PRIVATE FINANCING OF GEOTHERMAL DEVELOPMENT

GGA Stakeholders Meeting
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AGENDA

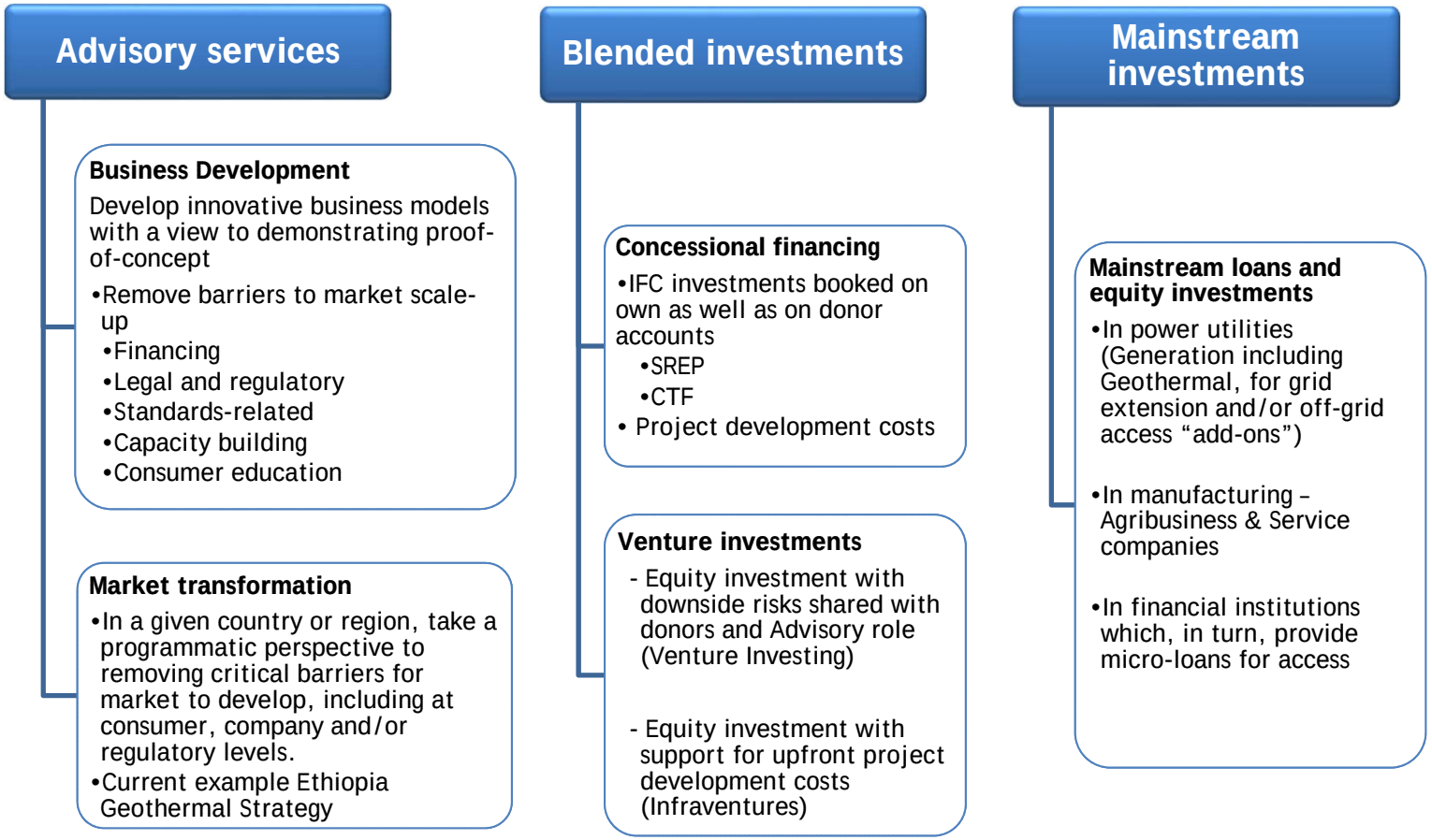
- Overview of IFC
- IFC's Geothermal Financing Experience
- Unlocking Geothermal Development

