

Geothermal Potential in Kenya

Kenya is endowed with geothermal resources mainly located in the Rift Valley. Electricity demand in Kenya has continued to grow steadily over the years and has caused great pressure on the conventional sources of energy like hydropower, which is normally affected by weather changes. It is estimated conservatively that the Kenya Rift has a potential of greater 2000 MWe of Geothermal Power. A total of twenty sites have been earmarked for further investigation. Exploration first started by drilling two wells in 1956 in Olkaria I and was followed by increased interest in the 1970s. Initial production started in 1981 when the first plant of 15MW was commissioned in Olkaria I currently 45MWe is generated by Olkaria I geothermal power station; 70 MWe is produced from Olkaria II (both operated by KenGen) and an IPP is producing 12Mwe at Olkaria III. KenGen and the IPP produce a total of 129 MWe of geothermal energy and this is expected to increase to 576MWe within the next 20 years.

The main problem hindering Geothermal Power development is one of high tariffs. The Government needs to raise funds both internally and through donor support in order to undertake geothermal resource assessment. For tariffs to be low the government needs to undertake exploration, including steam field development. This would leave the IPP' s to undertake plant construction for generating electricity.

The Olkaria geothermal field covers an area of approximately 70 km². A total of 110 wells have so far been drilled out of which 50 are production wells, 24 for Olkaria I, and 22 for Olkaria II, 6 re-injection wells and four production wells in Olkaria III. The main production zones are generally between 750-900m being steam dominated and from 1100 metres to 1300 metres which is richer in water though steam can be intercepted down to the full depth of the well.

Currently there is steam capable of generating an additional 25 MWe in Olkaria I and 28 MWe in Olkaria II. Geothermal production began in Kenya at Olkaria when the first 15 MWe generating unit was commissioned in June 1981 and the second 15 MWe was in November 1982. The third unit was commissioned in March 1985 raising the total installed capacity at Olkaria to 45 MWe. The other geothermal generation capacities are Olkaria II, which is currently producing 70 MWe, owned by KenGen and Olkaria III which is owned by an IPP (ORMAT) and is currently producing 12 MWe and plans are in progress and at and to increase its production to 48 Mwe by end of 2005.

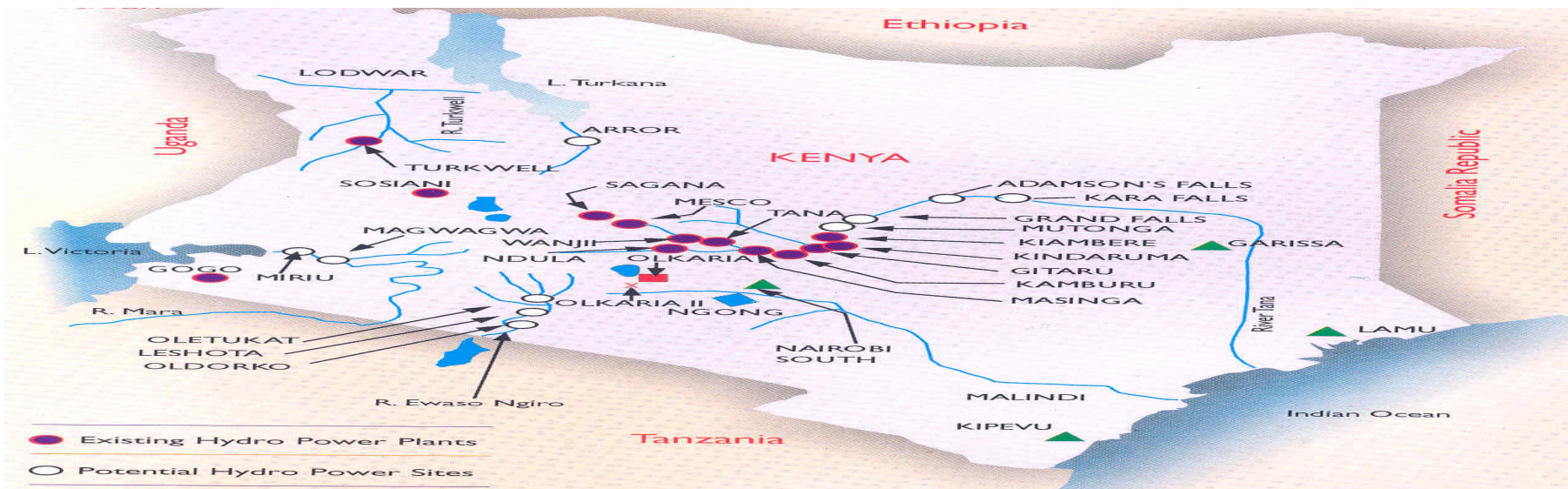


Fig. 1 shows existing and potential power plants of KenGen, the Power generation company of Kenya owned 70% by state and 30% by private shareholders (currently about 240.000).



