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The Energy Sector Management Assistance Program

Considerations on Planning and Financing Geothermal Power Generation in East-Africa

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Overview

- Basics
- Checklist for development
- Development phases and risks
- Development models to mitigate risk and facilitate financing
- Optimizing the power plant conceptual design
- Lessons Learned

Characteristics of Geothermal used for Power Generation

- Environmentally friendly / Option of carbon credits
- Limited and “reversible” impacts of power plants on nature and society
- Usually amongst the least cost options for power generation
- Indigenous resource, saves foreign currency
- Mature technology, high reliability
- Base load power (availability >90%)

Barriers to Geothermal Development

1. High upfront costs for exploration and drillings; access to funding and guarantees
2. Legal & regulatory framework; Commercial risks, incentives, feed-in tariffs
3. Institutional and technical capacity
4. Information and data base on resources
5. Location of geothermal fields in protected or rural areas (grid connection costs)

Basic considerations for newcomers

- What can a country do to enjoy the benefits and address the barriers?
- WHY should a country use its geothermal potential for power generation? Will it promote "Creation of Wealth", i.e. will the country get better and stronger? Who will benefit?
- These considerations lead us to the following "checklist" for geothermal power project development…

Checklist

a) Review and collect data on geothermal resource potential; develop inventory and identify the information gap.

b) Energy sector regulations need to be reviewed; can geothermal become the country's future strategy? What about environmental and social issues?

Checklist, continued

c) Integrated energy sector planning, i.e. Least Cost Analysis for electricity “delivered”, incl. necessary transmission, distribution and other infrastructure.

d) Business Model I: For development of F/S → Financing and Risk Sharing.

Who will take what risk? Who will fund what?

