

Rwanda Energy Sector Review and Action Plan



AFRICAN DEVELOPMENT BANK GROUP



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Energy Sector Review and Action Plan - RWANDA

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Foreword

The Government of Rwanda recognizes that availability of efficient and reliable energy supply is a pre-requisite for social prosperity, human development and economic growth. These are also the key objectives of Rwanda's Vision 2020 whose overarching goal is to transform the country into a middle income economy by improving its competitiveness while ensuring unity and inclusive growth.

Achieving the Vision 2020 objectives will necessitate transforming the country from a low-income agrarian economy to a medium income export oriented economy, operating as a knowledge-based service hub. Three key constraints will need to be overcome. First, the nascent but growing private sector is yet to play its role as a growth driver, in spite of the sustained improvements in the business regulatory environment. Second, inadequate physical infrastructure remains a key binding constraint to economic growth, human development and growth in exports. Third, institutional and technical capacity has emerged as bottleneck to achieving the desired rapid economic growth.

The energy sector is also faced with a cross-section of all these bottlenecks. An energy sector policy and strategy was prepared in 2009 and articulates the mandate of the energy sector to effectively contribute to the country's development agenda. However, achieving the sector's goals and objectives will require prioritizing the following policy imperatives: (i) development of domestic energy sources; (ii) efficient use of energy; (iii) rationalizing energy pricing and subsidies; (iv) institutional development of the sector; and (v) capacity building. This study aims to complement Government's efforts in ensur-

ing the availability of reliable and affordable energy production that is also environmentally sustainable. This study serves a number of purposes. First, it identifies the core energy infrastructure bottlenecks facing the country and options for mitigating these challenges. Second, it presents a road map and action plan covering both the expansion of physical infrastructure and the development of sector structure, regulation, and institutional capacity; distinguishing between the short-and longer-term measures. Third, it identifies innovative approaches to crowd-in private sector investment and financing including the use of partial credit guarantees and establishment of an energy efficiency development fund. The roadmap and action plan are expected to guide the preparation of the second Economic Development and Poverty Reduction Strategy and for informing dialogue on key reform measures.

This study is in line with the African Development Bank's Ten Year Strategy (2013-2022) whose principal objective is to ensure that growth is more inclusive and that inclusive growth is sustainable through a gradual transition to green growth. We believe that the study's findings will be used to inform the design and implementation of the required energy sector reforms and look forward to continued dialogue and collaboration with various stakeholders as we jointly work together to support Rwanda's economic transformation.

**Vice President,
Country and Regional Operations and Policy
African Development Bank**

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Acronyms

AfDB	African Development Bank
BADEA	Banque Arabe pour le Développement de l'Afrique
BEST	Biomass Energy Strategy
BTC	Belgian Technical Cooperation
CDM	Clean Development Mechanism
CEPEX	Central Public Investments and External Finance Bureau
CER	Certified Emission Reduction
CFL	Compact fluorescent lamp
COMESA	Common Market for East and Southern Africa
DRC	Democratic Republic of the Congo
EAC	East African Community
EAPP	East African Power Pool
EARP	Electricity Access Roll-out Program
EDPRS	Economic Development and Poverty Reduction Strategy
ELECTROGAZ	Rwanda Utility for Production, Transmission, and Distribution of Gas, Electricity and Water
ESMAP	Energy Sector Management Assistance Program
EU	European Union
FRW	Rwanda Franc
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GTZ	German Technical Cooperation Agency
GWh	Giga-watt hour
HFO	Heavy Fuel Oil
ICF	Investment Climate Facility for Africa
ICT	Information and Communications Technology
IMF	International Monetary Fund
IPP	Independent Power Producer
kWh	Kilowatt-hour
LRMC	Long-Run Marginal Cost
M&E	Monitoring and Evaluation
MINAGRI	Ministry of Agriculture and Animal Resources
MINALOC	Ministry of Local Government
MINECOFIN	Ministry of Finance and Economic Planning
MININFRA	Ministry of Infrastructure
MINIRENA	Ministry of Natural Resources
MW	Megawatt
NBI	Nile Basin Initiative
NDBP	National Domestic Biogas Program
NELSAP	Nile Equatorial Lakes Subsidiary Action Program
PPA	Power Purchase Agreement
PPIAF	Public Private Infrastructure Advisory Facility
PPP	Public-Private Partnership
PRSP	Poverty Reduction Strategy Paper
PV	Photovoltaic
RDB	Rwanda Development Board
REC	Rwanda Energy Company
RECO	Rwanda Electricity Corporation
REMA	Rwanda Environmental Management Authority
RIEPA	Rwanda Investment and Export Promotion Agency
RURA	Rwanda Utility Regulatory Agency
RWASCO	Rwanda Water and Sanitation Corporation
SINELAC	Société Internationale d'Electricité des Grands Lacs
SIG	Sector Implementation Group
UNDP	United Nations Development Program
UNEP	United Nations Environment Program
VAT	Value Added Tax

Executive Summary

Context and Objective of This Study. The Government of Rwanda (GoR) is widely recognized as an ambitious reformer with a strong track record in launching a comprehensive economic development agenda. Economic reform has impacted the power sector in two fundamental manners. First, the economic development agenda encompassed radical reforms in the energy sector, particularly the power sub-sector, to the point that the country's national electricity company is now viewed as a model utility in East Africa. Second, the sustained economic growth has triggered a rapid increase in electricity demand.

The government has fully recognized that the availability of reliable power supply is not only a pre-requisite for economic growth but also for social prosperity and human development. Accordingly, it has launched an aggressive program to increase the access to the electricity services by all sectors of the economy and all consumer categories. The target for the expansion of electricity supply was set by Vision 2020 and the Economic Development and Poverty Reduction Strategy (EDPRS) of 2009-2012 that primarily aimed at increasing electricity access from 4% in 2008 to 40% in 2025. However, the new cabinet formed in October, 2010, decided to accelerate the expansion of electricity services. A new target was set to reach an access ratio of 50% by 2017. This target was pushed up further to 70% in the Leadership Forum of February 2012. As part of meeting this goal, the government has also decided to expand the electricity generating capacity to more than 1,000 MW by 2017.

Achieving those ambitious goals will involve serious challenges spanning all aspects of energy planning, management and operation. Recognizing these challenges, the government and its development partners are trying to formulate a roadmap that will encompass the actions by the public and private sectors in achieving the announced objectives. In support of these efforts and in line with its Rwanda 2012-2016 Country Strategy Paper (CSP) the African Development Bank (AfDB) has carried out this study in

partnership with the government. The study focuses on the issues and options in the electricity sector, which is considered a critical factor in enabling socio-economic development and the main vehicle for energy diversification. The study reviews the electricity demand and supply parameters to derive a roadmap and prioritized action plan for the expansion of the power supply capacity. It also reviews the institutional aspects of the power sector to arrive at a roadmap and action plan for improving the regulatory and technical capacity of the sector. These roadmaps and action plans are expected to provide input into the preparation of 2013-2017 Economic Development and Poverty Reduction Strategy (EDPRS 2).

Government's Plan. Starting from an extremely low base, the government has expanded electricity access by an impressive 160% between 2008 and 2011. However, still only 16% of Rwanda's households are connected to the grid. As mentioned above, the government has now set a national target to increase electricity access to 70% by 2017. It has also prepared an expansion plan aimed at increasing the electricity generation capacity from about 100 MW in 2012 to 1,160 MW by 2017. The installed capacity in 2017 would comprise: 340 MW of hydropower, 310 MW of geothermal power, 300 MW of methane-based power, 200 MW of peat-based power and 20 MW of diesel thermal plants. The plan would have an estimated investment cost of at least \$500 million/year of which about \$200 million/year is designated to be undertaken by the public sector and the rest by the private sector.

Project Readiness. This study fully supports the above program while noting that the actual commissioning date of the corresponding projects depends on the state of preparation of each project. The study then reviews the technical readiness of various projects based on the availability of feasibility studies, the formulation of the implementation arrangements and the prospects for financing. This review indicates that the projects that are considered technically ready now and could be commissioned by 2017 will provide

a total installed capacity of about 595 MW (Table ES1). Other projects in the pipeline would be commissioned in the subsequent years. This raises the importance of technical preparation of the projects in the government's power expansion plan. At the same time, it indicates the need for understanding the extent of uncertainty in the investment requirements of the power sector.

Investment Requirements of the Power Sector. Table ES1 contains an indication of the power sector's investment requirements. The study has assessed the investment requirements under two scenarios – the government's plan of expanding the generating capacity to 1,160 MW by 2017; and the delayed scenario in which a number of projects that are not considered technically ready could shift from 2013-2017 to subsequent years. Under the government's accelerated plan (Scenario 1), the total investment needs of 2013-2017 are estimated at approximately \$4.2 billion, indicating annual investment of \$845 million. This annual investment requirement then drops to \$345 million in 2018-2025, demonstrating the heavy concentration of investments in 2013-2017. Under the delayed program (Scenario 2), investment requirements are estimated at \$2.5 billion for 2013-2017, indicating an annual investment need of \$510 million which would then continue at the rate of \$550 million/year in the subsequent years.

The Strong Need for Project Preparation and Pilot Implementation. It is crucial that project preparation work is carried out at full speed no matter whether the project is designated as a public or private sector undertaking. The international experience indicates that money spent on project preparation and upstream development is money well spent, as it contributes to a reduction in the technical and business risks. Investing in project preparation pays off in terms of reduced delivered cost of supply as well as more rapid and competitive reception by the private sector. It will also provide further transparency and information symmetry for potential private sector participants.

Establishing an Energy Efficiency and Development Fund. The government is aware of the need for reducing technical risks and has accepted to undertake project preparation, resource exploration and pilot operations

before inviting the private sector to carry out major projects. However, there is a need for government to fund such activities in a more rapid, efficient and systematic manner through a specialized fund. This study recommends creation of an Energy Efficiency and Development Fund (EEDF). This is now a common practice in developing countries some of which have established two or three separate funds to attend to energy efficiency, renewable energy and energy project preparation. In the case of Rwanda, a single fund should be sufficient for: (i) energy efficiency audits and retrofits (ii) project preparation activities including technical and feasibility studies (iii) initial exploration drilling in the identified geothermal sites (iv) construction of pilot geothermal projects (v) development of small hydro projects by the private sector (vi) the recruitment of transaction advisors for PPP projects.

The objectives of the proposed EEDF are in line with the priorities of most development partners (DPs). Thus, the EEDF may receive support from the DPs if properly structured and established. The concept of EEDF is also in line with the objective of the Climate Investment Funds (CIFs). It is therefore suggested that a proposal for establishing EEDF be prepared and submitted to CIFs with a request for \$30 million financial support. The country should apply to join the CIF as soon as possible as a number of countries are on the waiting list. The government should then seek contributions from other DPs with the objective of expanding the EEDF's size to \$100 million.

Sources of Financing Power Sector Investments.

Power sector investment requirements of 2013-2017 are estimated at between \$2.5 and \$4.2 billion. The potential sources of financing include: electricity tariffs; the internal resources of the Electricity, Water and Sanitation Authority (EWSA); the government; development partners; and the private sector.

Electricity Tariff. Electricity tariff is presently set at a flat rate of 134 RwF/kWh (22 US cents/kWh) for residential and commercial consumers. Industrial customers are subject to a time-of-use tariff of 168 RwF/kWh (28 US cents/kWh) for peak hours, 126 RwF/kWh (21 US cents/kWh) for intermediate load hours and 96 RwF/kWh (16 US cents/kWh) for

Table ES1: Investment Requirements of the Power Sector (\$ millions)

Investment Component	Scenario 1: Accelerated Program		Scenario2: Delayed Program	
	2013-2017	2018-2025	2013-2017	2018-2025
Generation				
Domestic Hydro	475	145	312	308
Regional Hydro	300	55	102	253
Geothermal	935	440	482	893
Methane	900	160	300	760
Peat	615	320	353	582
Total	3,225	1,120	1,549	2,796
Transmission	150	250	150	250
Distribution				
Urban Distribution	150	350	150	350
Rural Electrification	700	1,050	700	1,050
Total	850	1,400	850	1,400
Grand Total	4,225	2,770	2,549	4,446
Annual investment	\$845 million/year	\$345 million/year	\$510 million/year	\$555 million/year

Source: Electricity Master Plan (2011); Seven-Year Strategy (2011).

off-peak hours. These tariffs represent the main parameters of the power sector's revenue and thereby financial viability. Various reviews of electricity tariffs indicate that the present level of tariff is in line with the cost recovery principles. However, the power sector in the short to medium term will experience a shortfall in revenue and cash flow requirements due to the heavy concentration of investments in the next 5 years. Under normal circumstances such a shortfall could be met by utility's borrowing from external and domestic markets. However, EWSA does not yet have the established creditworthiness for such borrowing. It is therefore necessary to continue support from development partners and the government to enable EWSA to meet the 2013-2017 cash flow requirements while planning on curtailing this support gradually afterward.

Making EWSA Self-Sufficient. To make EWSA a self-sufficient utility, it must be put on a path toward becoming a credible entity capable of corporate borrowing from commercial sources (commercial banks and possibly bond issuances for sale to domestic investors.) The sector restructuring roadmap presented in this report recommends this process should entail three major steps. First, within its current structure, EWSA should ensure the transparent performance of each segment of the supply chain by separating the financial accounts of various business units including: generation, transmission and core services. Second, EWSA should be converted to a corporation that could then become an independent (fully government-owned) company that would be legally able to borrow on its own account. Third, EWSA should gradually improve its cred-

itworthiness. To put EWSA on this path, it is necessary to establish the performance benchmarks and the legal framework suitable for medium-term developments. In this regard, it is recommended that the government arranges for a management audit of EWSA. The objective of the audit would be to review the present functional structure and prepare the path toward improved creditworthiness.

Promoting Private Sector Investment and Finance. The power sector development plan is dependent on private sector investments of at least \$1.5 billion for the next 5 years. Mobilizing private investment of such a magnitude is totally unprecedented in Rwanda. The main experience in this regard relates to the formulation of the KivuWatt project. This project is presently being implemented with the aim of developing Phase I (25MW) of the Lake Kivu gas extraction and power production facility. The project cost is about \$128 million. The project sponsor is a private company - Contour Global, which has invested \$35.7 million in equity while attracting the Netherlands Development Finance Company (FMO) to contribute \$8.9 million in equity. The remaining \$83 million of the project's cost is in the form of borrowing from AfDB's private sector arm, the Emerging Africa Infrastructure Fund (EAIF), Belgian Investment Company for Developing Countries (BIO), Netherlands Development Finance Company (FMO) and the European Financing Partners (EFP). Even though the project is a private power plant, it has been able to attract about 72% of its funding from multilateral and bilateral entities that entered to support Rwanda's development rather than to pursue financial gain. The essential point is that the KivuWatt project has involved no commercial lenders.

Financing Large-Scale Projects. The forthcoming private projects are expected to be considerably larger than the KivuWatt project. The investment requirement in each of the geothermal, methane or peat-based power plants is expected to be \$400 million and upwards. A private investor typically contributes 25% to 30% of the cost as equity. The investor would then need to finance the rest as borrowing from various sources. The presently engaged development partners may provide only a small amount of such borrowing. The private investor is also likely to explore the possibility of assistance from other development partners (includ-

ing but not limited to China, India, Turkey, Korea, Brazil; Arab funds including The Saudi Fund for Development, the Kuwait Fund for Arab Economic Development, Arab Bank for Economic Development in Africa, OPEC Fund for International Development and Abu Dhabi Fund for Development; and the US government's Millennium Challenge Corporation). However, in all likelihood the private investor will have to tap into commercial sources of finance. The experience in other countries indicates that mobilization of commercial finance is a long, complex process for the first energy projects in a developing country. The government can facilitate this process by formulating certain international guarantee instruments that have a minimal impact on its contingent liabilities.

Formulating Partial Risk Guarantees (PRGs). The presence of political risk has proven to deter private sector participation in large energy projects. The deterrence relates partly to the concerns of investors and partly to those of commercial lenders. The investor normally requires that the government guarantee the utility's obligation to pay for electricity off-take and political risk insurance to protect its assets. The investor in the KivuWatt project has received both of these protections through a government letter of comfort and a MIGA guarantee. The commercial lender normally requires a guarantee for loan repayment in case of default by the private company. In Rwanda's circumstances, this guarantee should be provided by either the World Bank/IDA and/or the AfDB. It is important to note that since the guarantee is being extended as concessional support, it is not included in the IMF's non-concessional borrowing ceiling.

Initiating PRGs. The request for a partial risk guarantee is normally made by the private investor during the structuring of the financial package. Nevertheless, in many cases the government initiates the request so it can announce the availability of such support while inviting private investors. The initiation by the government could also save time and enable faster financial closure of the corresponding projects. The process of preparing a partial risk guarantee can be lengthy and taxing on the time of government authorities and the IDA/AfDB staff and management. This would especially be an issue when there are a number of

Box ES1: Suitability of the Proposed EEDF to the Climate Investment Funds

Climate Investment Funds (CIFs) consist of two main components: a large \$5 billion to \$6 billion Clean Technology Fund (CTF) and a number of small funds such as Pilot Program for Climate Resilience (PPCR), Scaling up Renewable Energy for Low Income Countries (SREP) and Forest Investment Program (FIP).

SREP is of particular interest to Rwanda since it suits the economic and energy situation of the country. Some of the conditions and objectives of SREP are as follows:

- The proposed project should encourage investment in renewable energy as an alternative to conventional sources, such as fossil fuels and inefficient use of biomass. It should ensure that renewable energy is fully integrated into the national energy plan
- Proposal for SREP funding should result in increased energy access through the use of renewable energy, particularly in the remote rural areas
- The proposed project should encourage private sector investments to significantly increase renewable energy capacity in the country's energy supply
- The proposed project should build local and national implementation capacity and institutions

SREP's present project portfolio and pipeline has a high concentration of energy projects in Africa with substantial focus on geothermal projects in Kenya and Ethiopia.

Application Process. All the climate investment funds are managed by the World Bank and can be accessed through multilateral

institutions such as the World Bank and AfDB. Therefore application for establishing the EEDF should be developed with the cooperation of one of these institutions. To be eligible for CIF support, the application should **demonstrate clearly the manner in which EEDF will reduce energy poverty while relying on low carbon energy options.** The specific objectives of the EEDF could be presented as:

- Increasing access to electricity services with particular emphasis on remote and rural areas
- Improving efficiency in energy production and consumption
- Facilitating the development of geothermal energy resources
- Supporting public and private investments in domestic hydro resources

Scope of EEDF could be defined to include:

- Energy efficiency audits and retrofits
- Project preparation activities including technical and feasibility studies
- Initial exploration drilling in the identified geothermal sites
- Financing of pilot geothermal projects
- Providing support to the development of small and micro hydro projects by private sector
- Recruitment of transaction advisors for PPP projects

Governance and Organizational Structure. Governance is normally the make-or-break aspect of creating a new energy fund. It determines the level of comfort development partners will have in supporting the fund. The implementation arrangements of EEDF should be designed to ensure strategic focus, operational effectiveness and clarity of fiduciary and resource-utilization responsibilities. Chapter 5 of this report describes briefly a recommended structure.

projects in the immediate pipeline. It is therefore of interest to prepare a program of partial risk guarantees that would cover a number of forthcoming projects in the power sector. Kenya has recently succeeded in securing such a program PRG for its power sector projects from the World Bank Group (IDA, IFC and MIGA).

The program covers the private sector power projects scheduled for implementation in the next 5 years, thereby avoiding case-by-case application. Rwanda can learn from the experience of Kenya, which has demonstrated a good appetite for PRGs in developing the power sector.

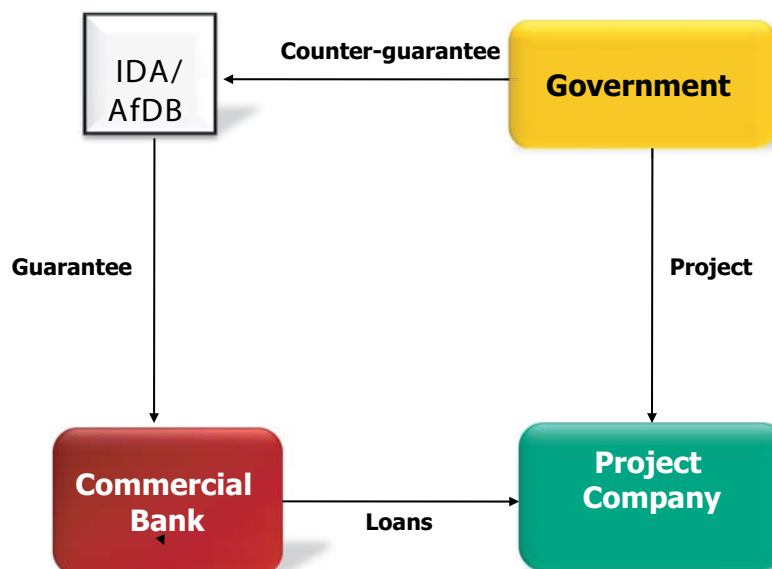
Formulation of a program PRG is a complex undertaking and therefore needs careful preparatory work. It is recommended that the government invite the AfDB Private Sector Department's advisory services to review and formulate such a package.

Summary of Sector Challenges. In line with the overall economic reform agenda, the power sector has gone through some significant changes with respect to structural reform and supply capacity. However, plans for future expansion of the power sector and electricity access are very ambitious, involving a number of significant challenges

Box ES2: The Basic Parameters of Partial Risk Guarantee

How the guarantee would work:

Guarantee Contractual Relationships



When and how a guarantee may be called upon?:

The guarantee is only called upon when the private company defaults in repayment of the loan **and it is demonstrated** that the default is due to the non-payment by EWSA. That is, the guarantee **does not provide** general coverage for the private company's financial problems and inability to pay back its loans.

What is meant by partial risk?:

The commercial loan may have a repayment term of 10 years. However, the lenders often are concerned about repayment in the first five

years. The guarantee would then cover the repayment obligations in the initial five-year period. The guarantee could be also partial in amount. For example, the lender may want \$50 million coverage for a \$100 million loan.

How is a guarantee counted in the IDA/AfDB allocation to Rwanda?:

Twenty-five % of the nominal guarantee amount counts in the allocation. That is, a \$100 million guarantee is equivalent to a \$25 million loan in the country allocation.

in regard to: (a) energy diversification (b) expansion of supply capacity (c) investment and finance (d) EWSA's financial strength (e) private sector participation (f) regional interconnection/integration (g) regulatory and institutional capacity (See Chapter 3).

Approach Taken by This Study to Derive Sector Priorities. This study uses a least-cost methodology to review the power sector issues and options. The subsequent chapters of this study provide a systematic analysis of sector priorities through (a) assessment of cost of investments and technical readiness of projects (b) review of financing require-

ments and the potential sources of finance (c) analysis of bottlenecks in private sector investment and finance. This analysis informs the priorities for the development of physical infrastructure and regulatory and institutional capacity (See Chapter 7).

Preparation of the Roadmap and Action Plan. The final chapter of this report consolidates the study's recommendations into a proposed roadmap and action plan covering both the expansion of the physical infrastructure and the development of sector structure, regulation and institutional capacity. The roadmap and the action plan provide input

Box ES3: Contribution of this Report to the Preparation of EDPRS2

The government has a well-formulated approach to preparing the 2013-2017 EDPRS in consultation with development partners (DPs) and other stakeholders. It has identified, through its ongoing deliberations, the need to derive: (i) a clear roadmap that determines the stream of future investments (ii) a plan for the development of the regulatory, institutional and technical capacities.

This report analyzes various outstanding issues while consolidating the major recommendations in a proposed roadmap and action plan which cover both the expansion of the physical infrastructure and the development of sector structure, regulation and institutional capacity. The Ministry of Infrastructure has already shared the proposed roadmap and action plan with the Energy Sector Working Group that has membership from all DPs and stakeholders and is leading the task of preparing the energy section of EDPRS-II.

The roadmap for the development of the physical infrastructure provides a detailed list of projects in electricity generation, transmission and distribution that Rwanda plans to implement in the medium term (2013-2017) as well as projects that would be undertaken in the longer term (2018-2025). The roadmap also emphasizes the actions that GoR should undertake in relation to cross-border interconnections and the East African grid integration.

The roadmap for the development of the regulatory and institutional capacity is developed to fit four emerging dimensions. First, with the introduction of private power producers, the technical and institutional requirements should be clearly specified so that the reliability and security of the power network operation are protected. Second, the emerging role of EWSA as a single buyer of bulk electricity has significant implications regarding its technical competencies in economic dispatch and transmission services. Third, the

potential partial unbundling of the power sector in the future should be reflected in the emerging institutional capacity of the relevant entities. Fourth, with the potential expansion of cross-border electricity trade, EWSA's staff and systems should be strengthened to manage the corresponding transactions.

The Action Plan presents an extensive list of activities, milestones and costs associated with the implementation of the roadmap. The structure of the action plan is presented for: short-medium term (2013-2017) and medium-long term (2018-2025) timeframes. Each plan contains the actions for:

- Development of Domestic Hydro Resources
- Development of Regional Hydro Resources
- Development of Methane Power
- Development of Geothermal Power
- Development of Peat-based Power
- Expansion and Reinforcement of Transmission and Distribution Networks
- Development of the Institutional Capacity

The Monitoring Framework is devised at two levels: a high level comprising global indicators of power sector performance that would be monitored by MINECOFIN, and a detailed set of indicators that will be monitored by MININFRA. The high level monitoring primarily involves tracking two main performance indicators: the increase in generation capacity (in MW) and the increase in number of connections. The detailed set of indicators falls into three categories: (i) increasing access to energy (ii) reducing the cost of service (iii) strengthening sector governance. The targets for each indicator are based on the proposed action plans and are also in line with the government's energy sector development targets.

into the preparation of EDPRS2 (see Table ES4).

The Roles of the Government, Development Partners and Private Sector. The roadmap and action plan for 2013-2017 expansion of the electricity sector indicate some unprecedented challenges in project finance and implementation. The government will have to initiate the action in all areas (generation, transmission and distribution). However, implementation of the action plan is expected to be a joint effort between the government, the development partners and the private sector. Therefore the agenda for the engagement of each party in the power sector is quite broad and intensive.

Public sector (mostly EWSA) is expected to undertake about \$1.1 billion of investment in 2013-2017. The public sector investment covers transmission, distribution and some generation activities (Table ES5). All of these investments would need to be financed by the government and the development partners. There is substantial uncertainty about the contribution of the development partners.

The government should organize a roundtable of development partners to seek pledges for financing the public sector share of power sector investments. A similar exercise was undertaken in 2009 to mobilize funding for the Electricity Access Roll-out Program (EARP) of 2009-2013. The

Table ES2: Financing Requirements of the Power Sector

Year	Investment Requirements by Sub-sectors (\$millions)				Investment Requirements by Public and Private (\$millions)		
	Generation	Transmission	Distribution	Total	Public Sector	Private Sector	Total
2013	200	35	150	385	200	185	385
2014	250	35	150	435	200	235	435
2015	300	30	150	480	200	280	480
2016	350	20	200	570	240	330	570
2017	449	30	200	679	260	419	679
Total: 2013-2017	1,549	150	850	2,549	1,100	1,449	2,549
Total: 2018-2025	2,796	250	1,400	4,446	1,946	2,500	4,446

Source: Electricity Master Plan (2011); Seven Year Electricity Development Strategy (2011)

experience was successful due to a well-prepared proposal for deliberation by development partners.

Private sector investments are estimated at about \$1.5 billion. To bring this amount of private sector resources to the country, the government and the development partners would need to join forces in improving the business environment. The main business risks are insufficient project development (technical risk) and the lack of confidence in EWSA's ability to pay for its increasing obligations (political risk). The development partners should support the formulation of risk reduction instruments.

More specifically, development partners should support the creation of the proposed Energy Efficiency and Development Fund (EEDF) that is aimed at reducing technical risks by undertaking project preparation, resource exploration and pilot operations before inviting the private sector to carry out major projects. The political risk is normally mitigated through three distinct arrangements – guarantee by the government of the obligations of EWSA under the power purchase agreement; insurance of investor equity by an international agency; and a guarantee by the World Bank

(IDA) and/or AfDB of the repayment obligations of the private project company to its commercial lenders. The development partners should support these arrangements in order to leverage resource mobilization from the private sector. Private sector investors should consider the attractive opportunity to engage in Rwanda's power sector, where electricity tariffs are at the level of cost recovery, a reformist government is willing and able to handle the emerging challenges, and a very ambitious program is in place to expand the electricity generation capacity. The private sector should study the experience of the KivuWatt power project as a good precedent for engagement. Through this experience, the government and the private sector were able to put in place various contractual arrangements that can be of use to future private sector projects. However, the private sector will need to go beyond the scope of the KivuWatt financial structure while attempting to mobilize debt and equity financing. The KivuWatt project sponsor was able to secure funds from the development partners for all of its debt and part of its equity financing.

Going forward, the financing needs of the power sector will be by far beyond the allocated resources of the pres-

ently engaged development partners. Therefore, private sector investors need to explore two new dimensions. First, there may be prospects for receiving support from other potential development partners such as China, India, and Brazil among others. Second, the private sector will need to mobilize funds from commercial sources of finance. This will be unprecedented in the case of Rwanda and involve some initial challenges. However, it is an unavoidable option considering the size of the financial requirements.

Linkage to AfDB's Long-Term Strategy and Rwanda's

Vision 2050. AfDB's long-term (2013-2022) strategy is aimed at supporting the quality of Africa's growth by emphasizing inclusive development and gradual transition to a green economy. Rwanda is considered a promising candidate for the transition to green growth. The Government of Rwanda has articulated its goal, through its Vision 2050 program, of becoming a climate-resilient, low-carbon economy by 2050. In regard to the energy sector, the government aims at overcoming the predominance of fossil fuel in energy production by developing the country's alternative resources including hydro, methane gas, geothermal and other sources.

The government further determined that green growth should be achieved by the promotion of public-private part-

nership in a green economy with a focus on clean energy and cleaner production for sustainable development. This report directly addresses the main avenues for the development of sustainable clean energy through maximizing the synergy between the public and private sectors. The proposed investment program aims at developing at least 500 MW of additional electricity generating capacity by 2017, all of which rely on renewable energy resources such as hydropower, geothermal, methane gas and peat-based electricity generation.

Although all these resources are classified as clean energy, the report points out that their development should follow strict site selection criteria to ensure environmental sustainability. The report's roadmap and action plan also include significant steps to be taken by the government and development partners to attract private investment into the energy sector. More specifically, the report recommends the government should (a) reduce the technical risks associated with energy resource availability (b) ask the relevant development partners for a partial risk guarantee to be used during the first phase of private sector participation (c) put EWSA on a path toward an acceptable level of creditworthiness. These actions would result in an improved business environment, which is needed to encourage participation by private investors and commercial lenders in Rwanda's energy sector development.



Chapter 1: The Context and Objective of the Study

Economic Context

Rwanda has made a remarkable progress in the political, social and economic spheres since the 1994 genocide and civil war. In particular, economic growth has supported political and social developments in a clear and impressive manner. The Government of Rwanda (GoR) is widely recognized as an ambitious reformer with a strong track record in launching a comprehensive economic development agenda. Economic growth has responded well to the reform agenda. The real GDP growth averaged 8% during the decade from 2000-2010 with per capita GDP increasing from \$264 in 2005 to \$360 in 2011. In spite of the global economic slowdown and high fuel and food prices, real GDP increased by 8.6% in 2011, surpassing the initial projection of 7%. The relative resilience of the economy to the global economic downturn indicates the solidness of the reform agenda. The national poverty rate fell from 57% to 45% between 2006 and 2011. This translates into one million of the country's 11 million citizens graduating from poverty during this period.

