REPUBLIC OF KENYA

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THE NATIONAL ASSEMBLY

DEPARTMENTAL COMMITTEE ON ENERGY

TWELFTH PARLIAMENT-SECOND SESSION

DELEGATION REPORT

ON

THE PARTICIPATION IN 42ND INTERNATIONAL GEOTHERMAL ASSOCIATION ANNUAL MEETING IN RENO, NEVADA USA ON 12TH -18TH OCTOBER, 2018

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FOREWARD

The Geothermal Resource Council non-profit, educational association formed in 1970 as part of International Geothermal (IRG). This Council is constituted by organization and individuals experts in the geothermal sector of the energy generation. It was established with the sole responsibility to provide a platform where research, development and utilization of geothermal resources are promoted. The Council actively seeks to expand its role as a primary professional educational association for the international geothermal community. The GRC serves as a focal point for continuing professional development for its members through its outreach, information transfer and education services. Since its inception International Geothermal Association has gain the status of a special observer in the United Nations Green Climate Fund

This year's annual congress meeting was held in the city of Reno in the State of Nevada, USA between the 12th and 19th of October, 2018, and the Departmental Committee on Energy was privileged to represent the National Assembly which was headed by the Hon David Gikaria, MP Chairperson Departmental Committee on Energy. Among the Kenya delegation included officials from Kenya Power Company Ltd and Geothermal Development Corporation.

On behalf of the Departmental Committee on Energy, we wish to express our gratitude to the State Department for Energy for inviting us to this remarkable event, and for their overall coordination throughout. Our greatest gratitude goes out to the office of the Clerk of the National Assembly for facilitating the travel arrangements for Members of the delegation and to the Clerk of the Committee for his seamless coordination of the event. It was this team work that made the event successful.

Hon. Dr. Robert Pukose, MP

Vice Chairperson Departmental Committee on Energy

1.0 MANDATE OF THE COMMITTEE

1.1 The Departmental Committee on Energy derives its mandate from the provisions of Standing Order No. 216(5) which grants the Committee amongst other functions:-

a) To investigate, inquire into, and report on all matters relating to the mandate, management, activities, administration, operations and estimates of the assigned ministries and departments;
b) To study the programme and policy objectives of ministries and departments and the effectiveness of their implementation;
c) To study and review all legislation referred to it;
d) To study, assess and analyze the relative success of the ministries and departments measured by the results obtained as compared with their stated objectives;
e) To investigate and enquire into all matters relating to the assigned ministries and departments as may be deemed necessary, and as may be referred to it by the House; and
f) To make reports and recommendations to the House as often as possible, including recommendations of proposed legislation.

1.2 Further, the Second Schedule to the Standing Orders mandates the Committee consider matters relating to the following subjects Fossils fuel exploration, Development, production, maintenance and regulation of energy

1.3 In executing this mandate, the Committee oversees various State Departments, namely:

i. The State Department of Energy ; and
ii. The State Department of Petroleum.

2.0 MEMBERS OF THE COMMITTEE

The Committee comprises the following Members-

1. The Hon. David Gikaria, M.P. - **Chairperson**
2. The Hon. (Dr.) Robert Pukose, M.P. - **Vice Chairperson**
3. The Hon. Cecily Mbarire, M.P.
4. The Hon. Ekomwa Lomenen James, M.P.
5. The Hon. Joseph Wathigo Manje, M.P.
6. The Hon. Lemanken Aramat, M.P.
7. The Hon. Oscar Sudi, Kipchumba, M.P.
8. The Hon. (Eng.) Vincent Musyoka Musau, M.P.
9. The Hon. Amina Gedow Hassan, M.P
10. The Hon. Abdikhaim Osman Mohamed, M.P
11. The Hon. Clement Muturi Kigano, M.P.
12. The Hon. Elisha Odhiambo, MP
13. The Hon. Elsie Muhanda, MP
14. The Hon. Gitau Faith Wairimu, M.P.
15. The Hon. Julius Musili Mawathe, MP
16. The Hon. Ken Chonga, MP
17. The Hon. Tindi Nicholas Mwale, MP
18. The Hon. Walter Owino, MP
19. The Hon. Mohammed Ali Lokiro, MP

