



An Overview of Geothermal Development in Kenya



By

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Outline

- ❖ Introduction
- ❖ Update on geothermal exploitation in Olkaria geothermal field in Kenya
- ❖ Briefs on status of exploration in other prospective areas
- ❖ Conclusions



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Background information

- ❖ Kenya's geothermal potential exceed 2000 MW
- ❖ Kenya's economic hydro sites have largely been developed
- ❖ Kenya has no oil or coal

Kenya's source of Energy



- ❖ Kenya relies on three major sources of energy:
 - **Biomass - 68%**
 - **Petroleum - 22%**
 - **Electricity - 9%**



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Kenya's source of Energy (2)

❖ In the Electricity sub-sector

- Hydropower - 62%**
- Thermal - 26%**
- Geothermal - 12%**
- Other forms of renewable energy (wind, solar, biogas, mini hydro etc) <1%**

Power industry players



KenGen 86%	Tsavo Power 7.2%	IberAfrica 5.4%	WestMont 3.7%	OrPower 4 1.2%	Uganda
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ERB

KPLC

Customers



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Installed and effective capacities

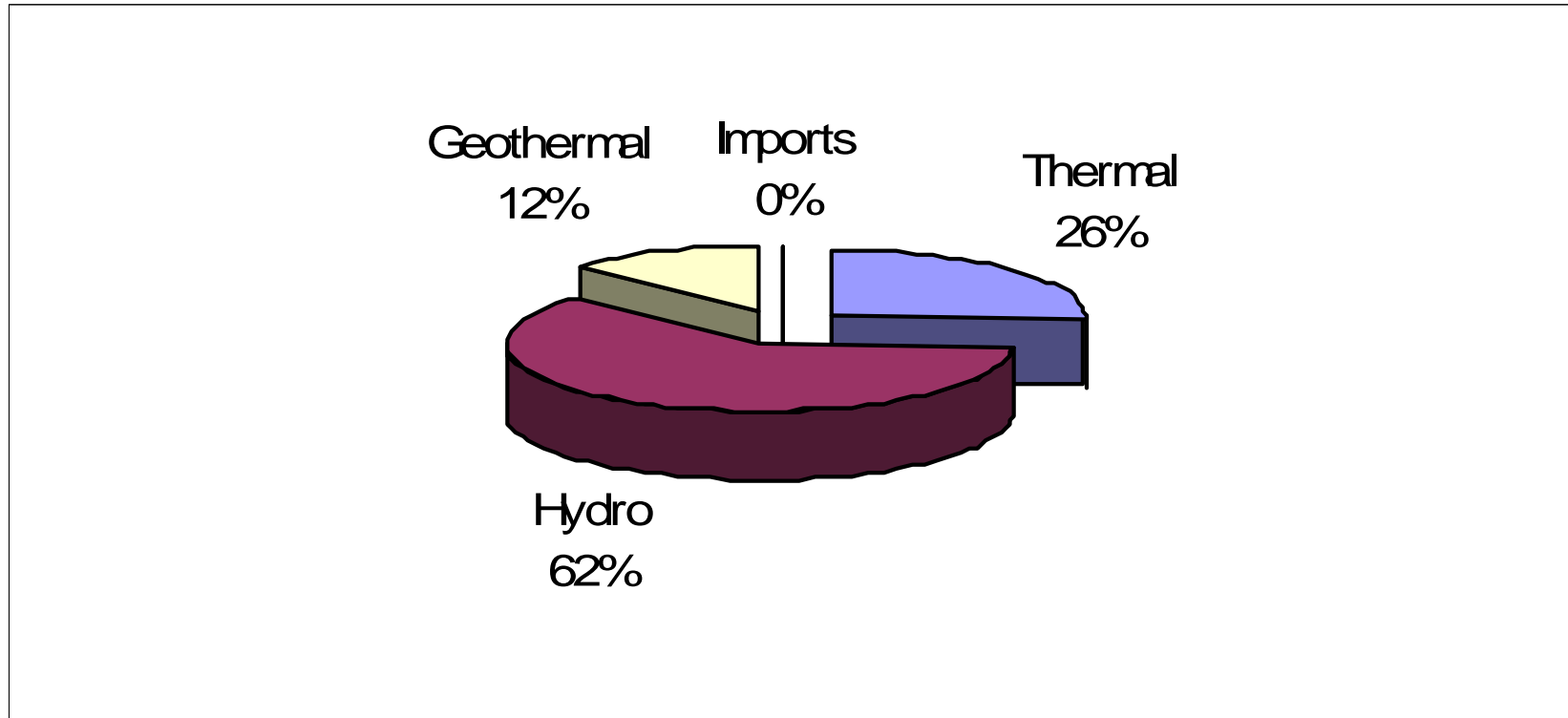
		INSTALLED	EFFECTIVE	SHARE (% Effective)
KenGen	Hydro	677.28	641	62%
	Geothermal	115	115	11%
	Thermal	214.2	133	13%
IPPs	Geothermal	13	13	1%
	Thermal	174	132	13%
UETC	Imports	30	0	0%
	TOTAL	1223.48	1034	

