responding to Climate Change, Sector Script for Energy Supply (version for EC internal use, July 2009).*

8.1.2 Preliminary SEA Impact Assessment (June 18 inputs)

As previously mentioned, a stakeholder consultation workshop / SEA scoping workshop was held on June 10, 2014 on NEP 2.5. Subsequent to that meeting, the SEA consultant (as well as a number of other stakeholders) submitted post-consultation-workshop comments on NEP 2.5.

To development most of the comments on the NEP 2.5, the Consultant first conducted a compatibility analysis of the 55 policy statements/objectives of ESSP (2012) [72] against the 42 objectives/statements from the 2003 Environmental Policy. With this core compatibility assessment, the text of NEP 2.5 (especially the 50+ specific policy statements) was subsequently subjected to a detailed content analysis. **Technical Annex 1** provides the list of the 2003 Environmental Policy Statements [73] that were used in the compatibility assessment, a full record of the comments submitted June 18 on the NEP 2.5 policy statements, and the details related to how the preliminary SEA inputs seem to have influenced draft NEP 3.5/3.8.

Table 8.1 summarizes how the preliminary SEA inputs influenced NEP 3.8. Grey highlights specifically identify the additions that were made to NEP 3.5/3.8 that are related to the June SEA inputs. Table 8.1 only lists the NEP 3.8 policy statements with SEA-relevant changes. As well, various additional mitigations/recommendations relevant to NEP 3.8 are provided in ***bold italic yellow highlight,*** based on a further content analysis of the NEP 3.8 policy statements and NEP text.

As mentioned previously, **Table 8.2** summarizes and consolidates all the potential impacts and mitigation & optimizing measures stemming from the three analyses.

[72] The ESSP, rather than the NEP, was used as the basis of this compatibility assessment because the ESSP is the document that was available for most of the scoping period. The first version of the NEP was received May 23, 2014. As the content of the NEP and ESSP is very similar, this is considered adequate and relevant.

[73] Technical Annex 1 ***does not*** provide the compatibility matrix between the ESSP and the 2003 Environmental Policy, as this is a very large unwieldy matrix that ***cannot*** be converted into a reader-friendly format.

Table 8.1: Possible Influence of the June 18 SEA Inputs on NEP 3.5/3.8

NEP 3.8 statement	Changes related to the June 18 SEA inputs
General Policy Principles and Priorities	
1) Promote integrated planning and streamline sector governance	Draft 3.5/3.8 combines 'integrated planning' and 'sector governance'. The text in this section addresses the issue raised in the June 18 SEA inputs regarding the need to address *water sharing arrangements* and *sustainable transport* issues within the energy sector. With regards to *sustainable transport*, draft 3.5/3.8 (in a footnote) now provides the example that one way to boost intra-sectoral planning would be to ensure fleet management and procurement strategies conform to policies on fuel importation and subsidy removal; it also *now* states that the Bugesera Airport should have more environmental measures (e.g., enhanced jet fuel storage infrastructure and clean on-site power, such as solar pv). ***Although the explicit addition of sustainable transport into Draft 3.8 is a good start, there should be a lot more energy-policy attention on sustainable transport issues.***
2) Mainstream gender-based equity, environmental sustainability, and climate concerns into energy planning and sector strategies	Draft 3.5/3.8 integrates into this part of the text the June 18 SEA inputs about integrating environmental criteria into the guidelines for the *siting of energy installations*; 3.5/3.8 also integrates *'transitioning from traditional biomass to biogas, LPG, and* ***modern biomass solutions***. Perhaps also due in part to the June 18 inputs, the text now mentions *the need to design energy sector micro-finance mechanisms that better reflect the financial means of women*.
3) Boost national ownership of the vision and build decentralized implementation capacity	Note that the need to develop the *environmental* management capacity at decentralized level was specifically highlighted in the June 18 SEA inputs, ***but has yet to be integrated into a policy statement***.
4) Promote value-for-money and increased market competition in energy development	The text in this section integrates the June 18 SEA inputs on ensuring that *competitive procurement should not override good environmental stewardship.*
5) Transition away from indiscriminate subsidies toward 'smart' subsidies aligned to social protection principles	It should be noted that the ***environmental impacts of subsidies (even 'smart' subsidies) should also be assessed:*** the text in this section of the policy only focuses on the need to assess the cost-effectiveness and socio-economic impacts of subsidies.
Policies on Promoting Private Sector Participation	
1) Streamline investment promotion processes for IPPs	The June 18 SEA inputs highlighted the need to balance technological solutions with solutions that also address social and quality of life issues, *and that streamlining private sector participation had to be tempered with Corporate Social Responsibility, and an ethic of safeguarding the environment.* ***CSR should be better integrated into the energy policy.***
Cross-cutting Energy Policies	
1) Enhance human, organizational and institutional capacity	*The need to develop the environmental management capacity of the private sector* was specifically highlighted in the June 18 SEA inputs, ***but the policy does not yet address that aspect.***
2) Promote and accelerate regional energy sector integration	***Care will need to be taken to ensure that accelerating regional energy sector integration does not compromise Rwanda's environmental quality standards in any way.***
3) Improve energy data collection and statistics	***This information system should also provide all EIAs (not only resource assessments and feasibility studies as mentioned in NEP 3.8).***
5) (Support) Research, development, and technological innovation	*As Rwanda is a small country, the choice of what to research should be very strategic, so that resources are not spread too thinly; research topics should include energy-and-environment topics, as highlighted in the June 18 comments.*
6) (Improve) Energy security and disaster mitigation	***Good environmental management should be explicitly mentioned as being a component of energy security, disaster prevention, & disaster mitigation.***
Energy Policy Principles for Energy Sub-sectors	
Electricity Sub-sector Policy Objectives	
2) Meet projected demand expected to exceed 400 MW by the end of 2018 by diversifying resources over time and increasing	***At the level of policy statement, 'renewable energy' (a focus of draft 2.5) is now more generally referred to as 'clean' power. 'Clean' power should be defined with transparent criteria, and the definition can be routinely updated, as technology improves.***

the share of clean power generation in the total generation mix over time	
Additional Policy Objectives for Electricity sub-sector	
4) Optimize the power mix to reduce long-run cost of service, diversify energy generation technologies, and gradually reduce the carbon-intensity of the grid	Draft 3.5/3.8 is more guided by the concept of 'optimization' and a *least cost* principle*;* it says that a ***balance*** shall be struck between more affordable electricity, energy security, and reducing the carbon-intensity or pollution attributed to the sub-sector. ***N.B. Without explicit attention to environmental management / carbon intensity, it is likely that 'environment' will lose out in this 'balancing' process.*** Draft 3.5/3.8 says that peat exploitation requires caution; a peat energy strategy and action plan is being developed in line with the general energy policy principles. It is stated that bog drainage and peat harvesting activities will have ESIA. ***The 'peat energy strategy and action plan' (which was in theory to integrate environmental aspects) should be assessed to review the extent to which environmental aspects have been integrated. It could be that an SEA may be relevant to address the sustainability of the bog/swamp habitat in Rwanda as a whole, especially given that 'peat' projects seem to be on a fast track. Such an SEA would help avoid irreversible environmental damage to the country's bog habitat ecosystem.***
6) Facilitate autonomous power generation through updated policy guidelines, streamlined licensing, and regulatory reforms	This section emphasizes that the ***simplified licensing*** regulations for mini-grids and small-scale power distributors will be extended to autonomous generation activities (to stimulate investments in autonomous generation, especially for mining and agro-industries). ***Care will be needed to ensure that 'simplified' licensing does not lead to less environmental management.***
Rural / Electricity Access Sub-sector	
4) Introduce greater competition and flexibility in off-grid service provision	The text here focuses on simplifying the licensing requirements for small-scale power distributors and on balancing minimum *technical and safety standards* with realistic and cost-appropriate standards to incentivize private actors to invest (this should also cover the licensing frameworks for cross-border interconnections). ***EIA is still required under the simplified requirements, but the capacity to conduct a high-quality EIA at decentralized level should be assessed, and strengthened where needed.***
Energy Efficiency and Demand-Side Management Sub-sector	
1) Adopt new laws, regulations, and codes that mandate energy efficiency measures	This section integrates the June 18 SEA inputs on *integrating sustainable transport into the energy policy*. The text specifically explains that *spatial planning of cities/towns can contribute to the reduction of liquid transport fuels by promoting more fluid circulation routes and pedestrian or bicycle friendly zones.* ***Sustainable transport should be further developed in the energy policy.***
4) Encourage and incentivize energy audits among commercial and industrial end-users	***Energy audits should also be encouraged and incentivized within all government ministries, activities, and buildings.***
Biomass Sub-sector Policy	
The revised policy objective for the biomass sub-sector is to facilitate fuel switching from traditional biomass energy carriers ***towards modern biomass energy technologies*** and cleaner fuel alternatives in order to reduce non-renewable fuel wood consumption and related social, health, and environmental costs.	Draft 2.5 focused on transitioning consumption away from traditional biomass carriers to biogas and LGP for cooking. The June 18 SEA inputs highlighted (as was the case of other stakeholders) the need to focus on switching from *traditional* to *modern* biomass carriers, to capture all the innovative modern biomass fuel options (e.g., various type of biomass pellets and biomass pyrolysis). The main focus of draft 3.8 however is still on LPG and biogas, but adding 'modern' biomass to the discussion allows for innovations such as biomass pellets***. Overall, the concept of 'modern' biomass could be further integrated into the next energy policy draft to enhance environmental benefits.***
2) Formalize charcoal production and supply to facilitate more effective regulatory control and	In addition to dwelling on improving charcoaling techniques, Draft 3.5/3.8 explicitly addresses the need to better enforce regulations to ensure that informal charcoaling, which can lead to illegal wood harvesting, is stopped.

mainstream improved harvesting and carbonization techniques	***N.B. Explicit social protection measures will be needed to protect the most vulnerable who currently engage in informal charcoaling as part of their livelihood strategy.***
3) Increase access to cleaner cooking technologies by promoting technology standards, introducing fiscal reforms, and piloting new market transformation activities	Although the 3.8 text in this section now more explicitly states that in the medium term, the vision is for extensive fuel switching to modern energy technologies and carriers, including biogas, LPG, green charcoal, ***and*** biomass pyrolysis stoves, ***there is no mention of a general charcoal exit (or charcoal reduction strategy) with explicit benchmarks and targets***.
Petroleum Sub-sector Policy	
1) Enhance the attractiveness of Rwanda as an investment destination for upstream oil and gas exploration and development: *d*. Develop a set of technical standards and environmental management protocols to ensure that activities do not compromise health, safety, or the environment	The June 18 SEA inputs highlighted the need to *address environmental standards, within 'technical' standards.*
2) Accelerate regional cooperation and strategic infrastructure development, including new refining, pipeline transportation, and railway infrastructure	***There should be a contingency plan if the oil and gas resources in Kenya, Uganda, and Tanzania are 'dirty' from an environmental perspective. Regional infrastructure (e.g., pipeline, rail) must also be built to high regional environmental standards.***
5) Improve data collection and enforce fuel quality standards through greater checks	Although this section covers quality of infrastructure and petroleum products, there isn't any information provided on the vehicle fuel quality standards. *The June 18 SEA inputs highlighted the need to adopt high (environmental) quality fuel standards*. ***The highest practicable environmental standards should be set for all petroleum imports, including fuels for the road sector and aviation sector.***

8.1.3 Compatibility Analysis of the NEP Objectives with the SEA Objectives

This analysis assesses the compatibility of the 55 NEP policy statements and the SEA objectives. **Technical Annex 2** shows the full matrix. The 55 policy statements are shown along the rows of the matrix, while the 7 SEA themes (biological, physical, climate, socio-cultural, energy, economic, and institutional objectives, covering the 24 SEA objectives) are in the column position. The Consultant systematically examined whether each of the 55 objectives was compatible with each of the 7 themes (55 x 7 = 385 interactions). To simplify the matrix presentation, if a policy objective was considered *compatible* with an SEA theme or when a policy objective had no significant interaction with an SEA theme, the cell was left blank. When there was some potential *incompatibility* between the policy statement and the SEA theme, descriptive comments were provided in the cell (i.e., potential for *incompatibility* means that without mitigation, it could be hard to achieve the policy statement without generating negative environmental impacts).

The results of the compatibility analysis are summarized below.

Findings

For the NEP statements under *vision and overarching policy goals,* the policies were generally considered compatible with the SEA objectives, but these concerns could arise during implementation:

- Power installations could be sited in environmentally sensitive areas and/or could demand a large land area coming into conflict with other land uses;
- Additional generation could be pursued before minimizing demand through energy efficiency and maintenance;
- The private sector may not have environmental awareness, capacity, or explicit budgets for environmental management;
- Some important energy-consuming sectors (including transportation, tourism, agriculture sectors) are not yet explicitly required to integrate *rational, efficient energy use* into their policy framework;
- A focus on 'competition' would tend to minimize costs, especially environmental management costs.

For the statements under *general policy principles and priorities,* the policies were generally considered compatible with the SEA objectives, with the following concerns:

- 'Streamlining' could lead to doing superficial environmental impact studies and could therefore lead to environmental damage;
- Competition would favour minimizing costs in general, and specifically would tend to minimize environmental management costs;
- Mainstreaming could make energy more expensive to produce
- There is likely no explicit implementation budget for mainstreaming;
- The capacity to mainstream environment at decentralized level is limited;
- Subsidies, including smart subsidies, would encourage careless energy consumption.

For the statements under *policy on promoting private sector participation,* the policies were generally considered compatible with the SEA objectives, with the following concerns:

- Streamlining investment processes and a focus on competition would decrease the attention to environmental objectives;
- Some investors could have little environmental awareness;
- Any type of viable economic partnership would be pursued, even between partners that have little environmental management capacity;
- Local partners may have little environmental management capacity.

For the statements under *cross-cutting energy policies,* the policies were generally considered compatible with the SEA objectives, with the following concerns:

- Capacity development may not cover capacity development in environmental management and sustainable energy development;
- The environmental performance of regional players/projects could be insufficient or the

environmental performance of regional projects may not be monitored;
- Lack of attention to energy-and-environment data, leading to insufficient environmental planning of the energy sector;
- Technology standards do not sufficiently integrate environmental standards, leading to environmental damage;
- A focus on energy security could come into conflict with water-, food-, health-, and disaster-management security.

For the statements under *electricity sub-sector policy objectives,* the policies were generally considered compatible with the SEA objectives, with the following concerns:
- A focus on *rapid* development of electricity would result in simplistic environmental requirements, resulting in environmental damage;
- Diversification would not necessarily increase the share of clean power or would not necessarily minimize environmental impacts;
- The *Power Sector Master Plan* does not sufficiently integrate 'best environmental performance' criteria (given its focus on *least cost*);
- Regional cooperation and trade could shift environmental impacts to a neighbouring country;
- Regional trade could result in losing some livelihood and domestic economic opportunities;
- Limited environmental planning, design, and monitoring capacity to streamline and fast track IPP projects;
- Energy sector information systems could omit environmental information, resulting in poor environmental planning of energy projects.

For the statements under *additional policy objectives for electricity sub-sector,* the policies were generally considered compatible with the SEA objectives, with the following concerns:
- The energy-and-environment planning function is neglected during the power sector restructuring because there is no explicit department / focal point responsible for energy-and-environment issues at national and sub-national levels (leading to environmental damage);
- The cost-reflective tariff does not integrate environmental costs, leading to insufficient cost recovery and financially unsustainable energy production;
- Decisions regarding trade-offs between reducing costs, increasing diversification, and reducing carbon intensity to optimize the power mix are not transparent, and mainly favour reducing costs;
- Exploitation of domestic energy resources conflicts with other sectoral uses (e.g., water for agriculture);
- The private sector is attracted to exploit domestic energy resources, rather than explicitly attracted to environmentally ***cleaner*** domestic energy resources;
- Streamlining the licensing process could compromise environmental management goals;
- There is insufficient capacity to monitor the environmental performance and cumulative impacts of a large number of small autonomous operators (which could tend to encourage non- compliance to environmental safeguards).

