Energy

The Opportunity in Rwanda

MININFRA

EWSA

RDB RWANDA DEVELOPMENT BOARD

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INTRODUCTION

Electricity accounts for only about 5% of primary energy use in Rwanda. Biomass is the primary source of energy accounting for some 84% of primary energy use, and petroleum products account for the rest. Rwanda has one of the lowest electricity consumption per capita compared to other countries in the region, and generation capacity is low – the country currently has about 100. MW of installed capacity and only about 11% of households are connected to the grid.

Existing Generation Capacity

The existing installed generation capacity and available capacity is show in Table 1.

Of the installed generation capacity, hydropower accounts for about 59%, thermal generation, primarily hired diesel and heavy oil fuel based generation units, for 40%, and methane gas for about 1%. The high reliance on thermal generation comes at a significant cost to Rwanda, especially given the present high prices for oil products.

Table 1: Installed and available generation capacity

Category	Name
In house Hydro Power	Ntaruka
	Mukungwa
	Gihira
	Gisengy
	Rukarara
Imported Hydro Power	Rusizi (SNEL)
	Rusizi (SINELAC)
Micro Hydro Power	Nya,yotsi I
	Mutobo
	Agatobwe
	Nyamyotsi II
	Murunda (REPRO)
	Rushaki
In house Thermal Power	Jabana (Diesel)
	Jabana (Heavy Fuel Oil)
Rental Thermal Power	Aggreko (Gikondo)
Methane to Power	KP1
Solar Power	Kigali Solar

Source: Electricity Development Strategy 2011-2017, MININFRA, March 2011

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ENERGY LAWS, POLICIES, AND ENABLING ENVIRONMENT

Electricity Law

Rwanda's draft Electricity Law was enacted into law in June 2011 and gazetted in July 2011.

The law on electricity governs the activities of electric power production, transmission, distribution and trading both within and outside the national territory of Rwanda. The primary objectives of the law are:

- Liberalization and Regulation of electricity sector;
- Harmonious development of power supply for all population categories and for all the country's economic and social development sectors in the framework of laws in force;
- Setting up economic conditions enabling electric power sector investments;
- Respect for the conditions of fair and loyal competition and for rights of users and operators.

The Electricity Law gives the Ministry in-charge of electricity the rights to provide Concession Agreements to firms, and provides the legal basis for the Rwanda Utilities Regulatory Agency (RURA) to approve and grant licenses for the production, transmission, distribution and sale of electricity, the conditions for licensing, and addresses the rights and obligations of the license holders.

The Law specifies that the electricity market of Rwanda shall be a single market based on free and open third party access to the transmission and distribution networks based upon the principles of regulated access to ensure a transparent and non-discriminatory marketplace.

The Electricity Law authorizes the

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issuance of an International Trade License for the import and export of electric power across the borders of Rwanda, and for the supply and sale to eligible customers in conformance with sector policies and other laws in force.

The Law also provides for a "Universal Access Fund" to provide greater access to rural and other un-served areas.

Energy Policy

the Ministry of Infrastructure (MININFRA) developed a draft National Energy Policy whose principle objectives are to;

a. Harmonize the National Energy Policy with Rwanda's long-term development plans and strategies;
b. Give particular attention to requirements for the progressive development of the electricity sector to support economic development and the National Access Roll Out Program
c. Have greater focus on household energy requirements and gender dimensions;
d. Bring down the average cost of electricity supply
e. Bring the (policy) statement up-to-date by reflecting the latest developments in methane and renewable energy and their environmental implications;
f. State more clearly Rwanda's commitment to private sector participation and to regional cooperation in energy.
g. Clarify the roles and responsibilities of public sector agencies and develop public sector skills in planning, procurement, and transactions' negotiation
h. Develop the legal, institutional and financial framework for rapid development of the electricity sector

The Energy Policy is a comprehensive document, which addresses the principal issues in developing the energy sector in Rwanda. Some of the key issues include:

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Integrated approach to energy planning: The need to develop energy plans within the framework of the broader national economic plan and strategic developmental objectives of the country.

Use of indigenous energy resources: Given the high cost of imported oil products, there is a need to fully develop available indigenous energy resources to the extent that they are financially, economically and socially beneficial.

Energy efficiency and conservation: use efficient technologies to make the best use of available energy supplies and reduce environmental impacts.

Energy pricing and subsidy policies: develop cost-reflective energy prices to ensure that energy suppliers can operate on a sustainable basis and make the necessary investments to expand power supply. Direct subsidies to one-time capital expenditures rather than to recurrent costs, and provide all subsidies in a transparent manner.

Regulatory framework: Empower RURA and build its capacity to ensure independence in energy price regulation and licensing of energy providers. Energy sector governance: Management of the energy sector, including decision-making about projects, must be open and transparent and in the best interests of the country. Procurement should be rooted in the principles of transparency, equal treatment and non-discrimination between competing bidders.

Institutional framework and capacity building: Strong energy sector institutions with adequate capacity are essential to meet ambitious growth targets. An effective energy information system is to be established and capacity building is to be provided to all sector institutions to undertake implement their roles and responsibilities.

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Private sector participation in energy:
Private sector participation should be promoted at all segments of the energy supply industry. Where Public-Private Partnerships (PPPs) are desirable, government will work with private sector entities to ensure the speedy structuring and financing of PPP projects in the energy sector.

Financing energy sector investments:
GoR to leverage private sector financing with public financing, where appropriate. Reduce the need for government guarantees and contingent liabilities.
New and renewable energies:
Promote the use of renewable energy technologies that are financially, economically and socially beneficial. Develop feed-in tariffs or other mechanisms to provide incentives and reduce risks for electricity production from renewable sources. Establish norms, codes of practice, guidelines and standards for new and renewable energy technologies.

Electricity Regulation

Some of the key functions of Regulator, RURA, are to:

i. Conduct all technical regulatory activities for the power production, transmission and distribution sectors
ii. Issue permits and licenses to firms that satisfy licensing requirements
iii. Monitor, evaluate and ensure the quality of the technical services provided by the electric utility
iv. Ensure both compliance to the adopted standards and a fair competition between electricity operators
v. Study and recommend tariffs and review and approve licensee tariffs
vi. Promote sustainable provision of quality and safe services
vii. Promote the utilization of renewable electrical energy resources in rural areas,
viii. Promote energy efficiency and conservation measures.