Mitigation of upfront risk.*

Options (in theory) from all public to all private. *

Identify optimal conceptual design. *

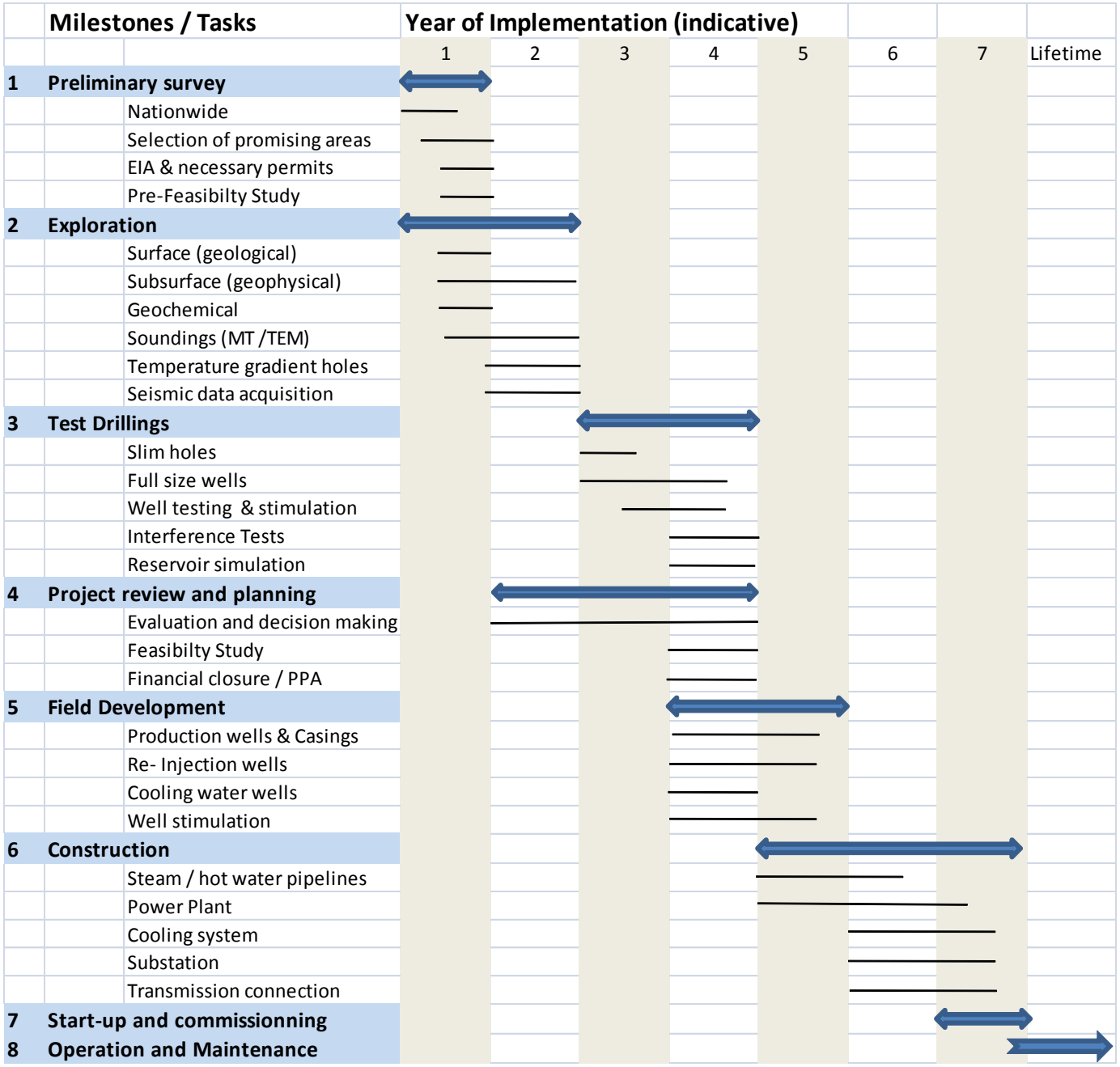
*=discussed later

Checklist finalized

e) Business Model II for the stages after the test-drillings, confirmation of the resource potential and conceptual design of power plant → project phases from construction to operation. A different business model or “project structure” can be used here, due to different kinds and levels of risk.

Result: Geothermal projects have two main parts, separated by the Feasibility Study.

Dev. Phases of a geothermal power project….



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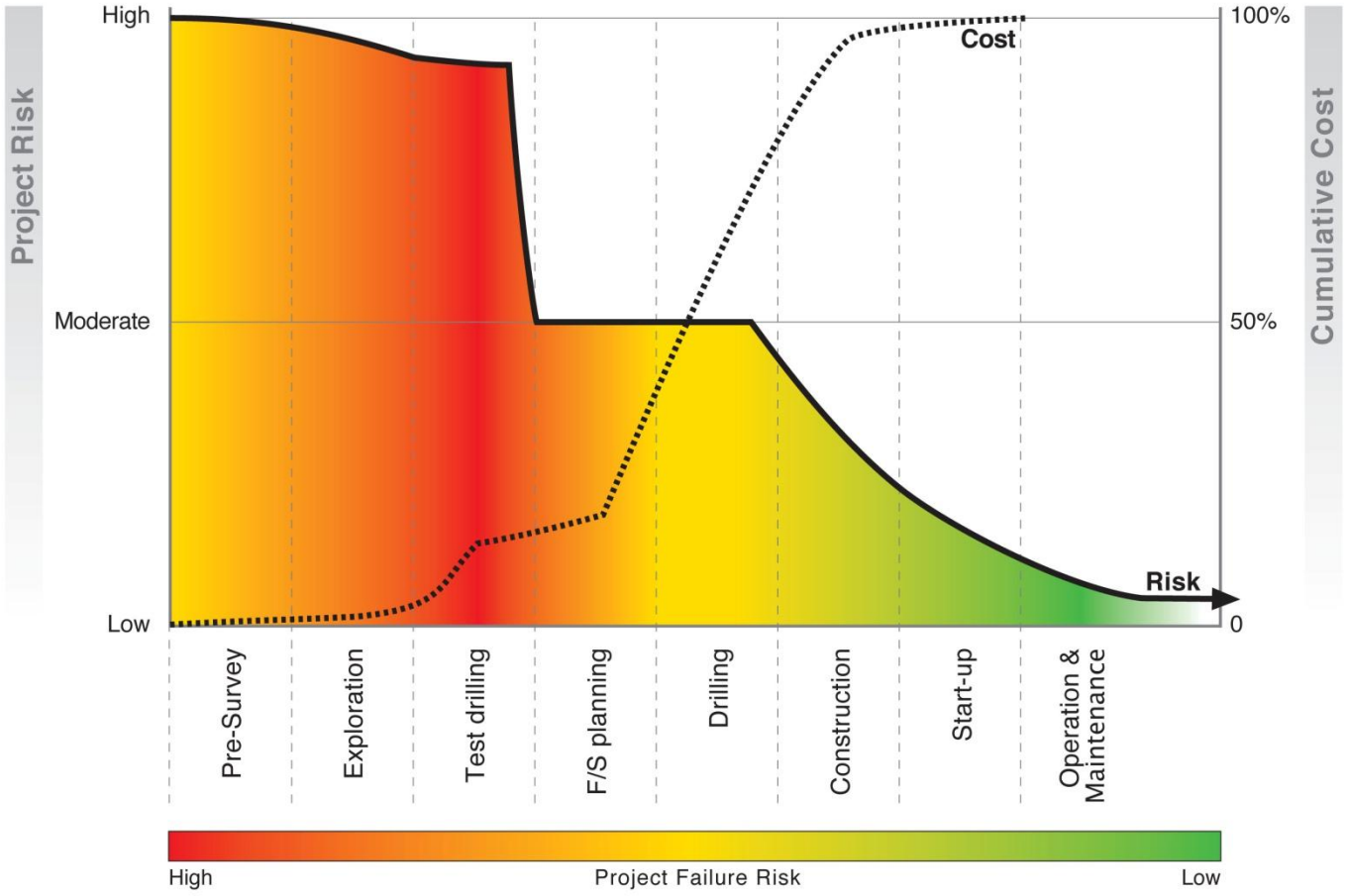
Risks in Geothermal Energy Projects