For the statements under *rural / electricity access sub-sector policy objectives,* the policies were generally considered compatible with the SEA objectives, with the following concerns:
- Electricity access, distribution, and transmission infrastructure could negatively impact environmentally sensitive areas;
- Universal access to electricity in all schools and health clinics means that some *environmentally-damaging projects* could be conducted;
- Having many small off-grid installations increases the economic costs of electricity or makes it impossible to monitor the environmental performance of a large number of small installations;
- Some innovative partnerships are with environmentally-negligent partners;
- Greater competition in the provision of off-grid services could result in fewer environmental safeguards.

For the statements under *energy efficiency and demand-side management sub-sector policy objectives,* the policies were generally considered compatible with the SEA objectives, with

the following concerns:

- Limited capacity to conduct energy-***and-environment*** audits results in poor audit recommendations and limited capacity to implement the audit recommendations;
- Insufficient focus from the energy efficiency mandate on some energy-consuming sectors (e.g., transportation sector) means that opportunities for energy efficiency and better environmental management are forsaken;
- Focusing the energy-and-environment audit efforts on only the commercial and industrial end-users means that opportunities to get government to lead by example are forsaken;
- Regional environmental standards may be lower than Rwandan standards;
- Efficient lighting program is not sustainable, due to lack of attention to post-use period, when bulbs require replacement;
- Limited capacity to implement and monitor a green procurement system, and hence spotty compliance with green procurement.

For the statements under *biomass sub-sector policy objectives,* the policies were generally considered compatible with the SEA objectives, with the following concerns:

- Insufficient capacity to implement environmental management at decentralized level, results in environmental damage;
- Negative impacts on the livelihood of informal charcoalers, who will be displaced when charcoal production is formalized;
- ICS technology standards fail to keep pace with best technology and fail to achieve significant environmental improvements (e.g., decrease health impacts);
- Lack of regional environmental standards for biofuel production and biofuel quality, leading to environmental damage from biofuel projects.

For the statements under *petroleum sub-sector policy objectives,* the policies were generally considered compatible with the SEA objectives, with the following concerns:

- Insufficient focus on minimizing the use of fossil fuels to comply with green-growth imperative (e.g., insufficient attention to sustainable road and air transportation issues);
- Insufficient focus on ensuring that petroleum products that are imported into Rwanda are mined, refined, and transported in the most environmentally-friendly manner;
- Insufficient attention to explicitly integrate and enforce high environmental standards for petroleum products;
- Insufficient focus on the environmentally-safe storage of the strategic reserve.

8.1.4 Environmental Management and Monitoring Plan (Impacts, Mitigation, and Monitoring Arrangements)

As mentioned above, there is some overlap in the results obtained from the four NEP analyses described above. **Table 8.2** (EMMP) summarizes and consolidates all the potential impacts stemming from the analyses; it also proposes various mitigation measures and indicators. (Note that the mitigation measures listed in Table 8.2 form the basis of the final recommendations on the NEP).

Likewise, there is a lot of similarities and overlaps between the NEP and the ESSP, discussion on those aspects follows in next chapter.

Table 8.2: Environmental Management and Monitoring Plan (EMMP) (with Indicators)

The National Energy Policy (3.8) **Source of the Potential Impacts**	**Issues / Potential Impacts**	**Proposed Mitigation / Optimizing Measures**		**Proposed Indicators**
The impact of the environment on the NEP				
The NEP and Climate Change				
Climate change and variability	Climate change and climate variability could disrupt energy supply through: ▪ Reduced availability of energy / reduced capacity to transform primary sources into useable energy (e.g., through damage to infrastructure; irregular stream flows that limit ability to generate hydropower; and decreased availability of water for the thermal-plant cooling towers); ▪ Damage to transmission and distribution infrastructure; ▪ Disruption to the energy-transport infrastructure (e.g., road or pipeline damage); ▪ Reduced yields of energy crops, including the yield from fuelwood plantations; ▪ Increased power transmission losses (because of higher ambient temperatures); ▪ Reduced or enhanced solar power production (depending on cloud cover pattern).	▪ Integrate extra robustness into the design of energy infrastructure to cope with climate change and variability; ▪ Make water-sharing agreements with other stakeholders, in areas prone to drought; ▪ Store water for hydropower, in areas prone to drought; ▪ Store water or provide irrigation for plantations in areas prone to drought.		▪ # of infrastructure designs adapted to climate variability; ▪ # of water sharing agreements; ▪ # of water storage facilities for hydropower or plantations.
The impact of the NEP on the Environment				
Vision and overarching policy goals				
1) Increase the supply of power generation in line with expected demand; 2) Create an enabling environment for increased private sector participation in energy supply and service provision; 3) Encourage and incentivize more rational, efficient use of energy in public institutions, and amongst industrial and household end-users; 4) Ensure the sustainability of energy exploration, extraction, supply, and consumption so as to prevent damage to the environment and habitats;	▪ Power installations could be sited in environmentally sensitive areas and/or could demand a large land area coming into conflict with other land uses; ▪ Additional generation could be pursued before minimizing demand through energy efficiency and appropriate-levels of maintenance, including maintenance related to environmental management; ▪ The private sector may not have environmental awareness, capacity, or explicit budgets for environmental management; ▪ Some important energy-consuming sectors (including transportation, tourism, agriculture sectors) are not yet explicitly required to integrate *rational, efficient*	▪ Avoid environmentally sensitive areas, when siting energy installations; ▪ Ensure that measures to minimize demand through energy efficiency and timely maintenance are broadly being applied, before considering generation; ▪ Enhance the capacity and prioritize the need to conduct maintenance, including environmental maintenance; ▪ Increase the private sectors' awareness and capacity related to environmental management and sustainable energy development;		▪ Location map of energy installations (showing low environmental sensitivity); ▪ Total budget allocated to maintenance works; ▪ # of environmental sensitivity training courses; ▪ Environmental criteria included into tender evaluation; ▪ Total budget for

The National Energy Policy (3.8) Source of the Potential Impacts	Issues / Potential Impacts	Proposed Mitigation / Optimizing Measures		Proposed Indicators
5) Promote safe, efficient, and competitive production, procurement, transportation, and distribution of energy.	*energy use* into their policy framework; ▪ A focus on 'competition' would tend to minimize costs, especially environmental management costs.	▪ Ensure that environmental criteria and good environmental performance are included in energy tender evaluations to temper 'competition' (which tends to want to minimize costs); ▪ Ensure that the private sector contracts and budgets include an adequate budget for environmental management.		environmental management in each tendered contract.
General policy principles and priorities				
1) Promote integrated planning and streamline sector governance; 2) Mainstream gender-based equity, environmental sustainability, and climate concerns into energy planning and sector strategies; 3) Boost national ownership of the vision and build decentralized implementation capacity; 4) Promote value-for-money and increased market competition in energy development; 5) Transition away from indiscriminate subsidies toward 'smart' subsidies aligned to social protection principles.	▪ 'Streamlining' could lead to doing superficial environmental management studies and could therefore subsequently result in environmental damage during implementation; ▪ Promoting integrated planning could *increase* the amount of sector governance (e.g., integrated planning for water resources; sustainable transport); ▪ 'Competition' could tend to minimize environmental management costs within project budgets; ▪ Mainstreaming could make energy more expensive; ▪ Gender-based equity only receives token attention, resulting in negative impacts on women; ▪ There is likely no explicit implementation budget for mainstreaming, and hence mainstreaming is not implemented; ▪ There is likely limited capacity to mainstream environment at decentralized level, and hence mainstreaming is not implemented; ▪ Subsidies, including smart subsidies, could encourage careless energy consumption.	▪ Ensure that integrated planning has a strong 'environmental' planning component; ▪ Provide additional focus on integrated water management, including water sharing agreements; ▪ Further mainstream sustainable transportation into the energy policy / develop a sustainable transport strategy for Rwanda*;* ▪ Further mainstream gender impact assessment into existing tools (e.g., EIA); o Provide relevant training to women (e.g., on better water management or water storage for energy purposes, including for the biogas installations; o Involve women in the selection of technologies (e.g., cook stoves) and in the selection of relevant research topics; ▪ Ensure that all findings related to integrated planning have excellent executive summaries that highlight core messages, to avoid a significant increase in sector governance; ▪ Provide clear environmental requirements and standards for sustainable energy project development to ensure a level playing field between competing parties; ▪ Ensure that specific and adequate mainstreaming budgets are included into energy project contracts and into government		▪ Environmental planners participate in the integrated planning of the energy sector; ▪ # of water sharing agreements; ▪ Sustainable Transport Strategy and Action Plan; ▪ Gender impact assessments integrated into energy-sector EIA documents and into technology assessments; ▪ Adequate budget for mainstreaming; ▪ Clear environmental requirements for all energy stakeholders; ▪ # of clear executive summaries on integrated planning / core mainstreaming outputs for the energy sector (to facilitate governance); ▪ Explicit budget for mainstreaming activities;

The National Energy Policy (3.8) Source of the Potential Impacts	Issues / Potential Impacts	Proposed Mitigation / Optimizing Measures		Proposed Indicators
		departments responsible for mainstreaming; ▪ Provide capacity development and awareness raising in environmental management, especially at decentralized level; ▪ Provide capacity development in environment when implementing smart subsidies.		▪ # of capacity development events on environmental-management and gender issues in the energy sector.
Policy on promoting private sector participation				
1) Streamline investment promotion processes for IPPs; 2) Extend and expand investment incentives to private investors; 3) De-risk investments through upstream resource assessments and pre-feasibility studies; 4) Accelerate and facilitate energy sector Public–Private Partnerships (PPPs); 5) Empower more local enterprises to engage in energy sector deals and accelerate the introduction of more competition in energy service provision.	▪ Streamlining investment processes and a focus on competition could decrease the attention on environmental objectives; ▪ Partnership between parties that have little environmental-management capacity could be pursued; ▪ Investors and/or local partners may have little environmental awareness and little environmental management capacity.	▪ Develop simplified but still comprehensive energy-and-environment guidance, for the streamlined investment processes; ▪ Subject resource assessments / pre-feasibility studies to EIA/SEA studies, where relevant; ▪ Include 'environmental qualifications' in the tender evaluation process; ▪ Explicitly provide sustainable energy awareness and management capacity building to local enterprises and private investors; ▪ Promote Corporate Social Responsibility (CSR) policies and environmental certifications (e.g., EMS, ISO) for the private sector.		▪ Simplified (but adequate) environmental guidance for the energy sector; ▪ Adequate EIA/SEAs of pre-feasibility studies; ▪ Environmental criteria included in tender evaluation grid; ▪ # of capacity building in environment events for local enterprises; ▪ # of firms with CSR or environmental certifications.
Cross-cutting energy policies				
1) Enhance human, organizational and institutional capacity; 2) Promote and accelerate regional energy sector integration; 3) Improve energy data collection and statistics; 4) (Improve) Energy technology standards, and related compliance and enforcement; 5) (Support) Research, development, and technological innovation; 6) (*Improve*) Energy security and disaster mitigation.	▪ The sector's capacity development plan may not cover capacity development in environmental management and sustainable energy development; ▪ The sector's monitoring and evaluation (M&E) system does not include environmental M&E needs; ▪ The environmental performance of regional players/projects could be insufficient or the environmental performance of regional projects may not be monitored; ▪ Technology standards do not sufficiently integrate environmental standards, leading to environmental damage; ▪ Lack of attention to energy-and-environment data and	▪ Require the private sector to have completed some training in sustainable-energy-and environment issues; ▪ Integrate environmental curriculum into the energy sector's capacity development program (government); ▪ Monitor the environmental performance of regional players (e.g., regional projects); ▪ Promote and enhance regional sustainable energy standards (that at least meet, or better yet, surpass Rwanda's standards); ▪ Integrate environmental standards into technology standards;		▪ # of Environmental training certificates obtained by the private sector; ▪ Environmental curriculum within the capacity development program; ▪ # of environmental management parameters in the M&E system (including regional environment indicators);

The National Energy Policy (3.8) Source of the Potential Impacts	Issues / Potential Impacts	Proposed Mitigation / Optimizing Measures		Proposed Indicators
	energy-and-environment research, leading to insufficient environmental planning of the energy sector; ▪ A focus on energy security could come into conflict with water-, food-, health-, and disaster-management security.	▪ Compile, analyze, and maintain energy-environment data sets (e.g., include energy-sector EIAs in the data set); ▪ Explicitly support some high-priority energy-environment research projects; ▪ Balance energy security against disaster mitigation, and water-, food-, and health-security (e.g., through the use of environmental CBA or environmental valuation methods).		▪ Adequacy/amount of environmental data in the energy data sets; ▪ (High quality) regional sustainable energy standards; ▪ # of high-priority environment-energy research projects; ▪ # of Environmental CBAs (to consider various balanced options).
Sub-sectors				
Electricity sub-sector policy objectives				
1) Revise and upgrade the existing policy, legal, and regulatory, institutional, and financial frameworks to support the rapid development of the electricity industry; 2) Meet projected demand expected to exceed 400 MW by the end of 2018 by diversifying resources over time and increasing the share of clean power generation in the total generation mix over time; 3) Align investment planning and funding mobilization more closely to a power sector master plan informed by the ESSP, a least-cost power development plan, and electricity sub-sector action plans; 4) Enhance regional cooperation and trade in electricity, including investment in transmission network development to further improve security of supply; 5) Streamline IPP processes and fast track project delivery by securing long-term funding for planned projects through a medium-term budget expenditure	▪ A focus on *rapid* development of the electricity sector could result in simplistic environmental requirements, resulting in environmental damage; ▪ Diversification will not necessarily increase the share of clean power nor therefore necessarily minimize environmental impacts; ▪ A *Power Sector Master Plan* mainly informed by a least-cost-power development plan may not sufficiently integrate 'best environmental performance' criteria; ▪ Regional cooperation and trade could shift energy-sector environmental impacts to a neighbouring country; ▪ Regional trade could result in the loss of some livelihood and domestic economic opportunities; ▪ Insufficient environmental planning, design, and monitoring capacity to streamline and fast track IPP projects, resulting in environmental damage; ▪ Information systems that omit environmental information, resulting in poor environmental planning of energy projects.	▪ Provide good, succinct guidance environment requirements and environmental management in the energy sector; ▪ Strongly link the concept of diversification ***and*** clean energy from the onset (i.e., do not include 'less clean' energy into the diversification mix); ▪ Ensure that the *Power Sector Master Plan* is ***also*** informed by a best environmental performance criteria; ▪ Evaluate loss of domestic livelihood and other economic opportunities when evaluating regional trade arrangements; ▪ Review the environmental impacts of regional trade to ensure that regional trade is not just shifting environmental impacts to another country; ▪ Build capacity in environmental planning, design, and monitoring at all levels of the energy sector (through training of the private sector and government at central and decentralized level); ▪ Integrate relevant environmental information		▪ Simplified (but adequate) environmental guidance for the energy sector; ▪ Use of some environmental criteria to set the power mix in the *Power Sector Master Plan;* ▪ CBA of regional trade; ▪ Regional EIAs/SEAs on the regional trade arrangements; ▪ Capacity development in environment planning for the energy sector; ▪ Amount/type of environmental data integrated into energy-sector information systems.

