Bridging the Skills Gap: Addressing the Lack of Technological and Professional Expertise in the Geothermal Sector - Kenya's Experience

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ABSTRACT

The presence of the Rift Valley in the Eastern Africa region favours the development of geothermal energy. A good number of the East African countries - Burundi, Comoros, Djibouti, Ethiopia, Eritrea, Kenya, Malawi, Rwanda, Tanzania, Uganda and Zambia - have taken keen interest in the development of geothermal energy. Kenya is leading in the region in the development of this indigenous resource, largely due to government commitment and well trained workers. Large investments have been made in training local personnel in geothermal exploration development and production activities.

The geothermal industry relies on a spectrum of professionals with varying technical backgrounds and experience. No geothermal training institutions exist in Africa. Since the 1970s majority of geothermal energy professionals have attended courses in the United Nations University in Iceland, the University of Iceland, Pisa University in Italy, Kyushu University in Japan and the Geothermal Institute of Auckland in New Zealand, utilising financial sponsorship of the host institutions as well as international and bilateral agencies. Unfortunately, today there are fewer opportunities for geothermal training than there were in the 1980's and 1990's. In this paper we discuss the concept of establishing a geothermal training institute in Africa, location and mode of operation.

1. INTRODUCTION

In recent years geothermal energy is being prominently more recognized as one of today's renewable energy mix and governments are taking note. The recent dramatic increase in geothermal development around the world has resulted in an inadequate number of trained industry professionals – especially higher-level geothermal power plant designers and managers, earth scientists, resource analysts, drillers and engineers. As the industry grows, so too does the need for geothermal education and training. In the developed countries, a number of colleges and universities are emerging with undergraduate, graduate, and certification programs related to geothermal. Unfortunately, Africa is yet to have institutions offering any level of geothermal educational and professional opportunities.

The presence of the Rift Valley in the Eastern Africa region favours the development of geothermal energy. The East African countries of Burundi, Comoros, Djibouti, Ethiopia, Eritrea, Kenya, Malawi, Rwanda, Tanzania, Uganda and Zambia all lie in the highly volcanic East African Rift, a zone with the geothermal manifestations of hot springs, fumaroles, and geysers. Geothermal development in this region (especially in Kenya) has been assisted by many agencies such as the European Investment Bank, the United Nations Development Program, the United States Department of Energy, the Japanese International Cooperation Agency and the United Nations University. By and large, the projects supported by these agencies have been highly focused on specific objectives or locations, and have had limited time and operational constraints. Assistance has been in form of exploration for geothermal energy resources, direct financing for power plant construction and technology transfer by taking students abroad for specialised training in geothermal energy prospecting and utilization. These former students (now professionals) are also assisted in attending international conferences at which they present technical papers and exchange information with other experts dedicated to the geothermal industry.

Kenya is leading in this region in the development of this indigenous resource, largely due to government commitment and well trained workers. Large investments have been made in training local personnel in geothermal exploration, development and production activities. Since the 1970s majority of these professionals have attended courses in the United Nations University in Iceland, the University of Iceland, Pisa University in Italy, Kyushu University in Japan and the Geothermal Institute of Auckland in New Zealand, utilising financial sponsorship of the host institutions as well as international and bilateral agencies. Many of these were non-degree introductory overview type courses, which lasted anywhere between 2 and 9 months. This level of teaching, however, could not cope with demand for specialized and academic type training. At the request of the UN Development Programme (UNDP) and with the support of the host governments the geothermal institutes escalated their programs to post-graduate diplomas and degrees in geothermal science and engineering (Hochstein, 2005; Friðleifsson, 2005). Unfortunately many these had to discontinue the geothermal training programs due to drastic cuts in government funding. The UNU-GTP, in Iceland, is at present the only international graduate school offering specialized training in all the main fields of geothermal science and engineering. In Kenya, the Kenya Electricity Generating Company (KenGen) and the Government of Kenya (through the Geothermal Development Company, GDC) have continued to shoulder a large part of the training cost, but a lot of support has been provided generously by the United Nations, the World Bank, the Icelandic, the New Zealand, and Japanese governments.

Currently there are fewer opportunities for geothermal training than there were in the 1980's and 1990's.