In spite of the marked progress in the decade to 2012, economic growth in Rwanda is mostly driven by expenditures related to large aid flows, heavy public investments and agricultural production. Therefore it is well recognized that sources of growth need to be broadened to a more diverse and sustainable set of drivers. Accordingly, the Government's articulated long-term vision is to transform Rwanda from a low-income agrarian economy to a medium income export-oriented economy, operating as a knowledge-based service hub by 2020. At the same time it is recognized that Rwanda is facing three major bottlenecks in achieving its vision.

First, the private sector still plays a limited role in contributing to economic growth. Private sector investment accounted for 12 % of Gross Domestic Product (GDP) in 2010, compared with 14 % in the East Africa Region. This is despite the fact that Rwanda is considered to have been successful in establishing a sound investment climate. Rwanda was named a top reformer in Doing Business 2010 and the second best-reformer in 2011, having jumped from the rank of 143 out of

183 countries in 2006 to 67 in 2010, and to 45 in 2011. The Doing Business survey indicates that it is now easier, faster and less expensive to do business in Rwanda. Nonetheless, it points out that the growing trade deficit presents a concern for foreign investors. Foreign direct investment in Rwanda was 0.5 % of GDP in 2010 compared with 2.5% for Sub-Saharan Africa.

The government is determined to facilitate private sector investment and has adopted the use of Special Economic Zones (SEZ) as a further economic policy instrument to promote it. These zones are seen as a solution to existing key business constraints such as availability of industrial and commercial land, availability and cost of energy, limited access to markets, complexity of the taxation system, availability of skilled labor and low cluster development. The Kigali SEZ, one of the several planned, was established in 2010.

Second, inadequate physical infrastructure is a major binding constraint to economic growth, human capital development and increasing exports of goods and services. Economic transformation to create employment and generate exports is one of the flagship programs of the Economic Development and Poverty Reduction Strategy (EDPRS). Within this flagship program, a key priority is to expand access, improve quality and reduce the cost of infrastructure services, especially transport, power and communications.

Third, institutional and technical capacity has become a severe bottleneck to rapid economic growth.

The shortcomings in technical capacity, particularly skill gaps, span all economic activities in both the private sector and government agencies. The government has been successful in strengthening the capacity to manage public resources with noticeable improvements in public financial management in the central and local government agencies. An extensive civil service reform including downsizing, restructuring and moving staff to sub-national levels has also been undertaken. It is now noted that the number of staff in the central government may not be sufficient to carry out the increasing responsibili-

ties and volume of work. The government has since adopted a strategic approach to capacity building. A capacity building and employment promotion sector working group was formed to enable the government and its development partners to attend to the capacity development requirements in a systematic manner.

The energy sector faces a cross-section of all of the above constraints. Most of the past progress that Rwanda has made in this sector has been achieved through effective partnership between the government and the international donor community. Looking ahead, however, the government fully recognizes the increasing importance of the private sector's contribution to the investment requirements of the energy sector. Encouraging greater private participation is accordingly a major element in the government's 2009 draft Energy Policy. The importance given to private participation in energy reflects the need to mobilize financial resources that substantially exceed what the government and donors can provide. It is also aimed at enhancing the efficiency in construction and operation of the corresponding energy facilities. Private sector participation and development of institutional and technical capacity are also intertwined. Foreign investment in the energy sector often provides an avenue for transfer of technical knowledge and professional skills. Local private investment also contributes to the national objective of job creation and capacity enhancement.

Energy Sector Policy and Strategy

As mentioned earlier a draft energy policy was prepared in 2009 through substantial analytical work primarily to support the country's economic development agenda. Government has addressed economic development within a Poverty Reduction Strategy Program (PRSP) framework. Rwanda's first PRSP covered the period 2002-2005 and was prepared in a post-conflict environment, where the primary emphasis was on managing a transitional period of rehabilitation and reconstruction. One of the important lessons from Rwanda's first generation PRSP is that a high rate of economic growth is a pre-requisite to effectively address poverty. The second

generation program is reflected in the Economic Development and Poverty Reduction Strategy (EDPRS) that covers the period 2008-2012/13. The EDPRS document redefines the country's economic objectives and assigns the highest priority to accelerating growth to create employment and generate exports. The EDPRS is framed around three strategic flagship programs: (1) sustainable growth for jobs and exports (2) Vision 2020 Umurenge (integrated rural development to eradicate extreme poverty) (3) governance.

To expedite the realization of the EDPRS and Vision 2020 objectives, the government approved in 2010 a Strategic Investment Program comprising six projects: (i) electricity roll-out - an increase in household grid connections from 6 % at end-2008 to 50 % by 2017 (ii) core ICT infrastructure - the building of infrastructure for high-speed broadband (iii) Kigali Convention Centre (KCC) - a five-star hotel and convention center (iv) RwandAir - expansion of the fleet and flight connections of the state airline (v) Regional Railway - the building/rehabilitation of a railway linking Rwanda to Burundi and Tanzania (vi) Bugesera International Airport - the construction of a new international airport.

In support of the long-term economic development agenda, an energy sector policy and strategy was prepared in 2009. These documents are now undergoing a final review and are due to be approved soon. The policy paper articulates the main mandate of the energy sector as contributing effectively to the growth of the national economy and thereby improving the standard of living for the entire nation in a sustainable and environmentally sound manner. Through this mandate, the energy sector will contribute to the goals of national socio-economic development, including the progressive elimination of poverty. This mandate is translated into three specific goals for the energy sector:

- Ensuring the availability of reliable and affordable energy supplies for all Rwandans
- Encouraging the rational and efficient use of energy
- Establishing environmentally sound and sustainable

systems of energy production, procurement, transportation, distribution and end-use

To achieve the above objectives, the energy sector will need to pursue the following specific policies:

1. **Development of Domestic Energy Resources.** It is clearly recognized that the only option for reducing the average cost of energy supply and the burden on foreign currency resources is to develop domestic resources. In 2010, the cost of imported petroleum products accounted for 40% of the country's foreign exchange expenditure. Imported petroleum is a major source of power generation resulting in a very high cost of delivered electricity. Energy diversification therefore has a combination of economic, financial and environmental benefits. The main alternative sources of energy are hydropower, estimated at 313 MW; renewable methane gas in Lake Kivu, estimated at 60 billion cubic meters; peat deposits of about 155 million tons; and some potential for solar energy particularly in the rural areas where electricity may be only an off-grid option. These energy resources are reviewed in more detail in Chapter 3.
2. **Efficient Use of Energy.** Rwanda cannot afford wasteful consumption of energy and should make the best use of existing supplies as well as future additions to them, and in so doing, minimize the adverse environmental consequences of energy use. Energy efficiency and energy conservation should be pursued through the use of efficient technologies and appropriate economic incentives. Energy efficiency in the household sector should be promoted through utilization of efficient appliances. Energy efficiency in the industrial sector should be supported through energy audits and the provision of financial incentives. Chapter 3 of this report summarizes the potential efficiency gains in the residential and industrial sectors as well as efficiency in transmission to alleviate technical losses.
3. **Energy pricing and subsidy.** Energy subsidies are known to result in inefficient use of energy resources, distortion in related technologies and a heavy burden on the government budget that would jeopardize fiscal

sustainability. Therefore appropriate pricing of energy is important in giving the right signals to consumers to encourage efficient and productive use of energy and to ensure that energy suppliers can operate on a sustainable basis. Chapter 5 of this report reviews the present tariff and subsidies in particular in relation to the financial requirements of the power sector and the government's objective to cut in half the average electricity tariff (\$0.10 /kWh).

4. **Institutional Development of the Energy Sector.** The Energy Policy paper provides a clear roadmap for the institutional development of the power sector based on a vision that in the very long term, the electricity sector should be unbundled into generation, transmission, and distribution components, with competition being stimulated in the generation and supply segments. However, it recognizes at the outset that this vision is achievable only after taking a number of intermediate steps. These steps include creation of a national electricity utility that would operate on a commercial basis; promoting private sector participation in generation of electricity and off-grid power supply; facilitating private (domestic and foreign) investment by putting in place transparent selection and contractual procedures; ensuring independence of the regulating agency that is mandated to promote competition and issue concessions and licenses; and a clear mechanism for sector coordination and strategy. Chapter 2 reviews the above developments.
5. **Capacity Building.** Considering the rapid and unprecedented forthcoming expansion of the energy sector, the need for capacity enhancement spans all segments and functions of the energy sector. MININFRA and all other institutions involved in energy sector management will need additional skills and institutional capacity to operate effective public-private machinery that would strategize, plan, develop and operate a sustainable energy sector. Chapter 2 reviews the capacity development activities and Chapter 7 proposes the actions to be taken in the short and long term.

Associated with the above energy policy, the government developed in 2009 an energy strategy that identifies the steps

toward achieving the policy goals in the following order:

1. Address the challenges in projects currently under implementation and develop plans to successfully complete them
2. Implement the least-cost electricity generation mix by developing specific projects with clear timelines
3. Secure the necessary funding for planned electricity projects, including ensuring sufficient private sector investment (both local and foreign)
4. Develop the required legal and regulatory framework to support the implementation plan
5. Develop conducive policies including appropriate incentives and tariffs to attract private sector participation
6. Develop human resource capacity to implement the planned electricity generation projects
7. Involve local communities to the extent possible in developing energy projects

The policy and strategy papers are currently under review and are due for submission to the cabinet soon.

Objective of this Study

In support of the above efforts and in line with its Rwanda 2012-2016 Country Strategy Paper (CSP), the African Development Bank (AfDB) plans to carry out a study, covering both the energy and transport sectors, to provide a comprehensive and prioritized action plan for these sectors. The action plan is envisaged to indicate the investment needs and financing options for each sector.

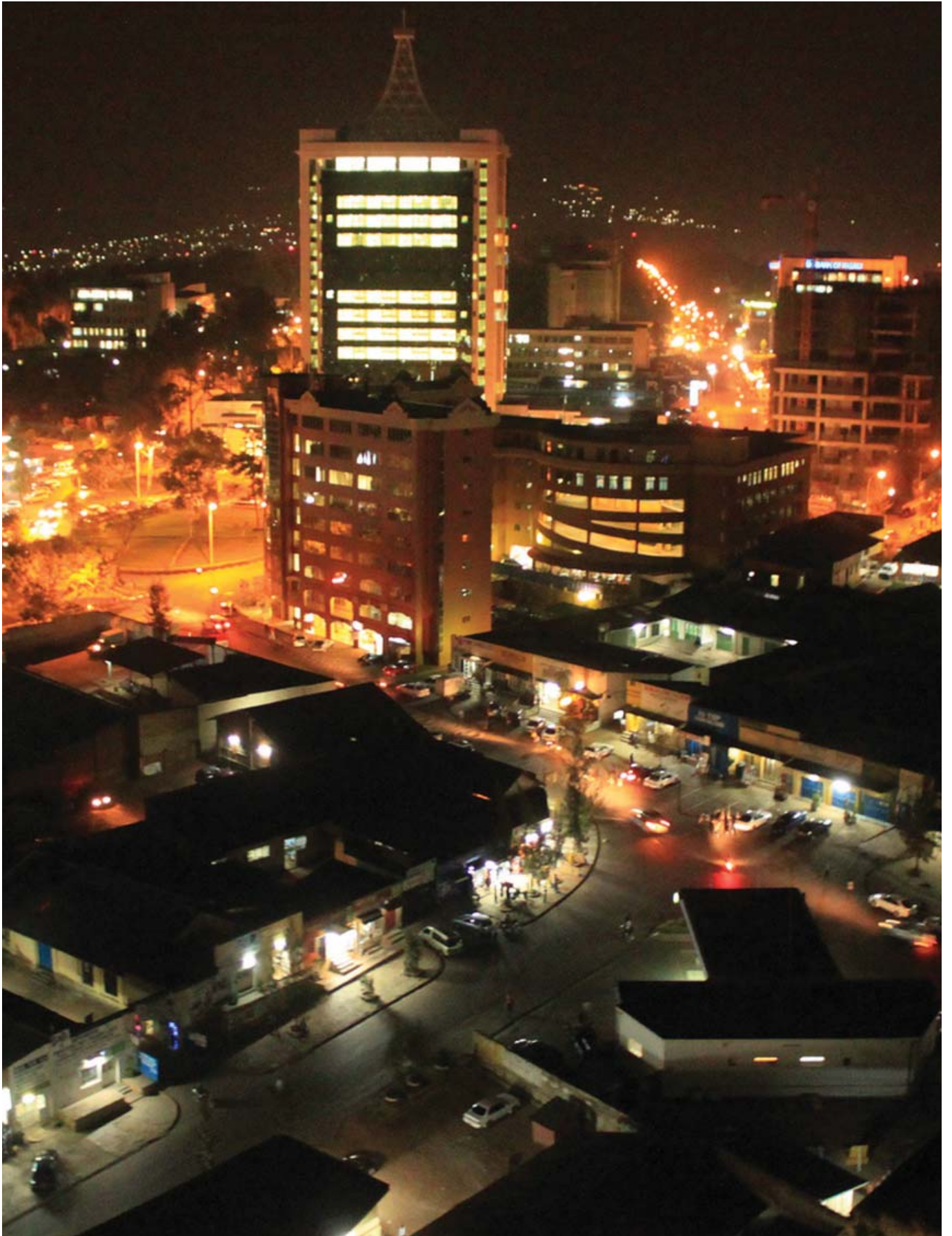
This study focuses on the energy sector with a specific emphasis on the issues and options in what has now become the main vehicle for energy diversification, and which faces enormous technical, institutional and financial challenges. Its objective is to:

- Identify the core energy infrastructure bottlenecks facing the country and options for mitigating these challenges
- Examine the present sector responsibilities, the restructuring

and reform process, the legal and regulatory aspects and the potential role of the private sector (domestic and foreign investors). The study will assess the adequacy of energy sector policies and strategies; the role, structure and capacity of institutions and agencies involved in the implementation of the energy investment and development program

- Review the past and projected energy demand and supply issues, including the description of domestic energy resources and the options for electricity imports. The study will assess the size and condition of existing energy infrastructure in both rural and urban areas including ongoing interventions by the government and its partners
- Analyze the cost structure of various supply options, the readiness of various candidate projects and the corresponding investments in electricity generation, transmission and distribution
- Review the options for financing power sector investments considering the potential for private sector participation, and the suitability of various projects to public vs. private sector role in ownership, construction, management and operation
- Review the prospects for the development of regional projects as well regional integration of power systems considering Eastern/ Southern Africa Power Pools and the Nile Basin Initiative including the required development of technical and regulatory capacity
- Formulate an action plan for short-, medium- and long-term implementation that would address the institutional, and policy aspects of sector management, as well as the required energy investment and finance

The rest of this report is organized as follows. Chapter 2 examines the structure and organization of the energy sector. Chapter 3 analyses the energy demand and supply. Chapter 4 provides an assessment of the investment program. Chapter 5 reviews the options for financing the power sector investment requirements. Chapter 6 addresses issues in attracting private sector investment. Chapter 7 formulates a roadmap, action plan and monitoring and evaluation framework.



Chapter 2: Structure and Organization of the Energy Sector

Present Sector Responsibilities and Organization

A number of ministries and government agencies play important roles in various aspects of the energy sector. MININFRA has the primary responsibility for setting the overall policy and strategy of the energy sector, and for coordinating the developments of the electricity sub-sector. MININFRA is the lead ministry responsible for development of renewable energy (methane, peat, geothermal, solar and wind energy) although it is recognized that some of these resources are distributed across the country and that Ministry of Local Government (MINALOC) and local government structures must be also involved in their future development. In particular, biomass (wood fuel, charcoal, briquettes and production of energy from solid waste landfills) is a very important energy sub-sector that is largely under the policy control of Ministry of Natural Resources (MINIRENA), MININFRA and Ministry of Agriculture and Animal Resources (MINAGRI), in coordination with MINALOC and local government structures.

Another prospectively important source of energy is methane gas deposits in Lake Kivu that are being developed under the guidelines of the draft Gas Law (prepared in 2008 and currently awaiting approval by Parliament). The law establishes a roadmap for the development of a competitive gas market and designates the Rwanda Utilities Regulatory Agency as the independent economic regulator for the gas sector. The law also anticipates the creation of a National Gas Utility (NGU) to be primarily involved in transmission and distribution of gas and possibly any gas-to-liquid developments which may become feasible. The law allows immediate private investment in production facilities, to enable the development of Lake Kivu and other natural gas facilities.

The petroleum sector is under the purview of the Ministry of Trade and Industry (MINICOM), which is responsible for setting the prices of petroleum products. However, petroleum pricing is determined by an inter-ministerial commit-

tee, with the final responsibility for fuel taxation and industry margins falling on the Ministry of Finance and Economic Planning (MINECOFIN) and MINICOM respectively. Upstream petroleum development is under the jurisdiction of Ministry of Natural Resources (MINIRENA) though this is presently at the exploration stage. If petroleum resources are identified, the institutional structure to plan and manage upstream activities will need to be developed.

The electricity sector has gone through some significant changes over the last 12 years. ELECTROGAZ, which had a monopoly for the production and distribution of water and electricity until the late 1990s, formally lost its monopoly power via a law that was enacted in 1999. After extensive deliberations, ELECTROGAZ was placed under a management contract with Lahmeyer International in 2003, which ended in 2006 when the management of the company reverted to the government and run by a board of directors. In 2008, ELECTROGAZ was split into the Rwanda Energy Corporation (RECO) and the Rwanda Water and Sewerage Corporation (RWASCO), which in 2011 were integrated within the Energy and Water and Sanitation Authority (EWSA). EWSA is responsible for generation, bulk transmission and distribution and retailing functions on a commercial basis, while it will buy electricity through power purchase agreements from some of new large generation projects that are planned for development by the private sector.

The private sector is currently a significant energy user and thereby an important partner for implementing the energy efficiency and conservation agenda. The private sector is also expected to play a much stronger role on the supply side by investing in future energy projects. However, it is recognized that presently the domestic private sector is very weak in implementing sizeable energy projects. An improvement in the capacity of local contractors is taking place with the help of EWSA and in the context of the Electricity Access Rollout Program (EARP). EWSA has been making greater use of local contractors in new connections while carrying out a systematic effort to build their capacity. EWSA

has also engaged foreign contractors under a turn-key contract arrangement through a competitive procurement process to design, procure, and erect network extensions and customer connections on a scale needed to meet the connection targets of the EDPRS.

The environmental aspects of the energy sector are placed under the Rwanda Environment Management Authority, which functions under the guidance of MINIRENA, and is responsible for the coordination and implementation of legislation and policies relating to the environmental impacts of energy production and consumption.

Finally, the international donor organizations support the implementation of the government energy strategy by providing technical and financial resources. A common Sector-Wide Approach (SWAp) is considered to be the basis of the partnership between the government and the development partners to ensure proper coordination, efficiency and effectiveness in the use of resources in the Rwandan energy sector. The SWAp for energy is anchored within MININFRA. It is led by the Minister of State in charge of Energy who also chairs the Sector Working Group (SWG) of the energy sector. The SWAp determines a clear requirement for monitoring, consultation and reporting by the SWG on the implementation progress of the electrification program as well as investment plans and prospects for mobilization of financial resources.

The government exercises a strong leadership role in donor coordination and has agreed with the development partners on a Division of Labor (DoL). The DoL agreement was finalized in July 2010 and limits each partner's activities to three sectors. Criteria for mapping sectors with donors were related to donors' preferred aid modality, track record in terms of achieving sector outcomes and the global experience of each donor in the corresponding sector. The DoL identifies as the main partners in the energy sector the following multilateral and bilateral donors: World Bank, AfDB, Arab Bank for Economic Development in Africa

(BADEA), UNIDO, Cooperative Technique Belgium (CTB), Netherlands, France, Japanese International Cooperation Agency (JICA) and Société Tunisienne de l'Electricité et du Gaz (STEG International).

Restructuring and Reform Process

Restructuring and reform of the energy sector in Rwanda has taken place through a systematic process with each step involving substantial analytical and preparation work. The reforms appear to have started with the reform of the power sector and hence the focus of the study. In conjunction with the Electricity Law of 2008, a separate law was enacted in 2008 to unbundle the national monopoly – Electrogaz – into separate electricity and water parastatals. Subsequently the Rwanda Electricity Corporation (RECO) was created and it assumed all of Electrogaz's electricity-related activities, assets, and liabilities. The two separate water and electricity successor utilities, RWASCO and RECO together with the Energy sub-sector working group directly under MININFRA, were integrated and the Energy, Water and Sanitation Authority (EWSA) was created in the next step of reform. The electricity business unit is authorized to invest in all segments of the industry but is expected to focus on bulk transmission and distribution and retailing functions, while new large generation projects are to be developed by the private sector that would sell electricity to the utility under power purchase agreements.

In terms of the sector structure, the electricity market is expected to remain dominated by EWSA in the short to medium term. EWSA will have an important role in generation, transmission and distribution. At the same time Independent Power Producers (IPPs) are encouraged to invest in the generation sector while self-contained, off-grid schemes can be owned and operated by EWSA or private developers. EWSA is licensed as the single buyer of electricity. It can enter into agreements with private developers of generation projects for the purchase of electricity. It is envisaged that in the long term, the power sector will be unbundled into separate generation, transmission and distri-

bution companies. Such unbundling should be designed and implemented in a careful manner.

The overall proposition to separate the responsibility and accountability of the generation, transmission and distribution segments of the power sector are in line with the international experience. However, the process and expectations from the restructuring should be adapted to country circumstances. For Rwanda's small power system, one should not expect that restructuring would lead to competitive behavior by electricity suppliers. Therefore, regulation of prices at the points of generation and distribution would remain essential in the foreseeable future. The unbundling would enable the regulator to monitor the performance indicators for each segment of the power sector while also providing a level playing field to public and private suppliers. The government would need to develop a clear vision about the future structure of the power sector and introduce a roadmap that demonstrates the steps to achieve this vision.

Chapter 7 proposes such a roadmap for the consideration of the government. MININFRA is expected to continue to develop the country's energy policy and power sector strategy while also serving as the main avenue for promoting investment in exploration and development of new energy resources and energy efficiency/conservation. It will continue to coordinate the support of the donor community and to promote the involvement of private investors. IPP projects are developed with the assistance of MININFRA and in close coordination with EWSA, which is the final counterpart for IPPs as the purchaser of electricity.

Legal, Regulatory and Institutional Framework and the Role of the Private Sector

In support of the sector reform, the government has launched a number of legal, regulatory, and private-sector development initiatives that seem to be moving on the right track. Several laws have been approved that together define the emerging sector structure and institutional framework, including the government's clear policy to increase private-sector investments primarily in generation and off-grid electricity distribution. The Electricity and (draft) Gas Laws have provided the legal basis for determining the roles of public

and private entities in each sector.

Electricity regulations fall under the purview of Rwanda Utilities Regulatory Agency (RURA) that regulates both the power and gas sectors. RURA was created in 2001, and is defined by law as an autonomous entity with its own board of directors who are appointed by order of the Prime Minister. RURA's mandate in the energy sector is to regulate an efficient, sustainable and reliable sector. In line with this mandate, the agency is responsible for promotion of competition, advising the government during formulation of energy policy, protecting consumers, educating stakeholders, approving contractual undertakings with regard to distribution and transmission of electricity and gas and assessing the tariff structure.

RURA's mandate for independent oversight also covers the transport, telecoms and water and sanitation sectors. Although RURA has developed some capacity over time, it still needs significant technical enhancement in order to handle the forthcoming regulatory issues of the power and gas sectors. In particular, there are two areas in which RURA will be facing new engagements and therefore would need to be well-equipped to handle. First, technical regulation and licensing of the power sector will become a major business for RURA. To allow the implementation of the emerging sector structure, RURA will be responsible for issuing various licenses including concession to IPPs and to off-grid private suppliers. It should enforce the grid code and market rules so that all market participants follow the approved technical standards. Second, RURA will be responsible for approving electricity tariffs including feed-in tariffs, power purchase agreements, subsidies and cross-subsidies. RURA will have autonomy but would need to remain within the following guidelines for energy pricing as set forth in Rwanda's energy policy:

- Energy prices are to be set to recover the costs of supply, at least of operating and maintenance costs, and in due course, the recovery of capital costs
- Resources available for energy subsidies (through the government or donors) are to be spent primarily on once-off capital subsidies to enhance access to modern forms of energy, rather than on recurrent ongoing subsi-

dies to reduce the cost of energy to those who already have access

- All forms of subsidy are to be made transparent to energy consumers. Cross-subsidies (for example within or between electricity customer categories) are to be justified on the grounds of maximizing social welfare. The economic implications of subsidies are to be systematically analyzed and included in the annual report made to Parliament by the Minister of Infrastructure

The current electricity tariffs have a simple structure. The residential and commercial tariff is set at a flat rate of 134 RwF/kWh. Industrial tariff has a time-of-day structure as follows:

- 126 RwF between 7 AM and 5 PM
- 168 RwF between 5 PM and 11 PM
- 96 RwF between 11 PM to 7 AM

The time-of-day tariff is aimed at encouraging industrial and commercial consumers to shift their electricity use to off-peak periods. All consumers pay a fixed payment per month of 500 RwF and 18% VAT.

Historically, the main reason for these high rates is that during 2005 to 2010, Rwanda had to rely heavily on oil-fired generation while international oil prices jumped up by some 300% to 400% compared with prices in 2000. The average tariff was indeed much lower (42 RwF/kWh) prior to 2005 but was sharply increased in 2005-2006 to around 110 RwF/kWh. Despite the sharp increases in electricity tariff, the average is still close to the levels in Kenya and Uganda but about 25% higher than in Tanzania.

In spite of the rapid reduction of Rwanda's dependency on oil-fired power generation, the high electricity tariff is still necessary to move the power sector on a track to financial viability. Even with the present high tariffs, the power sector will be facing a cash flow problem in the short to medium term because of the heavy concentration of the investment

expenditures. However, in the long term, the current level of tariffs would be sufficient for the profitability and sustainability of the power sector (see Chapter 5).

Looking into the future, the regulatory framework and the institutional capacity of the power sector should be further developed to fit four emerging dimensions. First, with the introduction of private power producers, the technical and institutional requirements should be clearly specified so that the reliability and security of the power network's operation are protected. Second, the emerging role of EWSA as a single buyer of bulk electricity has significant implications on its technical and financial competencies to play the role of the single buyer. Third, the potential partial unbundling of the power sector in the future should be reflected in the emerging institutional capacity of the relevant entities. Fourth, with the potential expansion of cross-border electricity trade, EWSA's staff and systems should be strengthened to manage the corresponding transactions. Specific recommendations are presented in Chapter 7.

The Need for Skills Development and Capacity Building

The weakness in institutional and technical capacity is of general concern to the government. After some deliberations the government has adopted a strategic approach to capacity strengthening, with a focus on capacity constraints in sectors that most affect the country's growth and export potentials. Capacity strengthening of the energy (particularly electricity) sector has been identified as a high priority. The corresponding assessments as well as Rwandan energy policy emphasize the need for capacity-building in MININFRA, EWSA and RURA. The policy paper recognizes that structural reform of the power sector can be successful only when the corresponding institutions have the skilled manpower, information technology and other material resources necessary to be effective in carrying out their designated roles and responsibilities.

The draft energy policy paper recognizes the strong need

for private sector investments in lieu of the country's significant financial requirements associated with the ambitious power development agenda. It welcomes private-sector participation in the form of private energy projects or in the public-private partnerships (PPP). It designates MININFRA as the main facilitator of private-sector participation. The Ministry is mandated to provide transaction support and coordination among the stakeholders. MININFRA works closely with other relevant government agencies particularly the Rwanda Revenue Authority (RRA) and the PPP Unit in Rwanda Development Board (RDB) which is in its formative stages, and not presently operational.

MININFRA has been working on the preparation of model agreements and contracts and devising procedures for competitive bidding and selection of energy suppliers including IPPs. But it is recognized that MININFRA and EWSA need to acquire more legal, financial, and technical skills that would put them at par with private sector negotiators. EWSA is in the process of establishing an Investment Unit that would take charge of the practical aspects of project preparation and processing. Chapter 6 provides recommendations in regard to the capacity requirements of the Investment Unit and also the status of the PPP unit at RDB.

EWSA would need a well-designed capacity enhancement agenda. Its immediate need is to strengthen its ability to plan transmission and distribution projects under the EARP. In the medium term, EWSA should acquire the technical skills to interact with the private sector. It should be also equipped to move to a system of cost-center accounting which would enable EWSA to categorize the financial statements of generation, transmission and distribution into separate business units. This separation of accounts for each cost center should be implemented as soon as possible, as this would be a useful management tool even while EWSA remains vertically integrated (see Chapter 7).

RURA would need substantial capacity enhancement to become a fully functional regulator in the energy sector. The monopolistic aspects of parts of the energy sector dictate a need for economic regulation while the public health and safety requirements of most forms of energy demonstrate the need for technical regulation. A program should be designed to ensure sufficient capacity at RURA to regulate energy prices and to coordinate with various other regulatory bodies involved in ensuring the technical, environmental and safety standards necessary for the energy sector.



Chapter 3: Energy Demand and Supply

Past, Present and Projected Demand for Electricity

Rwanda’s energy consumption is dominated by biomass that accounts for about 85% of primary energy use while petroleum accounts for 11% and electricity for the remaining 4%. Despite its low share in the present energy mix, the electricity sector is considered as a critical factor in enabling socio-economic development, and as the main vehicle for energy diversification. At the same time, it is noted that Rwanda has by far one of the lowest per-capita electricity consumptions in the world; Rwanda consumes about 42 kWh/year/capita compared with 478 kWh in sub-Saharan Africa and 1,200 kWh for developing countries as a whole. Although Rwanda’s densely distributed population should facilitate network expansion and access to electricity, presently only 16% of Rwanda’s households (350,000 customers) are connected to the grid.

The government has launched an aggressive program to increase access to electricity services by all sectors of the economy and all consumer categories. It has started from an extremely low base but the growth in electricity access has been an impressive 160% between 2008 and 2011.

Table 3.1 shows the growth in electricity service in the last 12 years.

With such a low level of electricity consumption, there is a sizeable need for additional electricity services. Projections of electricity demand are therefore reflective of government targets rather than behavioral factors that normally affect power demand. Based on the targets set by the EDPRS and the Vision 2020, peak demand was expected to grow from 51 MW in 2008 to 204 MW in 2015 and 328 MW in 2020. Extrapolation of the envisaged trend would result in a peak load of 500 MW by 2025. These figures were the basis of the extensive analysis that was carried out while preparing the Electricity Master Plan in 2009-2010. However, the new cabinet that was formed in October 2010 decided to accelerate the expansion of electricity services. A new target was set to reach an access ratio of 50% by 2017 (as compared with an access ratio of 28% set by Vision 2020). Extension of the envisaged trends would imply that electricity access would reach 94% by 2025 (as compared with the 40% goal set by Vision 2020). Accordingly, the number of household connections to the grid is expected to increase from about 350,000 in 2012 to 1,200,000 in 2017 and 2,400,000 in

Table 3.1 Growth in Electricity Service (2000 to 2012)

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Peak Load (MW)								47	51	56	64	78	92
Sales (GWH)	204	209	225	235	204	192	230	249	277	308	353	417	
Losses (%)			35				22	18	18	20	19	19	
No of customers (000)	46	49	58	67	68	70	77	86	109	140	175	280	350
Access (%)									4	8	13	14	16

Source: EWSA (2012)

Table 3.2 Vision 2020 vs. the New Electricity Supply Targets

Year	Based on EDPRS and Vision 2020			Based on Targets Set in 2010 by the New Government		
	Access (%)	Installed Capacity (MW)	Energy (GWH)	Access (%)	Installed Capacity (MW)	Energy (GWH)
2008	6.0	45	225.0	6.0	45	225
2010	11.0	85	353	11.0	85	353
2015	22	200	965.5	35.0	800	1200
2017	28.0	300	1,200.0	50.0	1000	1400
2020	32	400	1,478.0	90	1200	1950
2025	40.0		2,148.4	94.0	1500	3300

Source: Electricity Master Plan (2011), Seven-Year Electricity Strategy (2011)

2025. This target was further pushed up in February 2012 with a government desire to reach 70% access by 2017.

The new target would also include electricity supply by 2017 to 100% of schools, 100% of health facilities and 100% of public sector offices either through connection to the grid or through reliable off-grid systems. With these targets, the peak demand and electricity consumption are forecast to grow at about 12.0% and 11.6% p.a. respectively from 2010 to 2020.¹ Table 3.2 contains a comparison between the Vision 2020 and the new electricity supply targets.

