

THE DIRECT USE OF GEOTHERMAL ENERGY IN NON-UTILITY

**SMALL SCALE AGRICULTURAL AND INDUSTRIAL
USES SUPPORTING RURAL ELECTRIFICATION AND
ECONOMIC GROWTH**



KENYA AT A GLANCE

ECONOMIC ACTIVITIES





DIRECT USE STATUS AND POTENTIAL

Example: Eburru

Water harvesting
from fumaroles



Example: Lake Bogoria Prospect



Prospect to be developed into a key touristic attraction



Touristic Activities

Promote tourism



Hot bath/spa



Golf courses



Hotels - heated Swimming Pools⁶

Example: Oserian Green houses

i) Cut Roses Green house Heating ~50 hectares, ii) Refrigeration of cut flowers storage and processing stores, iii) Injection of CO₂ to aid in photosynthesis, iv) Fumigation of soils and sterilization of liquid recycled plant fertilizers





OUR DREAM

Promote Greenhouse Farming

➤ Provide water for irrigation



Fish Farming



Dairy Farming



Improved pasture land



Milk Processing

Provide heat for milk products processing



Community Slaughterhouses



Provide water & heat for meat processing



Treatment of Hides & Skins



Mining Industry

Supply power for industrial use

Cement Factories



Diatomite Mining

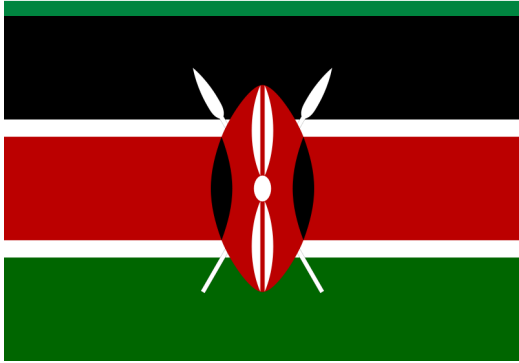


Soda Ash processing



Fluorspar Mining





EXPECTED IMPACT

Livestock Support

Electrical Capacity (MW)	Available Water		Acreage Irrigated (Ha)	No. of Cows supported	Total No. of Cows if Condensate & Brine are utilised
	Ton/Hr	Ton/Day			
100	800	19,200	6,400	51,200	102,400
1,000	8,000	192,000	64,000	512,000	1,024,000
2,000	16,000	384,000	128,000	1,024,000	2,048,000
5,000	40,000	960,000	320,000	2,560,000	5,120,000

Note

1 MW of electricity produces 8ton/hour of condensate and 8ton/hour of brine

3tons/day of water required for irrigation of 1 ha. of pastureland

8 cows supported from 1hactere of pastureland

Employment Opportunities

Electrical Capacity (MW)	No. of Employees (Power Plant)			Available Water (Ton/h)	Water (Ton /day)	Acreage for irrigation	No. of Employees	Total Employment (Generation & Irrigation)
	Direct	Indirect	Total					
100	100	100	200	800	19,200	1,920	57,600	57,800
1,000	1,000	1,000	2,000	8,000	192,000	19,200	576,000	578,000
2,000	2,000	2,000	4,000	16,000	384,000	38,400	1,152,000	1,156,000
5,000	5,000	5,000	10,000	40,000	960,000	96,000	2,880,000	2,890,000

