



MAGNUS GEHRINGER, M.Sc.
ESMAP / WORLD BANK GEOTHERMAL TRAINING DAYS
JUNE 2012

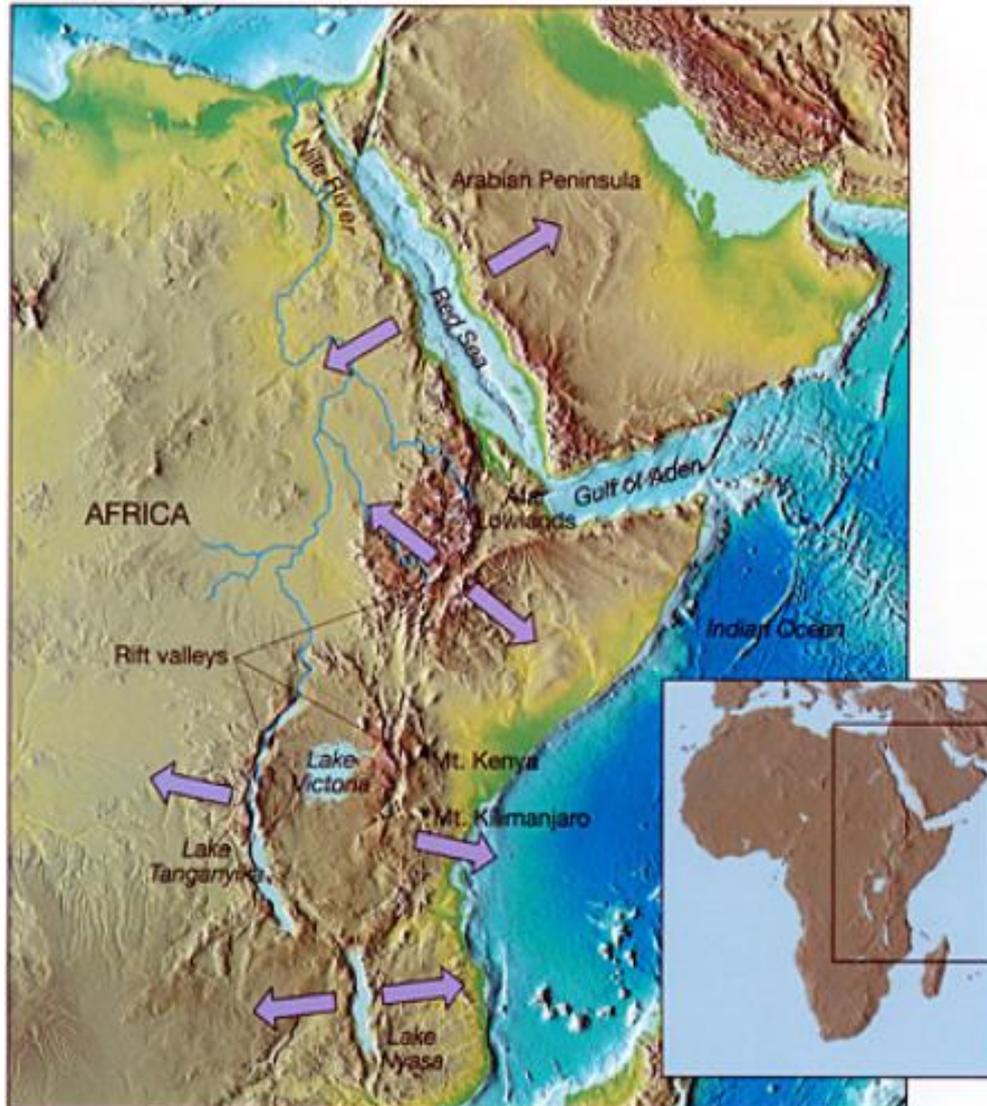
Geothermal in East-Africa: More than Kenya and Ethiopia