Projection of electricity demand depends very much on the assumptions about the progress toward the target for increasing household access as well as growth in industrial and commercial uses of electricity. The Electricity

Master Plan (2011) provides the basis of demand projections under a scenario that electricity access may reach 35% by 2017. The residential and non-residential demands are also disaggregated while electricity use by the industrial sector is considered to grow at about 25% p.a. The resultant demand for 2017 is then estimated at about 250 MW. The seven-year electricity development program uses a more aggressive growth rate for the overall electricity consumption (based on a 2017 access target of 50%) to arrive at an estimated peak demand of 350 MW for 2017. The most recent decision by the government to achieve 70% access by 2017 would imply total peak demand of up to 410 MW by 2017. Table 3.3 contains these various demand projections.

Domestic Energy Resources

Rwanda is rather well-endowed with domestic energy resources though most of these resources remain untapped. Energy sources for electricity generation include: hydro-power; geothermal energy; methane gas; peat energy; solar energy; wind energy and waste energy.

¹ The electricity load profile shows a rather high degree of variation over various hours. In 2010, the peak load was experienced at 7 PM, reaching about 68.4 MW. The off-peak load occurred at midnight at about 29 MW. The load factor was 56% in 2010. The load factor is expected to decline slightly over the next 15 years as more residential customers are connected to the grid.

Table 3.3: Electricity Demand Projections Based on Various Access Targets.

Year	Electricity Consumption (GWH)			System Peak (MW)		
	Residential	Non-residential	Total	(35% target)	(50% target)	(70% target)
2010	200	127	327	75	75	75
2011	254	142	396	80	80	80
2012	310	210	520	92	92	92
2013	445	315	760	153	168	172
2014	584	422	1,006	184	196	218
2015	729	535	1,264	204	243	275
2016	853	665	1,528	225	295	348
2017	996	778	1,774	248	350	410
2020	1,347	1,150	2,497	788	832	885
2025	1,689	1,420	3,109	985	1050	1120

Source: Electricity Master Plan (2011); Dhala (2012); ECA

Hydropower. Hydropower has generated the bulk of electricity in Rwanda since the 1960s. Its overall potential is estimated at about 313 MW but currently (end-2012) the utilized hydro capacity is 64.5 MW. Rwanda's domestic small- and medium-size hydropower is estimated to have a total potential of about 117 MW and is located in specific sites such as Ntaruka, Mukungwa, Gihira, Gisenyi, Rukarara and Nyabarongo. Until recent years, the Ntaruka and Mukungwa hydropower stations represented Rwanda's main sources of electricity; they are located in the Northern Province and supplied by Lake Burera and Lake Ruhundo respectively. The design capacity of these hydropower stations is about 23.5 MW but actual generation declined to about a quarter of this level in the mid-2000s due to falling water levels. Between the years 2004 and 2005, prolonged droughts reduced the water levels significantly in the rivers and the lakes. This affected power generation in the Lake Victoria Basin and forced an increase in thermal electricity generation. The Rukarara power station, with a design capacity of 9 MW, was commissioned in 2010. A further Rukarara 2 plant (in the downstream of the river)

with a capacity of 2 MW is scheduled for commissioning by end-2012. The Nyabarongo hydro project with a design capacity of 28 MW represents another major plant which is under construction and due for commissioning in 2014, and the Akanyaru regional hydro project is expected to be commissioned in 2016 with a design capacity of 3.9 MW.

Rwanda's Hydro Atlas (identified by MININFRA) shows 333 potential sites for mini and micro hydro-power plants with a capacity of between 50 KW and 1 MW each and total potential of 12.5 MW that could be tapped to supply electricity to the rural areas. This capacity would need to be verified after the relevant feasibility studies are carried out. There are currently more than 20 government-initiated and donor-supported projects that are aimed at supplying 11 MW of power to rural villages and towns. Micro hydro-power is expected to contribute around 8 MW of additional generating capacity by 2017.

Rwanda's share of regional hydropower is estimated at about 183 MW of which Rusumo Falls, on the border with

Tanzania, and Rusizi III and Rusizi IV, on the border with the DRC, are scheduled for joint development with Tanzania/Burundi and Burundi/DRC respectively. There are presently two operational plants on Rusizi with a total capacity of 15.5 MW. Two additional phases of Rusizi III (48 MW) and Rusizi IV (98 MW) are under active consideration. A preliminary estimate of the capital costs for Rusizi III and Rusizi IV are \$150 million and \$240 million respectively. Also at the feasibility stage is the project at Rusumo Falls, with 20.5 MW of capacity and an estimated capital cost of \$53 million. The development of the regional power projects would require interconnection between the Rusizi sites and Kibuye (the connecting point to the grid) with an estimated cost of \$28 million.

Gas (Methane). Natural gas is internationally considered a very desirable fuel due to its technical, economic and environmental advantages. In particular, it has become the fuel of choice for power generation internationally. Rwanda is endowed with an estimated 55 billion cubic meter (bcm) of usable methane gas found at the bottom of Lake Kivu, at a depth of 250 meters.² A pilot plant was built in 1963 where some gas from the lake was produced and used as boiler fuel in the nearby BRALIRWA brewery. More recent pilot projects were commissioned in 2008 to 2011 with installation of the 4.2 MW Kibuye Power 1 (KP1) plant (available capacity of 1.8 MW). These pilots have demonstrated the

² This is a unique case where the lake contains huge amounts of dissolved gases in its deep waters. These gases include 55 bcm of methane, 250 bcm of carbon dioxide, and 5 bcm of nitrogen and traces of many other gases. Scientists presume that the Lake Kivu continually recharges itself in gases. It is then conceived that if nothing is done, the lake might be saturated one day (in 100 years) and this might cause a gas outburst similar to the one which happened in Cameroon's Lake Nyos in 1986. A Lake Kivu gas outburst would be more catastrophic, releasing most of the more than 300 BCM of gases from the lake into the atmosphere. Such an outburst could kill the entire population in Lake Kivu's valley. In order to reduce this risk and make the lake safe, the extraction of methane gas (which is the trigger element of the outburst) is crucial. On the other hand, an inappropriate methane gas extraction might lead to the release of all (or part of) the gases from the lake into the atmosphere and this can have disastrous effects on the population and the environment in general. Therefore, a controlled methane gas extraction is needed which should be carried out under a strict monitoring system. The process has already started with monitoring near the Kibuye Power pilot plant.

technical and commercial viability of gas exploitation from the lake. A rather major undertaking has taken place with the development of the first phase (25 MW) of the KivuWatt project that is under construction and was scheduled to be completed by 2013. The second phase of this project is expected to add 75 MW of capacity. The total potential of methane-based power is estimated at 350 MW.

Geothermal Energy. Geothermal power has the potential to provide a very suitable complement to Rwanda's other sources of energy. Geothermal power represents a stable and reliable source of supply that could also compensate for fluctuations in hydropower generation. Therefore, geothermal energy is low-risk and low-cost when commissioned. However, the main risk is at the exploration stage, when the size and quality of the resource needs to be proven. This risk is particularly high in Rwanda where geothermal development is still at a very early stage.

The Electricity Master Plan (2011) points out that Rwanda could have a geothermal energy potential of about 700 MW of which 490 MW are considered economically recoverable. However, these estimates need to be firmed up through detailed surface studies and exploration drilling although some surface reconnaissance studies have been done already in the western region (Gisenyi, Karisimbi and Kinigi). There is a plan to carry out significant drilling in Karisimbi by-end 2013 and develop by 2017 four geothermal plants in Karisimbi and Gisenyi through power purchase agreements with the private investors. The envisaged configuration is that there will be a 10 MW pilot and four plants of 75 MW each providing a total of 310 MW by 2017.

Photovoltaic Market. Rwanda has a moderate source of solar energy with an average solar radiation of 4 – 6 kWh per square meter per day. Worldwide, development of solar energy in the form of grid-connected electricity is considered to be very costly even for countries that have more intense sunlight. However, the use of solar energy for electricity generation in isolated off-grid areas and for water

heaters has proven to be economically viable. Rwanda has chosen a realistic track by focusing on the use of solar PV in two main areas: (i) electrification of clinics, schools and administrative offices in remote centers and (ii) solar water heating, substituting biomass and electricity water heating, with significant environmental and recurrent cost savings.

Since the EDPRS has identified as a key priority objective providing electricity access to the health centers and primary and secondary schools, a number of donors (EU, BTC, Global Fund, USAID, ICAP, PEPFAR) have shown interest and support. However, the support from various donors has not been implemented in a coordinated fashion. As a result, the corresponding projects have used a broad range of different technologies and standards. Also there has not been a notable effort to develop local capacity for maintenance. A lack of skills for proper maintenance has led to a series of technical problems including malfunctioning batteries, faulty wiring, and broken DC appliances.

Biomass. Rwanda's energy mix is dominated by biomass that accounts for about 85% of primary energy use while petroleum accounts for 11% and electricity for the remaining 4%. Biomass is derived from wood fuel, mostly used in rural areas in the form of firewood, and charcoal that are used in the urban areas for cooking. Although the dependency on biomass has dropped from 95% to 85% in the last 20 years, the ratio is still considered too high and harmful to forest resources. Accordingly, the Biomass Energy Strategy for Rwanda (2009) articulates the government's objective to reduce the consumption of biomass energy from the current 85 % to 50 % of national energy consumption by 2020. The Biomass Strategy considers a combination of substitution and efficiency improvement measures to reduce biomass use and mitigate the risks of deforestation. These measures include:

- Promotion of other energy sources for cooking and heating such as biomass briquettes (peat, papyrus, waste), kerosene (using efficient and safe pressure stoves and lights), LPG, solar water heating and electricity (for users in the high-end market)
- Expansion and improved management of plantations on a sustainable basis to support growing wood fuel

and charcoal production

- Promotion of improved technologies for charcoal production and improved stoves to make more efficient use of biomass fuels
- Supporting the dissemination of biogas digesters to rural families where animal waste can be used and to schools, hospitals and other institutions where human waste can be transformed into biogas and slurry
- Encouraging the production of methane or other forms of energy from solid waste landfills or through gasification processes

Peat. Peat is considered a promising alternative source of energy. Rwanda has considerable peat reserves in Gishoma (western region), with an estimated reserve of 10 bcm, and at Akanyaru (southern province), estimated at 1.5 bcm. There are also some smaller reserves near Kigali. It has been noted that when peat is harvested and used as a fuel the stored carbon is released back into the atmosphere as carbon dioxide. However, in the post-production phase, the cutaway peatlands can be reclaimed for forestry or restored to wetlands, and once again become carbon sinks. The other global environmental benefit is that when peatlands are drained and developed, they stop the emissions of methane, which is a worse gas than CO₂ in causing global warming. The present plans include development of 200 MW of peat-fired power plants by 2017. The total potential capacity of peat-based power is estimated at 300 MW.

Energy from Urban and Agricultural Wastes. The lifestyle in urban areas involves significant post-consumption waste such as paper, cardboard, wood and yard matter that contain biomass energy which can be used to generate electricity. It is also noted that garbage dumps in the urban areas are a major source of methane emissions. As an efficiency improvement and climate change mitigation project, garbage dumps could be designed as landfills to capture the landfill gas (methane) as an alternative energy source for domestic and industrial application. In the rural areas, agricultural wastes could be used to generate electricity. Agriculture crop residues such as corn stover (stalks, leaves, husks, and cobs) and rice straw, etc. contain biomass energy. Also processing of wood for products or pulp produces unused sawdust, bark, branches and leaves/

Box 3.1 Rwanda's Energy Resource-Base for Power Generation

The total energy resource base for power generation is estimated at about 1,500 MW with the following composition:

- **Hydropower:** 313 MW (comprising approximately 130 MW of domestic hydro and 183 MW of regional hydro resources)
- **Domestic hydro** consists of small and medium-size hydro-power located in specific sites such as Ntaruka, Mukungwa, Gihira, Gisenyi, Rukarara and Nyabarongo, and a large number of mini and micro hydro sites scattered in numerous locations. Small- and medium-size hydros presently provide 39.7 MW of operational capacity and an additional 77.2 MW of potential capacity. Mini and micro hydro provides 4.5 MW of operational capacity with an additional 8 MW of potential capacity.
- **Regional hydropower** refers to joint hydro resources such as Rusizi on the border with DRC and Rusumo Falls on the border with Tanzania. The first two phases of Rusizi have been developed and are operational, providing 15.5 MW of capacity. Rusizi III (48 MW) and Rusizi IV (98 MW) are under active consideration. Rusumo Falls could provide 20.5 MW of capacity but is at the early stage of feasibility study
- **Geothermal:** Geothermal is considered the least-cost option. It has a potential capacity of 700 MW of which 490 MW are considered economic resource. The main fields are Karisimbi with 160 MW, Gisenyi with 150 MW, Kinigi with 120 MW and Bugarama with 60 MW
- Karisimbi has an estimated resource size of 320 MW with currently assessed potential production capacity of 160 MW. Detailed surface studies have been just completed. There are immediate plans for exploration drilling and infrastructure development. Production drilling and power plant construction for a 10 MW pilot will follow afterwards. The experience with the pilot plant will be used to design and implement the main schemes
- Gisenyi has an estimated resource size of 200 MW with currently assessed potential production capacity of 150 MW. Detailed surface studies have been just completed. There is need to build infrastructure and carry out exploration drilling, production drilling and power plant construction
- Kinigi has an estimated resource size of 120 MW. Surface studies have been just completed. There is a need to build infrastructure and carry out exploration drilling, production drilling and power plant construction
- Bugarama has an estimated resource potential of 60 MW. No surface studies have been done
- **Methane:** Lake Kivu has an estimated 55 bcm of methane. Potential power production capacity is estimated at 700 MW to be shared with DRC. Rwanda's share is 350 MW.
- **Peat:** Peat resources include 40,000 ha of peat bogs of various quality. Power production capacity is roughly estimated at 300 MW. Peat sites have been identified in Rwabusoro, Akanyaru, Murago, Gihitasi, Mashya, Gishoma, Rucahabi, Cyato, Cyabararika, Nyirabirande, Kageyo, Kaguhu, Mashoza, Gasaka, Bahimba, Bisika, Rwuya, Nyabigongo and Rugeramigozi.
- **Solar and Wind.** Rwanda has insignificant wind potentials and a moderate source of solar energy with an average solar radiation of 4 – 6 kWh per square meter per day. It has had a useful experience with the 250 kW Kigali solar project and solar water heaters
- **Biomass.** Rwanda's energy mix is dominated by biomass that accounts for about 85% of primary energy use. Although the dependency on biomass has dropped from 95% to 85% in the last 20 years, the ratio is still considered too high and harmful to forest resources. The Biomass Energy Strategy for Rwanda (2009) articulates the government's objective to reduce the consumption of biomass energy from the current 85 % to 50 % of national energy consumption by 2020

needles which have significant energy potential.

In summary, Rwanda's energy resource base provides about 1,500 MW of potential power generation capacity (Box 3.1). Chapter 4 will review the cost structure of various energy options and examine the technical feasibility of developing these resources to meet the electricity demand.

Past, Present and Projected Power Supply Capacity

Rwanda's power supply in 2012 was based on about 100 MW of installed capacity and 93 MW of available capacity. The installed capacity was projected to reach 132 MW by

end-2012 and would comprise: 48 MW of domestic hydro, 15.5 MW of regional hydro, 29.2 MW of methane power, 37.8 MW of thermal plants and 0.25 MW of solar power. Heavy dependence on hydropower has created some serious problems because the largest hydro plants are based on interconnected lakes whose levels decline precipitously during drought conditions.

In 2003-05, a combination of lower rainfall and over-utilization of the existing hydro plants created a severe power shortage. The government responded by renting additional (15 MW) diesel generation capacity at a high cost, increas-

ing tariffs by more than 100 % to about US\$0.21/kWh. This high tariff is considered an important bottleneck to the expansion of economic and business activities, particularly those geared toward export, where cost competitiveness affects the ability to market the commodities. The high cost of power supply is expected to persist as long as the country relies substantially on oil-fired power generation. Such dependency is not only very expensive but also jeopardizes the reliability of supply. The transportation of fuel oil to Rwanda takes place through a risky arrangement.

Petroleum products are transported from Mombasa in Kenya via pipelines to Eldoret in Kenya, then by road to Kigali and elsewhere in Rwanda. In addition to high inland transport costs from Mombasa, oil products imports are also subject to various duties and taxes so that, on average, retail prices of petroleum products are about 100 % higher than acquisition costs at the main supply sources. The post-election violence in Kenya in January 2008 temporarily stopped supply completely. This further reiterates the desirability of reducing dependence on oil-fired plants when possible.

In recent years, the supply situation has improved due to a combination of factors. The performance of hydropower plants has been satisfactory due to the better-than-expected rainfall. More importantly, some new generation projects have come online and several more are under construction. These include the 20 MW Jabana HFO power station, commissioned in 2009, the 9 MW Rukarara hydropower station, commissioned in 2010, the 2 MW Rukarara II plant commissioned in early 2013, and the 28 MW Nyabarongo hydropower station to be commissioned in 2014.

The government's power sector strategy aims to expand the generation capacity to 1,160 MW by 2017. The installed capacity in 2017 would comprise: 340 MW of hydropower, 310 MW of geothermal power, 300 MW of methane-based power, 200 MW of peat-based power, and 20 MW of thermal plants.³ The feasibility of this plan is reviewed in the next chapter.

3 There has been also a recent proposal for installing a 20 MW photovoltaic plant. A 50 Ha-area has been identified for the project and negotiations are underway to sign a PPA with a private company.

Regional Electricity Trade: East Africa Power Pool and Nile Basin Initiative

Regional integration of power systems in Africa is of considerable interest to the potential participating countries and their development partners. Numerous studies and technical assistance activities have been carried out to facilitate cross-border interconnections. The riparian states of the Nile River⁴ have formed a partnership called the Nile Basin Initiative (NBI) seeking to develop the river in a collaborative manner, share its socioeconomic benefits equitably and promote regional peace and security. One of the subsidiary programs is the Eastern Nile Subsidiary Action Program sponsored and advanced by the Eastern Nile Technical Regional Office (ENTRO). ENTRO is focused on promoting power trade through regional cooperation to increase access to electricity and lower the cost of supply. Several major hydropower projects are being studied under the program for facilitating energy trade among Ethiopia, Sudan, Kenya and Egypt.

The Eastern Africa Power Pool (EAPP) is a relatively new institution that was formally established in February 2005 by the seven countries who signed the Inter-governmental Memorandum of Understanding. These countries included: Burundi, DRC, Egypt, Ethiopia, Kenya, Rwanda and Sudan. Tanzania joined the pool in 2010 and Libya in 2011, bringing the number to nine countries. Potential future members include Djibouti, Eritrea, Somalia and Uganda. 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 (World Bank, AfDB, the European Union, the Norwegian government and USAID) 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. Several interconnections have been already implemented including a 296.5 km double-circuit 230 kV

4 The countries include Burundi, the Democratic Republic of Congo, Egypt, Ethiopia, Kenya, Rwanda, Sudan, Tanzania, and Uganda with Eritrea as an observer.

transmission link between Bahir Dar substation in Ethiopia and the Sudan border; and a 155 km double-circuit 230 kV link from the Sudan-Ethiopia border to Gedaref Substation in Sudan. The power export line from Ethiopia to Sudan is constructed on the basis of a three-year Power-Purchase Agreement (PPA) under which an annual firm supply of 100 MW will be purchased. Additional supply would be agreed upon in the future. Ethiopia has a large hydropower potential and has surplus power to export. The nation could however benefit from imports of thermal power from Sudan to manage seasonal variations in domestic generation. Ethiopia has also completed an interconnection to Djibouti and is pursuing an interconnection with Kenya to export the surplus from these projects and those under construction.

Rwanda is a member of NBI and the EAPP. However, apart from using its share of regional hydro plants - Sinelac and Rusizi I (SNEL)⁵, Rwanda is not connected to any regional transmission network. This limits the prospects for larger-scale trade as Rwanda's system expands and as development of domestic resources may provide additional capacity that can profitably be exported to the neighboring countries. Expansion of cross-border interconnections could be of significant benefit to Rwanda. Interconnectors could enable import of power from Uganda or Tanzania that could provide a valuable source of power for peak and mid-load in Rwanda while also providing an avenue for export of electricity from base-load generation. The benefits of each interconnection fall into two categories: (i) capacity saving benefits and (ii) energy exchange benefits. Capacity saving benefits result from the possibility that the interconnection allows Rwanda to share a reserve margin with another country and take advantage of the diversity of demand between the two power systems. Energy exchange benefits are based on electricity transfers during the peak and off-peak generation times of both systems. The present

interconnection capacity of 30 MW with DRC and Burundi has served Rwanda's needs in the critical periods of the past shortages. The EAPP's Master Plan has designated the transmission interconnections among Ethiopia, Kenya, Tanzania, Uganda and Rwanda as priorities for the development of the Eastern Africa power market. These interconnections will create the transmission backbone for the region.

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 the Mbarara (Uganda)–Birembo (Rwanda) 220 kV transmission line. The line will be designed for 220 kV for a possible export/import capacity of 200 MW. However, 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 estimated to cost approximately \$56 million and is expected to be completed by 2015. 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).

The international experience (Box 3.2) indicates that regional integration of power grids takes a long time to materialize. The ultimate goal of an integrated power market is to optimize the supply of electricity within a broad, regional (rather than confined, national) framework. Often this is thought to be achievable in a market environment where every party has equal access to all networks (domestic, regional and international); where market data and information (pricing, market operation, capacity allocation and so on) are transparent; and where electricity tariffs cover the cost of supply, power-grid codes are harmonized, systems are synchro-

⁵ Presently Rwanda purchases power from the Rusizi I plant (with import capacity of 3.5 MW) of SNEL of DRC, and Rusizi II (with import capacity of 12 MW), owned by Sinelac, with equal joint participation of Rwanda, DRC, and Burundi.

Box 3.2: Lessons from International Experience in Regional Integration

The objective of electricity market integration is usually addressed in three distinct dimensions: security of supply, sustainability and competition. While all three dimensions appear on the regional integration agenda of various parts of the world, the emphasis on each dimension has varied depending on the prevalent priorities in the corresponding region. For example, in the EU integration agenda, the emphasis has been on competition. This emphasis indicates that market integration can be achieved through a coordinated reform process, which in turn implies that the liberalization of individual national markets is a pre-requisite to regional integration. On the other hand, in East Asia, Latin America, South Africa and parts of the Arab world, the emphasis has been on improving the security of supply by building the required physical infrastructure and relying on simple rules for operation of the interconnected systems. This approach recognizes the fact that the individual national markets are at different stages of development and that the liberalization of these markets cannot be expected at the same pace.

The East Africa Power Pool (EAPP) is at an early stage of development characterized by a coordinated effort to establish the institutional framework and to promote regional interconnectivity. Elaboration of regional integration schemes often starts with an attempt to design a model for the integrated market. However, it quickly becomes evident that while the desirable model has a set of clear features; its achievement is only a long-term goal. The immediate challenge is then to draw a picture of the path that takes the region from its current status to the desirable solution in a calculated, systematic and practical manner.

The path to market integration should take into account the current realities. At the top of these realities is the fact that a country is not likely to trade with another country if by doing so it is placing its own customers at risk of reduced reliability. This is always a hampering factor at the initial stage of regional integration when each participat-

ing country needs to develop comfort about the reliability of power systems of other countries. International experience indicates that the path toward regional integration is likely to follow two stages:

- Stage 1: Implementing a transitional regional-market design, focusing on identifying and expanding trade opportunities
- Stage 2: Expanding the regional market's functionality, through unbundling transmission system operators (TSOs) and achieving wholesale competition.

To translate the above two-stage vision into practice, one would need to devise a clear and consistent long-term strategy that identifies specific policy actions to be undertaken during each stage of market development. At the first stage, electricity trade takes place according to direct utility-to-utility bilateral contracts. In the case of non-contiguous countries, the electricity trade would transit through the third-country networks for which a transit/wheeling service fee will be charged by the transit country. During this stage, the strategy should focus on reinforcing infrastructure.

The second stage emphasizes the creation of wholesale competition with all large customers and distribution entities allowed choice of supplier. During this stage, new financial markets are typically introduced as needed by regional market participants such as a bid-based balancing market, day-ahead market, intra-day market, emissions trading market, among others. At this stage, there will also be a move toward a regional economic-dispatch outcome consistent with objectives of competition, sustainability and reliability/security of supply.

The EAPP is in the process of preparation for the implementation of Stage 1. With funding from the AfDB and the European Commission, the EAPP has completed a Regional Power System Master Plan (EAPP Master Plan) and a Grid Code Study for governing the operations of the regional, interconnected electricity network. USAID is helping EAPP develop model agreements for electricity trade. In addition, the Government of Norway is funding studies on the development of the pool which would initiate the preparatory process for the move to Stage 2 of regional market development.

nized and markets liberalized. Meeting these requirements for the East African countries is expected only in the medium to long term. In the meantime, construction of cross-border interconnections between neighboring countries is considered as a very important step toward integration. In this regard, Rwanda's plan to expand its interconnections with neighboring countries is in line with the objective of regional integration of power systems. However, there is a need to develop the institutional capacity for cross-border trade which is also intertwined with the institutional capacity requirements of private sector participation (see Chapter 7).

Assessment of the Energy Services

The quality of energy services has shown impressive progress in the past 5 years. Improvements in billing and collections are now considered a successful practice that has attracted the attention of the other countries in the region

and the development partners. Along with the expansion of the generating capacity Rwanda has launched an extensive program to rehabilitate and expand the transmission and distribution networks. With the support of donors, the main substations and secondary distribution infrastructure have been overhauled and the national control center rehabilitated. Although many of the investments are still under construction, the current improvements have resulted in a drop in the outage rate and a decrease in electricity losses from more than 25 % in 2005 to approximately 19% in 2011.

The commercialization of electricity supply is on the right track. Based on the legal and regulatory requirements, the management team of EWSA is accountable to an agreed-upon performance contract, with clearly identified indicators linked to incentives. As a result, EWSA has experienced a turnaround in essential aspects of the business, particularly

in financial and technical performance as well as customer service. These impressive improvements include:

- A gradual transition from a loss-making to a profitable operation has been under way. Indeed, EWSA has been making a positive operating profit since 2005. It has also complied with transparency requirements by carrying out independent financial audits and preparing a publicly announced business development plan to meet its mandated service targets and requirements.
- EWSA has improved its technical performance by rehabilitating many of the main substations and key sections of the secondary distribution network with financial support from the government and the donors. As a result, electricity outages have declined by about 20% in 2005 to 2010 while electricity losses have dropped from 25% in 2005 to approximately 19% in 2010. These improvements are expected to continue as the investments already being implemented will strengthen the operational performance of EWSA.
- A noticeable change in EWSA's customer service has been welcome. This is impressive due to the fact that EWSA was previously confronted with a highly dissatisfied customer base. EWSA has had a successful experience particularly in regard to billing and collections through a complete revamp of the underlying systems. In 2007, ELECTROGAZ (now EWSA) was recognized with an award as one of Africa's most innovative power suppliers for its extensive use of prepayment technologies and revenue collection programs⁶. The widespread use of prepaid meters would also enable the country to lower the cost of the electricity access program because the number of additional utility service stations, meter readers and collection points can be kept to a minimum
- An impressive acceleration in electricity access is underway. Although in the first half of the 2000s, EWSA was barely able to add a thousand customers a year; in the second part of the decade it was able to expand electricity access by an average of 23,000 connections a year. The connections increased by about 44,000 in 2010. In this area, EWSA has made a significant change in the way it functions. It is relying to a large extent on private local contractors for new connections while also helping them develop their technical capacity
- EWSA established an energy efficiency initiative that has managed the compact fluorescent lamp (CFL) program for new customers in cooperation with the ongoing CFL replacement campaign. The program has been largely successful. It is estimated that some 400,000 CFL lamps have been installed since 2006 and another 400,000 CFL lamps were in storage in June 2012 to be installed in the subsequent months. The solar water heater program will be managed by EWSA, and delivered by the private sector to qualifying end users
- EWSA has made a twinning arrangement with Société Tunisienne de l'Electricité et du Gaz (STEG), the Tunisian national utility, to further the institutional strengthening needed for its operation and to benefit from best-practice Tunisian experience in low-cost designs and customer connection methods. This cooperation/partnership is taking place through mutual visits. It is also focused on a pilot electrification project in the Eastern Province. The pilot project has shown a significant improvement through a 13-20%% reduction in the cost of connections.

6 RECO (now EWSA) represents best practice in the area of billing and collection, recognized by several African utilities that sent delegations to Kigali to study RECO's experience with prepayment systems. It is noted that for most parts, RECO no longer sells power directly to customers but instead uses wholesale vendors. As a result, third-party electricity sales now represent the large majority of the RECO electricity revenue stream.

Looking into the future, EWSA is expected to operate on a commercial basis. It is estimated that the prevailing retail tariffs will continue to enable EWSA to recover all oper-

ating expenditures, i.e., fuel and operation and maintenance (O&M) costs plus at least 10% of the investment cost of the grid rollout program. This is consistent with the financing plan of the EARP that envisages shares of 10% from customer connection charges, 10 % from EWSA's retained earnings, and the 80 % balance lent to EWSA by the government. With respect to the last component, a substantial portion of the funds is to come from the government's fiscal resources and donors.

The reliability and cost of power supply will remain the most important aspects of energy services in the future. Present plans indicate a high reserve margin (the difference between available capacity and peak demand) for Rwanda's power system. The emerging reserve margin is likely to stay above 25% under various demand-supply scenarios. A reserve margin of 25% is considered appropriate for the present small size of the supply capacity. However, the reserve margin can be adjusted downward gradually with growth in the installed capacity.

Summary of Sector Challenges, Opportunities and Priorities

In line with the overall economic reform agenda, the power sector has gone through some significant changes with respect to structural reform and supply capacity. However, plans for future expansion of the power sector and electricity access involve a number of significant challenges in regard to: (a) energy diversification (b) expansion of supply capacity (c) investment and finance (d) EWSA's financial strength; (e) private sector participation (f) regional interconnection/integration and (g) regulatory and institutional capacity.

Energy Diversification. Rwanda paid a high price for its heavy reliance on oil-fired power generation in the past decade. The government is determined to diversify the energy mix to rely primarily on its domestic energy resources. The power sector is the main vehicle for energy diversification and is expected to go through a radical shift from the present oil and hydropower composition to an energy mix including hydro, geothermal, methane and peat-based electricity generation. The current plans indicate capacity developments by 2017 of 340 MW of hydro, 310 MW of geothermal, 300 MW of methane and 200 MW of

peat-based power generation. There are significant uncertainties about the technical ability to develop this level of capacity in each of these resources. The resource base for hydropower is estimated at 315 MW, some of which can be developed by 2017. The resource base for geothermal, methane and peat are tentatively estimated to be sufficient for meeting their respective targets but much more work should be done to validate the size of each resource and the pace at which it can be developed.