WORLD BANK GROUP

IFC: A MEMBER OF THE WORLD BANK GROUP

•IBRD	•IDA	•IFC	•MIGA	•ICSID
•International Bank for Reconstruction and Development	•International Development Association	•International Finance Corporation	•Multilateral Investment and Guarantee Agency	•International Centre for Settlement of Investment Disputes
•Loans to middle-income and low-income governments	•Interest-free loans & grants to lowest income governments	•Private & Subnational Sector Financing & Advisory	•Guarantees of foreign direct investment's non-commercial risks	•Conciliation and arbitration of investment disputes

IFC engagement in Energy Access cuts across inter-related Investment & Advisory activities



•Source: IFC analysis

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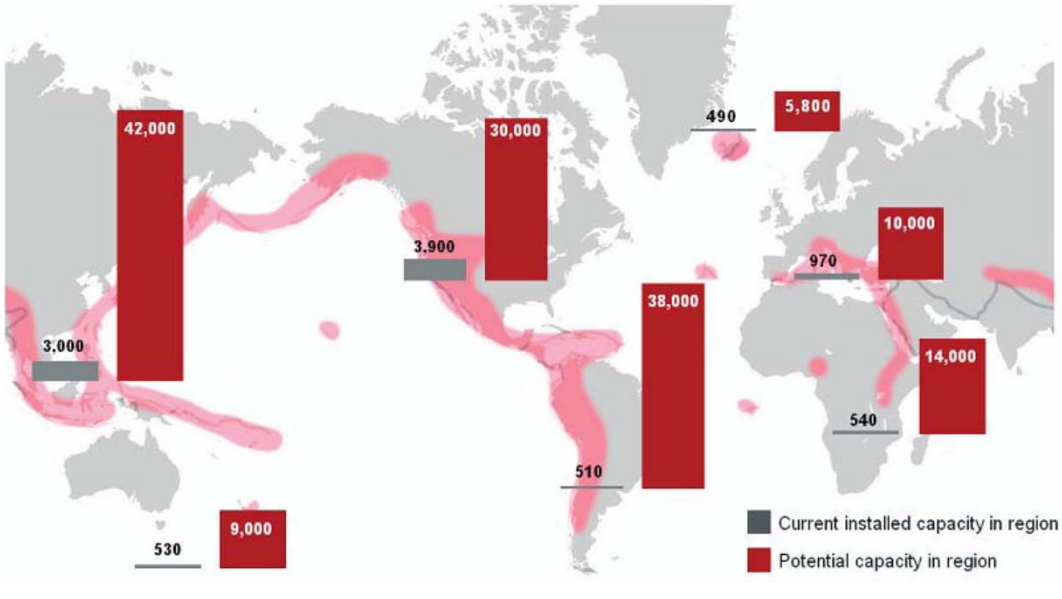
GT Potential – 150GW – 700bn$?



- With existing/proven technologies, the global potential of geothermal power is estimated to be ~150GW, Mostly around tectonic plate boundaries
- With more advanced techniques (Enhanced Geothermal Systems), the global potential is many times higher than this
- Installed capacity is approximately 10.7GW

IFC activities in geothermal

Advisory Services

Technical Assistance

- Donor-assisted advisory projects to raise awareness/understanding of geothermal including advising projects developers, analyzing drilling success rates, defining geothermal exploration best practices, and resource mapping. Recent work in Ethiopia

New Product Development

- Donor-assisted "Geofund" to remove barriers to geothermal development through creating and piloting "resource risk insurance" in Turkey