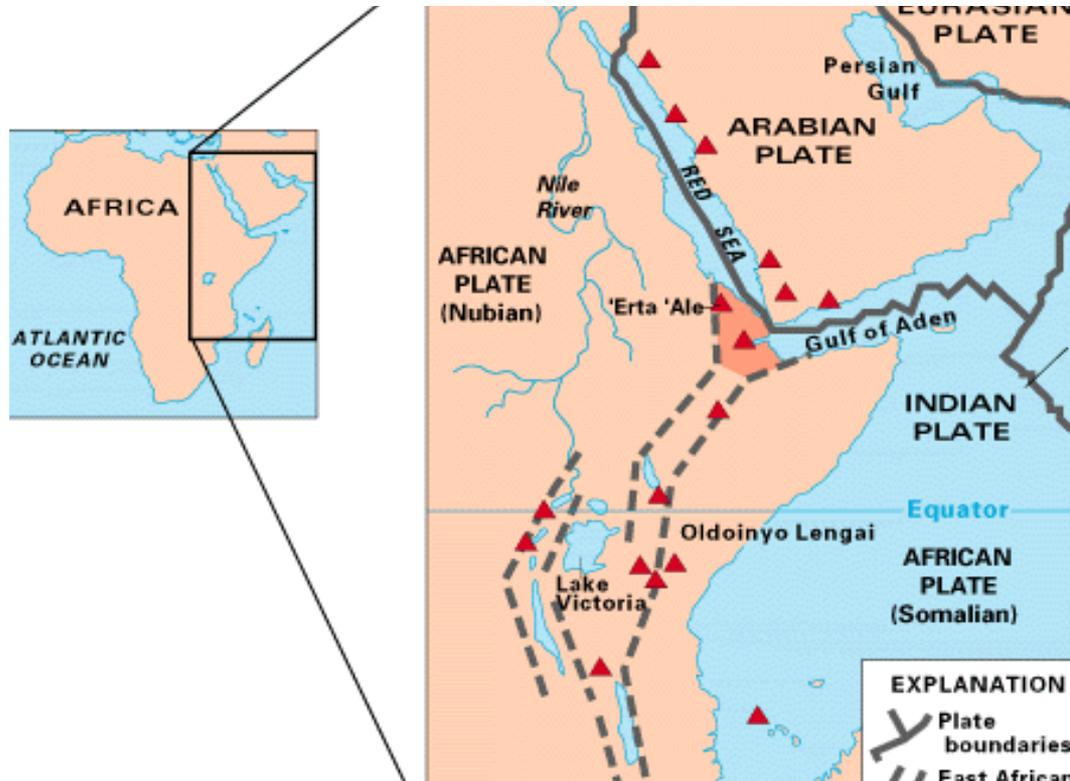
East-Africa overview

- Installed capacity around 7,000 MWe
- 2 to 20% of population connected
- El. -Prices cover the entire range from 5 cts. Per kWh to over 40.
- Demand growth has been projected to be from 5% per year to 12% (Tanzania)