- Current Peak demand 920 MW,
- Base load of 400 MW



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Effective capacities (MW)





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Kenya's geothermal prospects

Olkaria



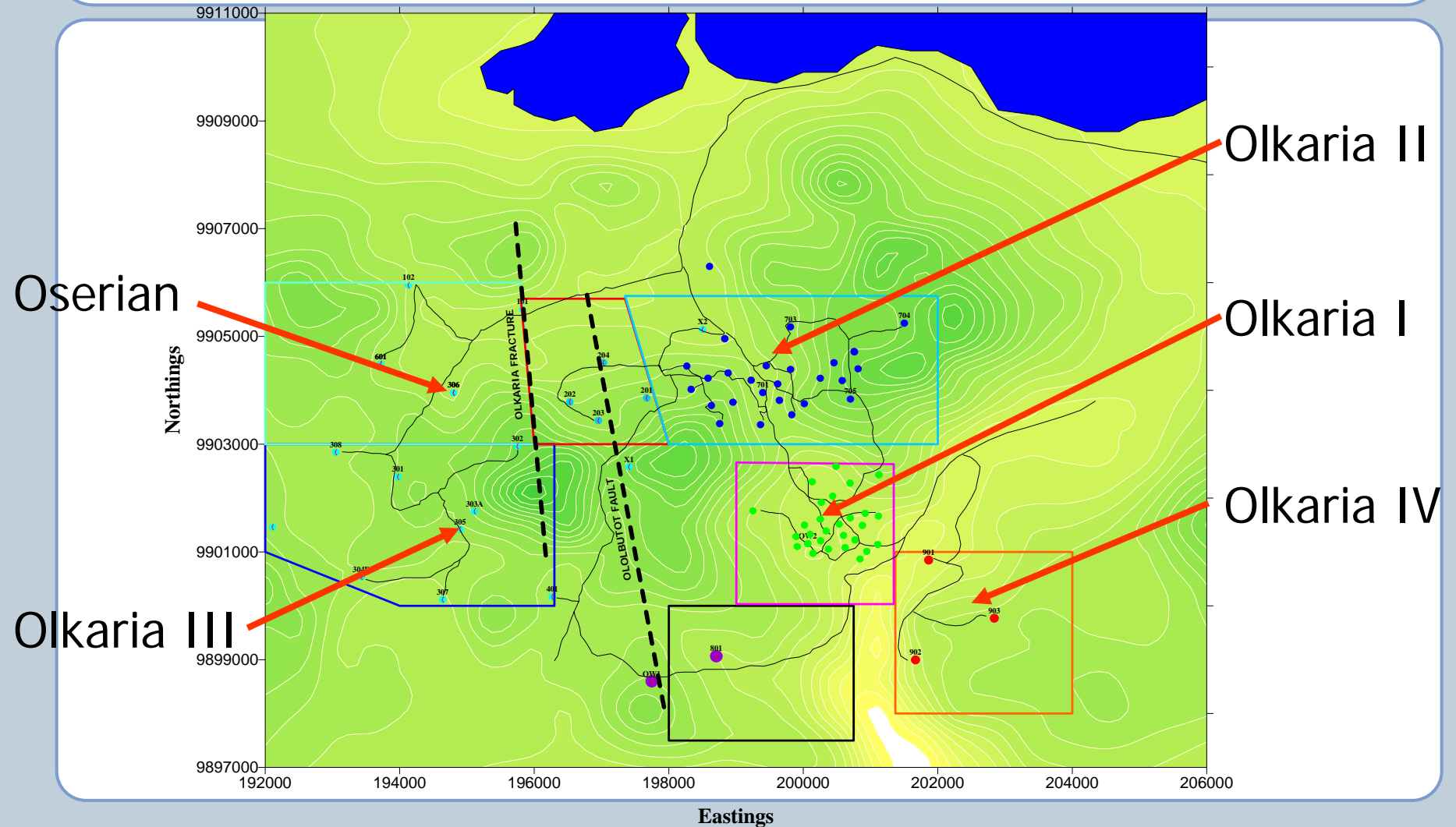


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Kenya's geothermal prospects (2)

- ❖ About 14 prospects in the Kenyan Rift.
- ❖ The total potential estimated > 2000 MWe.
- ❖ Wells have been drilled in Olkaria and Eburru.
- ❖ Exploitation is only at Olkaria.

Olkaria fields



The Olkaria Geothermal System



- ❖ The Olkaria geothermal field is about 80 km²
- ❖ Is divided into seven sectors
- ❖ Generation is 129 MWe, from 4 sectors.
- ❖ 3 exploration wells drilled in Olkaria Domes.
- ❖ Exploration drilling undertaken in the other sectors of Olkaria but shown poor results.

Geothermal utilisation

❖ Electricity generation

- In Okaria I power plant for the last 24 years
- 3 other power plants commissioned in the last 6 years

❖ Direct uses

- Bathing, cooking, therapeutic purposes (many years)
- Commercial use at Oserian Flower Company (5 years ago)
- Lake Bogoria Hotel swimming pool (3 yrs ago).



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Electricity generation

- ❖ Olkaria resource generating a total of 129 MWe in 4 fields.
 - Olkaria East (1981) - 45 MWe (KenGen)
 - Olkaria West (2000) – 12 MWe (Ormat)
 - Olkaria NE (2003) - 70 MWe (KenGen)
 - Olkaria Central (2003) – 2.0 MWe (binary) from a leased well for use at the flower farm.



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Olkaria I (45MW) power plant





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Olkaria I Power Plant

❖ Development

- Exploration (1970); drilling (1972); feasibility (1976)
- 3 x 15 MW units commissioned between 1981-1985 still operational.
- Funded by IDA US\$ 61 M, EIB US\$ 8.8 M, CDC S£15.5 M, KenGen KShs 40.8 M

