SUSTAINABLE
ENERGY FOR ALL

Rapid Assessment Gap Analysis
Rwanda

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Sustainable Energy for All

Rapid Assessment and Gap Analysis

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EXECUTIVE SUMMARY

The Sustainable Energy for All (SE4All) Initiative has been launched in 2011 by the UN Secretary General Ban Ki-moon, with the three global 2030 objectives of 1) achieving universal energy access, 2) Double the global rate of improvement in energy efficiency and 3) doubling the share of renewable energy in the global energy mix. The implementation of the SE4All initiative is country driven. This 'rapid assessment' document aims to provide a baseline review of the current situation *vis-à-vis* the national SE4All priorities. This 3rd Draft has had one round of input from MININFRA staff, plus a second round of input from a wider set of stakeholders. It is presented for final review and approval by the Sector Working Group at their meeting of 16th October. The next step will then be to develop an Action Agenda which is a strategy-driven document setting out key SE4All objectives at a national level, identifying the issues and gaps that need to be addressed, and prioritising actions required to achieve these goals.

The energy sector is key to Rwanda's economic development and poverty reduction goals. Electricity currently represents a small share of Rwanda's overall energy consumption, but is set to expand rapidly over the next few years. Businesses have identified access to affordable energy the number 1 challenge they face when considering their expansion plans in the country. The country is planning special economic zones to encourage growth in business, and the supply of electricity will have to expand dramatically to service their demand. Likewise, meeting Rwanda's goals of rapidly increasing access to electricity for households will require further expansion of the electricity system. Biomass consumption, mainly wood and charcoal for cooking, currently dominates primary energy supply. Although its share of primary energy will decline over time as other energy sectors grow, biomass will remain a key pillar of Rwanda's energy system. Ensuring the sustainability of biomass supply in terms of environmental and health impacts remains a major challenge for a densely populated country like Rwanda, especially in areas of the country where shortfalls are already evident.

Rwanda has ambitious targets to rapidly scale up its energy infrastructure starting from a low base. But with high levels of poverty in the general population, doing this in an affordable way presents a formidable challenge. Firstly, the scale of the investment is high. It will require $4bn cumulatively over 4 years to meet energy sector policy goals by 2018[1]. This represents an annual expenditure of almost 20% of GDP. Even if the upfront capital for such investments can be raised, building of assets at this scale also create large liabilities in terms of the operation and maintenance costs, as well the need to service the financial costs and depreciation. Even excluding the upfront capital costs, the affordability of the energy system therefore needs careful consideration. Implementing such major expansions of infrastructure presents another formidable challenge in terms of the capacity of supply chains to deliver, in terms of human capacity, skills equipment and know-how.

Currently the Ministry of Infrastructure is responsible for providing project-by-project oversight of new energy sector developments. It is already stretched in terms of capacity to do so. Providing such oversight will be even more stretched if generation capacity is 5 times larger in 4 years' time as planned. Re-structuring of the energy utility should help the Ministry to delegate more responsibility for project delivery, but this will take time to achieve. The speed at which infrastructure is rolled out will also have a big impact on the ability of local supply chains to expand in line with demand. Very rapid expansion may result in by-passing of local supply chains in favour of large multi-nationals which have the ability to deliver at scale.

[1] Energy Sector Strategic Plan 2014 (Table 21 – summary of costs and financing requirements 2013-2018)

Expansion of the energy system also raises major issues of foreign policy and trade. Many of the energy resources at Rwanda's disposal such as hydro and methane are shared with its neighbours, requiring international agreements to be forged on how these resources should be exploited. Developing regional trade in electricity is another major opportunity for Rwanda to gain access to lower-cost electricity for example from Kenya and Ethiopia. Whilst the issues raised by international trade are different from those of the shared energy resources for hydro and methane, important questions remain about the ability to establish the long-term trade relationships and contractual terms needed to ensure security of supply. The role of imports in Rwanda's electricity supply is therefore a major strategic decision, affecting the balance between large-scale investments in interconnectors vs. development of domestic supply.

Rwanda also has major plans to encourage re-settlement of people into areas with higher population concentration in order to provide them with greater access to jobs, and to streamline provision of public services such as education and health etc. These plans have very large implications for the design and roll-out of Rwanda's provision of energy services, both in terms of electricity infrastructure, and also in terms of provision of fuel for cooking. There are also important links with Rwanda's plans for development of secondary cities - again these urbanisation trends will have important implications for the energy system.

At the same time as considering how to achieve such a major expansion of infrastructure, Rwanda needs to consider a range of extremely important cross-cutting themes, including:

- Minimising the environmental impacts of energy provision which can arise from all aspects of the energy system including biomass, peat, hydro, methane and fossil fuels. Rwanda is committed to taking a green growth approach to development, and energy goals need to be aligned with maintaining a sustainable environment.
- Gender-based effects of policy need to be considered. The choice of energy source can have particular effects on women since they are often responsible for collecting biomass as well as cooking, having a disproportionately high impact on their time and health.
- Security of supply issues need to be addressed across all energy types. For example, security regarding petroleum products needs regional coordination, as well as country-specific actions regarding strategic oil storage reserves in order to reduce supply shortage risks.
- Some energy supply options, particularly hydro, are vulnerable to climate change, and the likely increase in variability that this will bring to rainfall patterns and water availability. The country needs to take a risk-based approach to assessing its dependence on different energy sources taking these vulnerabilities into account.

The need to address such a wide range of issues and cross-cutting themes creates a huge need for coordination. Not only a wide range of ministries and government agencies, but also with a wide group of stakeholders including development partners, private sector businesses, NGOs, and civil society. In addition to the sheer scale of infrastructure scale-up required, this need for coordinated planning presents an almost equally daunting challenge.

Rwanda has already taken major steps towards addressing these challenges. To begin with, there is a strong commitment at the highest levels of Government towards energy goals which are very well aligned with the overall global goals of SE4All. These include increasing energy access, development of clean low-carbon energy sources and improving energy efficiency. The country is close to approving a new National Energy Policy and an Energy Sector Strategic Plan. These set out a framework and specific actions for achieving policy goals to 2018 in all areas of the energy sector which provide an essential starting point for the roadmap towards longer-term SE4All goals.

At an implementation level, the country has seen some remarkable successes, notably in electricity access roll-out programme (EARP), which has seen the number of households connected to the grid

grow from around 11% of the population in 2010 to 20% of the population in June 2014. The level of planning for the expansion in distribution to households and small and medium enterprises is sophisticated, taking account of detailed spatial information and comparative costs of supplying different areas depending on distance from grid, terrain etc. There is currently less detail in the planning of generation, which tends to be based on an assessment of the current pipeline of potential projects. Steps are being taken to strengthen the ability to assess future power supply options on a more strategic basis, including the ability to carry out least-cost planning approaches over a time period consistent with SE4All. It will be important to ensure this planning capability can strengthen MININFRA's institutional role in driving the direction of the energy sector. Energy efficiency also needs to be strongly embedded and will require the ability to appropriately assess and target energy intensity taking into account changes in the industrial structure of the economy.

The private sector is expected to be instrumental in delivering SE4All goals. Whether it is supplying components and materials that are then installed by the state-owned utility company, or more direct investment in energy projects as independent power producers or suppliers of household equipment (improved cook stoves, biogas digesters, solar home systems etc.), the private sector will need to take an increasing role. There are many challenges to overcome in order to realise this however, including the capacity of Rwanda's energy sector supply chains, the human resources in terms of skills and knowledge. A key issue to address will be ensuring access of companies and individuals to sufficient credit on reasonable terms to enable the required levels of investment.

This rapid assessment provides a brief overview of the current energy situation, showing that Rwanda's energy objectives are well aligned vis-à-vis the SE4All goals. The major challenges and gaps that currently exist in Rwanda's ability to deliver SE4All goals are outlined, and will be the subject of more detailed analysis in the SE4All Action Agenda to be developed over coming months. This will be a collaborative process, engaging with stakeholders through the Sector Working Group.

Rwanda's Action Agenda will aim to achieve two main goals. Firstly, it will identify the actions required to meet the SE4All goals. Secondly, it will provide a process for on-going collaboration and coordination between stakeholders to implement the actions. The Action Agenda will be owned by the Ministry of Infrastructure, but the stakeholder engagement through the energy Sector Working Group process initiated during development of the Action Agenda will continue for years to come, allowing the agenda to be reviewed, updated and monitored by all relevant stakeholders. The strategic opportunity to Rwanda of engaging as an early mover in this process include:

1. Assessing Rwanda's energy needs within the context of SE4All framework should help to align the government's energy objectives with the global development community. Although SE4All does not represent a new source of financing, aligning and agreeing SE4All objectives should help to facilitate the flow of financing due to the high-level global political commitment, since SE4All is likely to drive the post-2015 development agenda on energy.
2. The SE4All Action Agenda will help identify the key gaps in Rwanda's ability to implement its energy sector goals, and prioritise specific actions to be taken to address these gaps. This will help to provide all stakeholders with an agreed roadmap, facilitating implementation.
3. SE4All assesses energy sector developments to 2020, 2025 and 2030. These planning horizons are well-matched to the timescales required for major infrastructure investment decisions, especially when they relate to novel or relatively complex projects being considered in Rwanda (e.g. hydro, methane, geothermal, peat and regional integration). Taking a longer-term view should help stakeholders focus on the strategic issues that need to be addressed in Rwanda's energy sector, also helping to facilitate implementation.

CONTENTS

ACRONYMS AND ABBREVIATIONS

ACRONYM	DESCRIPTION
AfDB	African Development Bank
BEST	Biomass Energy Strategy
BTC	Belgian Technical Corporation
CBOs	Community-Based Organization
CDM	Clean Development Mechanism
CFL	Compact Fluorescent Lamp
COMESA	Common Market for East and Southern Africa
EAC	East African Community
EAPP	East African Power Pool
EDCL	Electricity Development Corporation Limited
EDPRS	Economic Development and Poverty Reduction Strategy
EE	Energy Efficiency
EICV	Enquête Intégrale sur les Conditions de Vie
ESSP	Energy Sector Strategic Plan
EU	European Union
EUCL	Electricity Utility Corporation Limited
EWSA	Energy Water and Sanitation Authority
GDP	Gross Domestic Product
GIZ	German Technical Cooperation Agency
M/GWh	Mega/Giga-Watt hour
HFO	Heavy Fuel Oil
HPS	High Pressure Sodium-lamps
ICS	Improved Cook Stoves
IPP	Independent Power Producer
JICA	Japan International Corporation Agency
KWh	Kilowatt-hour (Unit of electricity)
LEDs	Light Emitting Diodes
MDGs	Millennium Development Goals
MEPS	Minimum Energy Performance standards
MINAFFET	Ministry of Foreign Affairs
MINAGRI	Ministry of Agriculture and Animal Resources
MINALOC	Ministry of Local Government
MINECOFIN	Ministry of Finance and Economic Planning
MINEDUC	Ministry of Education
MINICOM	Ministry of Commerce
MININFRA	Ministry of Infrastructure
MINIRENA	Ministry of Environment and Lands
MINISANTE	Ministry of Health
MTEF	Medium Term Expenditure Framework
NBI	Nile Basin Initiative
NDBP	National Domestic Biogas Programme
NELSAP	Nile Equatorial Lakes Subsidiary Action Program
NEP	National Energy Policy
NICA	National Inspectorate and Competition Authority
OGS	Office of The Government Spokesperson
PPA	Power Purchase Agreement
PPP	Public-Private Partnership
PSF	Private Sector Federation
PV	Photovoltaic
RBS	Rwanda Bureau of Standards
RECO	Rwanda Electricity Corporation

REG	Rwanda Energy Group
REMA	Rwanda Environment Management Authority
RWASCO	Rwanda Water and Sanitation Corporation
RWF	Rwandan Franc
SINELAC	Société Internationale d'Electricité des Grands Lacs
SWAp	Sector Wide Approach
SWG	Sector Working Group
SWH	Solar Water Heater
UNDP	United Nations Development Program
VAT	Value Added Tax

1 INTRODUCTION

This rapid assessment provides a brief overview of the current energy situation in Rwanda vis-à-vis its SE4All goals. It draws primarily on a number of existing Government documents, notably:

- Draft Energy Sector Strategic Plan (ESSP) (being reviewed for approval by cabinet)
- Draft National Energy Policy (NEP) (being reviewed for approval by cabinet)
- Economic Development and Poverty Reduction Strategy II (EDPRSII)
- Private Sector Development Strategy
- Biomass Strategy

In addition, a number of other sources have been used, and these are referenced in footnotes where appropriate.

1.1 COUNTRY OVERVIEW

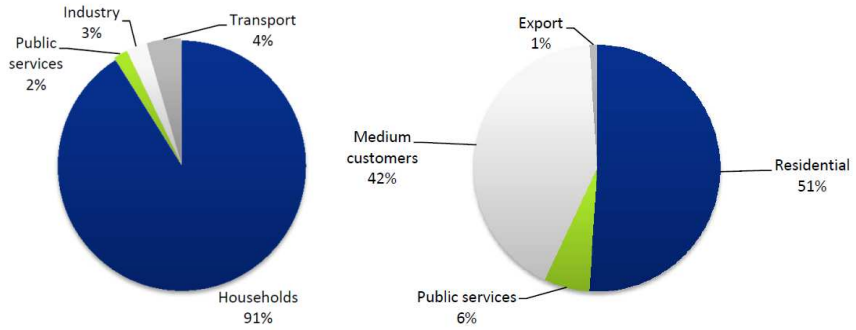
Rwanda is a small land-locked country of 26,000 sq km. With a population of around 10.3m (2010) it is densely populated relative to other African countries. In 2010, GDP was 548 USD/capita. Rwanda's economy has been growing at an annual average rate of 8.3% and government is targeting to achieve an annual average growth rate of 11.5% over the period (2017/2018). This is the time period covered by Rwanda's second Economic Development and Poverty Reduction Strategy (EDPRS II) which covers 4 thematic areas of achieving rapid economic growth, rural development, productivity and youth employment, and accountable governance. Ensuring access to affordable and modern sources of energy has been identified within the EDPRS II as an essential component to achieving these objectives.

1.2 ENERGY SITUATION

1.2.1 Energy supply & demand

In 2008, total primary energy supply was 111 PJ[2], mostly in the form of traditional biomass. Households are the dominant consumers of energy (91%), followed by the transport sector (4%), industry (3%), and public services (2%)[3]. Households are also the dominant consumers of electricity (51%), which is primarily used for lighting. The second largest consumer is the industrial sector (42%), which mainly comes from motor-drivers and lighting. Public sector consumption (6%) is largely due to public buildings, street lighting and water pumping[4].

Figure 1 Energy and Electricity Consumption by Sector, 2009 and 2012



Energy Consumption by Sector (2009) ***Electricity Consumption by Sector (2012)***

[2] IRENA country profile for Rwanda
[3] Low-Carbon Africa Report, November 2011
[4] Draft National Energy Efficiency Strategy, January 2014

In terms of household cooking energy, 97% of all consumption comes from biomass energy resources, comprising firewood 86%; charcoal 11%; crop waste 2%; and other fuels 1%. In urban areas, electric stoves and microwaves are used to a limited extent. Commercial establishments and wealthier households are increasingly using Liquefied Petroleum Gas (LPG). The balance of energy will shift over coming years due to a projected increase in demand for electricity as illustrated in Table 1. Nevertheless, over the time period to 2018, the main primary energy source in Rwanda will continue to be biomass, principally used in cooking.

Table 1 Illustrative view of planned use of energy from different sources by 2018

	Transport	Heating and Cooking	Lighting	Modern Domestic and commercial Technologies	Industrial processing
Bio-products	Small fraction of transport expected to use Biofuels	Bio-products dominate; transition away from wood to charcoal and Biogas.		none	Small use of Bio-products e.g. wood burning for tea processing
Petroleum	Vast Majority of transport will continue to use petroleum products	LPG will be used but will remain a luxury for the urban wealthy	Kerosene may be used but Electricity will dominate	none	Petroleum to be used for heavy machinery or where grid connections are unavailable
Electricity	Electric Vehicles not envisaged in the next 5-years	Electricity will not make economic sense for heating and cooking	We expect a significant increase in both on and off-grid electricity for lighting	Electricity will be the only possible option	We expect a significant increase in Electricity use for industrial processing

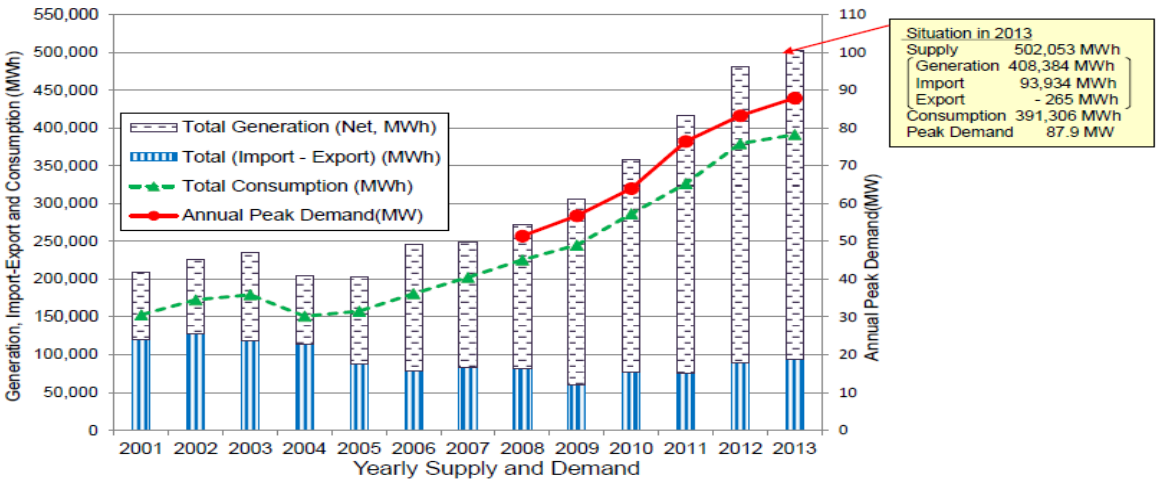
Note: A red arrow indicates a significant rise in use of a particular energy source for a given activity

Electricity is an essential driver of modern technology and socio-economic development, both for low consumption devices such as lights and mobile phones and large users such as industries which will enable industrial processing activities, value addition, driving exports and job creation. Although electricity currently represents only about 4% of primary energy consumed in Rwanda[5], it is planned to grow exponentially over coming years. Currently, Rwanda has one of the lowest per capita electricity consumption in the world[6]. Although the densely distributed population should facilitate network expansion and access to electricity, presently only 19% of Rwanda's households are connected to the grid. Government plans are to provide 70% of the population with access to electricity (both on-grid and off-grid) by the end of EDPRS II.

