# Olkaria III Geothermal power plant, Kenya

FEEM Seminar

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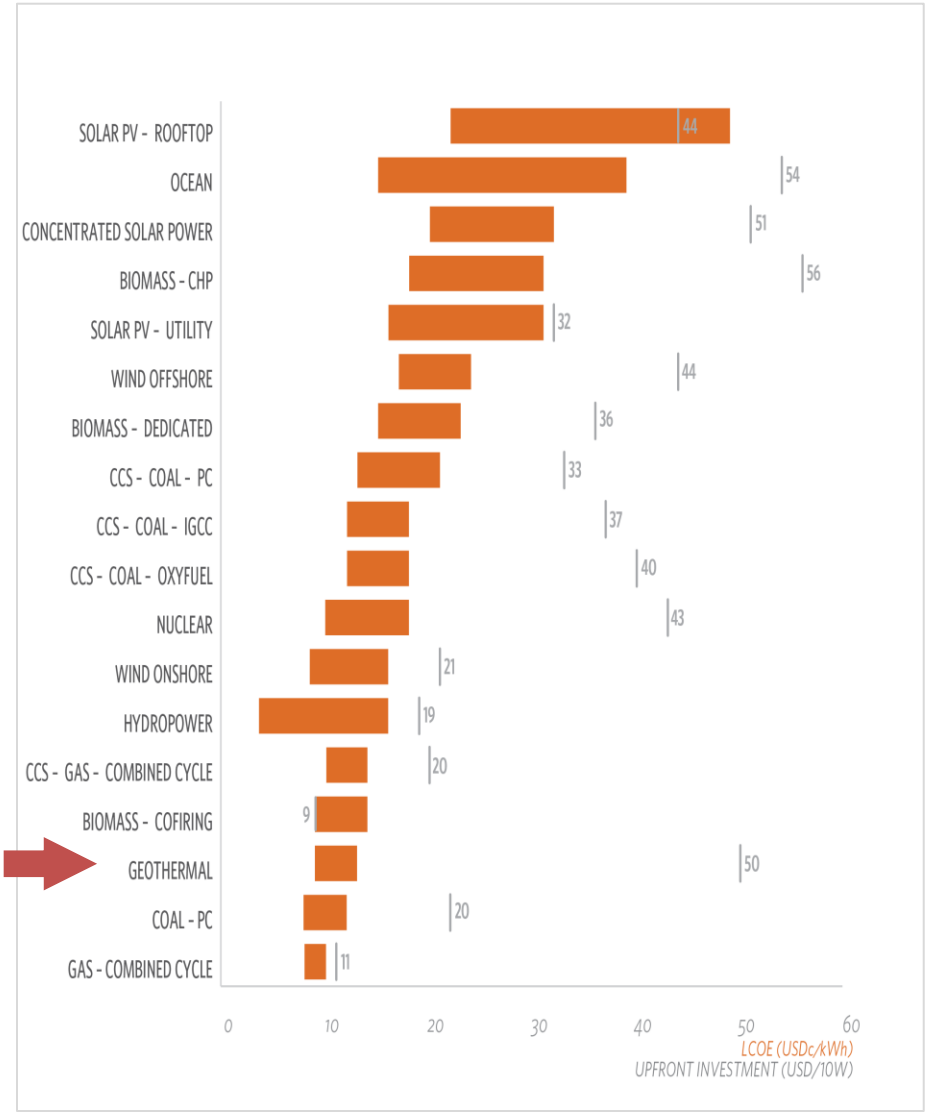
CLIMATE POLICY INITIATIVE

# Overview of presentation

- Global overview of geothermal energy
- Project background and finance
- Project's private returns, risk mitigation, and public benefits
- Scaling up geothermal in Kenya and East Africa
- Key takewaways

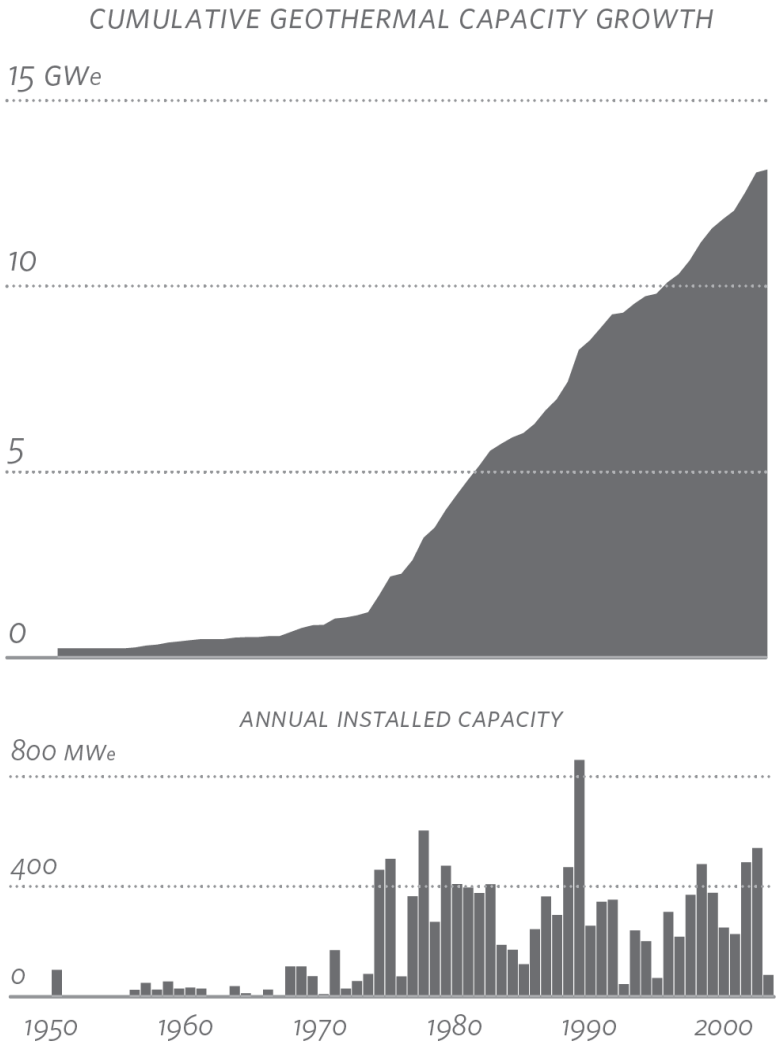
# Global overview of geothermal energy

# Benefits of geothermal




- Ability to provide the power grid with a **reliable** source of electricity
- A **low-cost** source of power in some countries
- A **low-carbon** source of power depending on the technology used and the nature of the geothermal resource

