Uganda's Electricity Outlook and Potential Role of Geothermal Energy

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

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1. Introduction

- Energy poverty is a global problem.
- Access to energy services is crucial to meet basic household needs, deliver and access public services, and generate income.
- Less than 10 percent of Sub-Saharan Africa (SSA) rural households have access to electricity, with an overall access rate below 25 percent (AEI-World Bank).
- Around 550 million people in the world remain without electricity in 2040 – the majority of them in SSA (WEO Factsheet 2015).

Global Access to Electricity (2008)

Region	Population without electricity millions	Electrification rate, %	Urban electrification %	Rural electrification, %
Africa	589	40.0	66.8	22.7
North Africa	2	98.9	99.6	98.2
Sub-Saharan Africa	587	28.5	57.5	11.9
Developing Asia	809	77.2	93.5	67.2
China & East Asia	195	90.2	96.2	85.5
South Asia	614	60.2	88.4	48.4
Latin America	34	92.7	98.7	70.2
Middle East	21	89.1	98.5	70.6
Developing countries	1,453	72.0	90.0	58.4
Transition economies & OECD	3	99.8	100.0	99.5
World	1,456	78.2	93.4	63.2

Source: World Bank June 2010

Sectors

The Ministry of Energy and Mineral Development has three sectors namely the:

- Energy sector.
- Oil and Gas sector.
- Mineral sector.

The Energy Sector of Uganda

This comprises of:

- The Electricity sub-sector.
- The Renewable Energy sub-sector.
- Energy Efficiency & Conservation sub-sector.

2.Objectives of Government in the Energy Sector

- To increase electricity generation capacity.
- To expand the electricity transmission and distribution networks.
- To increase access to modern energy services through rural electrification and renewable energy development.

Uganda Vision 2040

- To achieve the targets of this Vision, Uganda will need to develop and generate modern energy to drive the industry, mining and services sectors.
- Uganda will require 41,738 MW (895 MW 2015) by 2040 thus increasing its electricity per capita consumption to 3,668 kWh (75 Kwh in 2010).
- Access to the national grid must significantly increase to 80%, (11% in 2010).

Background to the Energy sector

- Electricity sector restructured in 1999 with the enactment of the Electricity Act, 1999,
- The only Utility then (Uganda Electricity Board) was unbundled into three companies;
  - Uganda Electricity Generation Company (UEGCL),
  - Uganda Electricity Transmission Company (UETCL),
  - Uganda Electricity Distribution Company (UEDCL).
- The objective of restructuring of the sector was to improve sector performance to: attract private capital, improve generation capacity, transmission and distribution system and improve access.

Current Status of Power Supply and Demand

- Electricity Installed capacity of Uganda currently stands at 892.7 MW (611 MW, 2010) distributed as follows: Hydropower (695 MW); Large HPP – 630 MW; Small HPP – 65 MW. Thermal power plants – 101.6 MW, Cogeneration power plants using Bagasse – 96.1 MW.
- Available capacity is 724 MW (81.1% in 2016 cf. 58.84% in 2010) and the total peak electricity demand (exports incl.) is 550 MW out of which domestic demand was 504 MW.
- Two large hydropower projects under construction: Karuma – 600 MW and Isimba – 183 MW due on line >2018. total expected: 783 MW.
- 23 licensed projects under development are expected to produce 346.1 MW on completion.

Predicted Peak demand

- Peak demand in 2030 is estimated to reach between 1,873-2,722 MW (PSIP, 2011).
- The key energy sources available to meet this demand include:
- Hydropower – resource potential estimated to be around 4,000 MW.
- Geothermal – resource potential estimated at 450 MWe.
- Fossil thermal including natural gas – near-term potential of several 100 MW.
- Other renewables, including biomass and waste – unknown potential but can be >100 MW.

Current uses of geothermal energy in Uganda (1)

1. Salt production

- At Kibiro, the geothermal water is concentrated using dry soil by capillary attraction, the impregnated soil is then scooped and the salt recovered by dissolution and evaporation to dryness by boiling.

- At Katwe, the method is different from that one at Kibiro, and is done by channeling the brine into concentration ponds from which the salt solidifies on the surface by natural evaporation during the dry weather.

Current uses of geothermal energy in Uganda (2)

2. Health spas and domestic uses

- Most of the Uganda hot spring waters are currently used as spas for bathing as they are believed to have curative powers for skin diseases and rheumatics.