Map of East-Africa



African Rift System



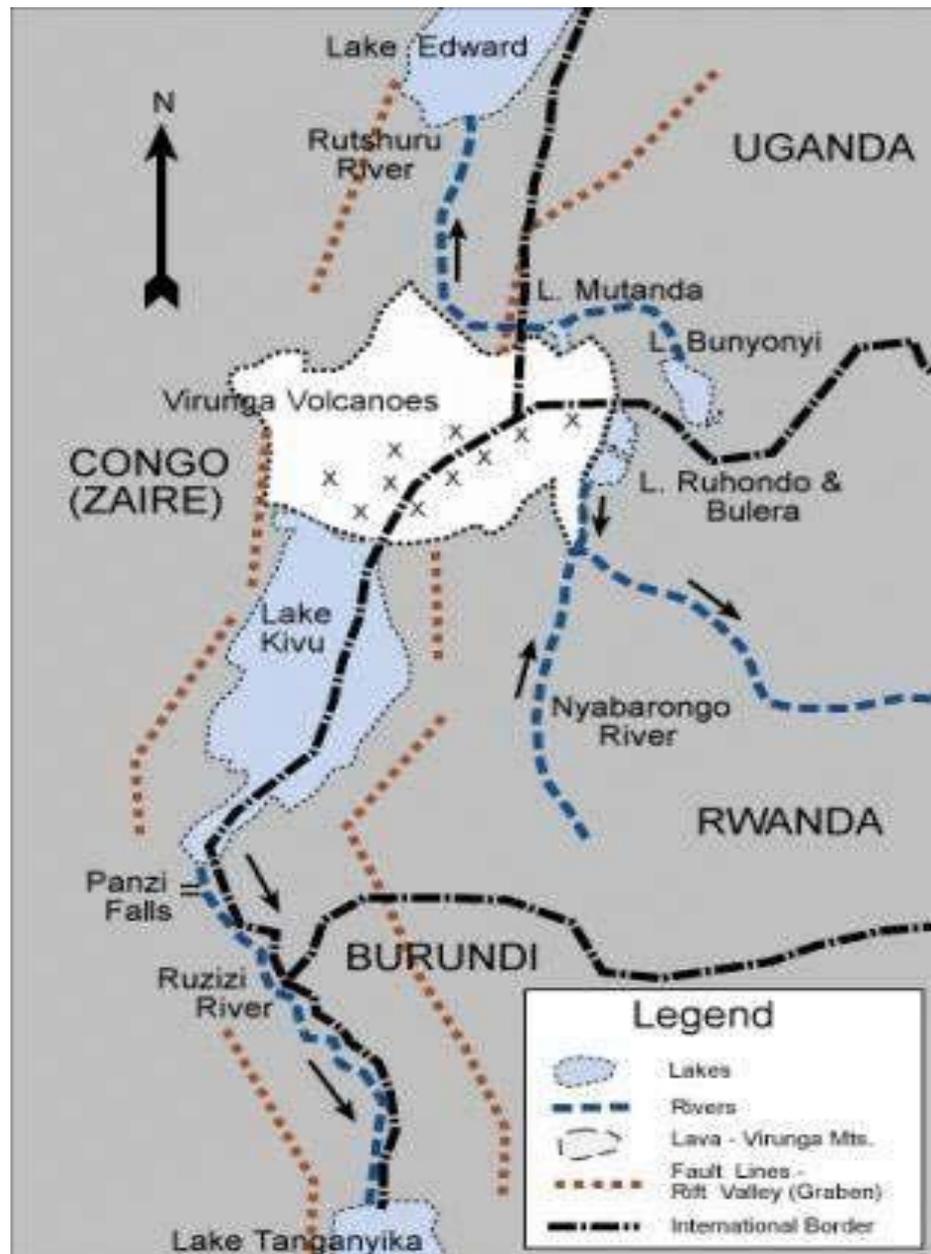
Geothermal potential in East-Africa

Eritrea, Ethiopia*, Sudan, Djibouti, Somalia, Uganda, Kenya*, DRC **, Rwanda, Burundi, Tanzania, Zambia**, Malawi, Mozambique, Comoros, Madagascar, Mauritius

- * Have currently operational geothermal power plant(s)
- ** Had geothermal power plant in the past (now decommissioned)

East-Africa has 17 geothermal countries

- Estimated potential of over 10,000 MWe, mainly in the Eastern branch of the Rift Valley. However, other areas like the Western Branch and off-shore islands might be of high interest.
- High enthalpy areas and limited chemical problems, all at convenient depths, therefore commercially viable
- Cascaded use of residual heat from power plants as hot water, for industries, for cooling and freezing
- Status of institution and manpower capacity differs between countries, and so does the regulatory system
- Kenya is the regional leader with high government commitment, after 2003 least-cost-option study.
- Following slides give a short overview over the main countries of interest and the most important known geothermal sites, in many cases based on the author's personal view.



CONGO
(ZAIRE)

UGANDA

RWANDA

BURUNDI

Legend

- Lakes
- Rivers
- Lava - Virunga Mts.
- Fault Lines - Rift Valley (Graben)
- International Border



Rwanda

- Quality and quantity of geothermal exploration data not adequate to determine geothermal potential of Karisimbi, Gisenyi and Bugarama geothermal fields around Lake Kivu.
- Energy law modified to include power generation from RE, including geothermal.
- Manpower capacity and experience should be strengthened further, but is under strong leadership of Kenyan expert. Geological conceptual model of the Western Branch of the Rift Valley not well known.
- Government shows high commitment and high targets, i.e. hundreds of megawatts within next decade.
- Test drilling in Karisimbi area scheduled for late 2012. Funded by Belgium and Germany.
- Expected geothermal potential: Temperatures around 150°C and good flow rates, ideal for binary power plants that can also be used off-grid and in rural areas. However...
- No test drillings have been done so far, and whoever will be the first to do them, will take all the risk for the entire region, including Uganda, Burundi and DRC.
- http://www.youtube.com/watch?v=tpT1dCx2Z_I

