RE-DESIGNING AND INTEGRATING NATIONAL INTO REGIONAL GEOHERMAL DEVELOPMENT STRATEGIES TO INCREASE ELECTRIC ENERGY FOR ECONOMIC AND SOCIAL TRANSFORMATION

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Keywords: geothermal energy, regional integration, East African Rift System,

ABSTRACT
Africa’s bleak energy consumption is summarized as the paradox energy poverty in the middle of plenty as shown by only South Africa being ranked the 16th while the rest of the East African region occupying between 104th and 163rd in the world. Sub-Saharan Africa generated power is estimated at 68-gigawatts (GW) no more than that of Spain, with South Africa alone accounting for 40-GW. Uganda’s paradox of growth without transformation is on the electric energy sector, as the building of dams, multilateral supported programmes like Rural Electrification Agency; electricity consumption of 75-kWH per capita is one of the lowest.

The challenge of overcoming the dire energy needs in rural and urban environments across the continent is to develop a customer strategy that aim towards eliminating fossil fuels by creating infrastructure for renewable energies. Among renewable energies is geothermal which has a lead solution to low electricity consumption and mitigation against its grave impediment to rapid economic and social development. The East African Rift System (EARS) is one of the major tectonic structures of the earth that stretches for about 6,500 km from the Middle East (Dead Sea-Jordan Valley) in the North to Mozambique and Madagascar in the South. The EARS passes through Eritrea, Djibouti, Ethiopia, Kenya, Tanzania, Uganda, Rwanda, Democratic Africa’s Republic of Congo (DRC), Zambia, Malawi, Mozambique and Madagascar. Its estimated geothermal energy resource potential is more than 15,000 MW. Despite the high geothermal potential of the EARS, only Kenya and Ethiopia have installed a capacity of about 214 MWe.

Other countries are still at the surface exploration stage and yet to locate their geothermal reservoirs. Geothermal energy presents a clean and more environmentally friendly alternative to traditional fuels and has the potential to provide long-term, secure base-load energy and greenhouse gas (GHG) emissions reductions. However this potential can only be realized if the following bottlenecks are eliminated or mitigated: risks associated with resource exploration and development; lack of funding; and lack or inadequate geothermal policy, legal and institutional frameworks in most countries of the ears. The regional geothermal development strategy is vital to overcoming many investors reluctance and triggering private investments including capital intensive and long-term investments which are needed for progressive development of the geothermal energy sector to meet the region’s growing energy demands in a climate friendly way.

1. INTRODUCTION

1.1 The Lion and Strategy
The need for a concerted and dynamic strategy to overcome Africa’s bleak energy consumption is best illustrated by lion and gazelle survival strategy. Each morning in Africa, lions and gazelles wake up with the same thought: “what a beautiful day! All I have to do is to run faster than the slowest gazelle around”. Yet the lion knows that every day he has to be a little bit faster, because today’s slowest gazelle runs faster than yesterday’s slowest gazelle. And at the same time, the gazelle is aware that it must continuously improve its own speed, or one day it will inevitably be the slowest (Richner, 2012).

The harsh reality shown above is akin to Africa’s generated power, challenge of overcoming the dire energy needs in rural and urban environments across the continent in general and the East African region in particular, response to the impact of climate changes on their economies and the need to re-design and integrate national into regional energy development especially renewable energy and in our particular interest; geothermal energy. Energy should be treated as a security matter because there is no adversary with such lethal fangs as poverty (Simiyu, 2012).

1.2 The Regional Geothermal Resource
The great East African Rift System (EARS) is one of the major tectonic structures of the earth that extends for about 6500 km from the Middle East (Dead Sea-Jordan Valley) in the north to Mozambique and Madagascar in the south. This system consists of three main arms: the Red Sea Rift; the Gulf of Aden rift; and the East African Rift, which develops through Eritrea, Ethiopia, Kenya, Tanzania, Zambia, Malawi and northern Mozambique floored by a thinned continental crust (Figure 1).
The EARS is composed of two rift trends; the eastern and western branches. The western branch develops from Uganda throughout Lake Tanganyika, where it joins the eastern branch, following the border between Rwanda and Democratic Republic of Congo (DRC). The western branch is, however, much less active in terms of tectonics and volcanism although both branches are seismically and tectonically active today.

The East African Rift is one of the most important zones of the world where the heat energy of the interior of the earth escapes to the surface in the form of volcanic eruptions, earthquakes and the upward transport of heat by hot springs and natural vapor emanations (fumaroles). The eastern branch, that forms the Ethiopian and Kenyan rifts, possesses, by far, the most extensive geothermal resource base in Africa and one of the most extensive in the world. Countries such as Djibouti, Uganda, Eritrea and other countries in southeastern Africa have lesser but still important resource bases. Using today’s technologies, EAC has the potential to generate more than 15,000 MW of energy from geothermal power. However, only 214MW is currently generated in Kenya (209MW) and Ethiopia (5MW) (Omenda and Teklemariam, 2010).