Expansion of Electricity Supply Capacity. Starting from an extremely low base, the government has expanded electricity access by an impressive 160% between 2008 and 2011. However, still only 16% of Rwanda's households are connected to the grid. The government has now set a national target to increase the country's electricity access to 70% by 2017. It has also prepared an expansion plan aimed at increasing the electricity generation capacity from about 100 MW in 2012 to 1,160 MW by 2017. A tenfold increase in the supply capacity within a five-year timeframe is quite an ambitious target that faces significant constraints in terms of energy resources, technical readiness of the corresponding projects, and financing and implementation capacity.

Investment and Finance. Power sector investment requirements for 2013-2017 are estimated at \$2.5-4.2 billion. The potential sources of financing would include: electricity tariffs; the internal resources of the Electricity, Water and Sanitation Authority (EWSA); the government and development partners; and the private sector. Electricity tariffs are already high and there is not much room for a further increase. However, the power sector in the short to medium term will experience a shortfall in revenue and cash flow requirements due to the heavy concentration of investments over the next 5 years.

EWSA's Financial Strength. Under normal circumstances the shortfall in the investment cash flow is met by the utility's borrowing from external and domestic markets. However, EWSA does not yet have an established creditworthiness for such borrowings. It is therefore necessary to continue the support from the development partners and the government to enable EWSA to meet the cash flow requirements

for 2013-2017 while planning on curtailing this support gradually afterwards. To make EWSA a self-sufficient utility, there is a need to put it on a path toward becoming a credible entity capable of corporate borrowing from commercial sources (banks and possibly through the issuance of bonds to be sold to domestic investors). Also, EWSA should be converted to a corporation which would eventually become an independent (fully government-owned) company with a mandate to borrow on its own account.

Private Sector Participation. The power sector development plan is dependent on private sector investments for at least \$1.5 billion for the next 5 years. Mobilizing such magnitude of private investment is totally unprecedented in the case of Rwanda. Mobilizing these private sector resources would require the government and development partners to join forces in improving the business environment. The main business risks are insufficient project development (technical risk) and the lack of confidence in EWSA's ability to pay for its increasing obligations (political risk). The development partners should support the formulation of risk reduction instruments. At the same time, private sector investors should consider the opportunity to engage in Rwanda's power sector where electricity tariffs are at the level of cost recovery, a reformist government is willing and able to handle the emerging challenges, and a very ambitious program is in place to expand the electricity generation capacity.

Regional Interconnection/Integration. Regional integration of power systems in East Africa is of considerable interest to the potential participating countries and also to the development partners. Rwanda is a member of two important regional initiatives - NBI and the EAPP. However, apart from using its share of regional hydro plants, Rwanda is not connected to any regional transmission network. This limits the prospects for larger-scale trade as Rwanda's system expands and as development of domestic resources may provide additional capacity that can be profitably exported to the neighboring countries. Expansion of cross-border

interconnections could be of significant benefit to Rwanda. Interconnectors could enable import of power from Uganda or Tanzania that could provide a valuable source of power for peak and mid-load times in Rwanda while also providing an avenue for export of electricity from base-load generation.

Regulatory and Institutional Capacity. Rwanda has implemented a power sector structure that separates the responsibilities for regulation, policy and operation. However, achieving the power sector's targets and objectives would require further development of the regulatory framework and the institutional capacity so as to fit four emerging dimensions. First, with the introduction of private power producers, the technical and institutional requirements should be clearly specified so that the reliability and security of the power network operation are protected. Second, the emerging role of EWSA as a single buyer of bulk electricity has significant implications on its technical and financial competencies to play the role of the single buyer. Third, the potential partial unbundling of the power sector in the future should be reflected in the emerging institutional capacity of the relevant entities. Fourth, with the potential expansion of cross-border electricity trade, EWSA's staff and systems should be strengthened to manage the corresponding transactions. It is further noted that with the rapid and unprecedented forthcoming expansion of the energy sector, the need for capacity enhancement spans all segments and functions of the energy sector. MININFRA and all other institutions involved in energy sector management would need additional skills and institutional capacity to operate an effective public-private machinery that would strategize, plan, develop and run a sustainable energy sector.

Key Strengths, Weaknesses, Opportunities and Risks. Table 3.4 contains a summary of the power sector's strengths and weaknesses. The strengths indicate that Rwanda has established a track record of economic reform and stability. The government is determined to continue with economic

Table 3.4: Analysis of Sector Strengths and Weaknesses

Strengths	Weaknesses/Challenges
GoR is widely recognized as an ambitious reformer with a strong track record	Only 16% of Rwanda's households are connected to the electricity grid
GoR considered a model partner by development partners	Rwanda paid a high price for its heavy reliance on oil-fired power generation in the past decade
Rwanda's economy has been exceptionally stable and resilient	The resource base for energy diversification is broad but much more work should be done to validate the size of each resource and the pace at which they can be developed
GoR has fully recognized that the availability of reliable power supply is essential for economic growth, social prosperity and human development	Power sector investment requirements for the period 2013-2017 are estimated at \$2.5-4.2 billion. Mobilizing this level of finance from public and private resources is very challenging
GoR has set an ambitious target for increasing electricity access and generating capacity	Despite the high electricity tariffs, the power sector faces a substantial shortfall in cash flow due to the heavy concentration of investments in the next five years
EWSA is considered a model utility in East Africa.	The power sector development plan is dependent on private sector investments for at least \$1.5 billion for the next 5 years. Mobilizing private investment of such magnitude is unprecedented in the case of Rwanda
Starting from an extremely low base, the government/EWSA have expanded electricity access by an impressive 160% between 2008 and 2011	EWSA's financial strength is not at a level that would enable it to borrow commercially. Its financial strength may not be considered sufficient as the single buyer of electricity from large private power suppliers
Electricity tariffs are on average more than 20 US cents/kWh and considered to cover the long-term cost of supply	The regulatory and institutional capacity of the power sector should be further developed to fit the emerging dimensions with respect to the introduction of private power producers, the role of EWSA as a single buyer of bulk electricity, the potential unbundling of the power sector, and the potential expansion of cross-border electricity trade
Rwanda has implemented a power sector structure that separates the responsibilities for regulation, policy and operation	Rwanda is not connected to any regional transmission network. This limits the prospects for larger scale trade
Regional integration of power systems in East Africa is of considerable interest to the potential participating countries and also to the development partners. Rwanda is a member of two important regional initiatives - NBI and the EAPP	

development at an ambitious pace. The government has a clear recognition of the role of the power sector in economic and social development and is willing to take serious actions to ensure sufficient expansion of electricity supply capacity. The weaknesses, on the other hand, relate to the challenges of pursuing very ambitious plans. The assessment of the energy resource base and mobilization of public and private finance constitute the most significant challenges.

Despite the above challenges, the opportunities for the development of power sector are also quite significant and attractive. Table 3.5 summarizes these opportuni-

ties as well as the outstanding threats. The opportunities indicate that the government's determination to increase electricity access provides a strong political signal for both public and private sector developers of power capacity. The potential involvement of Rwanda in cross-border electricity trade provides further opportunity for reliability and economic gains from energy exchanges. Finally, the risks are substantial and mostly relate to the difficulties associated with achieving ambitious targets. In particular, the technical and political risks associated with project development and finance relate to the unprecedented levels of investment and resource requirements. These risks should be mitigated and

Table 3.5: Analysis of Sector Opportunities and Threats

Opportunities	Threats/Risks
<p>GoR has a national target to increase the country's electricity access to 70% by 2017</p> <p>GoR plans to expand the electricity supply capacity by a factor of 10 during the next five years</p> <p>GoR is determined to diversify the sources of energy supply and considers the power sector as the main vehicle for energy diversification</p> <p>GoR's plan indicates generation capacity developments by 2017 of 340 MW of hydro, 310 MW of geothermal, 300 MW of methane and 200 MW of peat-based power generation</p> <p>Expansion of cross-border interconnections could provide significant benefits in system reliability and economic exchange of energy</p>	<p>A tenfold increase in the supply capacity within a five year timeframe is a very ambitious target that faces significant constraints in energy resources, technical readiness, and financing and implementation capacity</p> <p>There are significant uncertainties about the technical ability to develop the required capacity in terms of resource base and technical readiness of the corresponding projects</p> <p>Project preparation work needs substantial strengthening for all projects whether designated as a public or private sector undertaking</p> <p>Private investment requirements are huge (estimated at \$300 million/year). Mobilizing this amount would require concerted efforts from the government and the development partners in improving the business environment</p> <p>The main business risks are insufficient project development (technical risk) and the lack of confidence in EWSA's ability to pay for its increasing obligations (political risk)</p>

specific proposals for doing so are discussed in Chapter 5. Approach of this Study to Deriving Sector Priorities. This study applies the least-cost methodology to review the power sector issues and options. The least cost analysis of the generation options indicates that regional hydro and geothermal power are the lowest-cost energy options by a significant margin. Therefore the highest priority should be assigned to the development of these resources. Domestic hydro is also expected to provide a significant contribution. The cost structure of domestic hydro resources does not seem as attractive as large regional hydro or geothermal options but these domestic resources are still expected to provide energy supplies at acceptable costs.

Power plants fueled with extracted methane from Lake Kivu are expected to have a higher cost compared to geothermal and hydropower. However, given Rwanda's supply options, methane-based power generation is still quite attractive because it enables the country to avoid using imported oil.

Peat-fired power generation costs more than other alternatives and is not strictly the least-cost option. However, peat-fired plants also have the advantage of being flexible and capable of adjusting to the variations in the system load. In effect, peat-fired plants can be used to meet intermediate load requirements which would be otherwise generated by oil-fired plants.

The subsequent chapters of this study provide a systematic analysis of sector priorities through (a) assessment of the cost of investments and technical readiness of projects (Chapter 4); (b) review of the financing requirements and the potential sources of finance (Chapter 5); (c) analysis of bottlenecks in private sector investment and finance (Chapter 6). The study, drawing from these assessments, identifies the priorities for the development of physical infrastructure and regulatory and institutional capacity (Chapter 7). These sector priorities are summarized in Table 3.6 below for reference and the detailed discussions are presented in Chapter 7.

Table 3.6: Priorities for Development of Physical Infrastructure and Institutional Capacity

Physical Infrastructure	Institutional Capacity
<p>1. Development of Hydro Resources</p> <ul style="list-style-type: none"> • Prepare the Hydropower Master Plan; • Carry out feasibility studies for the sites selected in the Hydropower Master Plan; • Construct Giciye by 2014; • Construct Rukarara IV by 2014; • Develop Nyabarongo II Multipurpose Dam by 2017; • Develop Rusizi III by 2016. <p>2. Development of Geothermal Power</p> <ul style="list-style-type: none"> • Carry out resource demarcation in Karisimbi, Gisenyi and Kinigi fields (which is currently underway); • Build infrastructure-access road and water system for drilling in Karisimbi and Gisenyi by 2013; • Develop Karisimbi Pilot Project by 2014; • Develop Karisimbi I Project with 75 MW capacity by 2015; and • Develop Kalisimbi II Project with 75 MW capacity by 2017. <p>3. Development of Methane Power</p> <ul style="list-style-type: none"> • Develop KivuWatt II with capacity of 75 MW by 2015; <p>4. Development of Peat-based Power</p> <ul style="list-style-type: none"> • Complete EPC construction of 15 MW plant by 2013; • Complete construction the of 25 MW plant by 2015; and • Complete Hakan 100 MW plant by 2017. 	<p>1. Preparation and Establishment of the Energy Efficiency and Development Fund (EEDF)</p> <ul style="list-style-type: none"> • Prepare a proposal for the establishment of EEDF and submit to Clean Development Funds (CDF); • Mobilize financing, establish legal authority and governance processes; and • Operationalize the Fund by end-2013. <p>2. Development of the Institutional Capacity</p> <ul style="list-style-type: none"> • Establish transparency and accountability through separation of the financial accounts of generation, transmission and distribution units; • Prepare the Market Rules Document to establish the commercial requirements for the single-buyer electricity market; • Develop technical skills in: (a) Single Buyer market design principles (b) economic dispatch (c) two-part generation purchase tariff design (d) scheduling and dispatch on the basis of economic merit order (e) determination of revenue requirement, tariffs and contracts for services provided by one market participant group to another; and • Prepare a draft roadmap for sector unbundling.



Chapter 4: Energy Investment Program

Analysis of the Projected Energy Mix

As envisioned in Rwanda's draft energy policy, the main objective of the power sector is to provide sufficient, reliable and affordable supply of electricity through an accelerated expansion of the sector's capacity. The analysis of the supply options in Chapter 3 indicates that these objectives are achievable if the country embarks on the rapid development of domestic energy resources. The most immediate potentials are in the areas of geothermal, peat and gas (methane) resources. As discussed in Chapter 3, the estimated potential resource is 490 MW geothermal; 300 MW peat; and 350 MW methane-based power generation. Also it was noted that a large portion of these resources are now considered for development by 2017 in order to meet the government's objective of accelerated electricity supply program.

Cost Structure of Various Supply Options

The assessment of a precise cost structure cannot be carried out until feasibility studies are completed for all the corresponding projects. However, for the purpose of ranking the generation alternatives approximate numbers can provide significant policy guidelines. In the case of Rwan-

da's energy resources, the base-line numbers for various options seem to be sufficiently differentiated to provide a clear trajectory for the development of domestic resources. Table 4.1 includes estimates of long-run marginal cost (LRMC) of power generation from various resources. It is noted that LRMC of electricity generation from existing plants is indeed the same as the short-run marginal cost (SRMC) and is limited to operation and maintenance (O&M) cost while LRMC of the new plants includes capital and O&M costs.

Estimates based on EMP (2011), ESMAP (2012), IEA (2011)

Least cost analysis of the generation options indicates that regional hydro and geothermal power are by a significant margin the lowest-cost energy resources. Therefore the highest priority should be assigned to the development of these resources. Domestic small and mini hydro is expected to provide a significant contribution. The cost structure of these domestic and mini hydro resources does not seem as attractive as large regional hydro or geothermal options but they still provide energy supplies at acceptable costs. More specifically, among the domestic hydro projects Nyabarongo 1 would have a low cost of 7.1 cents/kWh while Nyabar-

Table 4.1: Long-Run Marginal Cost of Electricity Generation (US cents/kWh)

Generation Options	Capital Cost (a)	O&M Cost (b)	LRMC (a + b)
Existing domestic hydro	0	1.0	1.0
Existing regional hydro	0	3.3-3.5	3.3-3.5
New domestic hydro	7.1 to 10.8	0.8	7.9 to 11.6
New mini hydro (average for 10 sites)	14.5	0.5	15
New regional hydro	5.3 to 8.2	0.7	6.0 to 8.9
Existing diesel	0	27	27
Existing HFO	0	16	16
New diesel	3.3	27	30.3
Gas (methane)	3.2	8.8	12
Geothermal	6.2	0.5	6.7
Peat	9.3	5.5	14.8
Solar PV	35	0.5	35.5

ongo 2 would cost much more. Among the regional hydro projects, Ruzizi III and Ruzizi IV will have a cost of 7.3 and 5.4 cents/kWh respectively while Rusumo Falls is expected to cost 8.4 cents/kWh.

Geothermal is a clear least-cost option with a high degree of reliability and operational flexibility. However, there are serious constraints in the rapid development of geothermal resources. The development cycle is rather long, involving exploration and production of steam capacity prior to the completion of the corresponding power plant. Identified geothermal resources include 160 MW in Karisimbi, 150 MW in Gisenyi, 120 MW in Kigini and 60 MW in Bugarama. To meet the objective of the accelerated electricity supply program, the resources in Karisimbi and Gisenyi are considered for full development by 2017. This ambitious program would require an aggressive and costly procurement of a substantial number of drilling rigs that could be financially challenging⁷.

Power plants fueled with extracted methane from Lake Kivu are expected to have a LRMIC of about 12 cents/kWh which is more expensive than the international benchmarks for gas-based power generation.⁸ However, given Rwanda's supply options, the methane-based power generation is still quite attractive because it enables the country to avoid using imported oil. The government's plan indicates a target of developing some 300 MW of methane-based installed capacity by 2017.

Peat-fired power generation costs more than geothermal and is not strictly the least-cost option. However, it is still attractive when capacity expansion of geothermal is already

facing limitations. Peat-fired plants also have the advantage of being flexible and capable of following the variations in the system load. Peat-fired units in effect can be used for intermediate load needs that would be otherwise generated by oil-fired plants. In that regard, the cost of peat-fired generation can be also measured against an oil-fired benchmark. Furthermore, the peat-fired plants will have more flexibility to supplement hydropower which may fluctuate due to the hydrological conditions. The current plans indicate that from a total of 300 MW potential peat-fired capacity, some 200 MW could be commissioned by 2017 and the rest by 2025. The rapid development of the peat electricity generation provides a further benefit in terms of mitigating the development risks associated with the geothermal and methane options. Since both of these options entail substantial uncertainty in their speed of deployment, peat could provide a more certain supplement in the interim.

Although reliance on oil is expected to decline quickly and drastically, some oil-fired capacity would need to remain in the system. This capacity is required to meet peak demand as well as emergency power. It is estimated that the current 20 MW of HFO-fired power would stay in the system but hopefully serve only as the stand-by reserve margin.

Solar technology is at an early stage of development with several new technologies under consideration. Most solar energy produced today is based on photovoltaic (PV) technology. The capital cost of solar PV has dropped substantially in the last 3 years but still is far from being a competitive source of energy supply. Another major promising technology is concentrated solar power (CSP). Although there is a wide range of estimates for solar power generation cost, there is also a general agreement that these costs will decline substantially over the next 20 years.

The International Energy Agency (IEA) projects that the capital cost of CSP plants will decline by about 60% between 2010 and 2050. IEA also projects that Solar PV electricity prices globally will reach grid parity by 2020 and decline further to a range of US cents 7 to 13/kWh by 2030. The

⁷ It is estimated that some 20 wells have to be drilled for each 75 MW of steam capacity. Each rig can drill 5 steam wells a year indicating that there will be a need for 5 drilling rigs in Rwanda (at around \$33 million each).

⁸ Estimates of LRMIC of gas-based electricity vary depending on the market price of gas. For a price of \$5/MMBTU (which is currently the average price in developing countries), the LRMIC of gas-based power generation is 6.5 cents/kWh.

strategic issue facing policy makers is how to support the development of solar power in the short to medium term knowing that solar energy will become competitive with other sources of energy in the future. Rwanda has already established a useful experience with the 250 kW Kigali solar project located on Mount Jali and will benefit from the plan of installing PV panels on certain public buildings. There is also a 50 Ha location identified to construct a 20 MW plant through an IPP arrangement. However, larger-scale application of solar power is not expected in the near future. The preceding analysis of the cost and technical challenges of each resource option feeds into the assessment of project priorities and project readiness which is the focus of the next section.

Assessment of Project Readiness

The accelerated implementation program of power sector investments presents serious challenges in project readiness. Experience in developing countries particularly Africa indicates that many energy projects do not reach the implementation stage despite the country's dire need for electricity. Even among those power projects that receive financial support, many do not proceed according to the envisaged schedule. The reason is sometimes technical and more often, caused by the institutional arrangements for project implementation. Thus the examination of project readiness is essential in the case of Rwanda where there is such a huge ambition for capacity expansion. At the same time, it is pointed out that the examination of readiness of the projects, and thereby the investment program, is a core question that would in practice bring in many other institutional and policy issues.

Project preparation for hydro options is rather advanced. Among the hydropower projects three - Rukarara, Mukungwa 2, and Nyabarongo - are already under construction. Among other scheduled hydro schemes, only four projects - Rusizi 3 Rusumo Falls, Akanyaru, and Nyabarongo 2 - have been subjected to detailed feasibility studies. Rusizi 4 would need a feasibility study before consideration for construction. The hydropower plants at Rusumo Falls and Rusizi 3 are regional projects and represent the lowest-cost

electricity generation options. According to the available estimates, the final phase of Rusizi, i.e., Rusizi 4 (Sisi 5) is even more cost-effective but the cost would need to be verified after completion of the feasibility study.

Project preparation for methane-based projects is not sufficiently advanced compared with the intended construction and commissioning of these plants. Construction of the Kibuye 25 MW plant was due for completion by end-2012. A provisional contract has been signed for the extension of the plant by an additional 75 MW which would depend on the success of the first 25 MW. Preparation work and implementation arrangements for other methane-based plants have not been formulated.

Geothermal generation options are not sufficiently prepared to ensure timely implementation. The intention of the accelerated expansion program is to install about 310 MW of geothermal capacity by 2017. Although the rapid implementation of geothermal is economically justified, the project preparation work is lagging significantly. In particular, the exploration component needs to be carried out urgently in order to provide an assessment of steam resources to allow preparation of the corresponding power projects. Drilling for the Karisimbi 10 MW project was expected to start in December 2012; implementation of this project is expected to provide valuable information for preparation of other projects in Karisimbi and other sites (mainly Gisenyi).

Peat power projects are all at the planning stage. However, the accelerated expansion program indicates a rapid implementation of these plants. The interest regarding construction of peat plants is strong due to the fact that they are considered to be less complicated for preparation than the geothermal and methane options. Nevertheless, the preparation work should be carried out urgently to enable their implementation by 2017.

Table 4.2 shows the investment schedule of the power generation expansion program. The schedule indicates that although a large number of projects are considered for implementation during 2013-2017, only a few can be considered sufficiently ready for implementation.

Table 4.2: Schedule of Investments in Developing Power Sector Generation Capacity

Installed Capacity in 2012

Plant Type	Name	Capacity (MW)	Comments
Domestic Hydropower	Ntaruka	11.25	Operational
	Mukungwa	12	To be expanded by 2.5 MW by end-2012.
	Rukarara	9	Rukarara 2 with a capacity of 2 MW is expected to be completed by end-2012.
	Other (including Gihira, Gisenyi, Nkora, Cyimbili	9	Operational
	Keya, Mazimeru Rugezi)		
Micro Hydropower	Various sites	0.7	To be expanded by 1.94 MW by end 2012.
Imported Hydropower	Rusizi 1 (SNEL)	3.5	Operational
	Kabale (Uganda)	1	
	Rusizi2 (SINELAC)	12	
In-house Thermal Power	Jabana (Diesel)	7.8	Installed and utilized during peak periods and other times as needs may arise.
	Jabana (Heavy Fuel Oil)	20	
Rental Thermal Power	Aggreko (Gikondo)	10	
Methane Power	Kibuye Power Pilot (KP1)	4.2	Available capacity is only 1.8 MW. The plant failed to extract a sufficient quantity of methane. KivuWatt plant with a capacity of 25 MW expected for commissioning by end-2012.
Solar Power	Kigali Solar	0.25	Operational
Total	Total installed capacity is 100.64 MW and will reach 132 MW by end-2012		
	Domestic hydro capacity is 42 MW and expected to reach 48 MW by end-2012		
	Regional hydro is 16.5 MW		
	Methane power capacity is 4.2 MW and will reach 29.2 MW by end-2012		

Continued on next page

Table 4.2: Schedule of Investments in Developing Power Sector Generation Capacity
Continued from previous
2013-2017 Investment Program

Hydropower	Additional 275 MW including addition of 130MW to domestic hydro and 147 MW to regional hydro. The 2017 capacity would then consist of 178 MW of domestic and 162 MW of regional hydropower.	There are plans to build more than 50 MW of mini or small hydro projects. Electricity law passed, that among other things, sets Feed-in-Tariffs for hydropower plants of under 10 MW. This is expected to encourage private investments. There are also plans to implement the Rusizi 3 and 4 and Rusumo hydro plants. Feasibility studies of Rusizi 3 and Rusumo have been done but no feasibility study has been carried out for Rusizi 4.
Methane	275 MW including second phase of KivuWatt (75 MW) and further schemes of 200 MW.	KivuWatt 2 with capacity of 75 MW is under consideration but has taken some time to reach financial closure. There are considerations for additional schemes of up to 200 MW but no specific plans have been formulated yet.
Geothermal	310 MW	The expansion is envisaged to start with an initial 10 MW development in Karisimbi to be followed by Karisimbi I and II (each 75 MW), and Gisenyi I and II (each 75 MW). Detailed studies have been done on Karisimbi and drilling of some exploratory wells was expected to start in late 2012. If steam is available a feasibility study will be conducted and a 10 MW plant will be constructed. Based on this experience, development of Karisimbi I and II will then be pursued. The Geothermal Act is being prepared and is expected to facilitate participation of the private sector.
Peat	200 MW	The plan envisages 200 MW by 2017 but currently two projects seem to be moving forward. The first is a public sector plant (15 MW) to be constructed under an EPC arrangement. The second is an IPP with an estimated capacity of 100 MW for which a PPA has been negotiated.

2018-2025 Investment Program

Hydropower	Additional 60 MW of which 43 MW is expected to come from domestic hydro and 17 MW from regional hydro.	The estimates for hydro potential and associated projects are drawn from the Electricity Master Plan but should be considered as preliminary because there is no feasibility study for the corresponding projects.
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Table 4.2: Schedule of Investments in Developing Power Sector Generation Capacity

Continued from previous

Methane	An additional 50 MW is envisioned.	The total potential resource is 350 of which 300 MW is planned for development by 2017. Therefore, only 50 MW remains for development in 2018 to 2025.
Geothermal	An additional 150 MW is envisioned.	Assuming that Karisimbi and Gisenyi fields are fully developed by 2017, the remaining resources are in Kinigi and Bugarama with 180 MW of capacity.
Peat	An additional 100 MW is envisioned.	Assuming that 200 MW of peat resources are developed by 2017, then about 100 MW of resource base remains for development in 2018 to 2025.

Source: Electricity Master Plan (2011); Seven-Year Strategy (2011)

A Possibly Delayed Program

Table 4.2 above indicates the schedule of additions to the generation capacity that are required to meet the objective of the accelerated expansion program. Although the government's objective of expanding the installed generating capacity to 1,160 MW by 2017 should be pursued with full force, it is necessary to examine the impact of potential delays in achieving this objective. The report reviews the technical readiness of various projects based on the availability of feasibility studies, the formulation of the implementation arrangements, and the prospects for financing.

In regard to the hydro project candidates, this review points out that the present investment plan envisages expansion of domestic hydro from 48 MW in 2012 to 178 MW and the regional hydro from 16.5 MW to 162.5 MW during 2013-2017. Both of these targets are difficult to achieve. In particular, from about 130 MW of planned addition to domestic hydropower capacity, at least 45 MW has had insufficient preparatory work, and for the 146 MW addition to regional hydropower resources, some 98 MW (Rusizi 4) lacks detailed feasibility studies.

In the geothermal area, the present plan envisages devel-

opment of 310 MW by 2017 with an initial 10 MW development in Karisimbi to be followed by Karisimbi I and II (each 75 MW), and Gisenyi I and II (each 75 MW). Detailed studies have been done on Karisimbi and drilling of some exploratory wells was expected to start in late 2012. If steam is available a feasibility study will be conducted and a 10 MW plant will be constructed. Based on this experience, development of Karisimbi I and II will then be pursued. While the development of the Karisimbi field seems achievable, the possibility of completing the development of the Gisenyi field by 2017 is difficult to achieve.

For methane-based power, the present plan envisages 300 MW by 2017 that will include the first phase KivuWatt project (25 MW) that was to be commissioned by end-2012, using the experience to formulate the next phase of KivuWatt (75 MW), and preparation of some additional facilities of up to 200 MW. While the second-phase KivuWatt can be achieved, the further developments may not be possible for completion by 2017. In regard to peat-based power capacity, the present plan envisages 200 MW by 2017. At this stage, two projects seem to be moving forward. The first a public sector plant (15 MW) to be constructed under an EPC arrangement. The second is an IPP which is to be

Table 4.3: Accelerated Development Program vs. the Alternative Scenario

	Scenario 1 (Accelerated Development Program)	Scenario 2 (The Delayed Program)
Supply (2017)	Capacity would grow at about 200 MW/year and reach 1,160 MW by 2017 when the installed capacity would consist of: 340 MW of hydropower 310 MW of geothermal power 300 MW of methane-based power 200 MW of peat-based power 20 MW of HFO/diesel	Capacity would grow at about 92 MW/year and reach 595 MW by 2017 when the installed capacity would consist of: 200 MW of hydropower 160 MW of geothermal power 100 MW of methane-based power 115 MW of peat-based power 20 MW of HFO/diesel
Demand (2017)	550 MW of peak demand consisting of: 410 MW of domestic demand 70 MW of miners demand 70 MW of export to neighboring countries	360 – 410 MW of peak demand consisting of: 360 to 410 MW of domestic demand Balanced (net zero) exchange of power with neighboring countries
Supply-Demand (2018-2025)	Growth in installed capacity will slow down after 2017 to an average of 47 MW/year and reach 1,540 MW by 2025 when the installed capacity would consist of: 400 MW of hydropower 460 MW of geothermal power 350 MW of methane-based power 300 MW of peat-based power 20 MW of HFO/diesel	Growth in installed capacity would continue at the rate of about 118 MW/year and reach 1,540 MW by 2025. Therefore the final point of scenario 2 will be the same as Scenario 1 but the trend is smoother The installed capacity of 2025 would basically cater to the domestic demand while the electricity trade with neighboring countries will be a balanced exchange that would serve the mutual interest of the trading parties.

a 100 MW facility for which a PPA has been negotiated.

The preceding assessment review indicates that the projects that are considered technically ready now and could be commissioned by 2017 will provide a total installed capacity of about 595 MW. Other projects in the pipeline would be commissioned in the subsequent years. This raises the importance of technical preparation of the projects in the government's power expansion plan. At the same time, the assessment results in the presentation (Table 4.3) of the main parameters of the delayed program, as an alternative scenario that is worth consideration. Comparing this alternative scenario with the accelerated program, one can make the following observations:

- The supply capacity of the delayed scenario may still be quite sufficient to meet the 2017 domestic demand

which is estimated at 360-410 MW, giving access ratios of 50% and 70% respectively.

- The investment requirements of the accelerated program are concentrated in the 2013-2017 period. Growth in installed capacity will be 160 MW/year during 2013-2017 and slow down after 2017 to an average of 50 MW/year. This heavy concentration of investments imposes serious pressure on implementation and the financing capacity of the power sector. The development scheme of the delayed scenario depicts a smooth pattern with a growth in installed capacity ranging from 75 MW/year to 100 MW/year.

The above two scenarios are considered in the next chapter to assess the investment requirements of the power sector as well as the division of these investments between the public and private sectors.



Chapter 5: Financing Energy Investments

The Financing Needs of the Power Sector

Table 5.1 contains a rough estimate of the power sector's investment requirements separated into two intervals: 2013-2017 and 2018-2025. Under the government's accelerated plan (Scenario 1), the total investment needs of 2013-2017 are estimated at approximately \$4.2 billion, indicating an annual investment of \$845 million. This annual requirement then drops to \$345 million in the 2018-2025, demonstrating the heavy concentration of investments in 2013-2017. As explained earlier there are a number of projects that are not considered technically ready and may be shifted from 2013-2017 to the subsequent years. The investment requirements under the "delayed program" are estimated at \$2.5 billion for 2013-2017, indicating an annual investment need of \$510 million which would then continue at a \$550 million/year in the subsequent years.

