Climate Technology Centre and Network (CTCN)

Formulation of Geothermal Energy Policy, Legal and Regulatory Framework in Uganda

CTCN Request: 2015-022/UGA

GEOTHERMAL RESOURCES POLICY (FINAL DRAFT)

Carbon Counts Company (UK) Ltd

24 October 2016

Prepared by:
Paul Zakkour and Gregory Cook (Carbon Counts)

Our Ref: 073

CTCN
CLIMATE TECHNOLOGY CENTRE & NETWORK

ECA

Shonubi Musoke & Co.

PU PRO-UTILITY
Promoting Utility Excellence

CARBON COUNTS

NORTON ROSE FULBRIGHT

FOREWORD

The Great Rift Valley bestows a unique opportunity for the countries of East Africa to utilise geothermal energy to build modern, clean, reliable and affordable energy systems. The economic potential of this resource has been known about in our country for at least 30 years, and has been used in artisanal ways by our ancestors for much longer. The focus today is on building industrial-scale applications that can use this free and sustainable resource in a way that helps with economic and social development, primarily for electricity generation, but also in situations where the heat and minerals present in the geothermal fluids may be utilised directly.

In Uganda, we have spent several years assessing the viability of our geothermal resources, and pondering how to move ahead with their utilisation. Progress has remained slow, however, despite the introduction of incentives in the 2007 Renewable Energy Policy, and opening up of the resource to private sector developers in 2010. Geothermal resource use in Uganda today remains limited to small-scale artisanal applications delivering hot water for a hospital, bathing spas and for salt extraction.

If we look across the region we can see that several of our neighbours are making rapid progress with modern uses, in particular Kenya, where more than 500 MW of geothermal power generation has been developed over the last 5-10 years. Uganda must also seek to move at the same pace. Our country has an urgent need to increase electricity supply to meet rapidly rising demand both in the near-term and over the longer-term in order to meet the social and economic development goals outlined in Vision 2040. A safe, secure and reliable electricity supply system is a cornerstone for investment, industrial and commercial development, and ultimately, prosperity that benefits all Ugandan citizens. As we seek to increase Uganda's electricity supply base, we must also seek to diversify away from hydropower as the primary means for generating electricity. Our heavy dependence on hydropower leaves us critically exposed to the uncertainties of the climate, a problem which is only likely to get worse in future as we start to feel to effects of climate change. As we have seen in the past, the vulnerability of our power system to prolonged drought, and actions to remedy the situation by installing emergency power, comes at a great cost to our economy.

We continue our progress in developing our oil and gas resources, which could provide an alternative source of energy for power generation. But in doing so we must be mindful that burning fossil fuels emits carbon dioxide gas that is the primary cause of the climate change problem. We must therefore also consider the potential impacts of utilising fossil fuels to power our economic development, and take account of our pledge to the international community to tackle climate change under the landmark Paris Agreement, where we committed to increase renewable energy generation to around 3,200 MW by 2030.

Geothermal resources offer us a means to solve many of the challenges we face today in developing our future energy system. Geological survey work indicates the presence of good quality resources in a number of prospects, especially in Western Uganda, but we must also be realistic about the specific challenges we face in developing the technology. Although geothermal energy systems can provide a long-lasting and clean source of energy, the risks and

costs for the initial resource development that can catalyse the industry poses some near-term issues. These are different to those faced by other renewable energy technologies, and must be addressed head-on if we are to realise the potential benefits. For this reasons, Government has decided that it must establish new approaches and strategies to kick-start the industry and accelerate development. If we can prove the resource is viable, and that we have the capacity and competencies to develop it, we will be able to replicate that experience again into the future. This can lead us into a second phase of development where risks are reduced, confidence is gained, and new forms of ventures can be constructed through which to develop our resource. This can help us achieve the longer-term aim of achieving 1500 MW of installed geothermal capacity as outlined in Vision 2040.

My Ministry has therefore formulated this new policy with the overall goal of accelerating geothermal resource development for the benefit of all Ugandans. It seeks to address the key challenges facing geothermal resource development in Uganda today, namely: resource uncertainty, investment risk, lack of finance and an inadequate legal framework. By tackling these challenges, we will increase confidence around technical viability, reinvigorate interest in the resource, and stimulate a new wave of investment and technical expertise from both the private sector and development partners. The policy sets out ambitious objectives for resource development, and a coherent implementation plan through which to achieve the ambition. It includes a Communication Programme through which the policy will be widely disseminated and popularised, and identifies a near-term need for a Geothermal Resources Master Plan that can help to guide our approaches to geothermal resource development in the coming years.

In developing this policy, my Ministry has conducted widespread consultations including a review of experiences in other countries and discussions with a range of stakeholders from government, private sector, academia, development partners and local communities regarding the issues, challenges and solutions for geothermal resource development. The policy therefore reflects the views of all Ugandans. We will continue our discussions with all interested parties in order to further learn how to best expedite resource development, taking account of the need for socially sensitive and environmentally sound development, in line with the goal and objectives of this policy.

Finally, I wish to thank all stakeholders that have contributed to the development of this policy, and the various ministries, departments and agencies including my fellow Ministers in Cabinet for their inputs in helping shape our proposed way forward. I am deeply indebted to all those involved in its preparation both within my Ministry and externally. I am confident that investors and developers will appreciate the commitment the Government is making in this policy document, and that the spirit of cooperation will lead us to a new phase of accelerated geothermal development for the benefit of all Ugandans.

HON. ENG. IRENE MULONI (M.P)

MINISTER OF ENERGY AND MINERALS DEVELOPMENT

CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF BOXES

ACRONYMS AND ABBREVIATIONS

ARGeo	African Rift Geothermal Development Facility (UNEP initiative)
AUC	African Union Commission
BGR	German Federal Institute for Geosciences and Natural Resources
CSO	Civil Society Organisations
CIF	Climate Investment Funds
DfID	UK Department for International Development
DGSM	Directorate of Geological Survey and Mines
EARS	East African Rift System
EAGER	East African Geothermal Energy Facility
EIA	Environmental Impact Assessment
EMD-SWG	Energy and Mineral Development Sector Working Group
ERA	Electricity Regulatory Authority
FOAK	First-of-a-kind
GDC	Geothermal Development Company (Kenya)
GET FiT	Global Energy Transfer Feed in Tariff
GRMF	Geothermal Risk Mitigation Facility (for East Africa, ran by AUC/KfW)
GRD	Geothermal Resources Department
ICEIDA	Icelandic International Development Agency
iNDC	Intended Nationally Determined Contribution
JICA	Japan International Cooperation Agency
KfW	Kreditanstalt für Wiederaufbau (German International Development Bank)
kWh	Kilowatt hour
LCOE	Levelised cost of electricity
MEMD	Ministry of Energy and Minerals Development
MoU	Memorandum of Understanding
MW	Megawatt
PPA	Power Purchase Agreement
PPP	Public private partnership
PSIP	Power Sector Investment Plan
SE4All	Sustainable Energy for All
TUBITAK MAM	Scientific and Technological Research Council of Turkey, Earth and Marine Institute
UETCL	Uganda Electricity Transmission Company Limited
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNCST	Uganda National Council for Science and Technology

EXECUTIVE SUMMARY

The Government of Uganda has never before established a policy dedicated solely to the management of geothermal resources. Both the Energy Policy 2002 and the Renewable Energy Policy 2007 recognise the potential of the technology for power generation, although they make only superficial consideration of issues for its development. So far around twenty-three geothermal resource locations have been identified in Uganda, four of which are considered to be the most promising. Exploration efforts have primarily been led by Government with technical assistance from development partners, involving various surface studies. Additionally, since 2010 the private sector has also taken an interest in geothermal resource development, with fourteen (14) geothermal exploration licenses issued under the Mining Act 2003. But progress with development is proving slow, and it has become increasingly apparent that the characteristics of geothermal energy set it apart from other forms of renewable energy, indicating the need for a different approach to its management by Government.

Despite the various geological survey activities carried out, uncertainty still remains about the viability of the identified resources for industrial-scale utilisation. This can only be significantly reduced by moving from low cost surface studies into a phase of expensive test drilling to determine the presence of an economically viable resource or otherwise. But no test drilling has been carried out in Uganda to date. The level of investment and the risks involved mean that private sector is typically unwilling to finance such activities, especially in greenfield locations with no proven track-record of successful geothermal development as in Uganda today. This is the primary challenge faced today in embarking on a pathway for geothermal resource development.

The challenge is not insurmountable, however. Around the world more than 12 GW of geothermal electricity generating capacity exists across 28 countries, made up of over 700 operational power plants. Additionally, a further 50 GW of direct geothermal energy use is in place across more than 70 countries. These experiences provide valuable lessons which have helped inform the development of this policy. Additionally, the policy is a product of consultations with a wide range of stakeholders regarding the issues, challenges and solutions for geothermal resource development.

A key lesson is that governments need to take an active role in resource development in order to kick-start a geothermal industry in a country. The responsibility for resource development does not need to reside solely with government, however. Technical assistance, grants, loans and co-financing from development partners, alongside novel approaches to public-private partnerships can all contribute to the effort. The approach to regulating geothermal activities using the Mining Act 2003 is also sub-optimal, and a new legal framework to separate geothermal tenure rights from minerals and more effectively manage the expectations of both public and private developers through the licensing process is needed.

Recognising the long-term ambitions for geothermal resource development in Uganda, and the near-term need to urgently diversify the country's energy supply mix away from its dependence on hydropower, the overarching goal of this policy is to **accelerate the development of geothermal resources for the benefit for all Ugandans**. This policy firstly characterises the

contexts for resource development, current resource status, and the issues challenges for development. Based on these, the principles, objectives, and strategies for achieving the policy goal are outlined. These include:

1. Accelerating geothermal resource exploration through enhanced actions by Government;
2. Optimising development to ensure efficient use of geothermal resources;
3. Promulgating a new legal framework to improve the management of geothermal resources;
4. Ensuring environmentally safe deployment of geothermal energy technologies;
5. Promoting a geothermal industry of the future through improved human resource development and local content requirements for geothermal development activities.

The policy also sets out the institutional framework in which the objectives and strategies are to be established, and an implementation plan describing the actions to be taken that will assist in achieving the goal and objectives.

In doing so, the vision is that Uganda will become a geothermal energy generator within the next decade, an action that will help stimulate further inward investment into the technology from a variety of sources. These actions should help in achieving the long-term aim of achieving 1500 MW of installed geothermal capacity in line with the ambitions of Vision 2040.

1 INTRODUCTION

The Government of Uganda has never before established a policy dedicated solely to the management of geothermal resources. Both the Energy Policy 2002 and the Renewable Energy Policy 2007 recognise the potential of the technology for power generation, but make only superficial consideration of issues for its development: the Energy Policy 2002 highlights that evidence of the geothermal resource exists, and acknowledges that it could play a role in baseload power generation – it also noted that there is limited knowledge of the *economic* potential for geothermal energy in Uganda; the Renewable Energy Policy 2007 introduced a feed-in tariff for geothermal energy – including a standardised Power Purchase Agreement (PPA) – and various tax incentives for renewable energy technologies. The latter also set a basis for the establishment in 2014 of the Geothermal Resources Department (GRD) within the Ministry of Energy and Minerals Development (MEMD) to act as the government custodian of the resource. Neither policy addresses the specific risks and issues associated with geothermal resource exploration.

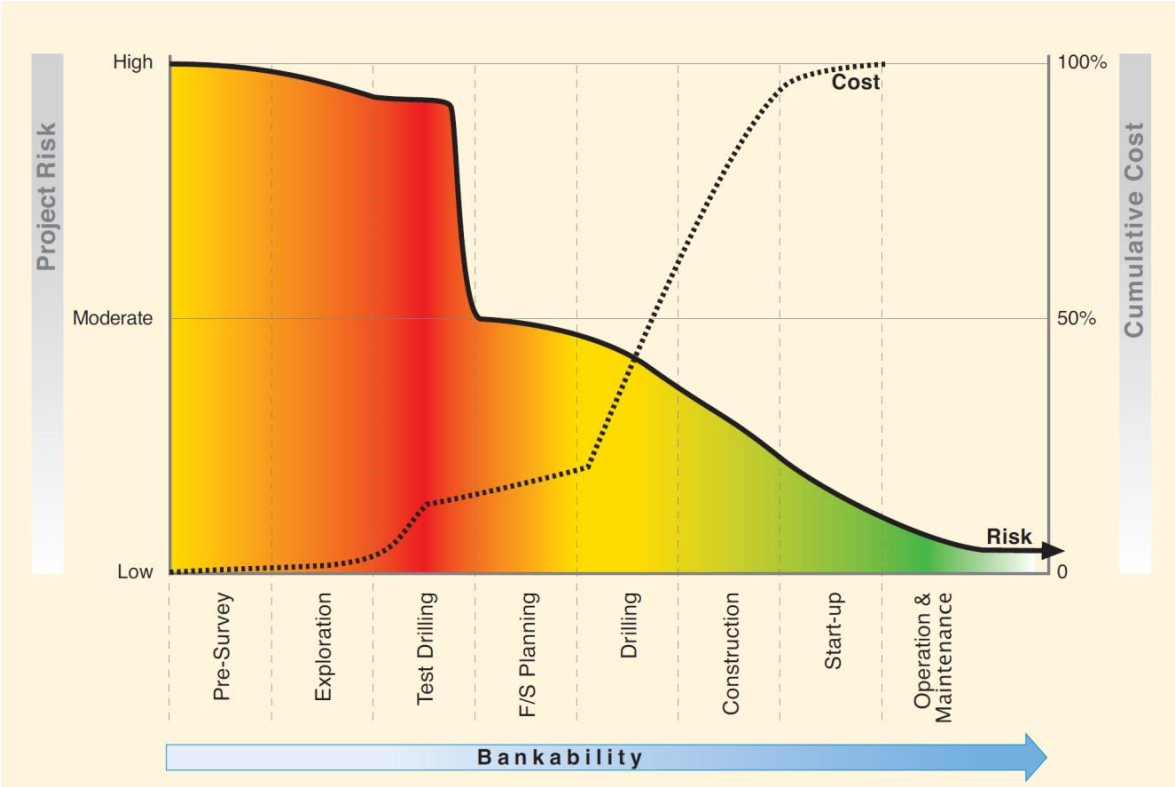
Today, however, there is growing acknowledgement that geothermal energy has different characteristics compared to other sources of renewable energy available in Uganda, and therefore its development needs to be managed differently by government. Whilst geothermal energy can offer an affordable, reliable and low greenhouse gas emitting source of base load power generation to complement other sources of power, there are specific features that set it apart from other renewable energies. In particular, resource uncertainty – and the high cost of reducing uncertainty – is an impediment to progressing resource development.

The cycle for geothermal energy resource development follows a fairly standardised path covering the following phases:

Phase 1 – Reconnaissance / preliminary survey / resource identification
Phase 2 – Exploration (desk reviews, surface studies, shallow drilling etc) (*pre-feasibility*)
Phase 3 – Test drilling (to confirm economic viability or otherwise)
Phase 4 – Review and planning (*feasibility*)
Phase 5 – Steam field development (production wells, injection wells, flow lines etc)
Phase 6 – Power plant construction
Phase 7 – Start-up and commission
Phase 8 – Operation and maintenance

It is only by moving from Phases 1 and 2 (reconnaissance and exploration) into Phase 3 (test drilling) that resource uncertainty at a specific site can be significantly reduced and the bankability of a project increased. Such a move requires a step-change in resource development expenditure compared to earlier phases, however. This risk and expenditure relationship across the development cycle is shown graphically below (Figure 1.1). These characteristics make geothermal energy different to other renewable energy sources such as wind or solar, which can be assessed on a regional scale, and deployed incrementally to test viability.