2.1 COMMITTEE SECRETARIAT

1. Mr Benjamin Magut - First Clerk Assistant–Lead Clerk
2. Mr Douglas Katho - Third Clerk Assistant
3. Ms Brigita Mati - Legal Counsel
4. Mr David Ngeno - Research Officer
5. Mr Salim Gorod - Fiscal Analyst
6. Mr Joseph Okong'o - Media Relations Officer
7. Mr John Ng'ang'a - Audio Recording Officer
8. Ms Sheila Chebotibin - Sergent at Arms

3.0 THE NATIONAL ASSEMBLY'S DELEGATION

The National Assembly Delegation comprised of the following:

1. Hon. David Gikaria, MP - Chairperson and Leader of the Delegation
2. Hon. Aramat Lemanken, MP
3. Hon. James Ekwoma Lomenen, MP
4. Hon. Faith Wairimu Gitau, MP
5. Hon. Julius Mawathe, MP
6. Mr Benjamin Magut - Committee Clerk and Secretary to the Delegation

From the Left Hon. Julius Mawathe, MP, Hon. James Ekwoma Lomenen, MP, Hon. Faith Wairimu Gitau, MP, Hon. David Gikaria, MP, Hon. Aramat Lemanken, MP,

4.0 ACKNOWLEDGMENT

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Signed: ..... **Date:** 4/12/2018

Hon. Dr. Robert Pukose, MP

Vice Chairperson Departmental Committee on Energy

5.0 INTRODUCTION

Although Kenya produces just enough electricity to light the country and power its industries tied to the grid, it is constantly faced with power outages that cause not only inconveniences, but a loss of income for those firms and households that depend upon it.

Currently the country's power generation mix is composed of **geothermal** 47%, **hydropower** at 39%, **thermal** at 13% and **wind** at 0.4%. This mix is leaning towards renewable energy which is expected to be upscale by injection of estimated 300MW from wind power (Lake Turkana Wind Power Farm) and commissioning of additional geothermal power in Olkaria and Menengai. Kenya's current installed electricity capacity is estimated at 2.4GW, 1.5GW of which is grid-connected and 500MW of which has come online since mid-2014. The country's demand of power at peak has increased from 1360MW in 2013 to 1860MW in 2018

A large part of the problem is the country's reliance on hydropower, which fuels about forty percent of Kenya's installed capacity. Since there is no reserve margin for reduced hydropower generation in times of drought, the government must pay for emergency generation. Given its cost, it is not a viable long term solution. While only 47 percent of Kenya's current power supply comes from geothermal energy, tapping the resource's full potential could produce five times the population's entire demand.

According to the Ministry of Energy geological studies, Kenya has the potential of producing 10,000 MW through geothermal power in the Rift valley. Currently the Kenya is producing an estimated 700MW in Olkaria which is only 7% of the total potential geothermal power prospects in rift valley

5.1 GEOTHERMAL RESOURCE COUNCIL ANNUAL MEETING (GRC) 2018

The GRC annual congress meeting was held in the city of Reno in the State of Nevada, USA between the 12th and 19th of October, 2018, and the Departmental Committee on Energy was privileged to represent the National Assembly which was headed by the Hon David Gikaria, MP, Chairperson Departmental Committee on Energy. Among the Kenya delegation included officials from Kenya Power Company Ltd and Geothermal Development Corporation.

The Annual congress was held in The Peppermill Resort in the city of Reno, a resort which is 100% powered by Geothermal power from a Well hosted within the resort. It brought together over four thousand (4,000) delegates from all over the world. The conference composed of technical Committee workshops on thematic areas as well as educational excursions on geothermal projects in the State of Nevada.

The thematic areas covered during the breakaway sessions included:-

1) Distributed Geothermal Generation: Emerging opportunity for Growth
2) Best Practice in Community Engagement for Geothermal Development
3) Risk Mitigation inn Geothermal Projects

5.1.0 DISTRIBUTED GEOTHERMAL GENERATION: EMERGING OPPORTUNITY FOR GROWTH

The session was chaired by Ms. Ezy Ram Director of Geothermal Institute in California, USA.