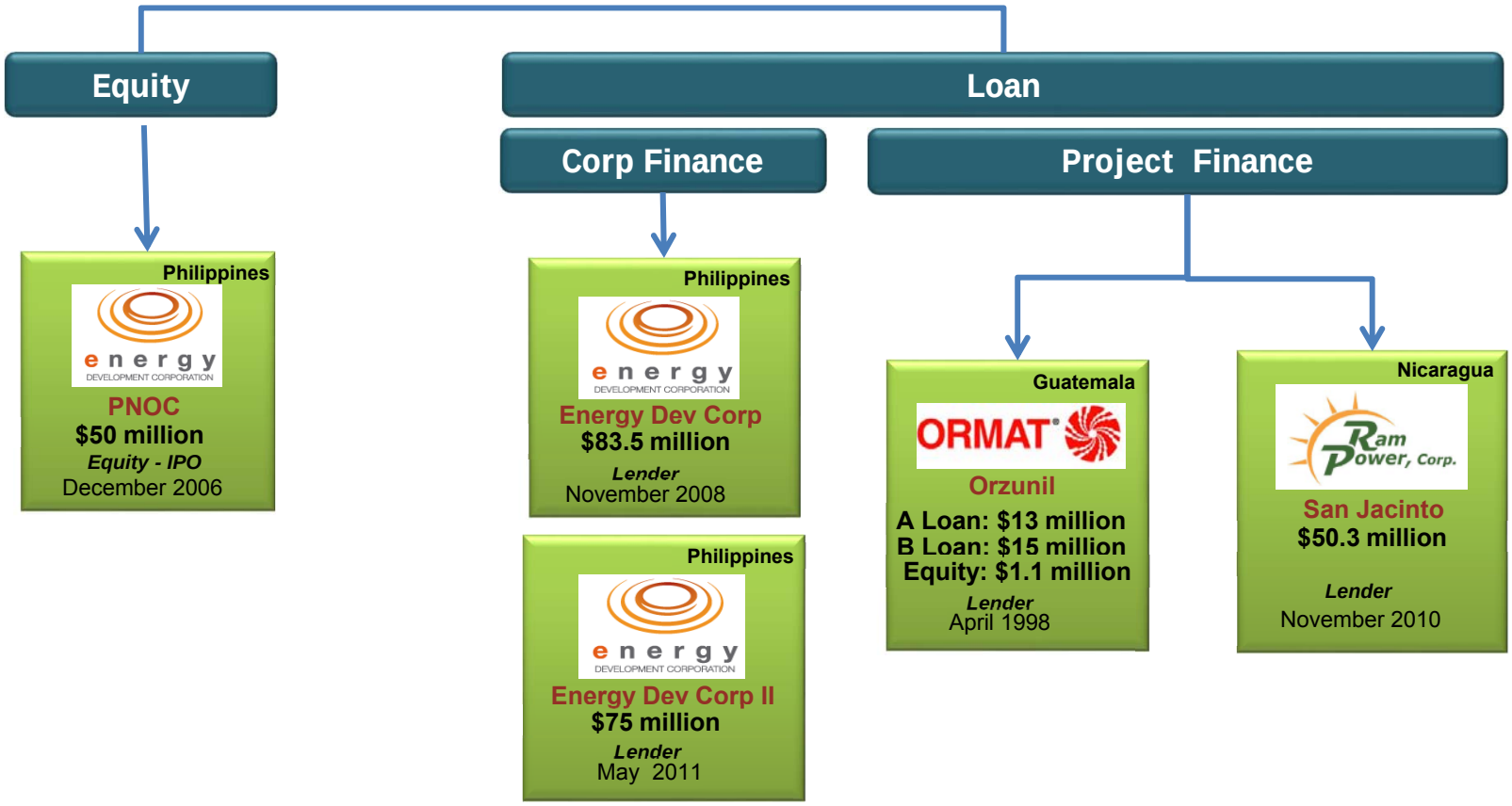
Government Support

- Support to governments in structuring and negotiating PPP transactions
- Support to governments' power sector strategy and implementation, including assessment of risks and approaches to mitigate risks

Investment Services

- Traditional and mainstream IFC business
- Infraventures
- Good track-record
  - Equity
  - Loan (project finance and corporate loan)

Investment – IFC Track Record



Investment –EDC (Philippines)

- The largest geothermal-dedicated company in terms of installed capacity (about 1,150MW) in the Philippines and the world;
- Fully privatized in a two-step process in 2006/7 as part of comprehensive power sector reform;
- Domestic-focused but now poised for international expansion.

❑ IFC Investment

- US$50 mill equity – IPO in 2006
- US$83.5 mill equivalent local currency loan in 2008
- US$75 mill equivalent local currency loan in 2011

❑ Resource Risk

- Five geothermal fields in operation with more than a decade of a proven-track record.
- Geothermal Resource certification at the time of IPO, etc.