Figure 1.1 Project cost and risk profile at various stages of development



Source: Gehringer and Loksha, 2012

So far around twenty-three geothermal resource locations have been identified in Uganda. Four of these are considered to be the most promising, and have been subject to further exploration over the last fifteen years or so, namely: Katwe-Kikorongo (Kasese district), Kibiro (Hoima district) and Buranga (Bundibugyo district) and Panymuir (Nebbi district). Resource exploration efforts have primarily been led by the Directorate of Geological Survey and Mines (DGSM) – and more recently the GRD – within the MEMD, and has also involved technical assistance from development partners. These activities have included various *surface studies* such as geochemical and geophysical survey techniques that can help better characterise the resource.

Since 2010 the private sector has also taken an interest in geothermal resource development, with fourteen (14) exploration licenses issued to ten different firms under the Mining Act 2003. Of these, six (6) have expired without renewal and eight (8) remain active.

Notwithstanding the activities described, no test drilling has been carried out and major challenges remain to further characterisation and realisation of the resource potential. Moving from low cost surface studies (US$50-100,000) into a phase of test drilling (US$5+ million) is necessary to determine the presence of an economically viable resource or otherwise. The level of risk and expenditure involved in making such a step-change indicates the need for a structured and orderly approach, with government taking an active role in its management.

1.1 Rationale

The need for a geothermal resources policy has been motivated by a number of factors: the need to increase access to modern forms of clean, reliable and affordable energy across the

entire country in order to aid the transition to a middle-income economy in line with Vision 2040 commitments – therein geothermal energy is envisioned to contribute 1500 MW of energy generation capacity by 2040; the need to diversify the electricity supply base away from hydropower in order to increase energy security; the need to address near- to medium-term ambitions for geothermal energy deployment as outlined in the *Power Sector Investment Plan 2011* (MEMD, 2011; PSIP) and the 2015 United Nations *Sustainable Energy for All (SE4All) Action Agenda for Uganda* (MEMD, 2015) – these both envision deployment of between 33-160 MW of geothermal power generation capacity by the mid-2020's; Uganda's intended Nationally Determined Contribution (iNDC) under the United Nations Framework Convention on Climate Change (UNFCCC), which pledges to increase renewable energy generation capacity from 729 MW in 2013 to 3,200 MW by 2030 (MWE, 2015); the different experiences around the world that show the need to for strong government leadership in, firstly, establishing a first-of-a-kind (FOAK) geothermal power plant and, subsequently, sustaining a vibrant geothermal industry thereafter.

The national Geothermal Resources Policy of Uganda seeks to establish a framework for development of the country's resources by giving clearer direction as to:

(a) how geothermal energy projects should be developed
(b) by who
(c) over what time frame
(d) using which sources of finance and support mechanisms

The policy framework provides principles, objectives and policy strategies that are aimed at establishing a clearer legal and regulatory framework and a sound geothermal resources strategy that accelerates development of the resource in an optimised way, and in doing so:- contributes to economic and social development goals; enhances value added elements; promotes linkages with other sectors and other energy development activities; harmonises land use and interaction with other subsurface exploration and exploitation activities; provides a clearer and more effective licensing regime; ensures recognition of environmental and social issues and opportunities; provides a solid basis upon which both private sector finance and overseas development assistance may be mobilised for financing of geothermal resource development.

1.2 Policy Development Process

The policy development process has been led by the GRD in consultation with a wide range of stakeholders. In December 2015 the GRD constituted an Interdepartmental Task Team to input into the process of policy and legal development. In June to September 2016 a broad stakeholder engagement programme was implemented involving all parts of government (ministries, departments, agencies and parastatal entities), research and academia (Makerere University; Ndejje University, Uganda National Council for Science and Technology (UNCST) etc.), development partners (United Nations Environment Programme (UNEP); United Nations Development Programme (UNDP); Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ); UK Department for International Development (DfID); International Finance Corporation (IFC) etc.), private sector, and local communities from areas surrounding key geothermal prospects (Hoima and Kasese districts). An additional workshop was held with senior

government officials in October 2016 to finalise the policy and supporting legal framework, and additional consultations with development partners were undertaken via the Energy and Mineral Development Sector Working Group (EMD-SWG).

The Policy also benefitted from an up-to-date review of experiences with geothermal energy development around the world compiled in the first half of 2016, with a particular focus on low- and middle-income countries including: Chile, El Salvador, Ethiopia, Costa Rica, Honduras, Indonesia, Kenya, Mexico, Nicaragua, the Philippines and Turkey. The review examined a range of policy related matters including geothermal resource development costs, approaches to project financing and structuring, institutional arrangements, risk sharing approaches (public / private), and management of local communities issues and land access, and drew from a wide range of literature sources. Additionally, a detailed review of dedicated geothermal energy laws was undertaken for selected countries, namely: Chile, Indonesia, Kenya, Mexico, Nicaragua, the Philippines and Turkey, in order to benchmark international norms and standards, best practice and issues that have arisen in the regulation of geothermal energy.

Relevant national policies and legislation that were reviewed include the following:

(a) The Energy Policy for Uganda, 2002
(b) The Renewable Energy Policy, 2007
(c) Uganda's Sustainable Energy For All Initiative Action Agenda, 2015
(d) The Development of a Power Sector Investment Plan (PSIP) for Uganda, Final Report, 2011
(e) Uganda's Intended Nationally Determined Contribution under the UNFCCC, 2015
(f) The Constitution of the Republic of Uganda, 1995
(g) The Mining Act, 2003.
(h) The Electricity Act, 1999
(i) The Water Act, Cap 152
(j) Water (Water Resources) Regulations SI 152-1
(k) Water (Waste Discharge) Regulations SI 152-4
(l) The National Environment Act, Cap 153.
(m) Environmental Impact Assessment Regulations No. 13 of 1998.
(n) National Environment (Waste Management) Regulations, S.I. No 52/1999.
(o) National Environment (Standards for Discharge of Effluent into Water or on Land) Regulations, S.I. No 5/1999
(p) The Land Act, 1998
(q) Registration of Titles Act, Cap 230.
(r) Petroleum (Exploration, Development and Production) Act, 2013
(s) The Public Private Partnerships Act, 2015

Technical assistance was provided by a consortium of experts sponsored by the UN's Climate Technology Centre and Network.

These consultations mean that the views, opinions and strategies expressed in this policy reflect the collective interests and aspirations of the full range of stakeholders relevant to geothermal resources development. It thereby provides an important basis upon which geothermal resources development may progress and evolve over coming years.

2 POLICY CONTEXT

2.1 Electricity Supply

Utilising a diverse range of energy sources is key to ensuring the security of Uganda's future electricity supply. The Energy Policy 2002 committed to *Diversification of power generation sources* as a near-term policy priority to meet this objective (0-10 years). Fifteen years on from its formulation, Uganda is still heavily reliant on hydropower, however, accounting for over 90% of all electricity generated in the country (over 80% of which is large hydropower from Nalubaale, Kiira and Bujagali). This heavy reliance will continue – or even be enhanced – as Karuma and Isimba hydropower projects come on stream towards 2018-19.

Reliance on hydropower comes with uncertainties and challenges. The availability of hydropower resources has been restricted by drought over recent years, leading to power supply disruptions which have adversely impacted on the industrial and commercial sectors; power shortages resulting from reduced hydropower availability have been cited as a cause of reduced GDP growth in 2005/06 and 2012 (Adeyemi and Aseme, 2014). Due to international treaties and hydrological restrictions, mainly the *Agreed Curve* for the Nalubaale (Owen Falls) Dam, only around 724 MW of the current installed capacity is available from large hydropower plants. Concerns have been raised regarding over-releases from the Nalubaale and Kiira dams in contravention of the *Agreed Curve* regime, which have been attributed as the cause of severe drops in the level of Lake Victoria (Kull, 2006). These issues could act as a future constraint to hydropower use on the Nile; this, combined with concerns that Uganda's hydropower will become increasingly vulnerable as a result of more volatile rainfall patterns resulting from climate change over coming years, has the potential to further limit its availability. The cost of deploying emergency power to back-up shortfalls in hydropower availability is extremely expensive, as experienced in 2006-2008. As such, the ability of hydropower to provide low-cost, reliable, secure energy in future looks uncertain. New hydropower projects are also proving expensive and have been subject to technical issues in their construction.

The Policy therefore seeks to promote geothermal energy as a key measure to help diversify the electricity supply base and, over the medium-term, help to reduce reliance on large hydropower as the primary source of electricity production and thereby reduce the overall cost of delivering reliable power to the electricity grid.

2.2 Geothermal Energy

Unlike other renewable energy sources where resource potential can be assessed at a regional scale, the resource potential for geothermal energy needs to be characterised and confirmed on a site specific basis. This resource uncertainty – and the high cost of reducing uncertainty – is a challenge for its development. Effective development of geothermal energy resources for power generation is therefore reliant on a range of critical supporting factors. These include:

(a) An Energy Policy that fosters the establishment of diverse, clean, reliable and affordable energy technologies that are innovative in Uganda today, such as geothermal energy, rather than continuing the reliance on hydropower;

(b) Access to infrastructure through which to bring vehicles and equipment to geothermal resource locations, usually rural areas, and to evacuate produced power to the local and national electricity grid;
(c) Strong leadership from government in supporting its development, including appropriate institutional arrangements to spearhead implementation;
(d) A skilled workforce that is able to implement resource exploration and exploitation activities;
(e) Sufficient finance to support these activities.

The Policy seeks to provide a supporting framework that catalyses these requirements and ultimately accelerates development of the technology.

2.3 Investment Climate

The risk profile of geothermal energy projects mean that commercial lenders will generally provide debt finance for private sector investment only when the quality of the steam resource has been proven; as such commercial debt is generally not available for exploration activities (Phases 1-5 of the development cycle). This problem is augmented for FOAK projects in greenfield locations with no experience of building geothermal power plants, as is the situation in Uganda today. Consequently, private sector development of geothermal resources is largely reliant on equity investment, which is more challenging to raise and more costly to service than commercial debt; this will increase the overall cost of privately-financed geothermal projects to levels that are unlikely to be acceptable to energy offtakers and, ultimately, electricity consumers. Experiences around the world clearly show that for nearly every successful FOAK greenfield geothermal resource development project, governments – alongside development partners in the case of low-income countries – have played a leading role in financing exploration and development.

Private sector investment may be forthcoming when a prospect has been sufficiently de-risked, i.e. for power plant construction and operation when steam resources have been proven and developed (Phases 6-8 of the development cycle). In addition, after further experience is gained, private sector may invest into earlier phases of development (Phases 3-5 of the development cycle), especially for step-out (brownfield) developments in proven geothermal steamfields (i.e. second-, third-, fourth-of-a-kind etc. projects). Even then, governments typically still need to play an important facilitating role in assisting with permitting and providing guarantees to help backstop investments.

Taking this into account, measures to be taken to improve the investment climate for geothermal energy shall include:

(a) Enhancing public expenditure on exploration activities in order to reduce resource uncertainty and investment risks so that the bankability of geothermal energy prospects are increased;
(b) Linking with other infrastructure development programmes to ensure that required infrastructure is established in tandem with other resource development activities;

(c) Attracting development partner financial assistance to support exploration and exploitation activities, including grants, concessional loans and other forms of finance such as climate and carbon finance;
(d) Providing a clear framework for risk sharing on resource development between public and private sectors, and establishing new means of enhanced cooperation between government and private corporations;
(e) Introducing a new legal framework that provides for an improved licensing regime that more clearly defines government expectations in terms of concessionaires, deters passive speculation, and provides greater clarity on the fiscal regime that will apply to resource exploitation;
(f) Supporting and enhancing private sector participation through provision of stronger incentives to invest in resource exploration and exploitation;
(g) Ensuring flexibility in the approach in order to adapt to prevailing circumstances in geothermal resource development activities into the future.

2.4 Governance

Greater clarity is needed regarding governance of geothermal resources in Uganda. As a greenfield location with no proven experience of developing bankable geothermal energy projects, government must lead the way in resource development today. The GRD can act as the lead on resource development, but its mandate needs further reinforcing.

The private sector also has a role to play. Presently the responsibility for resource development lies largely in their hands. The government does not wish to take away this opportunity. Rather, government will take measures to clarify roles and responsibilities for resource development and with respect to enhancing cooperation between government and private sector actors.

Development of geothermal resources must proceed in an environmentally and socially-acceptable manner, working in close consultation with local government and community groups in proximity to geothermal energy resources, and with government agencies responsible for environment and wildlife protection.

The following actions will be prioritised to address these matters:

(a) Strengthening the mandate and capacity of the GRD in respect of its ability to implement enhanced geothermal resource exploration activities;
(b) Further consideration of ways in which public and private cooperation on resource development can proceed, cognizant of the Public Private Partnership Act, 2015;
(c) Introduction of a new legal framework for geothermal resources that clarifies the approach to resource management, establishes clear regulatory functions, ensures environmentally-safe and sound deployment, and is aligned with norms and standards in existing extractives industry laws and regulations (e.g. Mining Act; Petroleum Development Act);
(d) Working within existing legal frameworks to ensure that geothermal resource exploration and exploitation proceeds compliant with all relevant environmental and social standards, and in consultation with the relevant authorities.

2.5 Environmental Management

Although geothermal energy offers environmental benefits in terms of a sustainable, reliable, low greenhouse gas emitting energy source, some local impacts are an inevitable part of its development. Construction of access roads, siting of well pads, corridors for flowlines from wellheads to power plant, and the power plant facility and electricity evacuation infrastructure can all impact on the natural environment.

Geothermal brines can contain chemicals that may be potentially hazardous, such as trace metals and other contaminants like sulphur and arsenic. These must be managed appropriately to avoid contamination of land and subsurface resources e.g. potable aquifers. Following heat extraction, cooled geothermal waters (brines) are typically reinjected back deep into the ground via dedicated reinjection wells to support recharge of the geothermal reservoir. This is the safest means of avoiding contamination risks. In some cases, the mineral contents of the brines may have value that can be extracted using different techniques. Geothermal power plants also require water for cooling, which may involve use of freshwater or geothermal waters.

Air emissions can also arise from production of geothermal brines, which can be managed through design of closed loop systems (binary plants) that avoid the "flashing" of steam in the open air. These systems are likely to be the most appropriate technology for the type of medium-temperature geothermal resources that are expected in Uganda.

Management and regulation of these types of environmental effects are already covered by much of the existing statute. For example, the National Environment Act 1995, the Water Act, 1997 and the Wildlife Act 2000 apply to geothermal developments *mutatis mutandis*; the National Environmental Impact Regulations of 1998 already apply to geothermal energy developments by way of the Third Schedule 4(d) and 10. The licensing procedures for power plants set out in the Electricity Act 1999 (§29, §33, §37), which also applies to geothermal power plants, also require such impacts to be taken into account. Water and potentially waste management laws and regulations will also apply *mutatis mutandis* with respect to the abstraction and discharge of surface and groundwaters. In the case of minerals extraction from brines, regulation under the Mining Act 2003 would also apply.

In promulgating new laws, there is the need to ensure they are established cognizant of the interactions with existing laws, and licenses are granted in close consultation with the National Environmental Management Authority, Uganda Wildlife Authority and other relevant Ministries and Agencies.