The National Energy Policy (3.8) Source of the Potential Impacts	Issues / Potential Impacts	Proposed Mitigation / Optimizing Measures		Proposed Indicators
framework, revising and expanding the existing REFIT regime, developing new information management systems to streamline steps and procedures, and building greater capacity in planning, procurement, and negotiating power transactions.		into energy-sector information systems.		

The National Energy Policy (3.8) Source of the Potential Impacts	Issues / Potential Impacts	Proposed Mitigation / Optimizing Measures		Proposed Indicators
Additional policy objectives for electricity sub-sector				
1) Increase accountability and cost efficiencies by power sector restructuring; 2) Transition to cost-reflective yet affordable electricity tariff; 3) Develop the national electrical power system to serve growing demand in an economically efficient way and to reduce technical and non-technical losses; 4) Optimize the power mix to reduce long-run cost of service, diversify energy generation technologies, and gradually reduce the carbon-intensity of the grid; 5) Enhance private sector engagement and the attractiveness of exploiting domestic energy resources for power generation; 6) Facilitate autonomous power generation through updated policy guidelines, streamlined licensing, and regulatory reforms.	▪ The energy-and-environment planning function is neglected during the power sector restructuring (there is no explicit department/focal point responsible for energy-and-environment issues at national and sub-national levels), leading to environmentally-damaging projects; ▪ The cost-reflective tariff does not integrate environmental costs, resulting in insufficient cost recovery and financially unsustainable energy production; ▪ Decisions regarding trade-offs between reducing costs, increasing diversification, and reducing carbon intensity to optimize the power mix are not transparent, and mainly favour minimizing costs over carbon intensity; ▪ Exploitation for domestic energy resources conflicts with other sectoral uses (e.g., water for agriculture; wetland/biodiversity protection); ▪ The private sector is attracted to exploit domestic energy resources, rather than explicitly attracted to environmentally ***cleaner*** *and/or* ***least-damaging*** domestic energy resources; ▪ Streamlining the licensing process results in superficial EIA studies and less environmental management; ▪ There is insufficient capacity to monitor the environmental performance of a large number of small autonomous operators (which tends to encourage non-compliance to environmental safeguards).	▪ Designate an environmental officer / focal point within the REG (national and sub-national level); ▪ Integrate environmental management costs into the tariffs; ▪ Explicitly outline and make transparent how trade-offs between costs, carbon intensity, and diversification will be decided while optimizing the power mix; ▪ Conduct an SEA on Rwanda's wetland habitats, especially bogs, to minimize impacts of peat-for-energy exploitation; ▪ Clearly define criteria / standards for what are Rwanda's sustainable ***clean*** *and/or* ***least-damaging*** domestic energy resources, in advance of engaging the private sector; update the definition on a routine basis to keep up with progress; ▪ Streamline the environmental guidance and procedures for a streamlined licensing process (but without losing environmental effectiveness); ▪ Outline environmental monitoring requirements.		▪ # of government officers designated as environmental focal points (national and decentralized); ▪ Tariff explicitly includes environmental management costs (e.g., erosion control to safeguard energy infrastructure); ▪ # of trade-off analyses using transparent evaluation grid to show optimization of the energy mix; ▪ SEA of Rwanda's peat lands and wetlands; ▪ Standards for 'clean' / least damaging domestic energy; ▪ Simplified environmental guidance for the energy sector; ▪ # of environmental parameters included in the M&E system.
Rural/ electricity access sub-sector policy objectives				
1) Restructure energy access and related electricity connection planning and policies; 2) Ensure universal access to electricity in all schools and health clinics by 2018;	▪ Electricity access, distribution, and transmission infrastructure could negatively impact environmentally sensitive areas and/or cause habitat/community fragmentation;	▪ Integrate environment, social, and disaster mitigation criteria into the route selection process of access infrastructure; ▪ Environmental assessment of energy		▪ # of location maps of energy installation, showing good environmental siting;

The National Energy Policy (3.8) Source of the Potential Impacts	Issues / Potential Impacts	Proposed Mitigation / Optimizing Measures		Proposed Indicators
3) Pilot innovative partnerships to increase rural access to appropriate off-grid solutions; 4) Introduce greater competition and flexibility in off-grid service provision; 5) Introduce short and long-term institutional reforms to increase sector coordination, accountability, and delivery effectiveness.	▪ Universal access to electricity in all schools and health clinics means that some *environmentally-damaging* projects are implemented; ▪ Having many small off-grid installations result in significant cumulative impacts on specific watersheds; ▪ Having many small off-grid installations increases the economic costs of electricity or makes it impossible to monitor the environmental performance of a large number of small installations, leading to non-compliance with environmental safeguards; ▪ Some innovative partnerships are with environmentally-negligent partners; ▪ Greater competition in the provision of off-grid services results in fewer environmental safeguards; ▪ The high degree of sector coordination generates delays in planning and implementation.	installations for schools/health clinics; ▪ Provide minimum environmental/social standards for all entities providing off-grid solutions; ▪ Strengthen capacity to conduct EIA at decentralized level; ▪ Conduct cumulative impact assessment, especially on watershed basins have a number of small energy projects; ▪ Develop appropriate environmental monitoring systems; ▪ Develop partnerships with entities showing commitment to green growth and continuous environmental improvement; ▪ Carefully design coordination mechanisms and inter-sectoral coordination mechanisms to be time efficient; compile excellent executive summaries of core information.		▪ # of good quality EIAs of off-grid installations; ▪ # of good quality Cumulative Impact Assessments of multiple similar projects in a given area; ▪ Simplified M&E for off-grid installations; ▪ Environmental certificates of energy sector investors; ▪ Well-coordinated and timely implementation of energy projects (as a result of efficient coordination mechanism).
Energy efficiency and demand-side management sub-sector policy objectives				
1) Adopt new laws, regulations, and codes that mandate energy efficiency measures; 2) Restructure electricity tariff methodology to incentivize efficiency; 3) Establish a demand-side management program within the Utility company to oversee implementation of relevant energy efficiency, conservation, and DSM programs; 4) Encourage and incentivize energy audits among commercial and industrial end-users; 5) Develop a regional standards and labelling scheme for common appliances; 6) Promote and remove barriers to the implementation of priority efficient lighting initiatives through bulk procurement, social marketing campaigns, and targeted subsidies for retrofit;	▪ Insufficient focus on some high-energy-consuming sectors (e.g., transportation sector) limit the effectiveness of the energy efficiency mandate and important opportunities for energy efficiency and better environmental management are forsaken; ▪ Limited capacity to conduct energy-***and-environment*** audits results in poor audit recommendations and limited capacity to implement the audit recommendations; ▪ Focusing the energy audit efforts on the commercial and industrial end-users means that opportunities to get government to lead by example are forsaken; ▪ Regional environmental standards may be lower than Rwandan standards, contributing to regional environmental management issues; ▪ The efficient lighting program is not sustainable, due to lack of attention to post-use period (i.e., when bulbs require replacement);	▪ Develop regulations and codes for a sustainable transport system (road, air, rail, and pipeline transport); ▪ Prioritize building capacity to conduct energy-***and-environment*** audits; ▪ In addition to conducting audits targeting commercial and industrial energy users, conduct energy-***and-environment*** audits of all government installations, to allow government to better lead by example; ▪ Ensure that regional environmental standards match or exceed Rwanda's environmental standards; ▪ Plan for: o The sustainability of the efficient-lighting program (e.g., how to replace the light bulbs in the future); o How to keep up with best available and		▪ Regulations and codes for a sustainable transport system; ▪ # of trainings and # of persons trained as energy-and-environment auditors; ▪ # of energy-and-environment audits conducted in government, commercial, and industrial locations; ▪ # of audit recommendations implemented; ▪ High quality regional environmental standards; ▪ Sustainable strategy

The National Energy Policy (3.8) Source of the Potential Impacts	Issues / Potential Impacts	Proposed Mitigation / Optimizing Measures		Proposed Indicators
7) Devise and implement 'green' procurement guidelines and strategies.	▪ Limited capacity to implement and monitor a green procurement system, and hence spotty compliance with green procurement mandate and fewer environmental benefits.	practicable environmentally friendly technology, as it emerges. ▪ Develop a system to monitor and enforce compliance to green procurement.		developed for lighting sector; ▪ Green procurement monitoring and enforcement system.
Biomass sub-sector policy objectives				
1) Consolidate institutional mandates and strengthen decentralized policy implementation; 2) Formalize charcoal production and supply to facilitate more effective regulatory control and mainstream improved harvesting and carbonization techniques; 3) Increase access to cleaner cooking technologies by promoting technology standards, introducing fiscal reforms, and piloting new market transformation activities; 4) Develop a harmonized policy and regionally integrated market for sustainable liquid biofuels.	▪ Insufficient capacity to implement environmental management at decentralized level, resulting in environmental damage; ▪ Negative impacts on the livelihood of informal charcoalers who will be displaced when charcoal production is formalized; ▪ Charcoal remains the preferred fuel in urban/peri-urban areas, given its ready availability; ▪ ICS technology standards fail to keep pace with best practicable technology and the technology in use fails to achieve significant environmental improvements (e.g., health improvements); ▪ Lack of regional environmental standards for biofuel production and biofuel quality, leading to environmental damage from biofuel projects.	▪ Develop environmental management and monitoring capacity at decentralized level; ▪ Develop alternative livelihood programs for the informal charcoalers; ▪ Develop an explicit charcoal exit strategy and action plan (or charcoal reduction strategy and action plan), with explicit benchmarks, targets, and timelines; ▪ Further develop and integrate ***modern*** biomass solutions into the policies of the biomass sub-sector; ▪ Routinely review ICS technology standards to keep abreast of best practicable environmental technology standards and emerging cleaner technologies; ▪ Develop regional environmental standards for biofuel production and biofuel quality.		▪ # of energy-and-environment training events at decentralized level; ▪ Alternative livelihood strategy for informal charcoalers; ▪ Charcoal exit / charcoal reduction strategy with explicit targets; ▪ Routine assessment of emerging and best performing modern biomass solutions; ▪ Routine assessment of emerging and best performing ICS; ▪ Regional biofuel production and quality standards.
Petroleum sub-sector policy objectives				
1) Enhance the attractiveness of Rwanda as an investment destination for upstream oil and gas; 2) Accelerate regional cooperation and strategic infrastructure development, including new refining, pipeline transportation, and railway infrastructure; 3) Institute a more effective public–private hybrid model for maintaining strategic petroleum product reserves;	▪ Insufficient focus on minimizing the use of fossil fuels, to comply with green-growth imperative (e.g., insufficient attention to sustainable road and air transportation issues); ▪ Insufficient focus on ensuring that petroleum products that are imported into Rwanda are mined, refined, and transported in the most environmentally-friendly manner; ▪ Insufficient focus on the environmentally-safe storage of the strategic reserve, leading to spills that cause	▪ Comply with environmental stewardship criteria when conducting exploration activities; ▪ Minimize the use of fossil fuels to comply with green-growth imperative (e.g., develop sustainable road and air transport strategy; assess the relevance of carbon tax in the aviation); ▪ Apply environmental standards and 'green procurement' criteria to regional petroleum		▪ EIAs of petroleum sector exploration activities; ▪ Strategy to reduce fuel use by Rwanda's transportation sector; ▪ High environmental standard and green procurement policy for all petroleum products imported into Rwanda;

The National Energy Policy (3.8) **Source of the Potential Impacts**	**Issues / Potential Impacts**	**Proposed Mitigation / Optimizing Measures**		**Proposed Indicators**
4) Enhance the effectiveness of price stabilization mechanisms (e.g., bulk purchasing arrangements) 5) Improve data collection and enforce fuel quality standards through greater checks; 6) Define clear institutional mandates; 7) Implement market transformation activities for Liquefied Petroleum Gas (LPG).	significant pollution; ▪ Insufficient attention to explicitly integrate and enforce high *environmental* standards within the fuel quality standards.	energy resources and infrastructure; o Integrate and enforce high environmental fuel quality standards for the road, aviation, & rail sectors (e.g., low sulphur fuels); ▪ Develop a contingency plan for the case where regional or domestic petroleum products are 'dirty' from an environmental perspective; ▪ Ensure that petroleum reserves are stored in an environmentally safe manner.		▪ Emergency Response Plan for petroleum product storage areas.

8.1.5 Recommendations related to NEP 3.8

The information compiled in **Table 8.2** (EMMP) is re-organized below into some key recommendations. The key NEP recommendations will be merged with the key ESSP recommendations in the last chapter of this SEA, and then developed into a prioritized list of overall recommendations.

General Recommendations

- Develop an energy sector land use plan (to reduce land use competition and to clarify where to locate generation and transmission/distribution infrastructure);
- Ensure that measures to minimize demand through energy efficiency and timely maintenance are broadly being applied, before considering generation;
- Avoid environmentally protected areas, when siting energy installations; apply environmental best practises in sensitive areas;
- Integrate environmental criteria into the site and route-selection process;
- Integrate extra robustness into the design of energy infrastructure to cope with climate change and variability;
- Provide environmental awards to energy producers with 'good environmental performance'.

Institutional capacity

- Designate environmental officers / environmental focal points within the REG (at national and sub-national level);
- Ensure that all findings related to energy, integrated planning, and environmental management have excellent executive summaries that highlight core messages (to avoid an increase in coordination and sector-governance tasks).

Capacity development: Environmental Training

- Provide capacity development and awareness raising in energy-and-environmental management to the government, to the private sector, to investors, to local enterprises, and provide capacity development at decentralized level;
- Integrate an adequate environmental curriculum into the energy sector's capacity development program (government).

Capacity development: Guidance and Standards

- Provide clear environmental requirements and standards for energy projects to ensure a level playing field between competing parties;
- Develop simplified but comprehensive EIA guidance for the streamlined investment processes and for the EIA of off-grid installations (this could take the form of an EIA class assessment, e.g. one 'class' EIA to cover a number of mini hydro grids);
- Integrate *environmental* standards into technology standards.

EIA, SEA, energy-and environment audits, CBA, and other economic instruments

- Strengthen capacity to conduct ESIA at decentralized level, through ESIA training;
- Conduct an SEA on Rwanda's wetland habitats, especially bogs, to minimize impacts of peat-for-energy exploitation (this assumes that the *Peat Strategy and Action Plan* did not sufficiently integrate environmental considerations);
- Conduct cumulative impact assessments, especially on watersheds that have a number of small energy projects;
- Prioritize building capacity to conduct energy-***and-environment*** audits;
- In addition to conducting audits targeting commercial and industrial energy users, conduct energy-***and-environment*** audits of government installations;
- Explicitly outline and make transparent how trade-offs between costs, carbon intensity, diversification, security… will be decided while optimizing the power mix (e.g., use environmental CBA or environmental valuation methods);
- Evaluate and apply other relevant economic instruments for the environmental management of the energy sector: e.g., carbon tax, user charges, and/or effluent charges.

Gender

- Incorporate gender impact assessment into existing tools (e.g., into EIA and technology assessments); develop the related guidance.

Data, Monitoring, and Research

- Compile, analyse, and maintain energy–environment data and monitoring data;
- Integrate the environmental monitoring data into the energy sector's information management system (project level data and national-level data);
- Develop environmental management & monitoring capacity at national and decentralized level;
- Explicitly support some high-priority energy–environment *research* projects;
- Publish and disseminate the energy–environment *research* findings in a user-friendly format.

Budgets

- Ensure that specific and adequate mainstreaming budgets are included in energy project contracts and in the budgets of government departments responsible for mainstreaming.

Tender processes

- Highlight environmental management requirements at time of tender [e.g., clean development mechanisms, cleaner production (and waste minimization); *corporate social responsibility*; ISO/EMS certification; availability of environmental management budget];
- Ensure that environmental qualifications, environmental criteria, and good environmental performance are included in the tender evaluation criteria of energy projects;
- Ensure that the financial bids show an adequate budget for environmental management.