Since 2008, power supply has increased by 10% to a total of 502,053 MWh. Total consumption has been growing on an annual basis, following a logarithmic trajectory. Power demand does not materially fluctuate seasonally. Total installed electricity generation capacity is currently 119.6 MW, of which roughly 60% comes from hydrological resources and 40% from diesel-powered generators.[7] Rwanda has a very pronounced peak demand load occurring during the early evening hours 6-9pm, which was registered at 87.9 MW on average annually in 2013. This is due to the dominance of household lighting as the main use of electricity. Supply is occasionally unable to match demand in

[5] Biomass use survey in urban and rural areas in Rwanda, 2012.
[6] EDPRS II, p.49
[7] EWSA, Grid Audit Report, 2013.

these peak hours. The electric utility has about 450,000 household customers and 170 customers in the industrial category[8]. Future demand for electricity by 2017/2018 is projected to reach 470 MW.



In terms of energy security, Rwanda has access to a variety of domestic primary energy resources. In addition to having significant renewable energy resources (hydro, solar, geothermal, and biogas) described in Section 2.3, Rwanda also has access to the following important sources of domestic energy supply:

- **Peat to power**. Currently peat is used as an input in cottage industries, cement production, and as a cooking fuel in a small number of decentralized institutions. Rwanda has estimated reserves of 155 million tons of dry peat[9] spread over about 50,000 hectares in Akanyaru, Nyabarongo, Rwabusoro and other areas. Approximately one-third of this resource is currently commercially extractable for industrial heat or electric power production. These resource estimates are largely based upon a 'high level' master plan undertaken in 1993, with only a small number of samples being taken and the majority of work carried out as desk-based research. In late 2013 and early 2014, more detailed resource assessments are being undertaken by Rwanda Energy Group (REG) in order to complement and refine the existing peat master plan. Parallel to this, several projects have independently developed feasibility studies based on peat resource potentials identified in specific locations. However, it is important that at the national level Rwanda has an accurate assessment of its resources in order to determine how to use them most efficiently and sustainably, as peat energy is not generally considered to be renewable. In addition, some peat resources are located in environmentally sensitive habitats. Peat bogs can play an important role in regulating water flow rates. It is therefore important that any peat extraction programmes assess the potential impacts on these environmental services, and any knock-on impacts on the ability to regulate flooding or drought conditions.
- **Methane Gas**. The majority of the country's methane gas resources stem from the unique geology of Lake Kivu. Some 1000 studies have been carried out on the methane gas found in Lake Kivu. Lake Kivu is estimated to contain 55 billion cubic metres of methane gas, with a further 150 to 250 million cubic metres of methane being generated annually in the lake. In recent years, the Government has focused its energy policy strongly on proving the technical and commercial viability of extracting methane from Lake Kivu in order to produce power and the more methane gas is extracted the safer the lake, as there will be less methane gas that could potentially explode in case there is volcanic eruption beneath the lake. According to feasibility studies undertaken by the energy utility, the gas potential of Lake Kivu is

[8] Energy Sector Strategic Plan 2014
[9] Peat Master Plan prepared by EKONO.

sufficient to extract around 700MW of power generation over a period of 50 years. This would put the national resource potential at 350MW, as the resources are shared equally by both Rwanda and DRC through an international agreement. The commercial viability of power generation from gas extracted from Lake Kivu has already been demonstrated at a pilot plant operated and owned by Kibuye Power I (KP I) with an installed capacity of 3.6MW. This plant is contributing to the R&D required to develop the methane resource. The expected commissioning of the 25MW KivuWatt power plant in late 2014 will be an important next step in assessing the feasibility of Lake Kivu methane gas.

As well as domestic resources, Rwanda is actively participating in a range of regional energy development initiatives, where it has a share of resources which lie on or across national boundaries. The Eastern Africa Power Pool (EAPP) was formally established in February 2005. There are currently 9 members including Kenya, Uganda, Tanzania, Burundi and the DRC... The aim of the EAPP is to foster coordinated power development by promoting synergies among the region's electricity utilities and therefore, optimize investments and resource allocation. Presently, EAPP is in the process of building its technical and regulatory capacity. A number of development partners are providing support in the design of the power system and control centre, harmonization of standards, preparation of grid codes and market rules. There are also a number of power interconnection projects between EAPP countries that are at different stages of implementation. The key power line projects which will help enable imports into Rwanda are:

- Gilgel Gibe III (Ethiopia) - Suswa (Kenya), High Voltage Direct Current: financing completed, expected completion date in December 2017.
- Lessos (Kenya) – Tororo (Uganda), 400 kV: under construction, expected completion date in December 2016
- Masaka – Mbarara (Uganda) designed for 400 kV but to be initially operated at 220 kV: currently under discussion, preliminary expected completion date in December 2016
- Mbarara – Mirama, 220 kV double circuit: under construction, expected completion date in in April 2015;
- Mirama – Shango, 220 kV double circuits: under construction, expected completion date in June 2015.

Rwanda is also a member of the Nile Basin Initiative (NBI). Apart from using its share of regional hydro plants - SINELAC and Rusizi I (SNEL), Rwanda is not connected to any regional transmission network; however, it's pursuing cross-border interconnections with Uganda and Kenya.

The governments of Rwanda and Uganda recently reached an agreement with AfDB and Japan (JICA), as part of the Nile Equatorial Lakes Subsidiary Action Plan (NELSAP), to develop a 220 kV transmission line, which is under implementation. The line is designed for a possible export/import capacity of 200 MW, although it will initially be operational at 110 kV with an interchange capacity of 20 MW. This 172 km line would form part of EAPP and permit the countries in the region to trade power and reap benefits from the development of the most competitive power generation candidates in the region. The project is expected to be completed by 2016.

The long-term vision is that Rwanda will become an active electricity trading partner to the regional grids; exporting electricity to the network while also importing power when cheaper supplies can be secured from sources like hydro plants in the Lower Kafue Gorge of Zambia (to be imported via Tanzania), and hydro plants in Ethiopia (to be imported via Kenya and Uganda).

International experience has shown that the establishment of wholesale trading arrangements to facilitate full cross border trade can take a considerable amount of time and in the short to medium term trade is likely to take place utility to utility. There are ongoing projects within the EAC that are building cross border interconnectivities to facilitate energy trade.

1.2.2 Energy and economic development

Because of the dominance of traditional biofuels, in monetary terms the energy sector represents a relatively small share of GDP. In the rural areas, biomass meets up to 94% of energy 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. Nevertheless, as noted in the Biomass Strategy of 2009, the biomass sector (especially wood and charcoal) represent important employment opportunities in rural areas. However, biomass is already in short supply with the country facing a biomass deficit of over 4 million m^3 per year[10]. Although fuel wood consumption is expected to increase in the short-term, the long-term strategy of the EDPRS II is to reduce fuel wood consumption for cooking from 94% to 50% by 2018, although plans for how to achieve this need further elaboration. The significant market for charcoal (~150,000 ton in 2008) has a total value of over $50 million, accounting for more than 2% of GDP; this is comparable to the market for electricity and is larger than the export value of coffee[11]. Whilst there are standards in place for charcoal production, enforcement can be an issue, leading to problems of competition between producers using higher efficiency methods and low-cost producers who tend to use more wood.

Currently, imports of fuels, mostly petroleum products, are significant, costing Rwanda USD 28m in 2009[12]. Petroleum consumption increased in absolute terms by over 16% between 2000 and 2012, yet the oil import bill grew by more than 700% in the same period. As a share of GDP, oil imports increased from about 2.5% in 2000 to above 5.5% by 2012. Still, this level of growth has been relatively more modest compared to Rwanda's neighbours. The demand for petroleum products will continue to rise on account of increased transport vehicles and expansion of the fleet for the National airline, more than offsetting the reduction of imported diesel for electricity production.

The diesel fuel and heavy fuel oil required to run petroleum-based power plants represents a large share of the total national import burden, and is one factor driving the high cost of electricity and currency depreciation. Approximately US$ 56,000 is spent per day as operational expenditure on diesel imports. The current average estimate of losses in the power system (both technical and non-technical) is around 23%.

Electricity costs for householders are currently heavily subsidized[13]. Tariffs of around US¢20-24/kWh cover a substantial portion of the current average system cost of the electricity system, but do not cover the much larger fixed costs associated connecting new households to the system. Currently consumer subsidies for electricity amount to around $50m per year[14], two-thirds of which is related to the cost of new grid extensions for households.

[10] BEST Strategy, 2009
[11] Global Alliance for Clean Cookstoves Rwanda Market Assessment Sector Mapping April 2012
[12] IRENA country profile for Rwanda
[13] Energy Sector Strategic Plan
[14] AfDB 2014 "Towards Inclusive Green Growth in Rwanda: Costing of Investment Needs, Focal Area: Energy"

2 CURRENT SITUATION WITH REGARD TO SE4ALL GOALS

2.1 ENERGY ACCESS VIS-À-VIS GOAL OF SE4ALL

Ensuring access to sustainable and affordable energy is integral to Rwanda's poverty eradication and socioeconomic transformation, and is prioritized at the highest levels of government. Energy access is fully integrated into Rwanda's Economic Development and Poverty Reduction Strategy (EDPRS II) for the period 2013-2018, with policies, targets and strategies further elaborated in recently proposed National Energy Policy and Energy Sector Strategic Plan, as outlined in the following sections. Whilst a strong focus of policy to date has been on the electricity access roll-out programme (EARP), other aspects including energy for cooking and productive uses of energy for industry, services and commercial activities are fully recognised as essential elements of energy access within Rwanda's energy policy and strategy.

2.1.1 Modern energy for thermal applications (cooking, heating)

Currently, the average household uses around 1.8 tonnes of firewood in a year to satisfy its cooking needs with a traditional stove[15]. Rwanda lost 37% of its forest cover (around 117,000 ha) between 1990 and 2010. To combat this, one of the approaches used by Government is to focus on increased wood production (over 80% of the country's firewood and charcoal currently comes from Eucalyptus trees through artificial plantations and agro forestry programs). Annual demand for woody biomass in Rwanda currently is 2.9 Mt, more than double the available sustainable productivity of 1.1 Mt[16]. Of this, around 0.7Mt is estimated to be commercial firewood[17]. Charcoal consumption is estimated at 150,000t per year, requiring 1.2Mt of wood to supply. Whilst it must be noted that there are significant health and social benefits of transitioning to charcoal, it is likely to increase the pressure on the limited wood supplies because of the inefficiencies of charcoal production. This issue is likely to be accelerated as more and more people move from rural to peri-urban environments where use of charcoal is more common.

There are important rural economic benefits to the use of biomass that should not be overlooked. The 2009 Biomass Strategy notes the employment and other net economic benefits of creating a sustainable biomass supply are much higher than those of importing more petroleum fuels to meet the energy demand. Therefore, although access rates to commercial non-solid fuels are low (Table **2**), the solution for Rwanda is not necessarily to expand access to fossil fuels, but rather to expand supply of sustainable biomass, and to focus on efficient stoves and biogas alternatives.

Table 2 Access to Non-Solid Fuel for thermal applications (% of population)[18]

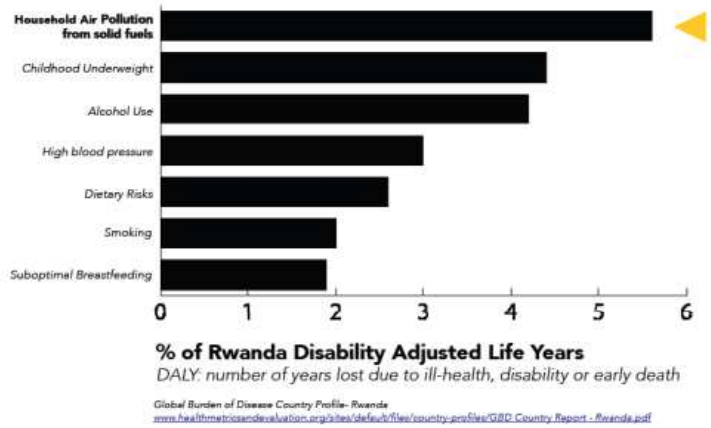
Total			Rural	Urban	
1990	**2000**	**2010**	**2010**	**2010**	**Latest available Source/year**
< 5%	< 5%	< 5%	< 5%	5%	National Survey 2007

An essential element of Rwanda's SE4All strategy is therefore to improve both the efficiency of cookstoves in order to close the gap between supply and demand, but also to reduce the environmental effects of biomass cooking, in particular household air pollution (HAP). There are an estimated 5,680 deaths a year in Rwanda related to HAP, but worst of all over 94% of these are

[15] Energy Sector Strategic Plan
[16] Global Alliance for Clean Cookstoves Rwanda Market Assessment Sector Mapping April 2012
[17] Biomass Energy Strategy 2009
[18] SE4All Global Tracking Facility – data annex

children. HAP kills more Rwandans than HIV/AIDS. As well as deaths, HAP has an extremely high disease risk factor compared with other health related issues such as underweight childhood or smoking (Figure 2).

Figure 2 Burden of disease by risk factor in Rwanda



It is with this in mind that the Energy Sector Strategic Plan set the following objective:

'The government target is to ensure at least 80% of the urban market is with access to improved cook stoves by 2015 and 50% in rural areas. Ultimately, the target is to reach 86% and 63% of urban and rural access to improved cook stoves by 2020 respectively'.

The Rwandan government initiated an Improved Cook Stove (ICS) program in the late eighties / ninties to combat deforestation. Various programs have been implemented since, which has led to a penetration rate of 'improved' stoves of over 60% in 2012. However, the World Health Organization suggest that some 'improved' cook stoves still have emissions 20x above safe air quality levels and much more efficient cook stoves now exist, and there is a need to provide standards for further improvements. Given that around 85% of all energy in the country is in the form of biomass used for cooking, such an intervention on improving cookstove standards could be one of the most significant interventions in the energy sector.

Another potential contributor to sustainable heat supply is biogas. The government is targeting 12,000 biogas digesters to be installed by 2018 and for the incorporation of digesters in relevant institutions, through two programmes:

- The National Biogas Program (NDBP): Started in 2007 and follows the principles of: supporting the poorest whilst still leveraging private sector involvement, and developing a commercial and sustainable domestic biogas sector by ensuring companies know how to maintain as well as install digesters. Since initiation roughly 3,700 digesters have been disseminated, with the support of 50% government subsidy through local credit giving institutions. If the program is to reach 100,000 biogas digesters by 2018 the total cost of the program, which includes the training of masons, subsidy etc., is estimated at $37.3M.
- Institutional biogas program: Has so far resulted in 68 installations, with 11 out of 14 prisons reached and the remaining 3 under development.

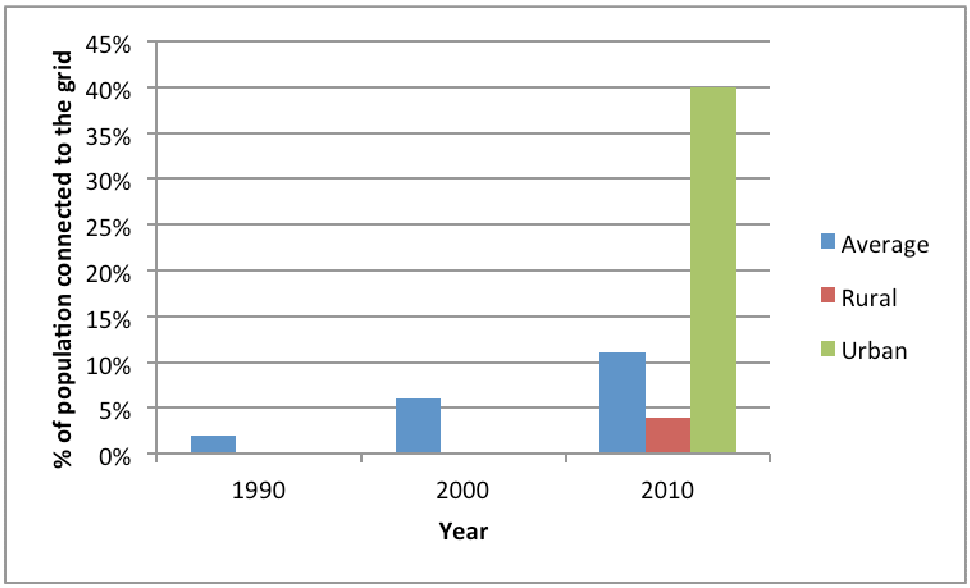
There are a variety of constraints to the provision of biogas digesters. Market absorption capacity is constrained by low purchasing power of households, and financing options need to be developed which can help households to spread out payments making the equipment more affordable.

Secondly, there is a lack of information and standards to allow better targeting and prevent digesters breaking down. Lastly, more training is required to increase mason numbers and ensure effective maintenance.

2.1.2 Access to electricity

As of the end of May 2014, about 19% of Rwanda households were already connected to the grid. This represents rapid progress compared to historical access rates (see Figure 3). Access rates in urban areas are significantly higher than in rural areas.

Figure 3 - % of population connected to the electricity grid[19]



The government is aiming to ensure at least 70% of households are connected by 2018. This means in particular targeting rural populations. This will be achieved through a mix of grid and off-grid solutions. Various scenarios are being considered for this goal as there are large uncertainties over capacity and ability to raise finance. Households connected through off-grid solutions will tend to be those households furthest from the grid and hardest to reach. More information on the government's plans for extending grid access over the current planning period of EDPRS-II to 2017/18 is contained in Section 3.3.2.

Connection costs depend on the distance of a household from the existing grid infrastructure, but typically average around $1000 per connection. The cost of connecting a household that relocates to an area that already has electricity provision can be much lower, around $350 per connection. Total costs of providing electricity access therefore depend on the roll-out of other policies and social trends relating to urbanisation and development of towns and clusters. These trends also affect the cost-effectiveness of provision of many other services such as health and education, as well as increasing opportunities for a wider range of economic activity and employment.

The household tariff for electricity is around US¢20-24/kWh. This is sufficient to cover the unit costs of generation, but not the total costs including transmission and distribution. Households are currently required to pay $10 per year over a 10-year period towards connection costs, amounting to $100 in total (excluding any interest charges). This is in addition to the charges for electricity consumption. The great majority of the connection fee is subsidised by government and development partners.

[19] SE4All Global Tracking Facility – data annex

For households whose income cannot support grid connection costs, or those located far away from the grid the government is sensitizing these people to utilize off-grid solutions. Main priorities for these communities tend to be low-consumption applications such as phone charging, radios and lighting. Electricity is planned, in such cases, to be provided from solar installations, small off-grid hydro installations, and biogas digesters. A more detailed strategy needs to be developed for how these off-grid solutions are going to be delivered, and how to coordinate provision of off-grid solutions with plans for expansion of the grid system in order to avoid duplication.

