Electricity Sector Reform in Sub-Saharan African Countries and the Required Measures for PPP in Geothermal Power Generation

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Keywords: Private Sector Participation in Geothermal Development Projects in EARS Countries, Public Private Partnerships (PPP)

ABSTRACT

In recent years the electricity sectors in many developing countries have begun programs of major reform and restructuring that reflect the need for better service delivery from state-owned utilities. The reforms have dramatically improved the market structure, regulation and institutional framework. These reforms for many Sub-Saharan African (SSA) countries began in the early 1990s. Two decades later the procedures for reform have been established. However in many developing countries the path and outcome of the reforms vary considerably. The reform outcomes are dependent on the political, economical and market conditions of each specific country.

Geothermal experts in Africa agree that geothermal power generation in the region needs huge investments and strong commitment from both private and public sectors. Serious questions have been raised about the incentives that governments in SSA countries are able to offer to the investors especially in this time of global economic downturn.

This paper attempts to assess the most suitable reform model for the electricity sector in SSA countries, based on evidence obtained from already reformed countries in the region and across the globe - a reform model, which can create a financially strong sector with positive environmental polices that will attract the required investment for geothermal development. The reform models proposed in this paper concentrates on several scenarios for the generation function with special attention paid to the geothermal energy development, and how the geothermal power generation can leverage on the energy sector in the region.

1. INTRODUCTION

Eastern African countries have estimated geothermal potential of more than 15,000 MW. However the national development program for each country in the region is scanty and far behind the aimed goal of utilizing the available resources.

Only Kenya and Ethiopia have geothermal power plants commercially operated with total installed capacity of 217 MW. Countries like Eritrea, Sudan, Uganda, Djibouti, and Tanzania carried out or are in the process of conducting detailed geothermal investigations. Other countries in the region such as Comoros, Burundi, Malawi, DRC, Rwanda, Mozambique and Zambia have not gone beyond the reconnaissance geothermal resource exploration and resource potential inventory (Meseret Teklemariam, 2011).

To accelerate exploitation and utilization of the geothermal resources in these countries, there are many challenges to be overcome through innovative solutions that can address the issues of policy, legislation, institutions and lack of investment thereof. However, in general the main constrains for development the geothermal resources are:

a. High cost of exploration and drilling;
b. Lack of investment due to inadequate incentives, legal and institutional framework;
c. Inadequate personnel with expertise related to geothermal development; and
d. Absence of long-term strategic plans.

2. PRIVATE SECTOR PARTICIPATION IN ELECTRICITY SUPPLY INDUSTRY IN DEVELOPING COUNTRIES

In the last three decades the electricity supply industry (ESI) in SSA countries has been under continuous change. Many countries have implemented a restructured electricity market and introduced competition, to attract private participation.

Private sector participation is arguably the most important element in ESI reforms implementation. For many reforming countries in Africa faced with an increasing burden of capital requirements for expansion of publicly owned electricity systems, private participation is an alternative source for securing the required investment for the industry (Jamasb, 2002). ESI technology has also improved considerably during this period, showing the

necessity of industry reforms to cope with these developments especially the renewable energy.

When designing ESI reforms in most countries, private participation is a best option to financing the expansion of the system and when combined with competition, can result in cost efficiency, lower prices, reduced system losses and improvements to the overall revenue collection (Newbery, 2002). Experience from implemented electricity sector reforms has provided evidence that the gain is higher than the transaction cost of breaking up vertical integrally systems, higher risk premium required by private investors and the cost of regulation (Jamasb, 2002).

Since 1990 the electricity sector across the globe has seen an increasing degree of private participation in many developing countries. Between 1990 and 2000, the World Bank estimates that the total private investment in the electricity sector of developing countries amounted to about US$239.1 billion. This investment is divided into 70% investment in generation, 20% in distribution, 9% in integrated utilities and only 1% in transmission (Figure 1).

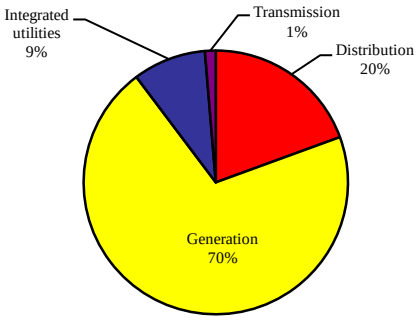

Figure 1: Total investments in the electricity projects with private participation in developing countries, by segment, 1990–2000 (Source: World Bank and PPIAF, PPI project)

Between 2001 and 2008 the total investment in the sector reduced to US$194.6 billion (Figure 2). In this period the investment in generation and transmission increased to 80% and 4% respectively, while the investment in the distribution decreased to 12%. This trend suggests that, the private investment prefers competitive functions (generation, retailing) rather than natural monopoly functions (distribution, transmission). However, in many countries provision of contractual protection is given to foreign investors such as government guarantees, take-or-pay assurances, fuel and currency clauses (World Bank, 1998)