Investment – Orzunill (Guatemala)

Earlier pioneers in geothermal project financing in emerging economies - 24 MW greenfield geothermal project; Total project cost ~ US$67m; Ormat was the Sponsor, EPC, O&M. Off taker : INDE (state-owned utility), effectively a steam "conversion" project. INDE's management of the steam resource kept the plant underutilized at roughly 16MW. Constant threat to renegotiate PPA. Plant still underutilized but INDE is paying under the PPA.

❑ IFC Investment

- US$ 13 mill in an A Loan;
- US$ 15 mill in a B Loan; and
- US$ 1.1 mill in equity.

❑ Resource Risk

- Contractually fully taken by the steam-supplier (the state-owned utility).
- The Plant underutilized as the Steam-Supplier failed to provide adequate steam.

Investment - San Jacinto (Nicaragua)

Nicaragua

Ram Power, Corp.

San Jacinto

$50.3 million

Lender

November 2010

- Among the first and only "project-financed" and vertically-integrated geothermal projects in the region in recent past;
- Two phased financing and development of 36MWx2= 72MW;
- The Sponsor, Ram Power, a geothermal start-up, but with good management team, raised capital through an IPO.
- Off-taker Disnorte/Dissur (Union Fenosa).

❑ IFC Investment

- US$ 30 mill in an A Loan;
- US$ 20 mill in an IFC subordinated loan; and
- US$ 110 mill in other loan mobilization.

❑ Resource Risk

- No resource / steam risks for the Lenders;
- But, variable loan amount, depending on confirmed steam resource, including an "equity take-out" portion to help improve an equity return.

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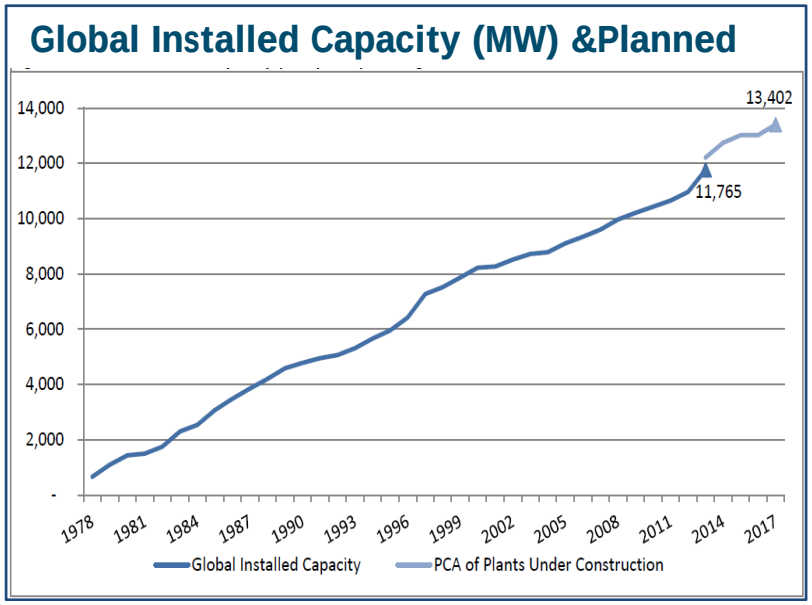
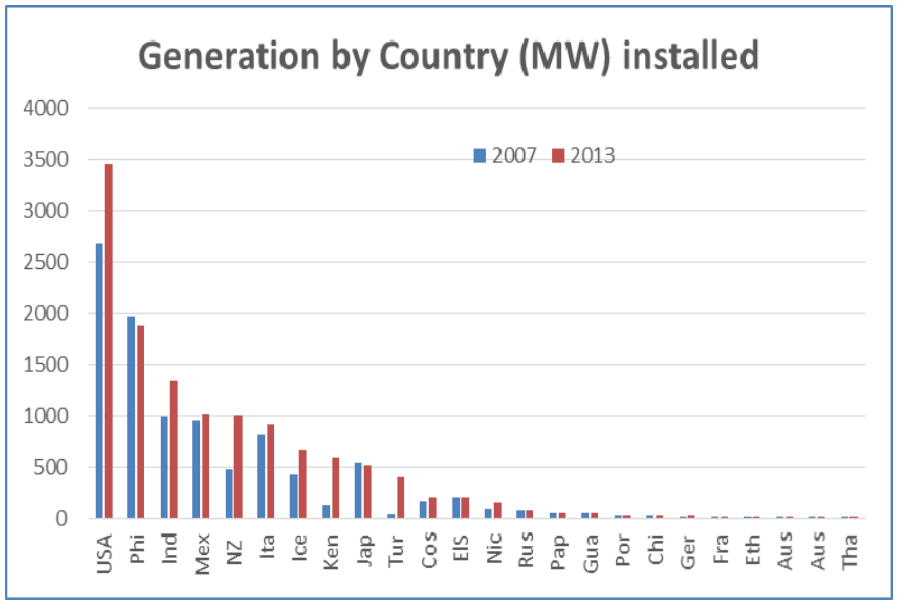
Installed capacity has been increasing steadily