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The Electricity Law empowers RURA to set and approve electricity tariffs, in consultation with the Ministry and pursuant to laws and regulations in force. The Law also allows for cost-based tariffs to ensure adequate return on investments made by license holders. The Law also allows for performance based pricing and benchmarking

Electricity Tariffs

Rwanda has some of the highest electricity tariff in the region. The current electricity tariff is FRW 112/kWh (+VAT) for small LV (low voltage) consumers, and FRW 105/kWh (+VAT) for large commercial and industrial MV (medium voltage) consumers. A consultant study estimates that the tariff for residential and smaller non-residential customers is below the marginal cost of supply to residential customers, whereas the current industrial tariff is above the marginal cost of supply. The cost of supply is expected to reduce by 2012-13 when electricity production shifts from expensive diesel fuelled plants to cheaper hydropower and other generation options.

The GoR has been supporting the power sector through:

- Direct operating cost support by paying for fuel imports/ equipment rental or exempting import-tax
- Capital Expenditure support by seeking external funds as well as funds allocation from budget
- Other indirect subsidies

Feed-in tariffs (FIT) for eligible generation technologies is being considered and consultant studies are being reviewed to determine appropriate feed-in tariffs, especially for small hydro and other renewable energy sources. FIT for select generation technologies to be adopted by RURA by early 2012.

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The Electricity Development Strategy

The objective of Rwanda's electricity strategy is to increase access to modern energy and to meet the ever increasing power demand for economic development of the country. To attain these objectives, the accelerated electricity generation mix proposed in the "Electricity Development Strategy 2011-2017", is to generate 1,000 MW from both the indigenous energy resources and from shared energy resources with neighboring countries. The following specific targets have been set in the Electricity Development Strategy:

- Hydropower generation to be increased to about 333 MW
- Geothermal power plants with capacity of 310 MW to be developed
- Methane gas to power projects will deliver 300 MW to the national grid
- 20 MW of additional diesel generation required for immediate power needs and serve as a back-up
- 5 MW to be generated from renewable energy sources (solar PV, micro hydro power or wind) and distributed to local communities beyond the national electricity grid
- Electricity connections to increase from 200,000 to a total of 1,200,000 by 2017, which will be equivalent to 50% of access
- Electrify 100% of schools, 100% of health facilities and 100% of sector offices by 2017, either through connection to the grid or through reliable off-grid systems
- Explore the possibility of developing all relevant projects as CDM projects right from the planning phase in order to sell emission reductions.
- Emphasize energy efficiency measures such as reduction of technical and commercial losses on the national grid, distribution of energy efficient lamps (CFL's) and the establishment of a Solar Water Heater subsidy scheme in order to decrease electricity costs and save energy (potential to save around 50 MW per year)

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EWSA

The Rwanda Energy, Water and Sanitation Authority (EWSA) was established in 2011 as a 100 percent publicly owned utility. EWSA is responsible for the planning and implementation of power projects in the country, while policy formulation and sector oversight functions remain within MININFRA.

Power Market

EWSA is presently the sole off-taker for all power generated in Rwanda. Rwanda is also a member of the Eastern Africa Power Pool and plans to strengthen transmission interconnections with neighboring countries of Burundi, DR Congo, Tanzania and Uganda.

EWSA provides long-term power purchase agreement (PPA) to project developers.

Once the interconnection with neighboring countries is strengthened and the Eastern Africa Power Pool becomes operational, power can be exported through bilateral trades or to the power pool.

Demand Forecast

An Electricity Master Plan (EMP) has developed a revised demand forecast reflecting the goals of a new Electricity Strategy for the country, which envisages the development of 1,000 MW of generation capacity by 2017.

Domestic demand is expected to account for 60% of peak demand, while cross border mining projects are expected to account for 20% and sub regional electricity markets for the remaining 20%.

Transmission Network in Rwanda

Rwanda has about 383.6 km of 70 kV and 110 kV high-voltage (HV) transmission lines, and about 4,900 km of and medium-voltage (MV, 30 kV, 15 kV and 6.6 kV) lines and low-voltage (LV, 380 V and 220 V) lines. Rwanda's electric network is interconnected with the networks of Burundi, the DRC and Uganda

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(there presently is no inter-linkage with Tanzania).

Power flows between Rwanda, Burundi and the DRC are managed by the Societe Internationale d'Electricite des Pays des Grands Lacs (SINELAC).

According to the Electricity Development Strategy for 2011-2017, Rwanda intends to extend its grid by 2,100 km (700 km of HV lines and 1,400 km of MV lines).

In addition to 110 kV lines, 220 kV interconnection lines are planned to evacuate power from planned generation plants and meet the expected demand in the future.

Construction of 400 kV lines is also under consideration within the framework of the interstate network development.

Feasibility studies have been prepared, or are under preparation, for a number of transmission inter-linkages including the 220 kV Kibuye- Kigali line, the 220 kV Kigoma–Rwegura (Burundi) and Birembo–Mbarara (Uganda) lines, and the 220 kV Rusomo– Kigali line.

SPECIFIC POLICIES, LAWS AND REGULATIONS TO PROMOTE POWER GENERATION PROJECTS

Incentives to Power Project Developers

Infrastructure support and transmission access: The GoR provides transmission access to all power projects at its cost, and also provides road access, water supply and other basic infrastructure needed to develop projects.

The GoR has also acquired at its cost land for power projects or compensated private developers for land acquisition. The GoR provides a variety of tax and fiscal incentives to promote private sector investment in

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the country, which is applicable also to power project developers.

Public-Private Partnership (PPP): The GoR has a draft PPP policy, which is designed to promote PPP investments in infrastructure development including in the power sector.

Hydropower Subsector

The GoR is in the process of developing a Hydropower Policy. The country also plans on developing a Hydropower Master Plan to develop water resources in the country, and has shortlisted consultants to conduct the study. FIT are to be adopted to promote development of micro and small hydropower projects.

Geothermal Subsector

The GoR is in the process of developing a Geothermal Policy and Geothermal Resources Exploration, Development and Management Act to guide the development geothermal resources in the country.

Methane Subsector

The GoR has developed a draft Gas Law and Regulations to develop methane based projects. The draft is currently under review by Parliament and is expected to be gazetted soon. Management Prescriptions for the development of Lake Kivu gas resources have been prepared and the GoR is expected to endorse and adopt the prescription.

Peat Subsector

The GoR is in the process of developing a Peat Policy to sustainably and safely harvest peat resources for power generation.