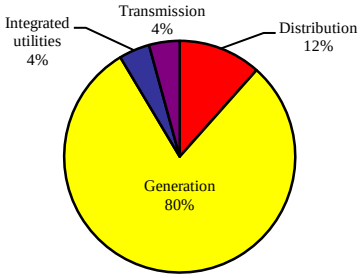

Figure 2: Total investments in the electricity projects with private participation in developing countries, by segment, 2001–2008 (Source: World Bank and PPIAF, PPI project)

Between 1990 and 2000, the majority of private investment in the electricity sector occurred in relatively few countries or regions, with Latin America and East Asia regions alone absorbing 78% of total investment (Figure 3) compared with 51% in the period between 2001 and 2008 (Figure 4). The investment received by Europe and Central Asia increased from 7% by the end 2000, to 24% by the end of 2008; while the SSA region received increased investment of 1% and 3% in the same period - far lower than other regions. Many developing countries face a huge backlog of maintenance and capacity expansion in their electricity power sector, and have experienced a marked deterioration in service quality and an increase in unserved power demand (Besant-Jones, 2004).

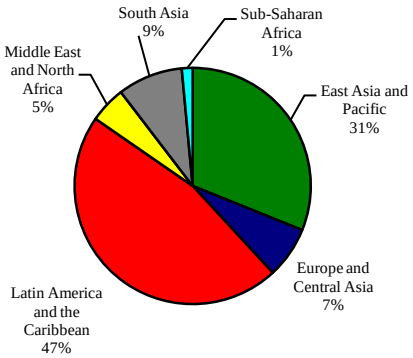

Figure 3: Total investment commitments to energy projects with private participation in developing countries, by region, 1990–2000 (Source: World Bank and PPIAF, PPI project)

It obvious that African countries in general and SSA countries in particular need to create reform models with adequate incentives and transparent regulations to meet the interests of the foreign investors. Furthermore, efficient methods in managing the financial risks experienced by new entrants to the sector are urgently required.

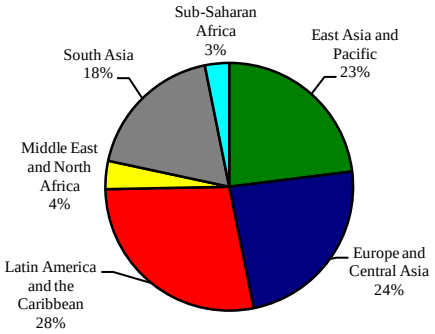

Figure 4: Total investment commitments to energy projects with private participation in developing countries, by region, 2001–2008 (Source: World Bank and PPIAF, PPI project)

3. ELECTRICITY SECTOR REFORM IN SUB-SAHARAN AFRICAN COUNTRIES

The performance of the on-going electricity sector reforms in SSA countries varies widely depending on the level of economic condition of each country, political commitment and stability, reform model implemented and the effectiveness of the institutions created to manage the reformed sector.

Against this background, many countries have experienced more problems than policy makers expected, simply because the main concept of the electricity market is the real time balance between supply and demand (no advance storages are possible). Thus the reform model needs to be designed with more care and adequate regulation than other regulated sectors (Jamasb, Mota, Newbery, Pollitt, 2005). In addition to this the electricity sector in developing countries differs considerably in size, structure and resource mix, with huge constraints by institutional endowment of their political and economic systems as well as lack of human resource with regulatory skills and experience (stern,2000) (cited in Jamasb, 2002).

The electricity sector reforms in SSA countries were implemented in different contexts with different driving factors. But there are two major factors that affected the outcomes of the reform in general, firstly: most of reforms were initiated without sufficient experiences with such initiatives (Jamasb, 2002), secondly: the level of political intervention and absence of continuous government commitment. Accordingly, the reforms have been implemented in different forms and followed a variety of tracks.

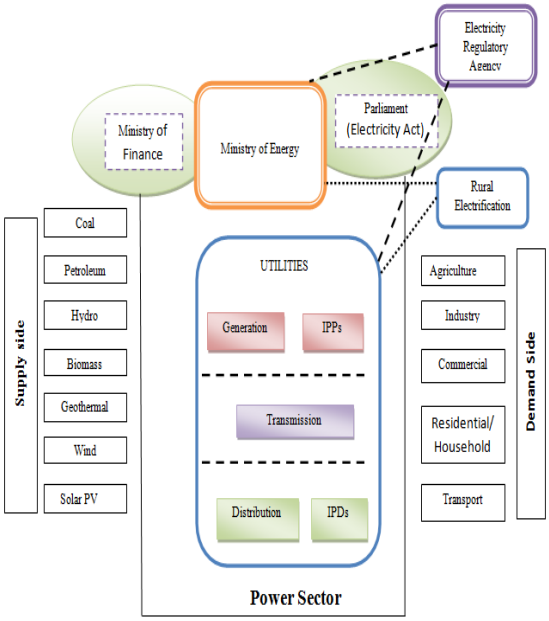

Figure 5: Typical institutional structure of the electricity supply industry in SSA countries (Source: World Bank, 2007)