2.1.3 Modern energy for productive uses

Current electricity consumption is dominated by households, but industrial demand is expected to grow rapidly in the period of EDPRS-II. In 2013, industrial electricity demand included the cement sector (15 MW), steel sector (10 MW), and irrigation (1.6 MW). Significant growth is expected in other sectors including tea plantations, mines, development of large commercial centres, and industrial parks. Current plans are very ambitious, aiming at almost a tenfold increase in power demand from these sectors over the period to 2017/18 as shown in Table 3.

Table 3 Electricity demand for industrial and large commercial users[20]

MW peak demand	**2013**	**2018 (projected)**
Cement	15.0	15.0
Steel	10.0	26.0
Industrial Park		32.0
Large Commercial		22.5
Mines		55.2
Irrigation	1.6	25.0
Tea		54.6
TOTAL MW	**26.6**	**230.3**

In addition to these large users, the Electricity Access Roll-out Programme (EARP) also aims to support the growth of smaller rural productive uses of electricity in agricultural and silvicultural product processing, irrigation, services, retail, etc. which can generate employment and raise rural incomes in the near term after lines are extended to a village. These can typically have more impact on rural household incomes than simply supplying electricity to the households themselves which does not tend to directly impact incomes, although it can rapidly improve welfare often dramatically and immediately due to far superior night lighting and ICT services: telecommunications, television and radio[21].

There are not currently statistics available to assess the percentage of productive uses that have electricity access, or levels of latent demand, though current levels of usage across the country are very low, and those that exist tend to be small retail & service providers. However, productive uses in rural areas is a vital sector to target (as noted in the mid-term review of EARP). Productive uses help raise rural incomes, and also provide a sufficient source of revenue for sales of electricity, helping lead to sustainable business models for electricity supply to rural areas.

[20] Figures from EWSA May 2014 – may not include latest expansion plans of individual companies
[21] EARP mid-term review

2.1.4 Availability: local supply chain and availability of required technologies

On-grid electricity is supplied by a single state-owned utility, Energy Utility Company Limited (EUCL). Electricity tariffs would potentially be high enough to cover costs in a country where consumption levels were high, but in Rwanda, individual consumption at the household level is still very low on average. This means that the fixed costs of generation (e.g. operating and maintenance of the grid infrastructure, as well as initial connection) form a large part of the overall cost of service. Under the current tariff structure, a household would need to use approximately 130kWh per month in order to fund the cost of their own connection. **Table 4** below illustrates the current consumption patterns across all of REG's consumers. Currently around half of consumers are using less than 20kWh per month. This means that grid roll-out will continue to be mainly financed by subsidies in order to enable increase in access rates.

Table 4 Current Electricity consumption patterns

Consumption per month (KWh)	
0 to 5	**18.4%**
6 to 20	**31.2%**
21 to 50	**26.1%**
51 to 150	**17.3%**
151 and greater	**7.0%**

Under a yearly tariff review, RURA assesses the cost structure of the EUCL and sets new tariff levels commensurate with revenue levels required to make the company financially sustainable under a "required revenue" approach and regional benchmarks for utility regulation. Additionally, in line with the general policy principles, specific social groups will be protected from necessary unit price increases, including through systems that target strategic industries and vulnerable social groups as low-income consumers.

Provision of off-grid electricity in Rwanda is assessed in Section 2.3.3. In terms of availability of improved cookstoves (ICS), it is estimated that overall, 60% of households use some form of ICS. According to the Global Alliance for Clean Cookstoves, the market for ICS can be divided into four segments (see table below), reflecting different incomes and abilities to pay.

Market segment	No. Households	Current cooking device	Willingness to pay for ICS
1. Charcoal purchasers	316k (13% of population),	Charcoal stove, traditional or improved, sometimes LPG	High, can afford to pay for simple ICS out of pocket
2. Wood purchasers	711 k (29% of population)	Traditional stoves, improved wood stoves	Medium, possibly can afford to pay for simple ICS out of pocket
3. Biomass collectors (priority areas)	305 k (12% of population)	3 stone fire, traditional self-made mud stove	Low due to lack of disposable income, but sometimes do not have a choice due to lack of biomass
4. Biomass collectors (other areas)	1.1 M (44% of population)	3 stone fire, traditional self-made mud stove	Low, little to no disposable income

Biomass collectors tend to be the lowest income groups, and so affordability and financing tend to be the main barriers to entry in these sectors. Priority areas are those in which biomass is scarce, making it particularly important from an energy balance point of view to improve the efficiency of ICS. Awareness of the benefits is also identified as a barrier, and development of supply chains needs to be strengthened. Private sector support is required in the form of training, standards and education. Programmes exist throughout the region for provision of reduced-cost or even free ICS financed through carbon financing, although according to some stakeholders such approaches are controversial because of the potential for distorting markets for local businesses and supply-chains within Rwanda for private-sector provision of such ICS. Biogas also presents an important distributed energy solution for Rwanda, as described in Section 3.4.1.

2.2 ENERGY EFFICIENCY VIS-À-VIS GOAL OF SE4ALL

2.2.1 Overview and Assessment

According to official statistics, Rwanda's energy intensity in terms of primary energy consumption per unit of GDP has improved over the period 1990-2010 at a similar rate to that of sub-Saharan Africa in general. These measures are however rather crude for a country like Rwanda, where much of the primary energy is consumed in the informal biomass sector, and where modern fuel consumption levels of for example electricity and petroleum products remain embryonic. However, it seems likely that Rwanda has a chance to benefit from global improvements in product efficiency, and needs to ensure where possible not to lock-in to inefficient infrastructure as its economy grows.

In terms of tackling current energy use, the largest usage is biomass for cooking, and this is a priority area for energy efficiency actions. Energy efficiency measures include improved cookstove programmes, introduction of biogas digesters for providing alternative cooking fuels, and a solar water heating programme. Improving the efficiency of charcoal production is also an essential component of reducing primary biomass consumption. At the latest survey in 2009, the efficiency of charcoal production was 12%. The target for 2015 is to increase this to at least 15% by 2015. The current strategy for improving efficiency in these areas are described in more detail in Section 3.3.1. Awareness raising of the benefits amongst potential users is an important component of this strategy, as well as tackling various financial barriers and strengthening private sector supply chains.

Rwanda's industrial energy consumption is currently relatively small. In terms of electricity, it accounts for around 26 MW, about a quarter of Rwanda's electricity demand. However, there are plans to scale up supply dramatically in response to expected increases in demand from industrial parks, increases in commercial demand, mining activities increases in irrigation and expansion of demand from tea plantations & processing facilities. Likewise, as the economy grows and incomes increase, household demand is also expected to increase. Other public uses such as street lighting are also areas where efficiency will need to be addressed. It is essential that energy efficiency is built into Rwanda's energy economy from the start of this process.

This is recognised by the Government, and has led to energy efficiency being positioned as one of the 5 main strategic pillars of the National Energy Policy (see Section 3 for further discussion). For newly connected households where lighting is the main energy requirement, efficient lighting is already ubiquitous[22]. Transmission & distribution losses in the electricity grid is also an issue that has been recognised as needing improvement. Current system losses are around 23%, much of which are technical losses. The utility company has developed a grid-loss reduction plan to bring this down to 15%.

[22] EARP Mid-Term Review August 2013

2.2.2 Energy intensity of national economy

Measurements of primary energy intensity vary depending on the source. According to IRENA, total primary energy supply is 111 PJ in 2010 against a GDP of $5.6bn. This gives a primary energy intensity of 20 MJ/USD. However, the global tracking framework (GTF) data annex gives the energy intensity figure as 8.6 MJ/USD (in $2005 terms). This discrepancy is probably associated with the difficulties of accounting for primary energy when consumption is so dominated by the informal biomass sector. In any case, the GTF data provides some interesting time series and comparisons between Rwanda and other regions, as shown in Table 5. Negative figures in this table represent an improvement (i.e. reduction) in energy intensity.

Rwanda has shown an overall reduction in energy intensity levels of around 0.9% per year, which is close to the average for SSA region over this timescale. This is a very high level indicator which combines economic structural effects which lead to growth in economic activities without a correspondingly large growth in energy demand, together with more specific technological improvements to the efficiency with which energy is used in any particular economic activity. With these data it is not possible to differentiate between these two components of energy intensity improvement, and further work is required to generate the data that could lead to a more sophisticated and informative analysis.

Table 5 Energy intensity trends over time for Rwanda compare to other regions

	Annual rate of change in primary energy intensity (%)		
	1990-2000	2000-2010	1990-2010
Rwanda	4.50	-6.04	-0.91
Sub-Saharan Africa	0.03	-2.19	-1.08
World	-1.61	-0.99	-1.30

One feature of Rwanda's relatively late entry to electrification is that it is benefiting from significant recent advances in product efficiency. For lighting in particular, which forms the bulk of initial consumption patterns for newly connected households, the roll-out of energy efficient lightbulbs has been almost ubiquitous. This means that in this sector in particular, Rwanda is very likely to continue along an energy efficient pathway. In other sectors, challenges remain, including in particular:

- Cooking – as mentioned above, the need to conserve energy and improve household air pollution is a high priority.
- Electricity supply – ensuring energy efficient supply options, including efficient dispatch of fossil fuel plant, as well as effective maintenance regimes to ensure plant operates efficiently and are updated / refurbished when necessary.
- Transmission & distribution – need to ensure system losses are reduced over time through improvement and O&M of the system.
- Efficiency standards – Rwanda should coordinate where possible with regional initiatives to set efficiency standards for products, appliances and vehicles.

2.3 RENEWABLE ENERGY VIS-À-VIS GOAL OF SE4ALL

2.3.1 Overview and Assessment

Rwanda already has a high share of renewable energy in its electricity generation mix, thanks to its use of hydro-power which currently amount to 55 MW of capacity, and is expected to grow to over

120 MW by 2018 under current plans. Fossil fuels in the form of diesel and heavy fuel-oil (HFO) currently amount to 46 MW, just over 40% of installed capacity. This was installed during the 2000s during periods of electricity supply crisis when the availability of hydro was constrained due to low rainfall levels over a number of years combined with previous over-use of the hydro reservoirs, leading to low water availability.

The plan is to diversify away from fossil fuels because the very high cost of generation from these sources. Rwanda has a variety of both renewable and non-renewable domestic energy resources which it plans to develop to help meet growing demand for electricity, as well as the potential for increasing imports from neighbouring countries. Many of the sources of imports include renewable energy sources, including for example Ethiopian hydro-power, and Kenyan geothermal power. Renewable energy will continue to play a central role in a balanced and secure energy system for Rwanda. In the provision of biomass too, renewable sources play an important role, with the GoR putting emphasis on provision of sustainable sources such as eucalyptus plantations.

2.3.2 Renewable Resources

Hydropower

Studies suggest that Rwanda's topography is most suitable for medium to high head pico and micro-hydro run-of-river schemes. Rwanda's overall technical hydropower potential has been estimated at 400 MW, but the most significant resource assessment conducted to date—the Rwandan Hydropower Atlas—which was conducted roughly five years ago found that the majority of sites identified would be rated between 50 kW and 1 MW in capacity. This study estimated a potential of 96 MW for the category of micro-hydro projects. Although fairly comprehensive, with some 333 potential sites identified across a large number of locations, additional viable sites have already been, and are likely to continue to be identified.[23] An assessment of the energy sector undertaken by the African Development Bank in 2013 estimated the domestic hydropower potential at 313 MW, broken down into 130 MW of domestic hydro and 183 MW of regional hydro resources. Feasibility studies have been completed or are under way for a number of sites representing at least 32 MW of technically viable new capacity. In addition, over 192 sites have been identified for pico-hydro with a capacity below 50 kW.

Evidently, a more detailed resource mapping for the hydropower sector would be valuable, particularly taking a spatial river basin approach before prioritizing specific sites for development. An on-going comprehensive assessment of hydro resources on the Akanyaru River basin, located on the border between Rwanda and Burundi, adopts this approach.

Geothermal

Rwanda possesses geothermal resources in the form of hot springs which have been categorized into four main prospect areas: Karisimbi, Kinigi, Gisenyi and Bugarama. The majority of resources lie along the belt of Lake Kivu. Preliminary exploration studies[24] estimate commercial power generation potential to be in the range of 170-340 MW. Two preliminary wells drilled at one of these sites did not prove the existence of a high-temperature resource in that location. However, exploration of geothermal is a long-term process, and much more detailed exploration studies are needed to derive realistic estimates of national geothermal resources.

Wind

[23] Roughly 20% of proposed sites to be developed to date were not already included in the Hydropower Atlas. Informal communication with Rwanda Development Board, 30 May 2014

[24] Among these include the Chevon Corporation Preliminary assessment of Rwanda's Geothermal Energy Development Potential (2006), BGR Geothermal potential assessment of Virunga prospect (2009), KenGen Geoscientific surveys in the Karisimbi Prospect (2009), Institute of Earth Sciences and Engineering Geoscientific surveys of the Karisimbi, Gisenyi and Kinigi geothermal prospects (2012), ESIA for Karisimbi and Kinigi geothermal prospects (2013).

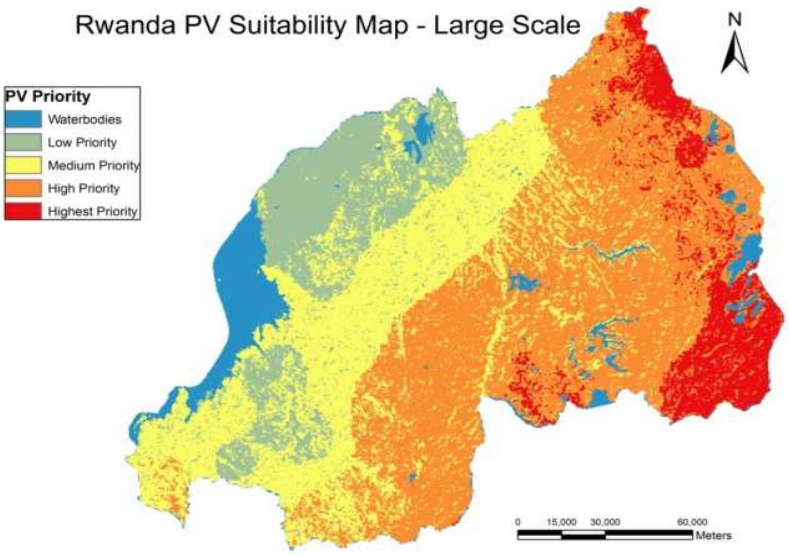
Being located close to the equator, Rwanda's inherent resource potential for wind energy is low. A rapid wind energy resource assessment was carried out in Rwanda in five locations in 2011. Field measurements of wind speeds and climate data over the course of one year were analysed and the preliminary indications were that most of Rwanda is not highly suitable for wind energy. The Eastern province was identified as the most promising potential location, and a simple analysis comparing wind and solar energy feasibility suggested that wind energy could be competitive in this region. More detailed longitudinal resource assessments and feasibility studies are required in this area to determine wind energy potential in Rwanda. Another academic study using modelling analyses based on recorded wind measurements at selected Rwandan meteorological stations noted that electricity production in the area of the Gisenyi station could be possible with a good mean value of both wind speed and power density whereas in areas such as Kigali, Butare and Kamembe wind energy potential is sufficient for windmills or water pumping for agricultural and intuitional needs.[25]

Solar

Rwanda's solar radiation and solar resources were assessed by the U.S. National Air and Space Agency (NASA) as well as the University of Rwanda in order to create a solar energy resource map. Rwanda's Eastern Province has the greatest potential for generating energy from solar resources, as shown in the map in Figure 4.

Another academic assessment undertaken in partnership with the Rwandan department of meteorology using a meteorological data set estimated that the monthly averaged global solar radiation varies between 4.3 to 5.2 kWh per m^2 per day over all regions of Rwanda.[26]

Figure 4 Rwanda PV Suitability Map



2.3.3 De-centralised electrification options

Solar energy

[25] Bonfils Safari. "Modelling wind speed and wind power distributions in Rwanda." Renewable and Sustainable Energy Reviews 15 (2011) 925–935.

[26] C. Museruka and A. Mutabazi. *Assessment of Global Solar Radiation over Rwanda*. Proceedings of the International Conference on Clean Electrical Power, (ICCEP), 21-23 May, 2007.

Solar systems for households are one of the most promising new sectors cost-already making an impact in Rwanda as in other parts of the region because of recent cost reductions and the small and relatively affordable nature of individual units. Initial cost range between $50 and $200 for a solar package, and can be delivered by the private sector. A small private sector already exists and is building capacity to be able to deliver these solutions. REG has provided technical support and training to help build this capacity, and now there are over 30 companies providing household solar systems. Grants from DPs for provision of solar systems are administered via REG in partnership with trade associations allowing these companies to benefit from the ability to provide systems to households at lower cost. Nevertheless, feedback from customers suggests that upfront payments remain a barrier. Some form of financing arrangement allowing payments to be spread out over time could help.

Progress has also been made through government provision in the following areas:

- Remote rural schools (EU funded) – Over 150 schools provided with 1.7kW solar equipment with an end target of reaching 300 schools.
- Health Centre access (BTC supported) – 46 health centres equipped with PV installations.
- Rural settlements - Solar Lantern Kits of 5W have been installed in 15 rural settlements (approx. 1500 households). 400 solar kits of 300W (from Government of China) have been installed in 4 rural settlements.

A proposal has been developed to roll-out off-grid solar home solutions to households which will not be connected to the grid, as summarised below[27]:

i) Solar home systems (SHS): Facilitate procurement and installation of 5W capacity solar lanterns to at least 731,000 households (30% of the off-grid homes by 2017).
ii) Centralised/shared solar systems: Pilot centralized off-grid solar systems. This is proposed to be a pilot for testing how a central solar system can serve 100 homes. This encourages people to resort to planned settlements sharing economies of scale and reducing the cost of service delivery. 4 pilot systems are proposed, with a total cost of $978,000 by 2018.

To ensure success in this sub-sector, Rwanda will need to carry out mass education of citizens on the different energy products available. This is key to technology receptivity, enabling informed decision making, ownership and hence sustainability of these solutions. It will also be necessary to provide support for training and maintenance, support access to finance, and develop the appropriate legal and regulatory environment to support the industry. As well as this, the government will need to ensure that efforts are not rendered obsolete by economic growth and the arrival of the grid. Sharing Electricity Access Roll-out Programme (EARP) connection plans with suppliers is a start.

Affordability remains a bottleneck to accelerated uptake, but any plans to subsidise SHS will need to be carefully thought through to avoid distorting the market. Rather than consumer subsidies, money might be better spent channelled towards indirect market building activities, e.g. training of retailers on marketing schemes, loans for last mile retailers so these are able to purchase lanterns in bulk to achieve economies of scale. Perhaps the most promising approach is to provide support to local micro-finance institutions or banks to encourage and enable provision of loans to the poorest.