Standardized Legal Document

The GoR is developing standardized legal documents and contract templates for the following:

- Memorandum of Understanding
- Letter of Intent
- Non-Disclosure Agreements
- Power Purchase agreements for different generation technologies

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such as hydropower, geothermal, peat and methane gas

- Concession agreements for energy projects: Peat Concession Agreement, Gas Concession Agreement, Geothermal Concession Agreement
- Fuel supply agreements (for example steam supply agreements in order to allow IPPs to buy steam from a developer, or equivalent gas or peat supply
- Management Contracts for power plants (for example for the Government owned hydropower plants)
- Engineering, Procurement and Construction Contracts

GoR Agencies/Institutions involved in Power Generation

Rwanda Utilities Regulatory Authority (RURA): The regulator is empowered to issue licenses to power generators, and provides licenses to private power developers following a transparent process.

The Rwanda Environmental Management Authority (REMA): provides environmental clearances to power projects.

The Rwanda Development Board (RDB): is the nodal agency for all private sector investment and Foreign Direct Investment in the country. The RDB negotiates all concession agreements with private project developers.

Business Process for Power Sector Project Development

The flowcharts below broadly map the general business process for development of power sector projects in Rwanda. The flow charts also indicate the principal GoR agencies and institutions involved in the development and approval of power projects in Rwanda.

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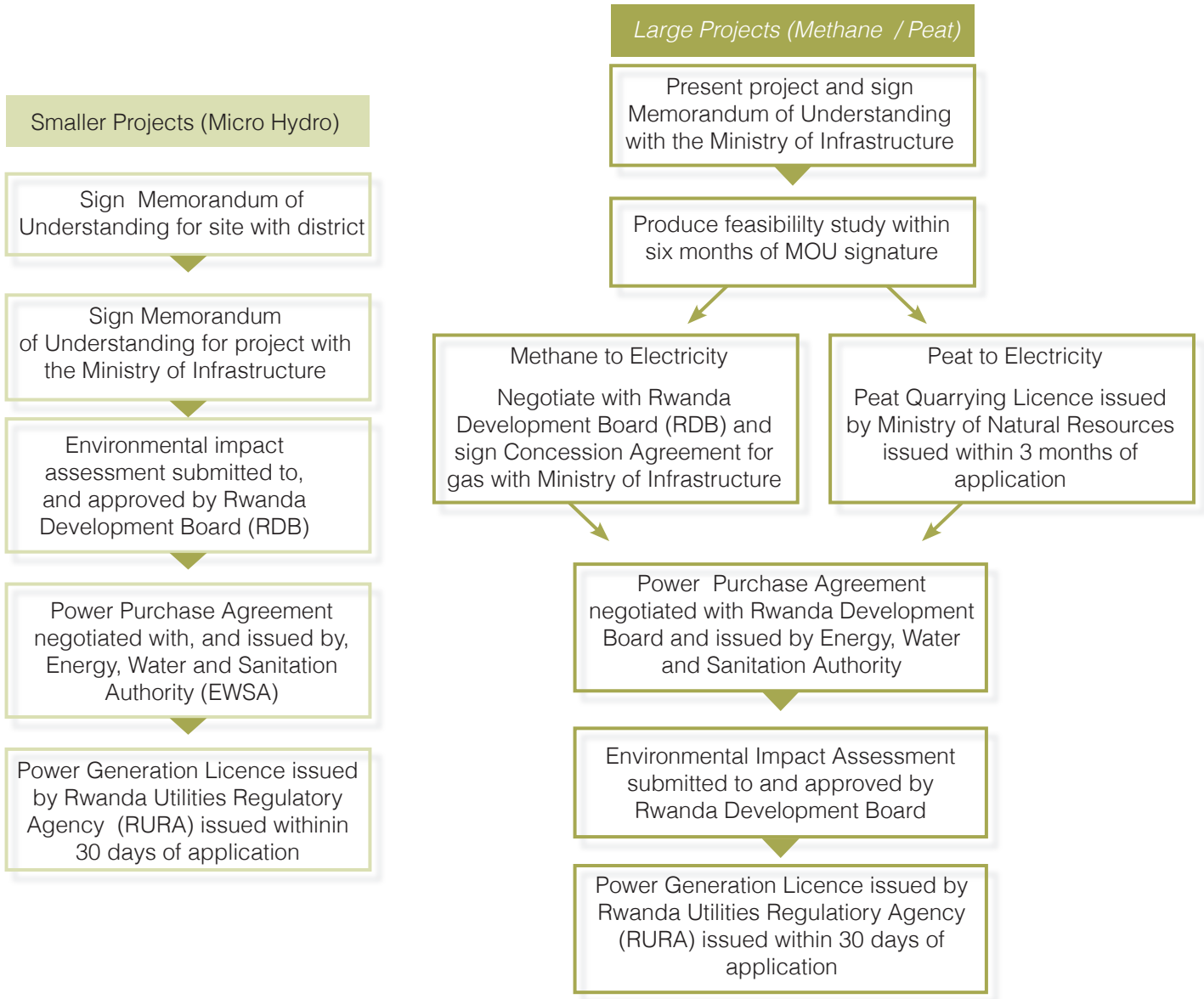
Flowchart Mapping the General Business Process for Development of Power Sector Projects in Rwanda



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HYDRO POWER

Rwanda's major rivers have proven potential to support run-of-the-river hydropower plants in a total of 333 sites across Rwanda.

Micro/Mini/Small Hydropower Projects

Small hydropower projects totaling 20.9 MW are currently under construction and will be operational between 2011 and 2013.

Domestic Medium/Large Hydropower Projects

The largest domestic hydropower project is Nyabarongo I, with an installed capacity of 28 MW. The project is under construction and will be commissioned by 2014.

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Regional Hydropower Projects

Some shared hydropower projects with neighboring countries include;

Rusizi III (145 MW)- shared by Burundi, DRC and Rwanda with an estimated 48 MW Rwandan share

Rusizi IV (287 MW) - With ≈96 MW, estimated as Rwanda's share.

Rusumo Falls (90 MW) -Planned to be jointly developed by Tanzania, Burundi and Rwanda. Rwanda's share would be 30 MW.

The Akanyaru project- Between Burundi and Rwanda with ≈ 4 MW potential.

Existing Potential

There is an estimated potential of ≈83 MW to be exploited with further sites with a potential of ≈ 22 MW. Feasibility studies to develop these projects are planned with the support of World Bank.