2.6 Socio-economic Issues

As a form of reliable, affordable and low emission source of baseload power generation, geothermal energy can offer benefits for social development. Experiences around the world show the levelised cost of electricity generated from geothermal sources to be in the range US¢5-15 per kilowatt-hour (kWh), and as low as US¢3 per kWh in some circumstances. This is similar to the cost of electricity for new power generation sources recently brought on line in Uganda; information reported by ERA shows new large hydropower generation tariffs to be in the range US¢10-14 per kWh (Bujagali), and thermal generators (heavy fuel oil) in the range

US¢21-29 per kWh.[1] The tariff for the new large hydropower at Karuma has been estimated to be upwards of US¢5 per kWh, with some suggestions that it will be as high as between US¢12.5 and US¢20 per kWh (Mwenda, 2015). Consequently, cost effective development of geothermal power can be competitive with other new sources of power available in Uganda today.

Development of geothermal resources offers a range of potential local benefits. As well as providing a localised source of reliable and affordable electricity, direct uses of geothermal heat provides for a number of potential economic opportunities. These include use of geothermal heat for food processing (e.g. drying of agricultural products and fish; milk pasteurisation), local amenities (e.g. communal laundries), fish farms, greenhouses (night heating to enhance growing), balneology (bathing) and health spas. All of these activities offer opportunities to increase the socio-economic wellbeing of local communities in proximity to the resource and create new economic opportunities for local people. For example, use of geothermal heat for food processing can enhance the longevity of agricultural and fisheries products, increasing food security and thereby offering access to more remote markets for sale of locally produced food products. A geothermal power plant can become a tourist attraction in its own right, as is the case with many geothermal power projects around the world today, as well as creating other tourism opportunities such as with health spas using geothermal waters. Mineral recovery from geothermal brines also offers another potential source of local economic activity. Increasing public awareness of these aspects of geothermal energy will be key to ensuring community readiness to absorb new geothermal energy technologies in the future.

A key part of capturing the local benefits will be ensuring a high level of national and local content in geothermal developments. As with the National Oil and Gas Policy, it will be vital to capture these interests in the new industry.

As well as offering local benefits, development of geothermal resources must be carried out sympathetic to local traditions and culture. An important aspect that needs to be taken into account in geothermal resource development is salt mining/production. These artisanal mining activities are closely aligned with potential geothermal resource centres in Katwe and Kibiro villages (Kasese and Hoima Districts respectively). The salt accumulations in Katwe and Kibiro arise principally from the presence of salt in the local geothermal hot springs that feed the Lake Katwe and the salt gardens at Kibiro. Recovery of these deposits to produce different types of salt is an artisanal industry that dates back centuries and which continues to this day using various traditional production techniques. It provides a traditional way of life and livelihood for many people in the villages and surrounding areas. Trona mining is also carried out in Lake Katwe. It is essential that the nature of these activities – and in particular the possible interactions between geothermal fluid extraction and effects on springs feeding the salt industry – is fully understood and analysed prior to proceeding with any development. Synergies may exist between geothermal energy production and salt mining, with the use of geothermal heat to evaporate saline waters being one possible industrial application today.

Whilst a properly constructed and managed geothermal power plant offers only very small risks to human health and safety, some risks are present. The production and transport of hot steam

[1] Source: ERA Generation Tariffs. Estimates based on period 2010-2015.

can be hazardous to humans and animals, and needs careful management to avoid risks to the public, livestock and wildlife. Use of appropriate signage and security fencing is essential to avoid unauthorised human contact with geothermal plant infrastructure (wellheads, flowlines etc.).

Many of the factors described are covered by the existing statue, principally the Electricity Act 1999 and the licensing procedures (e.g. §29, §33, §37) and emergency control requirements (§41) therein. The projects adaption to the landscape, the impact on public interests and mitigation measures, and impacts on private interests would all need to be described in any license application for a geothermal power plant submitted to ERA. On this basis, no additional regulatory requirements are presented.

The following actions will be prioritised to address the matters described:

(a) Working with local communities to raise awareness of geothermal resources, the issues involved in its development and the potential benefits that it offers;
(b) Identifying opportunities for local direct uses of geothermal heat/brines in locations around geothermal prospects and helping to support the economics of direct use applications;
(c) Working with local communities to ensure the social impacts of geothermal development are minimised;
(d) Ensuring national content is a key element of all efforts to build a geothermal industry.

2.7 Regional and International Cooperation

Ongoing collaboration through regional and international networks of expertise will continue to be a key feature of geothermal development in Uganda. These networks offer significant opportunities to learn lessons from other parts of the world that have progressed further with geothermal resource development. This includes neighbouring countries in East Africa, as well as other parts of the world and in particular those counties with similar geological settings as seen in Uganda today, namely extensional domain plays with fault-controlled geothermal systems; examples of the latter include the Western USA Basin and Range Province and the Anatolian Plate margin in Western Turkey.

In terms of collaboration with neighbouring countries, Uganda is a core founding member of the UNEP-Global Environment Facility: African Rift Geothermal Development Facility (ARGeo). The ARGeo aims to reduce exploration risk through various activities including networking and capacity building to raise awareness of geothermal energy, and to provide technical assistance for surface exploration studies. Uganda has also signed a Memorandum of Understanding (MoU) with Kenya and Rwanda to share experiences, knowledge, expertise and equipment for geothermal resource exploration and development.

Recently the UNCST entered into a MoU with the Scientific and Technological Research Council of Turkey, Earth and Marine Institute (TUBITAK MAM) that includes, amongst others, cooperation on geothermal resource development. The objectives include carrying out further studies and the possibility of test drilling of selected sites. An application for funding has been made to the Islamic Development Bank to support activities. A MoU has also been signed

between the MEMD and Toshiba Corporation of Japan covering equipment supply, operation and management guidelines and personal development.

As a low greenhouse gas emitting renewable energy technology, geothermal energy continues to be of key interest to development partners. Consequently, a range of technical assistance grants and concessional financing opportunities exist from international donors. This includes bilateral activities with institutions such as the Icelandic International Development Agency (ICEIDA), Japan International Cooperation Agency (JICA), Agence Française du Développement (AFD), United Kingdom's (UK) Department for International Development (DfID), the German Federal Institute for Geosciences and Natural Resources (BGR) and Kreditanstalt für Wiederaufbau (KfW), and multilateral organisations such as the World Bank, African Development Bank and the European Investment Bank. A summary of selected development partner activities is provided below (Table 2.1).

Table 2.1 Selected geothermal funding activities of development partner

Name	Aim	Host	Amount	Activities supported
AUC-KfW Geothermal Risk Mitigation Facility (GRMF)	Fund geothermal energy in EARS	AUC, Addis Ababa	**~US$75 million** (including country contributions)	(1) Infrastructure grants: 20%; (2) Surface studies grants: 80%; (3) Drilling grants: 40%; (4) Continuation Premium: up to 30%
UNEP-ARGeo	Support geothermal energy in EARS	UNEP, Nairobi	**~US$110 million** (excluding co-finance)	(1) Regional Networking, Information Systems, Capacity Building, Policy Advice and awareness creation; (2) Technical Assistance for Surface Exploration Studies.
DfID-EAGER	Catalyse private and public investment in geothermal in EARS	Adam Smith Intl, Nairobi	**~US$8 million**	Advice to Governments on strategy, policy and regulation to attract investment in and overcome barriers to geothermal power
Icelandic International Development Agency	Assist EARS countries with geothermal exploration	ICEIDA	**~US$13 million**	(1) Reconnaissance, exploration up to drilling; (2) Technical assistance and capacity building including: training, institutional support; policy and legal framework

Uganda has historically had some successes in securing technical assistance for geothermal resource exploration, but this has mainly been for surface studies related to Phase 2 of resource development, rather than large-scale exploration programmes. Recent activities include:

- Support from ICEIDA for surface studies at Kibiro and Katwe-Kikorongo;
- Support from BGR for surface studies at Buranga;
- Various interventions co-sponsored by the World Bank;
- Support from JICA on studies of geothermal prospects in the south and south west; and;
- MoU between GRD and the DfID-supported East African Geothermal Energy Facility (EAGER) for a project that seeks to improve geothermal resource data collection, interpretation, management and oversight of licensing.

Further efforts are needed from government in order to mobilise development partner funding, particularly for enhanced resource exploration studies and test drilling (Phase 3). This is because

most technical assistance grants are typically provided only on the basis of co-financing with government or other investors. For example:

- The Geothermal Risk Mitigation Facility (GRMF) provides a maximum of 40% grant for the cost of test drilling (Table 2.1);
- In 2011, the Government of Kenya needed to invest US$284 million of equity (38%) to leverage a further US$462 million in grants and concessional finance (62%), including its entire Scaled-up Renewable Energy Programme (SREP) funds, into the Menengai steamfield development;
- A geothermal test drilling programme to be launched in Armenia supported by the Climate Investment Funds (CIF) will involve the government investing US$2 million (18%) to mobilise US$9 million of SREP funding.

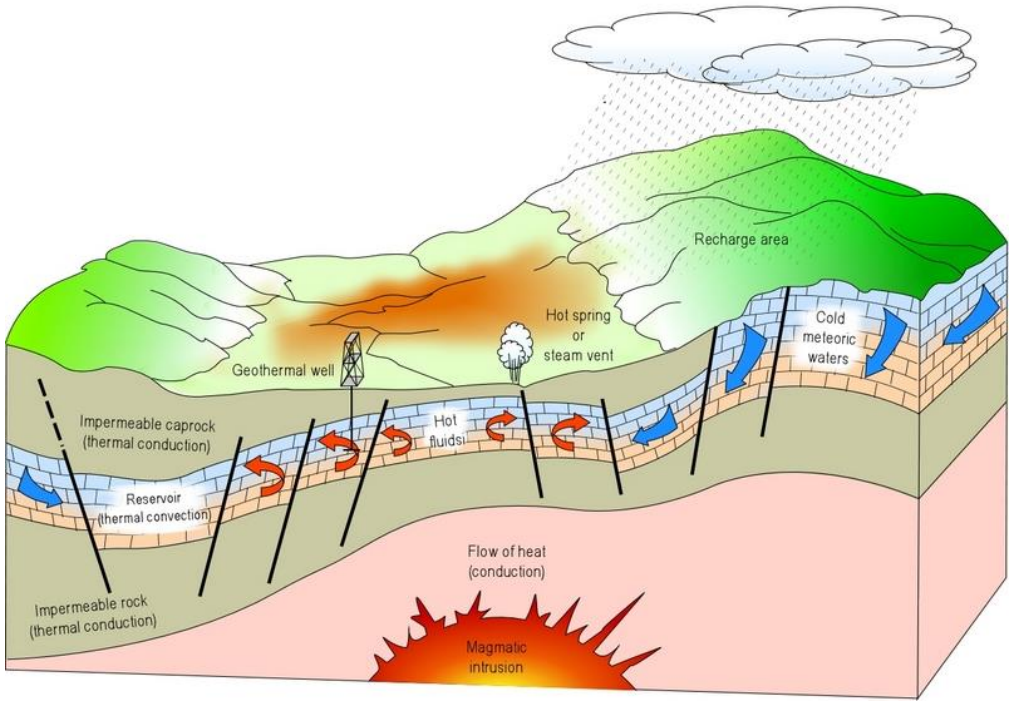
3 GEOTHERMAL RESOURCES OF UGANDA

3.1 About Geothermal Energy

Geothermal energy is heat from the Earth. In hydrothermal systems, meteoric (rain) water percolates through rocks into a naturally-occurring geological reservoir, where it is heated by a relatively shallow heat source rising from the Earth's mantle. The heated water in the reservoir can be tapped by wells and used as a heat transfer method to bring it from depth to the surface for utilisation, such as driving turbines for power generation (generally for resources >150°C) and for direct (heat) use purposes for lower temperature resources (<150°C). The presence of meteoric water allows for the recharge of the reservoir over time, making for a sustainable energy resource. These systems are typically found at active tectonic plate margins, such as around the Pacific Rim, the Anatolian plate margin (Turkey), the mid-Atlantic ridge (Iceland) and in Rift systems (East Africa).

A typical hydrothermal geothermal system is shown below (Figure 3.1).

Figure 3.1 Schematic of a geothermal energy system

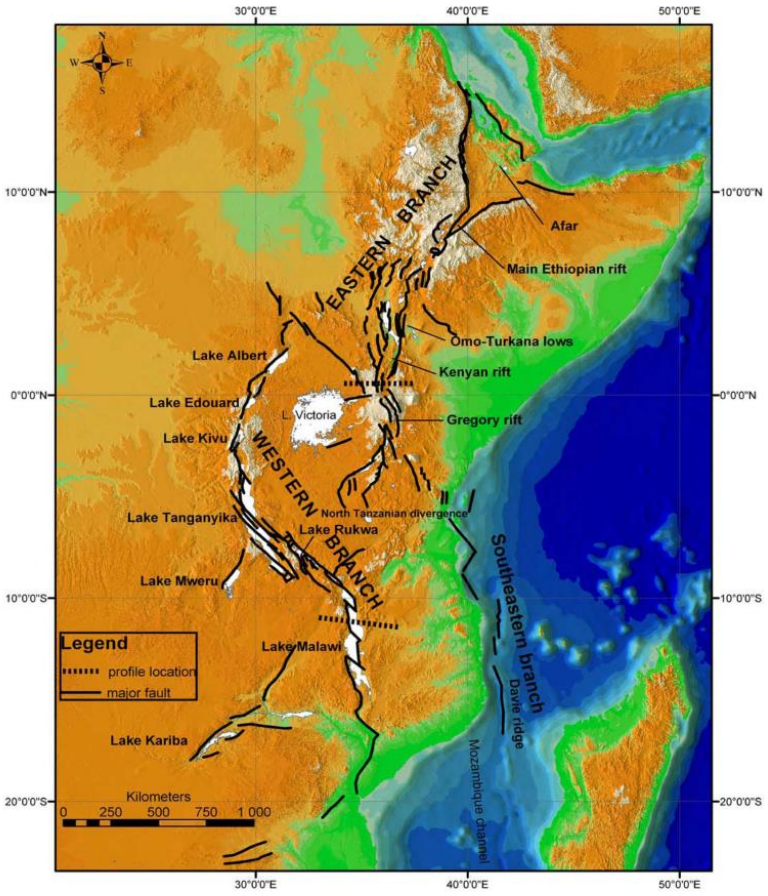


Source: Dickson and Fanelli, 2004

3.2 Geothermal Resources of Uganda

The main geothermal resources of Uganda are located in the west of the country centred on Lake Albert and Lake Edward in the districts of Kasese, Hoima, Bundibugyo and Nebbi. This area is underlain by the Western Branch of the East African Rift System (EARS), a continental rift zone where the African tectonic plate is in the process of splitting into two (Figure 3.2).

Figure 3.2 Map of the East African Rift System



Source: After Chorowitcz, 2005, cited in Harðarson, 2014

The EARS is formed of two main branches: the Eastern and Western Rift. The Eastern Rift runs from the Afar Triangle in Eritrea, Djibouti and Northern Ethiopia south into Kenya and Northern Tanzania. The Western Branch runs from Northern Uganda, south through Rwanda and Burundi, into western Tanzania and on into Malawi, Zambia and Mozambique (Figure 3.2).

In rift zones such as the EARS the driving force for tectonic activity is thought to be the presence of hot plumes of molten rock rising from deep in the Earth's mantle (mantle plumes). These give rise to hotspots in the asthenosphere, which results in both the melting and thinning of the rocks at the base of the Earth's crust and the rifting process through extensional tectonics. This creates the opportunity for relatively shallow hydrothermal systems to develop that can be economically tapped and used as a source of geothermal energy.