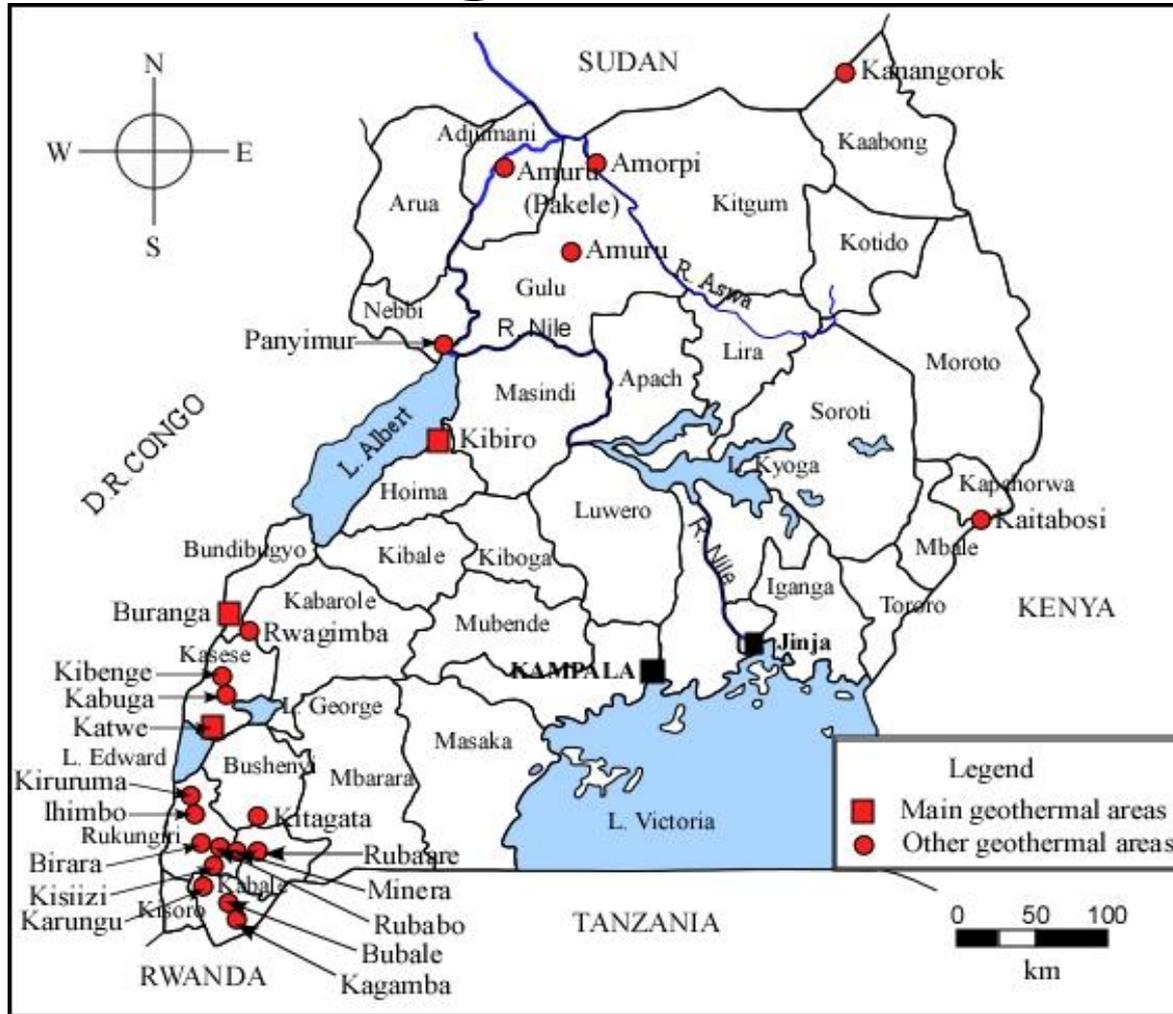




Uganda

- First assessment of geothermal potential provided by ISOR (Iceland Geosurvey). Conclusion not definitive. Recommended for acquisition of further deep data (MT soundings) for 2 out of 3 areas (Kibiro & Buranga). Katwe not recommended.
- Actions required: Prepare test drillings in Kibiro with additional soundings and refining the conceptual model.
- Expected potential similar to Rwanda, i.e. binary power plants for rural and off-grid applications.
- <http://www.youtube.com/watch?v=WcYK6ONxEVw>