2. NEED FOR A GEOTHERMAL TRAINING INSTITUTE IN AFRICA

The international geothermal schools have played a major role in geothermal manpower development for third world countries especially Africa. Countries like Kenya and Ethiopia now have the capacity to carry out surface geothermal exploration, drilling and reservoir monitoring, and environmental impact assessments. However, there is lack of expertise in power plant and steam field designs. Other countries like Uganda, Eritrea, Rwanda and Tanzania have not yet attained the capacity to carry out exploratory work, successfully.

For quite a while now, there have been discussions on the possibilities of setting up a geothermal training centre (in one of the countries in the East Africa region) to offer training in all aspects of geothermal technology from exploration through development to power station operations. The second aspect of the training centre was envisaged to serve as a scientific and engineering instrument pool for use by Eastern African countries to promote geothermal energy as a cheap source of renewable energy. Finally, such an institution would be used for data archiving. The data would include publications and reports on geothermal worldwide, activities in the region, an inventory of personnel with their expertise and available equipment in the region.

Recently, the concept of establishing a geothermal training centre in the East African region has had the support of several important institutions, including the Global Environmental Facility (GEF), Africa Region Geothermal (Argeo) and the United Nations University (UNU). It was proposed that the training centre be established at a location that would meet several conditions, namely: (1) easy travel access by road and by air, (2) easy availability of trained staff in aspects of instrument maintenance and geothermal exploration and development, (3) easy access to known and well studied geothermal systems for training and testing of equipment as control and (4) the existence of some facilities that could assist the institute in quick take-off. From these considerations, Kenya was selected as the location that met most of the above criteria. However the exact location of the training institute within the country has not been decided. Kenya was/is a natural choice because, compared to some other developing countries in the region with potential for geothermal energy, for example Ethiopia and Uganda, the rate of development of the geothermal resources in Kenya has been relatively fast. This rate has broadly been affected by: (a) trained personnel, (b) financial resources, (c) economic growth, (d) productivity of wells and (e) development policies. The geothermal industry relies on a spectrum of professionals with varying technical backgrounds and experience. These trades require substantial on-the-job training. The creation of a Geothermal Training Institute in Kenya will therefore be an important contribution to address the technical capacity and confidence barriers through shared experience and technical assistance in geothermal exploration, exploitation and utilization in the region.

Two proposals have been put forward as to where the geothermal training institute can be hosted within Kenya. First, it is has been suggested that this sort of centre be hosted within the Kenyan Electricity Generating Company or the Geothermal Development Company and adopt UNU/GTP curriculum, and with Iceland's support, increase the yearly total number of trainees while cutting down on the travel costs. The UNU-GTP would provide the expertise, with additional assistance of available experts in the region. It is envisaged that program would be modelled after the current annual 3-week short course sponsored and facilitated by the UNU-GTP, GDC and KenGen. This would help in developing further the expertise in the region, and would provide training to the locals in their surrounding environment which has the advantage of developing home-based solutions to problems.

The second proposal is for the training centre to be hosted by a Kenyan university in partnership with the UNU-GTP, GDC and KenGen. For example, in the US, some universities offer geothermal master's and doctorate degrees while others have Geothermal research laboratories. A host university would also be ideal as it would incorporate research and technology transfer, apart from students gaining a recognised certificate, diploma or degree. Thus, graduate studies, being of a more specialised nature would create a lot of opportunities for the graduates. It should be noted, however, that classroom instruction is often a minor aspect of learning technical skills. After the coursework a trainee needs a hands-on training and expertise which will accumulate gradually as one is involved more and more in a geothermal operation environment. Such a host university will therefore need to work closely with both GDC and KenGen for industrial attachment of the students. Mindful that the majority of technical training takes place after an individual is hired, such a university training program will be in the best interest of both GDC and KenGen since when recruiting they will find a ready market of professionals with some experience. Further, the two companies would also have an opportunity of recommending to the host university the type of courses to be offered

2.1 Mission and Objectives

The proposed Geothermal Training Institute will be mandated to pursue the establishment of an organized skill training and skill-improvement system for the specialists in the field, within the context of the growth of use of geothermal energy in the African region. It will focus on capacity building in promoting geothermal energy resource development and utilization in the African region. In this way, the concerned African countries with significant geothermal potential will be enable to build up groups of specialists who can cover most aspects of geothermal exploration and development.