Licensing process

- Integrate environmental criteria into the licensing procedure and approval process;
- Approve/renew energy licenses under the condition that the energy producer:
  - Currently complies with environmental standards (to be verified by REMA/RSB);
  - Has adopted new, cleaner technology, shows an adequate environmental management system (EMS/ISO), and has sufficient waste treatment capacity.

Biomass, Charcoal, and ICS

- Further develop and integrate modern biomass solutions into the policies of the biomass sub-sector;
- Allocate a lot more budget to the biomass sector (biomass currently has 1% of the budget, whereas it supplies about 90% of energy needs);
- Develop alternative livelihood programs for the informal charcoalers;
- Develop an explicit charcoal exit strategy and action plan (or charcoal reduction strategy and action plan), with explicit benchmarks, targets, and timelines;
- Routinely review ICS technology standards to keep abreast of best practicable environmental technology standards and emerging cleaner technologies (in particular, focus on quality standards that can achieve health improvements).

Petroleum Sector

- Minimize the use of fossil fuels to comply with green-growth imperative (e.g., focus on sustainable road and air transport sector);
  - Integrate and enforce high *environmental* fuel quality standards for all petroleum products, including the fuels used by road, aviation, and rail sectors (e.g., low sulphur) and the fuel used for thermal generation.

Regional Issues

- Monitor the environmental performance of regional projects;
- Apply high *environmental* standards and 'green procurement' criteria to all petroleum products (domestic, regional, and global petroleum products) and to the related transportation infrastructure (e.g., pipeline, rail, transportation routes);
- Ensure that Rwanda's environmental standards match or exceed regional standards.

Transportation Sector

- Develop regulations and codes for a sustainable transport system (road, air, rail, and pipeline transport) (e.g., assess the relevance of traffic management measures in urban centres and other sustainable transport measures).

Water

- Develop water-sharing agreements with other stakeholders, in areas prone to floods and drought;
- Store water for hydropower, in areas prone to floods and drought;
- Store water or provide irrigation for plantations in areas prone to flood and drought;
- Include ‘water scarcity’ and ‘value of water to be consumed’ into feasibility studies;
- Adjust the hydropower plans to reflect water scarcity and the cost of water.

9 ESSP Environmental Impacts

The aspect of environmental protection is today one of the prime social tasks. Negative effects that are present today are mainly the result of wrong planning for settlements and transportation system, uncontrolled and inadequate use of energy, as well as the lack of basic knowledge in the field of environmental protection. From the abovementioned point of view, the changes, which are a consequence of adaptation of nature to the needs of the man, can be such as he expected, but also, and often, quite unfavorable for him. The set of different changes entails very complex consequences which, in principle, have a feedback effect on initiators of changes, thus leading to new environmental conditions and new consequences.

The purpose of strategic environmental assessment for the ESSP is to consider possible negative effects on the environment and to give guidelines for their mitigation, i.e. to mitigate them to acceptable levels without creating conflicts, also taking into account environmental carrying capacity of the subject area.

The ESSP will be a framework for energy system development in Rwanda with all possible (positive and negative) implications for environmental quality. Bearing this in mind, the focus in the strategic environmental assessment has been placed not only on an analysis of strategic commitments which may imply negative impacts and trends, but also on strategic commitments which contribute to environmental protection and better quality of life of people. In this context, the SEA will provide an analysis of possible effects of planned activities on the environment which will be evaluated in relation to defined objectives and indicators.

Pursuant to the General guidelines and procedures for Strategic Environmental Impact Assessment in Rwanda (REMA, 2010) and based on the experience of the SEA team experts, the assessment of possible effects of plans and programs on the environment shall contain the following elements:

- Overview of the assessed impacts of alternative solutions of plans and programs that are favorable from the aspect of environmental protection, with the description of measures aimed at preventing and limiting the adverse effects or increasing the positive effects on the environment;
- The comparison of alternative solutions and an overview of reasons for selection of the most favorable alternative solution;
- The overview of the assessed impacts of plans and programs on the environment with the description of measures aimed at preventing and limiting the adverse or increasing the positive effects on the environment;
- The way in which the environmental factors have been taken into consideration in the environmental impact assessment, including the data on: air; water; soil; climate; ionizing and non-ionizing radiation; noise and vibrations; flora and fauna; habitats and biodiversity; protected natural resources; population; human health; cities and other settlements; cultural and historic heritage; infrastructure, industrial and other structures; or other man-made values;
- The ways in which the following impact characteristics have been taken into account: probability, intensity, complexity/reversibility, time dimension (duration, frequency, reversibility), spatial dimension (location, geographical area, size of the exposed population, transboundary nature of impact), as well as cumulative and synergistic nature of impact.

9.1 Assessment of alternative solutions

The Rwanda guidelines for Strategic Environmental Impact Assessment do not prescribe alternatives solutions of the plan/program which will be subject to strategic environmental assessment. However, in practice, the following two alternatives are considered:

1) The alternative according to which the plan and program would not be implemented;
2) The alternative suitable for the adoption and implementation of the plan and program.

Alternative solutions of the subject ESSP represent different rational ways, instruments and measures for the realization of the objectives though considering the possibility of using the natural resource for special purposes and activities.

The overall effects of the plan, thus also its effects on the environment, may be identified only by comparing the current status with objectives and solutions of the ESSP.

For the above mentioned reasons, the strategic environmental assessment will deal only with alternatives envisaged by the ESSP:

- Alternative A – reference scenario: 2012/2013 ("business as usual" – hereinafter referred to as the "BaU")
- Alternative B – scenario with the implementation of the energy strategic plan 2012/2013-2017/2018, version 16 September 2014 (hereinafter referred to as the "ESSP 2014)"

Here, it should be noted that non-adoption or non-implementation of the Strategy and continue to follow the current trend is, by no means, the BaU scenario of the Strategy itself, but a process which is, besides being contrary to the previous Strategy, also contrary to the regulations in the field of environmental protection and international obligations which Rwanda has ratified, and thus untenable.

The matrix method is used in exploring the fields for the needs of the SEA, or more precisely, for the assessment of effects of alternatives on the environment. The used method for developing scenarios of development allows for the assessment of positive and negative impacts of the two alternatives. In matrices, the sectors of the ESSP 2014 are intersected with objectives of the SEA, see **Table 9.1.** The guideline criteria are shown in **Table 9.2 – 9.5.**

Environmental protection implies resolving of potential conflicts in space in the context of national interest for energy sector development, on the one hand, and interests of local communities, on the other. In this context, the most important task of strategic assessment is to recognize signs of potential conflicts, as well as to prevent or minimize the importance and intensity of these conflicts through adequate guidelines.

Section 9.1.3 also discusses the impacts of a less pronounced development option than the ESSP maximum prognosis. We have chosen a scoring methodology rather than descriptive as for the NEP. The methodology used for impact assessment of ESSP is related to risk assessment (whereby certain impacts to the environment are identified), risk evaluation (by using a stipulated assessment criteria whereby impacts are given a rating or weighting and obtaining an overall rating or significance of an impact) and risk management (relating directly to applicable mitigation measures to be implemented to manage a risk of an impact in the best interest of a society; Schogren, 1990)[74]

[74] Schogren JF (1990): A primer on environmental risk analysis, Staff report, No 90-SR 46, December 1990, Center for Agricultural and Rural Development, IOWA State University, Ames.

Table 9.1: Assessment of impacts of the Strategy in relation to the SEA objectives per alternatives

SEA Objectives

1. Reverse deforestation; reduce pressure on forests
2. Prevent loss of wetlands and associated ecosystem services
3. Protect natural areas; protect biodiversity
4. Minimize land degradation and soil erosion
5. Minimize impacts on hydrological system; Support Integrated Water Resource Management
6. Reduce pollution
7. Promote adaptation to climate change; Build climate resilient assets
8. Improve capacity to manage disaster risks (especially flood, droughts, landslides)
9. Promote water and food security
10. Promote gender equality and equity
11. Reduce poverty; create alternative livelihoods/ improve livelihoods
12. Support welfare and health for all
13. Provide clean, affordable, reliable, secure, renewable, efficient, indigenous sustainable energy
14. Minimize economic costs of the energy sector (i.e. consider the financial and the environmental and social co
15. Provide a low carbon energy supply
16. Reduce demand for wood fuel and charcoal
17. Support economic growth
18. Increase employment opportunities (including jobs for youth and women)
19. Support green growth/green industry /cleaner production / energy efficiency
20. Support private sector development
21. Support other sectors to be more sustainable (ex: agriculture, mining, forestry, transport, waste management
22. Strengthen institutional coordination and compliance with government regulations
23. Strengthen management and monitoring capacity (public administration, private, and civil society capacity
24. Promote a culture of'maintenance'

Sector of the ESSP	Alternatives	SEA Objectives																							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Electricity Subsector	**A**	-	0	0	-	0	0	0	0	-	-	-	-	-	-	0	-	-	-	0	-	-	-	-	0
	B	+	-	0	+	-	0	0	0	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Electricity Access	**A**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	+	0	+	+	0	+	+	0	0	+	+	+	0	0	+	+	+	+	+	+	+	+	+	0
Energy Efficiency (EE) and Demand-side Management (DSM)	**A**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	+	+	+	+	0	+	+	0	0	+	+	+	0	+	+	+	+	+	+	+	+	+	0	0
Biomass Sub-sector	**A**	0	0	-	-	0	-	-	-	0	-	0	0	-	-	0	-	0	0	-	0	-	0	0	0

Sector of the ESSP	Alternatives	SEA Objectives																							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	B	+	0	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Petroleum Sub-sector	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	0	0	0	+	0	0	0	0
	B	+	+	0	+	+	0	+	0	0	+	+	+	0	+	0	+	+	+	0	+	+	0	+	+
Private Sector Engagement	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	0	0	0	0
	B	0	0	0	0	0	0	0	+	0	+	+	+	0	+	0	0	+	+	0	+	+	+	+	+
EDPRS 2 and Cross Cutting Themes	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+

Meaning of symbols:

+ **overall positive effect i.e. the alternative performs in general well against objective**

0 **no direct effect or vague effect i.e. the alternative is neutral (has positive and negative impacts)**

- **overall negative effect i.e. the alternative performs poorly against objective**

A **reference scenario**

B **scenario with the implementation of ESSP**

Summarizing the assessment of effects of alternatives in relation to the SEA, the following can be concluded:

- **Alternative A** – reference scenario ("business as usual" – BaU) is based upon the continuation of the current practice in energy production and consumption. This leads to more serious implications for basic environmental factors, but also for socio-economic development in Rwanda given the energy deficit in the country.

- **Alternative B** – scenario with the implementation of ESSP 2014 implies the implementation of a series of activities aimed to increase energy production but also to use energy efficiently. The implementations of these different activities will inevitably lead to increase in electricity production and consumption and will have many positive effects on environmental quality and socio-economic development in Rwanda.

Based on the above, it can be easily concluded that alternative B is much more favorable than the alternative A from the aspect of sustainability.

9.1.2 Evaluation of characteristics and significance of effects of strategic commitments

The evaluation of significance, spatial extent and probability of impact of planning solutions on the environment has been carried out, see **Tables 9.2-9.4.** The impact significance is assessed in relation to impact magnitude (intensity) and spatial extent of potential impact. Impacts, i.e. effects of planning solutions, are evaluated according to the magnitude of change by assigning scores from **-3** to **+3**, where minus sign is used to denote a negative change, while sign plus to denote a positive change. This evaluation system is used both for individual impact indicators and for related categories through summary indicators.

Table 9.2: Criteria for evaluating the impact magnitude

Impact magnitude	Designation	Description
Critical	**-3**	Significant environmental overload
Greater	**-2**	Environmental disturbance of great extent
Smaller	**-1**	Environmental disturbance of smaller extent
No impact	**0**	No direct and/or unclear environmental impact
Positive	**+1**	Smaller positive environmental changes
Favorable	**+2**	Favorable environmental changes
Very favorable	**+3**	Changes that significantly improve the quality of life

Criteria for evaluating the spatial extent of impacts are shown in **Table 9.3**.

Table 9.3: Criteria for evaluating the spatial extent of impacts

Impact significance	Designation	Description
International	**I**	Possible transboundary impact
National	**N**	Possible impact at the national level
Regional	**R**	Possible impact at the regional level
Local	**L**	Possible impact of local character

Criteria for assessing the probability of impact occurrence are shown in **Table 9.4**

Table 9.4: Scale for assessing the impact probability

Probability	Designation	Description
100%	**S**	Impact will definitely occur
More than 50%	**L**	Likely impact
Less than 50%	**P**	Possible impact
Less than 1%	**N**	Impact is not likely to occur

Additional criteria can be derived according to impact duration, i.e. duration of consequences. In this context, temporary/occasional (PO) and long-term (LT) impacts can also be defined. Based upon all abovementioned criteria, the importance of identified impacts for the realisation of SEA objectives has been evaluated.

It is adopted that: Impacts of importance for the ESSP are those which have strong or greater (positive or negative) effects on the entire territory of Rwanda or at the regional level, or which imply transboundary impacts, according to criteria shown in **Table 9.5.**

Table 9.5: Criteria for evaluating strategically important impacts

Level	Impact magnitude		Designation of significant impacts
International level:	Strong positive impact	**+3**	**I+3**
	Greater positive impact	**+2**	**I+2**
I	Strong negative impact	**- 3**	**I-3**
	Greater negative impact	**- 2**	**I-2**
National level:	Strong positive impact	**+3**	**N+3**
	Greater positive impact	**+2**	**N+2**
N	Strong negative impact	**- 3**	**N-3**
	Greater negative impact	**- 2**	**N-2**
Regional level:	Strong positive impact	**+3**	**R+3**
	Greater positive impact	**+2**	**R+2**
R	Strong negative impact	**- 3**	**R-3**
	Greater negative impact	**- 2**	**R-2**

Table 9.6 shows the ESSP priority actions which in the forthcoming tables have been evaluated against the SEA objectives, and **Technical Annex 3** shows Assessment of scope of effects of strategic priorities on the environment and elements of sustainable development. **Technical Annex 4** presents an Assessment of spatial extent of effects of strategic priorities on the environment and elements of sustainable development.

Table 9.6: Priory activities in the ESSP 2014 encompassed by SEA

Sector of the strategy	Priority activities	
Electricity Subsector	1	Restructure and corporatize EWSA
	2	Transition to a cost reflective tariff
	3	Balance demand/supply and security of supply (*baseline demand; optimize the power mix; Least Cost Power Development Plan (LCPDP)*; *power system*: *the electricity generation and transmission roadmap:* deliver 563 MW; Feasibility studies; REFIT; autonomous generation; transmission);
	4	Support regional trade
Electricity Access	5	Implement actions that are outside the scope of the EARP (productive users)
	6	Implement other activities contributing to access (Beyond EARP)
	7	Implement the *Electricity Access Rollout Program (EARP)*
Energy Efficiency (EE) and Demand-side Management (DSM)	8	Implement the grid loss reduction (from 23% to 15%)
	9	Develop new laws, regulations, and codes (and programs)
	10	Establish a dedicated demand-side management unit in the Utility
	11	Encourage and incentivize energy audits
	12	Institutionalize green procurement guidelines
Biomass Sub-sector	13	Introduce enabling frameworks to promote alternative clean cooking carriers and technologies (e.g., biogas, LPG, peat briquettes); develop a new strategy / action plan that will identify appropriate technologies
	14	Decentralize the biomass schemes
	15	Promote improved charcoal and wood stoves (e.g., training on modern ICS)
	16	Provide technical support on the choice of stove models
	17	Further formalize the charcoal supply chain
	18	Simplify the licensing scheme for charcoalers
	19	Train charcoaling professionals
	20	Revise the biogas subsidies
	21	Supply alternative fuels: briquettes, biogas, LPG, and liquid

		biofuels:
	22	Develop a national clean cooking database
Petroleum Sub-sector	23	Upstream petroleum (exploration)
	24	Midstream petroleum (wholesale bulk purchasing and storage better transport)
	25	Downstream petroleum (fuel standards, pricing, LPG growth)
	26	Infrastructure (regional pipeline)
Private Sector Engagement	27	De-risk investments by financing upstream resource assessments & pre-feasibility studies;
	28	Establish a *Rwandan Energy Development Fund (REDF)*
	29	Streamline investment promotion processes for IPPs (i.e., simplify)
	30	Empower local enterprises to engage in energy sector deals and introduce more competitive, transparent approaches to service provision
	31	Extend and expand investment incentives to private investors
EDPRS 2 and Cross Cutting Themes	32	Capacity building
	33	Environmental conservation, risk mitigation, and green growth
	34	Regional Integration

Table 9.7 presents a comprehensive identification and evaluation of strategically significant impacts of priority activities, where the most important impacts are described in details to form the basis for the recommendations for mitigating measures.