- Installed capacity has been increasing steadily, but not dramatically (compound ~4%/year)
- 90% of the installed capacity is in 9 countries.
- The USA dominates with over 3GW installed, followed by Philippines and Indonesia

The merits of geothermal

Advantages

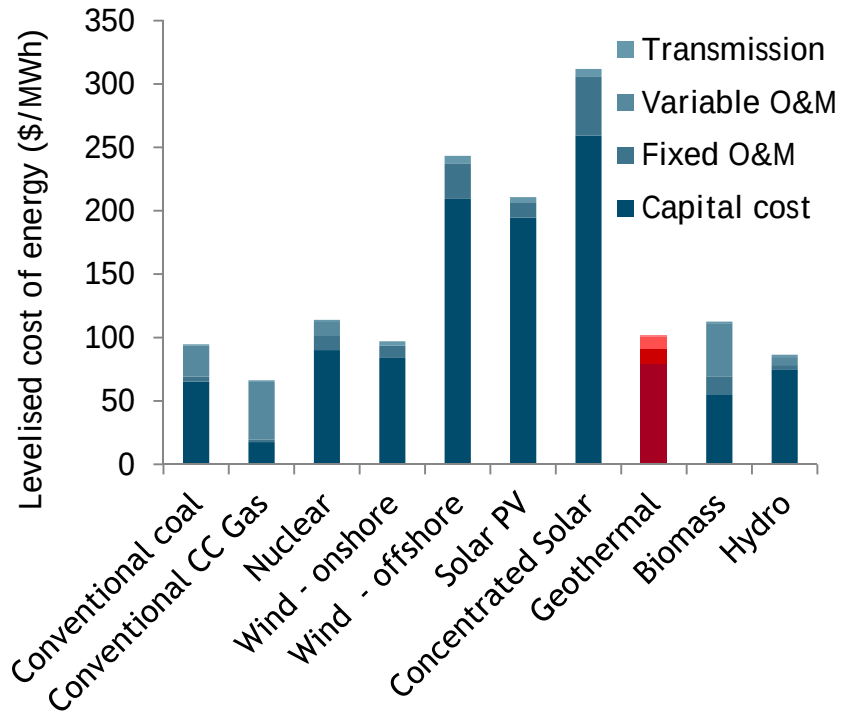
- Clean energy
  - Low or no carbon emissions
- Base-load power – geothermal plants produce at an average of >90% of rated capacity over a year
  - Compares with ~70% for coal, ~85% for nuclear, ~35% for wind, ~20% for solar
- Fuel is free once drilling is completed
- Native fuel source – unaffected by shifts in oil prices
- Low maintenance costs
- Renewable energy
  - Heat source is effectively unlimited

Disadvantages

- High capex costs and long lead-times
- High upfront risks in resource exploration, with high costs associated to this
  - Hard to confirm resource until several wells are drilled
- Conventional geothermal reservoirs are not widely available globally
- Some regulatory barriers in some countries, or a lack of support/knowledge
- Lack of capacity in developing regions
- Resource can degrade over time
  - Mitigated by proper resource management
- There is a risk of producing small earthquakes when drilling EGS wells

How much does it cost?