After many years of experience with on-going electricity sector reforms in SSA countries, practitioners and academics reached an agreement on the ideal institutional structure required. Figure 5 outlines the typical institutional structure of the power sector in most reformed African countries. In order to assess the on-going electricity sector reforms in Africa, technical and financial performance should be assessed and comparison made with other successful reformed countries across the globe laying emphasis on the general characteristic phenomena of the electricity market in SSA countries, as well as specific sector attributes subject to reforms, such as size and resources mix.

4. PERFORMANCE OF REFORMED ELECTRICITY SECTOR IN SUB-SAHARAN AFRICAN COUNTRIES

After two decades of on-going electricity reforms in SSA countries, electrification rate still remains far behind that of

other countries even within the African continent. While South Africa supplies 85% of the population with the electricity service, most of SSA countries have less than 20% electrification rate (Figure 6). The rural electrification rate is even worse with majority of the SSA countries realizing rates of less than 10 % (World Bank, 2007).

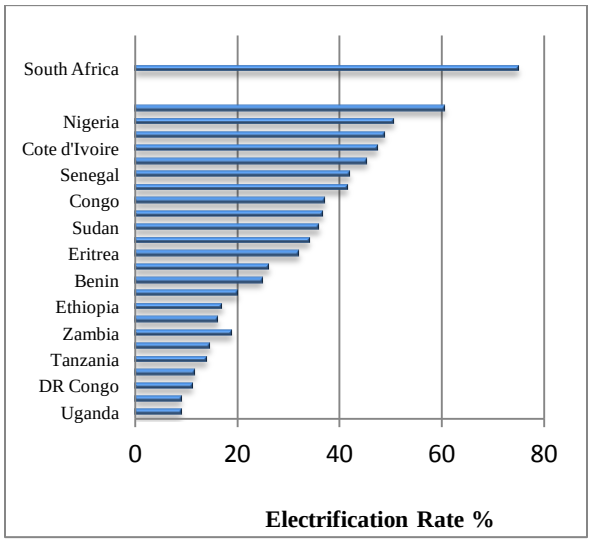

Figure 6: Electricity access in 2009 - Africa (Source: IEA, World Energy Outlook 2011)

World Bank's enterprise surveys estimated that the average electricity consumption per capita in SSA countries is far below the international consumption rate. Figure 7 shows that all the African countries with high resources of geothermal energy have lower electric power consumption rate per capita. In addition to the lack of power generation facilities in many SSA countries, the electricity tariffs are high and many customers are forced to depend on alternative power supply (World Bank, 2007).

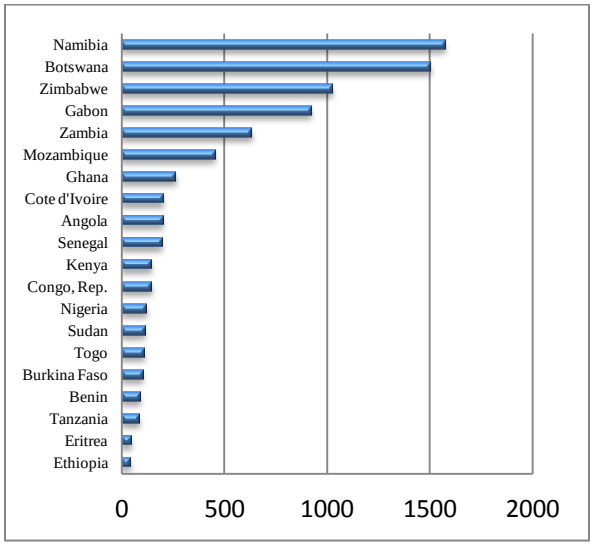

Figure 7: 2009 Electric power consumption in kWh per capita (Source: World Bank Data, countries development indictor, accessed on 10 May 2012)

Tariff reforms remain a crucial element in realizing the healthy financial performance of utilities in SSA countries after decades of reforms. To achieve this, subsidies should be removed to reflect the real cost of the electricity supply. Figure 8 shows that the significant difference in electricity tariff between SSA countries. While some countries secure huge subsidies to their electricity supply, other countries have very high tariffs reflecting the high price of the fuel and high losses of their system as shown in Figure 9.