Uganda



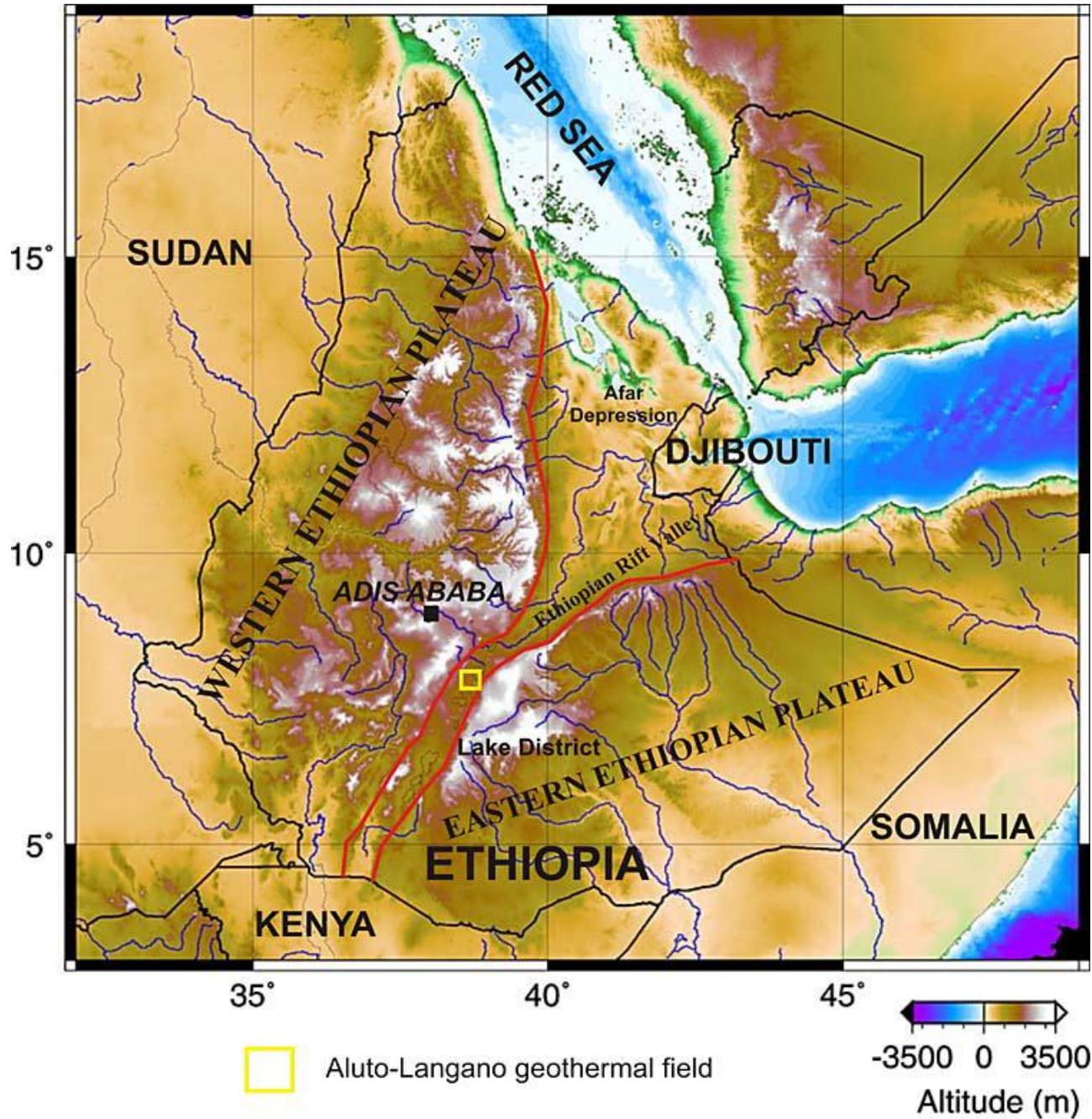
- Bahati, 2008

Tanzania

- Two main areas identified: Mbeya (SW) and Lake Natron (NE). German geosurvey (BGR) has completed initial evaluation study.
- Quality and quantity of data not adequate to ascertain geothermal potential. Likely to have at least some areas with high enthalpy steam comparable to Kenya.
- Actions required: Geothermal unit to be established in the MoE, REA to establish and fund a team for the integration of all available data, incl. petroleum exploration data around geothermal areas.
- Deep data & MT's required to locate geothermal source at Mbeya and do test drillings.