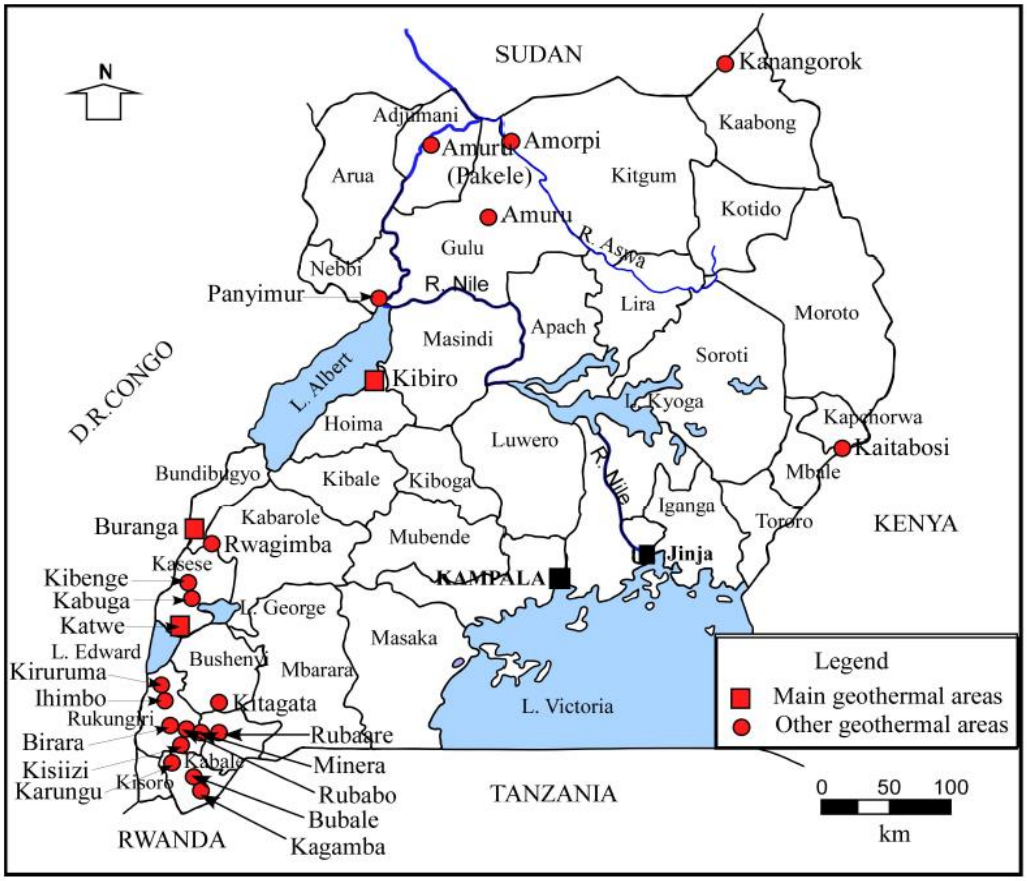
Controversy exists regarding the nature of the subsurface heat sources in the EARS, including the size, number and nature of mantle plumes (Harðarson, 2014). What is clear is that the geological forces in the EARS region are not acting in a uniform way, hence the existence of the two distinct systems within the EARS: the Western Branch and Eastern Branch. In general, the Eastern branch is characterised by greater tectonic activity than the Western branch. The temperature and nature of the heat source in the mantle across the region may be the driving force behind differing effects in the Eastern and Western Branch. The result of these general trends is that the geothermal resources of the Western Branch may be more complicated than the Eastern

Branch, because of the thicker layers of basal rocks through which to heat is to be conducted to the near-surface layers, and possibly lower temperatures in the underlying mantle.

According to Harðarson (2014), *"The differences in volcanism and uplift/subsidence in the Eastern and Western branch, respectively, undoubtedly reflect different mantle temperatures with temperatures underneath the Eastern branch probably 100-150°C higher than underneath the Western branch (White et al., 1987)."* On this note, he concludes that *"Geochemical studies in Western rift...in some areas...indicate that the geothermal activity in the Western branch is dominated by low temperature activity (<150°C reservoir temperature)"*. Consequently, there is greater uncertainty about the geothermal energy potential of the Western Branch relative to the Eastern Branch. Notwithstanding this uncertainty, Harðarson (2014) also noted that "*in a few places higher temperature* [geothermal resources] *might be found, of up to about 250°C"* and in some instances the use of binary technology for electricity generation may be possible.

Research into Uganda's geothermal energy resources has been ongoing since 1993 focussed on the four main geothermal areas that have been identified, namely: Katwe (Kasese district), Kibiro (Hoima district), Buranga (Bundibugyo district) and Panyimur (Nebbi district; Figure 3.3).

Figure 3.3 Geothermal resource map of Uganda



Source: Bahati, 2011

The local geology in these locations is characterised by various surface manifestations indicative of a the presence of a shallow geothermal/hydrothermal system such as hot springs, warm springs, gaseous emissions, travertine, hydrothermally altered rocks, mineral precipitates and thermophyllic grass (Kato, 2013).

The status of exploration activities in different geothermal prospects is shown below (Figure 3.4). As outlined, a range of surface studies and shallow well measurements have been undertaken (e.g. thermal gradient (T/G) wells to around 300 m; Gislason et al., 2008),[1] but no deep, full-size, test wells have been drilled to date, and no commercial geothermal reservoirs have been fully identified. Consequently, uncertainty persists regarding the nature of the resource in all geothermal prospects, and there is an urgent need to gain a deeper understanding of the resource quality in Uganda in order to unlock its use.

Figure 3.4 Status of geothermal resource exploration in Uganda

EXPLORATION STATUS

Not started
Some work undertaken
Around half completed
Nearing completion
Completed

	Prospect Name						
	Katwe-Kikorongo	Katwe-Bunyampaka	Kibiro	Buranga	Panyimur	Kanangorok	Other areas
GENERAL INFORMATION							
Phase 1 - PRELIMINARY SURVEY	57%	0%	63%	60%	60%	60%	50%
Field identification/description	100%	0%	100%	100%	100%	100%	80%
Desk-top review of geological information	95%	0%	100%	100%	100%	100%	90%
Land status/access issues identified	75%	0%	100%	100%	100%	100%	80%
Environmental/social factors described	10%	0%	10%	0%	0%	0%	0%
Baseline environmental data collected	5%	0%	5%	0%	0%	0%	0%
Phase 2 - EXPLORATION	48%	0%	76%	37%	27%	25%	8%
Geological assessment	60%	0%	90%	80%	70%	50%	20%
Mapping	60%	0%	80%	50%	70%	50%	0%
Geological summary report	50%	0%	70%	50%	50%	50%	0%
Structural interpretaton	50%	0%	70%	60%	60%	40%	0%
Geochemical analysis	80%	0%	100%	100%	40%	50%	20%
Flow rate	80%	0%	70%	70%	50%	50%	0%
Temperature	100%	0%	100%	100%	50%	80%	60%
pH + electroconductivity	100%	0%	100%	100%	100%	100%	60%
Soil sampling/gas flux	0%	0%	80%	0%	0%	0%	0%
Geophyiscal surveys	50%	0%	75%	50%	20%	0%	0%
Gravimetry	50%	0%	100%	0%	0%	0%	0%
Magnetics	50%	0%	100%	0%	0%	0%	0%
Resistivity	60%	0%	100%	0%	0%	0%	0%
Transient Electro Magnetic (TEM)	50%	0%	100%	0%	0%	0%	0%
Magno Telurics (MT)	0%	0%	100%	0%	0%	0%	0%
Seismic	0%	0%	0%	0%	0%	0%	0%
T/G wells + heat flow analysis	30%	0%	30%	0%	0%	0%	0%
Conceptual model	50%	0%	80%	40%	0%	0%	0%
PRE-FEASIBILITY study	0%	0%	0%	0%	0%	0%	0%
Phase 3 - TEST DRILLING	0%	0%	0%	0%	0%	0%	0%
Phase 4 - REVIEW AND FEASIBILITY	0%	0%	0%	0%	0%	0%	0%
Phase 5 - STEAMFIELD DEVELOPMENT	0%	0%	0%	0%	0%	0%	0%

Source: Compiled by GRD, July 2016. *Note*: Percentages shown are estimated level of completion

[1] This includes various technical assistance projects with agencies such as the *Icelandic International Development Agency* (ICEIDA; at Kibiro) and studies by the *Japanese International Cooperation Agency* (JICA) in the south west of the country (Kato, 2013)

To date only two deep exploration wells have been drilled in the Western Branch of the EARS, at Karisimbi, Rwanda, in 2013. This work was overseen by various Icelandic and Japanese experts and involved the use of a reservoir model prepared by the *Institute of Earth Science and Engineering* (IESE), New Zealand (Rutagarama, 2015). Problematically, both wells showed a thermal gradient of only 30°C/km and failed to provide any evidence of the existence of a hydrothermal system in the area (Rutagarama, 2014; Rutagarama, 2015). As a result, drilling was halted. The results from the Kirisimbi drilling programme has set back perceptions about the geothermal resource potential of the Western Rift. On the other hand, Onacha (2012) in a summary of the status of geothermal energy in the Western Branch of the EARS highlighted that some good prospects exist, outlining evidence of subsurface temperatures of 200-220°C at Kibiro and lower enthalpy resources at Katwe (140-200°C) and Buranga (120-150°C). Despite the failure of the test drilling in Rwanda, the evidence in Uganda provides a strong indication of the presence of an economically viable geothermal resource, and suggests further investigation is warranted.

3.3 Power Generation Potential

In terms of the total geothermal resource potential of Uganda, initial estimates made in 1982 stood at 450 MW (McNitt, 1982). This has now been upgraded to over 1,500 MW (Uganda Vision, 2040). The upgrade is in line with most other countries included to the 1982 regional assessment (Table 3.1). For example, McNitt (1982) estimated resource potential for Kenya at 1,700 MW, whereas the latest estimates have revised the potential to 7,000-10,000 MW and similarly in Tanzania the latest resource estimate is >5000 MW, up from 650 MW in 1982. The variability in resource estimates highlights the challenge involved in making regional extrapolations of resource potential, and shows that they tend to be quite conservative. As such, it is fair to speculate that Uganda's resources could be several times greater than estimated by McNitt in 1982, and more aligned to the long-term estimate of 1,500 MW of installed capacity envisioned under Vision 2040.

Table 3.1 Geothermal resource estimates for selected EARS countries

Country	Geothermal Resource Potential		Source
	McNitt (1982)	Recent estimate	
Kenya	1,700	7,000-10,000 [a]	MOE, 2011
Ethiopia	4,600	4,200-11,000 [b]	MWIE, 2015
Tanzania	650	>5,000 [c]	Mnjokava (2014)
Uganda	450	Over 1,500	Uganda, Vision, 2040

Furthermore, new understanding of the geology of the Western Branch of the EARS is emerging based on the analogue of other fault-controlled geothermal systems. Such fault-controlled systems are different to the magmatic systems of the Eastern Branch of the EARS in Kenya and Ethiopia, and more similar to parts of the western USA[1] and Anatolian plate margin in Turkey. These provinces are both active geothermal energy producers. For example Turkey has around

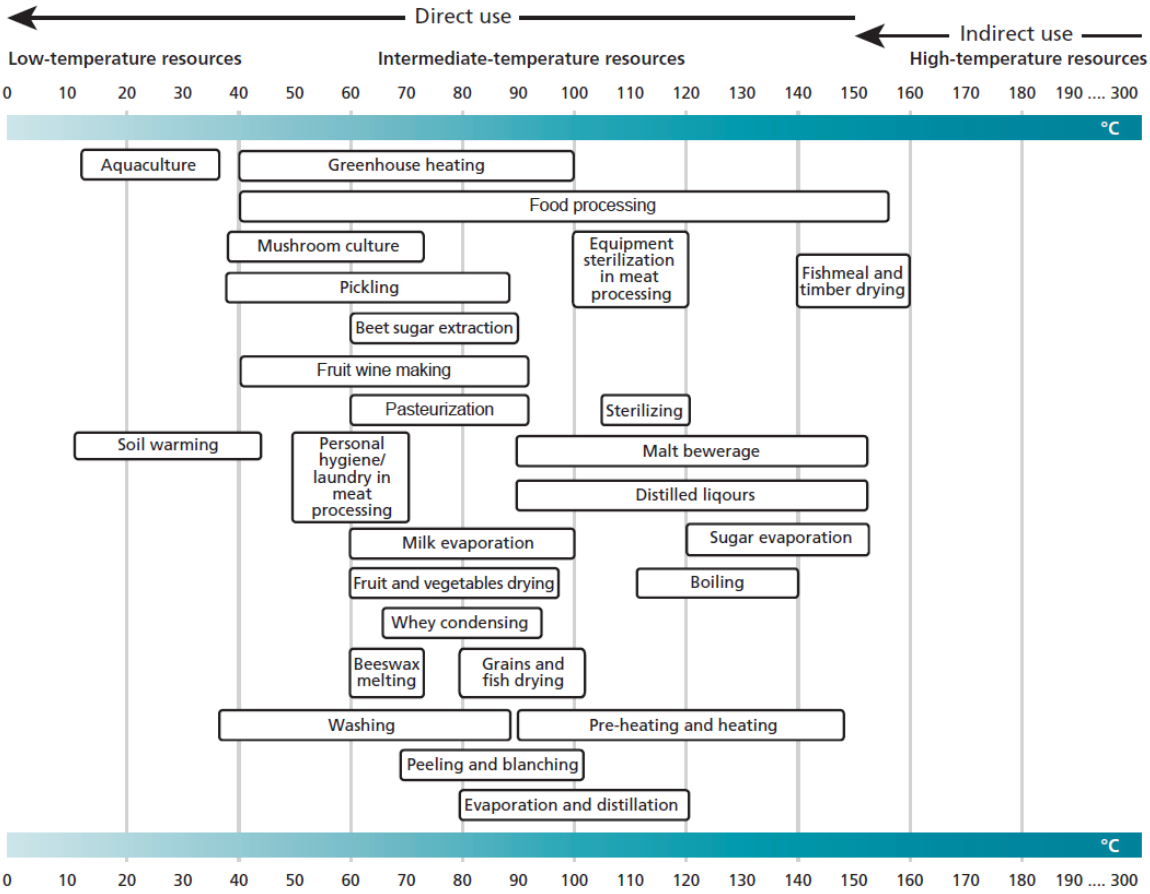
[1] An area known as the Basin and Range Province, which stretches east from the Sierra Nevada mountains through the states of Utah, Nevada, Arizona, New Mexico and into Northern Mexico.,

seventeen (17) geothermal power plants with an average capacity of 30 MW and a total installed capacity of around 400 MW, and has near-term targets to increase installed capacity to 750 MW by 2018 and more than 1,000 MW by 2020. It is also a significant direct user of geothermal heat, with more than 2,800 MW_{th} of capacity, mainly in balneology (spas) and heating applications (domestic, hotels). The State of Nevada in the USA has eighteen (18) geothermal power plants with an average capacity of 40 MW and a total installed capacity of over 600 MW, and an estimated resource potential of 2,500-3,700 MW. These analogues provide further evidence of the viability of the geothermal potential of Uganda.

3.4 Direct Use Potential

The potential for direct use is difficult to estimate as it depends on the proximity of the heat source to potential end-users. Salt mining is an industry already utilising geothermal resources at Katwe and Kibiro. Artisanal wellness spas using geothermal waters are also known exist in Uganda (e.g. Rwagimba Hot springs, Kabarole District), and at least one example is known of where warm of water from a geothermal spring is being used for heating and bathing in a hospital (Kisiizi hospital, Rukungiri district). It is clear, however, that other potential applications exist especially in respect of food processing and tourism sectors, both of which are already present in the districts where geothermal resources are located. A summary of the range of potential direct uses by varying temperature is outlined below (Figure 3.5).