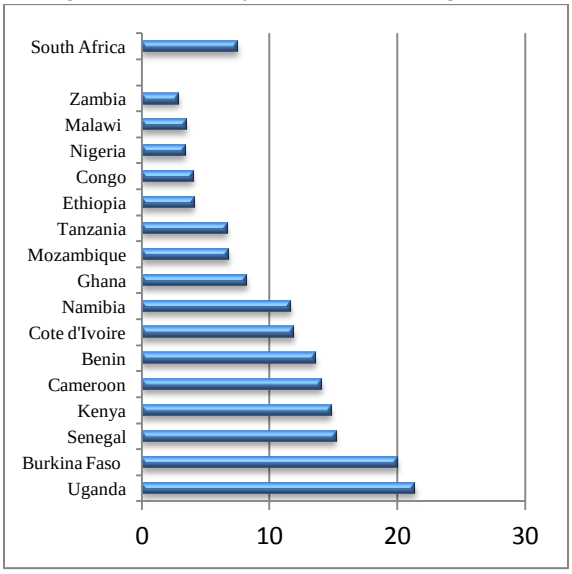

Figure 8: Effective residential tariff for 100 kwh monthly consumption in selected African countries (Source: World Bank, 2009)

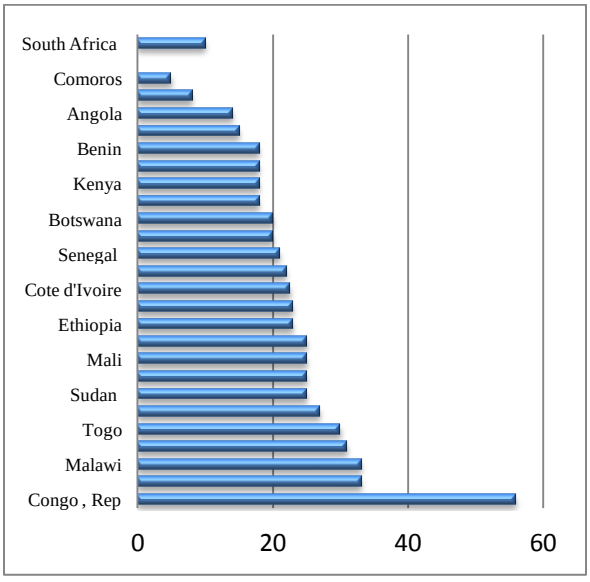

Figure 9: Losses (%) of electricity supply industry in selected SSA countries (Source: World Bank Data, countries development indictor, accessed on 10 May 2012). 2009 Data

In addition to the above-mentioned deficiencies, SSA countries still suffer from high rate of black out and power supply interruptions reflecting the lack in power generation facilities and poor infrastructures in transmission lines and distribution (Figure 10).

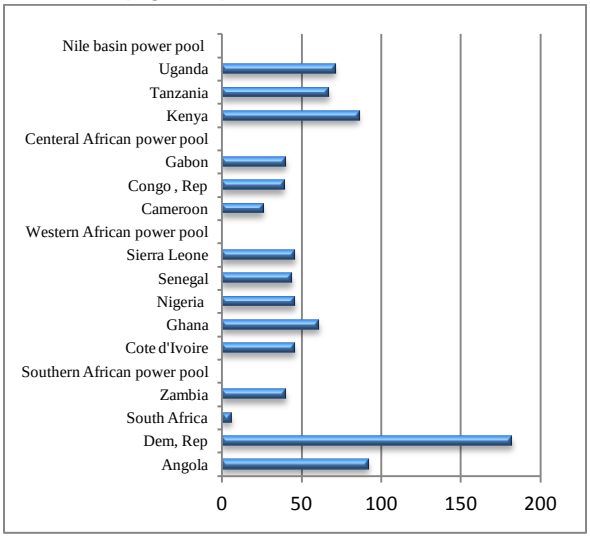

Figure 10: Blackout data for selected countries in SSA (day/year) (Source: Eberhard, Rosnes, Shkaratan, Vennemo, 'Africa's Power Infrastructure', World Bank, 2011)

In conclusion, SSA countries are still in the midst of power crisis after two decades of on-going electricity reforms. The region's electric power consumption per capita is lower compared to other regions in the world, the average tariff is almost double that in other developing regions and electrification rate is far below those of similar developing countries. The electricity supply is unreliable in most African countries and the achievements that have been realized are limited. In most practitioners' assessment, huge investments are still needed for power generation expansion assets and related facilities. Decision makers in the sector planned to create competition by attracting more private investments, but considerable advances are required to achieve this

The on-going electricity sector reforms in SSA countries will continue to face many constraints and challenges which need to be addressed properly when designing a sustainable reform model. It is very important to allocate sufficient time and expertise to enforce the existing institutions and ensure compatibility with the new concept and target of reforms. In addition, encouraging innovation and providing the required incentives through a credible regulatory body are vital factors that should be considered by decision makers in the region.