Ethiopia

- Two main geothermal areas identified (Aluto Langano & Tendaho). Aluto currently producing about 4 MWe.
- One project, Corbetti, is being developed by foreign IPP, now in early exploration stage.
- Actions required: Tendaho and other geothermal areas need further exploration and test drillings.
- Ethiopia's geothermal potential could be similar to Kenya, i.e. several thousand megawatts. Resource quality in Aluto Langano is also similar to Kenya.
- Expansion drillings in Aluto Langano will start in 2012. Four drillings will determine the potential, hopefully confirm the resource for a new geothermal power plant. Expected power capacity 30 to 50 MWe. Transmission lines are near by.
- SREP (Scaling-up renewable energy program) will further support the development of Aluto Langano.



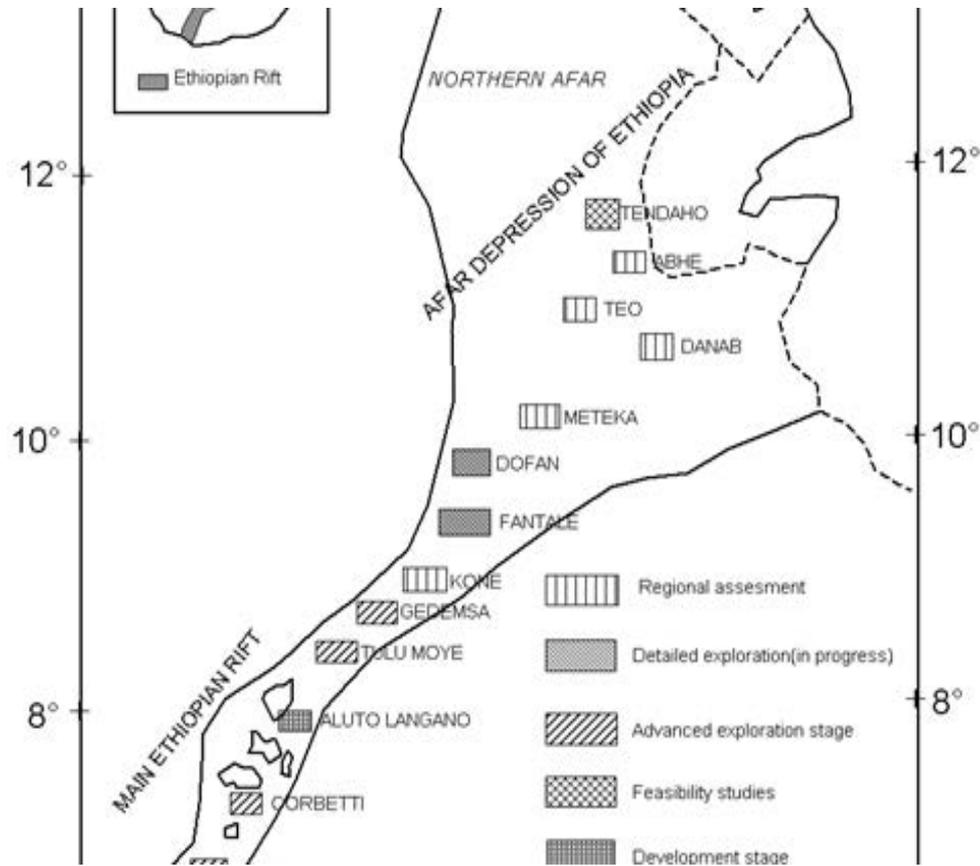


Table: Geothermal Power Development Plan in Ethiopia by 2018 #
Initial Output (MW) Estimated Completion Time (Revised)

1	Aluto Langano	75	2015
2	Tendaho	100	2018
3	Corbetti	75	2018
4	Abaya	100	2018
5	Tulu Moye	40	2018
6	Dofan Fantale	60	2018
TOTAL	450		

