

Accelerating **geothermal** power development

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at

Power & Electricity World Africa

Johannesburg, 16 March 2016



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POCKETS OF GEOTHERMAL

Across the world **power is derived from the Earth's internal heat**

- Here, we're looking at where it can be **scaled up for utility-scale electricity generation**

- Centres of geothermal excellence in **Iceland, New Zealand, North America** — expertise that can be applied to **Africa**

- **Iceland, US** may also bring money — as in **Ethiopia, Tanzania**

EAST AFRICA and the Rift alley is the geothermal 'mother load'

- *The potential of the East African Rift Valley's geothermal resources to meet the region's urgent need for power is now being realised. New funding avenues are opening up to help reduce early exploration risks, in turn encouraging developers to take on projects in several countries. (AEEP Status Report, 2014)*

- Recent Geothermal Risk Mitigation Facility (GRMF) grant applications/approvals to **Comoros, Djibouti, Ethiopia, Kenya, Rwanda, Tanzania and Uganda**

KENYA'S HUGE POTENTIAL

Kenya has an estimated geothermal potential of **7GW-10GW**

- Geothermal provides Kenya's least-cost baseload option (World Bank).
- Not subject to variables like rainfall
- The current least-cost power development plan (in Kenya's Vision 2030 programme) sets an ambitious target of generating over 5GW by 2030.

Kenya's geothermal areas



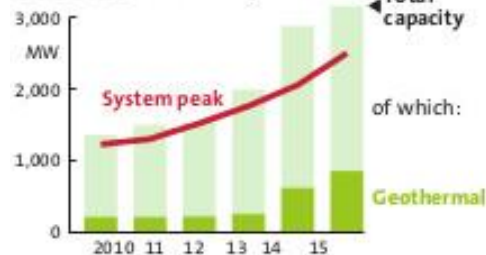
A LOT HAS BEEN ACHIEVED

Kenya's current geothermal generation capacity



Kenya's total generation capacity, 2010-15

Years ending 30 June



Kenya increased installed geothermal capacity from 240MW in 2013 to 600MW in 2015

Geothermal Development Company (GDC)'s creation was an imaginative way of overcoming several problems

Starting with drilling – the big up-front cost oil companies live with but power developers traditionally do not

Beware of ageing data!

New generation capacity, 2011-31

Least cost power development plan, base case

Geothermal	5,040MW	Wind	1,500MW
Nuclear	4,000MW	Medium-speed diesel	1,440MW
Coal	2,400MW	Hydro	200MW
Gas turbine	2,340MW	Import	2,000MW
Import	2,000MW	TOTAL	18,902MW

Commissioning schedule, 2013-20

2013/14	Olkaria I units 4&5; Olkaria IV	280MW
2015/16	Longonot I; Menengai I	280MW
2016/17	Paka I; Silali I	280MW
2017/18	Menengai II	140MW
2018/19	Longonot II; Silali II	280MW
2019/20	Paka II	140MW

Source: Geothermal Development Co. Ltd.

PROJECTS HAVE BEEN DEVELOPED

OLKARIA I-III — AE 317 (11-02-16): Ormat Technologies Ltd has begun commercial operations at the 29MW Plant IV at the Olkaria III geothermal complex, bringing total installed capacity at the site to 139MW.

- Power will be sold to Kenya Power under a 20-year power purchase agreement, amended in October 2015 to allow for the future increase in phases of capacity at Plant IV to 100MW.
 - Olkaria III now provides power to around 250,000 Kenyan households.
- Ormat brought phase one of Plant I online in 2000 and phase two in 2009. Plant II began commercial operations in 2013 and Plant III in 2014.

Also in *AE 317*: Tendering starts for Menengai geothermal drilling – GDC bids for directional drilling services and tools for the Menengai Geothermal Phase I project.

New licenses to come – Including the Barrier Complex, Turkana County, with local (PE-backed) Olsuswa Energy (which sees 750MW potential)



GEOHERMAL HAS ATTRACTED DONOR FINANCE...

- Menengai Geothermal Phase I drilling financed by the African Development Bank.
- World Bank Group, Clean Investment Fund
- KfW Development Bank
- The government will continue to help KenGen to borrow from development finance institutions (DFIs), KenGen managing director Albert Mugo told *African Energy* last month.
- This “*helps to stabilise the power price*”.