# Geothermal is not meeting its potential



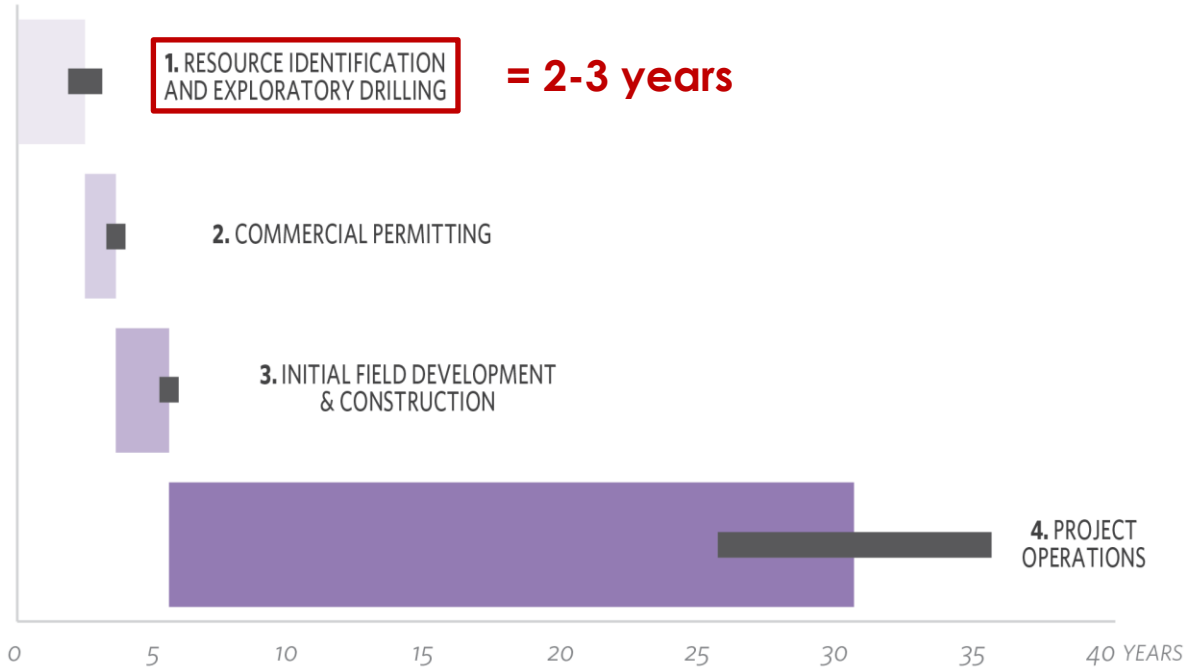

Rate of geothermal deployment **lower** than **deployment needs** and other **renewables**.

Wind and Solar now stand at **308** and **145 GW** capacity respectively Vs **13.5 GW** of geothermal power.



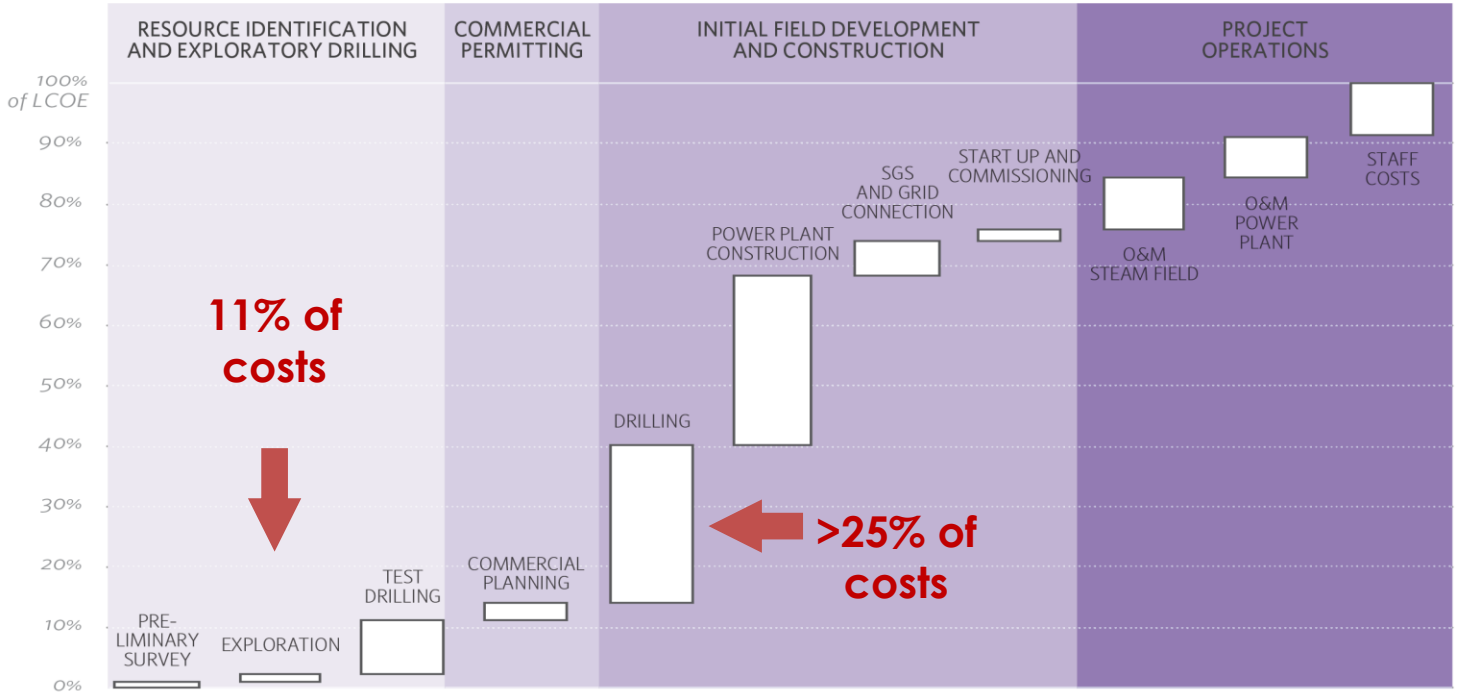
Olkaria III Geothermal power plant

# Development timeline longer than renewable alternatives




- Development of a geothermal project requires **5.5 years** on average.
- **2-3 years** of the development time is dedicated to **resource identification** and **exploratory drilling**