Table 9.7: Identification and evaluation of strategically significant impacts of priority activities

Strategic priorities	Identification and evaluation of significant impacts		Reasons explanation
	SEA objectives	Rank	
ELECTRICITY SUBSECTOR			
1. Restructure and corporatize EWSA	**8**	**N+1/L**	• The restructuration of EWSA has led to two corporations: *Rwanda Energy Group (REG)* and *Water Sanitation Corporation Ltd (WASAC Ltd)*. REG is organized in two subsidiaries, the *Electricity Utility Corporation Ltd (EUCL)* and *Energy Development Corporation Ltd (EDCL)*. • This restructuration will have direct positive impact on the management and monitoring capacity and indirect positive impacts on the country economic growth, employment opportunities and institutional coordination
	17	**N+2/L**	
	18	**N+2/P**	
	20	**N+2/L**	
	22	**N+2/S**	
	23	**N+2/P**	
2. Transition to a cost reflective tariff	**12**	**N+2/S**	• Under this strategic activity, it is expected that people's quality of life will be significantly improved at national level by implementing the anticipated activities (ex: Reviewing the tariff structure in 2014/15, differentiating residential from non-residential users, Establishment of a tariff regime for households and industry based on end users' voltage requirement (i.e., medium vs. low voltage customers), etc. • A cost reflective tariff may not reflect environmental costs to full extent.
	14	**N+1/P**	
	17	**N+2/S**	
	18	**N+1/S**	
	21	**N+1/S**	
3. Balance demand/supply and security of supply (baseline demand; optimize the power mix; Least Cost Power Development Plan (LCPDP); power system: the electricity	**1**	**N+2/S**	• Considering the number and the nature of projects/ activities under this strategic activity, there will definitely be negative trans- boundary impacts on hydrological regime of watercourses on which hydropower plants, peat to power plants, methane to power plants will be built, which may also cause the loss of wetlands and associated ecosystems, loss of biodiversity, water, air and soil pollution.
	2	**I-3/P**	
	3	**I-2/S**	

Strategic priorities	Identification and evaluation of significant impacts		Reasons explanation
	SEA objectives	Rank	
generation and transmission roadmap: deliver 563 MW; Feasibility studies; REFIT; autonomous generation; transmission)	**4**	**N+2/L**	
	5	**I-3/S**	• These activities could have other negative impacts like visual impact on landscape quality (Solar and hydropower projects), but also impact on trans-boundary biodiversity due to electricity interconnection project.
	6	**I-2/S**	
	7	**N+1/P**	• Positive impacts will be also important, these include economic growth, reduction in dependence on energy from thermal power plants, poverty reduction, employment opportunities and introduction of clean technologies in electricity production
	9	**L+1/L**	
	11	**N+2/S**	
	12	**N+2/S**	
	14	**N+2/S**	
	15	**N+1/L**	
	16	**N+3/S**	
	17	**N+3/S**	
	18	**N+3/S**	
	19	**R+1/L**	
	20	**N+2/L**	
	21	**L+3/S**	
4. Support regional trade	**5**	**I+1/P**	• Realization of this strategic priority may have significant positive effects

Strategic priorities	Identification and evaluation of significant impacts		Reasons explanation
	SEA objectives	Rank	
	6	I+1/L	which will contribute to improving the environmental protection service and the reduction of poverty, support welfare and health for all.
	7	N+2/P	• The harmonization of the grid codes and the creation of the institutional and regulatory arrangements will help the region to improve the capacity to manage the electricity interconnection system and this will have a trans-boundary socio-economic impact.
	9	R+1/P	
	10	N+1/P	
	11	N+2/P	
	12	N+2/P	
	13	R+1/P	
	14	R+1/L	
	15	R+1/P	
	16	N+2/L	
	17	N+1/P	
	18	N+1/P	
	19	N+2/P	
	20	N+2/P	
	21	R+1/P	
ELECTRICITY ACCESS			

Strategic priorities	Identification and evaluation of significant impacts		Reasons explanation
	SEA objectives	Rank	
5. Implement actions that are outside the scope of the EARP (productive users)	**1**	**L+1/S**	• Electricity access as a contributor to economic growth would almost significantly spur economic development and, indirectly, enhance environmental quality by using leading edge technologies and by reducing the pressure on forests. • There will be a creation of jobs due to the expansion and creation of small and medium enterprises (SMEs) in the country • Private sector participants may not have adequate environmental capability and capacity
	4	**L+1/P**	
	6	**N+1/P**	
	7	**N+2/P**	
	9	**L+1/L**	
	10	**N+2/L**	
	11	**N+2/L**	
	12	**N+2/L**	
	13	**R+1/P**	
	14	**N+1/P**	
	15	**N+1/P**	
	16	**N+3/L**	
	17	**N+3/L**	
	18	**N+3/L**	
	19	**R+2/P**	
	20	**N+3/L**	

Strategic priorities	Identification and evaluation of significant impacts		Reasons explanation
	SEA objectives	Rank	
	21	N+3/P	
	22	R+1/P	
	23	R+1/P	
6. Implement other activities contributing to access (beyond EARP)	1	N+3/L	• The implementation of this strategic activity will have strong direct and indirect impacts on both human and biophysical environment. It is expected that the implementation of other activities contributing to electricity access in Rwanda will contribute to reduce pressure on forest which will minimize land degradation and soil erosion. • Also this will certainly contribute to achieve many socio-economic developments such as poverty reduction, improvement of health, educational and administrative services, job opportunities, creation of small and middle enterprises (SMEs), etc.
	4	R+1/P	
	6	R+1/P	
	7	N+2/P	
	8	R+1/P	
	9	L+1/P	
	10	N+2/S	
	11	N+2/S	
	12	N+2/S	
	13	R+1/P	
	14	R+1/P	
	15	R+1/P	
	16	N+3/L	

Strategic priorities	Identification and evaluation of significant impacts		Reasons explanation
	SEA objectives	Rank	
	17	N+3/L	
	18	N+3/L	
	19	R+2/L	
	20	N+3/L	
	21	N+2/L	
	22	N+3/L	
	23	R+3/L	
	24	L+1/P	
7. Implement the Electricity Access Rollout Program (EARP)	1	N+2/L	The implementation of EARP will have many positive socio-economic impacts (direct and indirect) but also some negative environmental impacts especially to the construction of required infrastructure. • Positive impacts are but not limited to : (i) Reduction of pressure on forests (ii) Job opportunities; (iii) Indirect socio-economic impact due to electrification of rural areas (business diversification, education improvement, health, etc.) (iv) Improvement of the population livehood through the electricity access (70%) • Negative impacts will include but not limited to: (i) Land acquisition for electricity networks; (ii) Biophysical environmental impacts generated by the construction of
	2	L-1/P	
	3	L-2/P	
	4	R-1/P	
	6	N+2/P	
	7	L+1/P	
	9	L+1/P	
	10	N+2/L	

Strategic priorities	Identification and evaluation of significant impacts		Reasons explanation
	SEA objectives	Rank	
	11	N+2/L	new electricity networks, etc.
	12	N+2/S	
	13	R+1/P	
	14	N+2/P	
	15	N+1/P	
	16	N+3/L	
	17	N+3/L	
	18	N+3/S	
	19	N+1/P	
	20	N+2/P	
	21	N+2/P	
	22	R+3/L	
	23	R+3/P	
	24	L+3/L	
Energy Efficiency (EE) and Demand-side Management (DSM)			
8. Implement the grid loss reduction (from 23% to 15%)	**1**	**N+2/P**	• The implementation of this strategic activity will have significant positive

Strategic priorities	Identification and evaluation of significant impacts		Reasons explanation
	SEA objectives	Rank	
	2	L+1/N	impacts (direct and indirect) on all SEA objectives. • The reduction of grid loss will certainly contribute to the economic growth and development of Rwanda but also it will promote the adaptation to climate change and build the climate resilient assets.
	3	L+1/N	
	4	L+1/N	
	5	L+1/N	
	6	N+2/P	
	7	N+2/L	
	8	L+1/P	
	9	L+1/P	
	10	N+1/L	
	11	N+1/L	
	12	N+1/L	
	13	N+1/P	
	14	N+3/P	
	15	N+2/P	
	16	N+2/P	
	17	N+3/L	

Strategic priorities	Identification and evaluation of significant impacts		Reasons explanation
	SEA objectives	Rank	
	18	N+3/L	
	19	L+1/P	
	20	N+1/P	
	21	N+1/P	
	22	N+1/N	
	23	N+1/P	
	24	N+1/P	
9. Develop new laws, regulations, and codes (and programs)	1	N+2/L	• Strong indirect positive effects of legislative framework and legal norms are expected which will be reflected in the creation of preconditions for energy efficient and Demand side Management. • This will contribute human and biophysical environment in the energy sector
	2	L+1/P	
	3	L+1/P	
	4	L+1/P	
	5	L+1/P	
	6	N+2/P	
	7	L+3/L	
	8	N+1/P	
	9	N+1/P	

Strategic priorities	Identification and evaluation of significant impacts		Reasons explanation
	SEA objectives	Rank	
	10	N+2/P	
	11	N+2/P	
	12	N+2/L	
	13	N+3/L	
	14	N+3/P	
	15	N+3/P	
	16	N+3/P	
	17	N+3/P	
	18	N+2/P	
	19	N+2/N	
	20	N+1/P	
	21	N+1/P	
	22	N+1/P	
	23	N+1/P	
	24	N+1/P	
10. Establish a dedicated demand-side management	7	N+1/P	• Realization of this strategic priority may have significant positive effects at

Strategic priorities	Identification and evaluation of significant impacts		Reasons explanation
	SEA objectives	Rank	
unit in the Utility	**8**	**N+1/P**	national level which will contribute to improving the environmental protection service and monitoring and control service
	11	**N+1/P**	
	12	**N+1/P**	
	13	**N+1/P**	
	14	**N+1/P**	
	15	**N+1/P**	
	16	**N+1/P**	
	17	**N+1/P**	
	18	**N+1/P**	
	22	**N+1/P**	
	23	**N+1/P**	
11. Encourage and incentivize energy audits	**11**	**N+1/P**	• The expected positive effects will contribute to economic growth and social development of the country
	12	**N+1/P**	
	13	**N+2/P**	
	14	**N+1/P**	
	19	**L+1/P**	

Strategic priorities	Identification and evaluation of significant impacts		Reasons explanation
	SEA objectives	Rank	
	21	N+1/P	
	23	L+1/P	
	24	L+1/P	
12. Institutionalize green procurement guidelines	1	N+1/P	• Strong indirect positive effects of the introduction of this practice are expected which will be reflected in the creation of preconditions for efficient protection of ambient air, as well as for waste management and monitoring in the energy sector. • Negative impacts may be the current limited experience from green procurement
	2	L+1/P	
	3	L+1/N	
	4	N+1/N	
	5	L+1/P	
	6	N+2/L	
	7	N+3/L	
	8	N+1/P	
	10	N+1/P	
	11	N+2/P	
	12	N+1/P	
	13	N+1/P	

Strategic priorities	Identification and evaluation of significant impacts		Reasons explanation
	SEA objectives	Rank	
	17	N+1/P	
	19	N+3/L	
BIOMASS SUB-SECTOR			
13. Introduce enabling frameworks to promote alternative clean cooking carriers and technologies (e.g., biogas, LPG, peat briquettes); develop a new strategy / action plan that will identify appropriate technologies	1	N+3/L	• The realization of this strategic priority will have many positive impacts on biophysical environmental and human environment. These include but not limited to: a. Reduction of pressure on forests by drastically reduction of the pressure on forest reserves due to cooking fuel, b. Radically reduction of the amount of biomass required to meet cooking energy needs, c. Elimination of Household Air Pollution (HAP) d. Reduction of mortality & morbidity associated with HAP e. Reduction of CO_2 & black soot carbon emissions that contribute to climate change, • Minimize land degradation and soil erosion, • The promotion of alternative clean cooking carriers and technologies will contribute to the economic development based on latest achievements and leading edge technologies and will contribute to further economic growth and, consequently, to sustainable development and environmental protection.
	4	L+1/P	
	5	N+1/P	
	6	N+1/P	
	10	L+2/L	
	11	L+2/L	
	12	L+2/L	
	13	N+3/P	
	14	N+1/P	
	15	L+1/P	
	16	N+3/L	
	17	N+2/P	
	18	L+2/L	

Strategic priorities	Identification and evaluation of significant impacts		Reasons explanation
	SEA objectives	Rank	
	19	R+1/P	
	20	L+1/P	
	21	L+1/P	
	24	L+1/P	
14. Decentralize the biomass schemes	1	N+3/L	• The implementation of this strategic activity will probably have more significant positive environmental effects (direct and indirect) which will contribute to improving the environmental protection (especially deforestation) and socio-economic development of the country. • Negative impacts may occur if the competence in the regions would not match with the requirements.
	3	L+1/P	
	4	L+1/P	
	6	R+1/P	
	7	R+1/P	
	9	L+1/N	
	10	N+2/P	
	11	N+2/P	
	12	N+2/P	
	13	N+3/P	
	14	N+2/P	
	15	N+2/P	

Strategic priorities	Identification and evaluation of significant impacts		Reasons explanation
	SEA objectives	Rank	
	16	N+3/L	
	17	N+2/P	
	18	L+1/P	
	19	L+2/P	
	21	N+1/P	
15. Promote improved charcoal and wood stoves	1	R+2/L	• The realization of this strategic activity will have many impacts on human and biophysical environment at local, regional and national level. These include but not limited to: ▪ Increase efficiency (optimize combustion and maximize heat transfer) of biomass resources use in households, institutions and SMEs. ▪ Reduce indoor air pollution. ▪ Reduce drudgery and save time for women and children ▪ Reduce deforestation and land degradation ▪ Mitigate climate change. ▪ Enhance local income and employment generation. ▪ Scale up uptake and use of many smokeless, high efficiency, low to medium cost stove designs already in existence. • Negative impacts may occur if the pace of introduction of ICS does not match with the requirements
	3	L+1/P	
	4	L+1/P	
	6	N+1/P	
	7	N+1/P	
	8	L+1/P	
	10	N+1/P	
	11	N+1/P	
	12	N+1/P	
	13	N+2/P	
	14	N+2/P	