Comparison of energy costs, 2016



Source: Annual Energy Outlook 2011, US Department of Energy

Comments

- This chart looks at expected costs in 2016 for US power plants
  - Geothermal in other countries can be cheaper
- Geothermal has similar costs to onshore wind and coal
- This makes geothermal appear very attractive, and it is…
  - … But, the risk profile hinders development
  - 35-50% of capital costs come before resource is confirmed

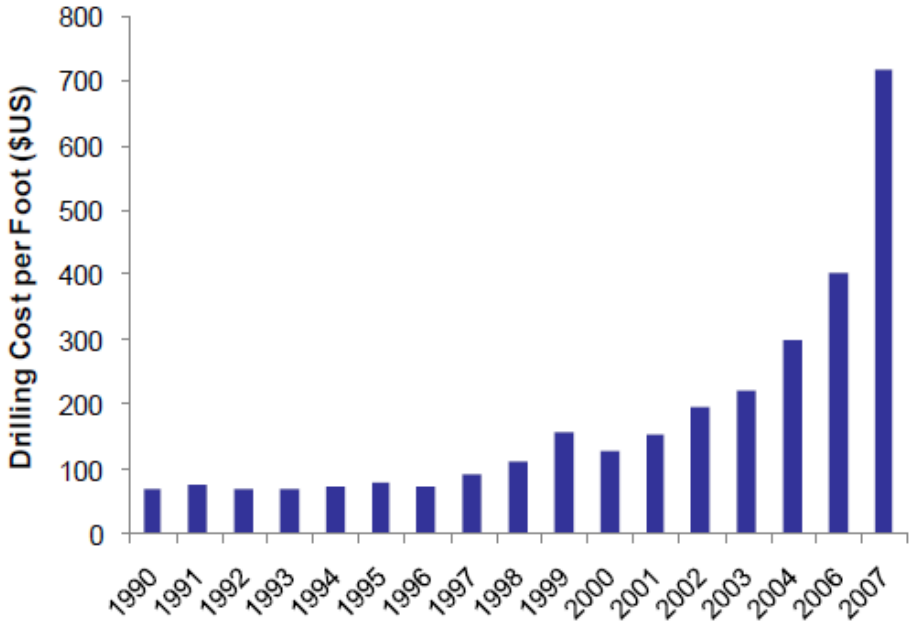
Capital Cost Breakdown:	
Exploration and resource confirmation:	10-15%
Drilling:	20-35%
Surface facilities:	10-20%
Power plant:	40-60%

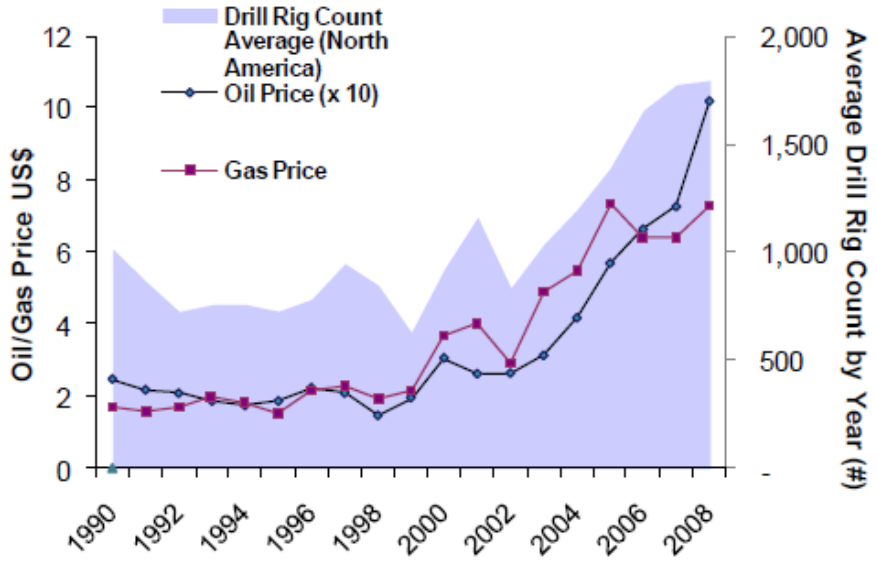
Source: Green Power Academy 2010

Exploration and Commercial Drilling

Drilling costs sky rocketed as energy prices increased in 2007 and 2008

Drill Rig Supply and Cost





Well Type	Casing Size	Total Cost (US$)	Days Drilling
Geothermal	11.75 inches	3.4 million	43
Oil and gas average	8 5/8 inches	1.8 million	29
Oil and gas slim-hole	5 ½ inches	1.4 million	21

Note: Average 2,500 meter well in the US
Source: Energy Information Administration, Baker Hughes Inc., Emerging Energy Research

Power Plant O&M

Largely Fixed Costs with a low variable component

Operation:

- Labor, property taxes, royalties, parasitic electricity consumption
- Lubricants, chemicals for H_2S abatement, scaling and corrosion control, spare parts, etc.