Off-grid hydro: Several projects were in existence, but maintenance has often been poor due to inadequate incentives for the utility and/or community owners. There is now a move towards encouraging private-sector development of pico-hydro and micro-hydro power plant (MHPP), which is showing positive results. The number of project developers has increased from zero in 2006 to

[27] MININFRA SE4All briefing paper

twenty in 2014[28]. International investors are providing financing, with larger MHPPs being developed on private financing alone (for the larger sites, approx. 1MW) and with limited public funding of 25% of construction costs for the smaller, less attractive sites. Also the investment unit within EDCL has gained valuable experience in setting up tenders for MHPPs.

Given the expansion of the grid, many MHPP, especially the larger ones, are likely to be attached to the grid in the near future. Off-grid applications are therefore probably limited to smaller and pico-hydro schemes. The major bottleneck for pico- and micro hydro development remains the availability of loans by local banks at acceptable terms, and this is an area where additional intervention could be targeted.

Project sites have been identified through Rwanda's Hydro Atlas and by expense and distance from the grid. Local investors therefore need to be supported in this area and furthermore, encouraged to develop mini-grids to help provide energy to as many rural people as possible as noted in the Energy Sector Strategic Plan (ESSP).

2.3.4 Use of renewable energy sources for thermal applications

There is some use of solar hot water systems in the cities, but statistics are not available to assess how widespread they are or the potential to further roll this technology out. Further work is required in this area.

2.3.5 Use of RES for productive activities

Data is not available on the use of RES for productive activities, except insofar as RES already makes a significant contribution to on-grid electricity supply, which provides a source of clean energy for industrial and commercial users of electricity.

2.4 SE4ALL GOALS

Rwanda's energy policy goals are in general well aligned with SE4All goals. The following specific areas are all high profile policy priorities for the country:

SE4All pillar	Sector	Goal	Document
Access	Electricity	At least 70% of households have access to electricity by 2018. This will be achieved through a mix of grid and off-grid solutions, with 48% of households planned to have on-grid access, and 22% off-grid access.	ESSP
Access	Thermal	Ensure at least 80% of urban households have access to improved cook stoves by 2015 and 50% in rural areas. Ultimately, the target is to reach 86% and 63% of urban and rural access to improved cook stoves by 2020 respectively	ESSP
Access	Thermal	Increase supply of wood from managed forestry sources (targets not defined)	ESSP
Renewables	Electricity	Diversify away from use of fossil fuels	GGCRS[29]

[28] http://endev.info/content/Rwanda
[29] Green Growth and Climate: National Strategy for Climate Change and Low Carbon Development. October 2011.

		towards less carbon-intensive forms of generation (targets not defined)	

3 CHALLENGES AND OPPORTUNITIES FOR ACHIEVING SE4ALL GOALS

3.1 INSTITUTIONAL FRAMEWORK

A summary table of key institutions is provided in the Annex. This section outlines the responsibilities of some of the key players in the energy sector.

3.1.1 Central government

Ministry of Infrastructure (MININFRA)

MININFRA is the lead Ministry responsible for developing energy policy and strategy, monitoring and evaluation of projects and programs implementation. The Ministry is in charge of setting an enabling policy and legal framework for the energy sector, including a suggested general approach to the optimal use of state subsidies in the sector, budget preparation, resource mobilization (together with MINECOFIN), and political oversight over government programs designed to expand energy access and service provision. A key coordination mechanism for the sector in Rwanda is the energy Sector Wide Approach (eSWAP)[30], which has a secretariat within MININFRA.

Rwanda Energy Group Ltd.

The legal mandate of Rwanda Energy Group Ltd is to translate energy sector policies and programs into the implementation of tangible projects to achieve the government vision in the sector and to efficiently operate and maintain the power system of the country. Utility operations have long been regularly subsidized due to a lack of financial sustainability. Guided by a Cabinet request, a task force was formed in mid-2013 to develop proposals for institutional reform in the water and energy sector. Subsequently, recommendations were made and approved by Cabinet to restructure the former EWSA into two separate companies: a Power and Energy Holding company (now the Rwanda Energy Group Ltd) comprising an electricity utility company (now the Electricity Utility Company Ltd) and an Energy Development company (now the Electricity Development Company Ltd), reporting to a CEO and an Independent Board. The Water and Sanitation Company shall be an autonomous company with its own CEO and also reporting to an independent Board.

Unbundling of the two companies was widely perceived as necessary to improve technical planning and operational performance in a manner that is more focused on each sector and less driven by political cycles. REG and its subsidiaries will continue to help execute and implement the energy policy and strategies and support day-to-day monitoring of project implementation. Operating under company law, it will have a more corporate orientation and greater autonomy from political interference whilst still being accountable to MININFRA and the Rwanda Utilities Regulatory Authrority (RURA) in charge in terms of project development activities, utility services and performance standards, respectively. This reform is expected to ensure more operations efficiency and financial sustainability in the medium-term.

EUCL is responsible for generation, bulk transmission and distribution and retailing functions on a commercial basis, while some of new large generation projects are planned for development by the private sector that would sell to the utility under PPAs. The electric utility also functions as a systems operator, and, as the Secretariat for the Grid Code Advisor Committee, has several related obligations including sharing critical information with other market participants and operators on the grid. Both a weekly and annual operations plan must be developed and issued to the regulator as

[30] Further details on Rwanda's eSWAP available at http://www.esmap.org/sites/esmap.org/files/ESMAP_Energy_Access_RwandaSWAp_KS013-12_Optimized.pdf

well as any other registered participants. EUCL is responsible for the following flagship grid roll-out and electrification project:

> ***The Electricity Access Roll-Out Program (EARP)*** is a thematic program for implementing government strategies related to improving electric grid access. It is implemented by the energy utility and has already greatly increased the number of customers connected to the system from about 187,000 at the end of 2010 to over 360,000 by mid-2013. EARP's activities are informed by a study on power transmission and distribution costs as well as an ongoing evaluation estimating the cost and benefits of electricity access to various population groups. EARP funds are managed by MINECOFIN while substantive oversight is ensured by a Steering Committee chaired by the Director General of REG and the World Bank, acting as lead donor for the energy sector. Other contributing donors also take part in the Committee.

Rwanda Development Board (RDB)
Rwanda Development Board plays the lead role in investment mobilization and promotion for the energy sector, acting as a gateway and facilitator. It actively promotes private investor participation in the energy sector, including local financial institutions. It leads on facilitation of foreign direct investment (FDI) into strategic energy generation projects, as well as other programs and activities involving cleaner, more energy-efficient technologies. RDB also issues Environmental Impact Assessments for all energy projects for which one is required. It is expected to also host a centralized authority or advisory agency for PPPs across government.

Ministry of Trade and Industry (MINICOM).
The Ministry of Trade and Industry has developed a number of key policies and strategies aimed at improving the business environment and supporting the development of the industrial sector and export markets, including the National Industrial Policy, which was adopted in April 2011. MINICOM has been responsible for the development and oversight of the downstream[31] petroleum subsector, including implementation of the downstream petroleum policy, establishing and developing petroleum-related legislation, and creating an enabling environment for petroleum products trade in line with the national energy policy objectives.

Ministry of Finance and Economic Planning (MINECOFIN)
The Ministry of Finance and Economic Planning leads on resource mobilization to support energy investment and related financing requirements, such as the funding proposed for national strategic energy reserves[32] and any related replenishments under progressive budget commitments or other modalities as appropriate. Provision of sovereign guarantees for strategic investment projects and IPPs is also granted from MINECOFIN as this is accounting for in a similar way as a debt obligation. MINECOFIN will support in resource mobilization to prove the feasibility of energy resources such as geothermal, peat, solar, and others. It will also provide necessary support required for the private sector in the upstream petroleum exploration activities under the upstream petroleum policy. The Government of Rwanda encourages pooled development assistance through direct budget support mechanisms to the greatest extent possible. The energy sector is no exception. MINECOFIN ensures the fiduciary framework to manage grants, loans, and other concessional finance from development partners into the sector.

Rwanda Utilities Regulatory Authority (RURA)
The Rwanda Utilities Regulatory Authority (RURA) is an independent entity with its own board of directors appointed by Presidential Order and supervised by the Prime Minister's Office.[33] The scope

[31] In Rwanda's case, this refers to the marketing and distribution of petroleum products and natural gas.

[33] See Law 39/2001 of 13/09/2001 Establishing and Agency for the Regulation of Certain Public Utilities and Law 09/2013 of 01/03/2013 Establishing the Rwanda Utilities Regulatory Authority (RURA) and Determining its

of RURA's mandate extends to public utilities involved in renewable and non-renewable energy, electricity, industrial gases, pipelines and storage facilities, and conventional gas extraction and distribution. As the regulator, RURA's principal mandate is to ensure consumer protections from uncompetitive practices while ensuring that such utilities operate in an efficient, sustainable, and reliable manner. This includes oversight of the financial sustainability of public utilities to ensure that they can provide the goods and services necessary to fulfill market demand. RURA also has the important role of updating the electric grid code and ensuring quality of service standards for electric power. Although it is not primarily responsible for the formulation of energy policy, RURA plays an important role, including assessing and reviewing energy tariff structures that promote the availability, accessibility and affordability of energy services to all consumers including low income, rural and disadvantaged consumers. RURA is also responsible for licensing of all power generation, transmission, and distribution companies as well as retail petroleum filling stations and related storage facilities. RURA ensures that upstream activities and operations of oil and gas exploration companies comply with existing and emerging national standards.

Ministry of Natural Resources (MINIRENA)

The Ministry of Natural Resources is responsible for ensuring the sustainability of natural resources exploitation including water, and also has the mandate for developing and managing compliance to the environment policy and law. As such it is the custodian of environmental welfare in Rwanda. Many of its mandates are shaped by the 2003 National Environment Policy. The Organic Law of 04/2005 also established that the "use of substances which may cause climate change" is governed by a Ministerial order of MINIRENA.

MINIRENA is also in charge of developing and implementing policies on petroleum exploration and development until the point of resource extraction. It works closely with the **Rwanda Natural Resources Authority (RNRA),** an autonomous authority charged with management of Rwanda's natural resources including hydrological resources such as land (peat reserves, etc.) RNRA provides technical services in the Upstream Petroleum activities and promotes the productive exploitation of Rwanda's petroleum prospects.

Rwanda Environment Management Authority (REMA)

REMA has the mandate to coordinate, oversee and implement environmental policy and also acts as a think-tank for MINERENA. Generally speaking, all infrastructure development is subject to environmental impact assessment. To avoid any doubt, Environmental Impact Assessment Certificates (EIAs) must be secured prior to the construction of any new energy investments in order to guarantee compliance to environmental regulations in place. REMA is mandated to enforce environmental compliance in the development of energy resources, such as upstream petroleum activities, hydropower plant construction, gas extraction and geothermal drilling among others. REMA monitors and evaluates the impact of exploiting energy resources on the environment both flora and fauna including the compliance of oil and gas distribution companies to environmental standards. REMA also plays an important role in coordinating approval of national climate finance projects, of which several are likely to be in the energy sector, including Nationally Appropriate Mitigation Actions (NAMAs) and projects and programs eligible to generate carbon credits under the Clean Development Mechanism (CDM).

National Fund for Environment and Climate Change (FONERWA)

The Law Establishing FONERWA (2012) outlines its organization, functioning and mission. While it is housed within REMA, FONERWA has an independent board and is charged with mobilizing and harmonizing funds across various areas to support Rwanda's green growth and sustainable development. The fund was fully operational at the end of 2013. FONERWA has been a key player in

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Mission, Powers, Organisation and Functioning.

mobilizing national funding and donor support for climate compatible development and infrastructure projects, with a particular focus on energy.

Rwanda Standards Bureau (RSB)
As an agency under the Ministry of Trade and Industry, RBS develops national technical regulations including national technology and performance standards. While RBS currently has an energy officer, the policy calls for RBS to play an increasingly important role in establishing, publishing, and disseminating national standards for energy technologies such as biogas digesters and solar appliances. Standards should be made freely available online to interested investors and project developers.

Ministry of Education (MINEDUC)
The Ministry of Education plays a role in the energy sector by building the competency and human resources base for sector development and by helping to link to research, technology development, and innovation to sector strategies. MINEDUC ensures that Technical and Vocational Education and Training schools (TVETs) address chronic skill shortages in the sector, including jobs related to electrical engineering and renewable energy technology installation and maintenance. Currently, Rwanda has 307 TVETs with each district having at least four schools.

Ministry of Local Government (MINALOC)
As the lead ministry for promoting decentralized basic services delivery, the Ministry of Local Government plays a critical role in promoting, disseminating, and monitoring the use of modern energy technologies, such as improved cook-stoves, biogas digesters, portable solar lamps and battery chargers, and solar home systems. Land siting for energy projects should be in line with District Land-Use Plans or Master Plans as well as Local Land Development Plans. In order to ensure conformity with local development plans, districts shall interact with MININFRA and furnish a letter of non-objection prior to the award of concessions for IPP projects, including micro-hydro and solar PV, that may involve use of public lands.

National Standards Inspectorate, Competition and Consumer Protection Authority (NICA).
Although recently established by law in August 2013, at the time of elaboration of this policy NICA was not yet in operation. Its main functions are: (i) to advise government on how to initiate greater competition, consumer protection, and product quality in the marketplace; (ii) to monitor the implementation of trade laws; (iii) to promote and educate Rwandans on consumer protection rights and principles; and (iv) to carry out inspections of quality standards. NICA is poised to play a central role in the inspection of petroleum storage and distribution facilities and harmonization of quality standards for downstream petroleum products.

Rwanda Transport Development Agency (RTDA).
Under the auspices of MININFRA; this agency manages all day-to-day aspects of the transport sector in Rwanda and the provision and planning of roads, including access roads for energy projects. It is currently responsible for oversight of a trilateral railway project connecting Dar-es-Salaam with Kigali and Gitega. Completion of the project would facilitate the importation of energy products in Rwanda and energy efficient equipment and contribute to greater energy security by reducing demand for imported petroleum products for road cargo trucks and vehicles.

Industrial Research and Development Agency (IRDA)
Born out of a restructuring and expansion of the Institute of Scientific and Technological Research (IRST), IRDA is charged with facilitating the transfer of innovative technologies, carrying out industrial research, and stimulating national and international partnerships that can promote growth and development. This includes among other sectors activities in the energy sector.

Ministry of Gender and Family Promotion (MIGEPROF)/Gender Monitoring Office (GMO)

The Gender Monitoring Office is responsible for monitoring progress toward adhering to the principle of mainstreaming gender-based equity into the policy and ensuring compliance to gender-specific legislation (e.g., land policy and affirmative solutions) in major sector programs. As part of the implementation and monitoring stage, MININFRA reserves the right to request a gender audit be undertaken on the national energy policy.

Ministry of East African Community (MINEAC)
The Ministry for East African Community Affairs is a coordinating body for EAC and Rwandan priorities within EAC Protocols, Treaties and Strategies. MINEAC follows commitments signed by Rwanda on energy projects and ensures Rwanda and Partner States deliver on these commitments. The Ministry defends energy related position of the government as agreed in bilateral meetings and strives to push for government interests in the EAC forums.

Ministry of Disaster Management and Emergency Response (MIDIMAR)
MIDIMAR works to improve capacity to manage disaster risks such as flood, droughts, and landslides. It develops emergency systems to respond to disaster, including for energy projects.

3.1.2 Local Government

Local governments have the authority and mandate to implement discrete enabling policies to drive local economic transformation. Under Rwanda's decentralization policy, local governments (districts) are responsible for the development of their District and for maintaining the District's infrastructure. Specifically, they have direct responsibility for all decentralized service delivery, including those that may be related to energy at the grassroots. This includes national programs to scale-up sustainable energy consumption currently being implemented by the electricity utility targeting communities. District Councils are responsible for approving local Development Plans, which should incorporate technical guidelines and policy directives from central government to ensure implementation strategies are effectively devolved to the lowest administrative level possible. With increased public finance available through the Capacity Development Fund (CDF) and direct transfers, local authorities have considerable resources to finance their DDPs and Performance Contracts (Imihigo), and energy service delivery should comprise a key part of such obligations.

3.1.3 Financial institutions and development partners

Financial institutions and development partners have a critical role to play by offering access to credit and financial services to the government, energy developers, and individual end-users. Development finance institutions such as MIGA and KFW could offer guarantees and risk insurance products to ensure high-risk energy investments reach financial closure. Development partners also support feasibility works undertaken by either government or the private sector to prove energy resources potential as well as technical support to commercialize those proven resources. Finally they have played an important role in supporting technology and knowledge transfer and institutional capacity building.

3.1.4 Research and Educational institutions

Rwanda's research, educational, training and technology institutions include IPAR, NUR, KIST, IRST, ISAE and others. These institutions play an important role in developing the right skills and knowledge needed to implement the energy policy and strategy in supporting research and capacity building for the sector.

3.1.5 Civil Society

Civil society also plays a vital role in support of implementation of energy policies and programs and in undertaking policy advocacy, civic education and community empowerment. Through its umbrella organization, the Rwanda Civil Society Platform, over 15 member organizations actively participate

in promoting sustainable energy resources and advocating for service delivery. In addition, MININFRA is in the process of actively supporting more formalized, accredited civil society organizations in Rwanda dedicated squarely to promoting renewable and cleaner energy technologies and related local entrepreneurship.

3.1.6 Energy sector governance and coordination framework

Policy oversight and regulation of the energy sector falls under the auspices of several state actors, while other non-governmental stakeholders, such as development partners, NGOs, and private investors play an important role in sector development through funding and implementing investment and capacity building programs. Inter-institutional coordination is vital to achieving the objectives of the national energy policy. For example, forestry policies have a strong impact on sustainable wood fuel and charcoal supply chains, while supportive policy frameworks for biogas and ICS can contribute to reducing deforestation and the burden of disease.

Although notable progress in improving coherence in policy development and strategic planning has been achieved, in part due to the creation of a sector working group (SWG) and sector-wide approach coordination Secretariat, government needs further strengthening. Sector stakeholders are supposed to engage in dialogues with government through the following channels:

Energy Sector Working Group (SWG)

Similar to other key sectors, the Energy SWG is a forum in which government meets its development partners to discuss matters influencing the sector, and to approve long-term plans and policy measures. SWGs are expected to convene at least quarterly. The Energy SWG is chaired by the Permanent Secretary of MININFRA and co-chaired by the World Bank. Chairs report directly to MINIECOFIN. A Joint Sector Review (JSR) forum is convened by the SWG in the first and third quarter of the fiscal year. The JSR held in the first quarter focuses on the performance and budget execution of the SWG in the previous fiscal year, while identifying priorities for preparing the budget for the following year. The JSR in the third quarter focuses on reviewing progress against ESSP targets and contributing to sector plans and prospects. At any time, the SWG can suggest analytical work to be undertaken in the energy sector and propose new logical frameworks to intervention approaches.

Energy SWAP and Secretariat.