Fig. 2 Map showing location of the Olkaria geothermal prospect



Fig. 3 Map showing location of Olkaria I, II and III

Olkaria I Power Station

To date a total of 33 wells have been drilled for Olkaria I the station. Thirty-one of these are currently connected to the power station while two of these have been retired. One well is currently being used for hot re-injection. The turbines are 4-stage single flow running with an inlet steam pressure of 5 bar absolute at a saturation temperature of 152 C and a steam consumption of 9.2 tonnes per hour for each megawatt hour produced. The plant has had an average availability and load factor of 98 per cent since commissioning. The power generated is connected to the national grid via a 132 kV transmission line.



Fig. 2 View of Olkaria I Power Plant

Olkaria II Power Station

Olkaria II Power Station is currently Africa's largest Geothermal Power Station. It is currently generating 70 MWe and is the second geothermal plant that is operated by KenGen. The power plant was commissioned in November 2003.

The power station is located in the North Eastern Sector of the greater Olkaria geothermal field. Wells were drilled between 1986 and 1993 but construction of the power plant was delayed until the year 2000 when funds became available. The project was co-financed by the World Bank, the European Investment Bank, KfW of Germany and the Kenyan Government. Designed and constructed with an advantage of newer technology, this state-of-the-art plant is highly efficient in steam utilization.

Olkaria II Power Station operates on a single flash plant cycle with a steam consumption of 7.5 tonnes per hour per megawatt generated. The turbines are single flow six-stage condensing with direct contact spray jet condenser.

The Power generated is transmitted to the national grid via 220 kV double circuit line to Nairobi. Olkaria II power station is also connected to Olkaria I Power Station by a 132 kV line.



Fig. 3 View of Olkaria II Power Plant



Fig. 4 Olkaria II visit, EGTT members and UNFCCC staff, 5th of November 2006

Olkaria III Power Plant

This is not only the first private geothermal power plant in Kenya, but also the first binary cycle plant in the country. Exploration Drilling of seven wells was completed in the Olkaria South West field, five wells were able to discharge with an output varying from 1 to 4 MWe. The Kenya government put the Olkaria West field out for International bid in 1996. Two companies submitted responsive bids and, after evaluation, ORMAT International was awarded the right to develop Olkaria III to a capacity of 64 MWe.

In 1997, ORMAT International was licenced by the Kenya Government to generate 64 MWe to 100 MWe in the North West sector of the Olkaria resource now called the Olkaria III field. In August 2000, ORMAT commissioned 8 MWe of geothermal generation that was later increased to 12 MWe from a combined-cycle binary pilot plant. The plant will generate 48 MWe when fully developed.

As part of the first phase, nine new wells have been drilled to further appraise the Olkaria III field. Following this appraisal programme, ORMAT has projected that it will be capable of producing 48 MWe over the next 20 years.



Fig. 4 and Fig. 5 - a close views of Olkaria III Power Plant

Table 1. Exploration Status Of Geothermal Prospects

Prospect	Reconnaissance	Surface Exploitation	Wells Sited	Wells Drilled
Olkaria domes	complete	complete	3	3
Longonot	complete	complete	3	Not done
Suswa	complete	complete	Not done	Not done
Menengai	complete	complete	Not done	Not done
Badlands	complete	Partial	Not done	Not done
Lake Magadi	complete	Not done	Not done	Not done
Arus	complete	Not done	Not done	Not done
Lake Bogoria	complete	Not done	Not done	Not done
Korosi	complete	Not done	Not done	Not done
Paka	complete	Not done	Not done	Not done
Silali	complete	Not done	Not done	Not done
Emurangogolak	complete	Not done	Not done	Not done
Namarunu	complete	Not done	Not done	Not done
Barrier Volcano	complete	Not done	Not done	Not done

The installed electricity capacity in Kenya currently stands at 1,232.6 MW. This includes a firm 20 MW import from Uganda, and 74 MW from Kipevu II diesel plant, which came into commercial operation in August 2001, 70MW from Olkaria II which was fully commissioned in November 2003.

Table 2. Electricity contribution by different energy sources

Source	Capacity in MW	Percentage (%) of total capacity
Hydro (Including Imports)	697.2	57.34

Geothermal	128	10.53
Oil Thermal Generation	133.5	10.98
IPP's (Thermal)	174.0	14.31
Gas Turbine	73.5	6.05
Wind	0.4	0.033
Isolated Diesel Plants	9.2	0.76
Total	1215.8	100