⇒ *Operating Costs ~7.0 $/MWh (50MW plant with +/- 40 employees)*

Maintenance:

- Plant Maintenance (consumables, overhauls, etc.)
- Field Maintenance (wells and gathering system), Well replacement (sometimes)

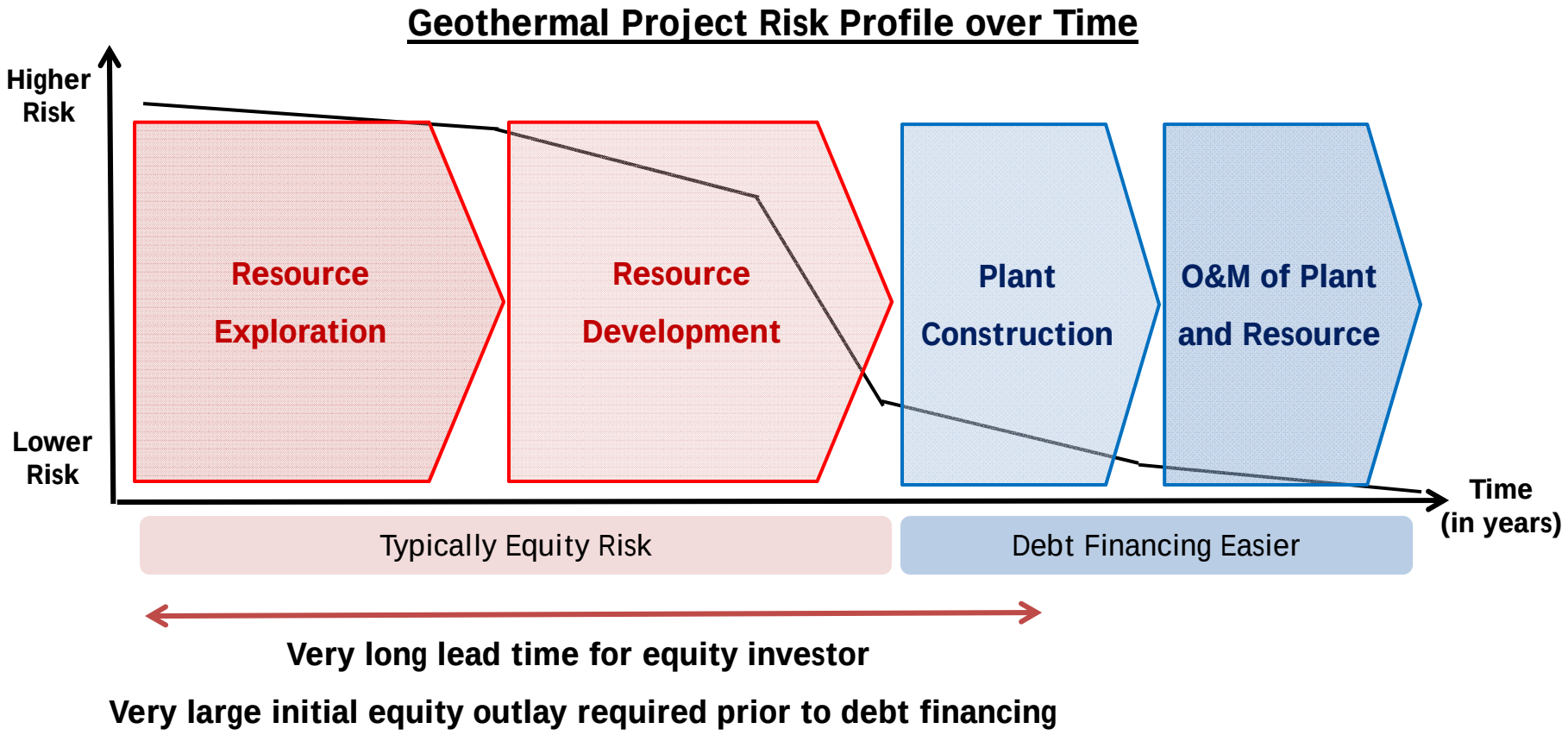
⇒ *Plant Maintenance Costs ~9.0 $/MWh (5% of plant investment @ 1,500 $/kW)*