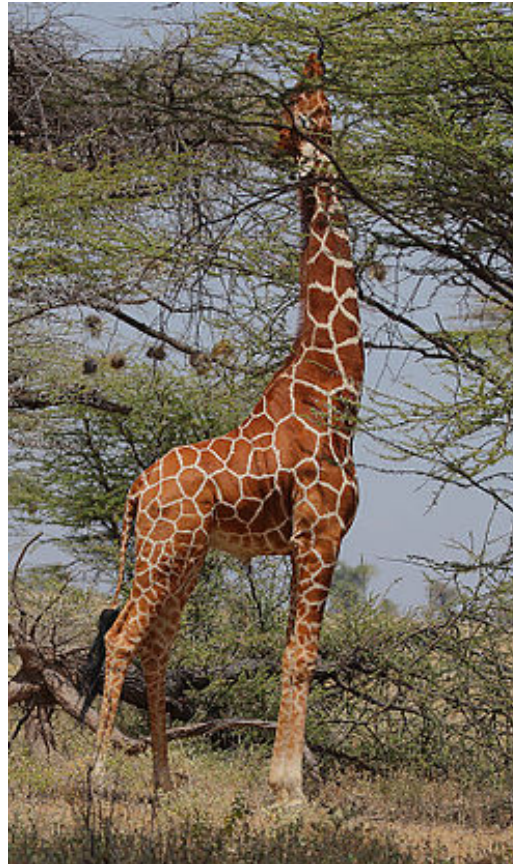
Note:

World Average - 1 MW/employee and 1 support staff for Power Plant Operation

8 tonnes/hour available from 1 MW generation

10 tonnes/day for irrigation of 1 hectare

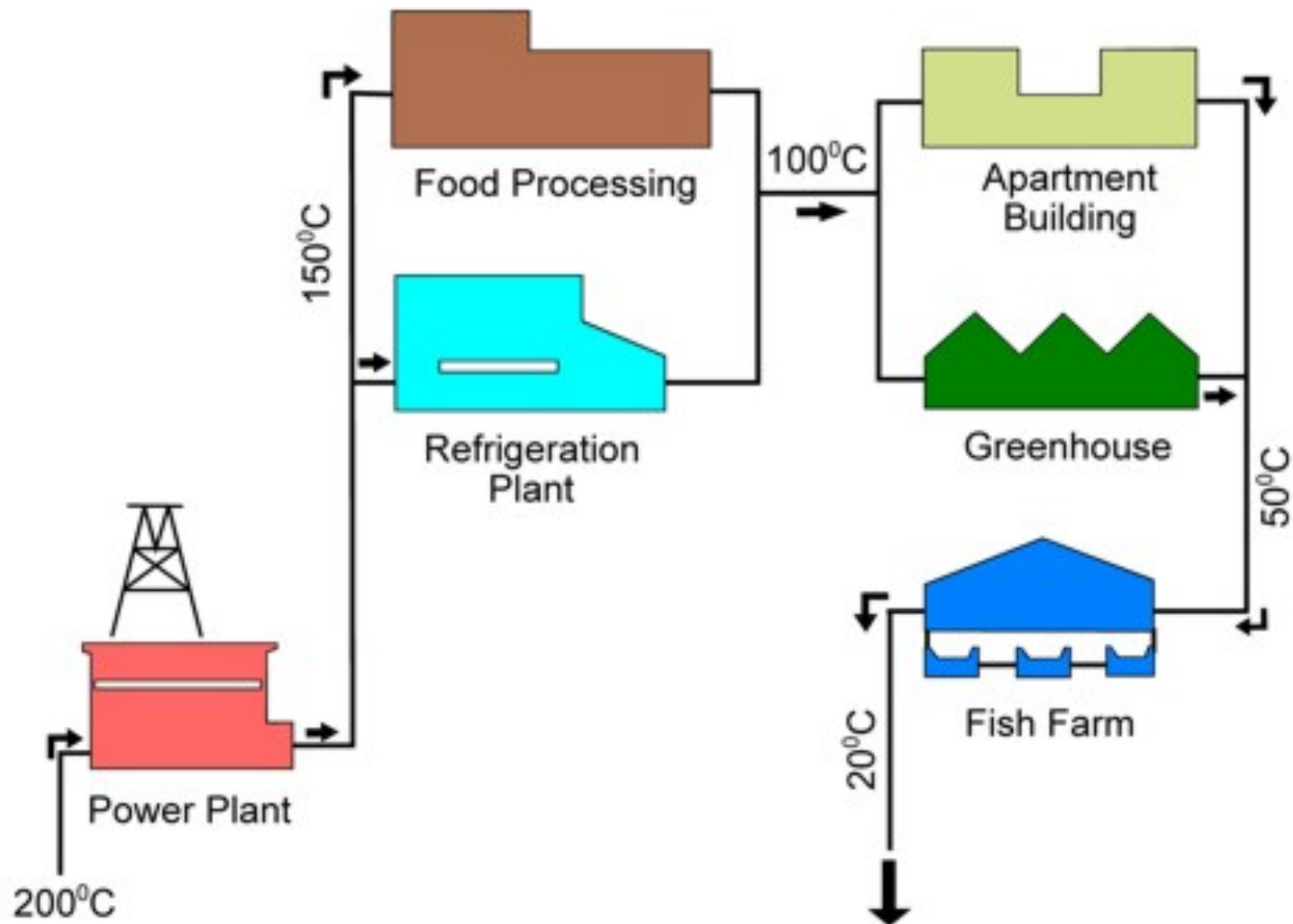
30 employees required for 1 hectare of irrigated farm