Strategic priorities	Identification and evaluation of significant impacts		Reasons explanation
	SEA objectives	Rank	
	15	L+1/P	
	16	N+2/L	
	17	N+1/P	
	18	L+1/P	
	19	L+1/P	
	21	N+1/P	
	23	R+1/P	
	24	L+1/P	
16. Provide technical support on the choice of stove models	1	L+2/L	▪ The implementation of this activity will have direct and indirect positive effects on human environment and on the biophysical environment of Rwanda. ▪ In Rwanda many people rely on wood fuels for most of their energy needs, despite the problems associated problems associated with traditional use of wood fuels-including energy inefficiency, deforestation, increasing use of time for collection of fuel, and deleterious health and environmental effects. ▪ Modern, efficient biomass stoves will certainly alleviate some of these problems by reducing some householders' cash outlays for fuel, diminishing the time others must spend to collect fuel, reducing air pollution, and relieving local pressure on wood resources.
	3	L+1/P	
	4	L+1/P	
	6	N+2/P	
	7	N+1/P	
	8	N+1/P	
	10	N+1/P	
	11	N+2/P	

Strategic priorities	Identification and evaluation of significant impacts		Reasons explanation
	SEA objectives	Rank	
	12	N+2/P	
	13	L+1/P	
	14	R+1/L	
	16	N+2/L	
	17	N+1/P	
	18	L+2/P	
	19	L+1/P	
	22	R+1/P	
	23	L+1/P	
	24	L+1/P	
17. Further formalize the charcoal supply chain	1	N+1/P	The realization of this strategic activity will have positive environmental and socio-economic impacts in Rwanda. These include but not limited to: • Improvement of working conditions of people working in this sector, • Reduction of greenhouse gas emissions in multiple ways (the reduction in deforestation that will occur from utilizing improved carbonization techniques or improved cookstoves). • Reduction of land degradation and soil erosion • There may be negative impacts on the livelihood conditions of the charcoalers
	6	N+1/P	
	7	N+1/P	
	10	N+1/P	
	11	N+1/P	
	12	N+1/P	

Strategic priorities	Identification and evaluation of significant impacts		Reasons explanation
	SEA objectives	Rank	
	13	L+1/P	
	14	R+1/P	
	16	N+2/L	
	17	N+1/P	
	18	L+1/P	
	20	L+1/P	
18. Simplify the licensing scheme for charcoalers	1	N+1/P	• The implementation of this activity will foster transparency and sustainability in wood harvesting. • This will have positive impact on deforestation and will support the development of the private sector operating in charcoal supply chain
	17	N+1/P	
	18	L+1/P	
	20	L+1/L	
19. Train charcoaling professionals	1	N+3/L	• Possible strong positive effects may contribute to enhancing economic development by creating labour which will be able to bear burden of structural changes in energy sector, more specifically in new technologies aiming to produce charcoals efficiently.
	6	N+1/P	
	7	N+1/P	
	8	L+1/P	• Training will contribute to environment protection in general and specifically to reduction of pressure on forests.
	9	L+1/P	
	11	N+1/P	

Strategic priorities	Identification and evaluation of significant impacts		Reasons explanation
	SEA objectives	Rank	
	12	N+1/P	
	13	R+2/P	
	14	R+1/P	
	16	L+2/L	
	18	L+1/L	
	20	L+1/L	
20. Revise the biogas subsidies	1	L+3/L	• A restructuration of biogas subsidies based on a detailed economic analysis should contribute to socio-economic development and to improvement of environment protection and preservation
	10	L+1/P	
	11	L+2/P	
	12	N+2/P	
	13	N+1/P	
	14	R+1/P	
	16	N+3/L	
	17	N+1/P	
	18	L+1/P	
	19	L+1/P	

Strategic priorities	Identification and evaluation of significant impacts		Reasons explanation
	SEA objectives	Rank	
21. Supply alternative fuels: briquettes, biogas, LPG and liquid biofuels.	**1**	**N+3/L**	• The realization of this strategic priority will have many important positive effects (direct and indirect) on both socio-economy and on the environment at local and national level. • The impacts include but are not limited to: (i) Contribution to economic growth, (ii) Increase employment opportunities, (iii) Supporting private sector development, (iv) Promotion of gender equity and equality, (v) Poverty reduction, (vi) Promotion of adaptation to climate change, (vii) Reverse deforestation, (viii) Reduce land degradation and soil erosion Negative impact may occur if the introduction of alternative fuels would be without attention to environmental issues
	3	**L+2/N**	
	4	**L+2/P**	
	6	**N+2/P**	
	7	**N+2/P**	
	9	**N+1/P**	
	10	**N+2/L**	
	11	**N+2/L**	
	12	**N+2/L**	
	13	**N+2/P**	
	14	**N+2/P**	
	15	**N+2/P**	
	16	**N+3/S**	
	17	**N+2/P**	
	18	**N+2/P**	
	20	**N+1/P**	

<table>
<tr><th rowspan="2">Strategic priorities</th><th colspan="2">Identification and evaluation of significant impacts</th><th rowspan="2">Reasons explanation</th></tr>
<tr><th>SEA objectives</th><th>Rank</th></tr>
<tr><td></td><td>21</td><td>N+1/P</td><td></td></tr>
<tr><td rowspan="7">22. Develop a national clean cooking database</td><td>11</td><td>N+1/P</td><td rowspan="7">• The implementation of this activity will have positive effects which will contribute to socio-economic development and to environment protection.

• Strict implementation of energy-efficiency measures will have positive effects on further economic development of Rwanda.</td></tr>
<tr><td>12</td><td>N+1/P</td></tr>
<tr><td>17</td><td>N+1/P</td></tr>
<tr><td>18</td><td>N+1/P</td></tr>
<tr><td>22</td><td>N+1/P</td></tr>
<tr><td>23</td><td>N+1/N</td></tr>
<tr><td>24</td><td>L+1/P</td></tr>
<tr><td colspan="4">Petroleum Sub-sector</td></tr>
<tr><td rowspan="9">23. Upstream petroleum (exploration)</td><td>2</td><td>I-2/L</td><td rowspan="9">• There will definitely be negative trans-boundary impacts on hydrological regime of water of lake Kivu where exploration is taking place.

• The environmental disturbance factor and potential effects of offshore petroleum exploration is summarized below:

<table><tr><th>Exploration activity</th><th>Environmental disturbance factor</th><th>Potential effect</th></tr><tr><td>Seismic</td><td>Air gun discharges</td><td>• Displacement or</td></tr></table></td></tr>
<tr><td>3</td><td>L-1/P</td></tr>
<tr><td>4</td><td>L-1/P</td></tr>
<tr><td>5</td><td>I-2/P</td></tr>
<tr><td>6</td><td>I-2/P</td></tr>
<tr><td>10</td><td>N+1/P</td></tr>
<tr><td>11</td><td>N+2/P</td></tr>
</table>

<table>
<tr><th rowspan="2">Strategic priorities</th><th colspan="2">Identification and evaluation of significant impacts</th><th rowspan="2">Reasons explanation</th></tr>
<tr><th>SEA objectives</th><th>Rank</th></tr>
<tr><td rowspan="5"></td><td>12</td><td>N+2/P</td><td rowspan="5"><table>
<tr><td></td><td>Chemical explosives</td><td rowspan="2">loss of biota especially fish and wildlife
• Disturbance of biota
• Displacement of fishing activities</td></tr>
<tr><td></td><td>Vessel transits</td></tr>
<tr><td>Drilling</td><td>Discharge of toxic drilling fluids</td><td rowspan="3">• Water pollution
• Loss of habitats
• Displacement or loss of biota</td></tr>
<tr><td></td><td>Discharge of fines and solids from drilling</td></tr>
<tr><td></td><td>Operational noise</td></tr>
</table>
• Potential positive impacts relate to spurring economic growth, socio-economic development and reduction in dependence on petroleum imports are also expected.</td></tr>
<tr><td>17</td><td>N+2/P</td></tr>
<tr><td>18</td><td>N+2/P</td></tr>
<tr><td>19</td><td>N-1/N</td></tr>
<tr><td>24. Midstream petroleum</td><td>20</td><td>N+1/P</td><td rowspan="3">• Improvements implied by economic growth and development are expected
• Negative impacts may occur during transport and storage of petroleum products.</td></tr>
<tr><td>22</td><td>N+1/P</td></tr>
<tr><td>23</td><td>N+1/P</td></tr>
<tr><td rowspan="4">25. Downstream petroleum</td><td>1</td><td>N+2/L</td><td rowspan="3">• By implementing this strategic activity, it is expected that people’s quality of life will be significantly improved at national level.
• Significant positive environmental effects are expected which will contribute to reducing pressure on forest and demand for wood fuel and charcoal.</td></tr>
<tr><td>4</td><td>L+1/P</td></tr>
<tr><td>10</td><td>N+1/L</td></tr>
<tr><td>11</td><td>N+2/L</td><td>• Negative impacts may occur if fuel standards are not syncronised within EAC.</td></tr>
</table>

Strategic priorities	Identification and evaluation of significant impacts		Reasons explanation
	SEA objectives	Rank	
	12	N+2/L	
	13	N+1/P	
	14	N+1/L	
	15	N+1/P	
	16	N+2/S	
	17	N+1/P	
	18	N+1/P	
	20	N+1/P	
26. Infrastructure (regional pipeline)	1	I+2/L	• The construction of regional pipeline will have both positive and negative effects. • Expected trans-boundary negative impacts will affect certain natural resources (soil, water, air and biodiversity): underground water pollution and possible surface water diversion, loss of forest and agricultural lands, loss of wetlands and associated ecosystems, visual impact on landscape quality. • Expected positive impacts include but not limited to: reducing pressure on forests, spurring regional and national economic growth, reduction in dependence on petroleum imports, socio-economic development, etc.
	2	I-1/P	
	3	I-1/P	
	4	I-1/P	
	6	L-1/P	
	7	I+1/P	
	10	I+2/L	
	11	I+2/L	

Strategic priorities	Identification and evaluation of significant impacts		Reasons explanation
	SEA objectives	Rank	
	12	I+2/S	
	13	N+1/P	
	14	I+1/P	
	15	I+1/P	
	16	I+1/L	
	17	I+3/L	
	18	I+1/L	
	20	N+2/P	
	20	I+1/P	
Private Sector Engagement			
27. De-risk investments by financing upstream resource assessments and pre-feasibility studies	10	N+1/P	• Significant positive effects on socio-economic development are expected from the implementation of this strategic priority. Negative impacts may include: • Partnerships between parties that have little environmental management capacity may be experienced.
	11	N+1/P	
	12	N+1/P	
	13	N+1/P	
	14	N+1/P	
	15	N+1/P	

Strategic priorities	Identification and evaluation of significant impacts		Reasons explanation
	SEA objectives	Rank	
	16	N+1/P	
	17	N+2/L	
	18	L+1/P	
	19	N+1/P	
28. Establish a Rwandan Energy Development Fund (REDF)	1	N+2/L	The establishment of Rwandan Energy Development Fund (REDF) will have positive effects on the country socio-economic development but also will contribute to reducing the pressure on forests and the demand of wood fuel and charcoal
	6	N+1/P	
	7	N+2/L	
	10	N+1/P	
	11	N+1/P	
	12	N+1/P	
	13	N+1/P	
	14	N+1/P	
	15	N+1/P	
	16	N+1/S	
	17	N+1/L	
	18	L+1/P	

Strategic priorities	Identification and evaluation of significant impacts		Reasons explanation
	SEA objectives	Rank	
	19	N+1/P	
	20	N+1/P	
29. Streamline investment promotion processes for IPPs	20	N+1/L	• The rationalization of investment promotion process for independent power producers will contribute to supporting the development of Rwanda private sector and positive contribution to the economic development. • Streamlining investment processes and focus on investment could decrease the attention on environmental objectives.
30. Empower local enterprises to engage in energy sector deals and introduce more competitive, transparent approaches to service provision	8	N+1/P	• Possible strong positive effects may contribute to enhancing economic development of the country by creating labor which will be able to bear burden of structural changes in energy sector. • The implementation of this action will specifically contribute to supporting the country private sector development in the energy sector; • Negative impacts may include: Investors/ local partners may have limited experience from environmental management and awareness.
	10	N+1/P	
	11	N+1/P	
	12	N+1/P	
	17	N+1/P	
	18	N+1/P	
	19	L+1/P	
	20	N+3/L	
	21	L+1/P	
	22	L+1/P	
	23	L+1/P	

Strategic priorities	Identification and evaluation of significant impacts		Reasons explanation
	SEA objectives	Rank	
31. Extend and expand investment incentives to private investors	**10**	**N+1/P**	• The realization of this activity may have potential positive effect on socio-economic development by : (i) Reducing poverty, (ii) Promoting gender equity and equality, (iii) Increasing job opportunities, (iv) Supporting private sector development and (v) Supporting economic growth
	11	**N+1/P**	
	12	**N+1/P**	
	17	**N+1/P**	
	18	**N+1/P**	
	20	**N+3/L**	
EDPRS 2 and Cross Cutting Themes			
32. Capacity building	**1**	**N+1/L**	• Local human resource development and institutional capacity development will have significant positive impact on all SEA objectives. • This may contribute to enhancing socio-economic development and environment protection. • The sector's capacity development plan may not cover capacity development in environmental management and sustainable energy development.
	2	**N+1/P**	
	3	**N+1/P**	
	4	**N+1/P**	
	5	**N+1/P**	
	6	**N+1/P**	
	7	**N+1/P**	
	8	**N+2/L**	
	9	**N+1/P**	

Strategic priorities	Identification and evaluation of significant impacts		Reasons explanation
	SEA objectives	Rank	
	10	N+1/P	
	11	N+1/P	
	12	N+1/P	
	13	N+1/P	
	14	N+1/L	
	15	N+1/P	
	16	N+1/L	
	17	N+1/P	
	18	L+1/P	
	19	N+1/P	
	20	N+2/P	
	21	N+2/P	
	22	N+2/P	
	23	N+2/P	
	24	N+2/P	
33. Environmental conservation, risk mitigation, and green	**1**	**N+3/L**	From the implementation of this cross cutting activity, possible strong positive

Strategic priorities	Identification and evaluation of significant impacts		Reasons explanation
	SEA objectives	Rank	
growth	**2**	**N+2/P**	effects may contribute to enhancing socio-economic development and environment protection of Rwanda Negative impacts may be: ▪ Risk not to meet with the biomass reduction target to 50% until 2018; ▪ Risk not to meet with the renewable energy ambitions
	3	**N+1/P**	
	4	**N+2/L**	
	5	**N+1/P**	
	6	**N+2/L**	
	7	**N+2/S**	
	8	**N+2/P**	
	9	**N+1/P**	
	10	**N+1/L**	
	11	**N+1/L**	
	12	**N+1/L**	
	13	**N+2/P**	
	14	**N+1/P**	
	15	**N+2/L**	
	16	**N+3/L**	
	17	**N+1/P**	

Strategic priorities	Identification and evaluation of significant impacts		Reasons explanation
	SEA objectives	Rank	
	18	N+1/P	
	19	N+2/L	
	21	N+1/P	
	22	N+2/P	
	23	N+1/P	
	24	N+1/P	
34. Regional Integration	1	I+1/P	The realization of this strategic activity will definitely have positive trans-boundary effects on socio-economic of the region and on the regional environment protection
	3	I+1/P	
	4	I+1/P	
	5	I+1/P	
	6	I+1/P	
	7	I+1/P	
	8	I+1/P	
	10	I+1/P	
	11	I+1/P	
	12	I+1/P	

Strategic priorities	Identification and evaluation of significant impacts		Reasons explanation
	SEA objectives	Rank	
	13	I+1/P	
	14	I+1/P	
	15	I+1/P	
	16	I+1/P	
	17	I+1/P	
	18	I+1/P	
	20	I+1/P	
	21	I+1/P	

9.1.3. Summary of significant strategic impacts

On the basis of the evaluation of impact significance shown in **Table 9.7**, it can be concluded that the ESSP 2014 produces significant number of strategically important, both positive and negative environmental impacts.