The Ministers of Finance and Energy and senior development partners (DPs) established an Energy Sector Wide Approach Program (eSWAP) and instituted an Energy SWG in 2008 in order to better coordinate activities between government and development partners. Tasked with inter-sectorial and intra-governmental coordination, the eSWAP Secretariat's main mandate is to harmonize processes, procedures, and policies so as to align government and DP efforts to achieve sector policy objectives and to better coordinate external assistance toward national sector priorities. The eSWAP also supports systematic monitoring of the implementation energy programs and policies. Since early 2010, the Secretariat has been embedded in MININFRA, acting as an advisory unit that also interfaces between government and DPs. The eSWAP Secretariat also serves as the Secretariat to the SWG, preparing regular meetings, reports, and minutes to be shared with members.

3.1.7 Analysis of legal and regulatory framework

No one single law or set of regulations governs the exploitation, utilization, and sale of energy resources. Activities and investments are governed by a set of stand-alone laws and regulations specific to each sub-sector. Nevertheless, the principle laws and related regulations connected to the exploitation and use of Rwanda's energy resources comprise the Investment Code (2014), Electricity Act (2011), the Law Establishing EWSA (2010) and the Law Repealing EWSA (2013), the Law Establishing and Determining the Mandate of the Rwanda Utilities Regulatory Authority (2001) and as revised (2013), Law on Mining and Quarry Exploitation (2008), and the Petroleum Law (2013). A set of other proposed laws, including the Gas Law and Law on Public-Private Partnerships are still

in draft form, pending approval by Cabinet. The mandate to regulate business operations across all energy subsectors falls under the mandate of the Rwanda Utilities Regulatory Authority (RURA). As an independent agency, RURA is obliged to regulate in an accountable, transparent and fair manner for the benefit of all stakeholders.

Ultimately, the existence of a clear legal and regulatory framework for the energy sector plays a fundamental role in boosting confidence in Rwanda as an investment destination and attracting more private sector operators and investors. An action agenda for enhancing the legal and regulatory framework in tandem with the policy upgrade includes both revising current legislation as well as putting in place new laws and regulations. In the short-term, adoption of the energy policy should give a clear political basis for the quick adoption of narrowly focused laws and regulations (i.e. by the end of the EPDRS II period), consolidation and integration of various laws and regulations into a unified national energy law should be adopted.

Under the National Energy Policy (NEP), it is proposed that MININFRA, MINIJUST, and the Law Reform Commission shall begin a long-term work plan to consolidate all existing energy legislation into such an umbrella Energy Law no later than 2015. This effort requires a considerable degree of resources, however, and is anticipated to take upwards of two years. New legislation should likewise be benchmarked with other East African countries, and attempts made to harmonize regional frameworks wherever possible. Some specific actions foreseen in the NEP include:

Amending the Electricity Law.
Although the main law in place for the electricity sub-sector is comprehensive, progressive, and flexible enough to allow for future anticipated changes in the structure of the sector, some minor amendments are proposed in the National Energy Policy to aid implementation and ensure consistency with the goals of the policy.

Amending the Law Determining the Organization and Functioning of the District (08/2006).
Districts shall be empowered and instructed to manage public lighting assets and to take responsibility not only for their maintenance, which is currently explicitly provided for in the law, but also for their running costs. A Ministerial Order by MINALOC could explicitly require all districts to regularly budget for the cost of public lighting services.

Amending the Downstream Petroleum Law.
The current law fails to clearly demarcate the respective roles and responsibilities of RURA and NICA, taking into consideration existing laws of establishment and institutional mandates. The boundary between RURA and NICA as competent regulatory authorities, with respective powers of inspection and enforcement, need to be more clearly delineated in order for the law to be effective and achieve its desired impact.

Further clarification of legal and regulatory frameworks regarding community-based and private non-profit operators in the energy sector (e.g. those engaged in the micro-hydro sector) may also needed to address current gaps. A renewable energy law is currently being developed which will help to address some of the issues specific to renewables.

3.2 POLICY FRAMEWORK

Energy sector goals are largely, though not solely, the responsibility of MININFRA. The ministry has developed an energy sector strategy plan (ESSP) and closely related National Energy Policy (NEP), that set out how the high-level targets in EDPRS are to be met, and specify new targets in more detail. In some cases, further detail is provided in separate strategy documents. These can based on particular technical/sectoral themes such as the biomass strategy in 2009, or the new rural electrification strategy that is currently being developed. The following sections outline key policy objectives arising from these documents in each of the specified areas.

3.2.1 Energy and development:

The overarching strategic economic planning process in Rwanda is the economic development and poverty reduction strategy (EDPRS). This sets out wide-ranging plans and targets for the country over 5-year planning horizon. The first EDPRS set out the governments officially agreed goals in all sectors of the economy for the period 2008-2012, and second EDPRS-II sets from 2013 to the period 2017/18.

The energy sector is one of the priority sectors of EDPRS-II, and as such the energy targets receive high-level attention. In particular, the energy access goals and the ambition to develop clean low-carbon sources of energy have a high level of political buy-in. Each relevant sectoral ministry is tasked with setting more detailed policy targets and implementation plans to meet the high-level EDPRS targets. There is therefore a very close coordination between energy and development goals and targets through this process.

3.2.2 Thermal energy for households:

The main policy objective for the biomass sub-sector is to improve the sustainability of biomass by improving efficiency of use of wood, improving charcoal production methods, facilitate fuel-switching from traditional biomass energy carriers toward modern biomass energy technologies, including modern carriers, and cleaner fuel alternatives. In particular:

- Consolidate institutional mandates and strengthening decentralization implementation
- Formalize charcoal production and supply, to improve regulatory control and mainstream harvesting and carbonization techniques
- Increasing access to cleaner cooking technologies by promoting technology standards, introducing fiscal reforms, and piloting new market transformation activities. This includes activities like behavioural change, promoting greener substitutes to charcoal and improving the LPG market.
- Developing a harmonized policy and regionally-integrated market for sustainable liquid biofuels.

Under the 2009 Biomass Energy Strategy (BEST) the government is targeting to ensure 80% of all households employ clean cooking energy technologies by 2018. This includes increasing improved cook stove penetration to 80% of households, distributing 3,500 domestic biogas digesters annually, 15 institutional biogas digesters annually, and increasing average charcoal yields[34] by 30 % from a 2009 baseline[35]. All of this will contribute to meeting the target of dramatically reducing the share of traditional biomass energy consumption, from 84% to 50% by the end of EDPRS II period.

Updated but broadly consistent targets under the ESSP for this sector are to ensure at least 80% of urban households have access to improved cook stoves by 2015 and 50% in rural areas. Ultimately, the target is to reach 86% and 63% of urban and rural access to improved cook stoves by 2020 respectively. Some ICS programmes supported by carbon finance operate in the region, to some extent competing with programmes of technical support and training aiming for expansion of local ICS supply chains.

3.2.3 Power sector:

Key policy priorities for energy access

[34] BEST report (2009)

[35] According to the BEST Report, average charcoal production efficiency was 12% in 2009.

Given that government resources are limited, policy prioritization of consumer groups has altered to help meet national objectives, namely: large and productive users first, followed by schools and hospitals, and lastly small and medium enterprises (SMEs) and households. Along with prioritization the NEP also focuses on: universal access to electricity in all schools and health clinics by 2018, increasing rural access through piloting innovative partnerships, introducing greater competition and flexibility in off-grid service provision, and improving institutional delivery through reforms such as the creation of a Rural Energy Agency after 2017/18.

As of June 2014, only 20% of Rwandan households had access to electricity. Over the EDPRS II period, the sector strategy is targeting to provide at least **70% of the households with access to electricity from both on-grid and off-grid solutions. 48% will be on-grid, 22% off-grid by 2018.**

Detailed plans have been developed to spread the electricity network across the country. This is made in tandem with relocation driven by the urbanisation and resettlement policy. For the consumers whose levels of income cannot support grid connection costs or those located more than 5km away from the national grid network, government will pursue PPPs and market transformation activities as solutions will mostly be delivered to end-consumers by the private sector.

There is also a target to **supply of up to 230MW of power to be provided for productive end-users**. Large users and productive users, such as industries in particular, are key drivers of growth providing employment, marketable goods and services; spurring further investment in the economy. Some rural industry and manufacturing will require reliable and consistent grid electricity in order to be competitive and have a profitable business. Data provided by MINICOM, MINAGRI and MINIRENA suggest that up to 230MW of supply will be needed by 2018 for sectors like mining, industry, special economic zones, tea factories and irrigation. This will be met by giving direct access to electricity through dedicated connections outside of the scope of EARP and by supplying reliable power to the grid.

Lastly, in addition to large and productive users, **100% of schools and hospitals will be provided with access to electricity by 2018 through a mixture of off-grid and on-grid solutions**. These will fall under the scope of the EARP, including specific targeted programs.

In total it is estimated that roughly $980 million of financing is required from 2014/2015 to the end of the EDPRS II period to meet the targets set.

In addition, it is intended to i**mprove and develop institutions to increase coordination, effectiveness and accountability:** Major off-grid activities will fall under the EARP in the build up to establishing a **Rural Energy Agency** (REA) by end 2018/2019. At this point future electrification plans will fall under the activities of the Agency as it is envisaged that most urban areas will already be connected to the grid and so on-grid and off-grid energy solutions will focus on rural areas. Having a separate agency will also provide a clear mandate and accountability, ensuring that the energy poor and marginalised in society benefit. REA will have several general functions:

a. to develop new policies to promote rural energy access, based on evidence and lessons learned of the costs and benefits;
b. to plan, appraise, and implement rural electrification projects in line with current government policy priorities;
c. to provide technical assistance to local districts and other public stakeholders implementing off-grid energy projects and programs, acting as a centre of excellence; and
d. To maintain a national database and tracking system on rural electrification projects and energy access. A levy on un-subsidized electricity tariffs, as proposed under the

current Electricity Law to promote rural electrification, could generate sustainable core funding for the proposed Rural Energy Agency and promote greater energy security by reducing dependency over time on contributions from development partners.[36]

3.3 PROGRAMS AND FINANCING

The Energy Sector Strategic Plan sets out details of existing and planned programmes and initiatives in all sectors of energy focussing on the period to 2018. These plans are summarised in the following sections.

3.3.1 Thermal energy for household cooking & heating

Table 6 outlines the key strategic goals and programmes set out in the ESSP for the biomass sector.

Table 6 Biomass Sub-sector Implementation Plan (ESSP)

Strategic Action	2013/14	2014/15	2015/16	2016/17	2017/18	Responsible Institution
Biomass Strategy			Update data and 2009 BEST strategy	Implement strategy		MININFRA
Promotion	Sensitization workshops and training seminars including the latest technology					EDCL, Local Gov.
Technical Support for cook stoves	ICS program	• Review of appropriate ICS technology • Large awareness campaign	On-going ICS program			Local Gov. with MININFRA
Biogas program	Program on-going	• Needs assessment and market segment study to inform detailed analysis on subsidies	Subsequent strategy and action-plan development on end-user finance/market			MININFRA
Train charcoal professionals		• Consider regulatory framework for small-scale producers • Design training program	Local level training programs and sensitization workshops			Local Gov. with MININFRA

[36] This refers to the proposed Universal Access Electricity Fund, which has not yet been operationalized for several reasons, including the parallel existence of the EARP and the fact that given the fact that under the status quo a levy would threaten customer affordability.

Biogas Technology		Feasibility study on technologies	Convene Energy Standards Committee, and develop subsequent guidelines		MININFRA with RBS
Database		Develop National clean cooking database	Gather data	Monitor	MININFRA with EDCL

The focus for the biomass sector is to achieve a greater formalization of charcoal supply chains (where more efficient production standards exist but are not uniformly enforced), more efficient use of biomass resources and promoting alternative clean cooking carriers and technologies such as biogas, LPG, and peat briquettes, among others. A biomass strategy will identify appropriate technologies for households at different levels of income and considering resource and market realities in relative geographies.

Promotion of improved charcoal and wood stoves: Government through REG will support sensitization workshops and training seminars on the economic use of improved cook stoves. This will boost demand for modern and improved cooking technologies, increasing private sector motivation to invest in this business and reduce the use of inefficient and traditional three stone wood stoves. The government target is to ensure at least 80% of the urban market with access to improved cook stoves by 2015 and 50% in rural areas. Ultimately, the target is to reach 86% and 63% of urban and rural access to improved cook stoves by 2020 respectively.

Technical support on the choice of stove models: Since 2010, the government energy agent has been the primary delivery organization for improved cook stoves (ICS) dissemination. Various ICS models have been promoted, including several which are locally manufactured.[37] These had penetrated 60% of the households market by the end 2012. The EDCL will offer technical guidance on the selection of the most fuel-efficient cook stoves. MININFRA through the EDCL will continue facilitating the promotion of the "rondereza" cook stoves programs in rural areas to increase penetration.

A national cross sector task force is already in place with full mandate to fast track the implementation of the alternative energy programs including improved cook stoves. The technical taskforce is currently planning a massive campaign to raise awareness. To beef up program financing, government will leverage **carbon finance** as much as possible to provide additional financing, and encourage project developers to do the same e.g. through the UN or voluntary carbon markets or NAMAs.

Energy conservation: Government will promote energy conservation measures among large non-domestic users of biomass such as those firing bricks, with the objective to reduce their consumption by 2018. These are the biggest users of wood fuels. This will be through the use of more carbonised charcoal, hydraulic charcoal and other improved technologies.

Biogas subsidies: Current subsidies provided by government to help households purchase biogas plants shall be restructured on the basis of a more detailed economic analysis. The process for targeting and prioritizing beneficiaries shall take greater advantage of market forces and complementary agricultural extension programs, as well as better "means tested" to align with social vulnerability levels as per the "Ubudehe" income classifications. Additionally, MININFRA will develop strategies and action plans on end-user financing and enhancing market transformation.

Decentralization of biomass schemes: The biomass sector is already predominantly a private sector activity, with supply of biomass and cook-stoves being provided on a commercial basis. However, to the extent that government is involved, such involvement should be at the local level. These

[37] To date 15 ICS production facilities have been constructed and technicians trained to manufacture Canarumwe stoves, and other 15 production units in the remaining districts are to be constructed.

interventions include; education and mass awareness, capacity building and monitoring and evaluation.

Simplified licensing scheme for charcoalers: MININFRA will continue calling for a more effective and simplified regulatory and licensing system for charcoalers from the responsible institutions. This strategy proposes a more decentralized licensing system done by local authorities following national guidelines to allow for a more transparent and sustainable wood harvesting. Clear requirements for tree harvesting and replacement should be put in public domain at local administrative levels to improve public awareness and adherence to the said regulations.

Train charcoal professionals: To manage supply side constraints whilst maintaining the right volume of trees harvested for charcoal, MININFRA will promote the use of improved charcoaling techniques that ensure high yield (kgs wood/kgs of charcoal) through training programs and sensitization workshops to the local levels. More efforts will be directed to the dissemination of improved carbonization techniques and reorganization of charcoal supply chain in supply centres of Rwanda. From the last biomass survey undertaken in 2009, the charcoal yield[38] was found to be ≈ 12%. The target of the energy sector strategic plan is to have this improved to at least 15% efficiency by 2015. MININFRA will use existing local authorities to identify local cooperatives involved in charcoaling who will also train other charcoalers in improved charcoal harvesting.

Alternative fuels: Briquettes made from peat or other biomass resources such as rice and maize husks or coffee grounds could replace wood and charcoal for cooking and heating. The biogas program currently being implemented is an example of an attempt to economically transition away from biomass. Alternative fuels may reduce GHG emissions[39], and as such could benefit from climate finance.

Peat briquettes: Rwanda has estimated reserves of 155[40] million tons of dry peat spread over an area of about 50,000 hectares in Akanyaru, Nyabarongo, Rwabusoro and other areas. Peat lands have traditionally been thought to be prepared to supply peat for electricity generation. However, though currently used on a very small scale, government through REG will continue to explore possibility of large-scale and commercial use of peat briquettes as biomass alternatives for cooking in homes and factories. These briquettes consist of shredded peat, compressed to form a virtually smokeless, slow-burning, easily stored and transported solid fuel used in cooking. The use of smokeless briquettes will reduce the emission of GHG to the environment and reduce the demand for wood fuel and charcoal both historically used for cooking.

Biogas: The National Domestic Biogas Program (Phase II) targets to disseminate at least 3,500 bio-digesters to households per year, leading to at least 18,000 additional bio-digesters in households by 2018, and 15 bio-gas digesters in institutions such as prisons and schools per year[41]. To fast-track the program, a **National taskforce** has been instituted to promote use of alternative sources of energy of which biogas is part. Through the institutional Biogas program, government is promoting the use of biogas for cooking and heating in schools, hospitals and prisons.

Under the NDBP, the EDCL will continue to give **technical assistance** on the installation, use and maintenance of bio-digesters, which reduces the demand for wood fuels previously used in cooking. The EDCL Investment Unit leads on technical and financial feasibility assessment of new business. For the institutional biogas program, MINEDUC, MINISANTE and MININTER shall take the lead on implementation and provide budget for routine maintenance and operations of biogas digesters in

[38] BEST report (2009)
[39] UNFCCC suggests that biomass in Rwanda is mostly non-renewable. Ref: CDM EB 67 Annex 22 11th May 2012
[40] Peat Master Plan prepared by EKONO
[41] EWSA, 2014.

schools, health centres, and prisons.

An **Energy Standards Committee** shall be convened to have existing standards in the biogas manual approved by RBS, and further work made to improve national technology standard for biogas digesters. There are currently no guidelines or standards in place for institutional biogas systems. Development of new standards will encourage new and emerging technologies to come into the marketplace that can make the technology more affordable and reliable.[42]

To improve the biogas program a business evaluation will take place in order to accelerate economic program dissemination; currently 25% of the companies have been responsible for installing 60% of the bio-digesters. A feasibility study **evaluating** the relative merits of new and improved technologies (including fiberglass and flexi-biogas) versus existing technologies on the basis of reliability, affordability, environmental impact, and job creation will be undertaken by MININFRA as part of the updated biomass sub-sector strategy. Lastly, small-scale commercially viable biogas projects including gasification of crop residues will be promoted through inclusion in the REFIT regime.

Liquefied Petroleum Gas (LPG): There are already efforts to promote the use of LPG in Rwanda such as the temporary suspension of VAT on LPG imports. Government will keep exploring other measures such as eliminating the non-economic LPG cylinders (20kgs), incentives on cost of investing in required infrastructure, bulk purchase and storage facilities among others to ensure affordability and efficiency of LPG facilities.

Developing a market for sustainable liquid biofuels for transport and agro-processing sectors: Liquid biofuels such as biodiesel and bioethanol provide alternative sources of fuel for vehicles and can be safely blended in small quantities with the existing petrol and diesel to reduce the quantity of imported diesel fuels.