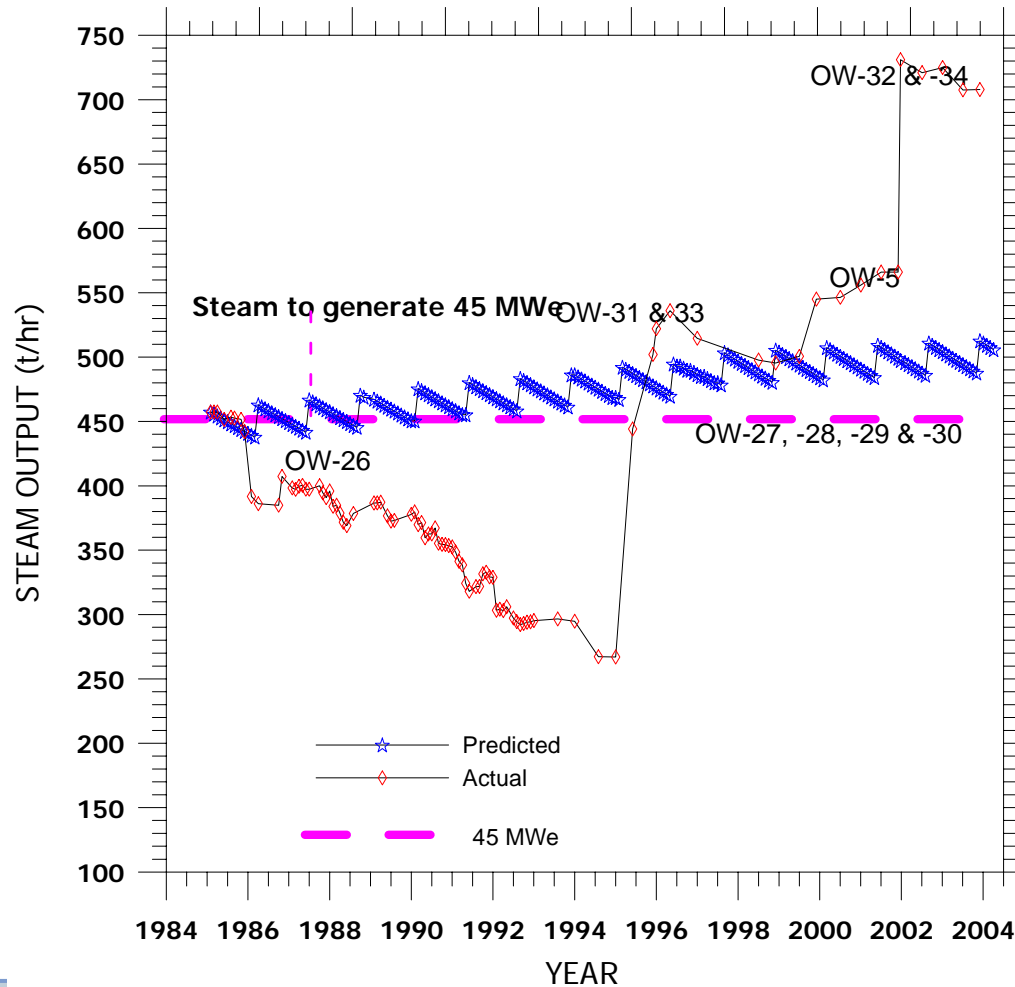
❖ Steamfield

- 31 wells interconnected
- 8 new make-up wells
- 1 deepened
- 2 retired
- Excess steam available

❖ Power plant

- All the machines - availability and load factors >95%

Excess steam at Olkaria I





Olkaria II (70 MW) power plant

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Olk. II project



- ❖ Location ~ 3.5 Km from Olkaria I
- ❖ Development
 - Project inception - 1988 after 6 wells
 - Drilling ended - 1993 with 33 wells and 80 MW steam
 - Funding closed in August 1998