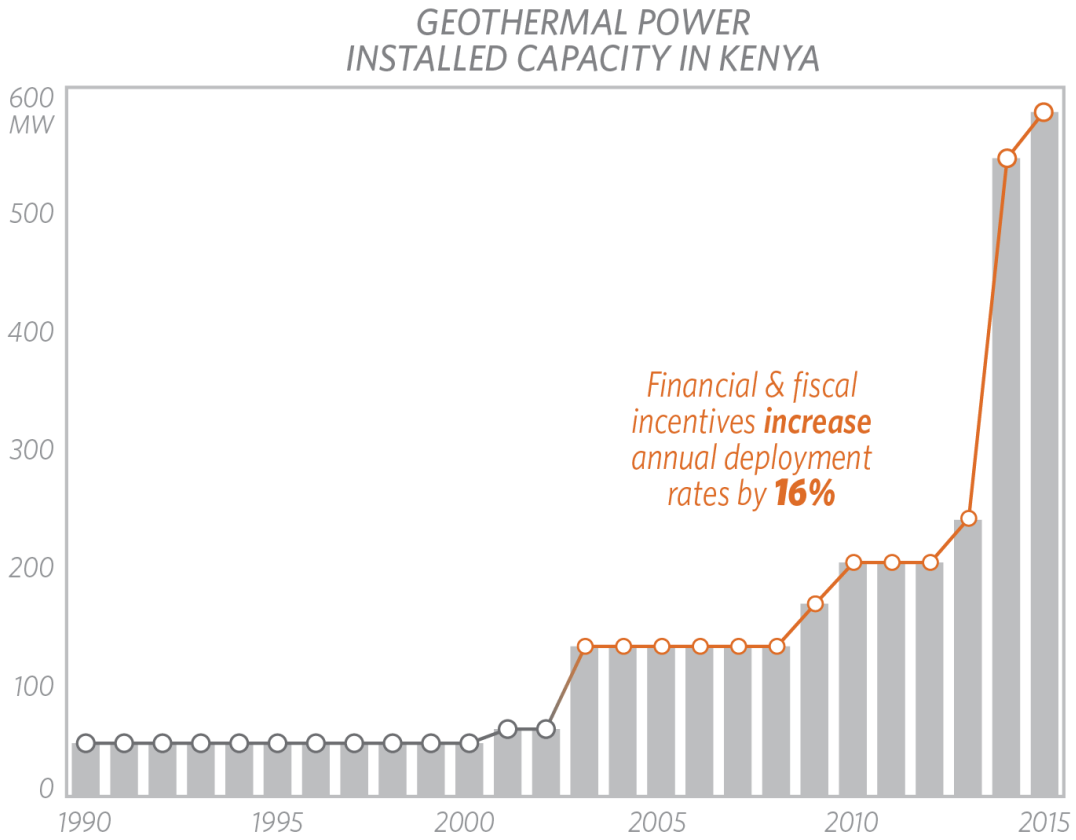
# Resource risks high during the exploration phase and still relevant in the development phase




| Avg. well success rates | 50-59% | | 74% | 83% |
|---|---|---|---|---|

# How Kenya has driven deployment

- Geothermal energy deployment **long been sluggish**
- Deployment rates increased following the introduction of **incentives**




*Note: Geothermal exploration started in the 1960s, while generation begun in the early 80s with the commissioning of the 45 MW Olkaria I plant.*

# Olkaria III - project background and finance

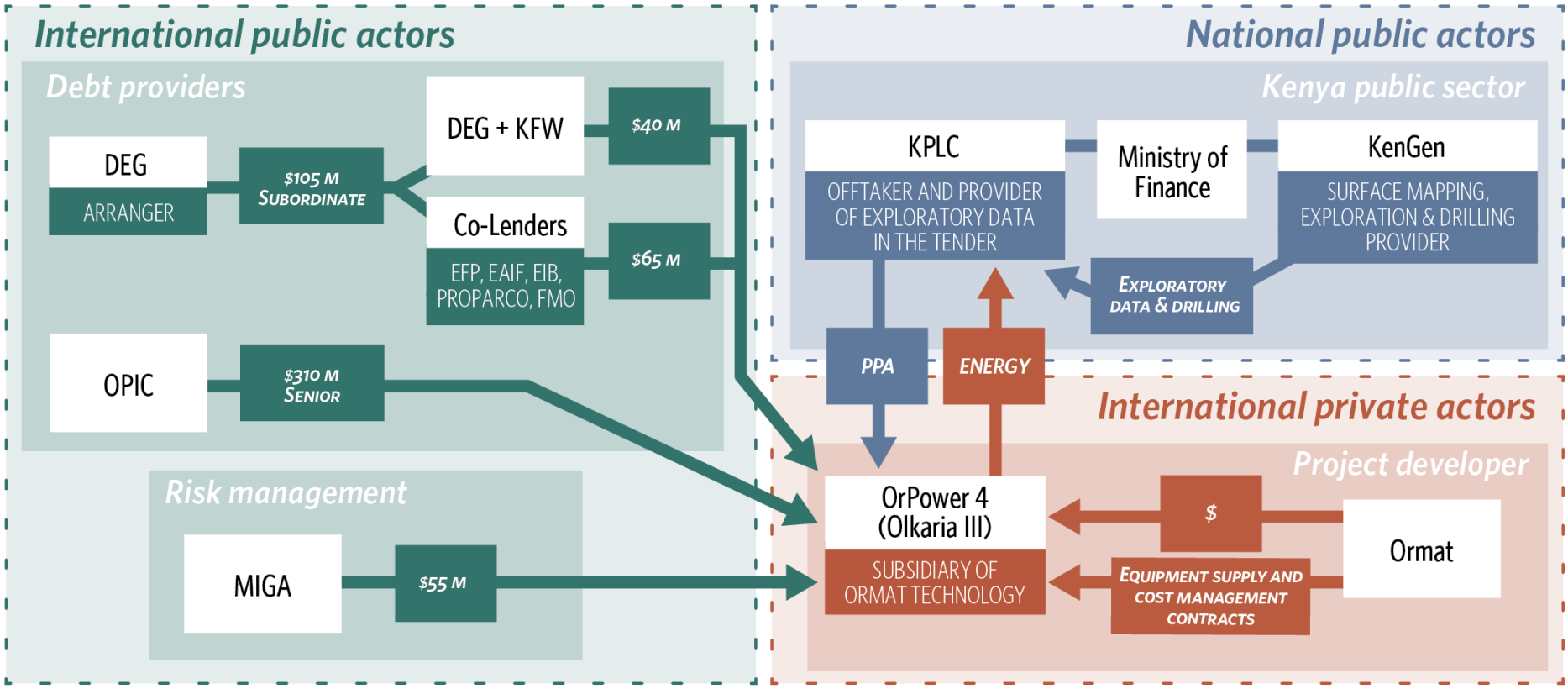
# Why Olkaria III?

- First and only **privately funded** and developed geothermal project in Africa
- Mix of private financing and **long-term public support** from DFIs and Government

Olkaria III Geothermal power plant

# Olkaria III stakeholders

***Mapping Olkaria III stakeholders and their contributions to the project***




*Source: Ormat Technologies (2014); OPIC (2011). Ormat operates the plant through its wholly owned subsidiary Orpower 4 Inc. More details on the stakeholders of the project can be found in Annex I of this paper.*