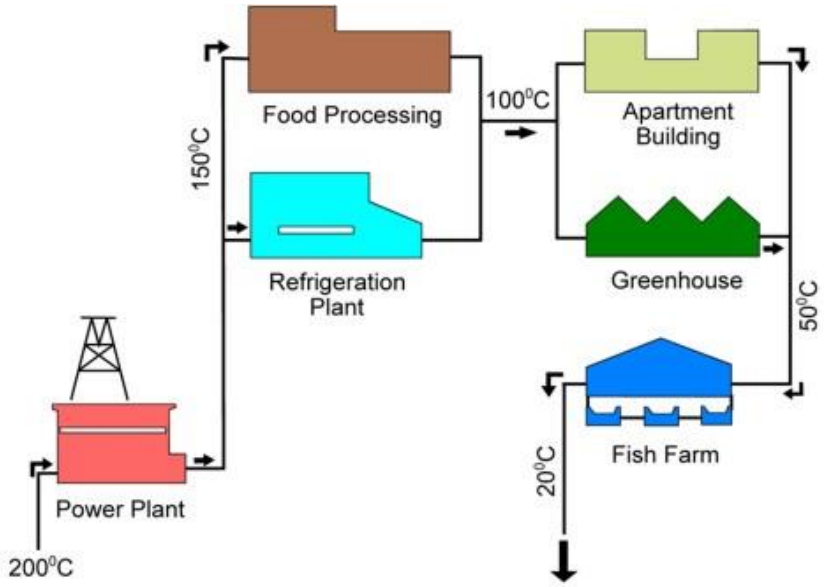
Figure 3.5 Direct use applications for geothermal energy (modified Lindal diagram)



Source: Van Nguyen *et. al.,* 2012, based on Lindal, 1973

Development of a 'cascade' geothermal system is also an area gaining increasing interest. In these systems, the waste heat remaining after successive processes is 'cascaded' to different industries depending on their heat needs. An example schematic of such a system is shown below (Figure 3.6).

Figure 3.6 General schematic of a potential geothermal cascade



A recent example of the growing interest in cascade systems is that of the Geothermal Development Company (GDC) of Kenya. As part of its mandate to "promote alternative uses of geothermal resources other than electricity generation", the GDC recently launched a cascade pilot at the newly-developed Menengai steamfield, as described further below (Box 3.1).

Box 3.1 Cascaded system of direct use at the Menengai Geothermal Project, Kenya

The Menengai Geothermal Project, about 180 km northwest of Nairobi, is the most recent large-scale geothermal development activity in Kenya. In developing Menengai, the Kenyan parastatal Geothermal Development Company (GDC) adopted a holistic approach in the development of the project, aiming to make extensive use of the geothermal resource beyond just power generation. In collaboration with USAID (United States Agency for International Development) GDC assessed the potential for a number of direct uses which identified several viable applications. Four direct use schemes have now begun operations, linked together in a cascade system. The schemes, currently at pilot-scale, have been set up on a single well pad of MW-03, which is currently venting waste exhaust heat from a back pressure wellhead plant of around 2-3 MW. The project is supplying water at around 75°C heated via a heat exchanger from the geothermal waters.

The first activity in the cascade is a dairy, in which the hot water is used to pasteurise milk. The milk, located inside a constantly stirred drum, is surrounded by a jacket filled with the heated water; once the milk reaches a temperature of 68°C, the hot water is removed from the jacket and replaced by cold water. Some of the hot water from the dairy is then piped to a laundry and used to wash items in a washing machine (geothermal heat is also used for drying). The remaining water from the dairy is then transferred to an aquaculture project. The water, at a temperature of around 40°C, is mixed with cold water to lower the temperature to an optimised fish growth temperature of 29°C. Finally, once the water has been filtered, it is used to water tomato plants inside a geothermally heated greenhouse (the greenhouse is only heated at night). The filtered ammonia from the aquaculture project is diluted and used to fertilise the plants. The pilot-level projects are expected to be scaled-up in the near future to help local farmers and communities.

3.5 Co-production of Minerals by Extraction from Geofluids

The nature of Uganda's geothermal resources, being largely formed in a fracture dominated system as opposed to a magmatic system, means geothermal fluids can have high mineral content that may be amenable to mineral recovery. The areas around Katwe and Kibiro already utilise geothermal deposits to produce salt (see Section 2.6). Other recoverable minerals in geothermal brines can include silica, zinc, lithium, manganese and a range of other rare Earth elements. Geothermal fluids could also be used in conjunction with the minerals industry in a fairly simple ore extraction method known as 'heap leaching' to extract precious metals such as gold and silver.

There are limited examples of such applications today, however. Silica is generally an issue for geothermal power generation due to the scaling problems that it can cause, but the preferred approach is to manage scaling through temperature management rather than extraction. Commercial silica has been produced at a geothermal power plant at Mammoth Lake in California, USA, where its recovery was a co-benefit from the installation, in the early 2000's, of a brine-fed evaporative cooling system used to increase plant efficiency during warm weather. A minerals and power coproduction facility was built at Salton Sea in California, USA (Salton Sea V, commissioned 2000) involving recovery of around 30,000 tonnes of zinc per year and using about 40% of the plants 49 MW output, the remaining power being sold to the grid. In the case of the latter, the zinc recovery plant closed down around 2004, however, due to operational difficulties and depressed zinc prices.

4 ISSUES AND CHALLENGES FOR GEOTHERMAL DEVELOPMENT

Uganda possesses an abundance of energy sources including hydropower, geothermal, biomass, wind, solar and fossil (thermal) resources. Geothermal energy needs to compete for funding and investment with these other resources. Problematically, although existence of the resource is known, its true extent and economic potential is not fully known. To reduce uncertainty greater investment is needed into exploration activities, in particular to support a test drilling campaign. This is an expensive and risky undertaking and for this reason is difficult to attract private investment, although the current policy strategy for geothermal resource development is mainly passive, relying largely on the private sector to explore for and develop the resource. Whilst this limits government exposure to the costs and risks of geothermal development, it is extremely unlikely to result in a bankable project emerging in the near-term, if at all.

The situation in Uganda is that a step-change in investment into exploration activity is needed if geothermal resource development is to be accelerated in line with ambitions to establish the technology in the country. Whilst development partners are willing to mobilise finance for geothermal exploration and test drilling, this is only likely to occur on the basis of co-financing. Consequently, further political guidance is needed in order to direct appropriate levels of spending and investment into resource development so as to reduce uncertainty and increase bankability of projects. The issues and challenges impeding such developments are briefly described in the following sections.

1. Uncertainty over future levels of electricity demand, and competition amongst sources of power generation to meet rising demand

Installed electricity generating capacity in Uganda at the end of 2015 stood at 896.5 MW, of which only 724 MW is available. Presently Uganda's energy sector faces considerable challenges including power shortages and growing demand (estimated to be growing at 9% per year). Household access to electricity is just 18% at the national level, one of the lowest in Africa. Increasingly unreliable rainfall and recent droughts, potentially attributable to climate change, is impacting upon hydropower generation, whilst investment in other renewable sources has so far been limited due to high upfront costs and other constraints. Significant uncertainty remains about the pace of development of oil and gas resources that could potentially be used to build new fossil fuel fired thermal (natural gas; heavy fuel oil) generating capacity. These sources of power also produce carbon dioxide (CO_2), a greenhouse gas that exacerbates human-induced climate change.

Peak demand for power in 2030 is estimated to reach between 1,873-2,722 MW according to the PSIP, and envisaged in *Vision 2040* to reach 41,738 MW in 2040. Resources available to meet this demand in the near-term include:

- Hydropower – resource potential estimated to be around 4,500 MW
- Geothermal – resource potential estimated to be at least up to 1,500 MW
- Fossil thermal including natural gas – near-term potential of several 100 MW
- Other renewables, including small-scale hydro, biomass and waste – unknown potential, perhaps several 100 MW

Of the 1,500 MW of new capacity needed over the next 14 years to meet the PSIP forecast, around 908 MW is already under construction at the Karuma and Isimba hydropower projects, which are expected to come online in 2018 along with around 80 MW of small-scale hydropower. These developments will provide a reserve margin of around 80%, which will persist above 25% until the mid-2020's as demand increases to fill the margin. In addition, at least 1000 MW of new hydropower capacity is under consideration at the Ayago and Oriang projects alone. Consequently, through the mid-2020's it is expected that there will be significant over-capacity on the electricity grid, with an unknown level of new demand sources expected to take up the new supply.

Notwithstanding this limited outlook, moving towards the longer-term target envisaged under *Vision 2040* involves a more than 20-fold expansion in power generation capacity over the decade 2030-2040 compared to the PSIP central forecast. To meet this ambition, it seems inevitable that geothermal energy will need to be scaled-up significantly beyond the role envisaged by the PSIP. This view is shared in the UN's *SE4All Action Agenda 2015* (MEMD, 2015a), which sets out a more ambitious plan to fast-track renewable energy over coming years, and includes an aim of around 160 MW of geothermal capacity to be implemented by around 2023, more than 400 MW by 2025, and over 700 MW by the late 2020's.

This policy aims to ensure that due account is taken of the potential benefits that geothermal energy offers in terms of diversifying electricity supply sources and increasing energy security.

2. Insufficient investment to support enhanced geothermal exploration, in particular test drilling

It is only by undertaking test drilling that the bankability of projects can be increased to levels likely to attract commercial investors. Experiences around the world have shown that nearly every FOAK geothermal power project in existence in low- and middle income countries has relied on government and development partner assistance to support their implementation. Private sector investment has typically occurred only in later stages of development, usually for the power plant once the steam resource is proven or for brownfield step-out development at existing sites, once confidence in the resource has sufficiently increased. As summarised in recent analysis: *"There is little appetite from the private sector to fund projects where the nature and extent of the resource are unknown. The private sector only financed all stages of the project in 7.5% of the utility-scale projects in our database. 58.5% of projects had the costs entirely borne by the public sector, while 34% projects had the private sector bear costs at later stages in the development chain once the resource had been proven."* and that: *"private financiers are not willing to provide financing until all or at least 70% of the MW capacity has been drilled"* (Micale et. al, 2014).

Current levels of government expenditure on geothermal resources – around UGX4.297 bn (US$1.3 million) for the Geothermal Resources Development Project (1199) budget in 2015 – are insufficient to fund a test drilling campaign, which could cost at a minimum US$5 million for a single full size well, or more likely in the order of US$15-20 million for a full programme. The level of funding for geothermal energy is significantly lower than for other energy technologies, such as hydropower, which received UGX92.5 bn in the 2015 budget (mainly for Karuma and Isimba) and capacity charges to thermal generators (UGX72.3 bn). The levels of government

finance are also insufficient to leverage co-financing from technical assistance grants and concession loans available from development partners.

This policy aims to mobilise increased Government expenditure on resource development, with a firm focus on leveraging co-funding from development partners, and the ultimate objective of accelerating resource development, reducing resource uncertainty and increasing the bankability of potential geothermal development projects.

3. Scarcity of competent, well capitalised private sector investors that add value to concessions

Although fourteen (14) geothermal exploration licenses have been issued to ten different firms since 2010 under the Mining Act of 2003, few have undertaken much activity that adds value to the concessions. Of the fourteen, six (6) have now expired without renewal, one (1) has been renewed, and only eight (8) are currently active. The firms taking concessions are generally small and are not sufficiently competent or capitalised to fund a fully-fledged exploration programme that includes test drilling and results in a feasibility study, nor capable of attracting the investment necessary to support such activities. For example, at the Katwe-Kikorongo prospect a US firm signed a power purchase agreement (PPA) with UETCL in 2013 on the basis of a US$1.2 billion investment into a 100-200 MW geothermal power plant, although little progress has been made with the project. Similarly, one firm holding a geothermal concession announced in 2015 that it is seeking US$42 million of investment for a joint venture to develop a geothermal prospect, drilling three (3) wells with a view to installing 30 MW wellhead plant on each (UIA, 2015). The size of the company and the high risk nature of the prospect suggests that it will face significant challenges in finding investors. Ultimately, the current approach means that concessions are becoming tied-up for five years with speculators that are either unwilling or incapable of undertaking the necessary exploration work i.e. passive speculators.

The issue of passive speculation is a widespread problem for geothermal development in many parts of the world, including in Chile and Indonesia.[1] In Indonesia, for example, concessions are awarded to the bidder offering the lowest power price, despite the bidder having very limited capacity to calculate this amount due to uncertainties about the resource i.e. due to the lack of public data access ahead of bidding. This has encouraged the allocation of concessions to passive speculators.

This policy aims to improve the way in which private and public sectors work together in resource development, and to deter passive speculation in order to promote the timely development of geothermal resources.

4. Absence of policy framework to guide public interventions on a strategic basis

The GRD was established in 2015 although its precise mandate remains unclear. It is presently acting in a variety of management roles, including:

[1] *Passive speculation* involves buying the concessions with a view of onward sale in the event that over time it acquires value through changes in demand for the mineral to which the license pertains. The opposite is *active* speculation, where a developer seeks to add value to the concession through acquisition of new information that could enhance the value of exploiting the area.

- Undertaking surveys and research into the geothermal resources of Uganda (under the Geothermal Resources Project (1199));
- Promoting investment into project development;
- Regulating private sector led exploration activities; and
- Coordinating the management of geothermal resources across government.

Further guidance is necessary regarding the order of priority the department should take in fulfilling these roles and ensuring that resources are mobilised in a structured and orderly manner that accelerates resource development.

This policy aims to clarify the mandate of the GRD in order that it can effectively promote and develop geothermal resources in a timely manner.

5. Inability to attract significant financial support from international development partners
A range of financial and technical assistance is available from development partners specifically for geothermal resource development in the EARS, such as the African Union Commission (AUC) hosted GRMF, which can provide up to 80% co-funding for surface studies and 40% for exploration drilling. So far Uganda has had only limited success in attracting support from these sources, however: the GRD has applied twice to the GRMF for support for surface studies at Buranga, but has been rejected on both occasions. A private sector license holder also made an application to the GRMF 3rd Application Round for support for surface studies at Panyimur, but was unsuccessful. Some support has been received on a bilateral basis from Japan, Iceland and Germany, and a technical assistance project will soon commence to improve data processing and management, supported by the UK (DfID). None of these activities are of the scale needed to support test drilling.

As well as the low level of co-funding offered by the Government of Uganda, part of the challenge lies in the uncertainty amongst development partners regarding the priorities of government in developing geothermal resources. The apparent mixed role of the GRD, and the lack of clear priorities, is affecting perceptions.

This policy aims to clarify Government's priorities regarding geothermal development and thereby help to attract technical and financial assistance from development partners.

6. Inadequate legal and regulatory framework
An effective legal regime for geothermal energy development should, *inter alia*, act to promote clear and secure tenure rights for private sector developers, create a firm basis upon which government can act to manage the resource, establish procedures by which open and transparent competition can evolve with the sector, establish a clear permitting and oversight regime for licensees, establish an appropriate fee and royalty structure for geothermal resource exploitation, and ensure coordination with other areas of policy and legislation (water, waste, environment, health and safety, wildlife conservation). Presently the regulation of geothermal exploration activities under the Mining Act 2003 is inadequate to meet these purposes. The framework does not allow for geothermal concessions to coexist with minerals concessions, and it does not provide sufficient safeguards against passive speculation, both of which can serve to reduce productivity for all involved.