Global capacity of geothermal power is reported to be just over 12.1GW. While growth in the U.S. might have slowed, emerging economies mostly in East Africa, Central America, the Caribbean, and the South Pacific are some of the fastest growing geothermal nations worldwide. Together these nations are developing nearly 730 sites and another 12.1 GW of potential power. Of that 12.1 GW about 1.6 GW are under construction. Africa for instance has an installed capacity of under 1000MW but a potential developing capacity of 3,000Mw while South Pacific region has installed capacity of approximately 4000Mw against a potential developing capacity of 10000Mw

The potential power under development is only a fraction of the estimated total. It is estimated that global potential is around 200 GW of geothermal power, with only a fraction of that total potential tapped. With the ever growing threats caused by climate change, geothermal energy can be an emission-free and cost effective option to produce electricity in many emerging economies. Most importantly, there are nearly 80 countries developing geothermal resources that fall adjacent to the Pacific Ring of Fire or East African Rift. In total, this market is estimated to reach nearly $9 billion dollar by 2019.

East Africa is an area of great interest for geothermal development due to its countries' geology. In addition, the economies of East Africa are in great need for energy as they transition off their current expensive an unsustainable energy options, and build energy infrastructure to meet the needs of their populations. The main countries of interest in the region are Kenya, Ethiopia, Djibouti, Rwanda, Tanzania, and Uganda; however there are projects elsewhere such as the geothermal plant at Comoros Island.
Additionally, there is work towards a regional interconnection where energy could be traded among East African countries. GEA estimates that at the moment the region has about 250MW of operating capacity, mostly concentrated in Kenya. However, capacity is

expected to grow substantially over the next decade, since East Africa is one of the fastest growing geothermal regions in the world.

a) Kenya

Kenya has a large geothermal resource estimated at 10,000 MW, with just about 700 Mw online. However, there are multiple projects underway that will bring several hundred megawatts online in the next five to ten years. Most of the country's geothermal resources are found in the Rift Valley with 14 geothermal fields located between Lake Magadi and Lake Turkana.

The Kenyan Geothermal Development Corporation (GDC), created in 2009 by the Kenyan government, oversees geothermal development in the country. It was created in part to help reach Kenya's 2030 plan, and has the goal to produce 1,500 MW of electricity every year, with one third of that coming from geothermal energy.

The Kenyan government hopes to diversify energy sources to help with the problems of high energy costs and unreliable hydropower sources, and provide power to some of the 84%of the population who do not currently have electricity access

b) Djibouti

Djibouti has an estimated geothermal resource potential of at least 1,000 megawatts, though there are currently no operating geothermal projects. Recently, the Government of Djibouti created the Djiboutian Office for Development of Geothermal Energy (ODDEG) to identify resources, assist with exploration and feasibility studies, and develop geothermal energy. In addition, the government recently announced their intention to become the first country in Africa to reach 100% renewable energy, with geothermal power as the main source of electricity.

c) Ethiopia

The energy demand in Ethiopia is projected to increase by over 25% every year for the next few years. The Ethiopian government is working with the World Bank to expand electricity access, with the goal to reach 75% of towns and add four million more people to the grid in the next five years with an estimated geothermal resource of 5,000 MW, Ethiopia is looking towards geothermal to help with their growing energy needs. Presently Ethiopia has installed capacity of 70 MW.

The International Finance Corporation is working to help the Ethiopian Government set up the proper governmental agency management and the legal and regulatory structures necessary for geothermal development in the country. Reykjavik Geothermal is heading up the Corbetti Geothermal Power Project, a project with a projected output of 500 MW.

5.1.1 BEST PRACTICE IN COMMUNITY ENGAGEMENT FOR GEOTHERMAL DEVELOPMENT

Ms. Grace Chepkwony, Manager Corporates Affairs of KENGEN made a presentation that provided general guidance on how KenGen was conducting its community engagement activities related to geothermal projects in Olkaria.