# Project took 16 years to reach full capacity

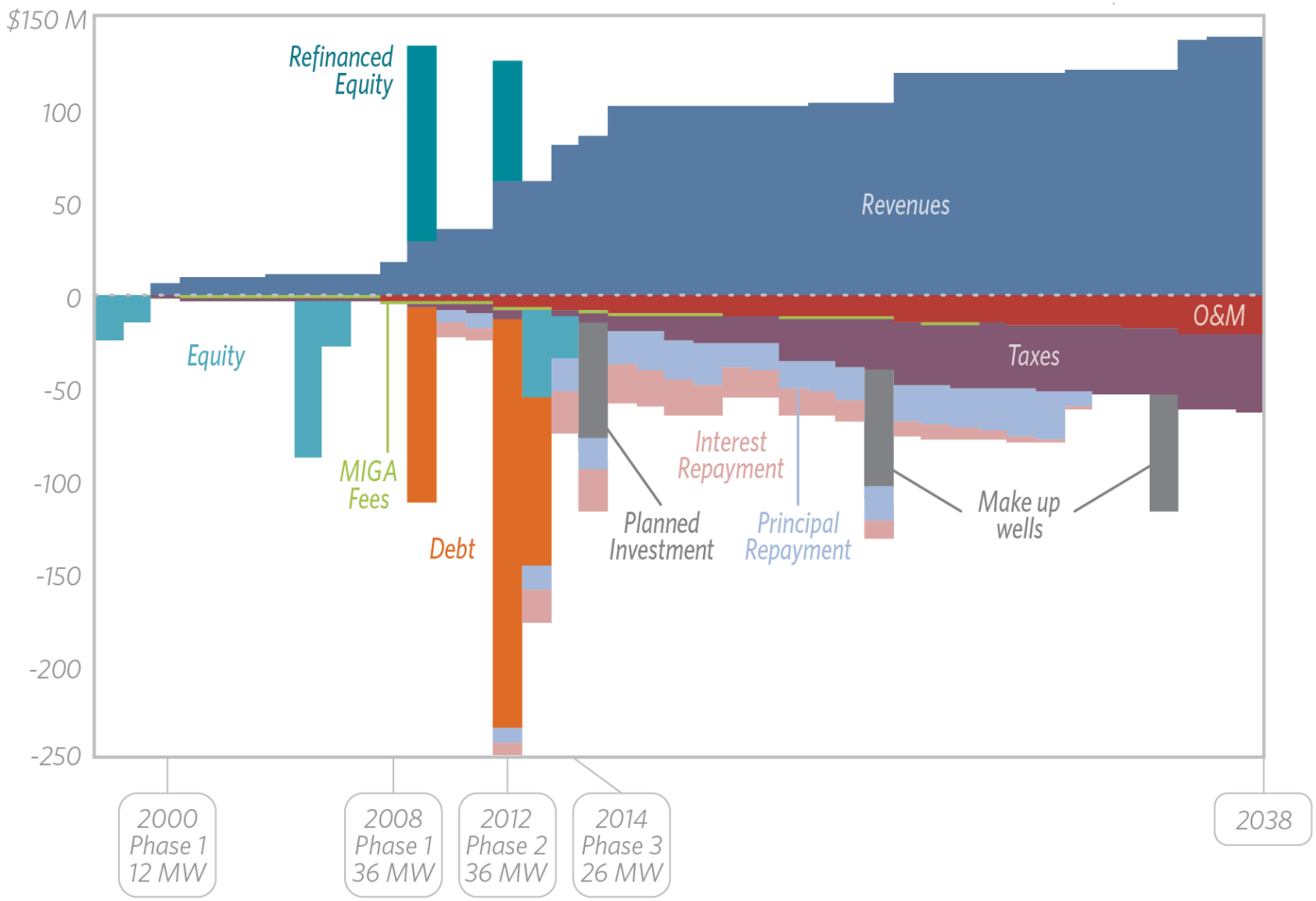
- Generation expanded in **three phases**
- Refinancing of equity and financing of subsequent project development **dependent on public guarantee**

| FINANCIAL SOURCES | | | | PHASE OF EXPANSION (MW ADDED) | | | | TOTAL FINANCIAL INPUTS | |
|---|---|---|---|---|---|---|---|---|---|
| ACTORS | TYPE | INSTRUMENT | YEARS DISBURSMENT | PHASE I | | PHASE II | PHASE III | FINANCE MOBILIZED | PROJECT COSTS (EXCLUDING REFINANCING) |
| | | | | 12 MW | +36 MW | +36 MW | +16 MW (OPTIMIZED TO 26 MW) | | |
| ORMAT | PRIVATE | EQUITY | 1998 - 2014 | 40 | 110 | 43 | 27 | **220** | **220** |
| DEG AND CO-LENDERS | PUBLIC | SENIOR (/ SUBORDI-NATED) LOAN (REFINANCING) | 2009 | 105 | | --- | --- | **105** | **---** |
| OPIC | PUBLIC | SENIOR LOAN (REFINANCING) | 2012 | 85 | | --- | --- | **85** | **---** |
| OPIC | PUBLIC | SENIOR LOAN | 2012 - 2013 | --- | | 180 | 45 | **225** | **225** |
| **TOTAL** | | | | | | | | **635** | **445** |

*Source: CPI elaborations*

# Olkaria III – private returns, risk mitigation and public benefits

# Returns for the Private Sector - Project Cash Flow




*Source: CPI elaboration. Planned investments for which financing structure is not known is here represented in grey.*

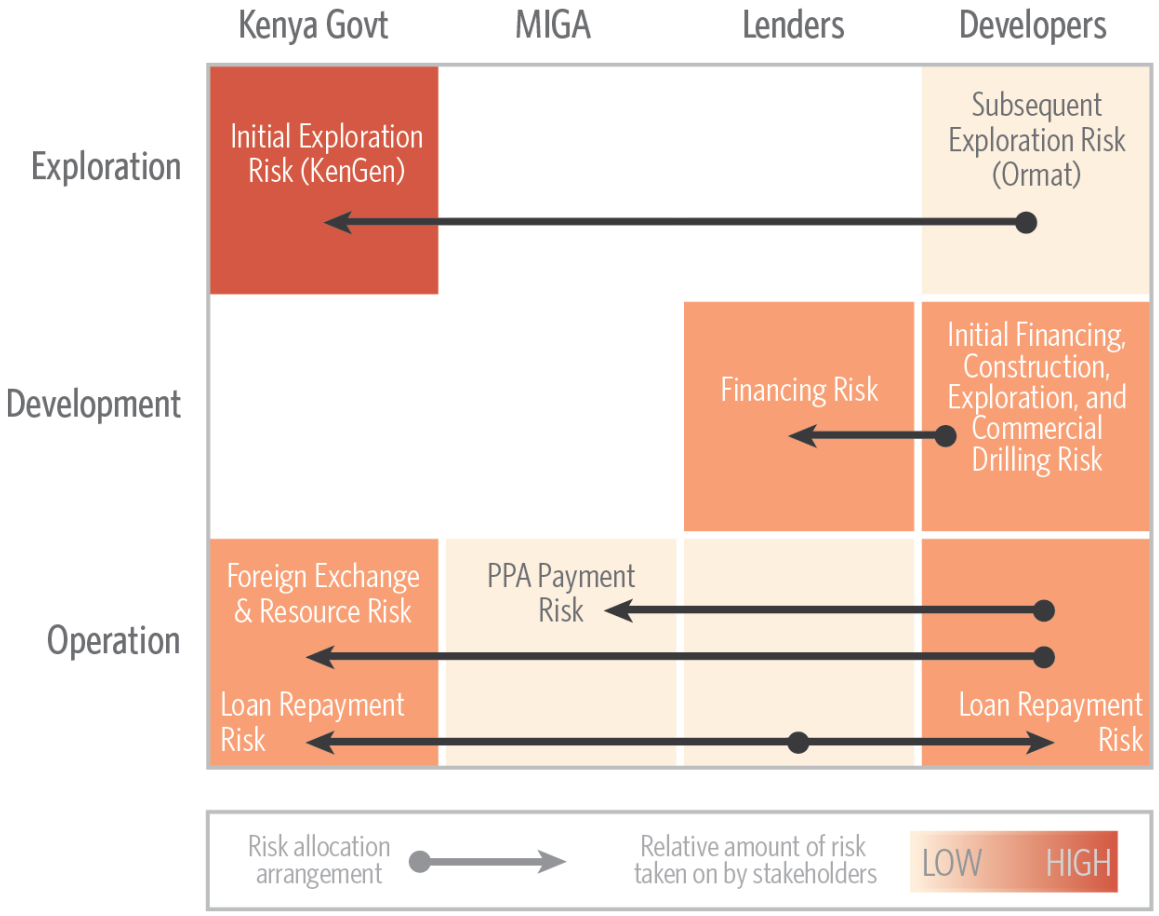
# Returns for the Private Sector – Public Financial support and Internal Rate of Return (IRR)