2. THE EAST AFRICAN COMMUNITY

The original East African Community (EAC), which was formed in 1963 and collapsed in 1977, composed of Kenya, Tanzania and Uganda was one of the most enviable regional communities replete with a single currency, comprehensive services composed of a railway, airline, ports and harbors, custom union, post and telecommunication system and their requisite infrastructures among others. This EAC broke down because of political differences brought about by the then president of Uganda, H.E. Amin Dada (RIP), and the leaders of Kenya and Tanzania who were fighting for superiority. The
community was revived in 2000 after ratification of the EAC treaty signed earlier in 1999 by member states of Kenya, Uganda and Tanzania. Rwanda and Burundi joined the Union in 2007. As by the treaty, the objectives of the EAC are to develop policies and programs aimed at widening and deepening co-operation among the partner states in economic, social, cultural and political fields for their mutual benefit. Within this framework partner countries also resolved to establish amongst themselves a customs union, a common market, subsequently a monetary union and ultimately a political federation to strengthen, regulate, and enhance an accelerated harmonious, equitable and sustained economic development (EAC, 2007). This collaboration of efforts has so far yielded a customs union launched in 2005 and the common market established in 2010 (Kutesa, 2012).

2.1 Regional Economic and Energy Sector Indicators

2.1.1 Economic indicators
At a glance the eac common market covers a geographical area of 1.82 million square kilometers and a growing population of 133.1 million people. The economic community displays some improvements in economic growth despite country level differences in economic performance. Market price gap which stood at USD74.5 billion accordingly in 2005 registered USD79.2 billion in 2010. Individual country contributions are shown in Figure 2 (ibid). This region borders with South Sudan and Ethiopia in the north, Democratic Republic of Congo (DRC) and Zambia in the west, Somalia and Indian Ocean in the east and Mozambique in the south. All member countries are categorized under Low Human Development Index (Human Development Report (HDR, 2013) with Kenya ranked highest at 145, Tanzania152, Uganda 161, Rwanda 167, and Burundi the least at 178 (Figure 3)

Figure 2: Regional Trends In GDP at Current Prices

![Figure 2: Regional Trends In GDP at Current Prices](image)

Table 3: East African member country development ranking compared to Norway

<table>
<thead>
<tr>
<th>Country</th>
<th>Human development index rank</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Norway*</td>
<td>1</td>
<td>0.955</td>
</tr>
<tr>
<td>Kenya</td>
<td>145</td>
<td>0.519</td>
</tr>
<tr>
<td>Tanzania</td>
<td>152</td>
<td>0.476</td>
</tr>
<tr>
<td>Uganda</td>
<td>161</td>
<td>0.456</td>
</tr>
<tr>
<td>Rwanda</td>
<td>167</td>
<td>0.434</td>
</tr>
<tr>
<td>Burundi</td>
<td>178</td>
<td>0.355</td>
</tr>
</tbody>
</table>

* Norway leads the 47 very high human development countries group in the world.

Another criterion used is the ease of doing business (World Bank, 2013). Despite the reform efforts of all 5 members, the EAC’s average ranking on the ease of doing business has remained static over the past 4 years, at around 117. This is a clear indication that critical obstacles to entrepreneurial activity remain and that economies in other regions have picked up the
pace in improving business regulation. But good regulatory practices do exist in the EAC. Indeed, if a hypothetical EAC economies were to adopt the best practices among partner states as measured by ease of doing business indicators, its ranking would stand at 117 (average for all the five EAC countries) in the global ranking as shown in figure 4.

**Figure 4: East African member country doing business ranking**

<table>
<thead>
<tr>
<th>Rank</th>
<th>Economy</th>
<th>Db2013 reforms</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Singapore*</td>
<td>0</td>
</tr>
<tr>
<td>52</td>
<td>Rwanda</td>
<td>2</td>
</tr>
<tr>
<td>120</td>
<td>Uganda</td>
<td>1</td>
</tr>
<tr>
<td>121</td>
<td>Kenya</td>
<td>1</td>
</tr>
<tr>
<td>134</td>
<td>Tanzania</td>
<td></td>
</tr>
<tr>
<td>159</td>
<td>Burundi</td>
<td>4</td>
</tr>
</tbody>
</table>

The rankings for all economies are benchmarked to June 2012. The above data is extracted from table 1.1.

**2.1.2 Energy sector indicators**

The biggest project undertaken under the 1946 plan in Uganda was the building of a hydroelectric station at the Owen falls in Jinja (Kaberuka, 1990). The station remained the sole major supplier of electricity to Uganda and supplemented the power generated in Kenya and Tanzania. This scenario persisted until late 1990s when another hydropower extension was added. The regional power sector like Uganda was state owned monopolies and like other state enterprises, characterized by inefficiency, waste, and corruption in the provision of public services (Bhagavan, -1990) and (the WB, IFC). It was thus inevitable that member states, like the rest of the developing world, had to undertake electricity sector reforms directed towards improving the quality of service, connectivity and other pertinent areas to achieve overall efficiency and attraction of private capital investment to the sector (Maweje et al, 2012).