FUTURE OUTLOOK

INTEGRATED GEOTHERMAL DEVELOPMENT

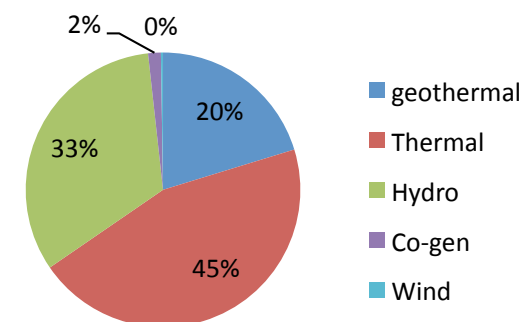
GDC WILL WORK WITH INDUSTRIALIST, FARMERS AND HOSPITALITY INDUSTRIES



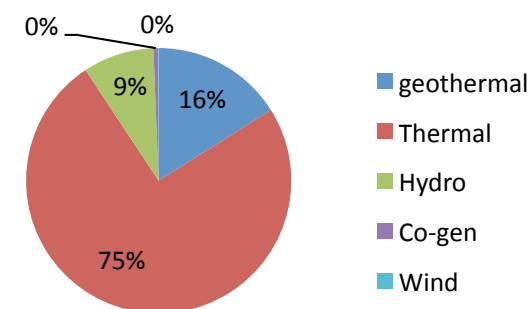
COMPARISON WITH 2010 ELECTRICITY DATA

	Energy Bought (GWh)	Cost of Power Bought (Kshs-million)	Unit Cost Kshs	Unit Cost (US \$)	% OF Power Bought	% of cost of power bought
Orpower 4	400,	2,737	6.84	0.0855	6%	4.80%
Aggreko	1,070	16,773	15.68	0.19	16%	29.40%
Tsavo	495	6,327	12.78	0.16	7%	11.09%
Mumias	99	332	3.35	0.04	1%	0.58%
Rabai	318	4,347	13.67	0.17	5%	7.62%
Ibera Africa	621	8,527	13.73	0.17	9%	14.95%
Kengen hydro	2,170	4,939	2.28	0.03	33%	8.66%
kenGen Thermal	481	6,605	13.73	0.17	7%	11.58%
Kengen geothermal	939	6,425	6.84	0.08	14%	11.26%