**16% IRR** meets investments expectations in the country, generally ranging from 15% to 23% for geothermal projects

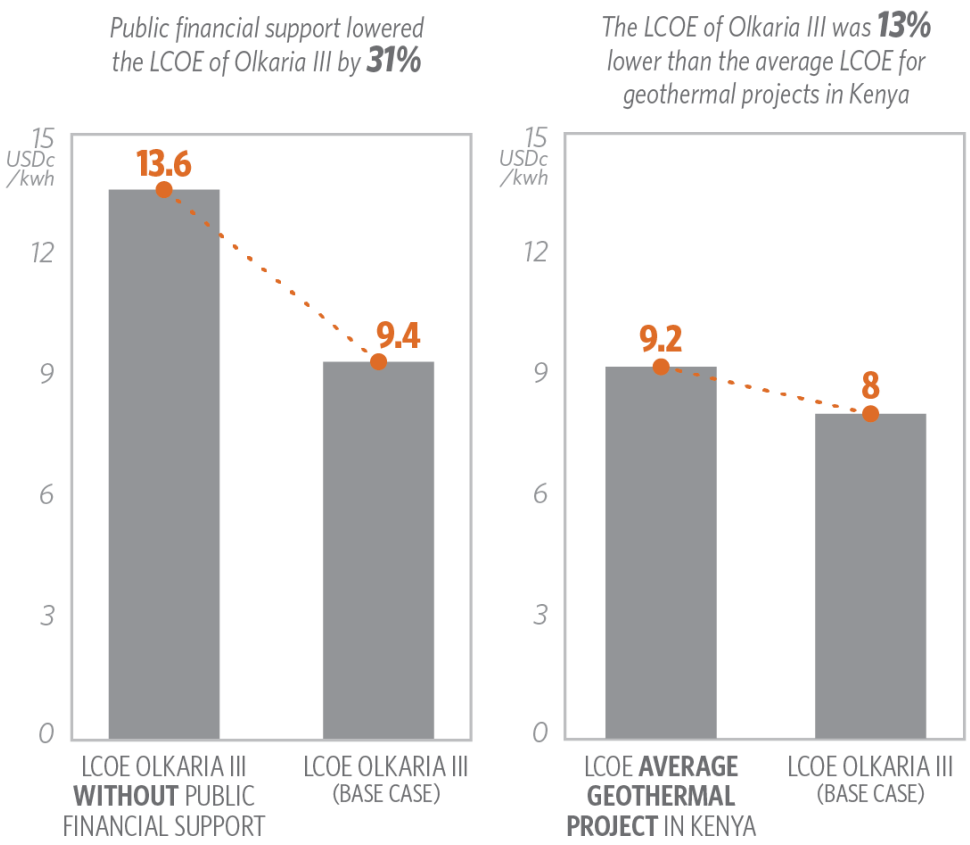
| EQUITY IRR | ENTIRE PROJECT (110 MW) |
|---|---|
| PROJECT CASE | 16% |
| W/O IN-KIND | 13% |
| W/O REFINANCING | 14% |
| W/O FAVORABLE COMMERCIAL TERMS OF THE LOANS | 12% |
| **W/O ANY OF THE ABOVE** | **10%** |

# Risk Allocation and Mitigation

In Olkaria III, the private party benefit from the **mitigation of credit risk and typical geothermal risk**, in particular exploration and early stage



# Outcomes for the Public Sector – Levelized Cost of Energy (LCOE) and electricity tariffs




**Electricity cost** per kwh from **USDc 18** to **USDc 14** in FY 2016

48% reductions in **electricity bill**

Olkaria III is contributing to meet **growing energy demand**, **lowering end-user tariffs**, while **improving the reliability** of Kenya's power system.

# Scaling up geothermal in Kenya and East Africa



Olkaria III Geothermal power plant

# New models for developing geothermal in Kenya are emerging

Olkaria III was the first project to demonstrate a **private-led geothermal development model**

## Geothermal Development Company

With the creation of **GDC** (2008), a company dedicated to geothermal exploration and drilling for steam, the GoK has encouraged private investment by **assuming the upfront risks associated with resource assessment**.



Olkaria III Geothermal power plant

# New models for developing geothermal in Kenya are emerging

Project implementation and steam supply agreement (PISSA) and joint development agreements (JDA) are increasing private involvement

| POWER PLANTS | YEARS COMMISSIONED | PRELIMINARY SURVEY | EXPLORATION | TEST DRILLING | FIELD DEVELOPMENT | POWER PLANT CONSTRUCTION | O&M | TECHNOLOGY |
|---|---|---|---|---|---|---|---|---|
| OLKARIA I & II (45 & 105 MW) | 1981-2010 | | | | | | | FLASH STEAM |
| **OLKARIA III (110 MW)** | 2000-'14 | | | | KENGEN 8MW/110MW | | | BINARY |
| OLKARIA IV (140 MW) | 2014 | | | | | | | FLASH STEAM |
| OLKARIA I (UNIT 4 & 5) (140 MW) | 2015-'17 | | | | | | | WELL HEAD |
| MENENGAI PHASE I (105 MW) | 2015-'17 | ← GDC → | | | | PISSA - PRIVATE DEVELOPERS (35 MW EACH) | | WELL HEAD |
| EBURRU (200 MW) | 2010 | | | | | | | FLASH STEAM |
| ARUS-BOGORIA (200 MW) | TBD | | | | | | | N.A. |
| BARINGO-SILALI (200 MW) | 2017 | ← GDC → | | | JOINT DEVELOPMENT AGREEMENT | | | FLASH STEAM* |
| SUSWA (150 MW) | 2016 | | | | JOINT DEVELOPMENT AGREEMENT | | | FLASH STEAM* |
| LONGONOT (140 MW) | 2017-2019 | KENGEN/GDC | GRMF GRANT | | | | | FLASH STEAM (TBC) |
| AKIIRA (70 MW PHASE 1) | 2017 | | GRMF & OPIC GRANT | | | | | FLASH STEAM |

PUBLIC SECTOR
PRIVATE SECTOR

# What are the benefits of involving private sector in scaling up geothermal?

- Private involvement in geothermal development is **accelerating deployment**
- Private involvement in geothermal development and **construction has the potential to reduce the cost of electricity**
- The success of Olkaria III was also down to **other factors not found in all East African countries** (skills in-country, etc.)