 - 5 construction & 1 engineering contracts awarded
 - Construction works began in Sept 2000
 - US\$185 million by the World Bank, the EIB, KfW and KenGen.



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Olkaria II

❖ Main features are:

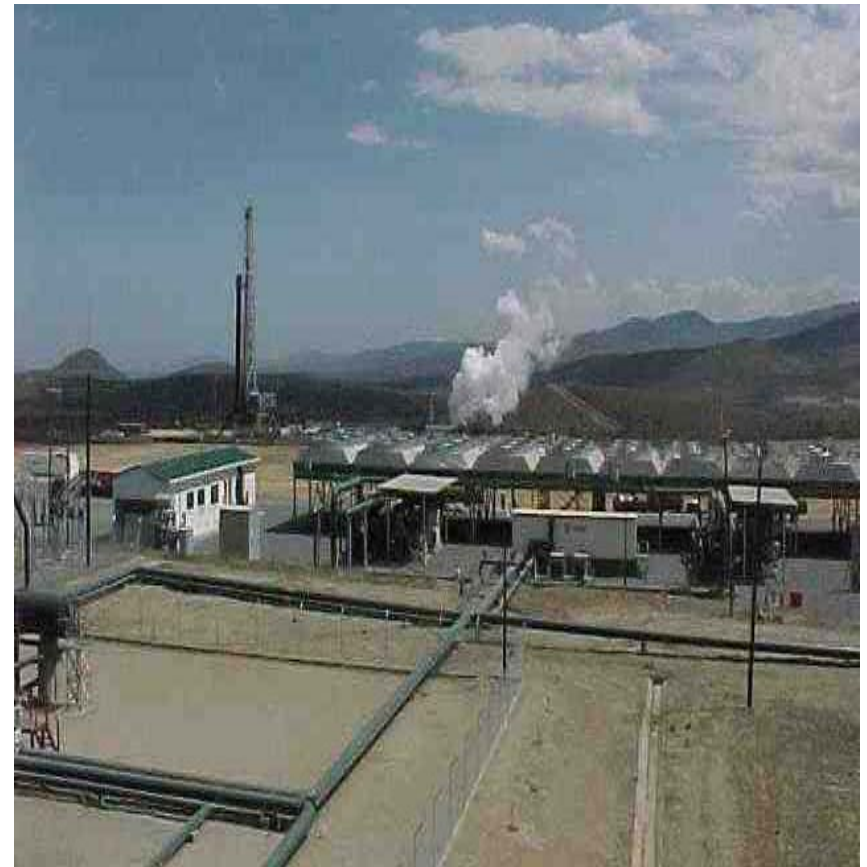
- 2 x 35 MW Mitsubishi turbines commissioned Oct and Nov 2003**
- Specific steam consumption: 7.5 t/h (9.2 t/h for Olkaria I)**
- 15 steam wells used out of 20**
- 25.7 km of steam and brine lines**
- 4 hot and 2 cold re-injection wells**
- DCS system (Analogue system for Olkaria I)**