Electricity Bought by KPLC - 2010



Cost of Electricity bought by KPLC -2010



KenGen prices are estimated

OVERVIEW OF THE SUPPLY SYSTEM

SUMMARY – SYSTEM CHARACTERISTIC

Hydro dominated – **Prone to adverse weather**

Significant Thermal – **expensive**

In adequate capacity

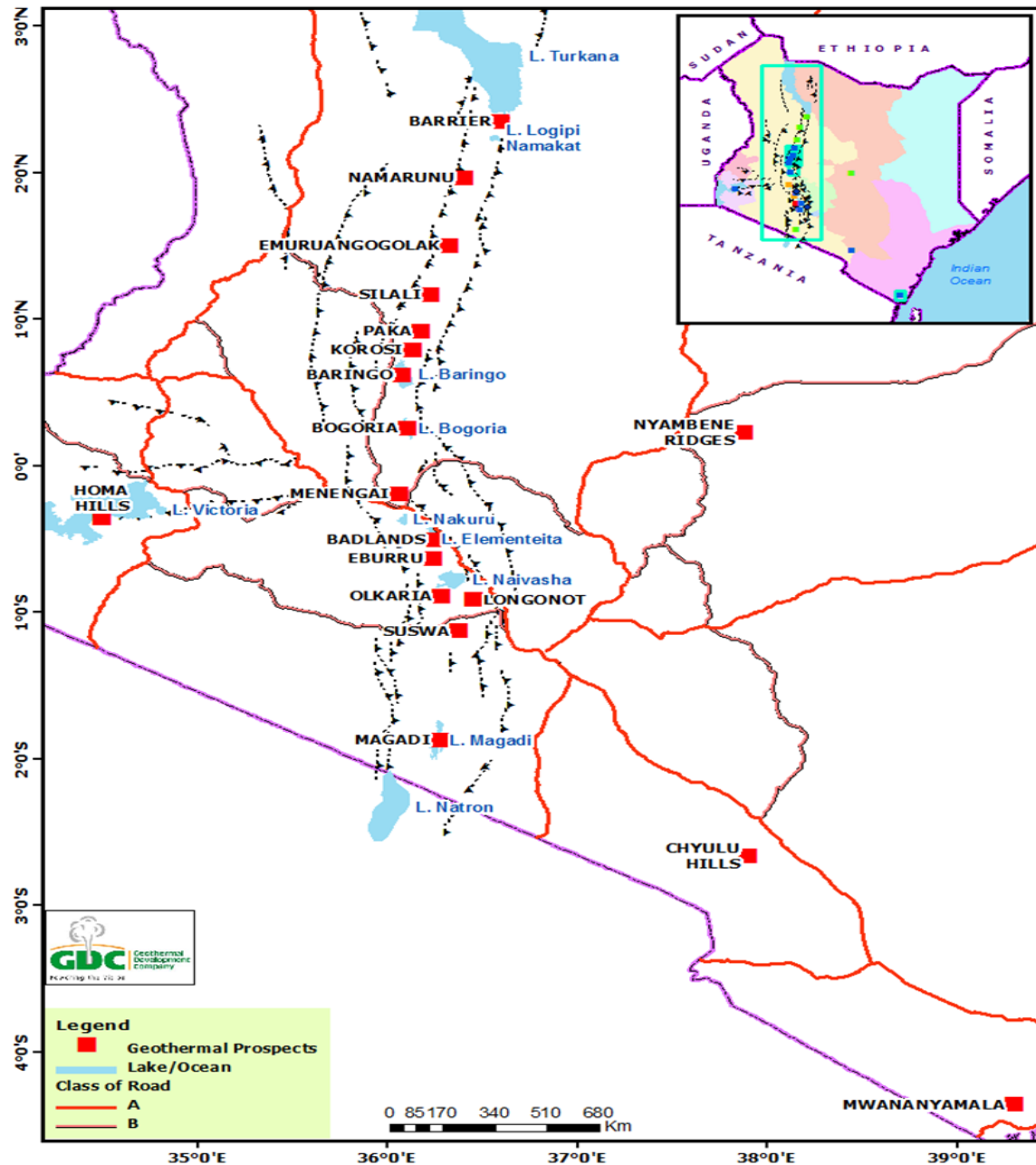
Poor mix

Traditional base load – **exceeded by Demand**

Expensive thermals being run as base load

Geothermal has highest availability

LOCATION OF RESOURCES IN KENYA



Estimated potential

7,000 – 10,000 MWe

- ✓ Suswa,
- ✓ Longonot,
- ✓ Olkaria,
- ✓ Eburru,
- ✓ Menengai,
- ✓ Arus-Bogoria,
- ✓ Lake Baringo,
- ✓ Korosi,
- ✓ Paka,
- ✓ Lake Magadi,
- ✓ Badlands,
- ✓ Silali,
- ✓ Emuruangogolak,
- ✓ Namarunu
- ✓ Barrier
- ✓ Mwananyamala
- ✓ Homa Hills
- ✓ Nyambene Ridges
- ✓ Chyulu Hills