3.3.2 On-grid Electricity

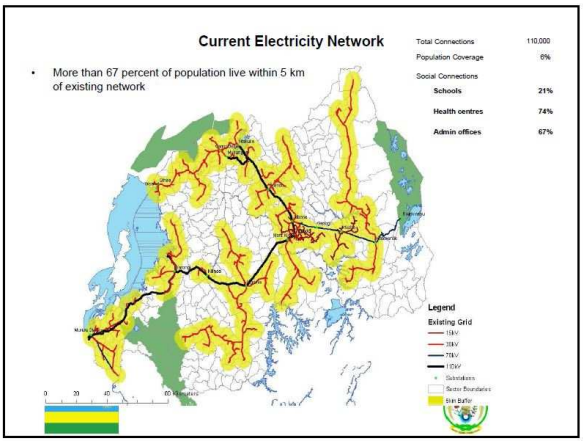
Electricity Access Roll-out Programme (EARP)

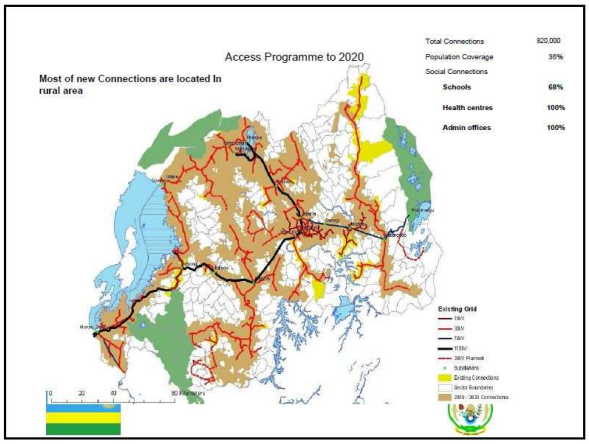
Rwanda's flagship Electricity Access Roll-out Programme is a nationwide initiative to extend access to electricity, mainly for households, but also for other social infrastructure. The cost of connecting a household to the grid depends on how far it is from the existing network, but averages around $1000 per connection. These connection costs are financed as follows: 80% government and development partners, 10% Energy Water and Sanitation Limited (EWSA), and 10% beneficiaries which is sub-divided by income brackets. EARP is designed along the lines of a least-cost development plan and is divided into two phases:

Phase 1 (2009-2012): Extend the network across the country and provide direct connections, with a target of 350,000 connections by the end of 2012, or 16%. Roughly $350 million in funding was mobilized for Phase 1 allowing for targets to be exceeded. Total connections were 379,851 as of August 2013 showing the major steps that have been made.

Phase 2 (2013-2018): Additional connections onto the network, which combined with off-grid solutions, results in 70% of the population with access to electricity, of which 48% is proposed to be on-grid. Provision of electricity to industrial parks and other productive activities are also planned to be scaled up significantly over this period.

[42] i) DRIMEX (Canvas biogas digesters), ii) Biogas International (Flexi biogas), iii) Fiberglass technology, iv) Q-Energy Consultants &v) Sim-Gas





As well as households, social infrastructure such as schools, health facilities and administrative offices are a focus of EARP.

Output	EDPRS target	Progress end of November 2013
Health Facilities	100 %	90% (grid and off grid)
Schools	50%	24% Prim & 44% Sec (grid&off grid).
Administrative Centers	100%	100%

Where electricity connections have been made, it has been found that living conditions improve, education improves due to access to modern lighting and computers, and service delivery improves e.g. health facilities are able to stay open longer and associated risks with energy security are reduced. However, as noted in the EARP, consumption levels for newly connected households remain at a low level for a considerable duration due to the focus on low-energy consumption appliances such as lighting & mobile phone charging.

Realizing the above requires significant human, institutional and financial resources, which is an uphill task on the side of the government. It will be a challenge to increase human skills and institutional capacities in contract management and local contractors, align EARP projections with revised generation plans, reduce losses, reprioritize towards productive users, and obtain the funding required. Table 7 highlights the extent of the funding gap that the Government of Rwanda faces if it is to tackle energy access poverty head on; up to $1.37 Bn.

Table 7: Different scenarios considered under EARP for on-grid vs. off-grid provision of access[43]

Scenario	Number of HH required	How?	Cost = Funding Gap
70%	1.6 M	0.9m from fill in connection (existing network,	$1.02bn[44] ($1.37bn inc.

[43] Source: EWSA presentation June 2014, SE4All briefing paper

connections		relocation, and population growth), 0.5m on new network, 0.2m existing	productive users)
60% connections	1.4 M	0.7m from fill in connections, 0.5m on new network, 0.2m existing	$0.90bn ($1.25 bn inc. productive users)
48% connections	1.1 M	0.4m from fill in connections, 0.5m on new network, 0.2m existing	$0.75bn ($1.11bn inc. productive users)
42% connections	1 M	0.3m from fill in connections, 0.5m on new network, 0.2 m existing	$0.68bn ($1.03bn inc. productive users)

Electricity Generation Plans

There are ambitious plans to expand the supply of electricity to keep pace with increasing demand from existing customers, as well as an expanding supply demand from new industrial users (see Section 3.3.4) and to supply the electricity required to service the additional households to be connected to the grid through the EARP.

In order to satisfy this demand, the energy utility company is currently planning a five-fold expansion of capacity shown in Table 8 (these are provisional plans subject to change depending on final on-grid vs. off-grid decisions on achieving access targets).

Table 8 Provisional on-grid electricity generation expansion plans

	2013	2014	2015	2016	2017	2018
	MW					
Hydro	56	76	87	107	113	122
Diesel	28	28	28	28	8	8
HFO	18	18	18	18	18	18
HFO converted to LNG	0	0	0	20	40	50
Methane (lake Kivu)	4	4	19	69	79	79
Peat	0	0	15	15	95	145
Solar	0	9	9	29	29	29
Import	4	4	4	4	44	74
TOTAL	**109**	**138**	**179**	**289**	**425**	**524**

The expected investment costs of this generation capacity, as well as the associated investment costs required to roll out the required transmission and distribution system are set out in

[44] billion

Figure 5.

Figure 5 Estimates of capital cost requirements of planned investments in generation and T&D infrastructure by 2018[45]

	2014/15	2015/16	2016/17	2017/18	Total ($M)
ELECTRICITY	**$613.9**	**$429.9**	**$603.9**	**$547.5**	**$2,195.3**
Generation (to deliver 591MW)	**$289.4**	**$318.6**	**$524.2**	**$510.5**	**$1,642.8**
Project Preparation (all Public/DP)	***$56.3***	***$28.4***	***$56.0***	***$0.6***	***$141.3***
Peat	$1.0	$0.5	$0.0	$0.0	$1.5
Hydro	$7.0	$0.0	$0.0	$0.0	$7.0
Geothermal	$38.6	$22.7	$55.2	$0.0	$116.5
Methane	$0.6	$0.0	$0.0	$0.0	$0.6
Solar	$0.5	$0.0	$0.0	$0.0	$0.5
Other sector studies	$8.7	$5.2	$0.8	$0.6	$15.2
Generation	***$233.1***	***$290.2***	***$468.3***	***$509.9***	***$1,501.5***
Public/Dev Partner	$96.4	$114.0	$78.7	$143.9	$433.0
Private	$136.6	$176.2	$389.6	$366.0	$1,068.4
Peat	$71.5	$116.4	$152.9	$103.1	$443.8
Hydro (Domestic)	$69.9	$26.6	$46.3	$24.8	$167.6
Hydro (Regional)	$19.5	$39.1	$62.4	$85.7	$206.8
Geothermal	$0.0	$0.0	$0.0	$0.0	$0.0
Methane	$0.0	$54.0	$176.0	$255.0	$485.0
Thermal	$24.2	$54.0	$5.7	$11.3	$95.2
Solar	$48.0	$0.1	$25.0	$30.0	$103.1
Transmission (all Public/DP)	**$324.5**	**$111.3**	**$79.7**	**$37.0**	**$552.5**
Domestic Lines and Substations	$147.8	$104.0	$70.0	$6.7	$328.5
Regional Lines and Substations	$176.7	$7.3	$9.7	$30.3	$224.1
ELECTRICITY ACCESS	**$127.1**	**$315.7**	**$302.1**	**$232.3**	**$977.2**
EARP (all Public/DP)	**$125.0**	**$312.8**	**$294.6**	**$220.3**	**$952.7**
Households and SME's	$86.4	$169.2	$176.5	$185.2	$617.4
Productive Users	$38.6	$143.7	$118.1	$35.0	$335.3
Off Grid Electrification	**$2.1**	**$2.9**	**$7.5**	**$12.0**	**$24.5**
Public Costs	$0.6	$0.3	$0.0	$0.0	$0.8
Private/Consumer costs	$1.5	$2.6	$7.5	$12.0	$23.7
BIOMASS	**$2.9**	**$2.6**	**$2.6**	**$4.7**	**$12.8**
Biogas	**$2.7**	**$2.5**	**$2.5**	**$2.4**	**$10.2**
Subsidy	$2.6	$2.4	$2.5	$2.4	$10.0
Private/Consumer costs	$0.1	$0.1	$0.0	$0.0	$0.2
Cook stoves	**$0.22**	**$0.11**	**$0.04**	**$2.28**	**$2.6**
Government Support to Cook Stoves	$0.22	$0.11	$0.04	$2.28	$2.6
PETROLEUM	**$9.4**	**$323.8**	**$413.3**	**$0.0**	**$746.5**
Government (Site Development)	$0.0	$0.0	$0.0	$0.0	$0.0
Government (Storage Facilities)	$0.8	$0.0	$0.0	$0.0	$0.8
Private (Storage Facilities)	$8.6	$70.4	$0.0	$0.0	$79.0
Pipeline (Investments)	$0.0	$253.3	$413.3	$0.0	$666.7
ENERGY EFF. & DEMAND SIDE MGMT	**$3.9**	**$8.7**	**$6.0**	**$5.2**	**$23.8**
Total ($M)	**$757.2**	**$1,080.8**	**$1,328.0**	**$789.7**	**$3,955.7**
Private	$146.8	$249.4	$397.1	$378.0	$1,171.4
Public	$610.4	$831.4	$930.9	$411.7	$2,784.3

[45] ESSP

3.3.3 Off-grid Electricity

The following set of action areas and programmes have been identified in the ESSP as priorities for the off-grid sector in the period to 2018.

Development of an off-grid electrification strategy: This will be developed by GoR in-line with the EARP electrification plan and clearly state the government's position and further spell out activities and support planned.

Improve and develop institutions to increase coordination, effectiveness and accountability: Major off-grid activities will fall under the EARP in the build up to establishing a **Rural Energy Agency** (REA) by end 2018/2019. At this point future electrification plans will fall under the activities of the Agency as it is envisaged that most urban areas will already be connected to the grid and so on-grid and off-grid energy solutions will focus on rural areas. Having a separate agency will also provide a clear mandate and accountability, ensuring that the energy poor and marginalised in society benefit.

Pilot innovative partnerships to increase rural access: The relative costs and benefits of on- and off-grid electricity need to be better understood. Therefore innovative PPPs are to be tested. These include areas such as solar home systems or solar/hybrid mini-grids in the medium-term. Capitalising support from FONERWA and other climate and renewable energy financing will be a key contributor to success. Such pilots will be accompanied by awareness campaigns to support market development in these areas and be rigorously evaluated to determine impact.

Fiscal reform for peri-urban and urban households to reduce consumption of kerosene and increase alternative solar technology: Kerosene represents an expensive and environmentally harmful product, which GoR wishes to phase out through affordable solar alternatives. Currently Kerosene is the only fuel, which is exempt from excise duty. A study would therefore be carried out on the market, fiscal and socio-economic impact of phasing out the kerosene 'subsidy'. Based on this, the excise duty would be reintroduced, and solar solutions promoted in its place.

Increase competition and flexibility in off-grid provision through measures to simplify licensing and stimulate small-scale (off-grid) power distributors (SPDs): The simplified licensing framework is being revised to make the regulatory environment clearer and more facilitating to SPDs. Experience with private sector pilot projects has informed the framework, and efforts will be made to ensure SPDs are not penalised for their size. The benefit of eventual inclusion of SPDs under REFIT frameworks also needs to be examined carefully as the grid expands. To ensure affordability and accountability, community-based consultations to deliver informed decision-making on energy technologies are to take place and be documented as part of the required EIA and license application process. Lastly, and importantly, EARP will publish electrification plans in the public domain, which will be valid for a period of 3 years. This will make it clearer to both consumers and private developers where potential for off-grid activities exists.

Facilitate private sector off-grid activities: The private sector will deliver the majority of off-grid technologies to end-consumers. Therefore, along with the development of an off-grid strategy and development of innovative PPPs, a conducive and legal and regulatory environment must be developed to support the private sector. Depending on the outcomes of the off-grid strategy, this will include increasing consumer awareness.

Closely monitoring the implementation of the resettlement policy: This is necessary to achieve the 70% electricity access by 2017/2018. MINALOC, with the mandate of designing and implementing policy on habitat, will be engaged in speeding up the settlement scheme program country over to keep pace with the rollout program if the connection bill is to be reduced to build Medium Voltage (MV) and Low Voltage (LV) lines and connecting new households. On average, MINALOC committed to increase the number of households relocated to organised settlements from 1.3 million

households already relocated to a total of 1.9 million households to be relocated by 2018, partly driven by the same trends behind urbanisation occurring in many countries as they develop.

Solar Installations: Small solar installations are available for an initial cost of between $50- $200 depending on the appliances they are required to power, with no need to pay further energy costs. This technology can be delivered by the private sector and help support local economic development, however, Government will be required to support the industry sharing information, defining a clear approach to deploy these solutions, educating the local population, quality testing and labelling the technologies and testing innovative solutions.

Off-grid hydro projects: Off-grid hydro projects can represent cost effective solutions. Past experience with micro hydros have proven this can be possible. Early estimations show that micro hydros represent good value for money when used to provide power to mini-grids at $5200/kW. However, other experiences have shown maintenance of plants to be an issue, and raising capital can be difficult. Therefore rather than encourage stand-alone micro hydro projects, they will be encouraged through mini-grids where economically feasible and representing the least-cost option. This will be done through:

- Mini-grid promotion by establishing enabling regulatory frameworks and licensing;
- Education of people on off-grid energy solutions; and
- Provide training and financial incentives to rural communities to operate micro hydro, which is already underway.

Other solutions: Biogas digester systems are possible on a stand-alone and mini-grid basis. A stand-alone system requires a minimum of two cows and under the current program can be used for cooking, lighting and heating. Biogas is further elaborated in the Chapter 'Biomass Sub-Sector'. Efficient diesel generators for independent generation are common in African countries. The affordability of these for mini-grids will need to be tested. Lastly, solar-wind and solar-diesel hybrid systems will be piloted to access their commercial viability.

3.3.4 Modern energy for productive use

Current electricity consumption is dominated by households, but industrial demand is expected to grow rapidly in the period of EDPRS-II. In 2013, industrial electricity demand included the cement sector (15 MW), steel sector (10 MW), and irrigation (1.6 MW). Significant growth is expected in other sectors including tea plantations, mines, development of large commercial centres, and industrial parks. Current plans are for almost a tenfold increase in power demand from these sectors over the period to 2017/18 as shown in Table 9.

Table 9 Electricity demand for industrial and large commercial users

MW peak demand	2013	2018 (projected)
Cement	15.0	15.0
Steel	10.0	26.0
Industrial Park		32.0
Large Commercial		22.5
Mines		55.2
Irrigation	1.6	25.0
Tea		54.6
TOTAL MW	**26.6**	**230.3**

In addition to the investments in electricity generation, there will also need to be corresponding investment in transmission and distribution infrastructure. Total expenditure plans to 2018 for the transmission system development (but excluding EARP investments for new households) amounts to $87m for domestic lines, plus $106m for sub-stations and other equipment. For distribution, the expenditure is expected to be $13 for lines, and $2m for sub-stations.

3.4 PRIVATE INVESTMENT AND ENABLING BUSINESS ENVIRONMENT

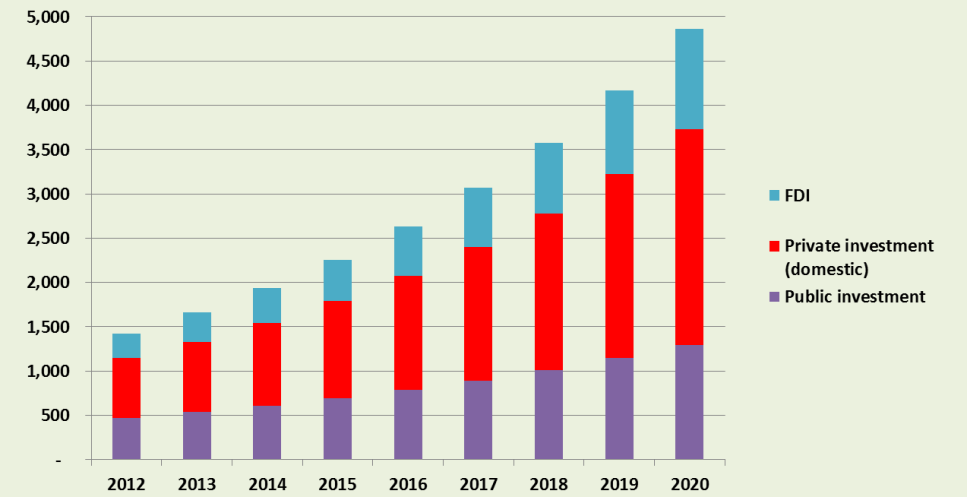
Rwanda has made significant strides in improving the enabling factors for new business. Between 2009 and 2010 Rwanda jumped from 139th in the World to 67th in the World Bank's 'ease of doing business' ranking. This made it 'top reformer' in the world. Since then improvements have continued and Rwanda was ranked 32nd in the world in 2013 ahead of South Africa[46]. Only Mauritius ranks higher in Africa. Rwanda ranks particularly high in the following indicators: starting a business (8th), getting credit (23rd), paying taxes (25th) protecting investors (32nd), and enforcing contracts (39th). There are, however, two indicators where the country lags significantly: resolving insolvency and trading across borders.

This is the result of very deliberate targeting of the private sector as a general policy in Rwanda. The Rwanda Development Board which provides a key point of liaison between private sector and the government has continuously sought to reduce barriers to private sector development – for example, the time taken to register a new business has fallen from 48 hours a few years ago to just 6 hours now.

It is planned that for the economy as a whole, the private sector will be responsible for the largest share of growth in investment, driving achievement of the 2020 vision goals. Figure 6 shows the estimated level of investment required to meet the 30 per cent investment target to GDP by 2020. This assumes that total private sector investment reaches 22 per cent of GDP, including FDI at 7 per cent of GDP, and public sector investment reducing from 11 per cent to 8 per cent of GDP by 2020.