Government will address this issue by introducing a new legal framework that improves the management arrangements for geothermal resources.

7. Low awareness amongst the public and limited community participation in geothermal development

Understanding of Uganda's geothermal resources, and the related economic opportunities, is generally low across all parts of Ugandan society. Poor knowledge presents a risk of negative public perception that could hamper developments. A lack of understanding about the risks and costs of geothermal energy development may also negatively affect perceptions about the cost of services that may be derived from geothermal resources. Increasing awareness of the nature of the resource, its benefits, and the related economic opportunities that may arise from its development – including in particular the scope for value added direct uses in conjunction with power generation (i.e. cascaded systems) – can all assist in creating an enabling environment for the technology. This can help accelerate resource exploration and project development by avoid costly delays in implementation, and help to optimise resource utilisation by local entrepreneurs.

This policy aims to improve knowledge and understanding about geothermal resource development and increase the level of opportunities for all.

8. Gap in education and skills to produce a workforce capable of maintaining a sustainable geothermal industry that adds value to the national economy

A survey of skills for geothermal resource development in East Africa undertaken by UNEP suggested a significant lack of skilled staff sufficient to meet future requirements (UNEP, 2015). It estimated that 3000-5000 new experts are needed across geosciences, engineering, environmental science, and project finance professions over the period from 2015 until 2030, making up a total workforce of around 12,000 dedicated to the technology in 2030. The greatest shortages are in the fields of reservoir engineers and technicians, drilling engineers and technicians, and plant engineers and technicians. A shortage of drilling technicians was highlighted as a specific skills gap in Uganda today.

The level of education and training on geothermal energy available in Uganda is generally weak. Some courses run at undergraduate and post-graduate level provide a general background module on geothermal energy, but do not provide dedicated elements specific to resource exploration and exploitation. Furthermore, these courses that do cover geothermal energy focus primarily on the mechanical engineering aspects. The topic coverage in geological sciences – the area crucial to understanding of the geochemical and geophysical survey methods necessary for resource exploration – has been low to non-existent to date. Some internship programmes have been run in conjunction with the DGSM and GRD, although these have tended to be *ad hoc* rather than on a structured basis. The strategic linkages to regional and international activities in the field – such as the United Nations University Geothermal Training Programme and the regional *Africa Geothermal Center of Excellence* (AGCE) to be hosted in Kenya – could be enhanced.

At the level of secondary education, geosciences content could be improved more broadly to help better prepare students for tertiary education in the related disciplines. Improving

education in this area, in particular in areas in proximity to the geothermal resources, could help improve general awareness of the resource and the opportunities it presents.

This policy aims to enhance the levels of education and training opportunities in geothermal technology for all Ugandans.

5 GEOTHERMAL POLICY FRAMEWORK

5.1 Introduction

The National Geothermal Resources Policy of Uganda provides a written declaration of the framework of policy objectives and statements that will guide the government and stakeholders in the management of the geothermal industry on a sustainable basis. Accordingly, the Policy is based on the following: goal, guiding principles, objectives and strategies.

5.2 Goal

The goal of this policy is "to accelerate development of Uganda's geothermal energy resources in order to realise its benefits for all".

This will be achieved by fostering and establishing a safe, secure, socially and environmentally responsible geothermal industry through increased investment that:

(a) enhances understanding of the resource;
(b) reduces risk and increases bankability of projects; and
(c) ultimately, unlocks and accelerates the potential of the technology so that it makes a substantial contribution to Uganda's mix of renewable energy supply over the medium- to long-term.

5.3 Guiding Principles

This policy is underpinned by several principles which guide development of its goals and objectives. These guiding principles include:

1. Establishing a diverse, secure, clean, reliable and affordable mix of power generation capacity to support economic and social development
Utilising a diverse range of energy sources is key to ensuring the security of future energy supply. Over recent years the expansion in the electricity supply base has primarily relied on hydropower – both large-scale and also a recent growth in small-scale hydropower spurred on by initiatives such as the Global Energy Transfer Feed-in Tariff (GET FiT) programme. This looks set to continue with commissioning of Karuma and Isimba hydropower schemes, as well as an array of small-scale hydropower schemes that are in the licensing process and under construction. Government needs to take an active role that promotes diversification away from hydropower to increase the security and reliability of electricity supply, not least because of the threat posed by variable rainfall and climate change and the cost of providing emergency power. Therefore, Government commits to an enhanced geothermal resource development programme to meet medium- and long-term needs for a secure, clean, reliable and cost-effective electricity supply.

2. Efficient and optimised resource management
Development and management of geothermal resources needs to be accomplished in an orderly and efficient way, and one that optimises the range of possible uses for geothermal energy; not only electricity generation, but also other direct uses that can act as a powerful catalyst for socio-economic development in some of Uganda's poorest rural communities. This policy

recognising the importance of promotion and facilitation in establishing strategies that establish affordable and scalable resource development, raising awareness of its benefits and seeking out potential opportunities for local industries and entrepreneurs to develop direct use applications.

The prime means of efficient management is to ensure that resource development costs are kept at an affordable level. The capital intensive nature of the technology means that this can be best achieved by using a mixture of different low-cost finance sources to fund development. Analysis has showed that the break-even tariff required (i.e. the levelised cost of electricity; LCOE) for a geothermal power plant developed in full by a private sector developer (requiring 25% return on equity) is in the range US¢14-17 per kWh, whereas for public-sector led development of Phases 1-4 supported by concessional loans, and an IPP entering at Phase 4/5 (with a 25% return on equity) a break-even tariff (LCOE) of US¢6.5-10.5 per kWh can be achieved (Musembi, 2014). This policy supports this aim by committing to attracting investment into geothermal energy from a variety of channels including: (1) the national budget; (2) technical assistance grants and concessional loans (with low costs of capital); and, (3) private finance. For the latter, this will be through the competitive engagement of Independent Power Producers (IPPs) to construct and operate geothermal power plants under Public-Private Partnership (PPP) arrangements so as to help reduce the overall cost burden of resource development on Government.

Flexibility is also needed in the approach to resource management. As the industry grows, it may no longer require so much direct intervention, at which point it may be necessary to establish new institutional arrangements that act more at arm's length from Government and thereby further promote competitiveness in the sector. This policy therefore commits to adopting a flexible and evolutionary approach to resource management responsive to the prevailing circumstances in the sector.

Geothermal resources are widely considered as a renewable resource but they can become depleted if not produced and managed in an appropriate way. It is therefore incumbent on Government to act as the responsible custodian of the natural resource. This policy therefore commits to the establishment of a robust regulatory framework and a competent regulatory authority to oversee resource development and exploitation activities.

3. Transparency and accountability

Effective resource management and engagement with stakeholders and private sector actors is reliant on openness and access to information. Availability of such information is a fundamental right in relation to activities which may have positive or negative effects on individuals, communities or states. The disclosure of information that enables stakeholders to assess how their interests are being affected is paramount. Disclosure of information on resource development will also be key to opening up competition in sector in the future. This policy recognises the important roles different stakeholders have to play in order to achieve transparency and accountability in the geothermal resource development area.

The policy shall promote high standards of transparency and accountability in licensing, procurement, exploration, development and exploitation operations as well as management of revenues from geothermal resource exploration and exploitation. The policy will also support

disclosure of payments and revenues using simple and easily understood principles in line with accepted national and international financial reporting standards.

4. Fostering cooperation

Government can act as a prime mover in geothermal resource development, but it cannot build a whole industry on its own. This requires a strong spirit of cooperation between government, individuals, communities, researchers and academics, entrepreneurs, private financiers and development partners. The interests of local communities in areas where geothermal resources are located shall be taken into account by, among other things, sharing of royalties in line with the Constitution and any relevant laws passed by Parliament. All efforts shall be made to avoid the development of conflicts and emphasize peaceful resolution of disputes. Where geothermal resource development activities or their impacts extend to neighbouring countries, this spirit shall be exercised in accordance with the principles grounded in the country's foreign policy. New methods of working with private sector actors will be established in order to more effectively distribute risks and rewards.

It is also important that geothermal resource development in Uganda retains benefits for the country. This policy therefore commits to promoting educational and professional learning opportunities to ensure strong national and local content in the geothermal industry of the future.

Important lessons can be learned from experiences in geothermal development around the world. This policy commits to further cooperation with regional and international partners to further understanding of resource management issues and approaches.

5. Protection of the environment and conservation of biodiversity

The environment, human development and biodiversity should be neatly balanced for mutual benefit and survival. Many actors engage in development initiatives and interventions focusing on expected benefits and often end up by doing harm. This policy shall contribute to and promote this balance to ensure sustainable development. It is the responsibility of all actors undertaking exploration – Government and licensed private sector companies – to protect the environment where they work or any areas in the country impacted by their operations. Government shall legislate, regulate and monitor compliance to meet this requirement.

5.4 Objectives

The objectives of the National Geothermal Resources Policy are:

Objective 1 – To accelerate progress in geothermal resource exploration and exploitation

Objective 2 – To optimise geothermal resource exploration and exploitation activities

Objective 3 – To establish an effective and transparent regulatory regime for geothermal resource management

Objective 4 – To ensure safe and environmentally-sound development of geothermal energy

Objective 5 – To promote a sustainable geothermal industry for the future

5.5 Policy Directions and Strategy

Objective 1 – To accelerate progress in geothermal resource exploration and exploitation

Strategies:
Government shall:

(a) Ensure a coherent package of energy policies that clearly recognise the role that geothermal energy can play in creating a secure and balanced energy mix for the future compatible with long-term targets for access to modern energy services, and prioritises investment in geothermal energy accordingly;
(b) Reinforce the existing institutional capacities to promote, develop and manage geothermal resources, in particular the Geothermal Resources Department;
(c) Increase spending on the government-led Geothermal Resources Development Project that results in enhanced exploration activities and the test drilling of at least one site by, at the latest, the early 2020's;
(d) Make significant progress towards the construction of the first-of-its-kind geothermal power plant by the mid-2020's with work underway to establish the second power plant shortly thereafter;
(e) Continue to explore for and appraise a range of geothermal prospects within the country;
(f) Work with a range of development partners to mobilise sources of technical and financial assistance that can be used to co-finance test drilling, feasibility studies, and power plant developments;
(g) Explore opportunities to access climate and carbon finance to support geothermal energy development using mechanisms such as the Green Climate Fund, Nationally Appropriate Mitigation Actions, and new market- and non-market mechanisms under the auspices of the UNFCCC Paris Agreement;
(h) Review and reform arrangements with the private sector in order to foster cooperation on resource exploration. This may include but not be limited to:
    a. Clarifying legal frameworks for resource exploration and exploitation;
    b. Establishing means by which public-and private sectors can work jointly on exploration projects including the leasing of equipment and manpower;
    c. Reviewing existing incentives for geothermal resource development, including the level of the feed-in tariff for geothermal energy;
    d. Introducing new fiscal incentives to promote geothermal resource exploration;
    e. Fostering the establishment of a Uganda Geothermal Energy Association.
(i) Utilise provisions of the Public Private Partnership Act 2015 to establish frameworks for collaboration with the private sector, in particular for geothermal resource exploitation (power plant construction and operation).

Objective 2 – To optimise geothermal resource exploration and exploitation activities

Strategies:
Government shall:

(a) Establish a legal framework that enhances the management of geothermal resources, and clarifies the expectations and requirements for private sector licensees and deters passive speculation;
(b) Develop a Geothermal Resources Master Plan including a Geothermal Roadmap to help guide development of the sector;
(c) Develop clear strategies for resource exploitation, such as the early phase use of wellhead power generation plants to demonstrate proof-of-concept and to provide power to support further stages of steam field development;
(d) Implement and maintain a modern, digitised, system of geothermal data management that can facilitate and optimise the use of all available data in geothermal prospects, including from pre-competitive oil and gas exploration data. This shall remain linked to the existing mining cadastre portal maintained by the Directorate of Geological Survey and Mines;
(e) Engage with District Local Government and local communities to raise awareness of geothermal resources and identify specific opportunities for local economic empowerment, including for the direct use of geothermal resources;
(f) Ensure the Ministry of Trade, Industry and Cooperatives considers opportunities for direct use applications in existing and planned industrial developments;
(g) Coordinate geothermal development activities with other resource development programmes to gain synergies in terms of shared infrastructure etc.
(h) Engage with a experts from around the world to keep abreast of the latest concepts and technologies available for geothermal resource optimisation;
(i) Continually monitor and review developments in the sector and adapt policies and strategies according to prevailing circumstances.

Objective 3 – To establish an effective and transparent regulatory regime for geothermal resource management

Strategies:
Government shall:

(a) Promulgate a geothermal energy law that clarifies the way in which the resource shall be developed and managed, and that is flexible enough to accommodate future changes in the prevailing circumstances in the sector;
(b) Separate geothermal tenure rights from other mineral and petroleum rights, and allow for the identification and declaration of geothermal resource areas in order to clarify the status of prospective areas;
(c) Prescribe new procedures and conditions for geothermal exploration licenses that include:
    a. Revised licensing periods and clear conditions for renewal, retention and conversion to exploitation licenses;

b. Clearer obligations for licensees in respect of investment requirements and technical progress to be made over a license period;
c. Financial requirements for licensees including financial instruments in order to deter passive speculation;
d. Ensure effective oversight of license implementation by a regulatory authority.

(d) Prescribe new procedures and conditions for geothermal fluid exploitation;
(e) Establish a new fiscal regime for geothermal resource exploration and exploitation that includes:
    a. Revised fees for licenses
    b. A basis for royalties to be levied on geothermal fluid production and exploitation
(f) Review measures by which any revenues generated from geothermal fluid production can be reinvested in local community developments, with a particular focus on nurturing direct use applications for local economic empowerment;
(g) Promote competitiveness in the sector in the future through provisions in the law that allow for tendering of concessions.

Objective 4 – To ensure safe and environmentally-sound development of geothermal energy

Strategies:
Government shall:

(a) Ensure the new laws and regulatory frameworks are developed cognizant of the need to protect human health and environment from potential hazards and damages that could arise during geothermal energy exploration and exploitation;
(b) Work within the existing statute and norms and standards established in other extractives sectors to ensure strong environmental protection;
(c) Require extensive exploration activities and any exploitation activities to conduct a baseline environmental study, an environmental impact assessment, and social and livelihood impact assessment, including mitigation measures;
(d) Require any geothermal developments to establish effective safe conditions for workers, the general public and wildlife through measures such as safety fencing, signage, burial of flowlines where feasible etc.;
(e) Require the full removal of infrastructure and restoration of the environment to its original condition upon cessation of exploration and exploitation activities.

Objective 5 – To promote a sustainable geothermal industry for the future

Strategies:
Government shall:

(a) Develop a communication strategy and programme through which to raise the general level of awareness about geothermal energy across Ugandan society, and in particular local communities and industries where geothermal resources are located;
(b) Ensure the enhanced Geothermal Resources Development Project referred to above uses local suppliers and workforce wherever possible;
(c) Work with educational and research institutions in Uganda to enhance research, education and training opportunities in all aspects of the geothermal industry;

(d) Facilitate internships for Ugandan university students at the GRD and other reputable institutions such as the United Nations University Geothermal Training Programme and the African Geothermal Center of Excellence;
(e) Continue knowledge sharing and information exchanges with regional and international partners to increase understanding of the geothermal resources of the Western Branch of the EARS;
(f) Continue with implementation of the MoU with Kenya and Rwanda;
(g) Seek to further implement elements of the MoU with Turkey (TUBITAK MAM);
(h) Seek to further implement elements of the MoU with Toshiba;

6 INSTITUTIONAL FRAMEWORK FOR MANAGEMENT OF GEOTHERMAL RESOURCES

6.1 Introduction

This policy outlines the goal and strategies needed to deliver an enabling environment in which geothermal energy becomes a reality in Uganda. The policy requires implementation, converting the objectives and strategies into a comprehensive, timely and orderly programme for geothermal resource development. It must be internalised, popularised and widely disseminated if the goal is to be achieved.