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Olkaria III plant (2000)

- Exploration drilling done by KenGen.
- Field bidded under BOO through an ICB in 1996.
- Orpower 4 Inc. signed PPA with KPLC in 1998 for 20 yrs.
- Planned to generate 48 MW on completion
- 1st Phase commissioned in year 2000 is currently generating 13 MW.
- Production drilling completed in 2003.





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Oserian power plant (2 MW)

- ❖ **Binary plant owned by Oserian Flower Farm**
- ❖ **Commissioned in July 2004**
- ❖ **Steam well leased from KenGen.**



Direct uses

- ❖ Greenhouse heating
 - Oserian Flower Company utilize both geothermal hot water and CO₂ from steam.
 - Initially 3 hectares but has been expanded to 30 hectares.
 - The company plans to lease more wells from KenGen for this purpose.



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Greenhouses (1)



Greenhouses (2)





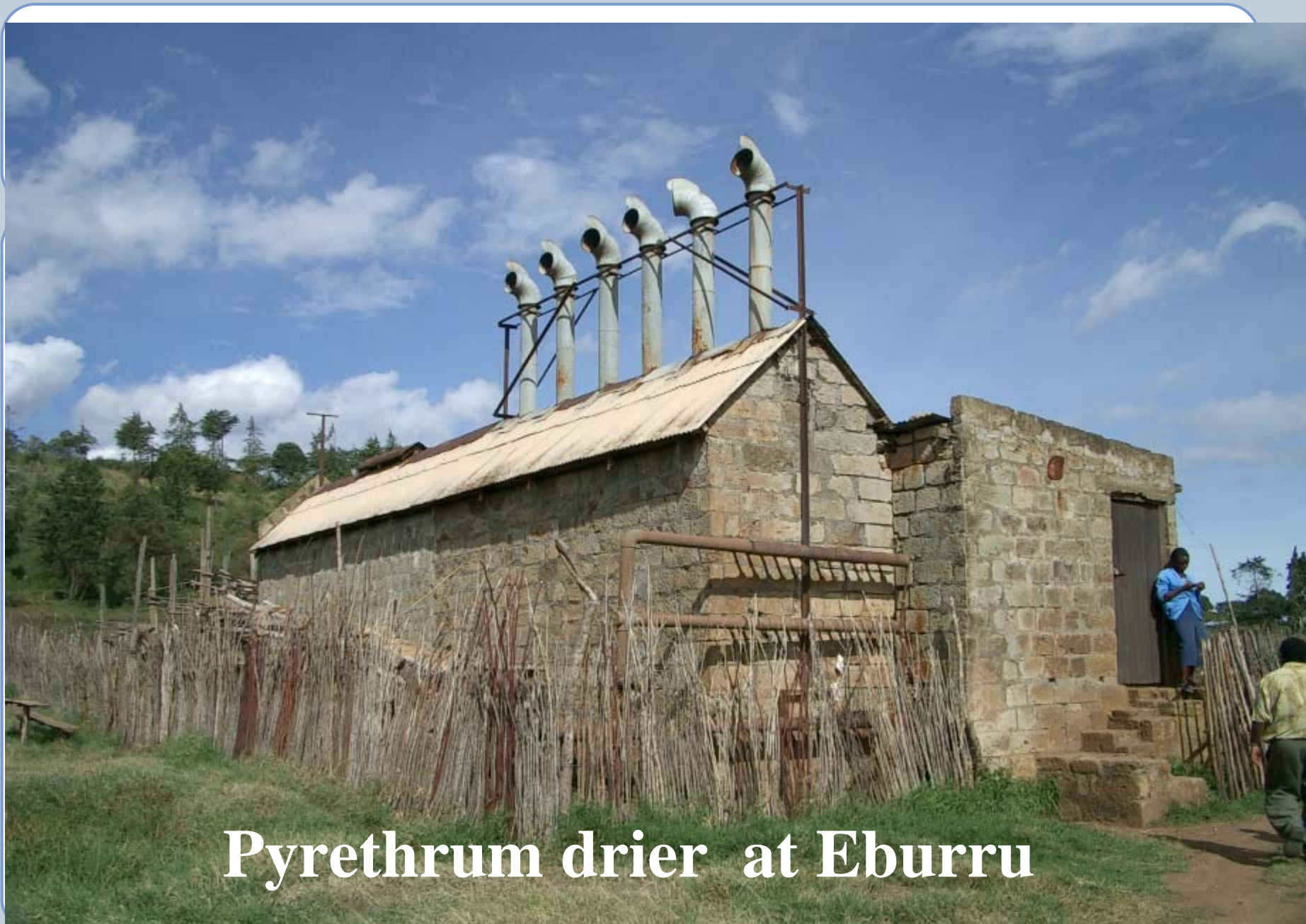
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Other minor direct uses