Prospect Area Estimated

Ministry of Water and Energy, 2012



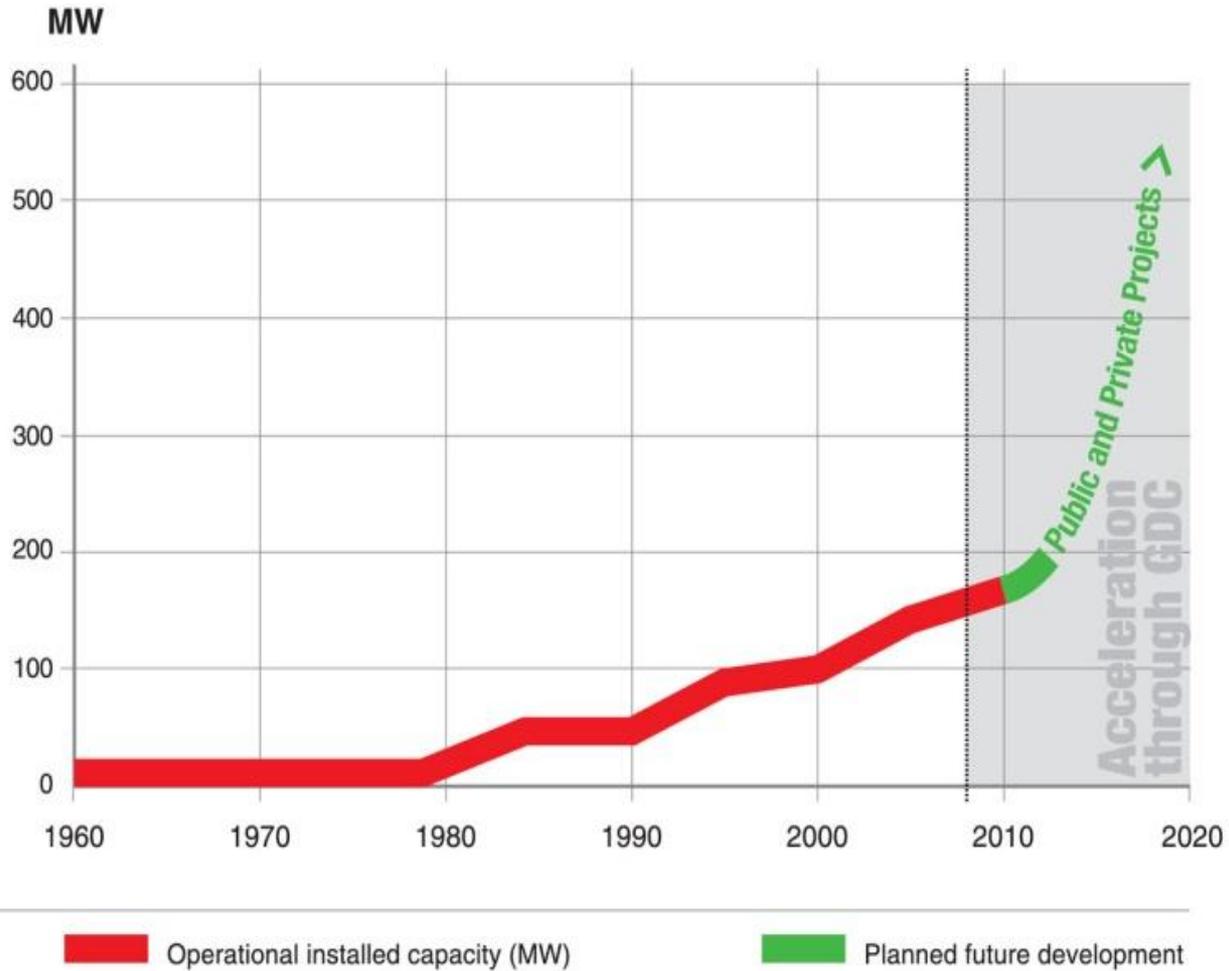
Kenya

- KenGen operates 209 MWe of geothermal power in Olkaria, which is a National Park south of Nairobi. An addition of 280 MWe in four power plants is under preparation / construction.
- An IPP generates approximately 48 MW at the same site.
- Kenya has enormous potential within the Rift Valley to generate competitively priced power from geothermal resources.
- Full government commitment is based on least cost option study from 2003. Other geothermal fields are being explored and test drilled.