GEOHERMAL RISK MITIGATION FACILITY (GRMF)

- Established by the African Union Commission (AUC), German Federal Ministry for Economic Co-operation & Development and EU-Africa Infrastructure Trust Fund (ITF) via KfW in 2012 to help overcome the barriers holding back geothermal investment.
- Initial €20m Germany; €30m EU-ITF-KfW
- AUC official implementing agency – its big infrastructure play
- UK has (unusually in energy) come in with £47m DfID.
- GRMF will cover up to 20% of infrastructure; 80% surface studies (usually \$1m-2m); up to 40% of 2 wells (approx. \$5m-7m); and 30% continuation premium
- 2nd application round:
 - Karthala, Comoros – surface study for 10MW, now applied for more
 - Fantale (Ethiopia) study \$876,770 – Cluff Geothermal
- 3rd round – evaluation reports for 14 projects
 - 2 each Ethiopia and Kenya, 1 each Djibouti, Rwanda, Comoros, with Tanzania + Uganda projects under discussion

RISK MITIGATION...

- Olkaria III Units 1-3 were financed using a \$310m loan from the US Overseas Private Investment Corporation (OPIC).
- OPIC involvement points to geothermal as a Power Africa priority
- Olkaria Plant IV has been financed through equity by developer Ormat, insured to cover political risk exposure by the World Bank Group's Multilateral Investment Guarantee Agency (MIGA).
- Agencies continue to show strong appetite

...AND PRIVATE INVESTMENT

- As KenGen's Mugo put it: *"We know we cannot raise all the financial resources that Kenya needs"*.
- Olkaria, Longonot are IPPs
- IPPs have a critical role to play
- Andrew Herscowitz, Power Africa, this morning: *Realistically not going to get 15-20GW in next few years – up to 5GW realistic*

LOOKING FOR PUBLIC/PRIVATE PARTNERSHIPS (PPPs)

- KenGen has appointed a transaction adviser to identify a joint venture partner for a pilot geothermal PPP.
- It might take 13-18 months to find the right candidate. *“We don’t know what it [the new partnership model] is going to look like”* (Mugo)
- *“Depending on how it works, we could use that model so we don’t leave everything to the IPPs”* (Mugo).

WORK IN PROGRESS

The World Bank has sought consultants to help the Ministry of Energy and Petroleum prepare a **new national geothermal strategy**. (Bids were due in on 4 March).

It looks like an all-embracing rethink, with the winning bidders expected to review:

- existing arrangements for geothermal development with particular focus on the policy, legal and regulatory framework, including **licensing and procurement**;
- models and delivery mechanisms including institutional roles of relevant stakeholders;

- pricing and incentives, including feed-in tariffs (FiTs), levies and taxes;
- different risk mitigation instruments' relevance and availability;
- social and land issues (much more on this to come);
- the framework to better address environmental issues, capacity needs and the use of local expertise; and
- the framework for promoting direct uses of geothermal resources.

To follow from this would be the **development of specific objectives, targets and plans**

GOVERNANCE ISSUES

Also from *AE 317*:

Geothermal Development Company looking for new chief executive

- after charges by the Ethics and Anti-Corruption Commission (November 2015) against chief executive Silas Simiyu, company secretary Paxidis Namioni Saisi, general manager drilling operations Michael Mbevi and six tender committee members over alleged illegal procurement of services for moving a drilling rig.

LAND ISSUES

Causing problems across African energy sectors

- Private projects including the Longonot geothermal – and other landmark schemes including the Lake Turkana wind farm and Lamu coal-fired projects – have all been subject to court petitions filed against them over land acquisition.
- Longonot land ownership was very complex, when it came to due diligence
- State-owned KenGen has not been immune – recent clashes at the Olkaria IV geothermal project’s 3,000 acre site (schools were closed and more than 30 arrests reported).

Kinangop Wind Park (KWP) announced in February that development of its 60.8MW wind farm would “cease implementation” after nearly two years of delays.

- Owned by Norway’s Norfund and African Infrastructure Investment Fund II, managed by African Infrastructure Investment Managers, KWP faced persistent civil unrest which ran down funds; the owners had invested \$66m in equity to cover project costs.

Securing land for transmission lines is problematic.