6.2 General

6.2.1 Overall Role of Government

(a) Establishing and implementing geothermal resources policy
(b) Establishing and developing legislation
(c) Organising the state's geothermal administration
(d) Investing and leading on an enhanced Geothermal Resources Development Project
(e) Seeking low cost sources of capital and technical assistance grants to support cost-effective resource development
(f) Planning and implementing licensing for private sector exploration
(g) Monitoring operations and administering compliance
(h) Managing data from geothermal operations
(i) Ensuring an appropriate level of national participation in geothermal operations
(j) Managing the impact of geothermal activities on the economy, environment and social life
(k) Using geothermal revenues to build sustainable capacity through education, development of infrastructure and a competitive economy in line with the goal of this policy
(l) Adjusting institutional framework conditions to meet any changes

6.2.2 Role of the Private Sector

The private sector can cooperate with government in leading development of the FOAK geothermal power project in Uganda, and supporting in the exploration of other resources to enable fast-start of the second-, third-, fourth and nth-of-a-kind geothermal resource development projects. In doing so, the private sector must act as good corporate citizens, respecting the environment, economic and social interests in resource development and acting accordingly within the provisions of the law.

6.3 Specific Roles of Government Institutions and Departments

The specific roles of government institutions are described below.

6.3.1 The role of Cabinet

(a) Putting in place a National Geothermal Resources Policy
(b) Authorising drafting and approving submission of the required legislation to Parliament
(c) Securing sufficient budgets to support an enhanced Geothermal Resources Development Project

6.3.2 The role of Parliament

(a) Enacting geothermal legislation
(b) Considering budgetary requirements
(c) Monitoring performance of the sector

6.3.3 The role of the Ministry Responsible for Geothermal Energy

The Policy direction for geothermal resource development and the industry of the future is the responsibility of the Ministry of Energy and Mineral Development. Specifically, the Minister shall be responsible for:

(a) establishing Geothermal Resource Areas and declaring areas as such in the gazette as necessary to facilitate management of the resource;
(b) issuing Geothermal Resource Exploration and Exploitation licenses to competent operators and persons;
(c) entering into Geothermal Resource Agreements with competent operators and persons; and
(d) carrying out ministerial interventions through administrative review of any decision made by the Director subsequent to grant of exploration or exploitation rights.

6.3.4 The role of the Directorate and the Duties of the Director

The DGSM oversees three Technical Departments responsible for Geological Survey, Mines and Geothermal Resources. The Director shall be responsible for the general administration of the Geothermal Resources Act and other sectoral laws that may be enacted from time to time.

Specifically, the Director shall be responsible for:

(a) in consultation with the Commissioner(s) for Department(s) of Mines, Geological Survey, and Geothermal Resources receiving applications, granting renewing, suspending, transferring and cancelling of exploration and exploitation licences and permits;
(b) confirming in writing within a specified period of its issuance, a temporary suspension order made by the Commissioner for Geothermal Resources and shall not delegate this power; and
(c) authorizing in the public interest and subject to such terms and conditions as he or she may determine, any person to undertake non-commercial investigations into the geological or mineral resources of Uganda.

6.3.5 The role of the Department of Geothermal Resources and duties of the Commissioner for Geothermal Resources

The Geothermal Resources Department shall be responsible for the implementation of the National Geothermal Resources Policy and Geothermal Resources law. The duties of the Commissioner and authorised officers shall include:

(a) promoting and facilitating the effective and efficient management and the development of geothermal resources;
(b) establishing and leading an enhanced Geothermal Resources Development Project that leads to test drilling by, at the latest, the early 2020's;

(c) ensuring that a range of geothermal prospects continue to be subject to exploration and appraisal;
(d) undertaking promotional and communication activities to raise awareness of geothermal resources;
(e) advising the Director on granting, renewing, suspending, transferring and cancelling licences and permits for geothermal exploration and exploitation;
(f) approving exploration and exploitation work programmes;
(g) exercising regulatory administration and supervision over all geothermal exploration and exploitation operations;
(h) determining that all conditions relating to geothermal exploration and exploitation rights and the requirements of the Geothermal Resources Law are complied with;
(i) carrying out monitoring, investigations and inspections necessary to ensure compliance with the provisions of the Geothermal Resources Law;
(j) making lawful orders that are necessary to enable him or her to effectually perform the functions and duties imposed upon him under the Geothermal Resources Law;
(k) advising holders of geothermal licenses on proper and safe drilling, production, utilisation and brine disposal methods;
(l) issuing directions in writing ordering exploration or exploitation operations to be temporarily suspended on an emergency basis, regardless of whether such operations are authorized by a license, until such arrangements are made that are in Commissioner's opinion necessary to prevent danger to life, property or the environment or to comply with the Law;
(m) maintaining a geothermal resource database for recording all geothermal data collected and all records of geothermal exploration and exploitation licenses issued, and maintaining these in a spatially related paper form and computerized geographical information system;

6.4 Role of Other Government Ministries and Departments

The role of other institutions and agencies are described below.

6.4.1 Ministry Responsible for Justice and Constitutional Affairs.

Specific roles under this policy shall be:

(a) drafting geothermal resource legislation;
(b) participating in geothermal resources policy formulation.

6.4.2 Ministry Responsible for Finance, Planning and Economic Development

In general the role of this Ministry is to ensure macroeconomic stability, which includes prudent fiscal management and ensuring appropriate distribution of Government funds to provide efficient and effective delivery of services.

Specific roles under this policy shall be:

(a) Enabling the establishment of an enhanced Geothermal Resources Development Project, including facilitating access to technical assistance grants and concessional loans from development partners relevant to geothermal resource development;

(b) Responsibility for designing fiscal incentives, fiscal regimes and other fees and charges applicable to the geothermal industry;
(c) Defining the roles of different institutions with regard to the collection of geothermal revenues;
(d) Ensuring appropriate management of revenue from the geothermal industry
(e) Participating in geothermal resources policy formulation;
(f) Participating in the formulation of geothermal resources legislation;
(g) Providing the necessary funding to support undertaking of the additional responsibilities for the different Ministries and operational/managerial agencies arising out of this Policy;
(h) Ensuring development and harmonization of accounting standards in geothermal activities in line with other minerals and energy practices and international best practices.

6.4.3 Ministry Responsible for Local Governments

This Policy recognizes that Local Government Authorities undertake development plans, capacity building and infrastructure development, among other activities, in accordance with the Local Government Act, 1997.

In accordance with these activities of the local government authorities, the Ministry responsible for Local Government shall have the following coordinating roles:

(a) Formulating and monitoring of local government policies which are in harmony with this Policy;
(b) Guiding local governments to undertake plans and capacity building that take cognisance of geothermal activities, in particular opportunities for local economic empowerment and the direct use of geothermal heat to promote local industry;
(c) Integrating geothermal resource development opportunities in local governments' plans and programmes;
(d) Mobilizing local governments to support geothermal resource development activities including provision where possible of the necessary infrastructure.

6.4.4 Ministry Responsible for Works and Transport

Specific roles under this policy shall be:

(a) Planning and regulating transport services such as road, rail, pipelines, air and waterways;
(b) Providing technical guidance on mechanical engineering aspects of machinery used in geothermal resource development activities imported into the country;
(c) Issuing approvals for movement along Uganda's roads of heavy equipment (above 56 tonnes) on roads in the country;
(d) Participating in verification of the structural integrity of drill rigs and other production facilities.

6.4.5 Ministry Responsible for Water and Environment

Specific roles under this policy shall be:

(a) Ensuring that geothermal activities conform to the requirements of the policies regarding the protection and utilization of water bodies and aquifers;
(b) Identifying opportunities to utilise climate and carbon finance to support geothermal energy development;
(c) Management of any potential impact of toxins from geothermal activities through appropriate brine management strategies;
(d) Participating in formulating and monitoring polices regarding protection of the environment, geothermal activities will comply with these policies;
(e) Monitoring the impact of geothermal activities on the quality of ground and surface water bodies, surrounding flora and atmosphere
(f) Regulating water use and pollution load into water bodies through issuance of water permits;
(g) Ensuring compliance with conditions provided for in the water permits;
(h) Ensuring protection of water catchment and drainage areas;
(i) Ensuring respect of Uganda's commitments towards cooperative frameworks for basin wide trans-boundary water resource management;
(j) Ensuring self-monitoring by the geothermal development and operation companies for compliance with wastewater effluent standards together with ground and surface water quality standards;
(k) Participating in monitoring and management of geothermal waste or effluent emergencies.

6.4.6 Ministry Responsible for Forests and Wetlands

Specific roles under this policy shall be:

(a) Ensuring that geothermal policies are in harmony with policies for the development and utilization of forest resources;
(b) Ensuring that geothermal activities are carried out in a manner that preserves and enhances forest reserves and wetlands.

6.4.7 Ministry Responsible for Tourism and Wildlife

Specific roles under this policy shall be:

(a) Ensuring that geothermal policies are in harmony with wildlife conservation and tourism development policies;
(b) Identifying opportunities for the geothermal sector to contribute towards tourism development;
(c) Ensuring that geothermal activities are in harmony with wildlife conservation and development of infrastructure and services for tourism;
(d) In collaboration with relevant stakeholders, monitor the impact of geothermal activities on wildlife conservation, development of tourist infrastructure and services together with the harmonious coexistence between ecotourism and geothermal operations;
(e) Monitoring the impact of geothermal activities on antiquities.

6.4.8 Ministry Responsible for Labour

Specific roles under this policy shall be:

(a) Carrying out regular statutory inspections to ensure health and safety in the geothermal industry;
(b) Ensuring that employment policies in the geothermal sector are in line with Uganda's labour policies, laws and regulations;
(c) Formulating and enforcing guidelines on safety and health in the geothermal industry;
(d) Monitoring compensation for occupational injuries and diseases;
(e) Mediating labour disputes and participating in conflict resolution;
(f) Issuing guidelines on labour unions in the geothermal industry;
(g) Monitoring compliance with the labour standards;
(h) Ensuring that the equipment and technologies brought into the country are environmentally friendly and comply with the desired safety and health standards.

6.4.9 Ministry Responsible for Education.

Specific roles under this policy shall be:

(a) Promoting the development of education and training programmes in order to create requisite national manpower expertise for the geothermal industry on a sustainable basis;
(b) Promoting relevant research and studies in collaboration with the Ministry responsible for Geothermal Development and any other relevant institutions;
(c) Identifying and proposing measures to mitigate any adverse effects of geothermal activities on the education sector.

6.4.10Ministry Responsible for Industry

Specific roles under this policy shall be:

(a) Ensuring that geothermal policies are in harmony with the country's industrial policy;
(b) Promoting opportunities for direct use of geothermal resources to support industrial development;
(c) Promoting the use of mineral co-production to support industrial development in the country.

6.4.11Ministry Responsible for Physical Planning

Specific roles under this policy shall be:

(a) Conducting physical planning for the areas where geothermal development activities are to be undertaken;
(b) Approving change of user in provided physical plans for any areas.

6.4.12Ministry Responsible for Foreign Affairs

Specific roles under this policy shall be:

(a) Ensure cordial bilateral relations with neighbouring countries;
(b) Supporting bilateral and multilateral initiatives aimed at promoting research, education, capacity building and technical cooperation in the field of geothermal resource development.

6.4.13 Ministries Responsible for Security

Securing geothermal activities and installations against external aggression and from any internal threats.

6.4.14 Ministry Responsible for Information and Communication Technology.

Specific roles under this policy shall be:

(a) Initiating the formulation and implementation of information technology laws and regulations that will provide a conducive and secure environment for data transmission and storage for geothermal activities;
(b) Promoting, supporting and guiding the use of ICT in order to among others enhance efficiency and effectiveness in geothermal operations and transactions;
(c) Ensuring that the infrastructure necessary for data and voice communication including telephone, internet and broadcasting are put in place.

6.5 Government Agencies

6.5.1 Role of the Central Bank

Specific roles under this policy shall be:

(a) Advising Government on the impact of the geothermal industry on the national economy;
(b) Ensuring that geothermal activities do not impact negatively on monetary policy and macro-economic stability;
(c) Managing and administering any fiscal instruments and mechanisms established for geothermal licensing.

6.5.2 Role of the Uganda Revenue Authority

Specific roles under this policy shall be:

(a) Administering the collection of revenue from geothermal activities in line with the relevant laws;
(b) Participating in the formulation of tax measures to regulate collection of the right revenues from geothermal activities;
(c) Enhancing fiscal compliance in the geothermal sector.

6.5.3 Role of the National Planning Authority

Specific roles under this policy shall be:

(a) Leading national planning for effective incorporation of geothermal activities into the national economy;
(b) Issuance of a certificate of compliance with the annual budget of the previous financial year in attestation to its consistency with the National Development Plan, the charter for Fiscal Responsibility and the Budget Framework Paper;
(c) Conducting in depth evaluation of the effectiveness and cost of geothermal energy development and other related activities;
(d) Studying and publishing independent assessments of key economic and social issues and options to increase public understanding and participation in geothermal activities;

(e) Participating in monitoring the relationship between the different agencies of the State's geothermal administration.
(f) Implementation of Vision 2040 with a focus on the development of 1,500 MW of geothermal energy to meet the target per capita consumption of 3,668 kWh and installed capacity of 41,738 MW.

6.5.4 Role of the National Environment Management Authority (NEMA)

Specific roles under this policy shall be:

(a) Coordinating the processes of environmental impact assessments for geothermal activities.
(b) Carrying out, alongside other stakeholders, environmental monitoring and audits of geothermal activities;
(c) Ensuring and monitoring compliance of geothermal activities with environmental guidelines;
(d) Issuing guidelines for strategic environmental assessment.

6.5.5 Role of the Uganda Wildlife Authority (UWA)

Specific roles under this policy shall be:

(a) Monitoring compliance of geothermal activities to regulations governing operations in wildlife protected areas;
(b) Harmonizing national and international performance standards on wildlife protected areas;
(c) Monitoring the impact of geothermal activities on wildlife protected areas;
(d) Participating in evaluation of Environmental Impact Assessments (EIA) and environmental audits for geothermal activities;
(e) Issuing consent to undertaking geothermal operations in wildlife protected areas.

6.5.6 Role of the Electricity Regulatory Authority (ERA)

Specific roles under this policy shall be:

(a) Coordination with the Geothermal Resources Department and Geothermal Resources Commissioner to ensure timely and effective permitting for feasibility studies (Intended Application permit) and licensing of geothermal power plants;
(b) Monitoring the compliance of geothermal power plant operators with their license conditions;
(c) Ensuring quality of electricity generated by geothermal energy for grid connection;
(d) Monitoring performance of licensed geothermal power plant operators;
(e) Regulating the cost (Tariff) of electricity generated by means of geothermal energy.

6.5.7 Role of the Rural Electrification Agency (REA)

Specific roles under this policy shall be:

(a) Identify opportunities for rural electrification through development of geothermal energy resources in support of its mandate;
(b) Mobilise finance in support rural electrification opportunities using geothermal energy.

6.5.8 Role of the Uganda Energy Credit Capitalization Company (UECCC)

Specific roles under this policy shall be:

(a) Facilitate financing of geothermal energy development opportunities;
(b) Consider innovative financing structures in order to improve the opportunities for multi-party financing of geothermal development opportunities.