Risk mitigation of the first phases

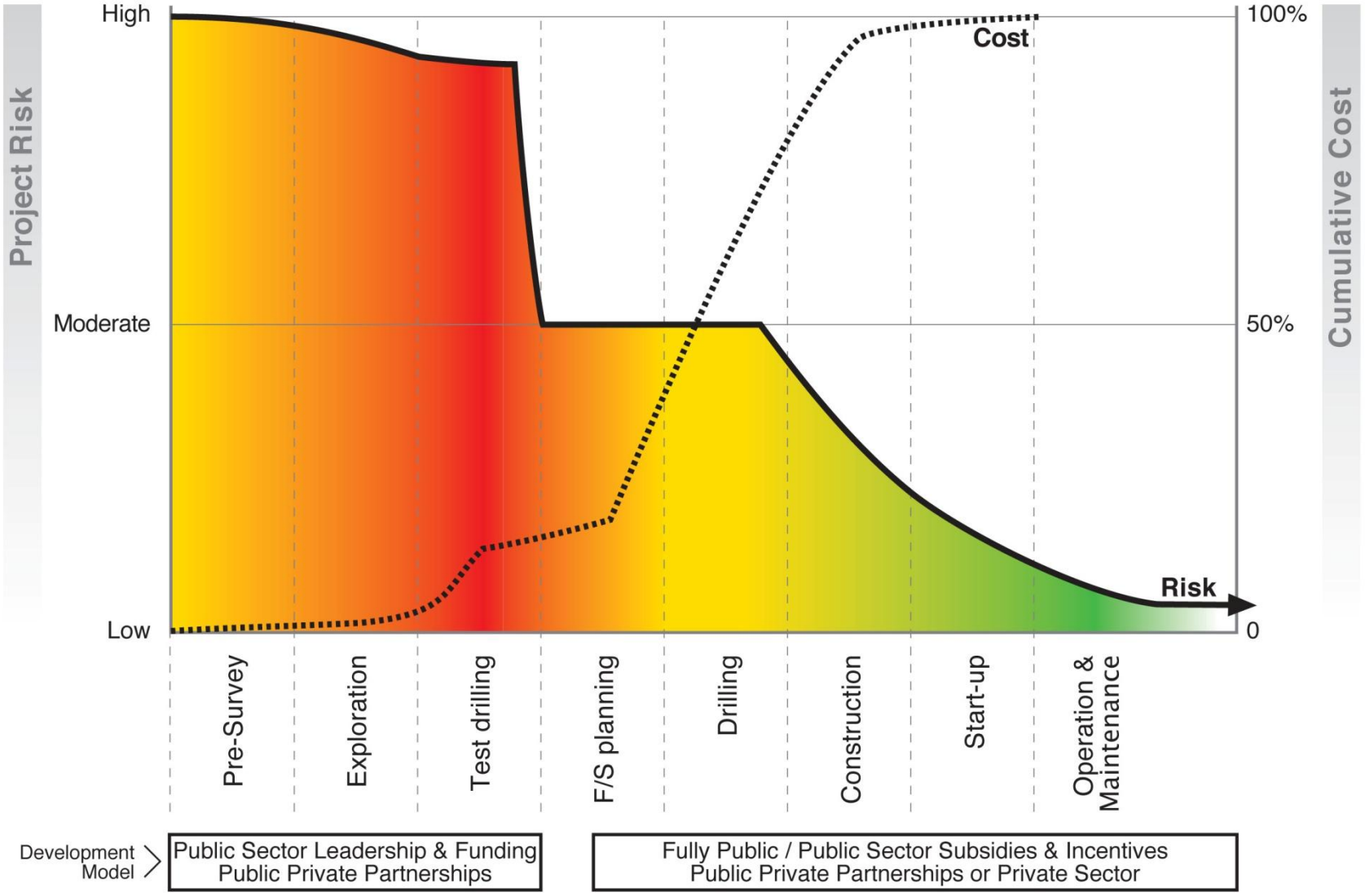
- Who takes the risk of the first development stages (Survey, exploration, test drillings) ?
- Three basic options: public, private, PPP
- Consider…
- a) portfolio of geothermal fields,
- b) access to funding
- c) Risk premium and demanded IRR of private sector companies, and
- d) duration of project development.