STATUS OF GEOTHERMAL DEVELOPMENT



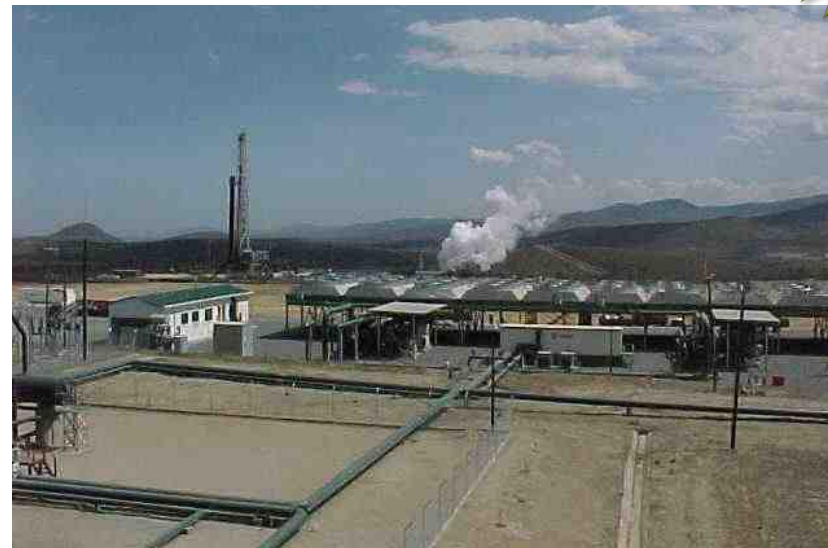
45MWe Olkaria I Power station



105 MWe Olkaria II Power station

PLANT	
OLKARIA I (3 UNITS X 15 MW)	45 MW
OLKARIA II (3 UNITS X 35 MW)	105 MW
OLKARIA III	55 MW * (48 MW)
OSERIAN (TWO UNITS)	4 MW
EBURRU	2.5 MW
OLKARIA (WELLHEAD)	5 MW

**212.5
MW**



55 MWe Olkaria III Power station

VISION 2030 & GEOTHERMAL VISION

Vision 2030

- ❖ The Vision 2030 envisages a GDP growth rate of 10% starting 2012. Electricity demand to grow in tandem.



Least Cost Power Development Plan (LCPDP)

- ❖ Projected electricity demand of more than 15,000 MW by 2030. It is expected that at least 5,000 MW of geothermal generation to partly meet this demand