Key Investment Opportunities

Mini & Small hydropower: 20 projects totaling 9 MW bid as 4 "bundles" with an expected investment of $25-30 million. Planned completion date is 2014-15 and 3 bundled bids for 10 MW of projects bid every year from 2015-17

Medium hydropower: 12-17 MW

Nyaborongo II is being evaluated, with an expected investment amount of ≈ $80Mn

Regional hydropower: Ruzizi III (145 MW) supported by EU, AfDB, among others with an expected investment capital of $450Mn and completion date in 2016. There is also a 90 MW Rusumo falls supported by WB and others. Its expected investment amount is $300Mn and planned completion date is 2017

PROJECT: RUSIZI III HYDROPOWER PROJECT	
Sector	HYDROPOWER
Geographical Location	Rusizi River, DRC/Rwanda Border in the Great Lakes Region
Responsible Agent (s)	Ministry of Infrastructure/EWSA; EGL/CEPGL
Project Description & Rationale / Objectives	The project is being developed under CEPGL umbrella for Rwanda, Burundi and DRC. Ruzizi III hydropower project is planned to generate 145MW and the power output is shared equally by three countries. The project consist of 105 m long dam crest whose height is 20.5 m, 2.82 km Headrace Tunnel and a surface power station with 3x50 MW Francis Units. Objectives: • Improving the electricity system security, reliability and economic power supply by switching to the cheap and renewable sources. • Increase electricity access rates. • Improve on cross-boundary energy trade among CEPL member Countries
Project Size	145 MW
Proposed Procurement Process	The Project is structured as a Public Private Partnership
Planned Start Date	2013
Project Documentation	Feasibility Study Report 2010; ESIA Report 2011
Current Status	• A Transaction Advisor is in place and preparing Tender document for recruitment of a preferred Investor • Three Investor candidates have been prequalified • Team of national negotiators have appointed in order to conduct negotiations with the would be selected Investor
Financing amount & Structure Required	US$ 565 Million, Private Public Partnership
Contact Person	Director General Energy Water & Sanitation Authority (EWSA) P.O. Box 537 Kigali. Rwanda Email: ymuyange@ewsa.rw or yuwamahoro@ewsa.rw

PROJECT: RUSIZI IV HYDROPOWER PROJECT	
Sector	HYDROPOWER
Geographical Location	Rusizi River, DRC/Rwanda Border in the Great Lakes Region, Africa
Responsible Agent(s)	Ministry of Infrastructure/EWSA; EGL/CEPGL
Project Description & Rationale / Objectives	The project is being developed under CEPGL umbrella for Rwanda, Burundi and DRC. Ruzizi IV hydropower project is planned to generate 287 MW utilizing 224 m natural head and the power output will be shared equally by three countries of Burundi, DRC and Rwanda. The project is envisaged to consist of 80 m feed channel, 4.5 km long low pressure tunnel, surge shaft and a surface power station with 4x72 MW Francis units. Objectives: • Improving the system security, reliability and economic power supply by switching to the cheap and renewable sources • Increase electricity access rates • Improve on cross-boundary energy trade among CEPL member Countries
Project Size	287 MW
Proposed Procurement Process	The Project may be structured as a Public Private Partnership
Planned Start Date	2016/17
Project Documentation	Pre-feasibility Study Report 2009 by Fitchner GmbH;
Current Status	Only Prefeasibility Study completed
Financing amount & Structure Required	US$ 432 Million as per Prefeasibility Study Report 2009, Private Public Partnership
Contact Person	Director General Energy Water & Sanitation Authority, P.O. Box 537 Kigali, Rwanda. Email: ymuyange@ewsa.rw or yuwamahoro@ewsa.rw

PROJECT: RUSUMO FALLS HYDROPOWER PROJECT	
Sector	HYDROPOWER
Geographical Location	Kagera River, Tanzania/Rwanda Border in East Africa, At Rusumo Falls, on the Kagera River about 2 km downstream of its confluence with the Ruvubu River
Responsible Agent(s)	Ministry of Infrastructure/EWSA; NELSAP
Project Description & Rationale / Objectives	The project is being developed under NELSAP umbrella for Rwanda, Burundi and Tanzania. Rusumo Falls Hydropower Project is planned to generate 90 MW and the power output will be shared equally by three countries. The project consists of concrete dam with crest length of 150 m whose height is 14.5 m, Headrace Tunnel of 460 m and a surface power station with 3x30 MW Kaplan turbines. Objective: • Improving the system security, reliability and economic power supply by switching to the cheap and renewable sources • Increase electricty access rates • Improve on cross-boundary energy trade among EAC member Countries
Project Size	90 MW
Proposed Procurement Process	The Project is structured as a Publicly Financed but privately managed
Planned Start Date	2013
Project Documentation	Feasibility Study Report 2012 by SNC Lavalin
Current Status	• Draft Feasibility Study Report and Institutional Framework complete with support from WB • Tripartite Agreement signed between the three Governments in Feb 2012 • Procurement process of Owners Engineer commenced
Financing amount & Structure Required	US$ $400m Million, Public Financed but Privately Managed
Contact Person	Director General Energy Water & Sanitation Authority, P.O. Box 537 Kigali, Rwanda. Email: ymuyange@ewsa.rw or yuwamahoro@ewsa.rw

PROJECT: NTARUKA A	
Sector	HYDROPOWER
Geographical Location	On Ntaruka River, Busanze Sector in Nyaruguru District, Sothern Province, Rwanda
Responsible Agent(s)	Ministry of Infrastructure/EWSA
Project Description & Rationale / Objectives	The project is to be developed under IPP arrangement and is planned to generate 2 MW and the power fed into the Rwanda National Grid. The project consists of diversion weir with crest length of 14 m, Headrace Canal 258, Penstock 30 m long and a surface power station with 1.125 x2 MW Francis turbines. Objectives: • Increasing national generation installed capacity hence meeting increasing power demand • Improving the national energysecurity, reliability and economic power supply by switching to the cheap and renewable sources • Increase electricty access
Project Size	2 MW
Proposed Procurement Process	The Project is structured as IPP
Planned Start Date	2013/14
Project Documentation	Feasibility Study Report 2010 by SHER Engineers
Current Status	• Feasibility Study completed in June 2010
Financing amount & Structure Required	Euro 10.4 Million as per SHER Engineers June 2010 Report, IPP
Contact Person	Director General Energy Water & Sanitation Authority, P.O. Box 537 Kigali, Rwanda. Email: ymuyange@ewsa.rw or yuwamahoro@ewsa.rw