Private sector example

- Demanded IRR 25%. Cost for exploration and test drillings is US$ 30 m. Accrued for 6 years.
- Accumulated costs before start of operation approx. $ 115m.
- For a 50 MW power plant ($ 200m), this means that the generation costs per kWh could double.
- For 20 MW ($ 100m) the generation costs could triple.
- Creation of Wealth as final target for the country?

A Solution for Business Model I

- Financing of the first project phases should be done by the country through, for example….
- Grants from geothermal development funds
- Soft loans from donors / institutions,
- Concessional financing,
- Loans from World Bank or similar institutions,
- Other sources of patient capital



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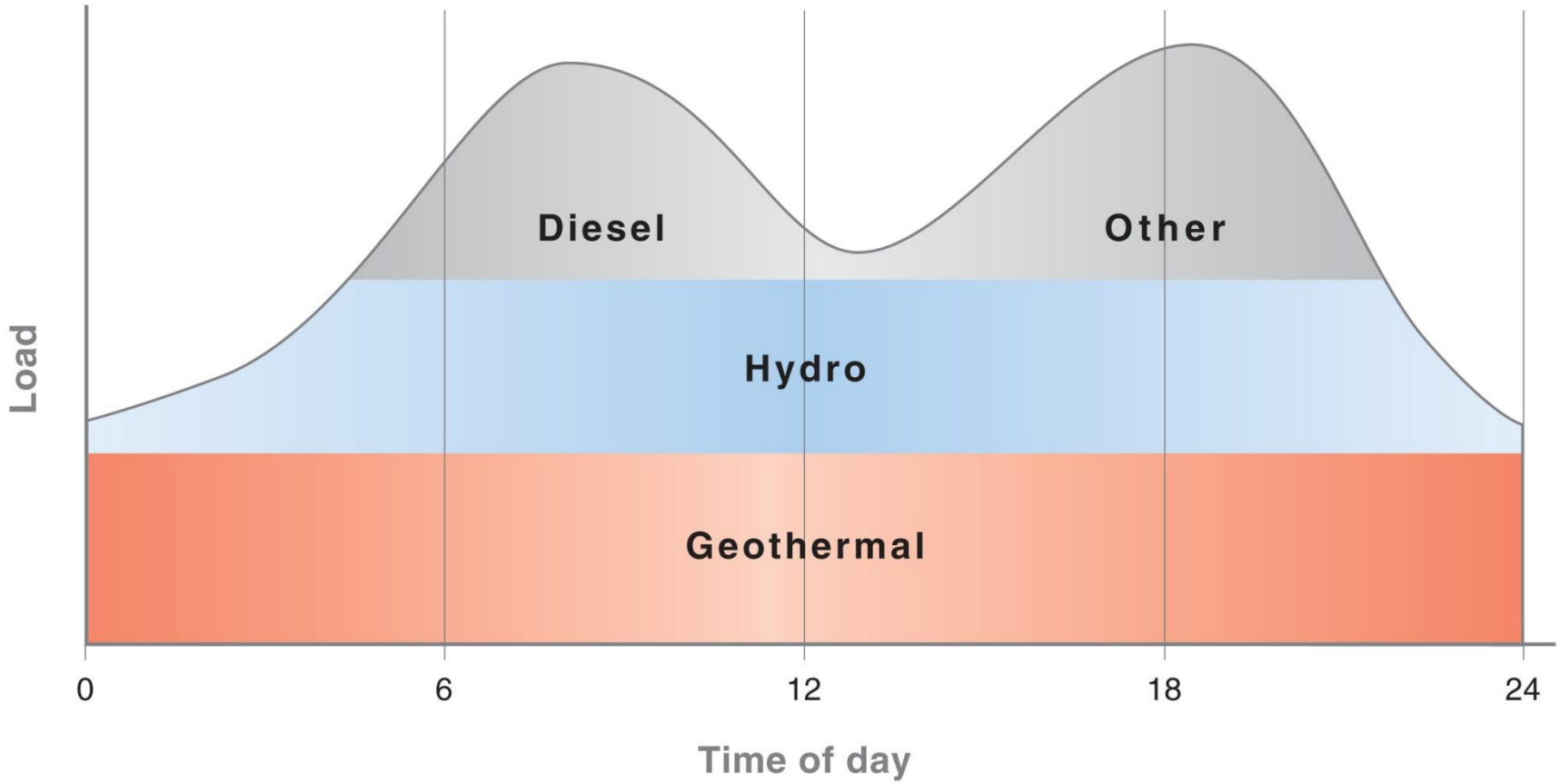
Business Model II