[46] World Bank http://data.worldbank.org/indicator/IC.BUS.EASE.XQ accessed 4 October 2014

Figure 6 Achieving Vision 2020 with investment (USD millions)



However, currently the private sector is still embryonic. According to EDPRS-II, in 2011, Rwanda's formal private sector employed a mere 4% of the country's labour force, and only 0.5% of firms had more than 30 employees[47]. The small size of Rwanda's private sector is a major limiting factor to future prospects for economic growth and economic transformation. A cautionary sign of this was the falls in private domestic and foreign investment in 2010 and 2011. The private sector overall needs to undergo significant structural transformation to be able to become the main driver of economic growth and create the large number of jobs the Rwandan economy requires. Rwanda's public sector can contribute to this transformation through the following proposed interventions during EDPRS 2:

a) Strengthen the investment process to pro-actively target large foreign investors in priority sectors of the economy;
b) Accelerate structural changes in the financial sector, in particular measures to increase long-term savings, with the objective of increasing credit to the private sector to 30% of GDP by 2017; and
c) Significantly strengthen the business environment through tax and regulatory reform to spur medium and large enterprise growth and attract large investors.

Tax reform has already been carried out via the new investment code to encourage investment in the energy sector, with corporation tax for projects greater than 25MW being halved (from 30% to 15%). Reductions in corporation tax can also be made depending on the number of employees are involved in the project. Other investment allowances include special arrangement for corporation tax relief of up to 7 years (compared to 5 years in other infrastructure sectors), and investment allowances of up to 50% of capital expenditure.

In the energy sector, private sector engagement through tendering is very active, with most new projects going via this route. EDCL routinely contracts out under EPC contracts for building generation, transmission & distribution systems. For generation projects, ownership may then transfer back to the utility. However, there is a growing trend to encourage independent power producers to retain ownership of plant, and then contract for supply of electricity to the utility under a power purchase agreement (PPA). For large projects, this mainly involves international private companies who have the necessary capital and technical capacity to handle the costs and complexities involved. Foreign companies often own plant outright, but sometimes enter into public

[47] EICV 3 (2012) "Enquête Intégrale sur les Conditions de Vie des ménages (Integrated Household Living Conditions Survey)"

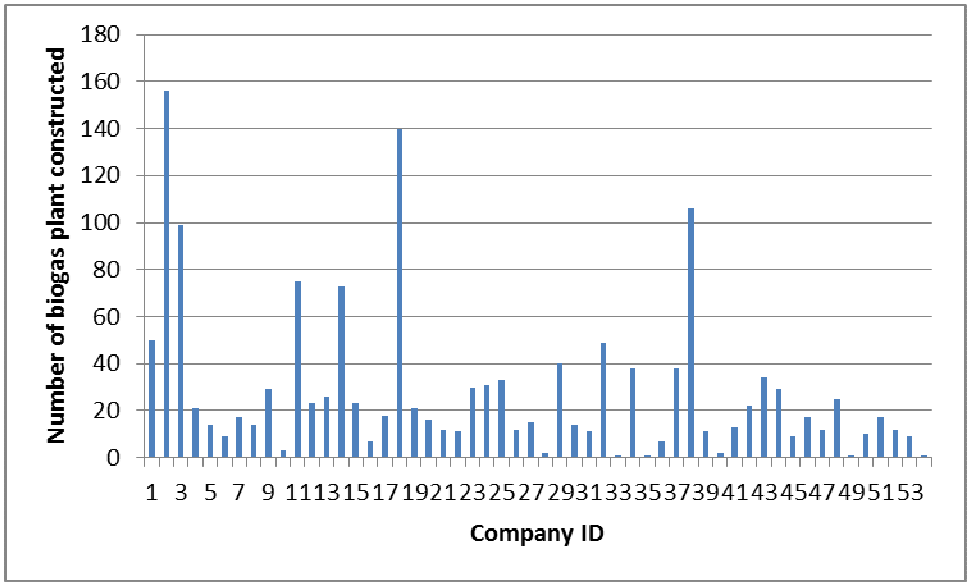
private partnerships (PPPs) in cases where part-government ownership is beneficial to managing particular project risks. Local contractors and supply chains are used particularly in the micro-hydro sector, off-grid energy solutions, and in the roll-out of the electricity distribution network, where the scale of projects is manageable for the smaller companies established in the country, and the skills and human resources exist to supply such projects.

3.4.1 Thermal energy for household cooking & heating

The supply chains for provision of biomass are well established in Rwanda, but over-use of resources remains a problem. The key challenge is to disseminate the techniques for improving the efficiency and safety of combustion, and to ensure that the sustainability of charcoal manufacturing is improved. The key interventions in this sector are outlined in Section 3.3.1.

There is a relatively strong private sector supply chain within Rwanda for provision of domestically manufactured biogas digesters, with over 50 companies providing such systems. These are generally small companies, manufacturing on average around 30 digesters each per year, but with considerable variation in size between companies as shown in Figure 7.

Figure 7 Number of biogas digesters produced in financial year 2013/14 by local companies



3.4.2 Power sector

The private sector is starting to play an important role in the power sector in developing projects under power purchase agreements with the GoR. Major private sector investments include:

- Fuel supply to the government-owned 15 MW peat-to-power plant at Gishoma[48]; and
- 8 MW solar plant[49];

Under the current Energy Sector Strategy Plan, a number of initiatives are planned to create a more favourable environment for private investors in the energy sector. Government will develop a coordinated plan to streamline investment procedures, guarantee stable and positive returns to investors, and reduce perceived and real risks to energy infrastructure investment. Among these

[48] http://www.theeastafrican.co.ke/Rwanda/Business/Rwanda--peat-firm-finally-seal-Rwf1bn-energy-agreement-/-/1433224/2339986/-/wv1wjg/-/index.html
[49] http://gigawattglobal.com/projects/rwanda/

measures include updating the investment code and clarifying the rules and modalities of engagement for PPPs. The ESSP also envisages the following actions in the power sector:

- **The Establishment of a Rwandan Energy Development Fund (REDF):** A REDF shall be conceptualized and established under the auspices of MINECOFIN as the primary means to co-finance strategic domestic energy projects with public resources. Its main purpose would be to leverage private capital through early-stage seed capital and equity required to fund projects to commercial bankability. While there are other various initiatives in this area already the EDF will consolidate all on-going activities into one single programme. The EDF could, for example, help de-risk investment by funding feasibility studies, legal due diligence, and service infrastructure to render projects commercially and technically feasible. It could also be used to bridge any perceived feasibility gap (i.e. the project doesn't quite make economic sense on its own but could do if we are prepared to fund a small part of the project). Initial capitalization by the GoR of the REDF is proposed at $30m, with development partners expected to provide additional finance.
- **Streamline investment promotion processes for IPPs.**
- **Accelerate energy sector Public-Private Partnerships (PPPs), taking advantage of new national guidelines and procurement procedures**
- **De-risk investments through financing risky upstream resource assessments and pre-feasibility studies:** A pipeline of projects will be developed that are investor ready, such that investments are aligned to demand. To facilitate this, preparatory project development work are essential. In addition, while a number of development partners fund elements of feasibility work, however, the timescales and governance required often result in funds not being released quickly enough. An Energy development fund would be a means of channelling this funding through one simple vehicle.
- **Empower local enterprises to engage in energy sector deals and introduce more competitive, transparent approaches to service provision where appropriate**
- **Law guiding public bidding in Energy sector:** The process of competitive bidding and procurement in all energy-related projects, including IPP generation activities, shall therefore be the default option to ensure market transparency as well as value-for public money.[50] Government will establish transparent processes and well elaborated guidelines for energy project procurement. It is important to emphasize that competitive procurement should not only take into account comparative financial analyses in order to assess value-for-money, but also relative economic benefits and ensuring that good environmental stewardship is not compromised in order to meet strategic energy development priorities.
- **Extend and expand investment incentives to private investors:** A process shall be instituted with agreement from all parties for which transmission connections could be forward paid by energy developers or operators and recouped through agreed fees or tariffs incorporated in Power Purchase Agreements (PPAs). Government shall facilitate the development of independent power production (IPP) projects through the provision of various incentives, including funding access roads and other facilitating infrastructure for projects that meet certain criteria and for which have a concession from MININFRA has already been awarded. The revised Investment Code treats energy as a strategic sector and extends other fiscal and non-fiscal investment incentives to various projects.

Additionally, MININFRA shall elaborate specific operational guidelines for the provision of access roads, including mechanisms for private sector procurement and reimbursement of access road costs as a way to streamline IPP investments in the energy sector. Lastly, a review of the EAC

[50] It should be noted in this context that the application of a REFIT for power procurement through IPPs would comply with this principle, as there is little room for negotiation of the set terms and conditions for supplying the energy.

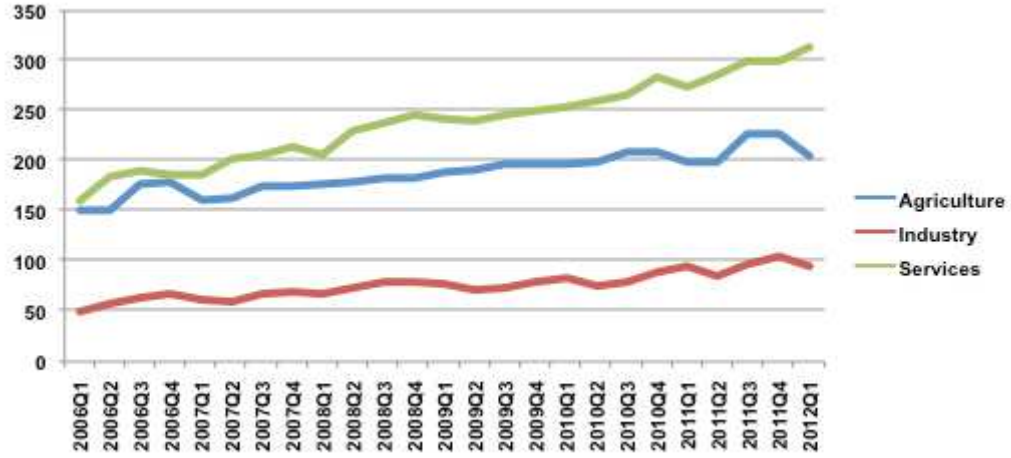
customs exemption schedule shall also be undertaken to ensure the current list fully encompasses all aspects of electric power facilities and that the formulation can be easily understood by customs inspection officers.

3.4.3 Modern energy for productive sectors:

From the first quarter of 2006 to the first quarter of 2012, the real annual GDP growth rate for the economy averaged 9.1 per cent. Total GDP in 2011 was 3.8 trillion RWF, or $6.1 billion at current exchange rates[9]. As shown in Figure 8, the growth rate of GDP has varied by sector. The highest growth rate has been in services with 11.8 per cent growth from 2006 to 2012. The rate was similar for industry at 11.5 per cent. The rate for agricultural growth was slower at 5.3 per cent annual growth.

The past six years have been characterised by numerous external shocks, as well as increasing global food and fuel prices, a regional food shortage due to drought in the Horn of Africa, and ongoing crisis in the Euro area. Rwanda has demonstrated economic resilience during this period, which has had significantly more serious consequences for many neighbouring EAC countries.

Figure 8: GDP growth in Rwanda by main sector of economy 2006-2012 (RWF billions in 2006 Prices)[51]



As noted above, in order to sustain this growth into the future, and number of programmes are being instigated. In particular, infrastructure developments including energy have been identified as a priority, and the programme outlined in Rwanda's Private Sector Development Strategy (2013) in this area is described in more detail below.

- **Programme 1: Infrastructure for Growth**. Infrastructure, and in particular energy, is the principal constraint to growth and investment. Addressing it will require investment in power generation and transmission capacity, as well as connectivity to pools of energy in the East African Community (EAC) region. This will take time. In the interim the Government of Rwanda will develop locations where the energy constraint is minimised. This should be through continuation and expansion of Rwanda's Special Economic Zone (SEZ) programme. The SEZs should function on the principle of providing localised areas for which land and energy are specifically prioritised, which are not designated for any specific sub-sector nor type of company. The GoR has already developed the Kigali SEZ. In addition to this, the Kivu Belt should be developed as a SEZ, and SEZ status should be extended to Bugesera Provincial Industrial Park. The additional three Industrial Parks at Rusizi, Nyabihu and Huye should be developed as low-cost SEZs. Infrastructure is also required to address logistics challenges, the GoR will therefore

[51] National Institute of Statistics of Rwanda (NISR) (2012) GDP tables Q1 2012

seek PPPs to establish an integrated logistics system based on a Kigali Logistics Platform, linked to Regional Logistics Centres, and supported by an e-freight exchange system.

The current mix of business requiring energy services is illustrated by the existing provision of electricity grid infrastructure to small business as shown in Figure 9.

Figure 9 Current Grid Infrastructure Provided to Small Businesses by Region

Zone	Coffee Washing	Market	Telecom Towers	Center Under development	Integrated craft production center (Agakiriro)	Milk Collection Center	Mines	Model Villages
Central		4	28	4	1	4	67	8
Eastern		18	68	18	1	25	160	12
Southern		35	91	27	3	19	172	16
Western	24	3	67	7	2	8	155	8
Northern	2	13	94	19	2	27	180	16
Total	**26**	**73**	**348**	**75**	**9**	**83**	**734**	**60**

The provision of grid infrastructure to big business by region is shown in Figure 10.

Figure 10 Current Grid Infrastructure Provided to Big Business and Agriculture by Region

Zone	Industry Zones	Second Cities	Tea Factory	Irrigation Water Pump
Central	1	1		9
Eastern	1	1		27
Southern	1	1	7	1
Western	1	1	8	
Northern	1	1	6	
Total	**5**	**5**	**21**	**37**

3.5 GAPS AND BARRIERS

This section draws on the challenges and barriers to implementation identified in the Energy Sector Strategic Plan (ESSP), which has a planning timeframe out to 2018. Further work will be carried out under the Action Agenda to identify more long-term strategic issues that will need to be addressed to meet 2030 goals, which can be incorporated into these to produce a coordinated review of gaps which can inform the prioritisation of identified actions. This subsequent review will take into account as far as possible the results of a number of ongoing reviews including:

- An assessment of gaps in the institutional capacity for energy planning
- Development of a rural electrification strategy
- Development of a least cost electricity generation development plan
- Institutional functional review of REG and MININFRA

In addition to sector-specific issues, general barriers to investment (in particular access to sufficient credit on reasonable terms both for companies and individuals) needs to be investigated in more detail in the Action Agenda process. Lack of availability of recent data remains a barrier in several areas of the energy system, and the Action Agenda is likely to identify needs for data collection and greater analysis energy market systems. Until this more detailed analysis can be carried out, the following sections outline the key issues facing each sector as identified in the ESSP.

3.5.1 Thermal energy for households

Deforestation and low availability of alternative to develop: In 2009, 4.2 million tonnes of conventional fuel wood and charcoal was consumed, resulting in a deficit of 870,000 tonnes per year[52]. Whilst this was less than previously expected due to government plantation programs, it still represents a 21% of demand deficit. At the same time alternatives such as LPG are expensive and hard to come by.

Deadly smoke and emissions from cooking fuels: Each year in Rwanda, there are 5,680 deaths a year related to household air pollutants, 94% of which are children[53]. This is unacceptable. Many more suffer respiratory illnesses resulting in reduced productivity, quality of life and act as an additional burden to the community.

Ownership: Biomass is a cross cutting-issue affecting energy, health, natural resources and local government. A lack of institutional accountability has led to responsibility overlaps and coordination failure. The national biogas program is such example, as it falls under the mandate of more than one institution.

Centralized dissemination: Implementation all biomass energy projects was previously centralized. This led to a lack of touch with end users, and at times poor cooperation leading to effort duplication. As an example, dissemination of biogas digesters and cooking stoves was done centrally and yielded less than the desired results. The current proposal is to decentralise implementation of biomass programs to the local government levels to improve the impact to the end users and speed up dissemination.

Biogas scale-up: Potential users of biogas have so far shown weak appetite for take-up of this technology. These market barriers are exacerbated by institutional challenges including the lack of a well-coordinated institutional framework to manage existing and prospective investments, lack of clear technology standards and regulations, as well as unclear processes for approving biogas investments.

3.5.2 Electricity supply

Ensuring financial sustainability of the generation investment: Rwanda has a high cost of electricity compared with the region, and at the same time individual households with access to electricity tend to have extremely low rates of consumption. Furthermore, household electricity demand tends to be very concentrated around an early evening peak, coinciding with the need for lighting during this period. This combination of factors makes it challenging for the utility company to balance the costs of generating electricity with the revenue they receive. As household incomes grow and demand increases over time, this gap should reduce, but finding a way to bridge the gap in the short term is a challenge, unless the poorest in society are enabled to access alternative (off-grid) solutions. Promoting industrial and other productive uses of electricity helps to spread the load more evenly during the day, which improves power generation economics.

Capacity to deliver the electricity infrastructure: Project development, monitoring and implementation require skilled and experienced managers to ensure efficient coordination. There is strong need to hire and retain enough qualified staff to monitor energy projects and engage in strategic investment negotiations.

Minimising system losses: In 2013 a consultancy[54] undertook a detailed analysis of the system estimating grid losses at 23% and reported proposals on measures to reduce system losses. On this

[52] WISDOM Report, 2013
[53] Global Burden of Disease Report, 2010
[54] MANITOBA , 2013

basis a clear loss reduction plan has been developed: an investment of $60m over 3 years will results in over $180m of savings potentially. This will reduce losses from 23% to 15%; the equivalent of a 15MW currently. It is worth noting that reducing losses requires capital expenditure and there will be a trade-off between the capital cost of loss reduction and the savings in operational costs.

Lack of timely maintenance and servicing of electric power infrastructure: Power plants require regular maintenance to ensure optimum productivity; otherwise plant capacity is threatened by regular breakdown, which impacts on electricity generation and contribute to potential technical losses. High losses in electricity distribution (≈23%) remain a serious issue jeopardizing sustainability of the power sector in Rwanda that requires government attention.

3.5.3 Electricity access

Key issues needing to be addressed for electricity access include:

- Governance (existence of enabling regulatory framework for investment, enforcement capacities);
- Supply chain (access to capital, technologies, subsidies and know-how); and
- End-users, agricultural and industrial enterprises, SME (capacities and access to capital).

Ensuring financial sustainability of network investments: The average annual cost of each connected consumer is around $50 (around $45 in financing the loan required for the connection and $5 for operations and maintenance). Under the current tariff structure, a consumer would need to use approximately 130kWh per month in order to fund the cost of their own connection. Currently around half of consumers are using less than 20KWh per month.

Terrain: Rwanda has an extremely unique terrain to manoeuvre in terms in terms of extending the power grid. This renders the EARP targets harder to achieve because of the increased cost that come with the engineering the necessary technique.

Capacity: There is urgent need to build both institutional and individual capacities in ministries and their implementing agencies (including local governments) so as to be able to effectively deliver on the set targets[55].

Coordination between the distribution plans and the generation plans: Though difficult due to the different determining factors of the two plans, there is urgent need to harmonize the distribution planning and coordination with the changing generation plans to ensure that they go hand-in-hand to meet the set targets.