- b) Hot springs used to heat spas in tourist hotels for e.g. in L. Borogia hotel.
- c) The Local community at Eburru condense steam from fumarole for domestic purposes.
- d) At Eburru, geothermally heated driers used to dry pyrethrum flowers.



Water harvesting at Eburru



Pyrethrum drier at Eburru

Swimming pool at L. Bogoria



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Future developments



- ❖ Geothermal power development has been hampered by lack of funds.
- ❖ GoK has proposed creation of a Geothermal Development Company (GDC) to:
 - Explore and develop geothermal energy for electricity generation and other uses.
 - Remove risk of field exploration from interested developers

Future plans - 1



Planned power additions between 2006 –
2026: **2330 MW**

Geothermal	Hydro	Thermal	Imports
576	224	1080	450
24.7%	9.6%	46.4%	19.3%

Future plans - 2



Planned power additions in the next 5 years: **830 MW**

Geothermal	Hydro	Thermal	Wind	Imports
143.5	120	630.2	30	100
14%	11.7%	61.7%	2.9%	9.8%

Olkaria II Extension Project



- ❖ An IDA funded **optimization study** done in June/July 2005 to allow for generation expansion in the Olkaria I/II/IV geothermal fields.
- ❖ Conceptual Design of **Olkaria II Extension** by 35 MWe complete.
- ❖ Unit construction planned to be **commissioned in March 2008**.
- ❖ Funding – EIB, IDA and KenGen
 - EIB – 41M\$ (32.5MEuros)
 - IDA – 24 M\$
 - KenGen - 6.9 M\$