# Key takeways

# Key takeways

1

**Public support** from the Government of Kenya and financing from DFIs, combined with a multi-stage approach for project development, enabled to achieve **positive outcomes**.

2

To ensure project viability the project also benefited from a **set of risk mitigation solutions** particularly for exploration and credit risk.

3

The 20-years PPA contract enabled project developer to obtain **stable and predictable returns** while **addressing risks** related to the operational phase of the project.

Thank you!

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# Back-up slides

# Selection of projects – criteria and short-list

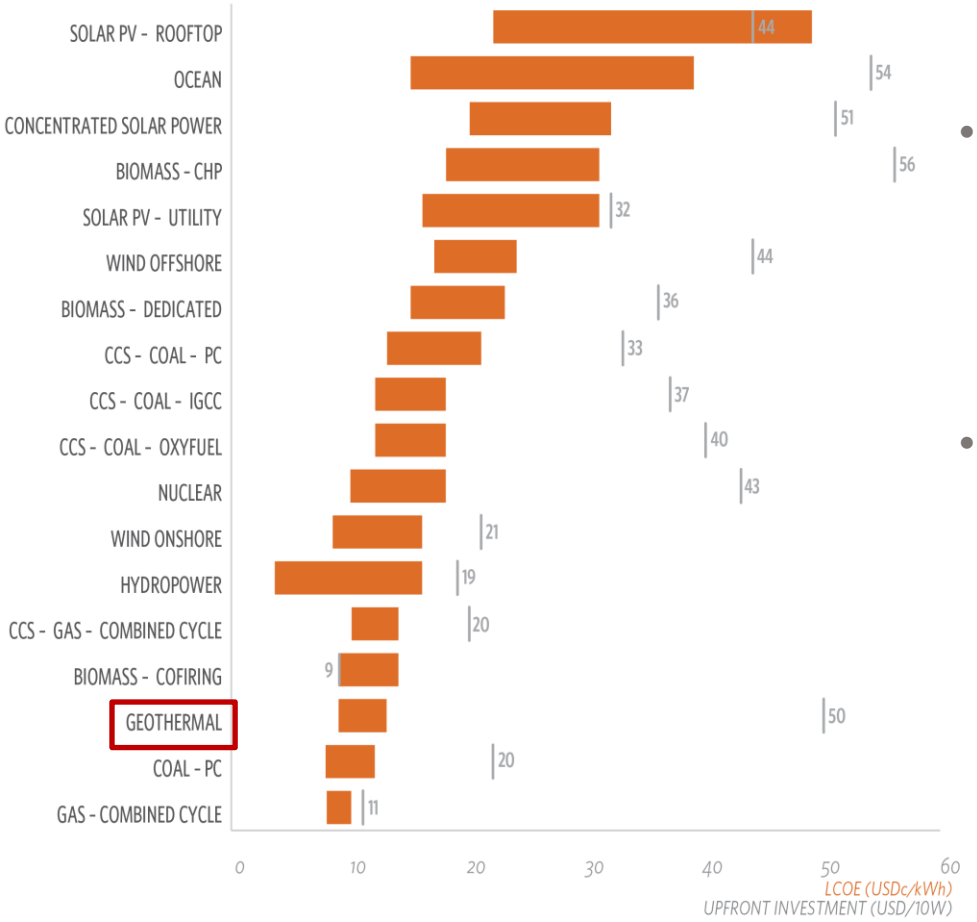
| | Country | Financing | CIF | Pro | Con |
|---|---|---|---|---|---|
| **Sarulla 351MW** | Indonesia | ADB 250m loan; JBIC 533.6m loan; CTF 80m; Canada 20m; Comm. banks 255.7m | Y | public-private finance leverage | Recent financing closure |
| **Olkaria III 110MW** | Kenya | MIGA PRI 88m; OPIC loans 310m; WB PRG 26m | N | Mix of risk instruments; public-owned Olkaria sites I/II/IV to compare | Limited priv. finance leverage on debt side |
| **Gumuskoy GPP 13.2 MW** | Turkey | EBRD MidSEFF $24.9m loan; a $9.6m lease finance loan; and $15m equity (70:30% debt to equity ratio) | N | Local private developer and significant private investment | Small scale project. |

## Our selection approach in brief

We identified over 50 projects in emerging or developing countries and compiled the list of candidates based on the following selection criteria:

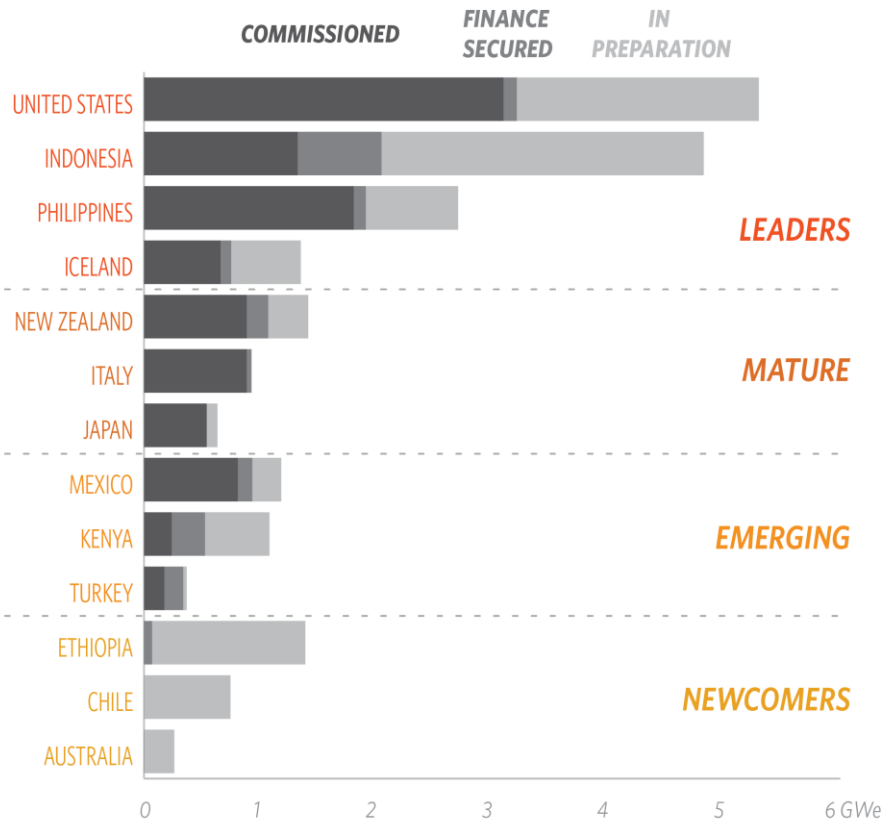
- A **geographical balance** between potential candidates
- **>50 MW** approximately for utility scale
- Full lifecycle: projects should cover all stages of development and implementation if possible
- Prospects of **substantial lessons** through different use of instruments and presence of private finance