Access to off-grid finance: Unlike the EARP programme where finance is being obtained by the government through international donor funds, finance for off-grid solutions will need to be sought separately. The private sector is small in this area, and due to low purchasing power of the rural population, the return on capital may not be an attractive option. The microfinance market is growing significantly at present but the government must also play a role in ensuring appropriate financial support is available for the success of these electrification projects.

Sustainability of off-grid solutions: Proper preventive maintenance and support for all projects is fundamentally critical to their sustainability. In the past, regular follow up of projects has not been adequately undertaken to ascertain their sustained functionality. The result of this has been that many projects have had to be rehabilitated at high costs. There is therefore need to establish suitable maintenance and support procedures for all projects. Furthermore, as Rwanda's economy grows, energy consumption will grow and more households will transition onto grid connections.

[55] SOFRECO, March 2013

There is need to design a programme under which this economic growth does not render any investment into these off-grid technologies obsolete.

Enabling environment for off-grid solutions: The government must play a role in ensuring conducive legal and regulatory environment supporting the industry to develop. Additionally, no recent market assessment has been carried out of rural and semi-urban areas to determine the viability of off-grid energy solutions in those areas.

Challenge 8: Scattered Settlements: A significant driver of the cost of any electrification programme is the density of the properties that are to be connected. The more scattered the settlements are, the higher the cost of extending the network between properties. The development of the plans for electricity connections have considered some level of resettlement, but this needs to be promoted by the local communities and MINALOC in particular.

3.5.4 Energy Efficiency

The most urgent needs for energy efficiency relate to the largest source of current energy consumption which is biomass, mainly for household cooking applications. The issues and actions outlined in Section 3.5.1. are mainly addressed at improving efficiency in this area, so these issues are not repeated here. In addition to biomass-related efficiency issues, Rwanda has to address the following gaps and barriers:

New priority area: The issue of energy efficiency is often looked at from an aggregate economy wide or from rather a household biomass side, excluding a rich discussion and assessment in between which will need to be taken up in the Action Agenda. A look at industrial classification and their energy efficiency issues and policies will be informative and useful start in this direction. Apart from regular maintenance and monitoring of supply-side energy, only ad-hoc EE & DSM initiatives have been undertaken. This means that there is little institutional knowledge or capacity, regulations are missing to govern the sub-sector, and there is no specific strategy to guide the sub-sector. Establishing a DSM unit in the EUCL and work on regulatory development will help address these issues.

Minimising system losses: A loss in energy between generation and consumption is an inherent feature of electricity networks and such losses cannot be totally eradicated. However, they can be reduced with thorough network planning and maintenance and best practice billing. We are currently experiencing losses of around 23%, of which the majority occur through heat losses in the distribution network. The implementation of a system loss reduction program based on a recent study is planned to reduce losses from 23% to 15%.

Up-front cost: Whilst DSM has an immediate impact on supply requirements and EE measures result in both energy and financial savings for customers the up-front cost of these measures can be large when considering the potentially long pay-back period. Disposable income in Rwanda is very low, and whilst the high cost of energy will make returns on EE activities more appealing, there will need to be subsidisation or provision of other financial initiatives to incentive participation.

Barriers to uptake: There is little public awareness or financial mechanisms in place to incentivise and encourage EE, EC or DSM activities. Therefore the DSM unit will be tasked with raising awareness and energy audits and decentralization of government energy use responsibility will address this challenge.

Data requirements: Load research activities, are fundamental to the development of any DSM initiative[56] and needs to be made an integral part of operations which apart from DSM can also feed into the utilities' planning as well as helping to inform tariff setting. Information required includes:

- Who or which sector is using electricity (residential, industry, public pumping, public lighting
- For what purpose is the electricity being used (lighting, cooling, heating, pumping, electric motors, fans, etc.)
- When is being used
- How much is being used
- At what cost
- What is the penetration level of appliances, efficient lighting, efficient appliances

[56] As recommended by Copenhagen Centre on Energy Efficiency (SE4All Energy Efficiency Thematic Hub)

ANNEX 1 – MATRIX OF EXISTING PROGRAMS AND INITIATIVES BY THE GOVERNMENT AND DEVELOPMENT PARTNERS RELEVANT TO ACHIEVING OF SE4ALL GOALS

ANNEX – Table A1: Existing Policies, Strategies and Study Reports

	Document
	Laws, regulations& policies
1	Electricity law, official gazette, July 2012
2	Electrical installations regulations, 2012 by RURA
3	Regulations on Feed in Tariff, Feb. 2012, by RURA
4	Energy policy-draft for validation, June 2014
	Biomass
5	National use campaign to promote the use of Alternative Energy sources, 2013-2015
6	Biomass Energy Strategy (BEST) Rwanda, Volume 1: Executive Summary, June 2009 by Marge
7	Biomass Energy Strategy (BEST) Rwanda, Volume 2: Background &Analysis, June 2009 by Marge
8	Biomass Energy Strategy (BEST) Rwanda, Volume 3: Rural Supply & Demand, June 2009 by Marge
9	Biomass Energy Strategy (BEST) Rwanda, Volume 4: Proposed Strategy, June 2009 by Marge
10	Biomass Energy Strategy (BEST) Rwanda, Summary, June 2009 by Marge
11	Biomass use Survey in Urban and Rural Erea in Rwanda VOLUME I, May 2012 by Africa Energy Service Group ltd Rwanda
12	Biomass use Survey in Urban and Rural Erea in Rwanda VOLUME II, May 2012, by Africa Energy Service Group ltd Rwanda
13	Promotion and Marketing Strategy Formulation for the Rwanda Urban ICS Project, March 2011 by Practical Action
14	Baseline Assessment on Improved Cook Stoves (ICSs) in Urban Area, 2011, by Anicet Munyehirwe
	Electrification
15	Electricity new connection policy
16	EARP impact evaluation- baseline survey, 2014 by Green and Clean Solutions Ltd.
17	Electricity Access Roll out Program/EARP mid-term review, July 2012
18	Study on current Electrification rate in Rwanda, 2011, by National University of Rwanda consultany Bureau (N .U.R. C B)
19	AEPE Program Actualisation study for Electricity Master plan, May 2011, by Fichtner
	Electricity Tariff
20	Electricity tariff study, Dec2011, by Economic Consulting Associates
21	Rwanda Renewable Energy Feed-in Tariff, April 2011, by NEXANT
22	Review of the current electricity end user tariffs, April 2014, by Energy&Economic Consulting
	Geothermal
23	Assessing Generating Capacity Rwanda Geothermal fields from Green field data only, 2009, by United Nations University
24	Geothermal potential Appraisal of Kalisimbi prospect Rwanda, March 2010, by KenGen
25	Geothermal Prospects in Rwanda, May 2011 by IESE
26	Reconnaissance Geothermique de la Republique du Rwanda, June 1983, by B.R.G.M
27	Assessment of existing geoscientific data and conceptual models, May 2014, by ISOR
28	Geoscientific Surveys of the Rwandan Kalisimbi, Gisenyi and Kinigi Geothermal Prospects, October 2012, by Uniservices
	Grid Audit & Rwanda Grid Code
29	Consultancy services to carry out a loss reduction audit in Rwanda electricity network, July 2013, by Manitoba Hydro International Ltd.
30	The Rwanda Grid Code, Governance code, September 2014, by RURA
	Privatization of MHPPs
31	Privatization of management of existing Micro power plant : Feasibility analysis and strategy, August 2010, by PSP Hydro team/GIZ
32	Privatization of management of Micro power plant : Assessment report for 5 Plants, January 2012, by

	MININFRA&EWSA
33	Consulting Services for Sustainable Micro-Hydro and Private Sector Led Micro-Hydro Expansion in Rwanda, March 2013, by CRISIL
34	Procedure/Changes/Guidelines for Small/Mini/Micro Hydropower Development in Rwanda, April 2013, by CRISIL
35	Assessment of the Pico Micro-Hydropower Market in Rwanda, December 2011, by GVEP
	Peat
36	Rwanda Peat Master Plan, 1993, by EKONO-BGMR
37	Peat Development Master Plan Update, Feb. 2013 by Poyry
38	Pre-Feasibility Study for the Peat Fired Powe Plant, May 2011 by ÅF-Consult Ltd
39	Rwanda:100 MW Peat to Power, June 2011, by Punj Lloyd
	Renewable Energy
40	Rwanda Renewable Energy Studies- Renewable energy strategy, August 2012, by Africa Energy Services Group
41	Rwanda Renewable Energy Studies- Investment prospectus, June 2012, by Africa Energy Services Group
42	Rwanda Renewable Energy Studies, final report, June 2012, by Africa Energy Services Group
	Solar Water Heater
43	Techinical Institutional and Financial Design of Solar water heater program in Rwanda, December 2010, by Naceur Hammani
44	Policy for Solar Water heater Market Development in Rwanda, September 2012 by SEDP
	Wind
45	Wind ressource assessment in Rwanda, 2010 by BTC
	LPG
46	LPG market assessmnent study for Rwanda, February 2013, Anicet Munyeshuli
47	Development of Uniform Standards for LPG usage in Rwanda, KURRENT TECHNOLOGIES Ltd.
	Other studies, reports
48	Rwanda Energy Sector Review and Action Plan, 2012 by African Development Plan
49	Rwanda Sustainable Energy Development Project, project completion report, July 2014, by EWSA
50	Due Diligence of Feasibility Studies on Power Sector, October 2011, by IIFC
51	Review of existing MoU, Concession agreements, MoA between GoR and IPPs, Nov.2011, by Maitre Ndahiro Faroh
52	Assessment of Micro Hydro policy and crosscutting issues, July 2011, by Mario MERCHÁN ANDRÉS Kigali
53	Energy Market System Framework, June 2014, by Practical Action Consultancy

ANNEX – Table A2 New legislative and regulatory texts envisioned planned in ESSP

Legal/regulatory instrument	Timeline	Lead Agency	Supporting Agencies
National Laws			
National Energy Law consolidating all existing legislation	First draft available end of FY 2015/16	MININFRA	MINIJUST, Law Reform Commission
Geothermal Resources Law	Adoption following approval of national energy policy and the geothermal sub-sector action plan	MININFRA	EDC, MINREMA, RURA, MINELOC
Gas Law ensuring adequate coverage of all gas types and special issues	Immediate adoption following approval of policy	MINICOM	MININFRA
Energy Efficiency & Conservation Law	First draft circulated to Cabinet Jan 2015	MININFRA	EUC
Regulations			
Revised renewable energy feed-in tariff (RE-FIT) regulations	Expected adoption immediately following approval of policy	RURA	MININFRA, EDC, RDB

Legal/regulatory instrument	Timeline	Lead Agency	Supporting Agencies
Regulations concerning simplified licenses for off-grid providers and related technical specifications	Adoption by end of 2014	RURA	MININFRA, EUC, MINALOC, RDB
Ministerial Order on Public Street Lighting	First draft Circulated to Cabinet end 2014	MINALOC	MININFRA, MINECOFIN, RURA
Secondary regulations on downstream petroleum activities including enforcement of product quality standards and strategic reserve requirements	Expected adoption immediately following approval of downstream petroleum policy	RURA	MINICOM MININFRA NICA RBS
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	MININFRA, ABAKIR	MINIJUST, REMA
Secondary Regulations under Environment Law on climate finance	First draft circulated to Cabinet beginning of FY 2015/16	MINIRENA	REMA, MININFRA
Technical Guidelines, Codes & Standards			
National Technology Standard on Biogas Digesters	Elaborate and gazette by end of 2014	RBS	MININFRA, RURA, REMA, MINELOC, MINEDUC
Updated National ICS Technology Standard	Elaborate and gazette by end of 2015	RBS	MININFRA, RURA, REMA, MINELOC, MINEDUC
Green Building Codes and Standards including Mandatory Solar Water Heater requirements	Elaborate and gazette by end of 2014	RHA	MININFRA, NICA
Guidelines on applicability of Water Resources Licenses under Water Law to Hydropower Projects	Elaborate and gazette by end of 2014	MINERENA	MININFRA

ANNEX – Table A3. Key institutions and organisations involved in Rwanda's energy sector

INSTITUTION	RESPONSIBILITIES

Government	**GOVERNMENT MINISTRIES**	
	Ministry of Infrastructure	Energy Policy and Strategies ; Signs MOUs with Independent Power producers before they start plant development
	Ministry of Local Government	Policy and oversight of Decentralized authorities i.e. Provinces, Districts, Sectors
	Ministry of Natural Resources	Policy on natural resources management and environment
	Ministry of Internal Security	Ensuring security of public energy infrastructure in rural and urban areas
	Ministry of Education	Resource mobilization; Logistical support in the identification, mobilization and sensitization of rural schools for electrification
	Ministry of Health	Resource mobilization; logistical support in the identification, mobilization, sensitization of hospitals and health centers for electrification
	Ministry of Finance and Economic Planning	Resource mobilization for energy projects/programmes; budget provision; Planning, monitoring and evaluation
	PUBLIC AGENCIES	
	Energy, Water and Sanitation Ltd (EWSA Ltd)	Off-take grid power; technical support to energy actors; energy generation; Electricity transmission and distribution; Electricity and water sales
	Rwanda Utilities Regulatory Agency (RURA)	Regulation of utilities; Tariff setting, licensing
	Rwanda Bureau of Standards (RBS)	Setting standard; certificate; controls right of importation
	Workforce Development Authority (WDA)	Policy and strategies promoting techno- vocational skills; Oversight of implementation by IPRCS and TVETs
	Rwanda Governance Board (RGB)	Registration of NGOs/INGOs ; Provide permissions for operation
	Rwanda Environment Management Authority (REMA)	Technical support; approvals of Environmental Impact Assessments
	Rwanda Revenue Authority (RRA)	Collecting taxes; approving tax exemptions
	Rwanda Development Board (RDB)	Entry point for all investment; one-stop-center for company registration & sector information; One-stop center for investment information; Conducts negotiations with investors, including Power Purchase Agreements
Development Partners	**DONORS & TA**	
	World Bank	Funding & Technical Assistance
	European Union	Funding & Technical Assistance
	Japan International Cooperation Agency (JICA)	Funding & Technical Assistance
	African Development Bank (AfDB)	Funding & Technical Assistance
	Belgian Technical Cooperation (BTC)	Funding & Technical Assistance
	United Nations Development Programme (UNDP)	Funding & Technical Assistance
	Dutch government	Funding & Technical Assistance
	German government	Funding & Technical Assistance
	KfW	Funding & Technical Assistance
	GIZ	Funding & Technical Assistance
NGOs	**NGOs/INGOs**	
	Practical Action	Training, Consultancy & Advisory services on renewable energy
	World Vision	Funding and Technical Assistance
	Care international	Trainings, Consultancy & Advisory services on ICS, Biogas, Solar
	SNV	Trainings, Consultancy & Advisory services on ICS, Biogas, Solar
	Millennium Village Project	Trainings, Consultancy & Advisory services on ICS, Biogas, Solar
	Delagua Ltd	Trainings, Consultancy & Advisory services on ICS and Solar
	Prison Fellowship	Funding & Technical Assistance
	UN Women	Funding & Technical Assistance
	Red Cross	Funding & Technical Assistance
R	**ACADEMIC/RESEARCH**	

	University of Rwanda/School of Science and Technology	Engineering & ICT training programmes & research
	Tumba College of Technology	Training programmes in Computer Hardware & Software
	TECHNICAL TRAINING	
	Integrated Polytechnic Regional Centers	Training in computer repair, welding, carpentry, masonry & metalwork
	Technical, Vocational Education and Training	Trainings in computer repair, welding, carpentry, masonry & metalwork
Private Sector	Rwanda Renewable Energy Association	Association of independent renewable energy power producers
	SOLAR COMPANIES	
	Munyax Eco (local)	Solar water heaters and solar kits
	GLE (local)	Solar kits
	Mobisol (local)	Solar systems and solar kits
	Gigawatt solar (USA)	Grid-connect solar investor currently constructing an 8.5 MW solar plant in Agahozo Shalom village /Rwamagana District
	Goldsol/Spain	Grid-connect solar investor currently conducting a feasibility study who will also construct a 10 MW solar plant in Rwinkwavu /Kayonza District
	IMPROVED COOKSTOVES	
	Inyenyeri (local)	Imports and sells improved cook-stoves
	BIOGAS	
	Various biogas construction companies	Construction of Household Biogas Digesters under the National Domestic Biogas Program (NDBP)
	MICRO-HYDRO	
	Multiple companies	20 MHP project developers[57]
Cooperatives	**IMPROVED COOKSTOVES**	
	"Ubumwe" cooperative	Production & sales (wholesale and retail)
	AJDR Cooperative	Production & sales (wholesale and retail)
Financial Institutions	**BANKS**	
	Banque Populaire du Rwanda	Provides biogas loans to farmers payable at special interest rates negotiated with EWSA Ltd. - 16% over 3 years
	Development Bank of Rwanda	Provide loans for Energy Projects
	I&M Bank	Provide loans for Energy Projects
	MFIs	Provide loans for Energy Projects
	"Unguka" Investment Group Ltd	Manage Biogas subsidies on behalf of Districts; provide 3 –year biogas loans to farmers' at negotiated interest rates of 16%
	Umurenge SACCOs	Provide approvals for hydro site developers which in turn facilitates them to enter into MOUs with MININFRA and enables them to obtain power generation licenses from RURA; Are responsible for the security of energy infrastructure; Mobilize and sensitize citizens on national energy programmes ; Support MININFRA and EWSA Ltd in maintaining a data base of all energy installations
Local Government	**DISTRICT LEVEL**	
	District council	Approves of District Development plans and programmes and advises on implementation
	Mayor	Heads the District
	Vice Mayor for Finance and Economic Development	Planning, Strategizing, Resource Mobilization
	District Officer in charge of Environment, Infrastructure & Lands	Focal person for infrastructure (which includes energy), environment & land affairs
	JADF	Forum of stakeholders that discusses and implements development plants of the district.

[57] http://endev.info/content/Rwanda

	SECTOR	
	Sector Council	Approval of Sector Development plans & programmes
	Executive Secretary	Head of Sector
	JADF	Forum of stakeholders that discusses & implements development plans for the sector.
	Sector officer in charge of cooperatives	Membership recruitment; registration, co-ordination & oversight of all the cooperatives in the sector
	Sector Agronomist	Focal person for infrastructure (including energy), environment & land affairs
	CELL	
	Cell council	Approval of Sector Development plans & programmes
	Executive Secretary	Head of Cell
	Officer in charge of social and economic development	Focal person for all social & economic development programs (including energy)
	VILLAGE/UMUDUGUDU	
	Village council	Mobilization and sensitization of people on government development programs; oversight of program implementation
	Head of Village	
End Users	Institutions / Companies / Hotels / Universities / Households / Individuals	Buyers & consumers

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