2.2 Source of Financing

Lack of adequate cheap funding is probably the most important cause of the slow pace of development in most developing countries. Taking into consideration the economic resources of the countries in the region, the candidates who qualify to secure a place for admission will receive a fellowship. The fellowship will cover tuition, living and travel expenses in Kenya and a return ticket to their respective countries. GEF, UNEP, multilateral donors and Argeo could be approached on possibilities of funding this training project. KenGen and GDC are also expected to contribute in some way, especially through the provision of facilities and equipment.

2.3 Trainees

In order for the centre to provide the required training needs for member countries in the East African region, two training levels have been considered, namely: (1) offer practical training on various aspects of geothermal technology. This would be appropriate for staff that are already trained in the technology and (2) offer theory and practical classes to those who do not have previous training in geothermal technology. Both programs could lead to the award of a diploma or degree from a recognised institution.

2.4 Host Institution and Training Facilities

Both GDC and KenGen have collaboration arrangements with some Kenyan universities and any of them can be well placed to host the proposed Geothermal Training Institute. For example, during the last two years, Kimathi University College of Technology (KUCT) has been collaborating with the Kenya Electricity Generating Company in carrying out joint research in geothermal related problems. This relationship could be enhanced by incorporating joint sponsorship of the proposed Geothermal Training Institute. KUCT could facilitate the classroom lecture part of the geothermal training, aided by laboratory equipment. Critical instruments will still need to be purchased buy KUCT. Table 1 indicates recommended pieces of equipment that will be a part of the laboratory resources.

Table 1: Proposed equipment pool for the training centre

Equipment type	**No. of Units**	**Cost Estimate (US $)**
Well Logging tool - geophysical	1	270,000
Well Logging tool – reservoir	1	230,000
Field truck - geophysical	1	135,000
Quartz type pressure monitoring assembly	1	135,000
Multi-gas logging equipment	3	20,000
X-ray Diffractometer	1	280,000
ICP-MS	1	190,000
Gas Chromatograph	1	130,000
Gravity Meter	1	230,000
Magnetometers	2	25,000
Reflection seismic system – shallow type	2	120,000
TEM equipment	1	70,000
MT equipment	2	200,000
Equipment Maintenance Tools		10,000
	TOTAL	**2,045,000**

This pool of equipment will not only be for classroom work, but also for value added research on such areas as volcano hazards and ground water distribution whose findings will be available to the public.

When participants are attached to either KenGen or GDC, these companies' developed facilities such as rigs, laboratories and equipment could be used for hands-on demonstrations.

2.5 Instructors

In the early 80's Kenya had very few qualified personnel to handle the various activities of exploration and drilling. The country therefore depended mainly on expatriate personnel particularly in drilling operations. In recent times investment has been undertaken in training local personnel in geothermal exploration, development and production activities. Currently, there are over 80 graduate professionals in KenGen, GDC and the Ministry of Energy. The majority of the former trainees are within KenGen and GDC, with qualifications ranging from post graduate Diploma, M.Sc. and PhD. Further, efforts in training have now expanded to include pipe design and power station construction supervision. Results of this were seen in the recently completed design and construction of Olkaria II in which KenGen engineers fully participated. Hence the two companies have the capacity and human resources to contribute to the pool of instructors of the proposed training centre. These will be expected to play an increasingly bigger role with time as the program evolves. In the beginning, however, experts from the UNU in Iceland, collaborating universities with the host university and other geothermal centres will be actively involved.

2.6 Curriculum

It is proposed that the Institute be set up to offer training in all basic aspects of most geothermal technology disciplines. It will provide the required training needs to participants and will have limited introductory theory and practical classes to those who do not have previous training in geothermal technology. The following courses are proposed to be taught at the training centre by the various disciplines.

a) Geology and Geochemistry:
- Common geological and geo-chemical exploration methods
- Interpretation of drill-hole rock samples
- Analysis of fluids, rocks and elements of geothermal significance
- Use of Mass Spectrometer for stable isotopes in reservoir management
- Application of Thermal Differential Analysis (TDA) in geothermal systems

b) Geophysics:
- Common geophysical prospecting methods and instrumentation
- Use of micro-gravity and micro-seismology in reservoir management

c) Reservoir engineering:
- Introduction to geophysical well logging tools
- Application of down-hole information to reservoir management

d) Drilling:
- Introduction to the drilling rig
- Deep geothermal drilling and its management

e) Environment:
- Introduction to environmental monitoring instruments
- Impacts of geothermal resources development on:
    - The environment
    - Occupational health
    - Socio-economic status of local communities.

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