SUCCESS FACTORS



US\$ 18 BILLION



- 12 RIGS MINIMUM
 - ASSUMES 5 MW WELLS
 - 70 DAYS DRILLING
 - ABOUT 85% SUCCESS RATE



**250 MW AVERAGE ANNUAL
INSTALLATION**

JUSTIFICATION FOR RIG PURCHASE



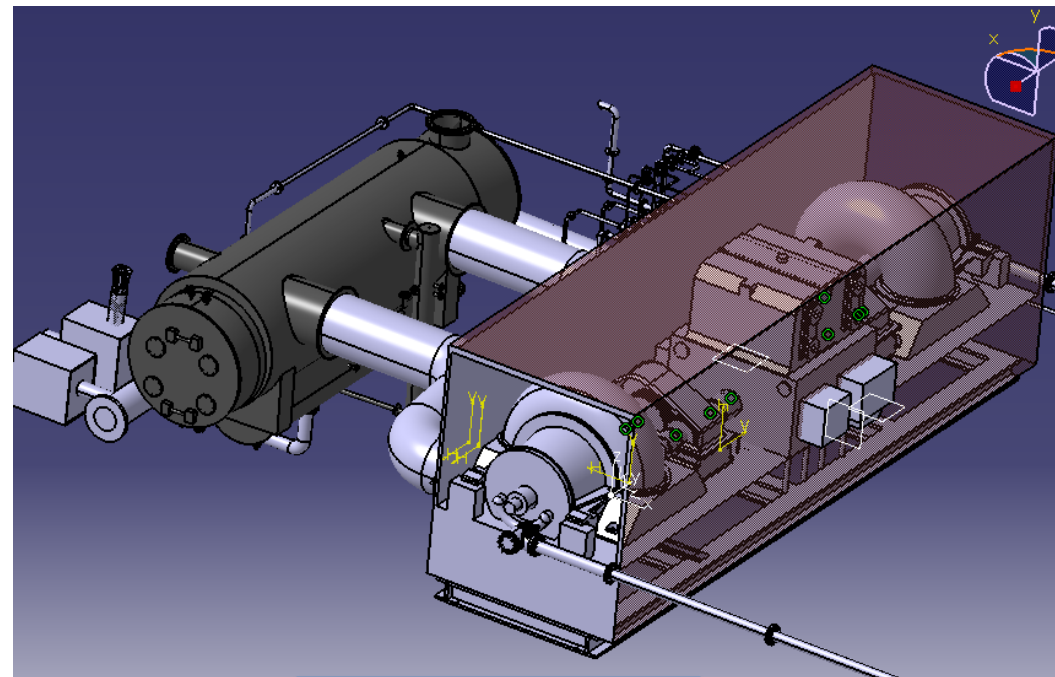
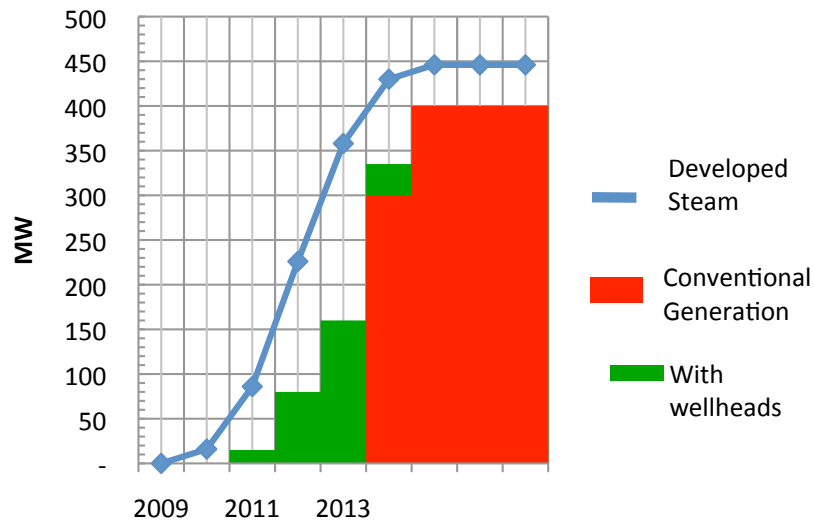
	No. of Rigs	Total No. of Wells	Total cost (MUSD)		Difference	% Savings
			Hired Rigs	GDC Rigs		
Ten Year Period	7	341	2,217	1,194	1,023	46%
	12	587	3,816	2,055	1,761	46%
Twenty Year Period	7	691	4,492	2,419	2,073	46%
	12	1,130	7,345	3,955	3,390	46%
<u>NB</u>						
Drilling by GDC Rigs(MUSD)			3.5			
Drilling by Hired Rigs (MUSD)			6.5			

REASONS

- Air freighting of expatriates
- Expatriates per diem
- Contractor profit \approx 15 – 30 % (factoring country risk etc.)
- Tax \approx 20% withholding tax + 16 % VAT on drilling services