PROJECT: AKANYARU HYDROPOWER PROJECT	
Sector	HYDROPOWER
Geographical Location	On Akanyaru River, in Nyaruguru District, Sothern Province, Rwanda
Responsible Agent(s)	Ministry of Infrastructure/EWSA
Project Description & Rationale / Objectives	The project will be developed under IPP arrangement and is planned to generate 4 MW and the power be fed into the Rwanda National Grid. The project consists of 35 m high dam with crest length of 125 m, Headrace Tunnel of 383 m long, Surge Chamber, Penstock 110 m long and a surface power station with 2 x2 MW Francis turbines. Objectives: • Increasing national generation installed capacity to meet increasing power demand • Improving the national energysecurity, reliability and economic power supply by switching to the cheap and renewable sources • Increase electricty access
Project Size	4 MW
Proposed Procurement Process	The Project is structured as IPP
Planned Start Date	2014/15
Project Documentation	Feasibility Study Report 1992 by SOGREAH Engineers
Current Status	Feasibility Study completed in 1992
Financing amount & Structure Required	USD 13 Million as per SOGREAH Engineers 1992 Report, IPP
Contact Person	Director General Energy Water & Sanitation Authority, P.O. Box 537 Kigali, Rwanda. Email: ymuyange@ewsa.rw or yuwamahoro@ewsa.rw

PROJECT: NYABARONGO II HYDROPOWER PROJECT	
Sector	HYDROPOWER
Geographical Location	Along Nyabarongo River, Bwenda Sector in Gakenke District, Northen Province, Rwanda
Responsible Agent(s)	Ministry of Infrastructure/EWSA
Project Description & Rationale / Objectives	This is a multipurpose project envisaged to cater for water supply, irrigation as well as electrical power generation. The project may be developed either under Public or PPP arrangement and is planned to generate 12- 17 MW and the power will be fed into the Rwanda National Grid. The project consists of 48 m high concrete gravity dam with crest length of 228 m, and a surface power station with 2x8.5 MW Kaplan turbines just situated at the dam toe. Objectives: • Increase the country's hydropower potential. • Improve the availability of municipal and industrial water for Kigali; • Enhance agricultural water supply for Bugesera; • Provide better flood control
Project Size	12-17 MW
Proposed Procurement Process	The project may be structured either as Publicly financed or PPP
Planned Start Date	2013/14
Project Documentation	Feasibility Study Report 2008 by KOICA
Current Status	Feasibility Study completed in 2008
Financing amount & Structure Required	USD 150 Million as per KOICA2008 Report, Public/PPP
Contact Person	Director General Energy Water & Sanitation Authority, P.O. Box 537 Kigali, Rwanda. Email: ymuyange@ewsa.rw or yuwamahoro@ewsa.rw

PROJECT: 20 SITES TOTALING 9 MW TO BE BID AS 4 "BUNDLES" OF PROJECTS.	
Sector	HYDROPOWER
Geographical Location	The sites are situated in Northern, Western and Southern Provinces of Rwanda
Responsible Agent(s)	Ministry of Infrastructure/EWSA
Project Description & Rationale / Objectives	These are mini hydropower potential sites that so far have their Pre-Assessment Studies and costing reports prepared. Planned completion: 2014-15. Objectives: • Increase the country's energy generation sufficiency by utilizing hydropower resources hence reducing costly fossil fuel dependence.
Project Size	9 MW
Proposed Procurement Process	The projects are structured as PPP
Planned Start Date	2013/14
Project Documentation	HydroAtlas Report by SHER Engineers 2008 and Pre Assessment Report by IFC 2011
Current Status	Identified in HydroAtlas 2007 and Pre-Assed by IFC in December 2012
Financing amount & Structure Required	Expected investment: US$25-30 Million. Envisaged to be developed as IPPs
Contact Person	Director General Energy Water & Sanitation Authority, P.O. Box 537 Kigali, Rwanda. Email: ymuyange@ewsa.rw or yuwamahoro@ewsa.rw

PROJECTS/PLANTS: Rukarara 9 MW; Rugezi 2.2 MW; Mutobo 200 KW; Nyamyotsi I & II 200 kW; Agatobwe 100kW, Mukungwa (II) 2.5 MW; Gashashi 200 kW; Nyabahanga 200 kW; Nyirabuhombohombo 500 kW; Nshili I 400 kW; Janja 200 kW; Keya (2.2 MW), Nkora (680 kW) and Cyimbili(300kW)	
Sector	HYDROPOWER
Geographical Location	The plants/projects are situated in Northern, Western and Southern Provinces of Rwanda
Responsible Agent	Ministry of Infrastructure/EWSA
Project Description & Rationale / Objectives	GoR intends to privatize some of its existing small hydropower assets (totaling 15.6 MW) by placing them under private sector management. Objectives: • To ensure efficiency and operational sustainability of the country's power systems. • To encourage wide participation of players in the Energy/Power Sector hence build confidence to the private investors and business community from both local and foreign circles.
Project Size	18.8 MW
Proposed Procurement Process	The plants/projects may be leased and/or private operated and maintained.
Planned Start Date	2012
Project Documentation	Feasibility Studies and Design as well as Final As built documentations
Current Status	Rukarara 9 MW, Keya (2.2 MW), Nkora(680 kW), Cyimbiri (300kW) and Rugezi 2.2 are in operation since 2011 while Mutobo 200 Kw; Nyamyotsi I & II 200 kW and Agatobwe 100kW became operational in 2010 while Mukungwa (II) 2.5 MW; Gashashi 200 kW; Nyabahanga 200 kW; Nyirabuhombohombo 500 kW; Nshili I 400 kW; Janja 200 kW are still under construction and earmarked to be completed end of 2012
Financing amount & Structure Required	Expected investment: Negotiable Planned to be placed under Private Management Contract
Contact Person	Director General Energy Water & Sanitation Authority, P.O. Box 537 Kigali, Rwanda. Email: ymuyange@ewsa.rw or yuwamahoro@ewsa.rw

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METHANE GAS

Lake Kivu Methane in Rwanda

Background

- Lake Kivu is located in the East African Rift Zone between Rwanda and the DRC
- The 2,400 sq.km. lake contains high concentrations of naturally occurring CH4 and CO2, with the highest concentrations at depths ranging from 270m to 500m
- The oxygenated upper layer of the lake from the surface to a depth of

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60m supports the lake's biology

- The resource is shared equally between Rwanda and the DRC
- The PMP (Peat, Methane and Petroleum) Unit, at EWSA is developing methane projects

Potential for Methane-to-Power Generation

- Lake Kivu contains about 300 billion cu.m of CO2and 60 billion cu.m of CH4 gas. An estimated 120 to 250 million cu.m of CH4 is generated annually in the lake
- Rwanda wishes to utilize this resource to develop methane-to-power projects and other uses such as fertilizer and gas-to-liquids projects
- The methane in Lake Kivu is estimated to be sufficient to generate 700 MW of electricity over a period of 55 years; Rwanda's share of the total generation potential is about 350 MW, with the rest being DRC's share