# Geothermal important for low-carbon transition



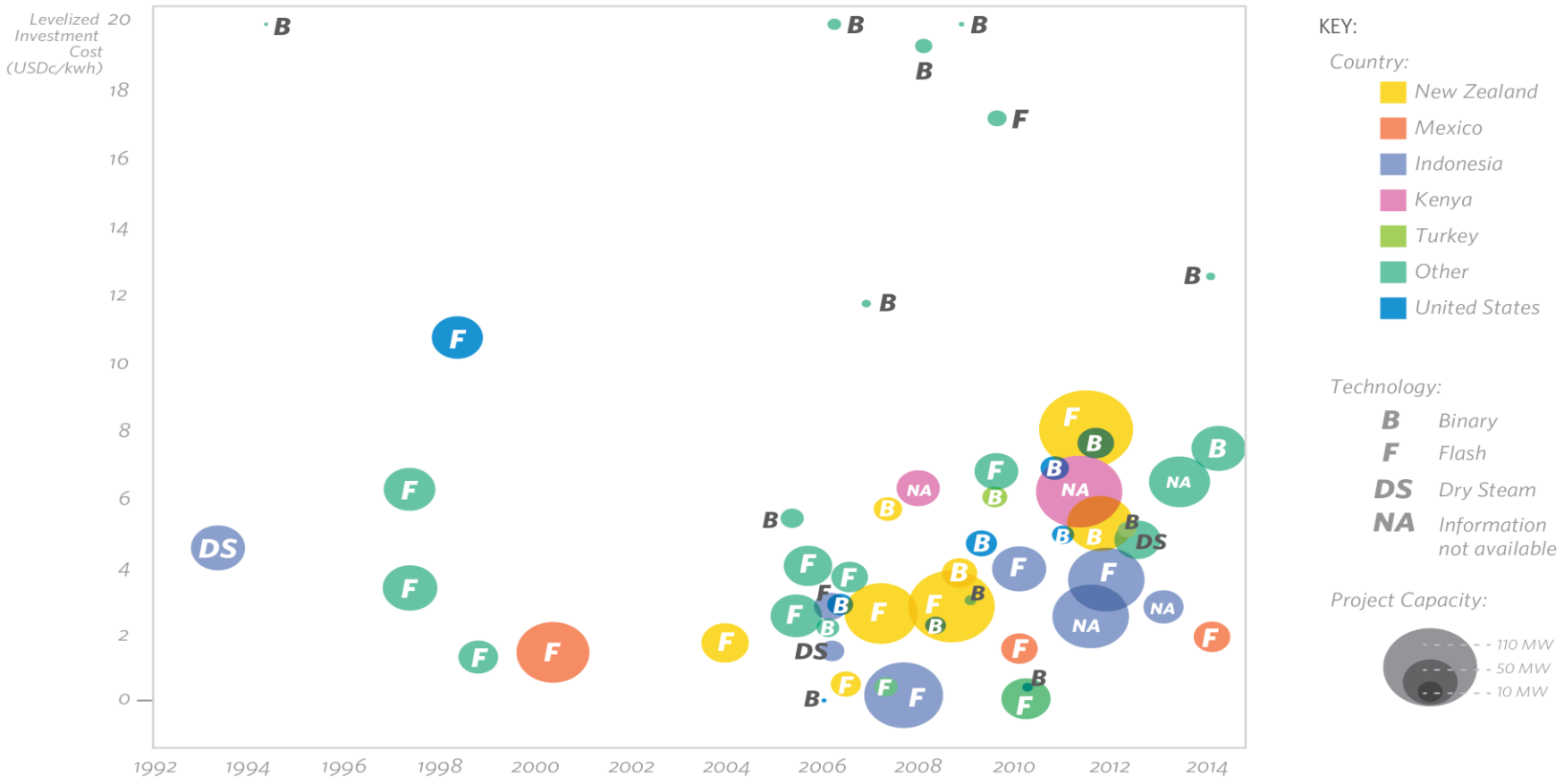

- Ability to provide power reliably and flexibly to both meet **base load** energy demand and respond to **fluctuating** supply.
- In addition geothermal is **cost-competitive** when compared to other renewable energies and – in many cases - fossil-fuelled generation, mostly due to its capacity factor.

# Overview of geothermal markets



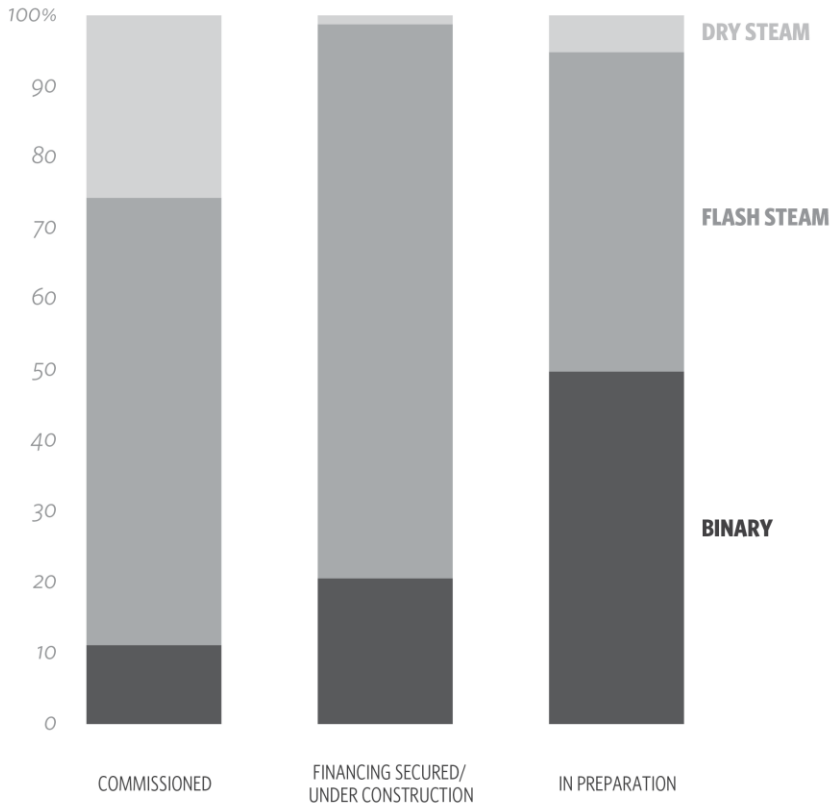

- Only a select few countries endowed with high temperature geothermal resources, are actively seeking to exploit the potential it may play in their national energy mix
- The U.S. hosts the largest share of global installed capacity and transferred their early experience to the Philippines. Indonesia is the leading growth market.
- Contraction in mature markets is being compensated by developing countries, starting to develop their geothermal potential