GDC WILL ENGAGE INVESTORS WHO WILL INSTALL WELLHEAD UNITS FOR EARLY GENERATION

Generation inclusive of wellheads



Characteristics

Importance

- Provide power shortly after drilling
- **They are cheaper than conventional power plants**
- Provide revenue early
- Improve the profitability of a project

- Typical Sizes – **5-10 MW**
- **Containerized - portable**
- Mounted on the well
- Take **9 months** to manufacture ship and install
- Cost **US\$ 1.5 million /MW(Kshs 120 million)**

Financial Requirements

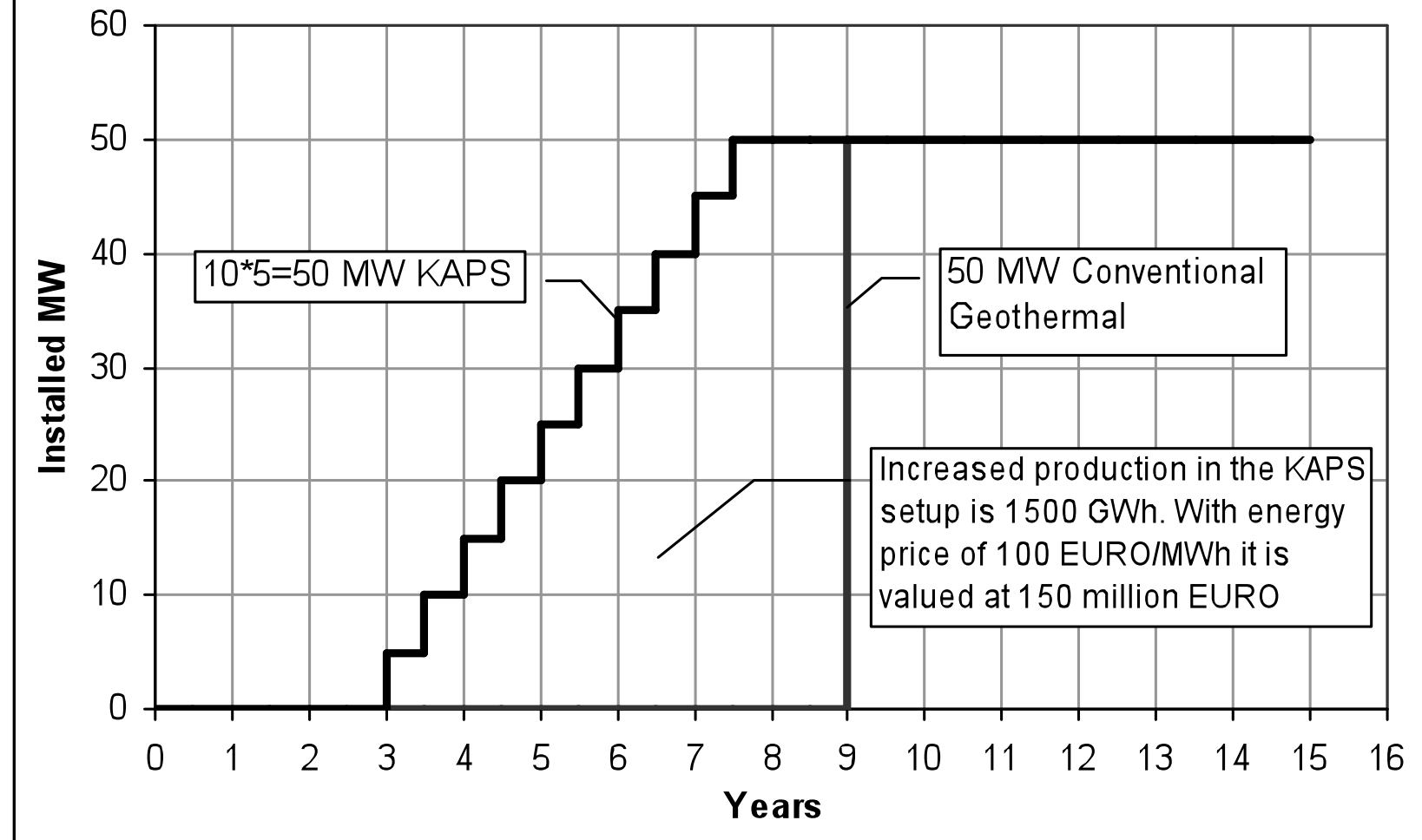
GOVERNMENT AND DONORS TO RAISE IUS\$ 2.7 BILLION FOR STEAM DEVELOPMENT

Description	Financing(MUSD)			Total
	GoK	GDC (Net Revenue	Development Partners	
Rigs & Equipment	130	177	205	512
Drilling Works	264.3	1,184	394	1,842
Scientific Services	25.3	58		83
Staff & Admin Costs	28.4	102		130
Total(MUSD)	448	1,520	599	2,567
% of Total	17%	59%	23%	100%

IPP TO RAISE US\$ 6 BILLION FOR POWER PLANTS

EARLY GENERATION VERSUS CONVENTIONAL

Comparing 10*5=50 MW KAPS and 50 MW Conventional Geothermal



SOURCE : KALDARA



**ARE WE GETTING
THERE?**

SCORE CARD -FINANCIAL MOBILIZATION