- Identification of the optimal conceptual design.
- Mistakes in the mitigation of resource risks have shown that geothermal projects should be developed in steps of e.g. 20 , 35, or 50 MW of installed capacity. The larger the first unit, the more the risk of reservoir depletion (pressure drop).
- When considering the size of the first step, it is important to know that

a) geothermal power plants can not adapt to the country load demand and

b) geothermal is base load power.

Base Load in the Load Curve



Lessons Learned

Country case studies from

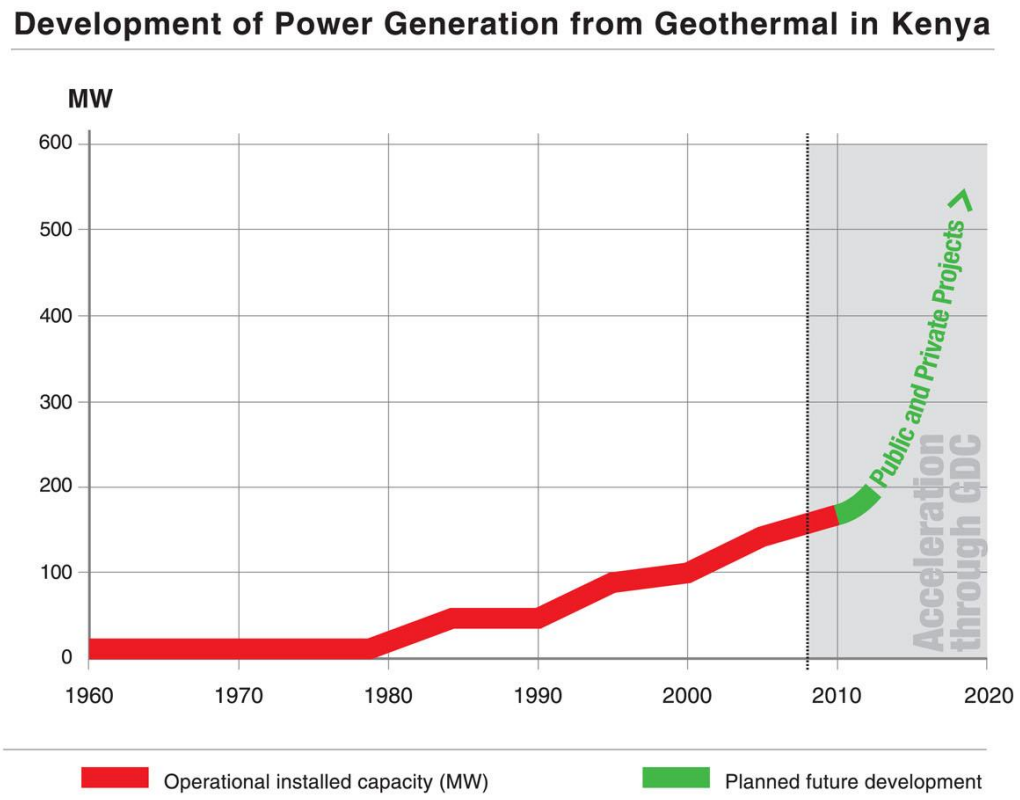
- Kenya (200 MW)
- Iceland (575 MW)
- Philippines (1700 MW) and
- Mexico (1000 MW)

show the following 5 options on how to develop geothermal power projects:

Options to develop geothermal power projects

1. Risks mostly assumed by Government; a **public fund** mitigates the exploration and drilling risk of all geothermal drillings, thereby leaving project developers with only a minimal risk (Iceland)
2. Steam field development is done by a separate **GDC**. Fields then tendered out to private or public sector for further development (Kenya)
3. **Build up capacity** in exploration and drilling (KenGen now finances new projects through its government and several development banks and bilateral donors)

Geothermal in Kenya

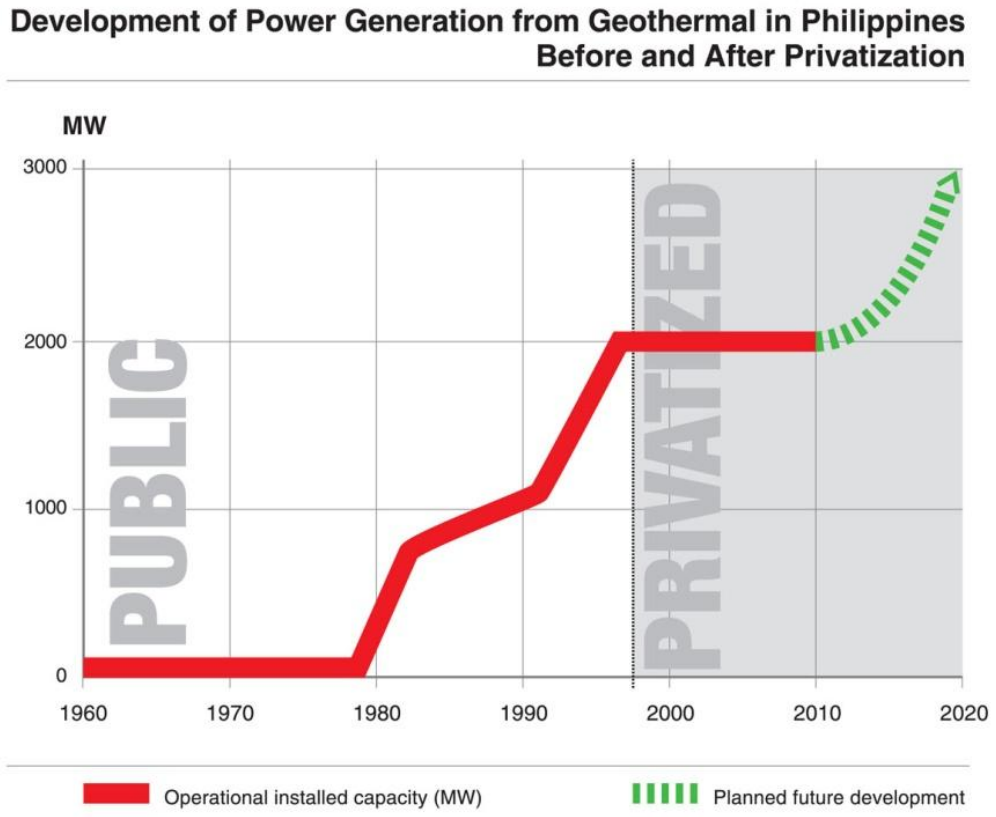


- Data Source: KenGen / Mwangi, M. 2005

More options

4. Public development and assuming all risks, involve the **private sector as EPC contractor**, delivering turnkey equipment to be publically owned and operated (Mexico)
5. Focus on letting the **private sector** do the job from exploration to operation. This implies that the country should offer a convincing package of incentives and subsidies, even refunding R&D costs, in order to attract private sector investors (Philippines)

Philippines privatize GPP's and establish legal and regulatory framework



Geothermal Power….

- Whatever option or combination of options is chosen, an important factor for success is the **determination** and commitment of the Government!

Thank you for your attention!

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