5. RISK AND MITIGATION MEASURES FOR PRIVATE SECTOR PARTICIPATION IN GEOTHERMAL ENERGY IN SUB-SAHARAN AFRICAN COUNTRIES

In defining effective measures to encourage public-private sector participation (PPPs) in the electricity supply industry in SSA countries in general with special emphases on geothermal energy, it is important to know the trends and the performance of previous PPPs already implemented in the region as well as the best practices from other developing regions. In other words, in order to achieve the successful public-private sector participation, the governments and regional institutions need to have clear visions of their targets from the private sector and be able to answer the questions: "What incentives should we offer to the private sector?" "What incentives are we able to offer to them?", "To what extent can we commit ourselves to our promises?" etc.

5.1 International Practices in Developing Geothermal Projects and Related Models and Institutions

Geothermal energy has been developed globally for power generation in 23 countries with total installed capacity 11,224 MW. Geothermal energy utilization is currently fueled by a number of factors: economic growth, especially in developing markets; the electrification of low-income and rural communities; increasing concerns regarding energy security and its impact on economic security. Additionally, most of the growth in the development of global geothermal resources has occurred in countries with large, untapped, conventional resources. As more countries recognize and understand the economic value of their geothermal resources, their development and utilization becomes a higher priority (GEA, 2012).

According to international practice, there has been no successful single model for geothermal energy resources development. Therefore it is worth exploring how different countries have developed their geothermal implementation model and the related institutions, before discussing the suitable required model for SSA countries.

The implemented geothermal development models have varied from country to country. The well known models are classified into 7 categories depending on the national policies, circumstances and a country's ability to bear a certain degree of embedded geothermal risk development. These models are:

a) A single national entity responsible for exploration, drilling, well field development, power plant construction and operation. The financing for these activities is secured from the government, government in conjunction with donors' grants and from

international lenders. In this model the government bears the entire risks directly or through sovereign guarantees of loan. This model has been successfully adopted in Costa Rica, Mexico and Italy, with lesser success adoption in El Salvador, Portugal.

b) Two national entities - one responsible for exploration, drilling, and well field development and the other responsible for construction and operation of the power plants. The exploration and drilling entity secures initial financing from the government and later on entirely from either selling steam or from its other activities. The second entity constructs the power plant through government financing or from international lenders with sovereign guarantees. The entire risk in this model is borne by national government in case the revenue from selling electricity does not cover the cost. This model depends on strong government commitment through a robust energy policy. The model has different level of success in Philippines, Kenya, New Zealand and France; less success in Turkey and Ethiopia and significant failure in Djibouti, Greece and Bolivia.

c) Several national and local governmental entities: In this model, the policy allows national and several local government entities to independently undertake exploration, drilling, well field development, power plant finance, construction and power plant commercial operation within their respective service districts or administrative areas. The risk is borne by those entities. This model has been successfully adopted in Iceland. However, the Iceland energy authority recently allowed for leasing of utilization rights to private developers while the resources ownership remains with national or local government entities.

d) One or more national entities performs exploration, drilling, well field development and sells steam to IPPs, normally based on BOT form. Electricity is then sold either to the entity selling steam same like in Costa Rica, or to a national electric utility as in the Philippines. The resources risks in this model are borne entirely by government, while the financing and construction risks of the power plant are borne by IPP developers as adopted in Costa Rica and Philippines.

e) One national entity responsible for exploration and drilling discovery of wells only, after which it promotes the discovered fields to private developers through competitive bids. The developers then develop the wells field, construct and operate the power plant. The national entity bear low cost of discovering the fields and the private developers bear the cost of well field development in addition to financial and economic risks of constructing and operating the power plant. This model has been adopted successfully in Turkey and Guatemala.

f) Government entities (national or local) finance all or most of surface exploration through grants or cost-sharing with private sector. Then, the private sector takes over to develop the wells field, finance, construct the power plant and sell electricity to the competitive market. Risks of initial exploration is borne by the government, risks for initial drilling are either borne by government or through cost-sharing with private sector. Risks for wells field development, power plant finance, power plant construction are borne by private sector. This model has been developed successfully in Japan, United States and Australia.

g) Government entities (national or local) carry out limited exploration and make data accessible through public domain to the potential developers. These government entities could be privatized, partly privatized or autonomous government entities. In this model the private sector entities after getting preliminary data, competitively continues with exploration, wells field development, drilling, and if success build and operate power plants. In this model the revenues are expected to cover all the expenses and satisfactory return on investment. Most risks are borne by the private developers while the government entities only bear the surface exploration risks. This model has been adopted successfully in United States.

5.2 Proposed Action Plan on National Geothermal Program for Countries of East African Rift System (EARS)

Most practitioners consider IPPs as a major component in electricity sector reforms, although the reforms in most African countries have not been far reaching. In most cases, state utilities remain vertically integrated and maintain a dominant share of the generation market with limited share of private sector. The policy and regulatory framework remains unchanged, competition limited and international competitive bids that have been advertised in most cases have failed to conclude due to tight timeframe. The lengthy power purchase agreement PPAs and slow governments' guarantees also increases the risk of development. African countries are exposed to significant exchange rate risks due to the hard currency denominated financing and costs (Anton Eberhard, Katharine Gratwick, 2011).