FINANCIER CATEGORY	FINANCIER	280 MW OLKARIA I & IV (WELHEAD INCLUSIVE)	36 MW OLKARIA III	400 MW MENENGAJ (WELHEAD INCLUSIVE)	TOTAL
PUBLIC	GOK	288		379	667
	KENGEN	140			140
DEVELOPMENT	JICA	323			323
	AFD	210		170	380
	AFDB			120	120
	WORLD BANK	120		102	222
	EIB	168		36	204
	CHINA EXIM	95.4			95.4
	KFW	95.6			95.6
	SREP			40	40
IPP	ORPOWER		130	26	156
	OTHERS			1000	1000
		1440	130	1873	3443

SCORE CARD – RIGS



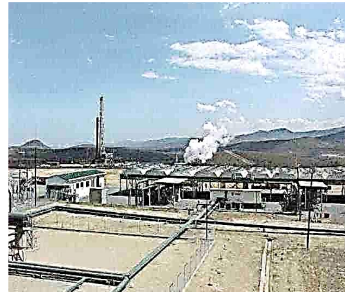
	2009/ 10	2010 /11	2011 /12	2012/ 13	2013 /14	2014/1 5	
GDC - HIRED	3	3	3	(3?)	(3?)	(3?)	Operating
GDC- OWNED		2	4	6	8?	8?	GDC – 2 rigs at Site TWO DELIVERY BY MID – JUNE 2012, ADDITIONAL 2 BY APRIL 2013
KENGEN - HIRED		1					DRILLED 2 WELLS
KENGEN OWNED		1	3	3	3	3	ONE OLD, TWO NEW
IPP							
Cumulative	3	7	10	9 (12?)	11 (14?)	11 (14?)	

SCORE CARD - STEAM

- **DISCOVERED NEW FIELD –
MENENGAI**
- **MENENGAI STEAM – 25 MWE**
- **OLKARIA I & IV – OVER 360 MW**
- **OLKARIA III – IPP - ?**



ONGOING GEOTHERMAL PROJECTS

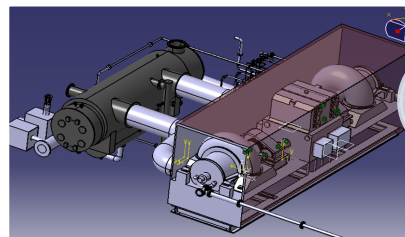


36
MW

Orpower 4
(2013/14)

KenGen
(2011-2013/14)

400
MW



410
MW

Menengai
(2014/16)

Bogoria – Silali block
(2018/19)

800
MW



**1650 MW
TO BE
REALISED
BY 2018/19**



***THANK
YOU***