The sources of financing would include: electricity tariffs; EWSA's internal resources; government and development partners; and the private sector. In its Seven Year Electricity Development Strategy, the government has indicated its desire that the private sector undertake major generation projects while the public sector will implement transmission and distribution projects. There is substantial uncertainty in this division of investment responsibility since most projects do not yet have a firm implementation arrangement in place. However, the current notional division indicates an average \$200 million/year of investment by the public sector and an average of \$300 million/year of investment by the private sector (Table 5.2). Both of these envisioned requirements present serious challenges in resource mobilization. The remainder of this chapter reviews the challenges in financing the public sector projects while Chapter 6 is devoted to the issues of private investment and finance.

Table 5.1: Investment Requirements of the Power Sector (\$ millions)

Investment Component	Scenario 1: Accelerated Program		Scenario2: Delayed Program	
	2013-2017	2018-2025	2013-2017	2018-2025
Generation				
Domestic Hydro	475	145	312	308
Regional Hydro	300	55	102	253
Geothermal	935	440	482	893
Methane	900	160	300	760
Peat	615	320	353	582
Total	3,225	1,120	1,549	2,796
Transmission	150	250	150	250
Distribution				
Urban Distribution	150	350	150	350
Rural Electrification	700	1,050	700	1,050
Total	850	1,400	850	1,400
Grand Total	4,225	2,770	2,549	4,446
Annual investment	\$845 million/year	\$345 million/year	\$510 million/year	\$555 million/year

Source: Electricity Master Plan (2011); Seven-Year Strategy (2011)

Table 5.2 Financing Requirements of the Power Sector by Public and Private Sectors

Year	Investment Requirements (\$million)				Investment Requirements (\$million)		
	Generation	Transmission	Distribution	Total	Public Sector	Private Sector	Total
	2013	200	35	150	385	200	185
2014	250	35	150	435	200	235	435
2015	300	30	150	480	200	280	480
2016	350	20	200	570	240	330	570
2017	449	30	200	679	260	419	679
Total: 2013-2017	1,549	150	850	2,549	1,100	1,449	2,549
Total: 2018- 2025	2,796	250	1,400	4,446	1,946	2,500	4,446

Source: Electricity Master Plan (2011); Seven Year Electricity Development Strategy (2011)

Past, Current and Prospective Sources of Finance

The government plans to optimize the financing of energy sector investments by striking a balance between the use of domestic fiscal resources and external financing. At the same time the government intends to seek financial instruments that would minimize government guarantee and contingent liability. Accordingly, the government has established a process for preparing a comprehensive and a credible power sector financing plan jointly with sector institutions, and development partners within the energy Sector Working Group (SWG).

An important focal point of the past financing efforts is the process of mobilizing resources for the Electricity Access

Roll-out Program (EARP) 2009-2013. It was initiated with the preparation of a draft Prospectus in late 2008 and continued until mid-2009, working with the energy SWG, EWSA (RECO at that time) and the key senior officials and decision-makers from the Ministries of Infrastructure, Finance, and other sector institutions. Workshops were held along the way to build ownership among the diverse group of stakeholders. The prospectus was then presented to the Donor Financing Round Table in March 2009. The prospectus had a clear description of the EARP's target: increasing the number of electricity connections from 110,000 to 350,000 by 2012 with a special emphasis on connecting social infrastructure - health facilities, schools and administrative offices. The prospectus also included a clear picture of investment requirements, implementation and financing arrangements.

Box 5.1 Summary of Pledges by the Development Partners for Funding EARP

New Pledges as at 23/3/2009:

African Development Bank: \$30 million
Arab Bank for Economic Development in Africa (BADEA): \$10 million
Government of the Netherlands: \$45 million
JICA: \$25 million
OPEC Fund for International Development (OFID): \$10 million
Saudi Fund: \$10 million
World Bank GEF/ESMAP/ CEIF: \$8.3 million
World Bank IDA: \$70 million
Total New Pledged Funding: \$208.3 million

Existing Funds

Existing funding was already available in the amount of \$35 million from the government, Belgium, European Union (EU), and Netherlands.

Internal Funding:

Beneficiary Contributions (Consumers' direct payments): \$27 million
EWSA (then RECO) internal cash: \$27 million
Government Counterpart Funding: \$40 million
Total funding mobilized: \$337.3 million
Total funding required: \$378 million

The total cost of EARP for the 2009-2013 was estimated at \$378 million, of which about \$284 million was allocated to the grid-connected component of electrification and \$94 million to off-grid electrification. Although the bulk of resources were considered for physical projects, some \$29 million was allocated to technical assistance to the power utility and the MININFRA, which turned out to be critical in developing the relevant capacities for project preparation, implementation and monitoring.

The main principle adopted for financing of the EARP investments was an "80-10-10" shared financing policy. Under this policy, 80% of the capital requirements for the first five-year grid program (excluding technical assistance) would be sourced from the government and the development partners; 10% from the utility's retained earnings, and 10% from customer connection charges. The utility covered all operating costs while the off-grid connections costs and

technical assistance were to be financed by the development partners. It is also noted that under this arrangement, the government was to lend (or onward-lend in case of borrowed funds from donors) the 80% of investment needs to the utility as an interest-free loan with a 5-year grace period and 20 years' repayment. These repayment terms are expected to enhance EWSA's financial performance in particular due to the absence of debt-service obligations in the initial years.

The EARP prospectus and the proposed financing scheme were endorsed at the Donor Financing Round Table of March 23, 2009, when a pledging session was also held at which donors announced their intended contributions as summarized in Table 5.3.

In addition to the above harmonized financing plan, the power sector received some major activity-specific financing

from various donors during 2009-2012, mostly in support of renewable energy development. These included:

1. The European Union provided support in the amount of 50 million Euros to equip around 350 schools, hospitals and district offices with PV systems, as well as to build about 3 MW of capacity of micro-hydroelectricity plants in various sites to serve up to 70 villages
2. Belgian Technical Cooperation (BTC) that has provided support in rural electrification including solar PV energy to health centers and rural hospitals, and construction of small hydro projects. BTC's contribution was about \$22 million
3. Gesellschaft für Technische Zusammenarbeit (GTZ) (now GIZ) has provided financial and technical support in the areas of micro-hydro and biogas development. In particular, it supported and financed the Private Sector Micro-hydro Power Supply (PSP Hydro) for Rural Development that builds local capacity in the private sector to commission micro-hydro plants. It gives responsibility to Rwandan private companies to do the design work, procure the equipment and services and install the plant. The same companies will then construct and operate local grids that deliver electricity to nearby rural areas
4. United Nations Industrial Development Organization (UNIDO) has partnered with the government in building three micro hydropower plants; Nyamyotsi II, Mutobo and Agatobwe. These plants provide electricity to households as well as emerging small- and medium-size enterprises
5. United States Agency for International Development (USAID) manages the President's Emergency Project For Aids Relief (PEPFAR) program, which considers energy supply to health centers a major bottleneck in the delivery of quality health services. Therefore, USAID's involvement in the energy sector is indirect and in the area of technical assistance and specific strategies focused on providing electricity to the health centers

Although the energy sector has benefited from all the above assistance, GIZ's approach to providing financial support is worth consideration due to its emphasis on developing local skills and capacity. Under the PSP Hydro program, six contracts were awarded to six Rwandan companies to build and operate six micro-hydro plants with capacities of 100-500 kW. The contracts provide up to 50% (both financial and technical) upfront subsidy, also an efficient way of encouraging private operators to carry out projects that are socially attractive but would need financial subsidy to cover their viability gap.

The financial aspects of micro-hydro plants are indeed a challenging issue for Rwanda. There have been a number of donors involved in this area. The past projects included: the three UNIDO sites, five sites under the BTC support with a total capacity of 5.15 MW, six sites developed under a Public Private Partnership scheme, financed by the Dutch government and with the assistance of GIZ, with total capacity of 1.6 MW, and various projects supported by the EU with a total capacity of 3 MW. The sustainability of a future micro-hydro program would be dependent on the country's ability to transit from government- and donor-driven projects toward a model led by the private-sector.

In this regard the GIZ project has initiated a model for private sector-driven approach that relies on local investors. As mentioned before, the GIZ schemes relied on up to a 50% investment subsidy with significant technical backup and coordination by the GIZ office. The future schemes are expected to rely on smaller subsidies and greater use of commercial financing through the local banking sector. Involvement of local investors and local banks represents an important step toward developing domestic financing capacity. However, given the resource requirements for the larger energy projects, foreign investors and foreign banks should be also considered (see Chapter 6).

The Role of Development Partners

International donors consider Rwanda as a model part-

ner that uses external development assistance effectively. Several development partners including 12 bilaterals, 3 multilaterals and about 16 UN agencies are active in Rwanda. The government has tried to bring the donor funds within a unified framework and to establish some predictability of available resources. Presently, some donors - the African Development Bank (AfDB), the World Bank (IDA), the European Union (EU), Germany, the Netherlands and the United Kingdom - provide general budget and/or sector support. Budget support is provided in accordance with the provisions of a 2008 Memorandum of Understanding (MoU) between the government and seven development partners. This MoU established the principle of joint monitoring of policy actions and expected outcomes through the Common Performance Assessment Framework (CPAF). Since the signing of the MoU, all budget support donors rely on the CPAF to design and monitor their budget support programs. The budgetary support is in both loan and grants form and has remained at around 6% of GDP during 2009-2012. The budget support donors try to provide, to the extent possible, annual commitments in time for the national budget formulation process and monthly disbursement plans.

In addition, the government agreed with development partners in July 2010 on a Division of Labor (DoL). This DoL maps donors to various sectors while limiting each donor to participate only in three sectors. As mentioned earlier, the donors active in the energy sector are: World Bank, AfDB, Arab Bank for Economic Development in Africa (BADEA), UNIDO, Cooperative Technique Belge (CTB), Netherlands, France, Japanese International Cooperation Agency (JICA) and Société Tunisienne de l'Electricité et du Gaz (STEG International).

Going forward, the role of development partners in the energy sector will be important in: (a) partnership with the government to support public sector projects including transmission, distribution and some generation investments (b) partnership with and assistance to the private sector in undertaking large power generation projects. The public sector electricity investments are estimated at \$1.1 billion during 2013-2017 and financed by the government and the development partners. The contribution from each

development partner should be reviewed and confirmed in a systematic manner. The government should organize a roundtable of development partners to seek pledges for financing the public sector share of power sector investments. The experience of EARP that was described in the preceding section provides lessons that could be used to inform the organization of this roundtable. The role of development partners in supporting private-sector investments is also essential especially given the nascent stage of private sector involvement. While the development partners' direct funding (grants and loans) to the private sector would be important, development partners can play an instrumental role in mitigation of technical and political risks. The specific areas for development partner support in this regard are discussed in Chapter 6.

Electricity Tariffs and Subsidies

Electricity tariffs represent the main parameters of the power sector's revenue and thereby financial viability. The electricity tariff is presently set at a flat rate of 134 RwF/kWh for residential and commercial consumers. Industrial customers are subject to a time-of-use tariff of 168 RwF/kWh for peak hours, 126 RwF/kWh for intermediate-load hours and 96 RwF/kWh for the off-peak hours.

The economic basis of setting electricity tariffs relates to two principles – efficiency of resource allocation as indicated by the long-run marginal cost (LRMC) of power supply, and financial performance of the utility as indicated by its average revenue requirements. The analysis of the Electricity Master Plan indicates a LRMC of around 100 RwF/kWh and an average revenue requirement of 90-100 RwF/kWh for high-voltage customers and 150-200 RwF/kWh for low-voltage consumers. A recent study (June 2012) by Economic Consulting Associates that was carried out on behalf of the Rwanda Utilities Regulatory Agency (RURA) arrives at similar numbers (LRMC ranging from 76 RwF/kWh for large industrial consumers to 124/kWh for residential customers).

Therefore, the fundamental measures of tariff setting indicate that the present flat tariffs are not far from appropriate for commercial and industrial consumers although they require some upward adjustment in the case of residential

consumers. With or without such adjustments, the power sector will experience a shortfall in revenue and cash flow requirements in the short to medium-term. Under normal circumstances such a shortfall could be met by the utility's borrowing from external and domestic markets. However, EWSA does not yet have an established creditworthiness to do so. It is therefore necessary to continue the support from development partners and the government to enable EWSA to meet the cash flow requirements of 2013-2017 while this support can be gradually curtailed afterwards.

Subsidy to the power sector comes from government resources or international donors' contributions. The flow of subsidies has been made transparent by: (a) consolidating all the flows within the government budget (b) separating the subsidies toward operational expenditures from those related to investment costs. The operational cost subsidies are included appropriately in the government's current budget and cover three categories of expenditures:

1. Payments for the rental diesel generation plants - Aggreko Unit 1 (10 MW) and Aggreko Unit 2 (5 MW), which is set at \$400/kW/year. This subsidy of about \$6 million/year was a heavy burden on the government's budget during the past 6 years but is not expected to continue in the future because there will be no need for these emergency units. The 20 MW Jabana HFO plant has replaced the rental units
2. Payments for fuel imports by the government for Aggreko Unit 2 (5 MW) comprised the actual cost of fuel, i.e., purchase price, as well as transportation and distribution charges. The amount of subsidy varied substantially depending on the fuel consumption and fluctuation of the price of diesel oil. Again, this component of subsidy is not expected to continue in the future. The cost of HFO that is required for the Jabana plant is expected to be covered by EWSA
3. Payments for taxes related to some power sector expenses, e.g., charges on fuel imports and charges on the import of energy-efficient lamps. There are three

types of taxes – concession fees, custom duties and value-added tax (VAT). However, the application of these taxes has not been uniform. For example, the Aggreko units are charged VAT, but do not pay duty while the Jabana diesel imports are not charged duty or VAT. The present taxes on imported diesel and HFO include: an import duty equal to 30% of the CIF cost for diesel and 5% of CIF cost for HFO; and a VAT of 18% of total delivered cost for each fuel. Further, the government has paid in the past and is expected to pay in the future the taxes applied to the import of energy efficient compact fluorescent light (CFL) bulbs.

Power sector investment subsidies are classified as part of the government's development expenditures. They include funds coming from the government as well as external funding normally provided by the development partners in the form of grants or soft loans. The investment subsidies have in the past provided the capital cost of the electricity access program as well as improvements in technical and institutional efficiencies. While more than 95% of subsidies have been spent on capital investments, some small amounts were spent on network loss reduction and CFL bulb distribution. There is also a small development expenditure item related to strengthening governance and institutional capacity, such as developing the legal and regulatory framework and procurement processes.

Looking into the future, subsidies to the power sector should become more focused on upstream investment support and decline over time as EWSA becomes a self-sufficient utility.

EWSA's Financial Sustainability

Transforming EWSA into a self-sufficient utility would necessitate transition into a credible entity that is capable of corporate borrowing from commercial sources (banks and possibly via issuance of bonds to be sold to domestic investors.) The sector restructuring roadmap presented in this report (Chapter 7) recommends that this process should

entail three major steps. First, within its current structure EWSA should ensure a transparent performance of each segment of the supply chain by separating the financial accounts of various business units including: generation, transmission, and core services. Second, EWSA should be converted to a corporation that could eventually become an independent (fully government-owned) company with the ability to borrow on its own account. Third, EWSA should gradually improve its creditworthiness. The financial projections of the Electricity Master Plan indicate that the present cost recovery strategy, i.e., that electricity tariffs cover O&M costs until 2017 and capital and O&M afterwards, is expected to enable EWSA to meet its financial obligations in the medium to long term. However, it is necessary to

examine the functional structure of EWSA, establish appropriate utility benchmarks and review its legal framework. In this regard, it is recommended that the government arrange for a management audit of EWSA to review the present organizational structure to inform recommendations and actions required to transform the utility into a creditworthy borrower. The audit can be done by a consulting firm or a credit rating agency. In either case, these firms have a tangible and specific process of assessing the likelihood of default by EWSA, and identifying the factors of concern on which EWSA and the government would need to concentrate. Findings from such audits usually cover the required legal and institutional actions that an entity needs to take to gradually become a creditworthy borrower.



Chapter 6: Options for Financing Private Sector Energy Projects

Preparation of Private Sector Projects

Preparation of a financeable energy project will require striking a balance among the following three components of the project structure:

- **Ownership structure.** The shareholding of the project interest could be purely private, purely public or some combination of both. It should be suited to the nature of the project and also to the ability of various shareholders to contribute to the successful implementation and operation of the corresponding facilities. The ownership structure is often adjusted through the course of project preparation in response to various constraints and requirements.
- **Financial structure.** The first decision in structuring the financial package is the portion of the project cost that should be funded in the form of equity; the rest will be project debt⁹. For energy projects, equity varies between 20 and 40% of the project cost. Clearly, a higher equity ratio means a higher commitment by project sponsors and a lower risk for lenders. Thus, lenders like to see high equity ratios, whereas sponsors prefer lower ratios in order to minimize the funds they lock into one project. The acceptable equity ratio depends on the creditworthiness of the sponsors, the risks and the location of the project.
- **Security Package.** Identification, analysis, allocation and mitigation of project risks are essential to structuring a project finance package. These risks are related to events that could endanger the project during development, construction and operation¹⁰. Ideally, the security

package should protect the project against all significant risks. In particular, measures intended to manage risks are designed to convince financiers that: (i) Costs will not exceed the projected levels, and, if they do, some other party will take the burden before the cost increase affects the financing of the project (ii) Revenues will not fall short of projected levels, and, if they do, some other party will make up the shortfall so that project finances are not hurt and (iii) the investment is safe and returns can be transferred out of the country, or, if funds cannot be transferred, a credible agency will cover legitimate losses due to the non-transferability.

The balance among the above three components of a project structure is a very delicate matter in the case of energy projects in Rwanda. Preparation of project structure may go through several iterations before one can get the right sponsors who will be willing and able to bring in financial resources while providing a comparative advantage in construction and operation.

Lessons from Financing of the KivuWatt Project

The power sector development plan is dependent on private sector investments for at least \$1.5 billion for the next 5 years. Mobilizing such private investment of such a magnitude is totally unprecedented. The main experience in this regard can be drawn from the formulation of the KivuWatt project. This project is presently under implementation with the goal of developing Phase I (25MW) of the Lake Kivu integrated-methane gas extraction and power production facility. The

9 Equity refers to funds put into the project company by shareholders of the company. Equity holders are owners of the company, and they receive dividends and capital gains based on net profits. Equity holders take risk; they would receive no dividend payments if the company lost money. Debt refers to funds lent to the project company by financiers such as commercial banks, insurance and pension funds and multilateral institutions. These loans are secured by the project's underlying assets. Lenders receive payments for principal and interest on these loans whether the company makes or loses money.

10 At the stage of project development, the main risk is rejection by the government or financiers. At this stage, risks are high but involve relatively small losses. These risks are borne primarily by project

sponsors. During construction, the main risk is failure to complete the project with acceptable performance levels and within an acceptable timeframe and budget. This risk falls mainly on the project company and its sponsors. They in turn hedge their risk by purchasing various forms of insurance and obtaining guarantees from contractors (often in the form of engineering, procurement and construction – EPC – contracts) regarding costs, completion schedule and operational performance of the project. Operational risk is that the plant may not run on a continuing basis within acceptable economic and technical parameters. These risks are borne by the project company. However, a project company can hedge against the risks through contractual and guarantee arrangements that in effect transfer some of them to other parties.

project cost is about \$128 million. The project sponsor is a private company - Contour Global, which provided \$35.7 million in equity while attracting the Netherlands Development Finance Company (FMO) to contribute \$8.9 million in equity. The remaining \$83 million was mobilized as borrowing from AfDB's private sector arm, the Emerging Africa Infrastructure Fund (EAIF); Belgian Investment Company for Developing Countries (BIO); Netherlands Development Finance Company (FMO); and the European Financing Partners (EFP). In effect, the project, even though a private power plant, has been able to fund about 72% of the project cost from multilateral and bilateral entities that entered it for the purpose of helping Rwanda's development rather than financial gain. The specific point to note here is that the KivuWatt project does not borrow from commercial lenders.

The forthcoming private projects are expected to be of a considerably larger scale than the KivuWatt project. The investment requirement in each of the geothermal, methane or peat-based power plants is expected to be \$400 million and upwards. A private investor typically contributes 25% to 30% of the project cost as equity. The investor would then need to finance the rest of the cost through borrowing from various sources. The presently engaged development partners may provide only a small amount of such borrowing. The private investor is also likely to explore the possibility of assistance from other development partners (China, India, Turkey, Korea, Brazil, etc). However, in all likelihood, the private investor will have to tap into commercial sources of finance. The experience in other countries indicates that mobilization of commercial finance is a long and complex process for the initial projects. The government can play a significant role in enabling commercial borrowing by private investors by formulating certain international guarantee instruments that would have minimum impact on the government contingent liabilities (see the section on Partial Risk Guarantees later in this chapter).

The contractual arrangements of the KivuWatt project are also of interest to potential private investors. The KivuWatt project

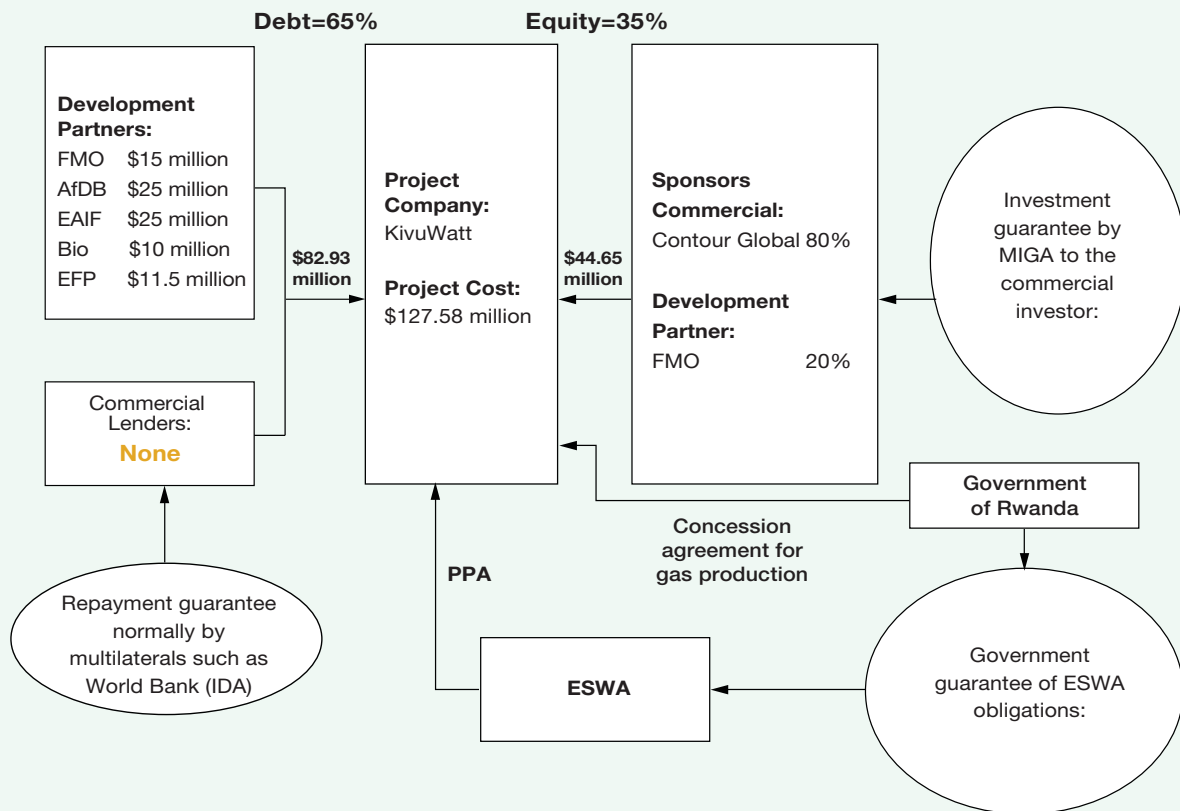
is governed by a 25-year Gas Concession Agreement (GCA) with the Government of Rwanda (GoR) and a co-terminating 25-year Power Purchase Agreement (PPA) with EWSA. The tariff is composed of: (1) a capacity payment based on net capacity and (2) an energy payment based on delivered power. The capacity payment includes capacity charges for both the power plant and the gas extraction facility (GEF) plus fixed O&M charges for both the power plant and GEF. The energy payment is based on monthly delivered power and represents approximately 5% of the total revenue. The tariff is denominated in USD and paid in RWF, with a quarterly currency true-up mechanism. There is a plan to implement Phase II of the project that would include an expansion of the facilities to produce an additional 75 MW of power. Upon Phase II completion, the all-in base tariff payment will reduce to USD 0.1063/kWh. Tariffs will be adjusted for inflation as indicated in the PPA.

The KivuWatt project structure (Figure 6.1) also indicates the risk mitigation instruments that are often required to encourage private sector investment. The project sponsor assumed significant technical risks since there were substantial uncertainties in the methane extraction process. However, the presence of political risk often deters private-sector participation in large energy projects. The limitation relates partly to the concerns of investors and partly to those of commercial lenders. The investor normally requires a guarantee of the obligation of the utility to pay for the electricity off-take as well as political risk insurance to private investors. The investor in the KivuWatt project has received both of these protections through a government letter of comfort and a MIGA guarantee. The commercial lender normally requires a guarantee for repayment of the loan in the event of a default by the private company. The KivuWatt project did not entail such an instrument because it did not borrow from commercial lenders.

Lessons from the Recent Private Sector Development Project in Kenya

The recent case of financing power sector investment in Kenya provides an important example of innovative financ-

Figure 6.1: Project Structure of KivuWatt Methane-Based Power Plant (25 MW)



EAIF: Emerging Africa Infrastructure Fund; BIO: Belgian Investment Company for Developing Countries; FMO: Netherlands Development Finance Company; EFP: European Financing Partners.

ing of private power. The challenges facing the power sector in Kenya are similar to those in Rwanda. Kenya is hard-pressed to finance such major infrastructure investments. The country's Vision 2030 aims at scaling up access to electricity from 20% in 2011 to 40% by 2030 which requires a tenfold increase in the generation capacity from 1,400 MW in 2011 to 11,000 MW in 2030. Kenya plans to add new generation capacity of about 2,000 MW in the next 5 years via public as well as private investment. Over the next 12 - 18 months, the Kenya Power and Lighting Company (KPLC) expects to contract over 600 MW of new generation capacity (including geothermal, wind and thermal power) through IPPs with financing requirements of almost \$1 billion. Mobilizing the resources needed to finance these investments over a short time period was the key challenge for the government and the utility. The traditional security package offered to IPPs by KPLC was not considered sufficient by investors due to their perception of high political risk. The

Kenyan government asked the World Bank for assistance in identifying a suitable solution.

Subsequent to the above request, the World Bank Group prepared and approved a project in April 2012 which aimed at enabling the private sector and the Kenyan government to work together to mobilize financing from commercial sources. There were two unprecedented features in this operation. First the World Bank Group including the International Development Association (IDA), the International Finance Corporation (IFC) and the Multilateral Investment Guarantee Agency (MIGA) provided a combination of support including MIGA investment insurance, IFC commercial loans and IDA partial risk guarantees (PRG). MIGA provided a political risk guarantee to the investors. IFC stepped in to provide long-term financing for two of the four IPPs, funding generally unavailable for long-term infrastructure projects. Moreover, IFC's engagement reassured

and supported South-South investors with an appetite for investments in Africa but with relatively limited structuring and project implementation ability. Second, the IDA guarantee was structured in the form of a “Program PRG” covering four IPPs. The total PRG amounted to \$166 million and was put in place to reassure commercial financiers concerned about the state-owned electricity utility and its obligations to them. An attractive feature of this PRG program is that it covers four private sector power projects. Such a programmatic approach would enable project sponsors to avoid a case-by-case application that would clearly save substantial transaction time and expenses.

Extending the Search for Financiers and Investors

Assessment of Rwanda’s energy project pipeline and potential energy resources reveals that several power plants will require funding amounts in excess of the current investment in Phase 1 of the KivuWatt project. The KivuWatt model provides a good starting point for structuring the future projects. However, the project sponsors would need to widen the search for sources of finance. Multilateral development institutions, which were traditionally supporters of state entities, have now introduced a variety of facilities to assist private sector investment and finance. The two important players are AfDB and the International Finance Corporation (IFC). Participation by IFC and AfDB in a private power project provides comfort for other financiers to come into the project. IFC and AfDB can often help with project preparation and effective advice about structuring a financeable energy project.

Bilateral sources of finance are numerous. Today, all OECD countries and some emerging economies—such as Korea, China, India, and Brazil—provide concessional financing for private (and even public) construction of power facilities. Often their main mandate is to promote exports of goods and services from their own countries, and overseas investments by their nationals. However, when it comes to low-income countries such as Rwanda, these bilateral sources

of finance pursue also a development support role. Their financing is provided either as a loan to the purchaser of the equipment or as a credit to the supplier. The loan can be made directly by the bilateral agency to either party or through a financial intermediary, such as a commercial bank. In addition, most bilateral agencies provide insurance and guarantees to cover 85-95 % of losses caused by commercial risks and 100 % of losses caused by political events.

Most bilateral financiers are already involved in Rwanda though may not be in the group that presently focuses on the energy sector. However, these agencies can be approached by the private project sponsors because each bilateral entity has a variety of vehicles which could fit Rwanda’s projects. Table 6.1 provides a summary description of the bilateral programs that may be of potential interest to private investors in Rwanda’s power sector.

The Option of Public-Private Partnership (PPP) for Financing Power Projects

The concept of PPP was initially considered to indicate joint participation of a private and public entity in the shareholding of a company. However, the concept has over time broadened to indicate any type of long-term contracts between the public and private sectors for construction and operation of infrastructure facilities. With this wider definition, PPP could mean: (i) joint shareholding by public and private investors in a project (ii) public contribution to debt (iii) subsidized purchase of output and (iv) public purchase of the output. Thus almost all private sector investments in the power sector are considered as PPP.