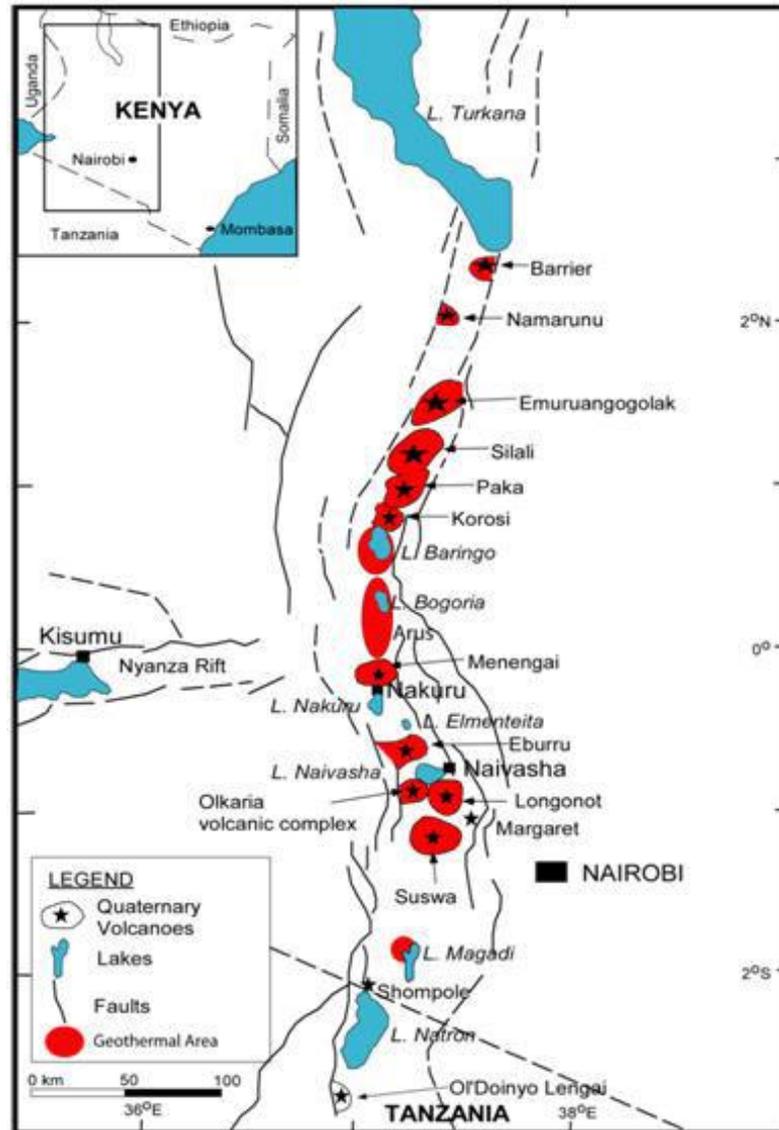
Kenya (Menengai)

- Menengai is located north of Nairobi and is the next field to be developed. Anticipated steps are 400 MWe within the next three.
- Test wells show good results.
- 19 IPPs participated in the EoI and got shortlisted for development of 4 x 100 Mwe.
- <http://www.youtube.com/watch?v=Nux6fH4I3ww>

Development of Power Generation from Geothermal in Kenya



Geothermal fields in Kenya



The GDC concept

- After GDC has finished the exploration and drillings of an entire geothermal field, the field will be internationally tendered out to private companies or, if the response is not sufficient or attractive for the country, be developed by KenGen.
- Thereafter, GDC will supply the steam to the power generator. Revenues will be used to continue exploration of new fields.
- GDC, as a public company, thereby accepts all resource risks. The power generator does not need to add a risk premium on the power tariff.
- Being a public company, the GDC has access to attractive financing.
- However, splitting geothermal power generation into two parts, with all their dependencies, can be legally challenging.
- Development targets in terms of added capacity are 3,000 MWe in 2021 and 5,500 MWe in 2031. The current installed capacity of Kenya is around 1,600 MW.

Latest from Nairobi – take the test

- **GDC is tasked to develop 5000 megawatts by 2030 to drive the country's economic progression**

Written By:Kamau Mbote, Posted: Tue, Jul 10, 2012

The Geothermal Development Corporation has completed 6 wells in Menengai four of which have the capacity to produce 24 megawatts.

According to GDC Managing Director Silas Simiyu , the corporation will be installing modular power plants before the end of the year to reduce the gestation period involved in geothermal power generation.

GDC has also announced that it expects 2 extra rigs by the end of the year.

The Menengai region located in the Kenya's Central Rift has the potential to generate 1600 megawatts and the corporation is drilling using 2 rigs it acquired last year.

Simiyu says that unlike in other geothermal projects, in the country the corporation will be installing modular power plants to supply electricity in short periods as the country is in dire need for energy.

This comes even as GDC expects two deep drilling rigs this financial year aimed at reducing drilling costs that would reduce electricity tariffs passed to the consumers.

The additional two rigs will be set up in the Bogoria-Silale Block that has a potential of 3000 megawatts

The 2 rigs are part of the 5 rigs partly financed by the AFD at a cost of \$90m and will be supplied by the Chinese petroleum drilling company.

GDC is tasked to develop 5000 megawatts by 2030 to drive the country's economic progression and people's quality of life.

© 2012 Kenya Broadcasting Corporation.

Thank you!

Questions?