Characteristics of Methane in Lake Kivu	
Methane	24.9% vol
Carbon Dioxide	73.5% vol
Hydrogen Sulphide	0.05% vol
Other gases	1.5% vol
Characteristics of Scrubbed Gas After Extraction	
Methane	80%
Carbon dioxide	18%
Nitrogen	2%

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Historic Use of Lake Kivu Methane in Rwanda

- Lake Kivu methane was first tapped by Union Chimique de Belge with a gas pilot plant at Cape Rubona in 1963 to supply the Bralirwa brewery
- Bralirwa brewery converted one of its boilers to use gas in place of fuel oil, and was supplied with 5,000 cu.m/day of methane gas purified to 80%
- The pilot plant was recently shut down after operating for over 40 years

Existing Methane-to-Power Projects in Rwanda

- KivuWatt, a subsidiary of Contour Global (USA), is developing a 100 MW plant: 25 MW 1st Phase by end 2012, and 75 MW 2nd Phase by 2015. Phase I is currently under construction
- KP1, a 4.5 MW pilot plant developed by GoR, is operating at about 1.5 MW since late 2007. GoR is in negotiations with a strategic partner to scale-up capacity to 50 MW in phases
- REC, a subsidiary of RIG (Rwanda), is a 3.6 MW plant. The plant is presently not operational and REC is seeking new partners and investors to revive and scale up the project

Opportunities in Existing Concessions

- KivuWatt's 25 MW Phase I (est. cost $140m), is under construction with GoR Sovereign Guarantee and MIGA guarantee. The 75 MW 2nd Phase will need financing. Estimated cost: $260m. Completion: 2014
- REC is seeking partners and financing to revive the plant and scale it up to 50 MW. Estimated cost: $106m. Completion: 2015
- Ongoing negotiations with private partners for 100 MW may be an opportunity once they are not concluded

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Project Structuring and Financing

Methane-to-Power Financing Opportunities

- 25 MW KivuWatt Phase I financed by a lending syndicate - Emerging Africa Infrastructure Fund, FMO, AfDB, etc. 75 MW Phase 2 needs financing. Project is an IPP
- The 4.5 MW REC pilot plant was developed as an IPP. Project may be restructured depending on the new partners and investors

Financing Support for Investors

- Financing institutions such as AfDB, WBG (WB, IFC, MIGA), EU and other bilateral donors and development partners will support eligible projects
- GoR will consider providing other incentives
- Risk mitigation instruments including PRI, PRG, PCG, from the AfDB, the WB, and MIGA will be available to eligible projects and developers

Policy, Law & Regulation

- Draft Gas Law and Regulations for methane projects is under review by Parliament, and is to be gazetted
- A draft Concession Agreement and draft PPA is under development for new projects (existing projects have PPAs with the utility)
- Management Prescriptions for the safe extraction of Lake Kivu gas resources are to be adopted

Available Documents

- Numerous reports on Lake Kivu going back to 1937 are available. Recent studies by LAHMEYER-OSAE and K. Tietze, and Lake Management Prescriptions are also available
- Project specific documents may be available subject to confidentiality agreements

Why invest in methane gas to power?

- Methane demonstration plants prove that the gas extraction technology is feasible.
- Rwanda is keen to develop its methane resources as part of its strategy to substantially increase the power capacity

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GEOTHERMAL RESERVES IN RWANDA

Background

Rwanda lies along the Western branch of the East Africa Rift Valley known as the “ring of fire” – an area with young volcanism, seismic and magmatic activity

There are 4 geothermal prospects 3 in the Nothern Region(Gisenyi, Karisimbi and Kinigi) associated with volcanoes and one in the Southern region (Bugarama) associated with faults along the East Africa Rift

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Potential for Geothermal Energy Generation

- The potential for power generation from geothermal energy in the country is estimated to be more than 700 MW out of which 310MW is planned to be developed by 2017.
- Surface exploration and reconnaissance studies have been carried out in the Western region (no studies have been conducted in the Southern region)
- Rwanda has conducted detailed surface studies and plans to drill three exploratory wells in August 2012 to confirm the commercial viability of geothermal-to-power projects
- 10MW well head generation units are expected to be operational in 2014.

Scientific Exploration Studies

Reconnaissance surface studies by BRGM in 1982 reported estimated temperatures above 100°C

Reconnaissance surface studies by Chevron in 2006 estimated reservoir temperatures in excess of 150°C

Detailed geo-scientific data (geo-chemistry, MT and TEM) by the BGR, KenGen, ISOR and the ITER in 2008 indicated the possibility of high temperature geothermal system

Uniservices of AU-IESE has conducted geophysical and MT & TEM studies, micro-seismic and micro-earthquake monitoring, heat flow measurements, geological mapping, and analysis of geochemistry data to prepare 3-D geological and physical models. Preliminary interpretation and analysis confirms previous findings and provides higher potential for one of the sites (Kinigi)

GoR will organize a peer review meeting to discuss the study results and validate the findings and help locate optimum sites for test drilling

Present Status of Development

- To reduce drilling and exploration risk, GoR is financing three exploratory wells in Karisimbi starting August '12.

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- Infrastructure development (water supply, access road) to the geothermal site is ongoing
- Feasibility studies and SEIA studies planned to assess commercial viability of developing geothermal energy in Rwanda

Greenfield Investment Opportunities

- 10 MW wellhead pilot plant to be installed if test wells are productive. Estimated cost: $30m. Planned Completion: 2014
- GoR plans to develop 300 MW (4 x 75 MW) of geo-thermal power by 2017. Estimated cost: $900m. Completion: 2014-17

Greenfield 10 MW Wellhead and Additional Projects

The initial 10MW will be publicly financed, and the scale up will be structured as PPP

Financing Support for Investors

- Financing institutions such as AfDB, WBG (WB, IFC, MIGA), EU and other bilateral donors and development partners will support eligible projects
- GoR will consider providing other incentives
- Risk mitigation instruments including PRI, PRG, PCG, from the AfDB, the WB, and MIGA will be available to eligible projects and developers

Policy, Law & Regulation

GoR has drafted a geothermal policy, a geothermal resources exploration, development and management act and regulations

Available Documents

- Studies by BRGM, Chevron, BGR, ISOR, ITER, KenGen, and Uniservices available for review
- International experts to peer review the Uniservices study
- Feasibility and SEIA studies to be completed after exploration drilling in 2013

Why Invest in Geothermal?