- The only known in-house use of geothermal energy is at Kisiizi hospital situated in Rukungiri district, SW-Uganda, where warm water at a temperature of 32°C is tapped from a hot spring and used in hospital for bathing and other domestic uses.

Rwagimba Hot springs, Kabarole District

Current uses of geothermal energy in Uganda (3)

3. Salt licks

- The hot water is also used for watering animals as a substitute for salt licks because of its high salt content.

Current use of geothermal energy in Uganda (4)

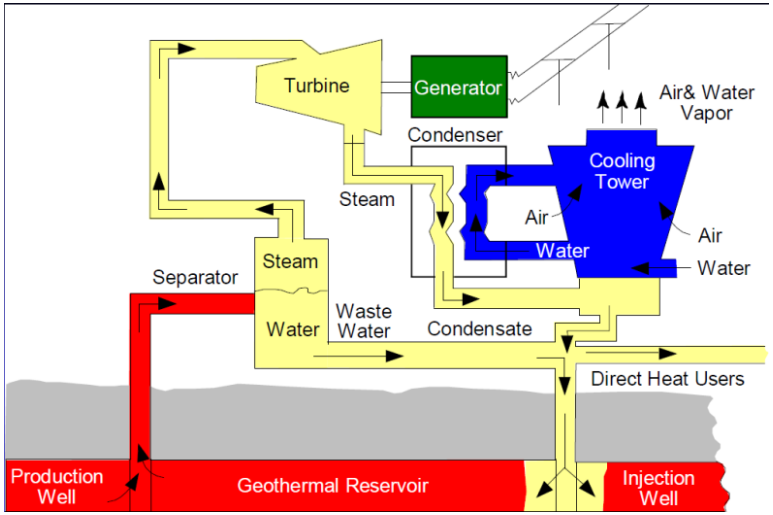
- 4. Tourist attraction

Sempaya (Buranga) Hot springs, Semliki Forest Protection Area, Bundibugyo District.

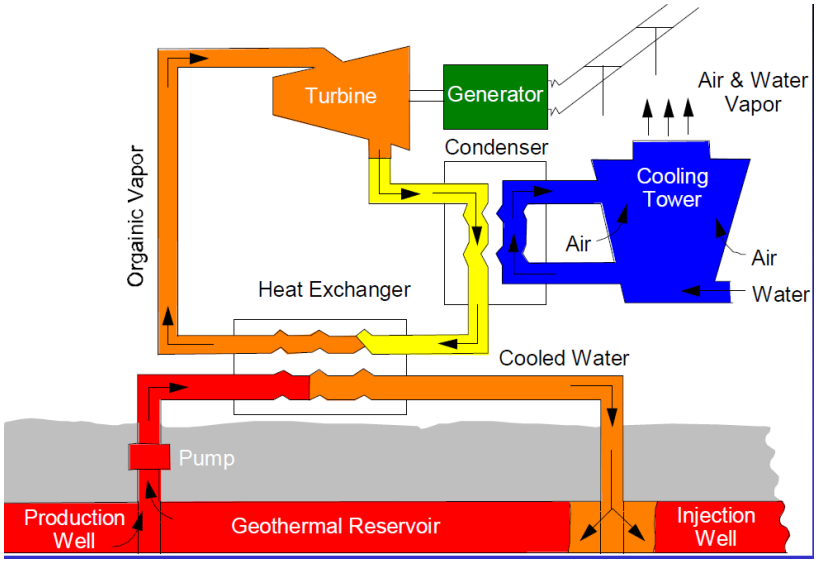
Lake Kitagata Hot springs/Crater, QEPA

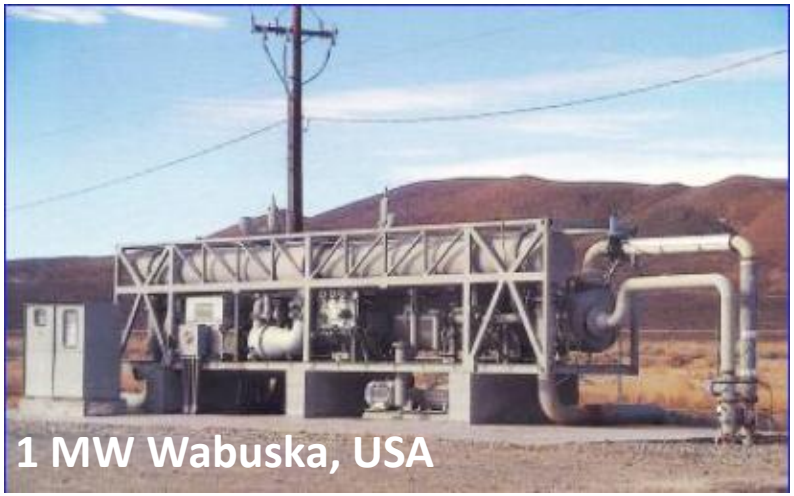
USES OF GEOTHERMAL ENERGY IN THE WORLD (1)