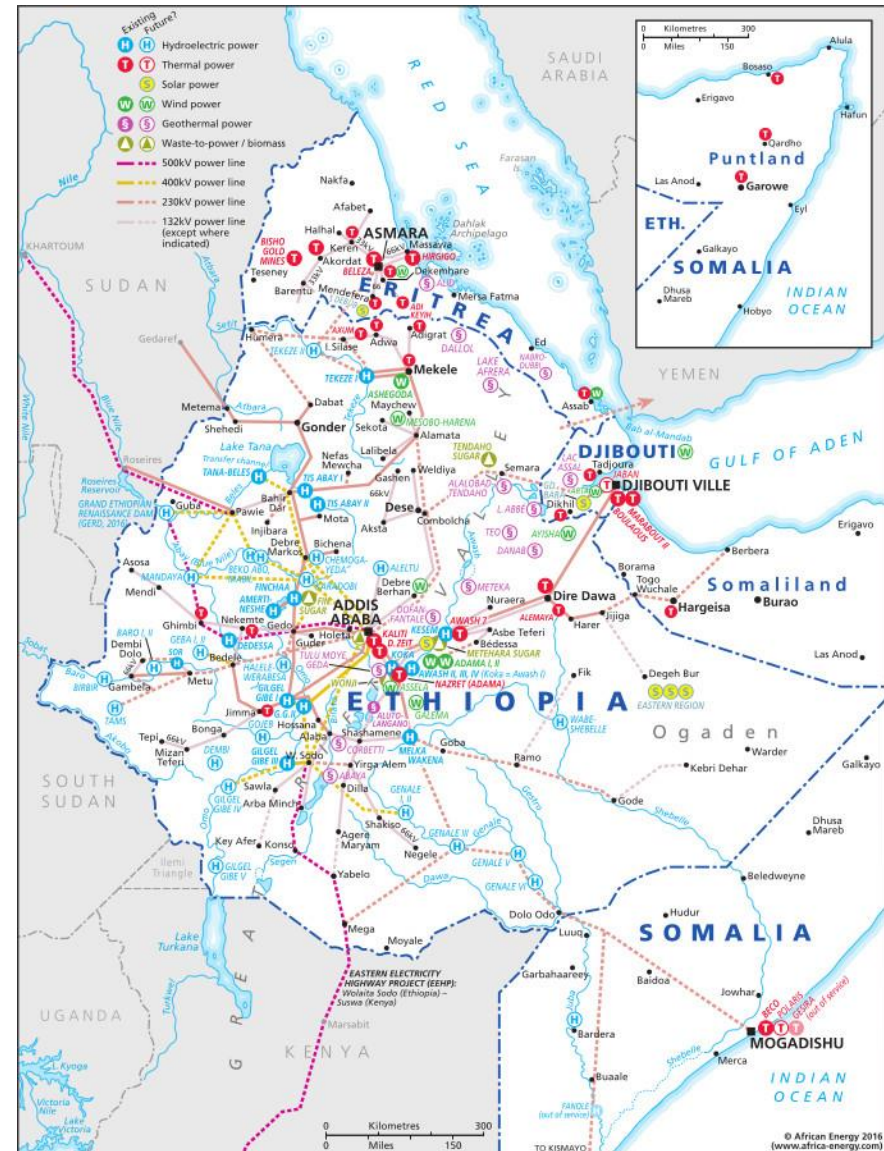
- incomplete land legislation
- antagonism between the National Land Commission and the central government’s Land Registrar.

ETHIOPIA

Geothermal high on the agenda of the “developmental state”

Several projects:

- Reykjavik Geothermal \$1.3m GRMF grant for surface studies at Tulu Moye – centred on the Tulu Moye volcano, 100km south of Addis Ababa.
- One of three prospects for which RG holds exploration licences – 1GW development agreement signed with the Ethiopian government in 2013. 25-year concession



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Corbetti is the flagship

- Project driven by Berkeley Energy (Africa Renewable Energy Fund – AREF), Iceland Drilling and Reykjavik Geothermal
- Power Africa ‘poster project’
- 1GW headline, but 20MW first phase, second phase will add a 50MW condensing unit; subsequent phases of around 50MW.
- Surface studies suggest a potential for power generation of at least 500MW.



RWANDA

Rwanda “looking at geothermal potential” — Infrastructure Minister James Musoni

- Project could be shared with DRC.
- Studies are under way *“and we will know the potential by March”* (Musoni in December: *“By mid- 2016 we will know the resource and look to develop an IPP.”*)
- Energy Development Corporation has recent GRMF grant for a drilling programme at the Kinigi project in Rwanda.

OTHER PLAYERS – with sample projects

DJIBOUTI

- Office Djiboutien de Développement de l’Energie Géothermique GRMF support for surface study at the Arta project

COMOROS

- Bureau Géologique des Comores and Comoros government GRMF grant for drilling programme at the Karthala project

TANZANIA

- Tanzania Geothermal Development Company Ltd and Icelandic International Development Agency called for consultant Eols to assist with surface exploration and training at the Luhoi (Rufiji district) and Kiejo-Mbaka (Rungwe) geothermal prospects.
- Contract funded by the Icelandic Ministry for Foreign Affairs and Nordic Development Fund through the Geothermal Exploration Project.



THANK YOU FOR LISTENING

I would like to thank the many East African and European officials and experts, and other sources who have fed into our thinking on the geothermal sector

And a word for my colleagues at Cross-border Information, including Dan Marks, Zak Samuels, John Hamilton and David Slater for their help on this, alongside Thalia Griffiths' *African Energy* team.