Negative impacts are identified as an inexorable consequence of the development and natural potentials of Rwanda upon which future energy sector development should inevitably be based. This primarily implies: the construction of new hydropower and mini hydropower plants, methane gas projects, petroleum exploration, peat to power projects which would have negative effects on hydrological regime of watercourses as well as on biodiversity and ichthyofauna, and will cause possible changes in the use of wetlands and agricultural lands.

Certain negative implications are also expected due to the implementation of interconnection projects, construction of new thermal power plants, development of solar projects, construction of regional petroleum pipeline, construction of new transmission lines, etc. All these projects will increase environmental pollution load to a great extent; change in the view of landscape and in biodiversity; as well as social implications which manifest themselves in land acquisition and expropriation, increasing water run-off, risk of erosion, etc.

Although most of the above mentioned adverse impacts have a local character in terms of their spatial extent, certain impacts have been evaluated as strategically significant because they manifest themselves at national and international levels, as shown in **Technical Annex 4.**

Transboundary impacts are of particular significance considering that they extend beyond the scope of the Strategy.

As a signatory to a number of regional and international protocols, conventions and treaties, Rwanda should inform other countries about proposed projects which may have transboundary impacts.

On the other hand, a whole series of positive strategic impacts were identified, out of which the most significant ones include the following:

- **Socio-economic development:** Energy sector development will contribute to economic growth of Rwanda and is believed to contribute to the achievement of objectives of EDPRS-II and vision 2020, based on the assumption that sustainable access to modern energy services fosters economic and social development, and leads to improvements in the quality of life (economy diversification, increase of employment opportunities, promotion of gender equality and equity, improvement of health, educational and institutional services, etc.). The related targets indicators include:
    - Increase the electric power system equivalent installed capacity (domestic generation + imports) to 563 MW.
    - Increase household access to grid electricity to 48% and access to off-grid electricity to 22%.
    - Achieve savings from energy efficiency measures of up to 10% per annum through Demand-Side measures and 8% through grid-loss reduction (from a 2013 baseline).
    - Reduce carbon intensity of the grid by 10% by 2018 and 25% by 2025 (from a 2013 baseline).
    - Ensure 80% of all households employ clean cooking energy technologies.
    - Realize all EAC Regional Integration Policy priorities for energy sector

- **Environmental Benefits**: The implementation of the 2014 ESSP will have also positive environmental effects: reduction of reliance on biomass – specifically, wood – as a source of fuel in the country. This will thus contribute to reduction of pressure on forests in Rwanda and thereby curb land degradation and soil erosion. Other environmental benefits include but not limited to:
    - reduction of GHGs emissions,
    - promotion of adaptation to climate change,
    - elimination of Household Air Pollution (HAP),
    - reduction of mortality & morbidity associated with HAP, etc.

- **Environmental quality**: there will be an improvement of environmental quality due to the reduction in water, air and soil pollution and reduction of greenhouse gas emissions by increasing the use of renewable energy sources and the application of clean technologies. The implementation of a whole set of energy-efficiency measures and the capacity building will contribute to more rational energy use and environment protection.

The exercise of impacts assessment of the ESSP 2014 has shown that several strategic priorities are compatible with SEA objectives and have potential positive (direct and indirect) effects.

Other Scenarios

Other scenarios than ESSP 2014 high level target objectives of installed electric power (domestic +imports) capacity of 563 MW until 2017/2018 and an access to grid of 48% and off grid electricity of 22% may also be discussed. At the same time to reduce the carbon intensity with 10%, and save 10% power output by efficiency measures and introduce smart subsidies to make power more affordable.

The ESSP discusses also other scenarios, where the lowest 'likely demand' would be 308 MW corresponding to a supply of 363 MW if the on grid target would be 35% instead of 48%.

Details of the scenarios will be developed in the envisaged Power Master Plan and the Least Cost Power Development Plan, LCPDP. The output of the LCPDP would be a recommended sequence of supply investments to ensure long term balance at least cost.

We have assumed that the other targets than the generation and demand targets would be the same. In that case the conclusions and recommendations specified in Chapter 10 would remain the same.

Another scenario may be that more than the assumed percentage of electricity (20-30%) is imported. This may have an impact on the price stability, and on the envisaged power mix, and on the environmental impacts from the various power sources since the impact would occur in another country than Rwanda. However, the details of the reduced environmental impact in Rwanda cannot be quantified at this stage.

Accordingly, if the domestic power generation would be greater than the ESSP has envisaged the environmental impacts would be larger and the recommendations and precautionary measures are most important to implement.

9.1.4 Environmental Management and Monitoring Plan (Impacts, Mitigation, and Monitoring Arrangements)

Similarly to the assessment and description of NEP **Table 9.8** summarizes and consolidates all the potential impacts from the above analyses of the ESSP; and proposes various mitigation measures and indicators. Many of the actions and impacts are the same as in the 2014 NEP, and those are also repeated in the Table. N.B. mainly the negative impacts/issues are noted in this table in order to generate mitigating measures to reduce the negative impacts.

Table 9.8: ESSP Environmental Management and Monitoring Plan (EMMP) with Indicators

The ESSP (version 16 Sept. 2014) Source of the Potential Impacts	**Issues / Potential Impacts**	**Proposed Mitigation / Optimizing Measures**		**Proposed Indicators**
The impact of the environment on the ESSP				
The ESSP and Climate Change				
Climate change and variability	Climate change and climate variability could disrupt energy supply through: ▪ Reduced availability of energy / reduced capacity to transform primary sources into useable energy (e.g., through damage to infrastructure; irregular stream flows that limit ability to generate hydropower; and decreased availability of water for the thermal-plant cooling towers); ▪ Damage to transmission and distribution infrastructure; ▪ Disruption to the energy-transport infrastructure (e.g., road or pipeline damage); ▪ Reduced yields of energy crops, including the yield from fuelwood plantations; ▪ Increased power transmission losses (because of higher ambient temperatures); ▪ Reduced or enhanced solar power production (depending on cloud cover pattern).	▪ Integrate extra robustness into the design of energy infrastructure to cope with climate change and variability; ▪ Make water-sharing agreements with other stakeholders, in areas prone to drought; ▪ Store water for hydropower, in areas prone to drought; ▪ Store water or provide irrigation for plantations in areas prone to drought.		▪ # of infrastructure designs adapted to climate variability; ▪ # of water sharing agreements; ▪ # of water storage facilities for hydropower or plantations.
The impact of the ESSP on the Environment				
Electricity Sub-Sector				
1) Restructure and corporatize EWSA	▪ Efficiency of the energy and water authorities	▪ Assess the outcome of the reorganisation after 1 year		▪ # of energy, water and sanitation projects implemented, # of people served
2) Transition to a cost reflective tariff	▪ The cost-reflective tariff does not integrate environmental costs, resulting in insufficient cost recovery and financially unsustainable energy production;	▪ Integrate environmental management costs into the tariffs.		▪ Tariff explicitly includes environmental management costs (e.g., erosion control to safeguard energy infrastructure).
3) (Balance) demand/supply and security of supply (baseline demand; optimize the	▪ Considering the number and the nature of projects/ activities under this strategic activity,	▪ Prepare project specific ESIAs for each development project;		▪ Prepare environmental guidance for the

The ESSP (version 16 Sept. 2014) Source of the Potential Impacts	Issues / Potential Impacts	Proposed Mitigation / Optimizing Measures		Proposed Indicators
power mix; Least Cost Power Development Plan (LCPDP); power system: the electricity generation and transmission roadmap: deliver 563 MW; Feasibility studies; REFIT; autonomous generation; transmission)	there will definitely be negative trans- boundary impacts on hydrological regime of watercourses on which hydropower plants, peat to power plants, methane to power plants will be built, which may also cause the loss of wetlands and associated ecosystems, loss of biodiversity, water, air and soil pollution. ▪ These activities could have other negative impacts like visual impact on landscape quality (Solar and hydropower projects), but also impact on trans-boundary biodiversity due to electricity interconnection projects.	▪ Transboundary studies and measures for international HP, peat and methane generation and interconnection projects ▪ LCPDP and sub-sector action plans integrate environmental costs.		energy sector; ▪ Include environmental criteria for the power mix in the *LCPDP;* ▪ Ensure inclusion of environment criteria and costs in plans
. 4) (Support) regional trade	▪ Regional power generation may export environmental impacts to a neighbouring country ▪ Loss of livelihood may be the result of regional trade.	▪ Ensure that regional environmental guidelines are at hand, and updated ▪ Evaluate loss of domestic livelihood and other economic opportunities when evaluating regional trade arrangements;		▪ EAC guidelines on environment; ▪ Regional ESIAs on the regional trade arrangements
Electricity Access				
1) Implement actions that are outside the scope of the EARP (productive users).	▪ Private sector may not have social and environmental impact management capacity	▪ Ensure that environmental criteria, staff and good environmental performance are included in energy contracts and roll out programme		▪ # of contracts including environmental aspects
2) Implement other activities contributing to access (beyond EARP)	▪ Ambitious off-grid connections may compromise environmental issues,	▪ Ensure that environmental criteria, staff and good environmental performance are included in the energy roll out programme		▪ # of 'green' energy connections
3) Implement the Electricity Access Rollout Program (EARP) sector strategies;	▪ Land acquisition for electricity networks; ▪ Biophysical environmental impacts generated by the construction of new electricity networks, etc.	▪ Ensure that environmental criteria, staff and good environmental performance are included in the energy roll out program; ▪ Minimise land acquisition, and ensure compensation through preparation of RAPs		▪ # of 'green' energy connections ▪ Compensation schemes
Energy Efficiency (EE) and Demand-side Management (DSM)				
1) (Implement the) grid loss reduction (from 23% to 15%)	▪ Only positive impacts envisaged.	▪ Put in place annual verification mechanism of grid loss reduction		▪ Annual improvement monitoring
2) (Develop) new laws, regulations, and codes (and programs)	▪ Insufficient focus on some high-energy-consuming sectors (e.g., transportation sector) limit the effectiveness of the energy efficiency mandate and	▪ Develop regulations and codes for a sustainable transport system (road, air, rail, and pipeline transport);		▪ Regulations and codes for a sustainable transport system;

The ESSP (version 16 Sept. 2014) Source of the Potential Impacts	Issues / Potential Impacts	Proposed Mitigation / Optimizing Measures		Proposed Indicators
	important opportunities for energy efficiency and better environmental management are forsaken;			
3) (Establish) a dedicated demand-side management unit in the Utility	▪ Qualifications of staff to be specified including environmental expertise	▪ Terms of reference for the position		▪ CV
4) (Encourage and incentivize) energy audits	▪ Limited capacity to conduct energy-*and-environment* audits results in poor audit recommendations and limited capacity to implement the audit recommendations; ▪ Focusing the energy audit efforts on the commercial and industrial end-users means that opportunities to get government to lead by example are forsaken;	▪ Prioritize building capacity to conduct energy-***and-environment*** audits; ▪ In addition to conducting audits targeting commercial and industrial energy users, conduct energy-***and-environment*** audits of all government installations, to allow government to better lead by example;		▪ # of trainings and # of persons trained as energy-and-environment auditors; ▪ # of energy-and-environment audits conducted in government, commercial, and industrial locations; ▪ # of audit recommendations implemented;
5) (Institutionalize) green procurement guidelines	▪ Limited capacity to implement and monitor a green procurement system, and hence spotty compliance with green procurement mandate and fewer environmental benefits.	▪ Develop a system to monitor and enforce compliance to green procurement, including training of procurement staff.		▪ Green procurement monitoring and enforcement system.
Biomass Sub-sector				
1) Introduce enabling frameworks to promote alternative clean cooking carriers and technologies (e.g., biogas, LPG, peat briquettes); develop a new strategy / action plan that will identify appropriate technologies	▪ Charcoal remains the preferred fuel in urban/peri-urban areas, given its ready availability;	▪ Develop an explicit charcoal exit strategy and action plan (or charcoal reduction strategy and action plan), with explicit benchmarks, targets, and timelines.		▪ Annual monitoring against specific targets
2) Decentralize the biomass schemes	▪ Limited capacity at regional level to manage environmental issues	▪ Develop environmental management and monitoring capacity at decentralized level.		▪ # of energy-and-environment training events at decentralized level.
3) Promote improved charcoal and wood stoves (e.g., training on modern ICS)	▪ ICS technology standards fail to keep pace with best practicable technology and the technology in use fails to achieve significant environmental improvements (e.g., health improvements);	▪ Routinely review ICS technology standards (in close collaboration with Rwanda Bureau of Standard (RBS/RSB)) to keep abreast of best practicable environmental technology standards and emerging cleaner		▪ Routine assessment of emerging and best performing ICS.

The ESSP (version 16 Sept. 2014) Source of the Potential Impacts	Issues / Potential Impacts	Proposed Mitigation / Optimizing Measures		Proposed Indicators
		technologies.		
4) (Provide) technical support on the choice of stove models	▪ See 3 above	▪ See 3 above		▪ Routine assessment of emerging and best performing ICS
5) (Further) formalize the charcoal supply chain	▪ Negative impacts on the livelihood of informal charcoalers who will be displaced when charcoal production is formalized	▪ Develop alternative livelihood programs for the informal charcoalers;		▪ Alternative strategy for informal charcoalers.
6) Simplify the licensing scheme for charcoalers	▪ Positive impact	▪		▪
7) Train charcoaling professionals	▪ Positive impact, increased efficiency	▪ Ensure regular training		▪ #of training sessions
8) (Revise the) biogas subsidies	▪ The subsidy may disrupt the marketing of the biogas digestors.	▪ GoR need to decide on the introduction speed and environmental costs for removing or changing the subsidy		▪ RWF / % subsidy of installation costs
9) (Supply) alternative fuels: briquettes, biogas, LPG, and liquid biofuels:	▪ Alternative fuels do not respect standards	▪ Ensure that fuel alternative respect standards		▪ Reports from RBS/RSB for alternative fuels
10) Develop a national clean cooking database	▪	▪		▪
Petroleum Sub-sector				
1) Upstream petroleum (exploration)	▪ There will definitely be negative trans-boundary impacts on hydrological regime of water of lake Kivu where exploration is taking place; ▪ Insufficient focus on minimizing the use of fossil fuels, to comply with green-growth imperative (e.g., insufficient attention to sustainable road and air transportation issues);	▪ Comply with environmental criteria when conducting exploration activities; ▪ Minimize the use of fossil fuels to comply with green-growth imperative (e.g., develop sustainable road and air transport strategy; assess the relevance of carbon tax in the aviation);		▪ ESIAs of petroleum sector exploration activities;
2) Midstream petroleum (wholesale bulk purchasing and storage, better transport)	▪ Insufficient focus on ensuring that petroleum products that are imported into Rwanda are mined, refined, and transported in the most environmentally-friendly manner; ▪ Insufficient focus on the environmentally-safe storage of the strategic reserve, leading to spills that cause significant pollution.	▪ Ensure that petroleum reserves are stored in an environmentally safe manner.		▪ Emergency Response Plan for petroleum product storage areas.
3) Downstream petroleum (fuel standards, pricing, LPG growth)	▪ Insufficient attention to explicitly integrate and enforce high *environmental* standards within the fuel quality standards.	▪ Apply environmental standards and 'green procurement' criteria to regional petroleum energy resources and infrastructure; o Integrate and enforce high environmental fuel		▪ High environmental standard and green procurement policy for all petroleum products