Due to the recession of 2008-2009, international firms are trying to reduce the exposure risks in developing countries. Developing financial institutions DFIs are forced to be more restricted on the infrastructure investment. Therefore, a hybrid solution emerged as public-private participation PPPs for infrastructure in developing countries.

PPPs have played an important role in infrastructures realization since the concept was established three decades ago in some developed and developing countries. The PPPs are able create mutual interest for both involved parties:

governments can utilize the private sector's resources in delivering infrastructures mega projects, on the other hand when private investors share exposure risks with government, the project's delivery processes tend to takes place much faster, with high efficiency, transparency and accountability (Jon Valentine, 2008).

To secure the required investment for developing geothermal project in SSA countries, on-going reforms need to be accelerated in order to eliminate system inefficiencies and increase the electricity sector reform sustainability in the region. By doing this, the existing recourses will be involved heavily in closing investment gaps in SSA countries, and also will create an attractive investment climate for international investors as well as local private sector.

To build a successful model in creating and managing sustainable PPPs for geothermal energy sector in SSA countries, sound action plans need to be created, established and monitored with consistency and integrity at the following levels:

i. Country level
ii. Electricity sector lev
iii. Geothermal energy project level

5.2.1Action Plans at the Country Level

In this level, governments need to establish general investment frameworks in order to enhance opportunities for PPPs in their countries, and to create favourable environments for effective competition throughout the electricity sector with transparency. The action plans at the country level can include but not be limited to the following:

a) Improve country's political and financial stability: Political and financial stability are some of most important factors for creating a favorable investment climate and fostering competition. Political stability will minimize risks to the investors such as expropriation, renegotiation of the contract and political violence. Financial stability will keep confidence on local currency, exchange rate risks, and minimize the expected risks cause by the government agencies (Asian Development Bank ADB, 2000).
International practices indicates that countries with better investment grade ratings issued by standards rating agencies, were able to attract investors more successfully than countries without or with low rating. The investment climate also goes a long way in setting the stage for negotiation and more balanced contracts (Anton Eberhard, Katharine Gratwick, 2011).

b) Establish strong and continuous government commitment for electricity sector reforms: Despite the fact that most SSA countries have already started reforms in their electricity sectors, restructuring processes are still dragging and far away from reaching the aimed targets. It is noted from Asian countries best practices that structuring for electricity sector is a critical element for PPPs' success. Governments need to implement the restructuring process as quickly as is politically and economically possible. In order to achieve momentum for the PPPs initiatives overtime through governmental change, a government's mandate and vision should be fixed through relevant legislative acts or presidential decrees.

c) Improve confidence on the legal system: Legal framework should be improved significantly including commercial law, contracting law and ownership and relevant court system procedures. Alternatively, third party arbitration in other countries may send positive signals to investors.
Efficiency, stability and consistency are the result of a well-designed legal framework, which must establish the regulatory standards and the institutions that enforce the electricity sector reforms. This measure should be horizontally integrated with good governance in order to turn to a positive investment landscape that enables governments to attract the private sector investment backed by strong legal framework, regulatory and institutions (Jon Valentine, 2008).

d) Encourage and develop the local capital markets: The SSA countries are urgently required to adopt national policies with long term objectives to make local capital available to the local investor. Employees' provident funds and pension funds are widely used to finance the PPPs projects according to some best practices.

Table 1: Country Level Action Plans and Required Measures

Action Plan Area	Measures
Improve political & financial stability	• Table macro-economic policies • Investment grade rating issued by standards rating agencies • Create innovative risk mitigation techniques through legal and political measure • Good repayment record • Keep confidence on local currency, exchange rate risks. • Minimize the expected risks cause by the government agencies
Establish strong and continuous government commitment for electricity sector reform	• Announced governments' mandate through relevant legislative acts or presidential decrees
Improve confidence on the legal system	• Improve commercial law, contracting law and ownership • Improve court system procedures. • Allow third party arbitration
Encourage and develop the local capital markets	• Empower local investors • Ease local capital to the local investors

5.2.2 Action Plans at the Electricity Sector Level

The action plans at the electricity sector level should consist of the following elements:

a) Proper planning and monitoring for electricity sector reform: Standard reform models for electricity sector have been implemented in most SSA countries by unbundling of power generation, transmission and distribution, with the intention of introducing competition and PPPs as seen in figure ----. However, most incumbent national utilities are state owned and still in dominant position (Eberhard, Gratwick, 2011)

   Evidence from electricity sectors reformed in several countries showed the difficulties of reforms and the risks that they introduce to the both countries and investors. Paying special attention to unpredictable reform paths will definitely lead to an increasingly poor operating environment for PPPs (Woodhouse, 2005). Therefore, it is very critical to develop a robust plan with integrated elements for each country in the SSA region based on best practices and each country's circumstances. The plan should identify the final structure of the sector, the required steps to reach the aimed result, the assessment of the existing utilities and the expected role for PPPs.