- GoR is committed to cover the upstream risks
- Rwanda is keen to develop its geothermal resources as part of its strategy to substantially increase power capacity
- Geothermal energy is base load

RFP FOR A 10 MWE WELL GENERATING UNITS

Sector	Energy Sector, Geothermal
Geographical Location	Kabatwa, Nyabihu District, Rwanda
Responsible Agent(s)	EWSA/Ministry of Infrastructure
Project Description & Rationale / Objectives	Description: The is a Government of Rwanda project to design and construct a 10 MWe well head generating units using steam from exploration wells as proof of concept for viability of geothermal energy in Rwanda Objectives ▯ Reduce risks in geothermal exploration to attract private sector involvement in geothermal development ▯ Provide environmentally friendly base load source of electricity ▯ Diversify the source of energy development
Project Size	10 MWe by 2014
Proposed Procurement Process	RFP, Short listing and EPC contract. The initial 10MWe will be publicly financed, and the scale up will be structured as PPP
Planned Start Date	February 2013
Project Documentation	▯ Draft geothermal policy, a geothermal resources exploration, development and management act and regulations ▯ Studies by BRGM, Chevron, BGR, ISOR, ITER, KenGen, and Uniservices available for review ▯ International experts to peer review the Uniservices study ▯ Feasibility and SEIA studies to be completed after exploration drilling in 2013
Current Status	▯ Drilling of exploration wells to start on August 2012 ▯ Development of infrastructure for drilling in progress ▯ Prefeasibility and feasibility studies after completion of drilling in 2013 ▯ Prefeasibility studies for the power transmission system ongoing
Financing amount & Structure Required	▯ GoR financing with support from development partners ▯ Estimated to cost between USD 16 to 20 M
	Yussuf Uwamahoro, Deputy Director General for EWSA

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PEAT-TO-POWER PROJECTS IN RWANDA

Background

A Peat Master Plan prepared by EKONO indicated that Rwanda has an estimated reserves of 155 million tons of dry peat spread over an area of about 50,000 hectares

About 77% of peat reserves are near Akanyaru and Nyabarongo rivers and the Rwabusoro plains

Potential for Peat-to-Power Generation

The theoretical potential (assuming all peat bogs are exploited) for electricity energy generation from peat is estimated to be about 1,200 MW

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Peat in the Rwabusoro marshland and around the Akanyaru river can fuel 450MW of electricity generation for 25 years

The Rwabusoro marshland and Rucahabi in the districts of Nyanza and Bugesera present significant opportunity for large-scale peat harvesting for power generation

Rwanda plans to develop its peat resources to generate about 200 MW of power by 2017

Present use of peat in Rwanda

- Two firms are mechanically harvesting peat in Rwanda
- PEC(Peat Energy Company) supplies 2,000 tons per month to a cement plant
- RAS (Rwanda Auto Service) supplies peat prisons for cooking

Peat-to-Power Projects in Rwanda

- GoR is developing a 15 MW peat-to-power in Bugarama Rusizi district.
- GoR is negotiating with a strategic partner to develop a 100 MW peat fired power plant in South Akanyaru prospect. Project to be developed as a PPP.
- GoR has advertised tenders for EPC contractor and an Owner's engineer for 100 MW peat-to-power project in Rwabusoro prospect. Project to be structured either as public or private.

Greenfield 100 MW Project

- The GoR is open to discussions with investors for the development of the 100 MW plant
- GoR is open to a long term concession with a strategic investor as long as the off-take price and project structure makes sense
- The project is planned to be developed as a PPP. GoR may consider a PPP or JV structure to lower the cost of capital and the cost of power generation

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Peat-to-Power Financing Opportunities

- Financing institutions such as AfDB, IFC, MIGA and other bilateral donors and development partners will support eligible projects
- GoR will consider providing other incentives
- Risk mitigation instruments including PRI from the AfDB and MIGA will be available to eligible projects and developers

Policy, Law & Regulation

The GoR is preparing a Peat Policy to sustainably and safely harvest peat resources for power generation

Available Documents

- The Peat Master Plan (1992/93) study prepared by EKONO energy
- An updated Peat Master Plan is under review
- Peat to power Pre-feasibility studies on 8 sites are under preparation

Why invest in peat to power?

- Peat-to-power technology is a proven commercial technology and the risks are low and peat mining projects are in operation
- Rwanda is keen to develop its peat resources as part of its short-term strategy to substantially increase power capacity

ENERGY SECTOR PROJECT PROFILES	
Sector	ENERGY : Greenfield 15MW peat fired power plant
Location	Bugarama, Rusizi Dstrict, Rwanda
Responsible Agent(s)	EWSA/ Ministry of Infrastructure
Project Description & Rationale / Objectives	Description This is a Government of Rwanda project intended to increase the installed capacity up to 1000MW by 2017 to support the national economic development, favor regional energy trade. The rationale of the project is to increase access to energy as enshrined in EPDRS and Vision 2020. The objectives are; 1. Improve access to energy for the Rwandan population 2. To boost economic activities 3. To support regional integration inter alia with energy trade.
Project Size	approx – 35 Million USD
Proposed Procurement Process	• Open tender for EPC contractor and supervising company
Planned project start Date	Mid 2012
Project Documentation	• Peat Master Plan • Feasibility study prepared
Current Status	GoR is looking for an EPC contractor
Financing amount & structure Required	• Public financing. The project is planned to be developed as Public. GoR may consider a PPP or JV structure to lower the cost of capital and the cost of power generation
Contact Person	Charles NYIRAHUKU Manager, Peat, Methane & Petroleum / Energy, Water and Sanitation Authority (EWSA). P. O. Box: 537 KIGALI Email: charles_nyir@yahoo.fr or cnyirahuku@ewsa.rw

ENERGY SECTOR PROJECT PROFILES	
Project	Greenfield 100MW peat fired power plant
Location	Akanyaru, Bugesera district ,Rwanda
Responsible Agent(s)	EWSA/ Ministry of Infrastructure
Project Description & Rationale / Objectives	Description This is a Government of Rwanda project intended to increase the installed capacity up to 1000MW by 2017 to support the national economic development, favor regional energy trade. The rationale of the project is to increase access to energy as enshrined in EPDRS and Vision 2020. The objectives are; 1. Improve access to energy for the Rwandan population 2. To boost economic activities 3. To support regional integration inter alia with energy trade.
Project Size	100 MW
Proposed Procurement Process	• The GoR intends to procure the services of private developers and investors to develop the 100 MW • The project is planned to be structured as PPP.
Planned project start Date	End 2012
Project Documentation	• Peat Master Plan • Tender document with technical specifications
Current Status	Request for proposals
Financing amount & structure Required	approx – USD 400 Millions, to be structured as PPP.
Contact Person	Charles NYIRAHUKU Manager, Peat, Methane & Petroleum / Energy, Water and Sanitation Authority (EWSA). P. O Box: 537 KIGALI Email: charles_nyir@yahoo.fr or cnyirahuku@ewsa.rw

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SOLAR ENERGY

Background

Rwanda is located in East Africa at approximately 2 degrees below the equator. It boarders with Burundi in the south, Democratic Republic of Congo in the west, Tanzania in the East and Uganda in the North.