The ESSP (version 16 Sept. 2014) Source of the Potential Impacts	Issues / Potential Impacts	Proposed Mitigation / Optimizing Measures		Proposed Indicators
		quality standards for the road, aviation, & rail sectors (e.g., low sulphur fuels).		imported into Rwanda.
4) Infrastructure (regional pipeline)	▪ The regional pipeline is expected to give trans-boundary negative impacts, which will affect certain natural resources (soil, water, air and biodiversity): groundwater pollution and possible surface water diversion, loss of forest and agricultural lands, loss of wetlands and associated ecosystems, visual impact on landscape quality.	▪ ESIA to be conducted on the Project and its implementation.		▪ ESIA according to Rwanda and EAC standards.
Private Sector Engagement				
1) De-risk investments by financing upstream resource assessments & pre-feasibility studies;	▪ Partnership between parties that have little environmental-management capacity could be pursued;	▪ Subject resource assessments / pre-feasibility studies to EIA/SEA studies, where relevant;		▪ Adequate EIA/SEAs of pre-feasibility studies.
2) Establish a *Rwandan Energy Development Fund (REDF)*	▪ Positive impacts are expected	▪		▪
3) Streamline investment promotion processes for IPPs (i.e., simplify)	▪ Streamlining investment processes and a focus on competition could decrease the attention on environmental objectives.	▪ Develop simplified but still comprehensive energy-and-environment guidance, for the streamlined investment processes.		▪ Simplified (but adequate) environmental guidance for the energy sector
4) Empower local enterprises to engage in energy sector deals and introduce more competitive, transparent approaches to service provision	▪ Investors and/or local partners may have little environmental awareness and little environmental management capacity.	▪ Explicitly provide sustainable energy awareness and management capacity building to local enterprises and private investors; ▪ Include 'environmental qualifications' in the tender evaluation process.		▪ # of capacity building in environment events for local enterprises; ▪ Environmental criteria included in tender evaluation grid
5) Extend and expand investment incentives to private investors	▪ Incentives cannot be counteracting to the environmental requirements of the investment projects.	▪ Promote Corporate Social Responsibility (CSR) policies and environmental certifications (e.g., EMS, ISO) for the private sector.		▪ # of firms with CSR or environmental certifications.
EDPRS 2 and Cross Cutting Themes				
1) Capacity building	▪ The capacity development plan may not cover capacity development in environmental management	▪ Require the private sector to have completed some training in sustainable-energy-and		▪ # of Environmental training certificates

The ESSP (version 16 Sept. 2014) Source of the Potential Impacts	Issues / Potential Impacts	Proposed Mitigation / Optimizing Measures		Proposed Indicators
	and sustainable energy development; ▪ The sector's monitoring and evaluation (M&E) system does not include environmental M&E needs;	environment issues; ▪ Integrate environmental curriculum into the energy sector's capacity development program (government); ▪ Establish environmental parameters in the M&E systems		obtained by the private sector; ▪ Environmental curriculum within the capacity development program; ▪ # of environmental management parameters in the M&E system (including regional environment indicators);
2) Environmental conservation, risk mitigation, and green growth	▪ Risk not to meet with the biomass reduction target to 50% until 2018; ▪ Risk not to meet with the renewable energy ambitions	▪ Implement incentives for biomass reduction measures, and renewable energy generation		▪ Monitor annually biomass use
3) Regional Integration	▪ The environmental performance of regional players / projects could be insufficient or the environmental performance of regional projects may not be monitored, e.g. Kivu lake exploration, other regional generation and interconnection projects	▪ Monitor the environmental performance of regional players (e.g., regional projects); ▪ Promote and enhance regional sustainable energy standards (that at least meet, or surpass Rwanda's standards);		▪ (High quality) regional sustainable energy standards;

10 Conclusions and Recommendations

10.1 General Conclusions

Strategic environmental assessment is a decision support process that ensures full integration of objectives and principles of sustainable development in the Strategy, taking into account a need to avoid or limit negative effects on the environment and human health and well-being in Rwanda.

Strategic environmental assessment carried out for the Energy Sector Policy and Plan of the Republic of Rwanda included an analysis of the current state of the environment with special view of areas affected by activities in the field of energy, importance and characteristics of the Strategy, characteristics of effects of planned priority activities, as well as other environmental protection problems, according to criteria for identifying possible significant environmental impacts.

In this process, a predominant planning approach which was used was the one which considered trends which can result from activities in the field of energy sector, as well as scenarios of energy sector development.

The used methodological approach to carrying out the SEA was based on defining the objectives and indicators of sustainable development, as well as on a multi-criteria evaluation of planned priority activities of the Strategy in relation to defined SEA objectives and associated indicators.

In this context, it is especially important to emphasize that SEA is the most important instrument in the implementation of principles and objectives of sustainable development in a planning process. This means that SEA has not addressed only environmental protection (although enhancing it), but also socio-economic aspect of development, so that the SEA objectives have been defined in this context.

The outcome from the various analyses of the NEP and the ESSP has revealed similar recommendations, which are summarised and prioritised in the below table.

10.2 Recommendations for programme enhancement

The recommendations are prioritised as priority 1, 2 and 3 in the below table, meaning that priority 1 should be considered an immediate requirements, priority 2 short term, and priority 3 long term measures, or of less urgency. The main criteria for the classification has been urgency and ease of implementation, but no financial/economic analysis has been conducted. Most of the recommendations are proposed would be the responsibility of REMA, unless specified otherwise in the table below. Moreover, some of the recommendations provided in the Draft Final Report has been removed, since they were taken care of in the NEP and ESSP submitted to the Cabinet. Thirdly, as a response to the stakeholder workshop on 3 December 2014 an attempt to propose implementation responsibilities has been added to the recommendations. The cost implications of the recommendations have not been assessed, since that was not part of the ToR for the assignment. However, in order to reassess the recommendations, such costing of the recommendations should be made by the responsible parties.

Priority	Recommendations	Proposed responsibility
General Recommendations		

Priority	Recommendations	Proposed responsibility
1	Ensure that measures to minimize demand through energy efficiency and timely maintenance are broadly being applied, before considering generation;	MININFRA and its authorities/companies
1	Avoid environmentally protected areas, when siting energy installations; apply environmental best practises in sensitive areas	Project developer, to be monitored / supervised by REMA
1	Integrate environmental criteria into the site and route-selection process;	Project developer, to be monitored / supervised by REMA
1	Integrate extra robustness into the design of energy infrastructure to cope with climate change and variability;	Project developer, to be monitored / supervised by REMA
2	Develop an energy sector land use plan (to reduce land use competition and to clarify where to locate generation and transmission/distribution infrastructure);	MININFRA in collaboration with MINIRENA, REMA and RNRA
3	Enforcing public participation in assessment of energy development projects	Project developer, to be monitored / supervised by REMA
3	Provide environmental awards to energy producers with 'good environmental performance'	MININFRA / REMA
Institutional capacity		
1	Designate environmental officers / environmental focal points within the REG (at national and sub-national level);	MININFRA / REG
2	Establish an institutional framework that can mobilize, co-ordinate and facilitate private and public initiatives for renewable energy/technologies usage in rural areas.	MININFRA in collaboration with Rwanda Development Board and Rwanda Private Sector Federation
2	Ensure that all findings related to energy, integrated planning, and environmental management have excellent executive summaries that highlight core messages (to avoid an increase in coordination and sector-governance tasks)	Project Developers
Capacity development: Environmental Training		
2	Provide capacity development and awareness raising in energy-and-environmental management to the government, to the private sector, to investors, to local enterprises, and provide capacity development at decentralized level;	REMA in collaboration with training institutions
2	Integrate an adequate environmental curriculum into the energy sector's capacity development program (government).	MINEDUC in collaboration with Rwanda Education Board and REMA
Capacity development: Guidance and Standards		
1	Provide clear environmental requirements and standards for energy projects to ensure a level playing field between competing parties;	MININFRA, MINIRENA / REMA / RSB
2	Develop simplified but comprehensive ESIA guidance for the streamlined investment processes and for the ESIA of off-grid installations (this could take the form of an ESIA class assessment, e.g. one 'class' ESIA to cover a number of mini hydro grids);	REMA
2	Establish a greenhouse gas (GHG) inventory in the energy sector, introducing and implementing the ISO 14000 standards for environmental management in energy companies.	MININFRA in collaboration with MINIRENA, REMA and RSB
2	Integrate *environmental* standards into technology	REMA and RSB

Priority	Recommendations	Proposed responsibility
	standards.	
EIA, SEA, energy-and environment audits, CBA, and other economic instruments		
1	Conduct cumulative impact assessments, especially on watersheds that have a number of small energy projects;	REMA to summarise from project developers
1	Prioritize building capacity to conduct energy-***and-environment*** audits;	REMA in collaboration with Training institutions
1	In addition to conducting audits targeting commercial and industrial energy users, conduct energy-***and-environment*** audits of government installations;	Trained and certified energy and environment auditors. Audit reports to be reviewed and approved by REMA
2	Strengthen capacity to conduct ESIA at decentralized level, through ESIA training;	REMA and training institutions
2	Conduct an SEA on Rwanda's wetland habitats, especially bogs, to minimize impacts of peat-for-energy exploitation (this assumes that the *Peat Strategy and Action Plan* did not sufficiently integrate environmental considerations);	MININFRA in collaboration with REMA and REG
2	Explicitly outline and make transparent how trade-offs between costs, carbon intensity, diversification, security… will be decided while optimizing the power mix (e.g., use environmental CBA or environmental valuation methods);	MININFRA in collaboration with REG and REMA
3	Evaluate and apply other relevant economic instruments for the environmental management of the energy sector: e.g., carbon tax, user charges, and/or effluent charges.	MININFRA in collaboration with MINIRENA and REMA
Gender		
1	Incorporate gender impact assessment into existing tools (e.g., into EIA and technology assessments); develop the related guidance.	REMA
Data, Monitoring, and Research		
1	Compile, analyse, and maintain energy–environment data and monitoring data;	REMA and REG
1	Integrate the environmental monitoring data into the energy sector's information management system (project level data and national-level data);	REMA and REG will feed in data to IMS open for nominated users.
2	Develop environmental management & monitoring capacity at national and decentralized level;	REMA and project developers
2	Explicitly support some high-priority energy–environment *research* projects;	REMA and Research institutions
3	Publish and disseminate the energy–environment *research* findings in a user-friendly format.	REMA and Research institutions
Budgets		
1	Ensure that specific and adequate mainstreaming budgets are included in energy project contracts and in the budgets of government departments responsible for mainstreaming energy and environment.	REG /REMA / MININFRA / MINIRENA
Tender processes		
1	Highlight environmental management requirements at time of tender [e.g., clean development mechanisms, cleaner production (and waste	REG / Financiers

Priority	Recommendations	Proposed responsibility
	minimization); *corporate social responsibility*; ISO/EMS certification; availability of environmental management budget];	
1	Ensure that environmental qualifications, environmental criteria, and good environmental performance are included in the tender evaluation criteria of energy projects;	REG / Financiers
1	Ensure that the financial bids show an adequate budget for environmental management.	REG / Financiers
Licensing processes		
2	Integrate environmental criteria into the licensing procedure and approval process;	RURA in collaboration with REMA
2	Approve/renew energy licenses under the condition that the energy generation: ▪ Currently complies with environmental standards (to be verified by REMA and RSB); ▪ Has adopted new, cleaner technology, shows an adequate environmental management system (EMS/ISO), and has sufficient waste treatment capacity.	RURA in collaboration with REMA
Biomass, Charcoal, and ICS		
1	Allocate a lot more budget to the biomass sector (biomass currently has 1% of the budget, whereas it supplies about 90% of energy needs);	MININFRA in collaboration with MINECOFIN and MINALOC (Districts)
1	Routinely review ICS technology standards to keep abreast of best practicable environmental technology standards and emerging cleaner technologies (in particular, focus on quality standards that can achieve health improvements).	MININFRA in collaboration with RSB
2	Develop alternative livelihood programs for the informal charcoalers;	MINALOC in collaboration with MINIRENA
2	Develop an explicit charcoal exit strategy and action plan (or charcoal reduction strategy and action plan), with explicit benchmarks, targets, and timelines;	MININFRA in collaboration with MINIRENA
2	Develop a novelty support to the biogas sector, specifically for institutions, including the environmental aspects;	MININFRA in collaboration with REG and districts
Petroleum Sector		
1	Minimize the use of fossil fuels to comply with green-growth imperative (e.g., focus on sustainable road and air transport sector); o Integrate and enforce high *environmental* fuel quality standards for all petroleum products, including the fuels used by road, aviation, and rail sectors (e.g., low sulphur) and the fuel used for thermal generation.	MININFRA in collaboration with REMA and RSB
Regional Issues		
1	Apply high *environmental* standards and 'green procurement' criteria to all petroleum products (domestic, regional, and global petroleum products) and to the related transportation infrastructure (e.g., pipeline, rail, transportation routes);	Regional institutions (EAC, COMESA, etc.)
1	Ensure that neighbouring countries are informed of energy development projects that has regional impact	REG / MININFRA

Priority	Recommendations	Proposed responsibility
2	Monitor the environmental performance of regional projects;	REMA in collaboration other regional environmental management agencies
2	Ensure that Rwanda's environmental standards match or exceed regional standards.	REMA/ RSB
Transportation Sector		
2	Develop regulations and codes for a sustainable transport system (road, air, rail, and pipeline transport) (e.g., assess the relevance of traffic management measures in urban centres and other sustainable transport measures).	MININFRA
Water		
1	Develop water-sharing agreements with other stakeholders, in areas prone to floods and drought;	MINIRENA
1	Store water or provide irrigation for plantations in areas prone to floods and drought;	Project developer
2	Store water for hydropower, in areas prone to floods and droughts;	Project developer
2	Include 'water scarcity' and 'value of water to be consumed' into feasibility studies;	Project developer
2	Adjust the hydropower plans to reflect water scarcity and the cost of water.	Project developer

The table reveals that most of the recommendations are prioritised as 1 or 2, which means that all recommendations are urgently required, and would be integrated in the revisions of the NEP and the ESSP after an economic and financial analysis by the responsible party.

10.3. Sources of finance for SEA implementation

The implementation of this SEA will require funds from different sources as suggested below:

- Through the operationalization and financing of FONERWA, Rwanda is well placed to attract additional financing from both domestic and external sources, including carbon finance to fund its Green growth and climate resilience strategy. Financing of FONERWA projects are from GoR, DFID, private sector and other development partners, e.g. JICA, Belgian Development Cooperation.
- Energy projects should have a component of environment management (proposed to be a minimum 5% of total project budget),
- Funds might come also from Multilateral Environmental Agreements (MEAs) ratified by Rwanda. Multilateral Environmental Agreements (MEAs) include the United Nations Framework convention on Climate Change (UNFCCC), RAMSAR Convention on wetlands of international importance, VIENNA Convention for the protection of the ozone layer, STOCKHOLM convention on persistent organic pollutants, the Convention on Biological Diversity, among other agreements. At national level, these agreements are coordinated by National Focal Points, Alternate National Focal Points and REMA has the mandate to coordinate all Multilateral Environmental Agreements (MEAs) as stipulated in article 3 of the Law Nº 16/2006 of 03/04/2006 determining the organization, functioning and the responsibilities of REMA.
- Funds from Carbon finance and from other donors (EU, DFID, BTC, etc.)

11 Technical Annexes

Annex 1: June 18, 2014 Preliminary SEA Impact Assessment on NEP 2.5

Annex 2: Compatibility Analysis of the NEP and the SEA Objectives

Annex 3: Assessment of scope of effects of strategic priorities on the environment and elements of sustainable development

Annex 4: Assessment of spatial extent of effects of strategic priorities on the environment and elements of sustainable development

Annex 5: References

Administrative Annexes

(bound in a separate Volume)

Annex 1: List of stakeholders engaged or consulted during scoping and SEA period

Annex 2: Records of Stakeholder Participation (proof of consultation)

Annex 3: Curricula Vitae for Consultants

Annex 4: ToR for the Study