   The World Bank concluded that there is a limited number of studies assessing the socio-economic aspects of power sector reforms in the reformed SSA countries, and that the studies available were scanty. To overcome this shortfall, a full assessment study about electricity sector reforms in SSA countries are required to point out the necessary improvements on policies, institutions and incentives.

b) Empower the regulatory commission: Although most of SSA countries have introduced legislation to allow for PPPs in electricity sector, few have actually formulated a coherent policy framework for procuring IPPs (Eberhard and Gratwick, 2011). In many cases, regulators are far from independent and subject to pressure from the government to modify or overturn decisions - the disconnection between law and practice is often wide (World Bank, 2010) .
   SSA countries should empowered their regulatory institutions to achieve financial viability, increase ability to attract new investment, encourage efficiency, create competition, reduce cost and ensure reliable services. These targets cannot be achieved without a strong regulatory commitment, clarity of regulatory framework and procedures, effective appeal processes and dispute settlement facilities, competent institutions and capacity building.

c) Effective electricity sector planning: A coherent electricity sector plan is a pre-condition for any successful PPP especially in the generation function. According to the reformed countries experience, the required plan should identify reliability standards for: energy security, completion of detailed supply and demand forecast as well as least-cost plan with alternative scenarios. It is critical for decision makers in SSA countries to clarify how the planned generation will be split between private and public sector (Eberhard, Gratwick, 2011).

   Electricity sector planning should also be developed to ensure the sustainability of the sector by enhancing access to electricity among the population especially in the rural areas, because increasing the electrification rate is likely to widen the scope of required generation opportunities (World Bank, 2007).

Table 2: Electricity Sector Level Action Plans and Required Measures

Action plan area	Measures
Planning & monitoring for electricity sector reform	• Assessment studies of electricity sector reform • Create mechanism to continuously identify the necessary improvement on policies, institutions and incentives.
Empower the regulatory commission	• Strong regulatory commitment. • Clarity of regulatory framework and procedures. • Effective appeal process and dispute settlement facilities. • Competent institutions • Capacity building.
Effective electricity sector planning	• Identify reliability standard for energy security • Completion of detailed supply and demand forecast • Least-cost plan with alternative scenarios. • Clarify the planned role for private and public in generation • Set target for electrification rate

5.2.3 Action Plans at the Geothermal Sector Level

The proposed action plans at the geothermal level is based on addressing the constrained risks that hinder national development program for each country as well as regional cooperation in developing geothermal. The following part highlight the necessary measures that can be implemented to mitigate the risks associated with resource exploration and well field development as well as financial risks associated with investment in power project development.

a) Mitigation measures for exploration and well field development: These stages of geothermal project are very sensitive to the country risks. The stages of exploration and well field development in particular need long lead-time before power plant construction and without income revenue for several years. During that lengthy period many factors can interrupt the project activities or even to be cancelled. The influencing factors and mitigation measures can be classified as follows:

- Financial factor:

Financing is the most important factor that to needs to be addressed properly in any successful project planning. The funds mobilized in these stages are a reflection of the government's commitment and effective institutions set up as discussed in section 5.1. Table 3 summarizes the international practice on options used to finance exploration and well field development.

Table 3: International practices on financial sources for geothermal exploration and well field development (Source: geothermEx, Inc, 2010- study prepared for WB)

Stage	Source of Finance
Reconnaissance	Typically borne by government agency, may be borne partially by private developer
Detailed surface exploration	Often borne by government agency, usually augmented or borne by largely by private developer
Drilling	Occasionally borne by government agency, usually borne by private developer
Long-term flow testing and numerical simulation of reserves	Very rarely borne by government agency, always borne by private developer

International practices indicate several ways of reducing exploration and well field development costs , which can be adopted in the eastern African countries such as: (1) cash grants, (2) cost-sharing between government/ regional institutions and private sector (Risk Mitigation Fund), (3) reservoir insurance and (4) government-sponsored exploration and drilling. However, reduction of financial risks of exploration and drilling alone is not enough. Adequate incentives for private sector participation and further powerful incentives related with electricity sector level will send positive signals to the private developer to participate in exploration and drilling. These incentives include:

i. Unrestricted access to the national grid
ii. Subsidies in the form of market set-asides
iii. Preferential pricing
iv. Loan guarantees
v. Freedom from government restrictions and interference

It is worth noting that availability of complete and comprehensive geothermal prospects mapping is essential for encouraging the PPPs in exploration and drilling. Furthermore, lack of appropriate institutions has also contributed in the lack of PSP in geothermal development in EARS.