- 1a. Power Generation – Conventional



- 1b. Power Generation – Unconventional (Binary Power Plants)





2. Direct and Cascade Geothermal Use

- Geothermal use is temperature dependent.
- Heat transportation limited – longest in world is in Iceland, where high volume of 90°C water piped 27 km from Nesjavellir Field heat exchanger to Reykjavik for space heating
- Local resources must fit local needs. For example, oil and mining applications must be near.

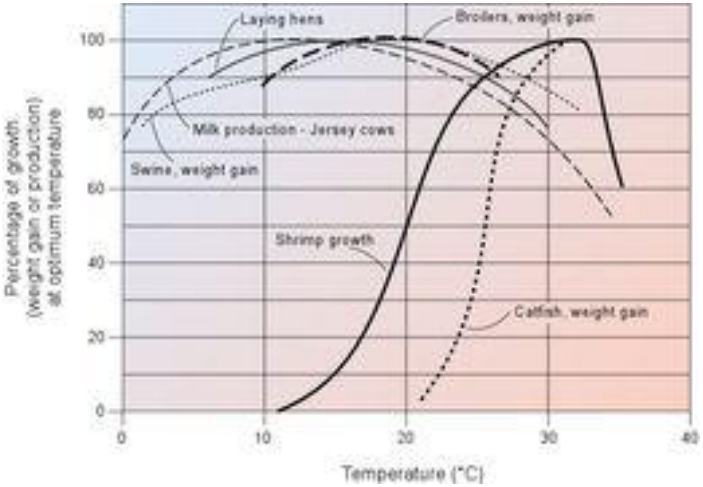
Cascaded use sometimes possible, but depends on chemistry.

GeoHeat Center, 2006

2a. Agriculture and Aquaculture

Increasing growth rate of flowers, vegetables, and other crops in greenhouses in cool climates

Increasing growth rate and shorten time to maturity of fish, shrimp, abalone and alligators



2b. Svartsengi Geothermal Field

77 MWe power generation
90 MWt district heating of Reykjanes suburbs of Reykjavik
The Blue Lagoon – a major tourist attraction

Lund and Dipippo, 2003

2c. Hot Spring Bathing and Spas (Balneology)

- Since pre-history, all regions in which hot springs are found have used them for bathing
- Japan is world leader in balneology, with Beppu alone having 4,000 hot spring baths serving 12 million tourists a year
- Romans built cities around baths supplied by hot springs, such as the city of Bath, still a major tourist center.

Beppu Health spa, Kyushu, JAPAN

The potential role of geothermal energy in Uganda's development

- With current technology, geothermal energy can produce base load (i.e. reliable) electricity at temperatures above 100°C. Plant availability factor averages >98%.

- Geothermal energy can produce heat for direct uses in industry (as process heat) and agriculture (vegetable & flower growing in greenhouses), fish farming at cascaded temperatures below 150°C.

- Spent geothermal water is being increasingly channeled to health spas in many countries of the world. , They are believed to have balneological and health values. The Blue Lagoon in Iceland, Beppu Health Spa, Japan. Hot springs (and power plants) are a powerful attraction to tourists.

- Spent brines before re-injection hold potential for economic minerals, e.g. Zn and Li recovery at the Salton Sea, California.

Potential future uses of geothermal energy in Uganda

- Electricity production from some of the geothermal areas of Uganda with an estimated potential of 450 MW in the western rift.
- Commercial salt production at Katwe and Kibiro.
- Fish drying at Katwe, Kibiro and Panyimur.
- Drying of agricultural produce at Katwe, Buranga and Panyimur.
- Enhancement of oil production in the Albertine Graben.
- Spas in all the geothermal areas of Uganda contributing to the growth of tourism in all the geothermal areas of Uganda.

Opportunities and Challenges

Opportunities

- Harnessing of potential and diversifying the country's energy mix.
- Progress in technologies and business models for decentralized energy access.

Challenges

- Over reliance on hydropower for electricity.
- On-and-off supply deficits.
- Under achievement of electrification targets.
- Low national access rates.
- High investment costs in generation.

THE REPUBLIC OF UGANDA

THANK YOU