It is generally characterised by Savannah climate and its geographical location endows it with sufficient solar radiation intensity approximately equal to 5kWh/m2/day and peak sun hours of approximately 5 hours per day.

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Existing Projects

In 2006, the Government of Rwanda signed an MoU with the German state Rhineland-Palatinate to construct, own and operate a 250 kWp grid connected solar plant.

The plant was constructed on the top of mount Jali in Kigali city. Since its commissioning date, the plant has been operating successfully.

Greenfield 10MW grid connected Solar PV plant

- Following the successful operation of the 250 kWp solar plant and good potential for solar energy in Rwanda as highlighted above, the Government of Rwanda has identified and reserved 25 hectors of land for the construction of 10 MW solar plant.
- This site is located in Eastern province of Rwanda in Nyagatare District , approximately 190 km from Kigali. Access is made from main road by a secondary road that cuts through the land plot, 2.4 km long. Within the site there is a 30 KV transmission line and a 50KVA transformer that will be up graded to evacuate the power generated from the 10 MW plant.
- The plant (10MW solar plant) will be constructed on IPP (Independent Power Producer) basis. The PPA (Power Purchase Agreement) and a 25years Land Lease Agreement will be signed between the investor and theGovernment of Rwanda.
- Consquently, interested investors are invited to construct, own and operate the above mentioned solar plant.

ENERGY SECTOR PROJECT PROFILES	
Project	Construction of a 10 MW grid connected solar PV plant
Location	Nyagatare District, Rwanda
Responsible Agent(s)	EWSA/ Ministry of Infrastructure
Project Description & Rationale / Objectives	Description This is a project of the Government of Rwanda (GoR) to reduce diesel consumption used in thermal plants. The rationale is to reduce expense on diesel and save the environment from pollution. Project objectives The objectives are; 1. To reduce the quantity of fuel (diesel) used for thermal generators 2. To save the environment by using clean energy 3. To save money spent in buying fuel (diesel) for thermal plants
Project Size	$29M
Proposed Procurement Process	The project will be conducted as a Private Public Partnership
Planned project start Date	October 2012
Project Documentation (available proj. documents)	Site survey and data collection completed
Current Status	Preparations for feasibility studies are ongoing
Financing amount & structure Required	Private Public Partnership
Contact Person(to be provided later)	Director General of EWSA ymuyange@ewsa.rw or yuwamahoro@ewsa.rw

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WASTE-TO-POWER

Municipal Solid Waste in Kigali City

Kigali City produces around 450 tons per day of solid waste of which between 300 and 350 tons/day is centrally collected.

The fraction of organic waste comes from households, restaurants, hotels and markets.

Other types of waste solid waste available in the country include: agricultural waste, livestock waste, water hyacinth.

The waste is transported to Nyanza

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landfill where it is dumped and covered with soil by using bulldozers.

Kigali City Council and MININFRA are in charge of waste to power projects.

Opportunities in Waste to Power Projects

It is estimated that 100 tons per day of raw municipal solid can produce 1MW, using traditional thermal technologies.

The population in Kigali is expected to reach about 1.5 million by 2020. It is believed that the waste collected will reach about 1000 t per day.

This represents about opportunity of 10 MW plant.

Key parameters for a biogas to power project (5 MW)

Amount of Gas Extractable	6 million m3/yr
Electricity Generation	4,000,000 kWh/yr
Capital Expenditure	2.5 million Euros
Operation Period	10 years

Policy, Law & Regulation

Regulations regarding solid waste management (collection and disposal waste) have been developed by RURA and REMA.

Kigali City has developed also the rules and directives on sanitation and hygiene promotion.

GoR is developing the strategic plans of integrated solid waste management.

Strategies and Solutions developed

- Renovation and eventual closure of Nyanza landfill
- Construction of a new engineered landfill
- Recovery of all recoverable material from the waste stream
- Proper and sustainable waste management through 3R (Reduce, Reuse and Recycle) principles.

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Available Documents

- Numerous reports on Waste to Power Projects are available
- Recent guidelines developed by RURA are available and can be checked on: www.rura.gov.rw/board_decision/18_GUIDELINES_Landfill.pdf

Waste-to-Power Opportunities

Waste to power projects are eligible for climate change funds (eg. CDM), this means that additional revenues for emission reduction can be generated by the project.

An integrated waste to power project will not only generate the much needed power for the grid, but also contribute to addressing issues related to sanitation, health and environment.

LIST OF ABBREVIATIONS

AfDB	African Development Bank
AU-IESE	Uniservices of Auckland University's Institute of Earth Science and Eng.
DRC	Democratic Republic of Congo
EWSA	Electricity Water and Sanitation Authority
EU	European Union
FMO	Dutch Development Bank
GDU	Geothermal Development Unit
GoR	Government of Rwanda
IFC	International Finance Corporation
ISOR	Icelandic Geo Survey
ITER	Spanish Institute for Technology and Renewable Energies
IPP	Independent Power Producer
JV	Joint Venture
KenGen	Kenya Electricity Generating Company
MIGA	Multilateral Investment Guarantee Agency
MINECOFIN	Ministry of Economy and Finance, Rwanda
MOU	Memorandum of Understanding
MININFRA	Ministry of Infrastructure, Rwanda
MT	Magnetotelluric
PCG	Partial Credit Guarantee
PPP	Public Private Partnership
PRG	Partial Risk Guarantee
PRI	Political Risk Insurance
RDB	Rwanda Development Board
REC	Rwanda Electricity Company
REMA	Rwanda Environment Management Authority
RIG	Rwanda Investment Group
TEM	Transient Electromagnetic
UPEGAZ	Unit for the Promotion and Exploitation of Lake Kivu Gas
WB	World Bank
WBG	World Bank Group

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For more information
Email us: investinrwandaenergy@rdb.rw

MININFRA

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