# Trends in geothermal costs



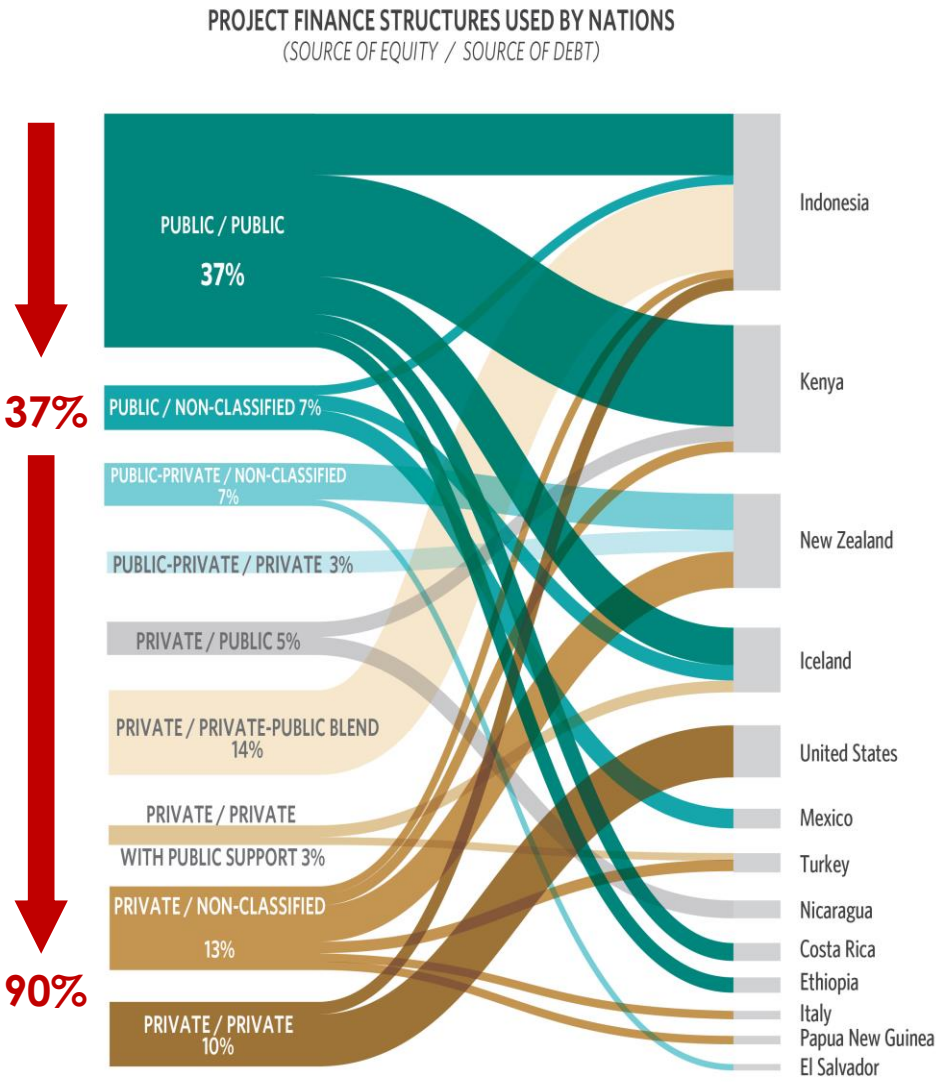

- Observed data on geothermal projects in different market across the world show that the levelized investment costs of projects are broadly stable

# Geothermal technologies




- 25% of global installed capacity is in **dry steam** plants mostly due to the technology's early application in the 70s and 80s.
- **Binary** plants while being a small part of installed capacity they currently represent the fastest growing form of geothermal electricity technology.
- **Flash steam** plants are the most common form of geothermal electricity utilization due to their efficiency

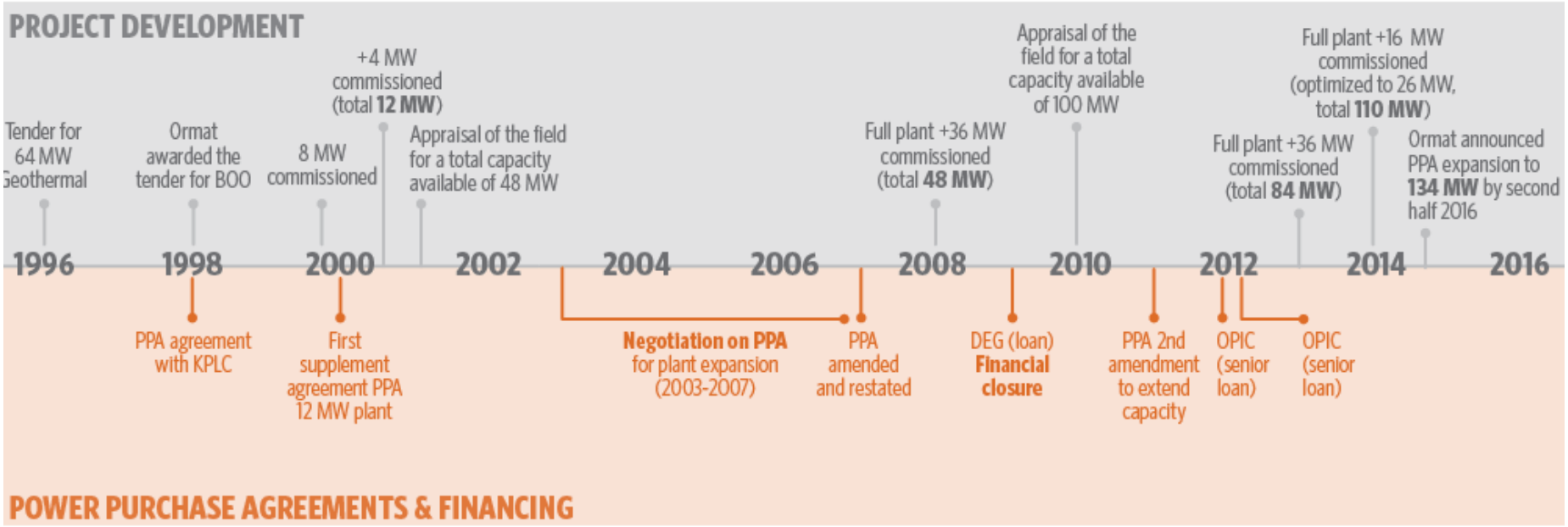
# Public sector plays key role in investment




- **37%** of projects are **purely public**.
- **Public sector** plays a role in **76-90%** of investments
- Little appetite for **private sector** where resource risk is high.
- Financing structures are highly **dependent on the location**

# Timeline


Phase 0
Pilot Phase
Phase 1 (ongoing)
Phase 2 (ongoing)
Phase 3 (ongoing)


PROJECT DEVELOPMENT
Tender for 64 MW Geothermal
Ormat awarded the tender for BOO
8 MW commissioned
+4 MW commissioned (total 12 MW)
Appraisal of the field for a total capacity available of 48 MW
Full plant +36 MW commissioned (total 48 MW)
Appraisal of the field for a total capacity available of 100 MW
Full plant +36 MW commissioned (total 84 MW)
Full plant +16 MW commissioned (optimized to 26 MW, total 110 MW)
Ormat announced PPA expansion to 134 MW by second half 2016
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
PPA agreement with KPLC
First supplement agreement PPA 12 MW plant
Negotiation on PPA for plant expansion (2003-2007)
PPA amended and restated
DEG (loan) Financial closure
PPA 2nd amendment to extend capacity
OPIC (senior loan)
OPIC (senior loan)
POWER PURCHASE AGREEMENTS & FINANCING