- Required geothermal expertise:

Exploring and developing geothermal resources is a multi-disciplinary task, where experts from varying fields such as environmental scientists, geologist, geochemist, geophysics, drilling engineers, reservoir engineers and design engineers for geothermal facilities are needed.

Getting access to such a pool group of experts in the various fields of geothermal science and engineering, is difficult for most countries in EARS. In order to build the required capacity, national and regional capacity building policy needs to be adopted with adequate regional capacity sharing.

b) Mitigation for geothermal power plant construction and commercial operation: The following measures will address the risks associated with geothermal power plants in the different construction phases including planning, procurement, contracting, construction and commercial operation:

- International competitive bids (ICBs) for geothermal power plant projects:

African IPPs bidding selection practices have drawn attention to the importance of ICBs. Eberhard and Gratwick-2011 stated that there is evidence that ICBs reduce the stated cost of IPPs power plant with up to 60 %.

It is worth noting that the success of ICBs depends on the number of bids received, which is linked with other factors in the country level and electricity sector level as discussed before. Decision makers should also consider the lengthy period and significant costs associated with ICBs.

- Promote local investors' participation in financing geothermal projects:

International investors have been the dominant players in most SSA countries' IPPs practices. This is different when compared to the Asian countries' practices where local participation in financing has been one of success factors. The success is attributable to the fact that local participation helps projects and host countries to release projects from expected local opposition, reduces the possibility of changing contracts or renegotiations from host countries and reduces the foreign exchange exposure risks associated with the projects.

Since capital markets in many African countries are not deep or liquid enough to share in such big projects (Eberhard, Gratwick 2011), the mitigation measures should be linked to the factors discussed in the country and electricity sector levels.

- Investment guarantees:

Most IPPs in African countries have adopted several combinations of credit enhancements reflecting the country risks profile and investors' confidence. The most common guarantees used in the previous IPPs in African countries which will remain valid for coming geothermal projects in EARS countries are:

i. Escrow account;
ii. Letter of comfort from the government covering political risks; and
iii. Partial risk guarantees from international development association, supported by political risks cover from multilateral investment guarantees agency.

In conclusion, lack of sovereign guarantees will be the main obstacle in developing geothermal projects in EARS countries through PPPs. Like most elements in geothermal project level, this factor should also be linked to and integrated with other factors in the country and electricity sectors levels.

6. POLICY INTEGRATION AND CAPACITY BUILDING FOR GEOTHERMAL ENERGY LEVERAGE

Due to the complexity of the PPPs in infrastructure particularly in geothermal development projects, where several stakeholders are involved, there are two important considerations to be understood by and communicated to concerned participants in geothermal development projects. These are:

I. Policy integration:

The policy integration and the action plan harmonization between country level, electricity sector level and geothermal development project level are essential success factors for PPPs in national geothermal development projects.

In addition to that, most experts believe that strengthening regional institutions and developing regional plans on geothermal development will the fill the gaps in expertise and financial requirements for each country in the region

II. Capacity building:

For successful planning and implementing of national and regional geothermal development projects, each country in EARS should have easy access to the pool of experts in the different fields related to geothermal, policy, contracting,

investment etc. Highly skilled expertise is urgently required at the country level, electricity sector level as well as geothermal project level. Regional and international cooperation is key in building the required capacity.

Figure 11 show the proposed model for geothermal development program summarizing the action plans required to implement the three levels described in previous sections. This model is suitable for implementation both nationally and regionally in EARS countries.

7. CONCLUSIONS

- SSA countries are still in the midst of power crisis after two decades of on-going electricity reforms. The region's electric power consumption per capita is low compared to other regions in the world, the average tariff is almost double that in other developing regions and electrification rate is far below those of similar developing countries. The electricity supply is unreliable in most African countries and the achievements that have been realized are limited. In most practitioners' assessment, huge investments are still needed for power generation expansion assets and related facilities
- Geothermal energy utilization projects in EARS countries are fueled by a number of factors: economic growth, the electrification of low-income and rural communities; increasing concerns regarding energy security and its impact on economic security. EARS countries recognize and understand the economic value of their geothermal resources, hence their development and utilization has become a high priority.
- It obvious that African countries in general and SSA countries in particular are still unable to attract the required investment in electricity supply industry after two decades of on-going reforms. Therefore reforms in many countries need to be assessed and improved to meet the interests of the foreign and local investors.
- To secure the required investment for developing geothermal projects in SSA countries, on-going reforms should be accelerated in order to eliminate system inefficiencies and increase the electricity sector reforms sustainability in the region. By doing this, existing recourses will involve heavily in closing investment gap in SSA countries, and also will create attractive investment climate for international investors as well as local private sector.
- To build a successful model for creating and managing sustainable PPPs for geothermal energy sector in SSA countries, sound action plans should be created, established and monitored with consistency and integrity at the country, electricity and geothermal energy project levels.

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