The regional power consumption, however, remains very low. Demissie (2013) as well as Civil Society Organizations (CSOs, 2009) summarizes it as the paradox energy poverty in the middle of plenty taking Africa’s potential of the renewable energy mix of wind, solar, hydro, bagasse and geothermal power potential of say 386,000TWH. Mungai (2011), puts Sub-Saharan Africa generated power at an estimated value of 68 GW that is no more than that of Spain, with South Africa alone accounting for 40GW (Table 2): therefore, investment in renewables, especially geothermal, should be given priority (Simiyu, ibid).

**Table 2: Power generated in selected sub-saharan African countries compared to the World and China**

<table>
<thead>
<tr>
<th>Rank</th>
<th>Country</th>
<th>Electricity consumption (MWh/yr)</th>
<th>Year Of data</th>
<th>Population</th>
<th>As of</th>
<th>Average power Per capita in (watts/person)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>World</td>
<td>18,471,105,332</td>
<td>2002-10</td>
<td>6,882,980,472</td>
<td>2005-12</td>
<td>306</td>
</tr>
<tr>
<td>1</td>
<td>China</td>
<td>4,603,700,000</td>
<td>2011</td>
<td>1,347,350,000</td>
<td>2011</td>
<td>389</td>
</tr>
<tr>
<td>16</td>
<td>S.Africa</td>
<td>212,200,000</td>
<td>2008</td>
<td>50,586,757</td>
<td>2011</td>
<td>478</td>
</tr>
<tr>
<td>104</td>
<td>Dr Congo</td>
<td>6,036,000</td>
<td>2008</td>
<td>71,712,867</td>
<td>2011</td>
<td>10</td>
</tr>
<tr>
<td>107</td>
<td>Kenya</td>
<td>5,738,000</td>
<td>2008</td>
<td>41,070,934</td>
<td>2011</td>
<td>16</td>
</tr>
<tr>
<td>117</td>
<td>Sudan</td>
<td>3,787,000</td>
<td>2008</td>
<td>30,894,000</td>
<td>2008</td>
<td>14</td>
</tr>
<tr>
<td>120</td>
<td>Tanzania</td>
<td>3,431,000</td>
<td>2008</td>
<td>43,188,000</td>
<td>2010</td>
<td>9</td>
</tr>
<tr>
<td>133</td>
<td>Uganda</td>
<td>1,958,000</td>
<td>2008</td>
<td>32,369,558</td>
<td>2009</td>
<td>7</td>
</tr>
<tr>
<td>159</td>
<td>Burundi</td>
<td>273,400</td>
<td>2008</td>
<td>10,216,190</td>
<td>2011</td>
<td>3</td>
</tr>
<tr>
<td>163</td>
<td>Rwanda</td>
<td>236,800</td>
<td>2008</td>
<td>11,370,425</td>
<td>2011</td>
<td>2</td>
</tr>
</tbody>
</table>

3. CHALLENGES TO EAST AFRICAN REGIONAL INTEGRATION

3.1 Internal Regional Challenges
Some of the major constraints are the planned processes of member states which do not take into cognizance of the need to have a regional component in the planning process and matter of interests of individual member states. Consensus becomes difficult because junior or middle level officers come with fixed briefs from their countries and they stick to them with no room for flexibility, the whole aspect of the national ownership of the programmes, as opposed to what are regional interests. How for example, can a regional organization transposition or show the usefulness of our regional programmes when they are juxtaposed with the national programmes? Member states do not want to pay their dues, pay on time without any follow-up in addition to weakness in the rate at which member states meet their commitments (Maulim, 2013). Un even human resource and technical competencies in geosciences and technologies. Fear to combat corruption because of risk to commit political suicide (Kiltgaard, 1998).

3.2 External Regional Challenges
Some of the key challenges facing the regional geothermal industry are the reluctance of many investors to finance exploration endeavors, weak ability to attract sufficient and competitive foreign direct investment as well as risks that directly affect production, power markets, venture liquidity and profitability that are external in character. These risks are the same as those that face the investors in other large projects elsewhere in the world but more pronounced in geothermal exploration, especially before the advent of the successful showcase Kenyan geothermal power projects.

4. AVAILABLE GEOTHERMAL DEVELOPMENT FACILITIES

4.1 International and Bilateral Programmes

4.2 Regional Programmes
All East African Country Energy Regulators are Members of the Energy Regulators Association of East Africa (EREA) and are represented at the Power Working Group of The East African Community and partner with Eastern African Power Pool (EAPP) to Implement Regional Power Master Plan (Waco, 2014). There are numerous Regional and Continental Africa Private Sector Researchers engaged in The Power Sector to Compliment Public Sector Players.

5. CONCLUSION
Integrated geothermal development would address energy resource development imbalance across the region, overcome national financial and associated risks, investors’ reluctance to invest in the capital intensive exploration, optimizing regional and international facilities in addition to triggering private investments and their protection.

Great challenges are facing African countries with regard to environmental destruction, protection and response to the impact of climate changes on their economies and attendant climate risk management and adaptation. This, further demonstrates the need for the integration of and developing and strengthening climate change capacity for African countries and, climate risk management and adaptation strategy into geothermal energy development.

6 REFERENCES


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