As part of its growth strategy, KenGen firmly believes that investing in and conducting community engagement more robustly as a core business best practice. These community engagements are guided by Constitution of Kenya and other legislation in Kenya that relates to land management, companies, access to information and the Capital Markets Code of Corporate Governance Practices for Issuers of Securities to the Public
Most Finance Institutions have environmental and social safeguard policies and guidelines that require meaningful stakeholder engagement

KenGen can expect a Return on Investment (ROI) by conducting more proactive, coordinated community engagement, which leads to faster project implementation, reduced direct project costs, gains by avoiding additional costs, reduced risk and cost avoidance of litigation or breach to legal obligations, enhanced social benefits for local

communities and increased self-sufficiency of communities and less dependency on KenGen

KenGen has developed and operationalized a comprehensive Grievance Management Mechanism that registers, tracks and address grievances from communities and other stakeholders. This mechanism features an escalation matrix that involves the relevant departments, senior management or the Board as necessary.

KenGen operates under four (4) key principles that is; first, undertake proactive consultation, inclusive participation, and disclosure and access to information. Secondly, ensure gender equality, female empowerment, considerations for the marginalized, and cultural appropriateness. Thirdly, do no harm and manage to address grievances in a timely manner. Fourthly, maintain a Respectful and a sustained engagement throughout the project lifecycle, from inception to decommission

5.1.2 RISK MITIGATION IN GEOTHERMAL PROJECTS (OVERVIEW OF RISK MITIGATION SCHEMES IN EAST AFRICA)

Mr. Peter Omenda, President of GRC African Chapter presented on a Facility that aims to increase production of clean and reliable energy to supply power grids in Eastern Africa by attracting public and private developers and to mobilise finance for the construction of geothermal power plants. The Facility provides grants to co-finance surface studies and exploration drilling programmes for public and private developers. The support will reduce the high upfront risks related to the development of geothermal resources and thus geothermal power. The projects it supports are located in Eastern Africa in the countries that have signed the Addis Ababa resolution with the African Union Commission on Geothermal Energy.

The Facility will induce positive social and environmental impacts and contribute to sustainable development by providing affordable and reliable power from sustainable sources. It will increase the amount of renewable energy by supporting exploration activities leading to the development of four geothermal power plants with a combined capacity of 300 MW.

The grant is used for the following:

- financial support for drilling of exploration wells at the most promising geothermal prospects to assist developers secure finance for subsequent exploration or appraisal wells;
- surface studies to determine the optimal location of exploration wells at the most promising geothermal prospects;
- development of regional geothermal database of prospects in the region;
- pre-application training workshops for developers;
- support to AUC for management of the project.
- first grants from the first application round were signed during in 2014, resulting in an overall commitment of €16 900 000. These grants were dedicated to financing two drilling projects in Kenya, one surface study project in Ethiopia and one drilling project in Ethiopia which led to the Ethiopian Government signing the first Head of Terms on a Power Purchase Agreement with a beneficiary of GRMF, Reykjavik Geothermal. This was the first PPA with a private energy producer in Ethiopia.

6.0 KENYA DISTRIBUTED ORC FEASIBILITY STUDY

The Committee held a side meeting with Mr. Stephen Hirsch a geothermal expert who has worked in many geothermal projects including Kenya. His presentation was focused on Small ORCs

The Organic Rankine Cycle (ORC) is electricity production methods that follows the same principles than the traditional steam Rankine cycle used in most thermal power plants to produce electricity but uses an organic fluid instead of water. The chief advantage of small ORC generators (35kW to 3 MW electrical output) is the ability to recover useful energy from low temperature geothermal and low grade industrial waste heat and use it to generate high value zero emission electricity in decentralized locations. Most small ORC power generation units use heat between about 70°C- 120°C to generate power.

Small ORCs are, in general, designed for ease of transportation, installation and maintenance. Technicians trained in the installation and operation of power generation or heating, ventilation and air conditioning equipment can readily be easily trained to install, operate and maintain small ORC units. Central to the use of many small ORC units is the use of a twin screw expander instead of the turbines found in larger, high temperature systems.