There are now numerous examples of PPP projects in the power sector from many developing countries. The cases of India and China have attracted substantial attention due to the specific strategy that each country has used to promote PPPs and the sheer magnitude of the PPP ventures. The specific features of India’s PPP agenda include: (i) introduction of a Viability Gap Fund (financed by the government)

Table 6.1: Information about Bilateral Development Partners with Potential Interest in Supporting Private Sector Investment in Rwanda's Power Sector

Country	Main Programs of Bilateral Assistance
United States	The U.S is the largest provider of assistance to developing countries. Its main agencies are the U.S. Agency for International Development (USAID), U.S. Export-Import Bank (US Exim), Overseas Private Investment Corporation (OPIC), and the U.S. Trade and Development Agency (TDA). USAID has numerous support programs, many of which cover energy projects, studies and other types of assistance requirements. A special Private Sector Energy Development Program (PSED) promotes private sector solutions to energy development issues. The TDA provides grants for feasibility studies for proposed projects in developing countries. US Exim provides loans and loan guarantees for procurement of U.S. goods and services. OPIC provides loans, guarantees, insurance and equity to ventures involving significant capital and management participation by American companies.
Canada	Canada's development assistance program is channeled through the Canadian International Development Agency (CIDA) and has a special focus on Africa. Canada was the first G8 nation to establish a fund especially for Africa, which now has \$500 million. CIDA has many bilateral programs focused on energy efficiency and clean energy. A Petroleum and Natural Gas Regulatory Assistance project is aimed at increasing the use of natural gas, and the Canada Climate Development Fund has a focus on reducing emissions. Export Development Corporation (EDC) provides export credit and has special interest in the power sector.
Japan	Japan is the second-largest provider of assistance to developing countries. The proportion of Japanese loans to the energy sector has increased very sharply in the last two decades and now represents nearly 50% of the overall volume. The philosophy of the development assistance is to avail Japan's surplus funds to less developed countries. The main vehicles for Japanese assistance are the Japan Bank for International Cooperation (JBIC), and the Japan International Cooperation Agency (JICA). However, the Ministry of Foreign Affairs of Japan (MOFA) is officially the first point of entry and receives requests for grants and loans. JBIC will then appraise the application based on economic, social, technical and environmental concerns. Financial support for pre-investment studies, training and other types of technical assistance is provided by JICA and JBIC. Export support is provided through the International Financial Operations division of JBIC.
Germany	The German development assistance program aims to increase its support to Africa. The program is implemented through: the Technical Assistance Corporation: "Deutsche Gesellschaft für Internationale Zusammenarbeit " (GIZ which was formed last year by combining GTZ with other relevant German agencies), the Kreditanstalt für Wiederaufbau (KfW), which provides financing tied to procurement from German firms as well as export credits, and Deutsche Investitions-und Entwicklungsgesellschaft, which is a member of the KfW Bankengruppe that promotes the private sector by providing loans and making equity investments. It also provides technical assistance to German firms making investments in the developing world. Financial assistance is available from KfW or directly from Germany's federal budget to support private investment in developing countries. German aid programs emphasize transfer of technology.
Netherlands	Netherlands' development assistance program is considered to be most generous and strongly focuses on the eradication of poverty. The program has a special focus on energy which is administered by The Climate, Energy, and Environmental Technology Division. It is very supportive of renewable energies, energy efficiency, and rural energy in Africa.
France	France's development assistance is the fourth largest in the world. Agence Française de Développement (AFD) previously known as the French Development Fund (CFD) is the principal implementing agency for French ODA. Top recipients are the Francophone countries but it is also supportive of other Sub-Saharan countries particularly in the power sector and renewable energy and energy efficiency areas. Export credit support is provided through the Compagnie Française d'Assurance pour le Commerce Extérieur (COFACE)
United Kingdom	The UK provides development assistance through the Department for International Development (DFID) that is responsible for managing British aid. The predecessor to this department was the Overseas Development Administration (ODA). The Capital for Development (CDC, formerly known as Commonwealth Development Corporation) is responsible for creation of businesses in poorer countries. CDC's investments have mainly been contracted to Actis which maintains the overseas staff and offices formerly belonging to the Commonwealth Development Corporation. Actis is very active in the power sector while mostly focused on Sub-Saharan Africa and South Asia. The UK's official export credit agency is the Export Credit Guarantee Department (ECGD) which provides insurance against non-commercial risks.
Italy	Italy's development assistance program is implemented by the Directorate General for Development Cooperation (DGCS) of the Ministry of Foreign Affairs and has a strong commitment to good governance and human rights with heavy emphasis on Sub-Saharan Africa. Insurance for export credits against political and commercial risks is provided for export credits by the Sezione Speciale per l'Assicurazione del Credito all'Esportazione (SACE).

Continued on next page

Country	Main Programs of Bilateral Assistance
<i>Continued from previous</i>	
Sweden	Sweden bases its development assistance program on the philosophy of solidarity with the less privileged with main emphasis on Africa. The Swedish International Development Authority (SIDA) handles most of the assistance program and also provides export credit while guarantees are provided by the Swedish Exports Credits Guarantee Board (EKN). Both agencies have strong interest in supporting energy projects.
Swiss	Swiss aid is managed by two agencies, the Swiss Agency for Development and Co-operation (SDC) and the State Secretariat for Economic Affairs (SECO). The Export Risk Guarantee Agency (ERG) is the official credit agency in Switzerland. However, concessional funds are also made available for export credit, administered through the Federal Office of Foreign Economic Affairs. Swiss aid focuses on the low-income developing countries in support of both public and private sector projects.
China	China still receives a significant amount of development assistance particularly from Japan. However, it also provides aid to other countries. Most of the aid has been directed to Africa. The objective of the aid was initially to support the export of Chinese goods and services and establish good relations with certain governments. However, as China is taking center stage in the international economic environment, it is also taking more responsibility to assist the development efforts of low-income countries. The Chinese Export-Import Bank (Exim Bank), established in 1994, is the third-largest export credit agency in the World. Exim Bank provides export credits, guarantees and concessional loans. It is particularly active in the energy sector, extending credit lines to China's national oil companies for exploration and development. Involvement in some countries has been linked to securing oil supplies for China. However, China appears to be pursuing win-win opportunities in a broader sense. It is estimated that presently China is involved in more than 1,000 projects in Africa where Chinese firms bring in their strong implementation capacity as well as financial support from the Exim Bank.
Korea	Korea has established an Economic Development Cooperation Fund (EDCF) as its bilateral ODA program with the aim of building economic relationships. Agencies involved in bilateral assistance are: the Korea International Cooperation Agency (KOICA), which handles bilateral grants, and the Export and Import Bank of Korea (KEXIM) that manages the EDCF. The Korea Export Insurance Corporation (KEIC) is the official Export Credit Agency (ECA) of Korea.

that will provide up to 20% of project cost in order to make a desirable project financially viable for undertaking by the private sector (ii) establishment of a Project Development Fund that would finance feasibility studies and all the project preparation work prior to presenting the project to the potential private companies (iii) developing institutions and capacities for PPPs in central agencies and state governments and (iv) launching a widespread training effort informed by needs assessments. The PPP program in India was initiated in 2005-2006 and became successful to the point that payments from the Viability Gap Fund (up to 20% of project cost) became less necessary. However, the benefit of project preparation and institutional capacity development has been recognized as key to the success of the PPP agenda.

China's PPP experience is extensively intertwined with the economic and management structure of the government and the country. The successes of China in the energy sector are enormous – from gains in energy efficiency to installation of 1,000 GW of power capacity and becoming the largest producer of wind power equipment in less than 5 years. In every area, this accomplishment is through a shared agenda between the public and private sector. The most distinct aspect is that the government presents in a very clear manner the strategy and incentives, and the private sector invests and develops the facilities at an internationally unprecedented speed.

Although the experience of China and India are fascinating,

one should perhaps draw lessons from the PPP ventures more similar to the potential projects in Rwanda. A rather famous example of a PPP venture that fits the profile is the Bujagali Hydropower Project in Uganda. The financial structure of this project underscores the limitations of the KivuWatt project structure. More specifically, it is evident that additional contractual requirements and risk mitigation instruments are critical when borrowing from commercial sources for a large-scale project.

The Bujagali project is a 250 MW (run-of-river) scheme on the Nile River at Dumbbell Island in Uganda. The project was under consideration as a public sector project for a long time. Almost every involved party admired the technical attractiveness of the project but financing about \$800 million for a Ugandan public utility did not appear forthcoming. The project was then formulated as a PPP venture in 2005-2006 and reached financial closure in 2007. A project company – Bujagali Energy Limited – was created and signed a 30-year power purchase agreement with the Uganda Electricity Transmission Company.

The project's financial structure demonstrates a case in which project sponsors are able to bring in donor funds as well as commercial resources into a large energy project in a country with weak creditworthiness and substantial perceived risks. The shareholders are the government of Uganda, a subsidiary of the Aga Khan Fund for Economic Development (AKFED) and a private company - Sithe Global World Power Holding. The lenders include multilateral development banks (AfDB and IFC), European Development Finance Industries DEG (Germany), KfW (Germany), and FMO (Netherlands) while the commercial lenders include Absa Capital (South Africa) and Standard Chartered Bank (UK). As expected, commercial lenders entered the project with a loan repayment guarantee by the World Bank (IDA) and Sithe Global entered into the project with an investment guarantee from MIGA.

The contractual arrangements of this project cover almost all aspects of a typical PPP venture. As shown in Figure 6.2, these contractual arrangements include:

1. Project implementation agreement (concession given

by the government to the project company)

2. Power purchase agreement (PPA) between the project company and the utility
3. Government guarantee of the utility obligations under the PPA
4. MIGA guarantee of private investor
5. Equity contribution agreement among the public and private sector
6. Government counter-guarantee of the IDA guarantee
7. IDA guarantee of loan repayment to the commercial lenders
8. Individual loan agreements and common terms agreement
9. EPC contract to mitigate the risks of construction delay and cost overruns
10. O&M contract to mitigate the operational risks

Lessons for Rwanda

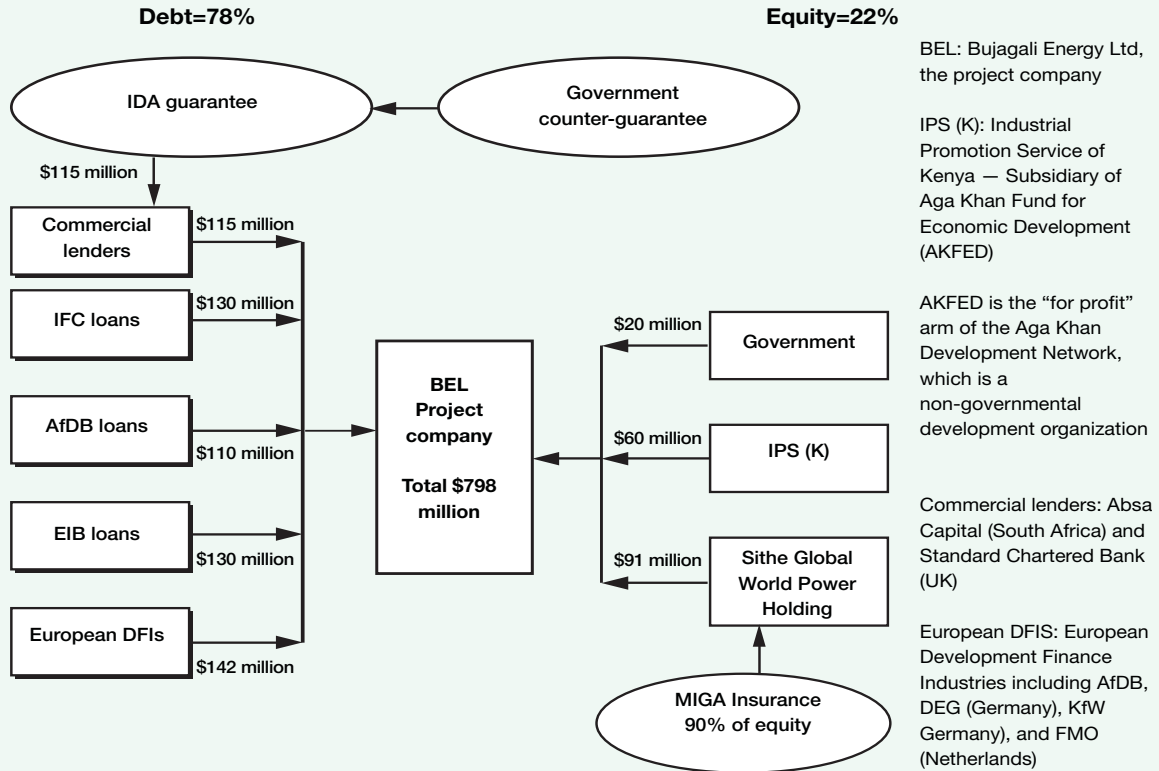
The above examples and more generally, the international experience offer many lessons for successful implementation of PPPs in Rwanda. These lessons fall into three main categories: (i) what business conditions should be created to encourage private sector participation (ii) what procedures should be followed to launch and implement a PPP venture and (iii) what institutional capacity should be developed to handle the PPP process.

Creating an Energy Efficiency and Development Fund (EEDF).

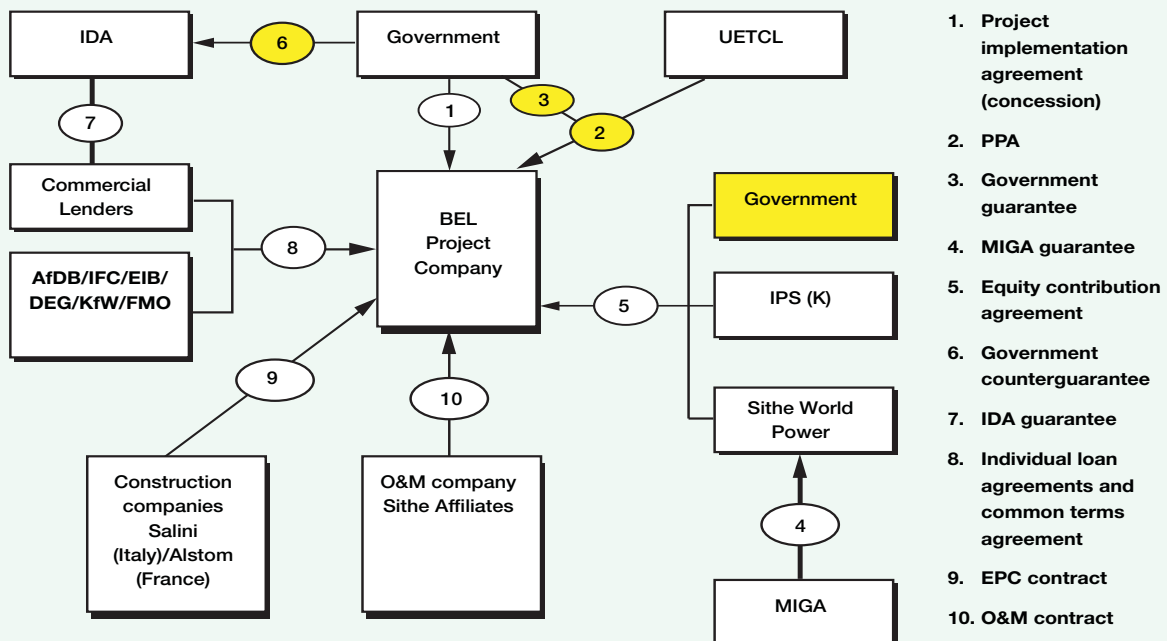
Business conditions conducive to private sector participation are eventually judged by the extent and acceptability of the prevailing business risks. There are two distinct aspects of these risks that the government of Rwanda should act upon. First, in regard to technical risks, the international experience indicates that money spent on project preparation and upstream development is money well spent as it contributes to a reduction in the technical and business risks. The private sector is normally comfortable to take risks that are under its own control (such as construction delay, cost overruns, among other things) but not comfortable to take those not under its control such as insufficient project information and political risks. Should these risks be present, the number of potential investors declines, the competition will be limited, and there will be a significant risk premium incorporated into the private sector bids.

Figure 6.2 Financial Structure and Contractual Arrangements of the Bujagali Project

Financial Structure of Bujagali Hydropower Project



Contractual Agreements of the Bujagali Hydropower Project



Box 6.1: Suitability of the Proposed EEDF to the Climate Investment Funds

Climate Investment Funds (CIFs) consist of two main components: a large \$5.6 billion Clean Technology Fund (CTF) and a number of small funds such as the Pilot Program for Climate Resilience (PPCR), Scaling up Renewable Energy for Low Income Countries (SREP), and the Forest Investment Program (FIP).

SREP is of particular interest to Rwanda since it suits the economic and energy situation of the country. Some of the conditions and objectives of SREP are as follows:

- The proposed project should encourage investment in renewable energy as an alternative to conventional sources, such as fossil fuels and inefficient use of biomass. It should ensure that renewable energy is fully integrated into the national energy plan
- Proposal for SREP funding should result in increased energy access through the use of renewable energy particularly in the remote rural areas
- The proposed project should encourage private sector investments to significantly increase renewable energy capacity in the country's energy supply
- The proposed project should build local and national implementation capacity and institutions

SREP's present project portfolio and pipeline has a high concentration of energy projects in Africa with substantial focus on geothermal projects in Kenya and Ethiopia.

Application Process. All the climate investment funds are managed by the World Bank and can be accessed through multilateral institutions such as the World Bank and AfDB. Therefore application for establishing the EEDF should be developed with the cooperation of one of these institutions. To be eligible for CIF support, the application should **demonstrate clearly the manner in which**

EEDF will reduce energy poverty while relying on low carbon energy options. The specific objectives of the EEDF could be presented as:

- Increasing access to electricity services with particular emphasis on remote and rural areas
- Improving efficiency in energy production and consumption
- Facilitating the development of geothermal energy resources
- Supporting public and private investments in domestic hydro resources

Scope of the EEDF could be defined to include:

- Energy efficiency audits and retrofits
- Project preparation activities including technical and feasibility studies
- Initial exploration drilling in the identified geothermal sites
- Financing of pilot geothermal projects
- Providing support to the development of small and micro hydro projects by the private sector
- Recruitment of transaction advisors for PPP projects

Governance and Organizational Structure. Governance is normally the make-or-break aspect of creating a new energy fund. It determines the level of comfort with which development partners will support it. The implementation arrangements of the EEDF should be designed to ensure strategic focus, operational effectiveness, and clarity of fiduciary and resource utilization responsibilities. The governance and management arrangements should maintain a simple structure and streamlined internal processing. The initially proposed structure is that EWSA takes responsibility for implementation and operation of the fund, and a Steering Committee (could be the same committee that is proposed for clearing the PPP transactions) be established to assume the responsibility for approval of the proposed activities and the financial oversight of the fund. The composition of the members of the Steering Committee should be proposed by the Energy SWG and approved by the Ministry of Infrastructure.

Therefore, spending an initial amount of money on project preparation pays off in terms of reduced delivered cost of supply as well as more rapid and competitive reception by the private sector. It will also provide further transparency and information symmetry for potential private sector participants. The government is aware of the need for reducing technical risks and has accepted to undertake project preparation, resource exploration, and pilot operations before inviting the private sector to carry out major projects.

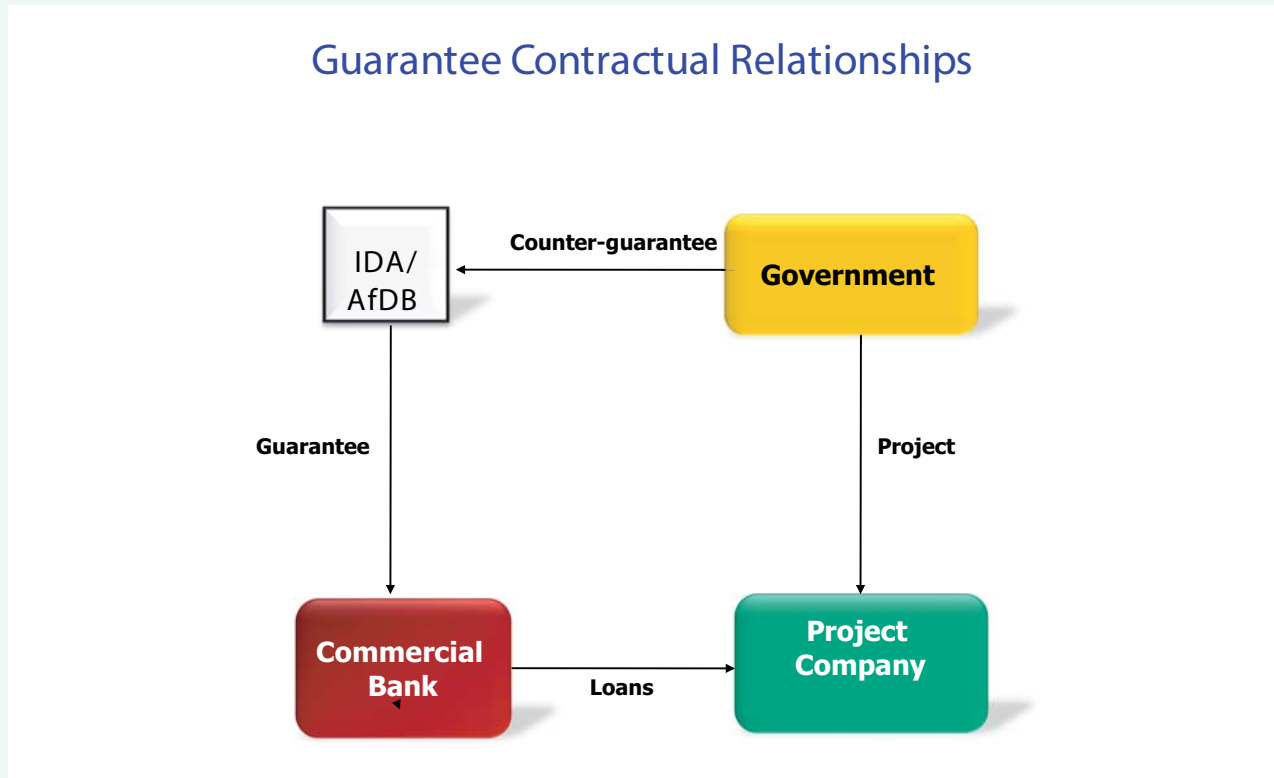
However, there is a need for government to fund such activities in a more rapid, efficient and systematic manner through a specialized fund. It is recommended that a process should be initiated to create an Energy Efficiency and Development Fund (EEDF). This is now a common practice in develop-

ing countries some of which have established two or three separate funds to attend to energy efficiency, renewable energy, and energy project preparation activities. In the case of Rwanda, a single fund should suffice to be used for: (i) energy efficiency audits and retrofits (ii) project preparation activities including technical and feasibility studies (iii) initial exploration drilling in the identified geothermal sites (iv) pilot projects (v) development of small hydro projects by the private sector and (vi) the recruitment of transaction advisors for PPP projects.

The objectives of the proposed EEDF are in line with the priorities of most development partners (DPs). Thus, the EEDF may receive support from the DPs if properly structured and established. The concept of the EEDF is also

Table 6.3: The Basic Parameters of Partial Risk Guarantee

How the guarantee would work:



When and how a guarantee may be called upon?

The guarantee is only called upon when the private company defaults in repayment of the loan **and it is demonstrated** that the default is due to the non-payment by EWSA. That is, the guarantee **does not provide** a general coverage for a private company's financial problems and inability to pay back its loans.

What is meant by partial risk?

The commercial loan may have a repayment term of 10 years. However, the lenders often are concerned about the repayment in the

first 5 years. The guarantee would then cover the repayment obligations. The guarantee could be also partial in the amount of coverage. That is, the lender may want \$50 million coverage for a \$100 million loan.

How is a guarantee counted in the IDA/AfDB allocation to Rwanda?

25% of the nominal guarantee amount counts in the allocation. That is, a \$100 million guarantee is equivalent to a \$25 million loan in the country's allocation.

in line with the objective of the Climate Investment Funds (CIFs). It is therefore suggested that a proposal for establishing the EEDF be prepared and submitted to CIFs. It is recommended that the EEDF proposal aims at initially securing \$30 million from CIFs. It should then seek contributions from other DPs with the objective of expanding the EEDF's size to \$100 million.

Partial Risk Guarantee. The presence of political risk has

proven to deter private sector participation in large energy projects. The deterrence relates partly to the concerns of the investors and partly to those of commercial lenders. The investor normally requires a government guarantee of the obligation of the utility to pay for the electricity off-take as well as political risk insurance to protect its assets. The investor in the KivuWatt project has received both of these protections through a government letter of comfort and a MIGA guarantee, respectively. The commercial lender normally requires a

guarantee for repayment of the loan in the event of a default by the private company. In Rwanda's circumstances, this guarantee should be provided by either the World Bank/IDA and/or the AfDB. At the outset, it should be pointed out that such a guarantee would not add to the IMF's assessment of the government's contingent liabilities because the guarantee is being extended as a concessional financial support.

The request for a partial risk guarantee is normally made by the private investor as he or she attempts to structure the financial package. Nevertheless, in many cases the government initiates the request in order to announce the availability of such support while inviting private investors. The initiation by the government could also save time and enable faster financial closure of the corresponding projects. The process of preparing a partial risk guarantee could be lengthy and taxing on the time of the government authorities and the IDA/AfDB staff and management. This would be especially an issue when there are a number of projects in the immediate pipeline. It is therefore of interest to prepare a "program" of partial risk guarantees that would cover a number of forthcoming projects in the power sector.

Kenya has recently succeeded to secure such a program for its power sector investment projects from the World Bank Group (IDA, IFC and MIGA). The program covers the private sector power projects that are scheduled for the next 5 years and thereby avoids a case-by-case application.

Formulation of a program PRG is a complex undertaking and therefore needs careful preparatory work. It is recommended that the government invite the AfDB's Private Sector Department to review and formulate such a package for Rwanda's power sector. It is noted that IFC's advisory service is usually paid by its clients but IFC has been able in recent years to use donors' funds while providing service to low-income developing countries.

Procedures for PPP Concession Design. To launch the construction of a power plant through a PPP arrangement, the government should prepare responses to the following 5 questions:

- What factors should we consider in deciding where to build the plant? It is important that the location of the

plant is secured prior to invitation of the potential investors. This would enable the government to locate the plant where it best suits the power system and would remove certain risks that investors have to take into account in offering terms of the contract.

- What preparation should be made before starting the tender process? The government's role is instrumental even if the project is a purely private venture. The government should prepare new legislation (if required), appoint consultants, complete a feasibility study to investigate the technical, financial and contractual aspects of the project; purchase the preferred site and compensate landowners; and supervise consultants in preparing a "Request for Proposals" including draft contracts. A common misunderstanding in the PPP ventures is that governments assume that the private sector should take care of identifying and formulating relevant projects. This is perhaps the case in Rwanda now, with the expectation that private sector would formulate relevant geothermal and peat-based power plants. The public sector should carry out the preparation work prior to engaging with private companies. The case of Korea is considered a best practice in this regard. Korea carries out complete project preparation and only then decides whether the project should be undertaken by the government or by the private sector.
- What are the main steps in the tender process? The main steps for which the government would need to prepare for are: (i) prequalification of suitable bidders (ii) issue of the Request for Proposals (iii) responding to questions from bidders (iv) evaluation of proposals (v) announcement of the Preferred Bidder (vi) negotiation of contracts (vii) signing of contracts and (ix) financial closure. Although the government should use the services of a transaction advisor, it should supervise the process and make timely decisions at various stages of the transaction.
- What criteria should we use in the prequalification of bidders? The most important considerations in prequalification are: (i) experience in the private financing and development of private power projects (ii) financial standing (iii) commitment to working in the country.
- What should the government do to obtain competitive bids? This is the most complex step in the process

of launching PPPs. To get the best bid, the tender process should follow the international practice which requires clear and simple criteria for selection of the Preferred Bidder. The government should provide a draft contract, and all information necessary to prepare bids (site surveys, records, EIAs, borehole logs, among other things) with the RFP. The government should be responsive to requests from bidders during bid preparation and ensure that the same information is given to all bidders at the same time. The timetable should be fixed and bids opened in public according to the schedule.

Institutional Capacity for PPP Undertaking. Because of the broad definition of PPP, the review of the skill required establishes a good basis for the general assessment of the institutional requirements for private sector participation. The international experience indicates that in order to formulate and implement PPP schemes, the country should have the competencies for: (i) setting PPP policies and strategies (ii) originating and identifying projects (iii) analyzing individual projects (iv) managing transactions and (v) managing, monitoring and enforcing contracts.

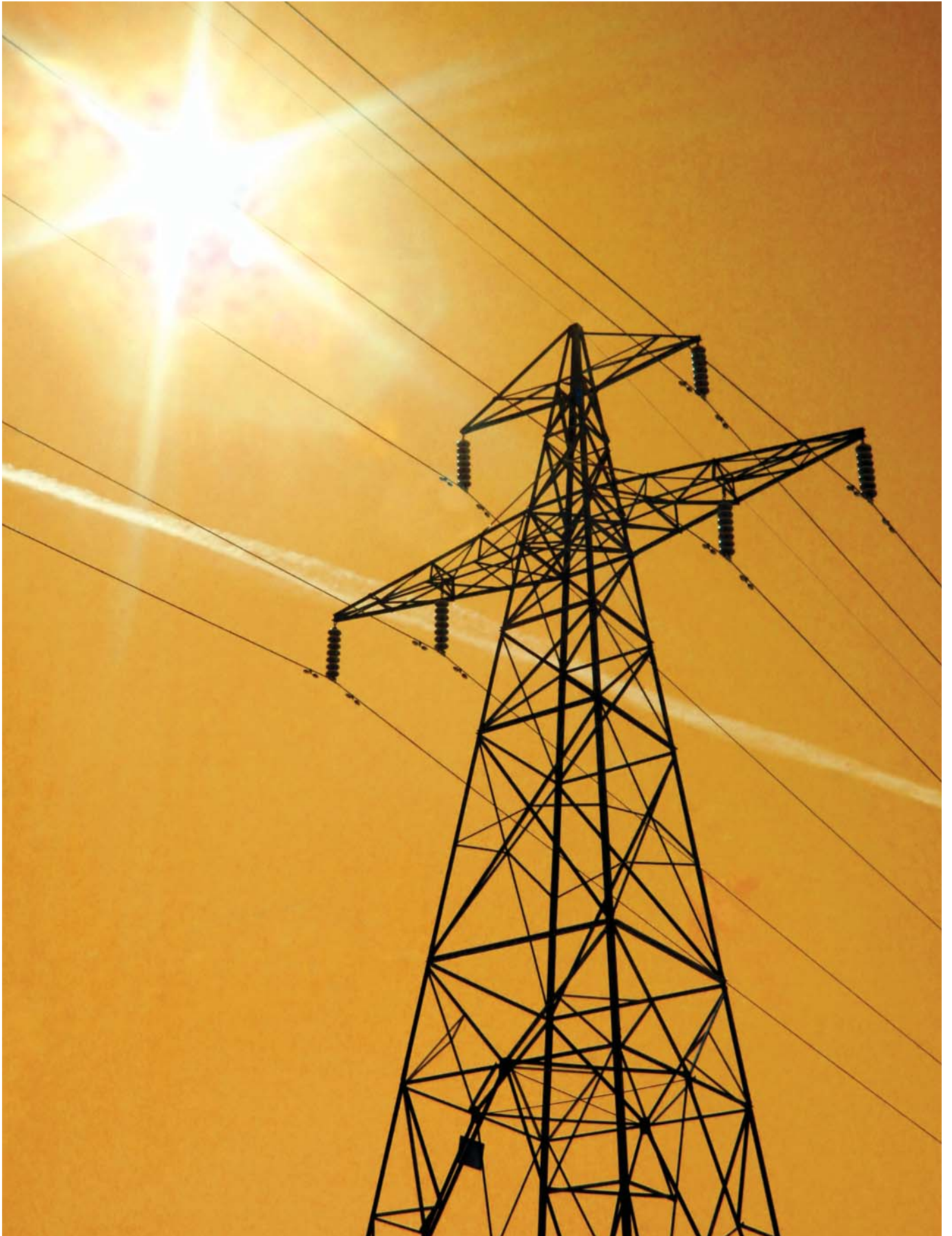
MININFRA and EWSA have initiated capacity development in each of the above areas. In particular, EWSA is in the process of establishing an Investment Unit. There is also a PPP unit at RDB that is formally charged with some aspects of the above roles. However, capacity development will be necessary for the PPP unit at RDB to facilitate the effective execution of its mandate.

In most countries that have gone the PPP route, there is a central PPP entity and there are sector specific PPP units that work together according to a division of responsibility. The central PPP agency's mandate spans several sectors and is primarily responsible for: policy coordination and guidelines, promotion of best practice, contract standardization, technical advice and quality control. The sector-specific PPP units are normally responsible for project development including project identification/origination,

recruitment of consultants, execution of feasibility studies, preparation of contractual documents and negotiations with the private companies. A conflict of interest can also arise when a PPP unit is involved in both the development of projects and the post-completion evaluations. Separation of functions is the best solution to avoid conflicts of interest.