6.5.9 Role of Uganda Electricity Generating Company Limited (UEGCL)

Specific roles under this policy shall be:

(a) Providing support to GRD in consideration of geothermal power plant development opportunities;
(b) Advising on financing opportunities and challenges for geothermal power plant development.

6.5.10 Role of Uganda Electricity Transmission Company Limited (UETCL)

Specific roles under this policy shall be

(a) To continue entering into negotiations with geothermal power plant developers with a view to executing value for money PPAs that are sufficient to support economically-viable geothermal power plant developments;
(b) Acting as an off-taker for geothermal generated electricity to the national grid.

6.5.11 Role of the Auditor General

Specific roles under this policy shall be:

(a) Providing an independent oversight of Government geothermal operations through financial and other management audits in accordance with the constitutional provisions and any other relevant legislation;
(b) Ensuring adherence to national and international accounting standards in the mineral industry.

6.6 The Role of Civil Society and Cultural Institutions

This policy recognizes the role Civil Society Organisations (CSO's) and Cultural Institutions can play through advocacy, mobilization and dialogue with communities. These institutions will contribute to holding the different players accountable with regard to geothermal development issues and participate in getting the voices of the poor into designing, monitoring and implementation and participation in geothermal industry. CSO's may also be contracted in the delivery of various services, especially in the communities where mineral activities are undertaken.

7 IMPLEMENTATION FRAMEWORK FOR THE GEOTHERMAL POLICY

7.1 Introduction

The Geothermal Resources Policy introduces new ambitions, principles, objectives, and strategies through which to accelerate geothermal energy resource exploration and exploitation in Uganda ahead of historical levels. But to achieve its objectives, it must be implemented to ensure that the valuable natural resource bestowed upon Uganda is put to optimised beneficial use for all citizens. The policy must be converted into a comprehensive programme for implementation. The policy must be internalised, popularised, translated and widely disseminated if it is to achieve its objectives.

7.2 Implementation Plan for the Geothermal Resources Policy

The Geothermal Resources Policy contains a wide number of objectives that cut across issues of technology, finance, law, education, training and international cooperation. Implementation will therefore require a variety of approaches to ensure that the diverse objectives are achieved. To achieve an orderly progression of resource development in line with the policy objectives, several implementation strategies will be adopted as follows:

(a) Providing a legal a basis upon which to implement the policy;
(b) Developing a master plan to guide technical resource development and investment;
(c) Establishing a communication programme to increase awareness of geothermal energy;
(d) Continuing with efforts to build knowledge, expertise and human resource capacity.

7.2.1 Promulgate a Geothermal Resources Act

A Geothermal Resources Law will be enacted by Government that creates harmonised rules for geothermal resource development in line with objectives set out in this policy. The draft law will be promulgated in parallel with this policy, thus ensuring a comprehensive and timely package is prepared upon which to embark on the new strategies agreed for geothermal resource development under this policy.

7.2.2 Develop a Geothermal Resources Master Plan

The GRD will develop, as a priority, a Geothermal Resources Master Plan to guide orderly and optimised resource development, cognizant of the constraints on technical, financial and human resources. It shall, *inter alia*:

(a) Guide the technical development of resource prospects in Uganda based on, *inter alia*, exploration activities undertaken, resources status and quality, priorities, plans and strategies for exploration and development etc.
(b) Explore options for funding and structuring investment into resource development in line with the technical development plan prepared, including public sector investment, private sector investment, technical assistance grants and concessional loans from development partners and carbon and climate finance opportunities;
(c) Review, evaluate and recommends potential incentives to promote greater private sector involvement in the sector;

(d) Further consider methods through which public-private partnerships may be established to promote survey activities, enhanced exploration and resource development;
(e) Sets out a roadmap for resource development over the short-, medium- and long-term.

The Geothermal Resources Master Plan shall provide a sound basis on which to establish a Government-led exploration programme that leads to the test drilling of at least one site by, at the latest, the early 2020's, progress towards the construction of the first-of-its-kind geothermal power plant by the mid-2020's, and the longer-term approach to resource development for the second-, third-, and fourth-of-a-kind geothermal development projects.

Recognising the likelihood of ongoing development and changes in the sector over time, the Master Plan should be periodically updated to reflect changing circumstances.

7.2.3 Establish a Geothermal Communication Strategy

The GRD will establish a strategy for disseminating the National Geothermal Policy to all stakeholders, and more broadly communicating the role that geothermal energy resources can play in supporting social and economic development in Uganda. The strategy will act to, *inter alia*:

(a) Raise awareness, increase knowledge and improve understanding about the resource and the technical means to utilise it amongst all sections of Ugandan society (e.g. stakeholders in Government, Parliament, investment community, industrial actors, local communities, and the general public);
(b) Promote the use of geothermal energy and foster support from all stakeholders, including ensuring a clear place for geothermal resources in national energy policies;
(c) Increase awareness amongst development partners of Uganda's ambitions for geothermal energy development;
(d) Build the capacity of leaders of local communities in proximity to geothermal resources to understand the benefits and challenges involved in its development; and,
(e) Help attract investment, expertise and entrepreneurs into the sector.

The communication programme shall employ a variety of channels to ensure wide coverage, with relevant materials translated into major local languages. Channels shall include:

(a) Stakeholder workshops;
(b) Social media;
(c) Webpages;
(d) News items (national and local press and television);
(e) Brochures and literature; and,
(f) Regional and international forums.

7.2.4 Continuing Efforts to Build Human Resource Capacity

The GRD, alongside other parts of Government, will continue to reach out to academic and research institutions, both in Uganda and abroad, in order to increase the level of education and training in the field of geothermal energy available to Ugandans. This will include further implementation of the MoUs with Kenya, Rwanda, Turkey and Toshiba Corporation, and continued cooperation with Ugandan universities. The latter should lead to the systematic

integration of geothermal energy in teaching, research and internships carried out by the higher education sector.

7.3 Financing the Geothermal Resources Policy

7.3.1 Financing Activities in the Geothermal Resources Policy Implementation Plan

The development of the various elements outlined in the Implementation Plan will place additional responsibilities and burdens on the GRD. The GRD will review the additional human resources required to manage implementation of the policy, and prepare a budget accordingly to be funded by the MEMD. It will also seek technical assistance to help with implementation.

7.3.2 Financing Government-led Exploration

An increase in Government funding for geothermal exploration will be needed to meet the objectives of the policy, primarily the financing of a test drilling campaign at, as a minimum, one geothermal prospect. Government-led test drilling is essential to reduce investment risk, increase the bankability of prospective geothermal energy developments, leverage co-financing from development partners and encourage private investment in the sector. The need for additional funding may not be significant in the near-term since additional surveys and pre-feasibility studies will be needed over the next 2-3 years prior to commencing with test drilling at any prospect in Uganda. It is necessary, however, to ensure that commitment to future funding is in place in order to commence discussions with potential co-funders so as to ensure a fast-start to test drilling when pre-feasibility studies have been completed.

This policy commits Government to this ambitious strategy. Government shall ensure that the Geothermal Resources Development Project (1199) budget has sufficient funds available for undertaking pre-feasibility studies over the next 2-3 years as needed to prepare for a test drilling campaign. It shall also ensure that additional funding projections are earmarked at a level sufficient to co-fund a test drilling campaign sometime from 2020 onwards (or sooner if pre-feasibility work is completed in a timely manner).

Funding requirements shall be clarified upon completion of the national Geothermal Resources Master Plan by the GRD.

7.3.3 Financing the Regulatory Framework

The legal and regulatory framework for geothermal resource exploration and development to be established in accordance with this policy may create additional regulatory obligations for the DGSM and the GRD. Over the short-term, the precise level of additional effort required relative to previous regulatory activities implemented under the Mining Act, 2003, is uncertain, since it will be dependent on the number and type of licenses granted to private sector actors. On the one hand, the legal framework will introduce additional measures to limit passive speculation, which may result in a decrease in licensees in the short-term. On the other hand, the policy aims to encourage private sector participation and cooperation with the GRD in undertaking surface studies, supported by new provisions in the legal framework, which will create additional near-term responsibilities for the GRD. Over the medium- to longer-term, growth in the geothermal sector in response to implementation of the policy will lead to greater resource requirements to manage and oversee an expected growth in private sector interest in geothermal resource development.

The cost implications for implementation and enforcement of the new legal framework shall be monitored and assessed by the DGSM and GRD on an ongoing basis, funded from the MEMD recurring budget and using additional resources allocated as necessary.

7.3.4 Financing Additional Roles for Other Arms of Government

The successful implementation of the policy will lead to increased activity for various Ministries, Departments and Agencies outside of the MEMD, as highlighted in Sections 6.4 and 6.5 above. This will depend on the level of ongoing licensing activity arising in response to the policy, which is uncertain as described above (Section 7.3.3). The Ministry of Finance, Planning and Economic Development shall monitor and evaluate the need for additional resources required to carry out these roles and provide the funding as necessary.

7.4 Monitoring, Evaluation and Review

Successful implementation of the Geothermal Resources Policy will accelerate geothermal resource development in order to realise its benefits for all. It is important, therefore, that mechanisms are put in place in place to measure the effectiveness of the statements and policy strategies in achieving the vision, goal and objectives of the policy.

Government shall execute the Implementation Plan for the Geothermal Resources Policy. Success shall be measured in terms of the enactment of a Geothermal Resources Act, establishment a Geothermal Resources Master Plan, a Geothermal Communication Strategy and greater cooperation with Universities and other international stakeholders. The GRD shall monitor progress in all these areas to ensure that the policy is being effectively implemented.

Government shall institute a system by which to monitor implementation of the policy with respect to progress in geothermal resource development and establish a means for measuring its effectiveness. This may include:

(a) Levels of financing mobilised for geothermal exploration through the GRD, and the sources of finance mobilised;
(b) Exploration activities undertaken by the GRD;
(c) Number of licenses issued to private sector, by type;
(d) Activities undertaken by the private sector, including in cooperation with Government;
(e) Number of test wells drilled;
(f) Status of geothermal exploration and development by prospect over time;

In undertaking monitoring activities, Government shall be mindful of the need to take a flexible approach to geothermal resource development, recognising changing circumstances in the sector, and identifying alternative strategies for resource development. On this basis, the policy shall be reviewed within a period not exceeding 8 years from its entry into force.

8 REFERENCES

Adyemi, K.O., and Asere, A.A. 2014. A Review of the Energy Situation in Uganda. *Int. J. of Sci. and Res. Pub.*, Vol. 4(1), January 2014

Bahati, G., 2011. Status of geothermal exploration and development in Uganda. *Presented at Short Course VI on Exploration for Geothermal Resources, organized by UNU-GTP, GDC and KenGen, at Lake Bogoria and Lake Naivasha, Kenya, Oct. 27 – Nov. 18, 2011.*

Chorowicz, J., 2005. The East African rift system. *J. African Earth Sciences, 43, 379–410.*

Dickson, M.H. and Fanelli, M., 2004. *What is Geothermal Energy?* Paper published on the website of the International Geothermal Association (www.geothermal-energy.org)

Gehringer, M. and Loksha, V. 2012. *Geothermal Handbook: Planning and Financing Power Generation.* Energy Sector Management Assistance Programme (ESMAP). Technical Report 002/2012. Washington D.C. June 2012.

Harðarson, B.S., 2014. Structural geology of the Western branch of the East African Rift: tectonics, volcanology and geothermal activity. *Paper presented at Short Course IX on Exploration for Geothermal Resources, organized by UNU-GTP, GDC and KenGen, at Lake Bogoria and Lake Naivasha, Kenya, Nov. 2-23, 2014*

Kato, V., 2013. Geothermal exploration in Uganda: Status Report. *Paper presented at Short Course VIII on Exploration for Geothermal Resources, organized by UNU-GTP, GDC and KenGen, at Lake Bogoria and Lake Naivasha, Kenya, Oct. 31 – Nov. 22, 2013*

Kull, D., 2006. *Connections Between Recent Water Level Drops in Lake Victoria, Dam Operations and Drought*. Report available through the International Rivers Network, 9 February 2006. Available at: https://www.internationalrivers.org/resources/dams-draining-africa-s-lake-victoria-4117 Accessed, March 2016.

McNitt. J.R., 1982: The geothermal potential of East Africa. *Proceedings of the Regional Seminar on Geothermal Energy in Eastern and Southern Africa, Nairobi, Kenya, June 15-21 1982.*

MEMD, 2011. *The Development of a Power Sector Investment Plan for Uganda: Power Sector Investment Plan, Final Report.* Prepared by Parsons Brinkerhoff in association with Sunshine Projects. January 2011.

MEMD, 2015. *Uganda's Sustainable Energy For All Initiative Action Agenda*. June 2015.

Micale, V., Oliver, P., and Messent, F., 2014. *The Role of Public Finance in Deploying Geothermal: Background Paper*. Report by Climate Policy Initiative to the San Giorgio Group/Climate Investment Funds, October 2014.

Mnjokava, T.T., 2014. Geothermal Development in Tanzania – Status Report. *Presented at Short Course IX on Exploration for Geothermal Resources, organized by UNU-GTP, GDC and KenGen, at Lake Bogoria and Lake Naivasha, Kenya, Nov. 2-23, 2014.*

MOE, 2011. *Scaling-up Renewable Energy Program (SREP) Investment Plan for Kenya*. Submitted by the Government of Kenya to the Climate Investment Fund (CIF) Board, September 2011.

Musembi, R., 2014. GDC's Geothermal Development Strategy for Kenya: progress & opportunities. Presentation during *the Power Africa-Africa Union Commission Geothermal Roadshow*, September - October 2014

Mwenda, A.M., 2015. *Does government need to buy back Bujagali?* Article for the *Daily Monitor*, Uganda. 17 May 2015

MWIE, 2015. Highlights of the Ethiopian Geothermal Sector. Presentation to the Global Geothermal Alliance Stakeholder Meeting, Nairobi, by the Ministry of Irrigation and energy, Federal Democratic Republic of Ethiopia. June, 2015

Onacha, S.A., 2012. Challenges and Opportunities of Geothermal Exploration and Development in the Western Branch of the East Africa Rift Valley. *Proceedings 4th African Rift Geothermal Conference 2012, Nairobi, Kenya, 21-23 November 2012*

Rutagarama, U., 2014. *Geothermal exploration and development in Rwanda*. Presentation by Geothermal Development Unit Energy, Water and Sanitation Limited (EWSA Ltd) to the Geothermal Donor Collaboration Meeting and Geothermal Workshop for Donors and Decision-makers 26th to 28th May, 2014

Rutagarama, U., 2015. Geothermal Resources Development in Rwanda: A Country Update. *Proceedings World Geothermal Congress 2015, Melbourne, Australia, 19-25 April 2015*

UIA, 2015. *Uganda Investment Portfolio and Guide to Investing*. Prospectus published by the Uganda Investment Authority and the Uganda Tourist Board

UNEP ARGeo, 2015. *A skills audit and gap study for the Geothermal Energy Subsector in African Countries*. Report by UNEP ARGeo, 01/08/2015

Van Nguyen, M., Arason, S, Gissurarson, M., and Pálsson, P., 2015. *Use of geothermal energy in food and agriculture: Opportunities for developing countries*. Report for the Food and Agriculture Organization of the United Nations, Rome. 2015.

White, R.S., Spence, G.D., Fowler, S.R., McKenzie, D.P., Westbrook, G.K., and Bowen, A.N., 1987. Magmatism at a rifted continental Margin. *Nature, 330, 439-444*