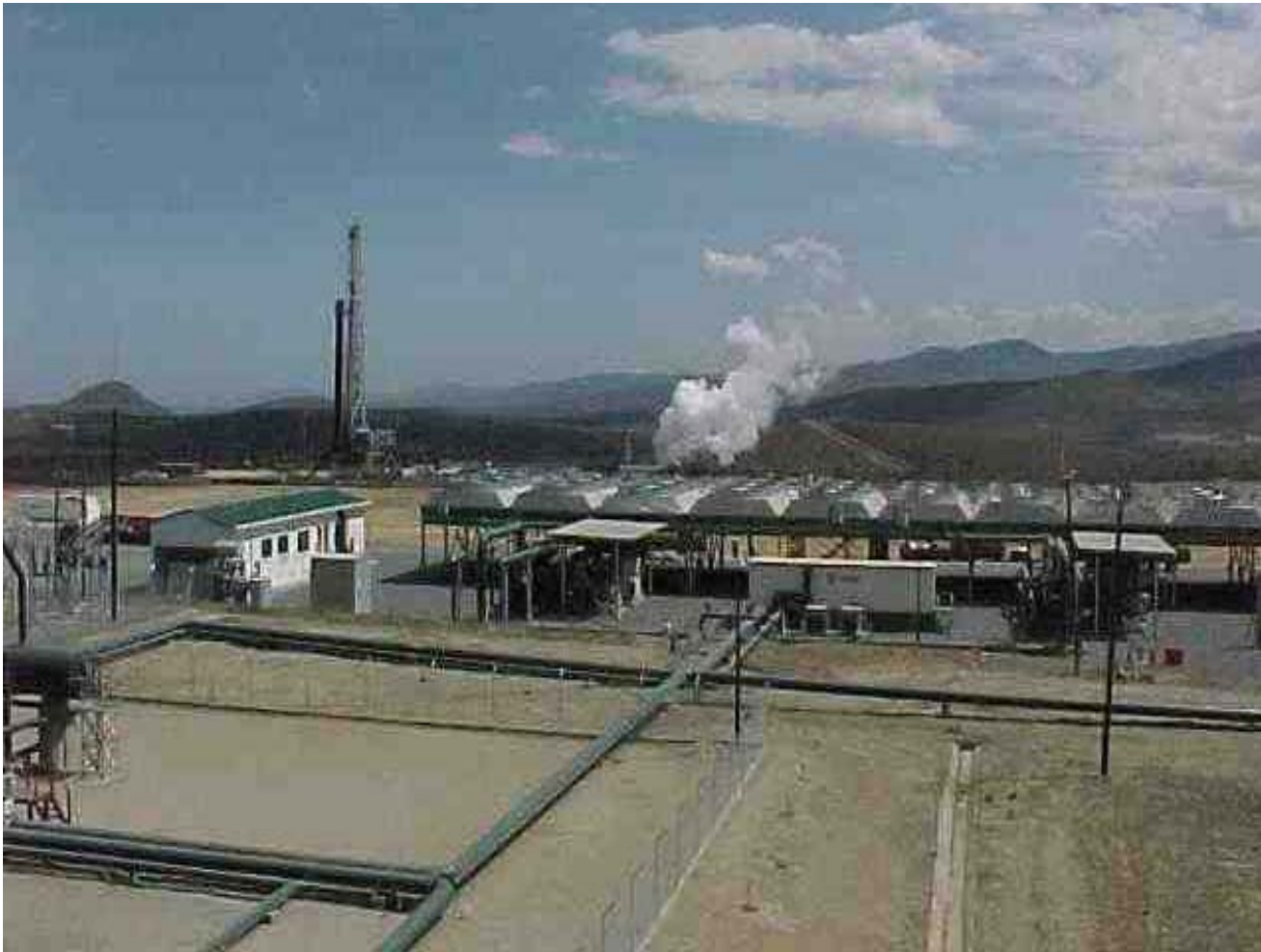


Olkaria IV

- ❖ Appraisal drilling of Olkaria - Domes field for Olkaria IV to start in October 2006 and commissioning of a 70 MW power plant in 2010 or earlier.

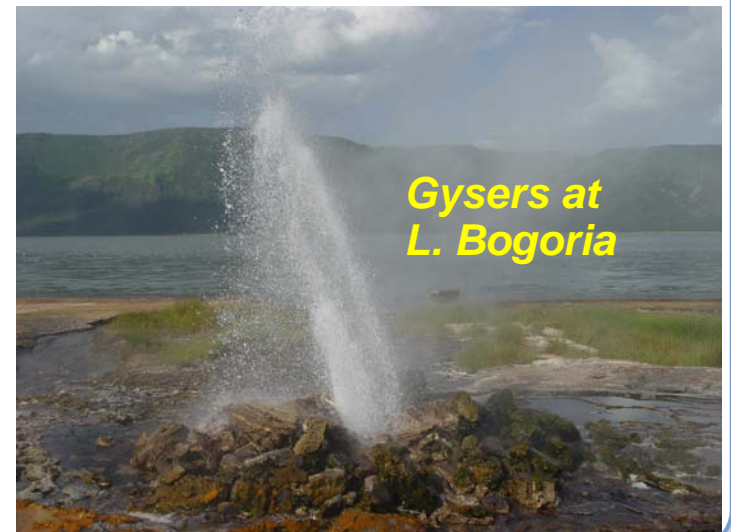


Olkaria III - Phase II



Other prospective areas

- ❖ Detailed surface exploration in:
 - Suswa (1993)
 - Longonot (1998)
 - Menengai–Olbanita (2004)
 - L. Baringo (2004)
 - Arus – L. Bogoria (2005)
 - Korosi - Chepchuk (2006)





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Other prospective areas (2)

- ❖ Surface studies to be complete by 2010
- ❖ Suswa, Longonot, Menengai, and Eburru, are high temp (285 - 300 °C) with low resistivity (10 -15 Ohm-m) and heat losses >3000 MWt at 1 m depth
- ❖ Arus, L. Bogoria & Baringo are low temp systems with estimated heat losses of 1000 – 1150 MWt at 1 m depth.