It is recommended that EWSA's Investment Unit be equipped to take responsibility for the entire implementation process including project inception, feasibility study, dissemination of project information to potential bidders, procurement and contract negotiations. It is proposed that the work be carried out under the oversight of a Steering Committee that would consist of all the relevant entities. This oversight is necessary to ensure that there will not be an issue of conflict of interest. The EWSA Investment Unit should be staffed primarily with project officers (investment officers) and investment analysts, with core expertise in project management and project finance. The Unit should have the capacity to negotiate with private sector bidders who are likely to be highly skilled and organized. It is also important to clarify and document the process that EWSA would need to follow at each stage of its work so that it can quickly deal with changes in the project, users, unforeseen events, and termination.

Recruitment of Transaction Advisor. The complexity of structuring and managing a PPP project indicates the need for various types (technical, financial and legal) of advisory services. In some country situations, the government uses various advisors for each area. In the case of Rwanda it seems more appropriate to recruit a transaction advisor who would stay with the project throughout various phases of feasibility assessment, transaction development and marketing, bid evaluation, and construction and operation monitoring. The transaction advisor brings advantage through experience from similar transactions and can usually protect the project against cost and avoidable mistakes. In addition, the PPP unit would need to recruit various experts to help in the formulation of specific transactions.



Chapter 7: Roadmap and Action Plan

The government of Rwanda has an ambitious approach to the development of the power sector. To address the objectives of the power sector, there is a need to formulate a clear roadmap and action plan which would cover both the expansion of the physical infrastructure and the development of sector structure, regulation and institutional capacity.

Roadmap for Development of Physical Infrastructure

The plan for the development of the power sector's physical infrastructure was initially dictated by the targets of Vision 2020. Based on the targets set by the EDPRS and the Vision 2020 strategies, electricity access was expected to grow from 4% of the population in 2008 to 28% in 2017 and 40% by 2020. However, the new cabinet that was formed in October 2010 resolved to accelerate the expansion of electricity services. A new target was set to reach an access ratio of 50% by 2017. Extension of the envisaged trends would imply that electricity access would reach 94% by 2025 (as compared with the 40% set by Vision 2020). According to this, the number of household connections to the grid is expected to increase from about 350,000 at the end of 2012 to 1,200,000 in 2017 and 2,400,000 in 2025.

The access target was in February 2012 pushed further up to 70% of household connections by 2017. A related but distinct dimension of the accelerated program is the objective of expanding the generating capacity to more than 1,000 MW by 2017. Rwanda's resource base for power generation is estimated at about 1,500 MW. By coincidence, the capacity requirement to meet domestic demand reaches 1,500 MW by 2025. Therefore all of this resource base will be needed in 15 years to meet the then-prevailing domestic power demand. The government's accelerated program is aimed at developing more than 1,100 MW of the resource base by 2017 and the remaining 300-400 MW over 2018-2025. This accelerated pace of capacity development is not essential for meeting the domestic demand, which is estimated to reach 360-460 MW by 2017. The government's hope is that the extra generated capacity would enable

Rwanda to export electricity to its neighboring countries. Should the export aspiration be realized, the export volume should then gradually decline after 2020 in order to align the supply capacity with the increasing domestic demand.

The assessment of technical and implementation uncertainties (Chapter 4) and financing constraints (Chapter 5) indicate that the objective of expanding capacity to 1,100 MW by 2017 will require substantial scaling up of project preparation and mobilization of funding. It is further noted that the export of electricity from Rwanda is not likely to materialize in the medium term because: (a) Rwanda's energy supply may not be competitive in the regional market where some cheaper options (e.g. hydropower from Ethiopia) could constitute the price benchmark and (b) the international experience with regional integration indicates that formulating and executing a cross-border electricity trade agreement takes a very long time to become operational. Although the electricity export option may not be feasible or advisable, Rwanda should still continue its efforts in becoming an active member of the East Africa Power Pool, where it can reduce the overall cost of supply through balanced exchange with other countries in the pool¹¹.

Moreover, the assessments in Chapter 4 and 5 reveal that the projects that are considered technically ready now and could be commissioned by 2017 will provide a total installed capacity of about 595 MW. Other projects in the pipeline would be commissioned in the subsequent years. This raises the importance of technical preparation of the projects in the government's power expansion plan. At the same time, the assessment yields the main parameters of the delayed program (Table 7.1) as an alternative scenario that is worth some consideration. Comparing this alternative scenario with the accelerated program one can make the following observations:

11 Most trade transactions in the newly established power pools are in the form of balanced exchange where members of the pool sell electricity during their off-peak hours (seasons) and buy back during peak periods.

- The supply capacity of the delayed scenario may still be quite sufficient to meet the 2017 domestic demand which is estimated at 360-410 MW for access ratios of 50% and 70% respectively
- The investment requirements of the accelerated program are concentrated in 2013-2017. Growth in installed capacity is expected to be 160 MW/year during 2013-2017 and slow down after 2017 to an average of 50 MW/year. This heavy concentration of investments imposes serious pressure on implemen-

tation and financing capacity of the power sector. The development scheme of the delayed scenario depicts a smooth pattern with a growth in installed capacity ranging from 75 MW/year to 100 MW/year.

Table 7.2 presents a roadmap for implementation of power projects. It contains all projects that are included in the government plan and assumes that work will continue on all of them. The commission dates of the technically ready projects are scheduled for 2013-2017 period. The commis-

Table 7.1: Main Characteristics of the Generation Development Program

Energy Resource Base
<p>Energy Resource Base for power generation is estimated at about 1,500 MW comprising:</p> <ul style="list-style-type: none"> A. Hydropower: 313 MW, comprising approximately 130 MW of domestic hydro and 183 MW of regional hydro resources B. Geothermal: 700 MW, of which 490 MW are considered economically recoverable. The main fields are Karisimbi with 160 MW; Gisenyi with 150 MW, Kinigi with 120 MW and Bugarama with 60 MW C. Methane: Lake Kivu has an estimated 55 bcm of methane. Potential power production capacity is estimated at 700 MW to be shared with DRC. Rwanda's share is 350 MW D. Peat: Peat resources include 40,000 ha of peat bogs of various quality. Power production capacity is roughly estimated at 300 MW. Peat sites have been identified in Rwabusoro, Akanyaru, Murago, Gihitasi, Mashya, Gishoma, Rucahabi, Cyato, Cyabararika, Nyirabirande, Kageyo, Kaguhu, Mashoza, Gasaka, Bahimba, Bisika, Rwuya, Nyabigongo and Rugeramigozi. E. Solar and Wind: Rwanda has insignificant wind potentials and a moderate source of solar energy with average radiation of 4 – 6 kWh per square meter per day. It has established a rather useful experience with the implementation of a 250 kW Kigali solar project and solar water heaters for some commercial buildings. The solar project could pave the road for somewhat larger ones in the future. Construction of a 10 MW solar plant is being discussed between the government and potential bidders F. Biomass: Rwanda's energy mix is dominated by biomass which accounts for about 85% of primary energy use. Although the dependency on biomass has dropped from 95% in the last 20 years, the ratio is still considered too high and harmful to forest resources. The Biomass Energy Strategy for Rwanda (2009) articulates the government's objective to reduce the consumption of biomass energy from the current 85% to 50% of national energy consumption by 2020
Installed Capacity in 2012
<p>Total installed capacity is 100.64 and will reach 132 MW by end 2012.</p> <p>The end of the year capacity comprised:</p> <ul style="list-style-type: none"> A. Domestic hydro: 48 MW B. Regional Hydro: 15.5 MW C. Methane power: 29.2 MW D. Thermal plants: 37.8 MW E. Solar power: 0.25 MW

Scenario 1: Accelerated Development Program

The accelerated program is aimed at expanding the power generating capacity at the rate of about 200 MW/year to grow from 132 MW at the end of 2012 to 1,160 MW by 2017. The installed capacity in 2017 would comprise:

- 340 MW of hydropower including 178 MW of domestic and 162 MW of regional hydro
- 310 MW of geothermal power
- 300 MW of methane-based power
- 200 MW of peat-based power
- 20 MW of HFO (will be considered as reserve capacity)

Since most of the resource base is expected to be developed by 2017, the growth in installed capacity will slow down substantially after 2017 to an average of 47 MW/year and reach 1,540 MW by 2025 when the installed capacity would consist of:

- 400 MW of hydropower
- 460 MW of geothermal power
- 350 MW of methane-based power
- 300 MW of peat-based power
- 20 MW of HFO

Technical uncertainty. There are substantial technical uncertainties about all types of energy options because of the lack of feasibility studies for a number of projects that are planned to be commissioned by 2017. There is also resource uncertainty about geothermal and peat that would need to be studied and explored

Investment and finance bulge. The investment requirements of 2013-2017 are estimated at approximately \$4.2 billion, indicating an annual investment of \$845 million. This annual investment requirement then drops to \$345 million in the 2018-2025 demonstrating the heavy concentration of investment requirements in 2013-2017. The average annual investment in the past five years is \$170 million/year.

Scenario 2: The Delayed Program

This scenario envisages that the installed capacity would grow at about 92 MW/year and reach 595 MW by 2017 when the installed capacity would consist of:

- 200 MW of hydropower
- 160 MW of geothermal power
- 100 MW of methane-based power
- 115 MW of peat-based power
- 20 MW of HFO

Growth in installed capacity would continue at the rate of about 118 MW/year and reach 1,540 MW by 2025. Therefore, the final point of this scenario will be the same as the accelerated program but the expenditure trend is smoother.

Technical uncertainty. This scenario focuses on projects with appropriate feasibility studies and prospective implementation arrangements for commissioning by 2017. It assumes that work will continue on all other projects while the commissioning date of those less ready for implementation are shifted to 2018-2025.

Investment and finance. The investment requirements for 2013-2017 are estimated at \$2.5 billion, indicating an annual investment of \$510 million. This annual investment would then continue at the level of \$550 million/year during 2018-2025.

sioning dates of projects which are less ready for implementation are scheduled for subsequent years (2018-2025).

The above roadmap assumes participation by the private sector on the order of \$1.5 billion in 2013-2017 and \$2.8 billion in 2018-2025. To attract such levels of private sector investment, there will be a need for mitigating certain risks and demonstrating financial sustainability in the power sector. It is recommended (Chapter 6) that in order to encourage private sector participation, the government should: (a) reduce the technical risks associated with energy resource availability (b) request the relevant development partners for a partial risk guarantee to be used during the first phase of private sector participation and (c) put EWSA on a path toward an acceptable level of creditworthiness.

The government is aware of the need for reducing technical risks and has accepted to undertake project preparation, resource exploration and pilot operations before inviting the private sector to carry out major projects. There is a need for the government to fund such activities in a more efficient manner through a specialized fund. This report proposes that a process should be initiated to create an Energy Efficiency and Development Fund (EEDF). In regard to providing guarantees, the government has a clear strategy of limiting its contingent liabilities and obligations. This report suggests that the structuring of a “program partial risk guarantee” by IFC, MIGA and private sector arm of AfDB may enable the government to provide a risk mitigation package with minimum contingent liability. It is noted that the IFC’s advisory services may be effectively used to formulate such a package. Finally, the issue of EWSA’s financial sustainability is important not only for attracting private sector investments but also for securing the financing needs of its own investments. To this end, this report recommends that the government arrange for a credit rating agency to review the EWSA’s creditworthiness. The objective of the review should not be ranking or grading of EWSA but preparing the path toward improved creditworthiness.

Roadmap for Development of Sector Structure and Regulations

The international experience indicates that in order to ensure efficiency and suitability of the power sector, the institutional aspects should be developed in the following manner:

- The market structure should ensure separation of policy, regulation and operations. This seems to be on the right track in Rwanda where MININFRA, RURA and EWSA are clearly charged with the responsibility for policy, regulation and operation respectively.
- Market liberalization should be ensured by providing an open and competitive environment in which private sector investments and public-private partnerships can function effectively. This is an area in which Rwanda has taken the initial steps by providing in the Electricity Law and its energy policy a clear role for private sector participation. Some further unbundling of the power sector is also envisioned to create a level playing field for private investors.
- The regulatory framework should be designed to provide for clear legal authority for policy, regulation and operation. This is an area in which Rwanda has taken the initial steps by passing an Electricity Law and providing RURA with the mandate to regulate the electricity and gas market. There is a need to develop further regulations for the operation of the power sector including the technical and commercial responsibilities of the market participants.
- Human resources and technical capacity should be developed through recruitment of new expertise, training of the staff and outsourcing of selected tasks. This is also an area in which Rwanda has taken some initial steps but needs substantial further developments.

As discussed earlier (Chapter 2), the present structure of the power market is appropriate for its size and state of development. Going forward, the regulatory framework and the institutional capacity of the power sector should be further developed to fit four emerging dimensions. First, with the

Table 7.2: Roadmap for the Development of Physical Infrastructure

Category	Short to Medium-Term (2013-2017)	Medium to Long-Term (2018-2025)
Generation	Expand the generating capacity from 132 MW in 2012 to 595 MW by 2017 when the installed capacity would consist of: <ol style="list-style-type: none"> 1. 200 MW of hydropower 2. 160 MW of geothermal power 3. 100 MW of methane-based power 4. 115 MW of peat-based power 5. 20 MW of HFO 	Expand the generating capacity from 595 MW in 2017 to 1450 MW by 2025 when capacity would consist of: <ol style="list-style-type: none"> 1. 310 MW of hydropower 2. 460 MW of geothermal power 3. 350 MW of methane-based power 4. 300 MW of peat-based power 5. 20 MW of HFO
Transmission	310 km of countrywide interconnections 65 km from Karisimbi to Musanze 180 km from Kibuye-Rubavu- Kigali	15 km from Geothermal III & IV to Gisenyi 10 km from Ruzizi III to Ruzizi IV 85 km from Ruzizi III to Kibuye 85 km from Rusumo to Kigali
Distribution	Expand electricity access from 16% in 2012 to 70% by 2017. 1400 km of distribution lines 1200 distribution substations	Expand the electricity access from 70% in 2017 to 94% in 2025. (2500) km of distribution lines (2000) distribution substations
Regional integration	Construct interconnections that are needed for development of regional hydro projects.	Construct interconnections that are needed for development of regional hydro projects.
Investment Requirements	Generation: \$1.549 billion Transmission: \$150 million Distribution: \$850 million Total: \$2.549 billion Average: \$510 million/year	Generation: \$2.796 billion Transmission: \$250 million Distribution: \$1,400 billion Total: \$4.446 billion Average: \$555 million/year

introduction of private power producers, the technical and institutional requirements should be clearly specified so that the reliability and security of the power network operation are protected. Second, the emerging role of EWSA as a single buyer of bulk electricity has significant implications for its technical and financial competencies to play the role of the single buyer. Third, the potential partial unbundling of the power sector in the future should be reflected in the emerging institutional capacity of the relevant entities. Fourth, with the potential expansion of cross-border elec-

tricity trade, EWSA's staff and systems should be strengthened to manage the corresponding transactions.

This report examines the above emerging dimensions and consolidates its recommendations into a roadmap as summarized in Table 7.3. The roadmap contains a set of actions for 2013-2017 that would enable the sector to improve efficiency and transparency within the present structure. The roadmap also includes a set of actions during 2018-2025 that are aimed at guiding operations in

an unbundled market. The underlying assumption is that unbundling should be pursued in a gradual and smooth manner to avoid business disruption. However, systematic steps should be taken to establish commercial accountability and a level playing field between private and public suppliers of electricity.

The government of Rwanda should provide a sense of stability by avoiding frequent changes to the structure and organization of the power sector. The process of unbundling should entail three major steps. First, within its current structure, EWSA should ensure a transparent performance of each segment of the supply chain by separating the financial accounts of various business units including: generation, transmission and core services. Second, EWSA should be converted to a corporation that could then become an independent (fully government-owned) company that would be legally able to borrow on its own account. Third, EWSA should gradually improve its creditworthiness and establish a market position that could enable gradual sales of its shares on the stock market.

Preparation of Market Governance Documents

If the power system is destined to be unbundled, it remains important to document roles and responsibilities of the unbundled entities to ensure that the power system's supply reliability and security are maintained. Further, there is a need to have a document that governs the commercial and technical aspects of the market so that participants are aware of their current rights and responsibilities as well as how these may change in the future. For this purpose, it is normally necessary to prepare two fundamental documents – the Grid Code and Market Rules – that would govern the commercial and technical aspects of the single-buyer market. Rwanda has prepared a Grid Code that covers some aspects of both documents. This Grid Code is considered sufficient for the current market conditions. However, as the number of IPPs increases and cross-border trade is developed, MININFRA and EWSA should in a few years' time initiate preparation

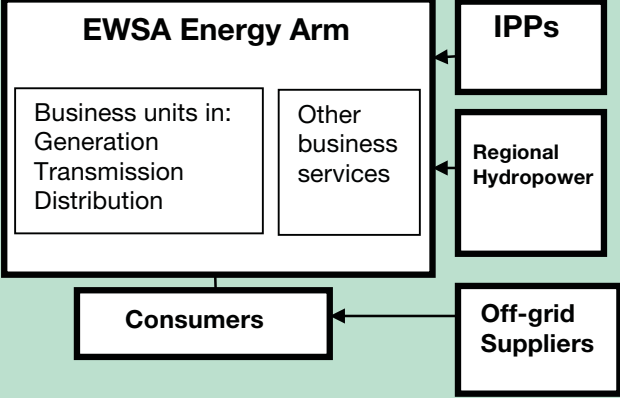
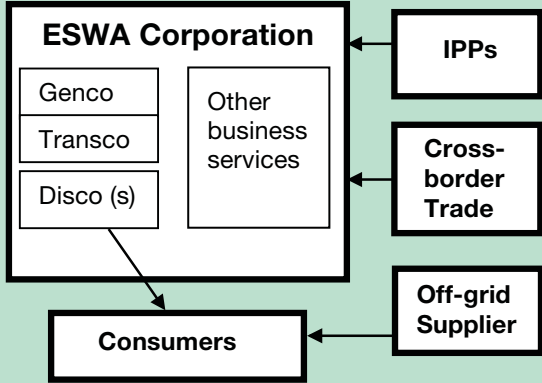
of the following governance documents:

1. A Single Buyer Market Rules document that would cover: authorization, commitment of the participants in the market; services to be traded and procedure to be followed during the conduct of trade; transmission services, responsibilities and payment for services; metering, billing, settlement and payment, and administrative matters such as force majeure, confidentiality, liability, applicable law, review and amendment, dispute resolution, effective date, validity and termination, etc.
2. A Revised Grid Code that legally establishes the technical requirements for the connection to and use of the transmission system by network users in a manner that ensures reliable, efficient and safe operation, and enables network interconnection with the East Africa Power Pool. Grid Codes are legally binding on all parties and specify the duties of both network users and operator like EWSA. The revised Grid Code document should be developed by EWSA through a stakeholder process, and approved by RURA.

Technical Capacity for Economic Dispatch

EWSA as the single buyer will be responsible for economic dispatch of all plants. Economic dispatch is the practice of operating a coordinated power system so that the lowest-cost generators are used as much as possible to meet demand, with more expensive generators brought into production as loads increase (and conversely, more expensive generation eliminated from production as load falls). It is the process of operating generation facilities to produce energy at the lowest cost to reliably serve consumers, recognizing any operational limits of generation and transmission facilities. Many factors influence economic dispatch in practice. These include contractual, regulatory, environmental, scheduling, unit commitment, and reliability practices and procedures. Because economic dispatch requires a balance among economic efficiency, reliability

Table 7.3: Roadmap for Development of Sector Structure and Regulation

Short to Medium Term (2013-2017)	Medium to Long Term (2018-2025)
<p>Structure:</p>  <p>The diagram shows a central box labeled 'EWSA Energy Arm' containing two sub-boxes: 'Business units in: Generation, Transmission, Distribution' and 'Other business services'. To the right, three boxes labeled 'IPPs', 'Regional Hydropower', and 'Off-grid Suppliers' have arrows pointing towards the 'EWSA Energy Arm' box. Below the 'EWSA Energy Arm' box, a box labeled 'Consumers' has an arrow pointing from the 'EWSA Energy Arm' box to it.</p>	<p>Structure:</p>  <p>The diagram shows a central box labeled 'ESWA Corporation' containing three sub-boxes: 'Genco', 'Transco', and 'Disco (s)', and another box labeled 'Other business services'. To the right, three boxes labeled 'IPPs', 'Cross-border Trade', and 'Off-grid Supplier' have arrows pointing towards the 'ESWA Corporation' box. Below the 'ESWA Corporation' box, a box labeled 'Consumers' has an arrow pointing from the 'ESWA Corporation' box to it.</p>
<p>Ownership:</p> <ul style="list-style-type: none"> • IPPs are owned by private sector or PPP arrangements • EWSA fully owned by the Government • Generation, transmission and distribution are parts of the Energy Arm of EWSA but run as business units with separate accounts • Off-grid suppliers operate under clear regulatory guidelines 	<p>Ownership:</p> <ul style="list-style-type: none"> • IPPs owned by private sector or PPP arrangements • EWSA is legally structured as an independent corporation • Generation, transmission and distribution entities are converted into separate subsidiaries of EWSA. • The corporation can be partially or fully privatized through selling shares on the stock market
<p>Market Function:</p> <ul style="list-style-type: none"> • IPPs sell to EWSA • EWSA serves as the single buyer and single seller of electricity • EWSA receives and transfers electricity subsidies • EWSA receives its share of electricity from the regional hydro projects. Therefore, cross-border trade remains limited to import of electricity from regional hydro projects 	<p>Market Function:</p> <ul style="list-style-type: none"> • IPPs will sell to the transmission company and are allowed to sell directly to the distribution company/ companies or large consumers • Transmission company provides open access service • The transmission company also serves as a TSO in cross-border trade • Cross-border trade will be developed into an energy exchange arrangement through bilateral trade as well as participation in the East Africa Power Pool

Continued on next page

Short to Medium Term (2013-2017)	Medium to Long Term (2018-2025)
<p>Actions:</p> <ul style="list-style-type: none"> • Prepare the design of internal processes including transfer pricing among the business units and separate accounting for generation, transmission and distribution • Equip EWSA to play the roles of the single buyer, and the transmission system operator (TSO) • Equip EWSA to carry out economic dispatch of all grid-connected generating units in the country • Train EWSA, RURA and MININFRA staff to manage two-part generation purchase tariff • Train EWSA, RURA and MININFRA staff in Single Buyer Market Design Basics • Train EWSA, RURA and MININFRA staff in Roles and responsibilities of Market • Put in place guidelines for off-grid operations including the roles and responsibilities of each stakeholder in off-grid markets 	<p>Actions:</p> <ul style="list-style-type: none"> • Design the structure and governance of the subsidiary companies • Prepare a plan for creation of a transmission company that would manage and reinforce the transmission network, and provide transmission capacity and services to market participants • Prepare a plan for creation of a distribution company that would manage and reinforce the distribution network, deliver electricity to consumers, and collect electricity consumption bills • Train EWSA, RURA and MININFRA staff in Unbundled Electricity Market Design • Train EWSA, RURA and MININFRA staff in cross-border trade • Prepare the Market Rules document to reflect the unbundling of the market and the cross-border trade responsibilities • Revise the Grid Code document to reflect the unbundling of the market and the cross-border trade responsibilities

and other factors, it is best thought of as a constrained cost-minimization process.

Economic dispatch in a single-buyer market structure is best promoted through what is known as a two-part generation purchase tariff. A two-part tariff recognizes that a generator provides two services: generating capacity that will be at the disposal of the single buyer; and electricity that will be produced as needed by the power system of the country. The two-part tariff therefore has two components: 1) an energy charge for recovery of the generator's energy production costs and 2) a capacity charge for recovery of the generator's fixed costs; i.e., all costs that are not recovered in the energy charge. Under a well-designed two-part tariff EWSA would be free to dispatch on the basis of economic merit order without concern about the genera-

tor's revenue requirement¹².

In order for EWSA to be able to carry out the economic dispatch responsibility, the staff of the operational planning units should be trained while acquiring the relevant software for operation optimization.

A vertically-integrated utility such as EWSA requires a highly-skilled work force to operate and properly maintain assets. However, the introduction of private producers and international trade adds another level of complex-

¹² The capacity charge is determined based on the amount of capacity that the private generator has available for dispatch, whether or not the generator is actually dispatched at this level. Capacity charge normally compensates the private generator for all its capital cost and the fixed O&M expenses. The energy charge compensates the power producer for the incremental cost of operation for actual generation

ity, demanding an even broader range of skills with an increased emphasis on the financial aspects of the market, including for example, transparency, pricing and contracts, risk management, market surveillance, etc. The broadening of such skills is necessary for EWSA as well as RURA.

For EWSA, training requirements should include market design, economic dispatch, and development of two-part generation purchase tariffs. Other aspects such as the specific roles and responsibilities of the different market participant groups could start later after the Market Rules document has been drafted and approved. The experience in other countries indicates that the training of EWSA staff should be undertaken in three tranches, as follows:

- Single Buyer Market Design Basics
 - ✓ Single Buyer Market design principles
 - ✓ Economic dispatch
 - ✓ Two-part generation purchase tariff design
 - ✓ Scheduling and dispatch on the basis of economic merit order
 - ✓ Determination of revenue requirement, tariffs and contracts for services provided by one market participant group to another
- Roles and responsibilities of Market Participants in Single Buyer Market
 - ✓ Overview of Market Rules and Grid Code
 - ✓ Roles and responsibilities of each market participant group
 - ✓ Determination of revenue requirement and tariffs for services provided by one market participant group to another (this component of the training would be based on actual data, if available)
- Unbundled Electricity Market Design
 - ✓ The modalities of an unbundled market
 - ✓ Transparency and data publication
 - ✓ Pricing principles and role of market prices in promoting efficiency and attracting generation investment
 - ✓ Role of the Transmission System Operator (TSO) including coordination mechanisms, short-, medium- and long-term planning, priority of reli-

ability over commercial trading, dealing with transmission constraints, available transmission capacity, cross-border transmission capacity auctions, ancillary services, losses, emergency operation, data collection and publishing, etc.

- ✓ Role of the Market Operator including markets, auctions, settlement, metering systems, payment mechanisms, security deposits, etc.
- ✓ Balancing market design and organization, opportunity trading, short-term energy prices, incentives for efficiency and new investment
- ✓ Administrative aspects including market governance, rules amendment, market power/surveillance, audits, etc.
- ✓ Incorporating social/environmental aspects such as lifeline tariffs, RES, carbon allowances, etc.
- ✓ Trading, investment and risk management.
- ✓ Cross-border Trade.

Action Plan for the Short to Medium Term

The action plan summarises the power sector's development plan as articulated in the roadmap and identifies specific actions for the development of physical infrastructure as well as the development of the institutional structure and capacity. The action plan is provided for two distinct time-frames: the short-to-medium plan for 2013-2017; and the medium-to-long-term plan relating to 2018-2025.

Each plan contains the actions for:

- Development of Domestic Hydro Resources
- Development of Regional Hydro Resources
- Development of Methane Power
- Development of Geothermal Power
- Development of Peat-based Power
- Expansion and Reinforcement of Transmission and Distribution Networks
- Development of the Institutional Capacity

The action plan for 2013 to 2017 program is summarized in Table 7.4.

Table 7.4: Action Plan for the Development of Physical Infrastructure and Institutional Capacity
Section I: Short-Medium Term (2013-2017)

Project/Activity	Actions	Cost	Time-Frame
I.1 Development of Domestic Hydro Resources			
Assessment of Hydro Resources	<ul style="list-style-type: none"> -Prepare Hydropower Master Plan Study -Carry out feasibility studies for the sites selected in the Hydropower Master Plan 	US\$ 700,000	To be completed in 2013/14
Development of Small and Micro Plants With Total Capacity of About 50 Mw to Be Constructed During 2013-2017	<ul style="list-style-type: none"> -Encourage Local PPP to invest in the construction of small micro hydropower plants with capacity not exceeding 0.25 MW. Government will assist in providing engineering studies, the procurement of consultants and service providers and provision of technical advice -Mobilize the Private Sector to invest in plants with capacity exceeding 0.25 MW -Mobilize resources from Development Partners to support studies and construction of plants exceeding 0.25 MW -Construction of Selected Sites based on EPC Contracts or Design & Build Modes 	Total project cost is estimated at \$200 million to be disbursed in increments allocated to each project during 2013 to 2017.	<p>Various small and micro projects with completion dates during 2013-2017.</p> <p>Should be monitored by capacity to come on line according to the following schedule:</p> <p>2013: 15 MW 2014: 12MW 2015: 9 MW 2016: 8MW 2017: 8 MW</p>
Development of Nyabarongo 28 MW Hydropower Project	<p>Under construction.</p> <p>To be completed by April 2014</p>	Already committed.	2014
Development of Nyabarongo II Multipurpose Dam Development (17 MW)	<ul style="list-style-type: none"> -Feasibility study completed earlier but need further studies. -Award EPC contract -Construction of the project to be completed by 2017 	\$158 million	<p>2017</p> <p>Being a multi-purpose dam, the project poses coordination challenges. The cost is also high compared to other power options.</p>
Construction of Giciye (4 MW) Developed by RMT	<ul style="list-style-type: none"> Prepare design and estimate of construction cost for GoR consideration Build the plant 	\$ 2 million by GoR	2014
Construction of Rukarara IV/ Mushishiro (5 MW) Developed by REFAD	<ul style="list-style-type: none"> Prepare design and estimate of construction cost for GoR consideration Build the plant 	\$1.5 million by GoR	2014

Project/Activity	Actions	Cost	Time-Frame
I.2 Development of Regional Hydro Resources			
Develop Rusizi III Rwanda's Share 48.3 MW (Out of Total Capacity of 145 MW)	<ul style="list-style-type: none"> FS study completed in 2010 Develop new institutional framework treaty Reach financial closure with DPs Construction to be completed by 2016 	Rwanda's share is \$150 million; total cost \$ 400 million	2016
I.3 Development of Methane Power			
KivuWatt 2 with Capacity of 75 MW (525 GWH energy)	<ul style="list-style-type: none"> Phase 1 is under construction and was due for completion by end -2012. Review the experience of Phase 1 construction to incorporate into Phase 2 design Complete negotiations with KivuWatt company Financial closure by end-2013 Construction completion by 2015 	\$225 million by PS.	2015
I.4 Development of Geothermal Power			
Resource Demarcation in Karisimbi and Gisenyi and Kinigi fields	Detailed surface studies intended to reduce risks and costs of geothermal development by quantifying geothermal resource, and demarcating fields for giving concessions. Completed in 2011 and reviewed in 2012	Committed and disbursed.	2012
Building Infrastructure - Access Road and Water System for Drilling in Karisimbi and Gisenyi	<ul style="list-style-type: none"> Complete construction of access roads by October 2012 Complete the preparation of drill sites and water system by before end of 2012 	\$15 million by GoR	2013
Assessment of Karisimbi geothermal Resources	Drill 3 exploration wells in Karisimbi to test the wells, to determine well productivity and to demonstrate commercial geothermal potential	\$ 25 million by GoR	2013
Development of Karisimbi Pilot Project with capacity of 10 MW (70 GHW energy)	<ul style="list-style-type: none"> Prepare project documents Award EPC contracts Complete by 2014 	\$25 million by GoR	2014
Development of Karisimbi I Project with 75 MW Capacity (525 GWH energy)	<ul style="list-style-type: none"> -Negotiate PPA -Negotiate geothermal concessions -Drill and test 17 production wells -Confirm steam for power plant -Determine reservoir properties -Drill 20 production wells Design & construct the geothermal plant including steam gathering system 	\$330 million by PS	2015

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Project/Activity	Actions	Cost	Time-Frame
Development of Karisimbi II Project with 75 MW Capacity (525 GWH energy)	Prepare detailed modeling after Karisimbi I -Negotiate PPA -Negotiate geothermal concessions Drill 20 production wells Construction of the plant to be completed by 2017	\$225 million by PS	2017
I.5 Development of Peat-based Power			
GoR 15 MW (105 GWH energy)	Negotiations with EPC contractor completed Completion by December 2013	Total cost around \$33 MN	Dec 2013
Hakan 100 MW (700 GWH energy)	Negotiations between GoR and Hakan of Turkey are under way. PPA agreement to be signed Project to be completed by 2017	Costs are not known at this stage. Should be estimated after negotiations	2017
REFAD 25 MW (175 GWH energy)	Negotiations between REFAD and GoR are under way Plant to be built by 2015	Costs are not known at this stage. Should be estimated after negotiations	2015
I.6 Expansion and Reinforcement of Transmission and Distribution Networks			
Construction of transmission substations during 2013-2017.	-Construction of 110 kv substations in KABARONDO, KILINDA, NYABARONGO, BUTARE, KIGOMA, GIFURWE, and RWINKWAVU Construction of substation at Nyabarongo and upgrading of Kilinda substations is part of the Nyabarongo Plant (28 MW) construction The remaining (above) substations are for upgrading- they are there already -Construction of 220 kv substations at KIGALI (BIREMBO), KIBUYE, GISENYI, KIGALI AIRPORT, RUZIZI3(MURURU 2), BUKAVU (DRC), and GOMA (DRC)		2015
Construction of transmission lines during 2013-2017.	-Upgrading RWINKWAVU to JABANA line (67 km) at 110 kv		2015
	Construction of KIGOMA to BUTARE line (30km) at 110 kv		2015

Project/Activity	Actions	Cost	Time-Frame
	<p>There are two project packages. The first package includes:</p> <p>Karongi -Rubavu- Shango (starts in Dec 2012)</p> <p>Mirama (Uganda)-Shango (Rwanda)-</p> <p>The second package includes:</p> <p>Kigoma (Rwanda)-Ngozi-Gitega (Burundi)- still in feasibility studies</p> <p>Rusumo-Kigali Airport- Birembo, Rusumo-Nyakanazi are in feasibility studies and will form part of Rusumo Falls Hydropower Project</p>	The cost of the first package estimated at 110 million Euros. No estimate for the second package is available at this stage.	2017
Distribution and Access	Construction of country-wide distribution substations during 2013-2017	\$60 million	2017
	Construction of 950 km of distribution lines during 2013-2017.	\$57 million	2017
	Access: 725,000 connections to be commissioned during 2013-2017.	\$870 million	2017
I.7 Development of the Institutional Capacity			
Establish Energy Efficiency and Development Fund (EEDF)	<p>Prepare a proposal for the establishment of EEDF and submit to Clean Development Funds (CIF)</p> <p>Mobilize financing from development partners</p> <p>Establish the legal authority and governance processes</p> <p>Operationalize the Fund</p>	\$100 million	2013-2014
Prepare and Implement Account Separation of Generation, Transmission and Distribution	<p>Recruit international experts</p> <p>Prepare detailed design of account separation</p> <p>Validate the design through pilot simulation.</p> <p>Implement account separation.</p>	\$250,000	2013-2014
Announce a Roadmap for Future Market Modifications	<p>Prepare a draft roadmap</p> <p>Stakeholder validation</p> <p>Announcement by the Government</p>	\$50,000	2013
Reinforcement of Commercial Regulations Through the Market Rules	<p>Recruitment of international experts by EWSA</p> <p>Preparation of the Market Rules Document</p> <p>Stakeholder Validation</p> <p>Approval by RURA</p>	\$150,000	2013

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Project/Activity	Actions	Cost	Time-Frame
Single Buyer Market Capacity Development at EWSA and RURA	Develop technical skills in: <ul style="list-style-type: none"> -Single Buyer Market design principles -Economic dispatch - Two-part generation purchase tariff design - Scheduling and dispatch on the basis of economic merit order - Determination of revenue requirement, tariffs and contracts for services provided by one market participant group to another 	\$250,000	2013
Market Rules Capacity Development at EWSA Roles and Responsibilities of Market Participants in Single Buyer Market	Develop technical skills in: <ul style="list-style-type: none"> -Implementing Market Rules and Grid Code -Enforcing roles and responsibilities of each market participant group -Determination of revenue requirement and tariffs for services provided by market participants 	\$250,000	2014
Launch a Review Process of EWSA's Creditworthiness	Prepare the terms of reference Recruit a rating agency Carry out the review of creditworthiness Stakeholder consultation and validation	\$200,000	2015

Action Plan for Medium-Long Term

The action plan for the 2018-2025 program is summarized in Table 7.5.