The use of this type of expander introduces a number of advantages, including:

i. Robust and proven design
ii. Low cost and high reliability of proven 'off the shelf' components
iii. Low RPM allowing for direct coupling to a standard induction generator – which reduces capital and maintenance costs, and improves reliability and efficiency
iv. Wet vapor tolerance allows for fluctuations in the heat source, reduces demand for high grade heat that would be required for dry vapor systems and allows for in-process lubrication which has always been a challenge for turbine based systems

These characteristics make ORC technology a highly reliable option for power generation using heat sources like mid-low temperature geothermal brines, biomass combustion, stationary diesel engine cooling jacket and exhaust heat, waste heat recovery from industrial processes, and solar thermal applications. In the last ten years, installations of small ORCs for these applications has grown significantly in Europe, the U.S. and Japan.

6.1 RATIONALE FOR SMALL ORC'S POTENTIAL ROLE FOR RURAL ELECTRIFICATION IN KENYA

In Kenya, as in many other areas of the world, supplying electrical power to rural areas from a national grid is not an economically viable strategy. In these situations, the use of diesel generators is a frequent, lowest-cost baseload solution to meet domestic, commercial and industrial needs. Although not ideal environmentally, diesel generators are frequently deployed since they are easy to install and can be used as either standalone systems or as part of hybrid systems in conjunction with other sources like solar power.

The levels of rural electrification in Kenya have been low in areas including Turkana, Marsabit, Mandera, Wajir, Garissa and Lamu Counties. The Kenyan Rural Electrification Authority (REA) is concentrating on electrifying off-grid rural areas through renewable energy generation. Prior to the recent development of small ORC systems, standardized, modular power generation equipment that could use relatively low temperature geothermal resources was unavailable and/or uneconomical for small-scale, rural electrification.

Both REA and local government agencies in Kenya presently have programs to extend electricity access to rural communities in which modular, easily transportable ORC power generation units can play important roles and be "game-changers" in this context. If a geothermal or other heat source are not locally available and a diesel genset is necessary, small ORCs can be deployed today or in the future to increase the power output from the diesel genset for added efficiency using the significant waste energy from hot exhaust and cooling jacket water.

6.0 OBSERVATIONS

While participating in the conference the delegation observed the following that

1. The geothermal resource is the most indigenous, reliable, environmentally clean and economically viable, renewable energy resource;

2. The entire Eastern Africa has an estimated potential of more than 15,000 MWs in geothermal generation. Despite this potential, only Kenya and Ethiopia have geothermal operations as part of the country's electricity generation infrastructure.

3. The progress of geothermal development in Kenya similar to entire region is affected by high upfront cost of exploration including drilling, inadequate access to funding and guarantee, inadequate policy and legislation as well as institutional and regulatory framework to attract private developers and inadequate infrastructure and database in resources

4. Arising from the high cost of drilling geothermal well and its attendant infrastructure there is need to adopt cheaper technologies that uses any heat source to provide power for communities in the areas that are not covered where national grid, a classic example is small ORCs.

5. Holistic Utilization of Geothermal energy resource (both Power generation and Direct Uses) can create wealth, tackle food insecurity and boost socio economic development.

7.0 RECOMMENDATION

Arising the various Committee engagement during the conference, the delegation recommends that:-

1. **Ministry of Energy to consider to undertake feasibility study on viability of small ORC unit in the country as a way of addressing power distribution in the remotes areas not covered by the national grid.**

2. **The National government through the Geothermal Development Corporation (GDC) consider fully funding exploration process in order to shoulder the capital intensive ventures and let the private sector engage in the production and exploration of the found geothermal resource**

3. **The National government to consider providing incentives for the private sector for the Holistic Utilization of Geothermal energy resource for Direct Uses which will result in wealth creation through manufacturing sector as well as through agriculture and tourism.**

4. **The Government of Kenya to explore establishing or joining an existing risk mitigation fund in the region in order to provide cover for the local firms engaged in the geothermal production.**