Other prospective areas (3) **KenGen**

- ❖ Estimated geothermal potential ~700 MW for Menengai, 200 MW (Longonot) and 25 MW (Eburru)
- ❖ Drilling lagging behind surface studies due to high costs
- ❖ GDC establishment is one strategy
- ❖ ARGeo initiative could be of assistance

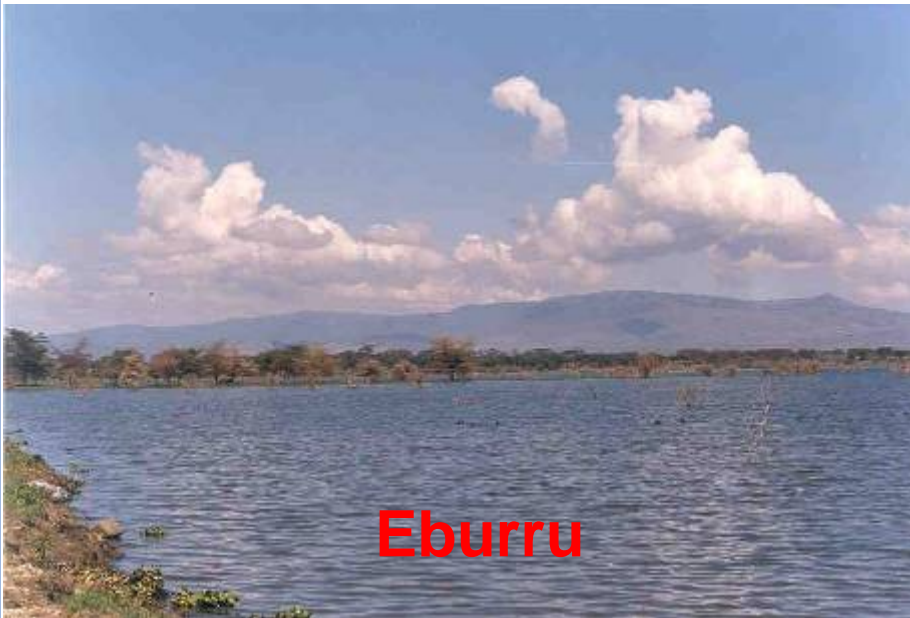


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Future plans

- ❖ Construct 2.5 MW Eburru plant and expand in future
- ❖ Continue with surface exploration
- ❖ Prioritise fields as they are explored
- ❖ Carry prioritisation of Menengai, Suswa and Longonot with BGR
- ❖ Critical is exploration drilling funding
- ❖ Targeting ARGeo funding
- ❖ Pilot plant if exploration strikes steam
- ❖ Carbon credits funding under Kyoto protocol

Eburru



Heating



Swimming pools





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Conclusions

- ❖ **Kenya rely on biomass as the primary source of energy.**
 - **Electricity accounts for 15%.**
 - **Hydropower dominates electrical sector (62%), followed by fossil fuel.**
- ❖ **Geothermal exploitation has been hampered by lack of funds**
- ❖ **Initiatives like ARGeo and other donor funding agencies augmented with local funding can accelerate geothermal exploitation.**



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Conclusions (2)

- ❖ In Kenya, creation of GDC will accelerate geothermal development
- ❖ Due to the changing weather patterns, geothermal power is the way to go for countries with the potential
- ❖ Kenya plans to generate additional 576 MW from geothermal sources by 2026.

A group of approximately 20 people are swimming in a large, light blue geothermal pool. The water is calm and reflects the overcast sky. In the background, there are dark, rocky hills and a large plume of white steam rising from the left side. The overall atmosphere is serene and natural.

MUCHAS GRACIAS

ASANTE SANA