It includes the actions required for the development of the physical infrastructure as well as the development of the institutional structure and capacity.

Table 7.5 Action Plan for the Development of Physical Infrastructure and Institutional Capacity

Section II: Medium-Long Term (2018-2025)

Project/Activity	Action	Cost	Time-Frame
II.1 Development of Domestic Hydro Resources			
Small and Mini Hydro Projects with Total Capacity of 18 MW	<p>It is envisioned that by this time, the easily accessible sites will have been developed, therefore:</p> <p>It will be too expensive to develop significant capacity in the new sites</p> <p>GoR will need to put more resources and give much more concessions so that PS can develop these sites</p> <p>Feasibility studies should be completed at the earliest possible time</p>	\$ 100 MN	2025
II.2 Development of Regional Hydro Resources			
Development of Rusumo Falls. Rwanda's share 30 MW (of Total Capacity of 90 MW that Could be Reduced to 80 MW)	<p>FS study completed in Dec 2011</p> <p>Develop new institutional framework treaty</p> <p>Reach financial closure with DPs</p> <p>Construction to be completed by 2018</p>	Rwanda's share \$ 135 million; total cost \$406 million	2018
Development of Rusizi IV, Rwanda's Share 96 MW (out of Total Capacity of 287 MW)	<p>Carry out feasibility study to be completed by 2013.</p> <p>Develop new institutional framework treaty</p> <p>Reach financial closure with DPs</p> <p>Construction to be completed by 2020</p>	Rwanda's share is \$240 million; total cost is \$500 million. Costs are preliminary and need to be verified	2020
Development of Akanyaru project with Capacity of 3.9 MW	<p>Carry out feasibility study to be completed by 2015.</p> <p>Prepare institutional framework/bilateral treaty for adoption by Burundi & Rwanda on Akanyaru River Basin/Hydro sites development</p> <p>Mobilize resources from DPs</p> <p>Construction to be completed by 2020</p>	US\$ 20 MN	2020
Development of RC2 with Capacity of 16 MW	<p>Carry out feasibility study to be completed by 2015.</p> <p>Prepare institutional framework/bilateral treaty for adoption by Burundi & Rwanda on Akanyaru River Basin/Hydro sites development</p> <p>Mobilize resources from DPs</p> <p>Construction to be completed by 2025</p>		2025

Project/Activity	Action	Cost	Time-Frame
II.3 Development of Methane Power			
Kibuye Power 1 (KP1) with Capacity of 30 MW under negotiations with Israel Africa	<ul style="list-style-type: none"> Complete negotiations with private sector Construction to be completed by 2018 LRMC of 12 	US\$ 100 MN (estimate)	2018
Kibuye Power 2 with Capacity of 75 MW	<ul style="list-style-type: none"> Review the experience of Phase 1 - Complete negotiations with private sector Construction to be completed by 2020 	\$225 million by PS	2020
Joint Venture Project between GoR and DRC to Produce 50 MWe from Methane	<ul style="list-style-type: none"> -Complete feasibility study -Establish a regional regulatory framework for Lake Kivu Gas Management and Electricity Trade conducive for private investors -Complete negotiations with private sector -Construction to be completed by 2018. LRMC of 12 	\$ 150 million by PS.	2018
Joint Venture Project Between GoR and DRC (Phase II) to Produce 50 MW from Methane	<ul style="list-style-type: none"> -Review the experience of Phase 1 - Complete negotiations with private sector Construction to be completed by 2020 	\$150 million by PS	2020
II.4 Development of Geothermal Power			
Assessment of the Resource Potential of Gisenyi field	<ul style="list-style-type: none"> Drill 3 exploration wells in Gisenyi Confirm steam for power plant Determine reservoir properties Conduct feasibility studies 	\$25 million by GoR	2018
Development of Gisenyi I Project with 75 MW capacity (525 GWH energy)	<ul style="list-style-type: none"> Drill production wells Design and construct the power plant 	\$231 million by PS	2020
Development of Gisenyi II project with 75 MW capacity (525 GWH energy)	<ul style="list-style-type: none"> Drill production wells Design and construct the power plant 	\$231 million by PS	2022

Project/Activity	Action	Cost	Time-Frame
Assessment of the Resource Potential of Kinigi field	Drill 3 exploration wells in Kinigi	\$23 million by GoR	2020
	Confirm steam for power plant		
	Determine reservoir properties		
	Conduct feasibility studies		
Development of Kinigi I Project with 75 MW capacity (525 GWH energy)	Drill production wells	\$231 million by PS	2022
	Design and construct the power plant		
Resource Demarcation at Bugarama	Detailed surface studies in Bugarama to: (a) reduce risks and costs of geothermal development (b) quantify geothermal resource, and (c) demarcate fields for giving concessions.	\$680,000 by GoR	2018
Assessment of the Resource Potential of Bugarama field	Drilling of exploration wells in Bugarama & testing, infrastructure	\$23 million by GoR	2020

II.5 Development of Peat-based Power

There are no specific plans for development of peat-based power after 2017. It is, however, possible that HAKAN or REFAD can be invited to develop further plants provided that a complete resource assessment and environmental impact studies are carried out and support further expansions.

II.6 Expansion and Reinforcement of Transmission and Distribution Networks

	Construction of 220 kv substations at KIGALI AIRPORT, GISENYI, KABUGA, GASOGI, and Mt KIGALI		2025
	Construction of KIBUYE to GISENYI 2nd circuit (64 km) at 220 kv		2020
	Construction of RUZIZI III (MURURU II) to KIBUYE 2nd circuit (82 km) at 220 kv		2020
	Construction of GISENYI to KIGALI(BIREM 2nd circuit (110 km) at 220 kv		2020
	Construction of KIGALI_AIRPORT to BIREMBO 2nd circuit (32 km) at 220 kv		2020
	Construction of RUSUMO FALLS to KIGALI AIRPORT 2nd circuit (77 km) at 220 kv		2020
	Construction of BIREMBO to MIRAMA (UG) 2nd circuit (116 km) at 220 kv		2020
	Construction of GOMA to GISENYI 2nd circuit (10 km) at 220 kv		2020
	Construction of RUZIZI IV to RUZIZI 3 line (11 km) at 220 kv		2020

Project/Activity	Action	Cost	Time-Frame
	Construction of KIBUYE to KIGALI AIRPORT interconnector (100 km) at 220 kv		2025
	Construction of KIGALI AIRPORT to KIGALI NEW interconnector (10 km) at 220 kv		2025
Distribution and Access	Construction of country-wide distribution substations during 2018-2025	\$60 million	2020
	Construction of 950 km of distribution lines during 2018-2025	\$57 million	2020
	Access: 725,000 connections to be commissioned during 2018-2025	\$870 million	2020
II.7 Development of Institutional Structure and Capacity			
Create Generation Company	<ul style="list-style-type: none"> -Prepare a plan for creation of a generation company as a subsidiary of EWSA. -Structure a legal entity -Transfer assets 	\$500,000	2018
Create Transmission Company	<ul style="list-style-type: none"> -Prepare a plan for creation of a transmission company that would manage and reinforce the transmission network, and provide transmission capacity and services to market participants -Structure a legal entity -Transfer assets 	\$500,000	2019
Create Distribution Company	<ul style="list-style-type: none"> -Prepare a plan for creation of a distribution company that would manage and reinforce the distribution network, deliver electricity to consumers, and collect electricity consumption bills. -Structure a legal entity -Transfer assets 	\$500,000	2020
Revise the Market Rules Document to Reflect the Unbundling of the Market and the Cross-Border Trade Responsibilities.	<ul style="list-style-type: none"> -Recruit international experts -Revise market rules document -Validate with stakeholders -Approval by RURA 	\$50,000	2018

Project/Activity	Action	Cost	Time-Frame
Revise the Grid Code Document to Reflect the Unbundling of the Market and the Cross-Border Trade Responsibilities.	<ul style="list-style-type: none"> -Recruit international experts -Revise the grid code document -Validate with stakeholders -Approval by RURA 	\$50,000	2018
Develop Capacity to Manage an Unbundled Electricity Market at EWSA	Develop technical skills in: <ul style="list-style-type: none"> -The design and modalities of an unbundled market -Transparency and data publication -Pricing principles and role of market prices in promoting efficiency and investment. -Role of the Transmission System Operator (TSO) -Role of the Market Operator -Role of the balancing market 	\$250,000	2023
Develop Capacity to Manage Cross-Border Electricity Trade at EWSA	Develop technical skills in: <ul style="list-style-type: none"> -Bilateral trade agreements -Cross-border market rules -Cross-border grid codes -Cross-border transmission capacity auctions, and ancillary services -Power pool participation 	\$150,000	2022

Monitoring and Evaluation Framework

The monitoring and evaluation (M&E) framework should be devised at two levels: a high level comprising global indicators of power sector performance that would be monitored by the Ministry of Finance and Economic Planning (MINECOFIN), and a detailed set of indicators that will be monitored by MININFRA. MINECOFIN's concern is to ensure that sector strategies are aligned with the overall EDPRS.

MINECOFIN will monitor the EDPRS performance of each sector at a high level. In the case of the energy sector, this will primarily involve tracking two main performance indicators: the increase in electricity generation capacity (in MW) and the increase in number of connected households and enterprises, both of which are included the Common Performance Assessment Framework Indicators (CPAF). The proposed indicators are given in Table 7.6.

Table 7.6: High Level Monitoring Indicators for the Power Sector

Year	Number of Household Connections (000s)	Electricity Generation Capacity (MW)	Year	Number of Household Connections (000s)	Electricity Generation Capacity (MW)
2010	175	85	2018	1,350	650
2011	270	100	2019	1,500	800
2012	350	132	2020	1,650	950
2013	475	160	2021	1,800	1,100
2014	637	208	2022	1,950	1,250
2015	800	358	2023	2,100	1,350
2016	935	468	2024	2,250	1,450
2017	1,200	595	2025	2,400	1,540

MININFRA/EWSA have initiated a monitoring framework by establishing an energy information system and a set of Key Performance Indicators (KPIs). The selected sets of indicators are in line with the international practice and include:

A. Increase Access to Energy With the Following Specified Targets

- A.1 Increase electricity generation capacity to at least 1000 MW by 2017
- A.2 Increase in the installed hydroelectric capacity to 333.9 MW in 2017
- A.3 Install 299.1 MW of gas capacity using Lake Kivu methane as fuel source
- A.4 Develop a generation capacity of 310MW from geothermal resources
- A.5 Extend the electrical transmission and distribution system to 7,430 km in 2017.

A.6 Increase access to electricity to at least 1,200,000 connections by 2017

A.7 100% of schools to have access to electricity by 2017

A.8 100% of health centers to have access to electricity by 2017

A.9 100% of administration offices to have access to electricity by 2017

B. Reduced Cost of Service, Introduction of Cost-Reflective Tariffs as Follows:

B.1 Improve the quality of the network through the reduction of losses to 10%

B.2 Use 1,800,000 CFLs, Solar Water Heaters, inverters, 15 installations of energy saving equipment in the tertiary sector carried out during 2010-2017

C. Reduced Cost of Service, Introduction of Cost-Reflective Tariffs as Below

- C.1 Strategic studies on renewable energies and energy efficiency
- C.2 5,000 biogas digesters put into service during 2010-2017

D. Strengthen Sector Governance

- D.1 Monitoring and Evaluation System in place
- D.2 Adopt a sector-wide approach, backed by an energy sector strategy based on the EDPRS.

It is recommended to use the same set of indicators with the specified targets in Table 7.7.

Table 7.7 Key Performance Indicators for Monitoring Power Sector's Performance

Key Performance Indicator	2017 Target	2025 Target
A. Increase Access to Energy With the Following Specified Targets		
A.1. Increase electricity generation capacity	595 MW	1,540 MW
A.2 Increase in the installed hydroelectric	200 MW	400 MW
A.3 Install gas capacity using Lake Kivu methane as fuel source	100 MW	300 MW
A.4 Develop a generation capacity from geothermal resources	160 MW	310 MW
A.5 Extend the electrical transmission and distribution system	3000 Km	5000 Km
A.6 Increase household access to electricity	1,200,000	2,400,000
A.7 Schools' Access to electricity	100%	100%
A.8 Health centers' access to electricity	100%	100%
A.9 Administration offices' access to electricity	100%	100%
B. Reduce Cost of Service		
B.1 Improve the quality of the network through the reduction of losses	Loss reduction to 10%	Loss reduction to 10%
B.2 Use CFLs, Solar Water Heaters, and energy saving equipment	1,800,000 CFLs installations of 15 energy saving equipment	2,500,000 CFLs
B.3 Reduce technical risks	Establish Energy Efficiency and Development Fund (EEDF)	Success of EEDF
C. Strengthened Governance Framework and Institutional Capacity of the Energy Sector		
C.1 Improve sector structure	Prepare and Implement Account Separation of Generation, Transmission and Distribution	Create Generation Company
	Announce a Roadmap for Future Market Modifications	Create Transmission Company

Key Performance Indicator	2017 Target	2025 Target
C.2 Strengthen the regulatory framework	Reinforcement of Commercial Regulations through the Market Rules	Create Distribution Company
	Reinforcement of Technical Regulations through the Grid Code	Revise the Market Rules document to reflect the unbundling of the market and the cross-border trade responsibilities
C.3 Strengthen technical capacity	Single Buyer Market Capacity Development at EWSA and RURA	Revise the Grid Code document to reflect the unbundling of the market and the cross-border trade responsibilities
C.4 Strengthen financial sustainability	Market Rules Capacity Development at EWSA	Develop Capacity to Manage an Unbundled Electricity Market at EWSA
	Roles and responsibilities of Market Participants in Single Buyer Market	
C.4 Strengthen financial sustainability	Launch a Review Process of EWSA's Creditworthiness	
C.5. Support regional integration	Be an active member in regional energy activities	Develop Capacity to Manage Cross-Border Electricity Trade at EWSA

The primary objectives of the evaluation systems are: transparent communication of results, ensuring accountability, and an adaptive feedback process. The results of monitoring of KPI should be communicated widely with the stakeholders. The evaluation of the results should also describe the corrective measures that need to be taken by various parties.

MININFRA has established a system of dissemination as follows:

- Regular meetings will be held with the Energy Sector Working Group, which will participate in joint reviews of performance
- The MININFRA website will be updated regularly, with significant information about the Strategy being made

easily accessible to the public

- National media (newspapers, radio and television) will be used to communicate about the Strategy and in particular to raise awareness about energy efficiency and other energy sector issues

It is recommended that the results of the evaluation should include an objective assessment of delays and cost overruns. It is also recommended that the M&E results should be at the first stage presented to the Steering Committee that would take account of major short comings.

Environmental and Gender Equality Considerations

All energy projects should be developed in compliance with Rwandan environmental regulations, as well as the safe-

guards required by project lenders. Each project would require a complete Environmental and Social Impact Assessment (ESIA) which is normally a prerequisite for projects with the highest environmental impact. The ESIA should be prepared prior to the award of concessions to private investors. The ESIA should formally confirm that there are no significant social and environmental risks associated with the site of each project in terms of land use, or other characteristics associated with the site itself. Plant site selection criteria should include: (a) minimal environmental and social impacts (b) sites from which power could be easily evacuated and (c) sites immediately available for allocation.

Given their respective generating capacities, prevailing winds, and distances from each other, the air-sheds of the power projects should not impose adverse impacts on ambient air quality and the social structure of the surrounding areas. Also, a reasonable range of project alternatives should be evaluated, including a “no-project” alternative. Most lenders have specific operational guidelines regarding the following environmental safeguards: (i) Environmental Assessment (ii) Natural Habitats (iii) Pest Management (iv) Physical Cultural Resources (v) Involuntary Resettlement (vi) Forests (vii) Safety of Dams (viii) Projects on International Waterways and (ix) Projects in Disputed Areas. Therefore, the preparation of an ESIA should start with an identification process through which one would decide which of these safeguards are triggered for the project under consideration. From an environmental point of view, the hydro and geothermal projects are often considered more favorably than fossil fuel plants due to the absence of pollutant emissions.

However, development of hydro and geothermal projects should follow strict site selection criteria. While Rwanda has substantial experience in dealing with environmental aspects of hydro projects, the case of geothermal may raise specific challenges. The experience with geothermal projects in neighboring Kenya provides some valuable insights. Kenya had substantial difficulty in getting environmental approval for the third phase of the Olkaria geothermal project because the project site is located within Hell’s Gate National Park, which is designated as a protected area as the only national park in Kenya in which hiking is encouraged. The park was designated as a protected area after

the Olkaria geothermal fields had been gazetted and the first power plant had been built. Nonetheless, because of the location of the project within the park, the operational policy regarding Natural Habitats was triggered when Olkaria Phase 3 was prepared. As a result, the park was divided into two sections: the western section in which geothermal production is permitted, and the eastern section in which hiking and recreational activities (primarily bird watching) are encouraged. The Olkaria expansion is located within the western sector of the park in which geothermal field development is already permitted. A gorge separates the eastern and western sectors of the park, and topographical features west of the gorge (i.e., Olkaria Hill, Hobbly’s Volcano, and Hell’s Kitchen) effectively isolate the Olkaria III geothermal field from viewers in the eastern sector of the park.

Although the above experience is specific to the situation in Kenya, it has an important lesson for Rwanda in the selection of geothermal sites. While Rwanda has no prior experience in geothermal development, the government is eager to develop these resources as rapidly as possible to provide power generation capacity at the lowest possible cost. Therefore, there is a strong emphasis on the assessment of geothermal resources in the identified sites. The government and EWSA should complement these efforts with a well-formulated and comprehensive plan to assess environmental issues, options and remedies for each geothermal site. This is indeed a necessity for the development of all energy resources.

A major burden of energy poverty falls on women and children who spend their time on gathering biomass fuels, and also bear the brunt of indoor air pollution created by such fuels. Availability of clean energy for lighting and cooking is essential for improving gender equality.

Studies by the UNDP (Lambrou and Piana 2006) and the World Bank (World Bank 2011) indicate that the time and labor expended by women in collecting fuel woods limits their ability to engage in other productive and income-generating activities. Their health suffers from hauling heavy loads of fuel and water, and from cooking over smoky fires. Their opportunities for education and income generation are

limited by lack of modern energy services, and as a result their families and communities are likely to remain trapped in poverty (World Bank 2011). Therefore, gender-sensitive energy programs can ease the burden on women while also allowing them opportunities for education, income generation and improvement in the living standards of their families and communities. However, formulation and implementation of such programs would require actions at: (a) the policy level, to ensure that the challenge of gender equality becomes a visible and key concern (b) the program level, to ensure that all energy interventions create opportunities for women's empowerment and gender equality; and (c) the organizational level, to ensure that space and opportunities are available to women as well as men.

Gender mainstreaming in the energy sector in Africa has received substantial international attention. The Energy Sector Management Program (ESMAP) has established a dedicated activity (and fund) to support specific efforts in this direction. This program has helped some African countries in the review of the gender aspects of specific projects in order to reflect the gender considerations in project design, while also developing indicators to measure gender aspects through the life of the project. In Mali, Tanzania and Senegal, the ESMAP work has promoted modernization of cook stoves, and powered up rural health centers that are considered significant steps in improving women's quality of life. The ESMAP experience also indicates that providing electricity to communities and homes in rural areas significantly facilitates the performance of the tasks considered women's work, and improves gender equality, and women's and girls' access to education, health care and employment. Rwanda is taking significant steps in these directions. Increasing electricity access to the health centers and schools has been a top priority for the government. Rural electrification represents the bulk of the distribution network investment in the next five years. Gender mainstreaming can be further strengthened through a targeted consultation process. Rwanda may wish to use the ESMAP Africa Gender program to receive assistance in devising and carrying out the relevant consultations.

The Roles of the Government, Development Partners and Private Sector

The roadmap and action plan for 2013-2017 expansion of the electricity sector indicate some unprecedented challenges in project finance and implementation. The government will have to initiate the actions in all categories (generation, transmission and distribution). However, implementation of the action plan is expected to be a joint effort between the government, development partners and the private sector. Therefore the agenda for the engagement of each stakeholder in the power sector is quite broad and intensive requiring participation in and contribution to country level dialogue processes, financing, and jointly monitoring the implementation of the roadmap and action plan.

The public sector (mostly EWSA) is expected to undertake about \$1.1 billion of investment during 2013-2017. Public sector investments will cover transmission, distribution and some generation activities (Table 7.8). All of these investments would need to be financed by the government and the development partners. The contribution from each development partner should be reviewed and confirmed in a systematic manner. The government should organize a roundtable of development partners to seek pledges for financing the public sector share of power sector investments. A similar exercise was undertaken in 2009 to mobilize funding for the Electricity Access Roll-out Program (EARP) of 2009-2013. The experience was successful due to a well prepared proposal for the deliberation of the development partners.

Private sector investments are estimated at about \$1.5 billion. Mobilizing this amount of private sector resources will necessitate concerted efforts from both the government and the development partners in improving the business environment. The main business risks are insufficient project development (technical risk) and the lack of confidence in EWSA's ability to pay for its increasing obligations (political risk). The development partners should support the formu-

Table 7.8: Financing Requirements of the Power Sector

Year	Investment Requirements by Sub-sectors (\$million)				Investment Requirements by Public and Private (\$million)		
	Generation	Transmission	Distribution	Total	Public Sector	Private Sector	Total
2013	200	35	150	385	200	185	385
2014	250	35	150	435	200	235	435
2015	300	30	150	480	200	280	480
2016	350	20	200	570	240	330	570
2017	449	30	200	679	260	419	679
Total: 2013-2017	1,549	150	850	2,549	1,100	1,449	2,549
Total: 2018-2025	2,796	250	1,400	4,446	1,946	2,500	4,446

Source: Electricity Master Plan (2011); Seven Year Electricity Development Strategy (2011)

lation of risk reduction instruments such as the proposed Energy Efficiency and Development Fund (EEDF).

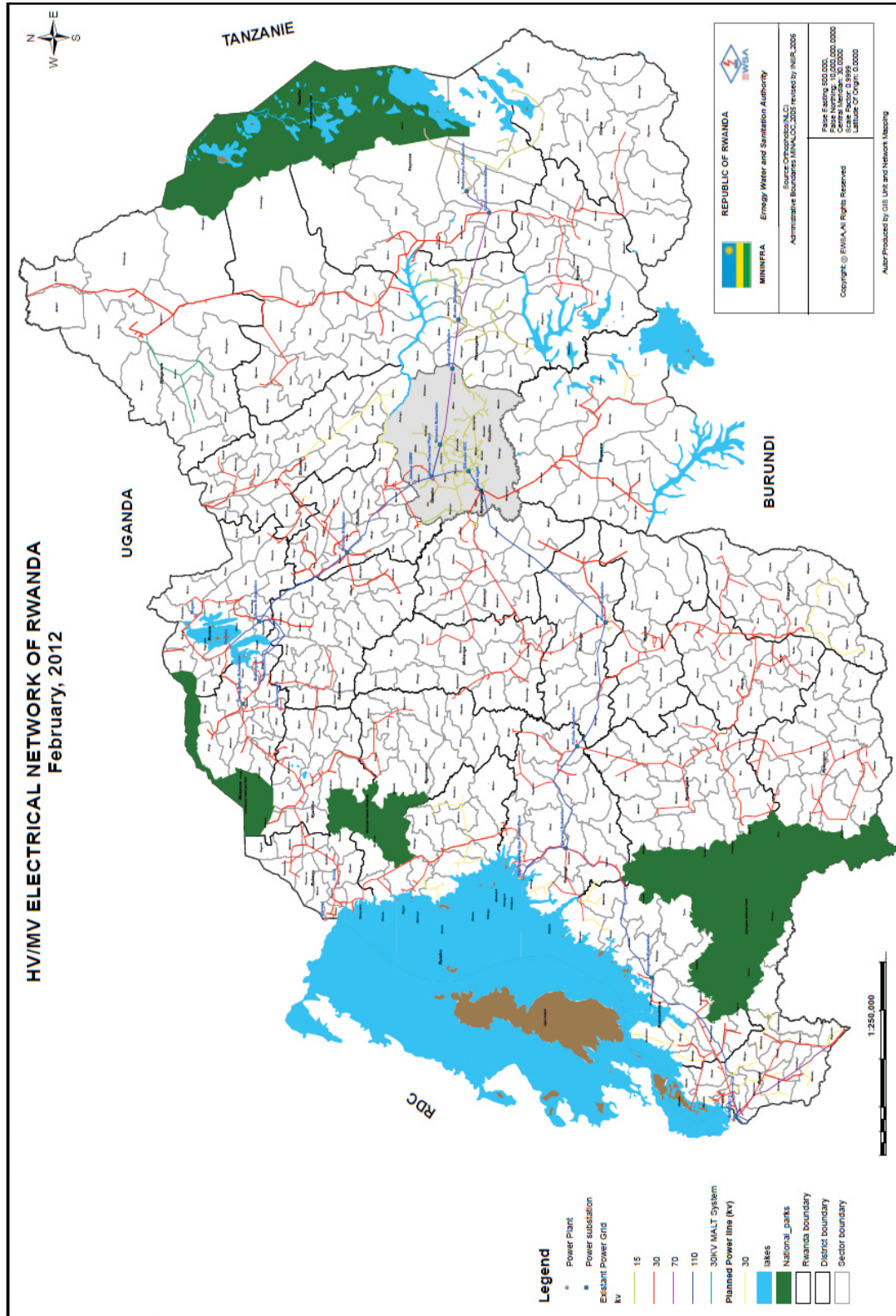
The EEDF is aimed at reducing technical risks by undertaking project preparation, resource exploration and pilot operations before inviting the private sector to carry out major projects. The political risk is normally mitigated through three distinct arrangements – a guarantee by the government of the obligations of EWSA under the power purchase agreement; insurance of investor equity by an international agency; and a guarantee by the World Bank (IDA) and/or the AfDB of the repayment obligations of the private project company to its commercial lenders. The development partners should support these arrangements in order to leverage resource mobilization from the private sector. The example of the PRG in Kenya (See Chapter 6) underscores role of government and development partners in catalyzing private sector finance.

Private sector investors should consider the attractive opportunity to engage in Rwanda's power sector. In particular, three factors should be of interest: (i) electricity tariffs are at the level of cost recovery (ii) a reformist government is willing and able to handle the emerging challenges (iii) an ambitious but robust program is in place to guide the expansion

of electricity generation capacity. The private sector should study the experience of the KivuWatt power project as a good precedent for engagement in the electricity sector. Through this experience, the government and the private sector were able to put in place various contractual arrangements that can be of use to future private sector projects. However, the private sector would need to go beyond the scope of KivuWatt financial structure while attempting to mobilize debt and equity finance. The KivuWatt project sponsor was able to secure funds from the development partners for all of its debt and part of its equity finance.

Going forward, the financing needs of the power sector will exceed the allocated resources of the presently engaged development partners. Therefore, private sector investors would need to explore to new dimensions. First, there may be prospects for receiving support from other potential development partners such as China, India, Brazil and others. Second, the private sector will need to mobilize funds from commercial sources. As discussed in Chapter 6, this will be unprecedented in the case of Rwanda and involve some initial challenges in mobilizing equity and debt finance. However, it is an unavoidable option considering the size of financial requirements of the power sector.

Rwanda Electrical Map



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