⇒ *Field Maintenance Costs ~8.0 $/MWh (2% of field costs & 5% drilling costs)*

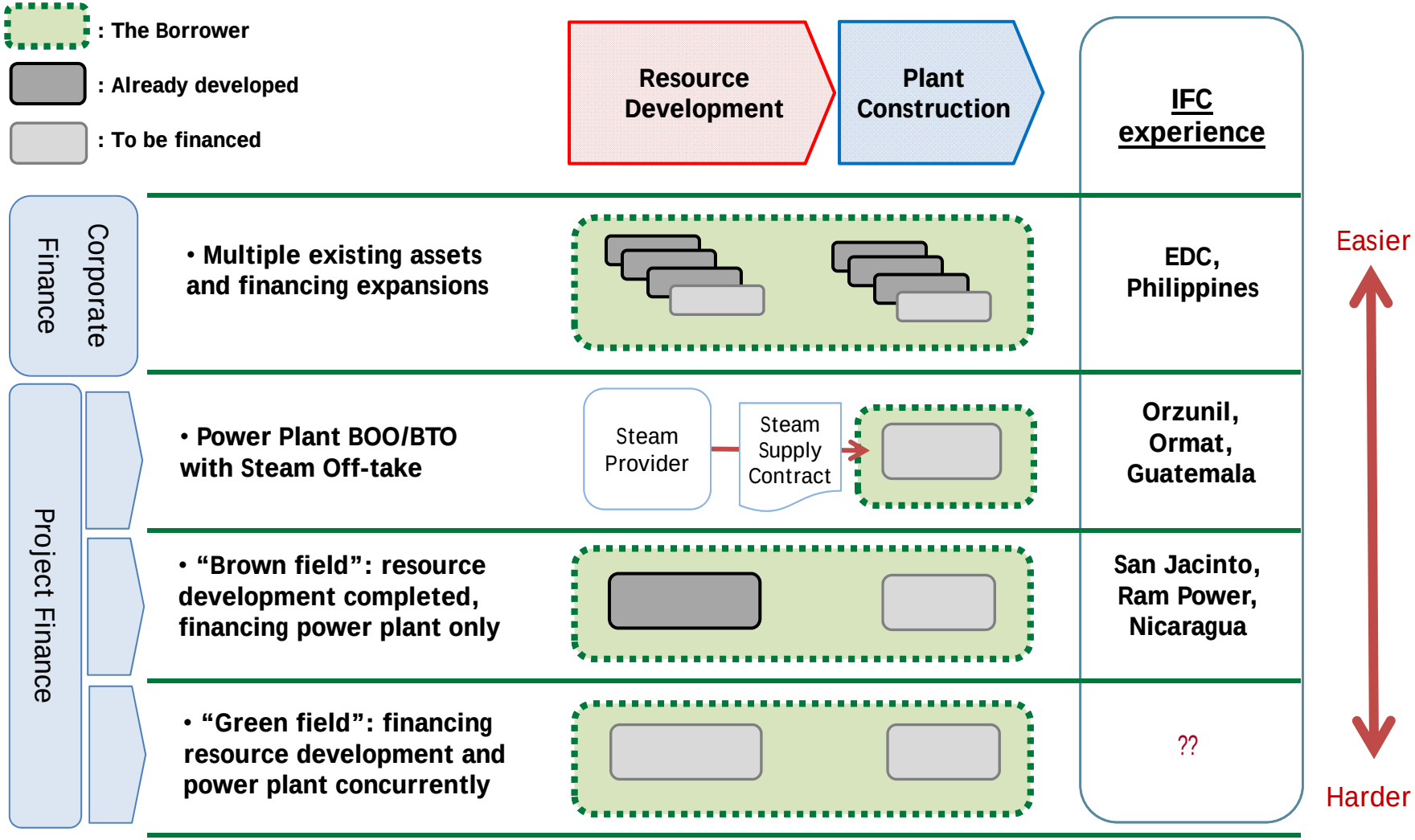
TOTAL O&M COSTS ≈ 24 $/MWh (range 16 - 25 $/MWh)

Geothermal financing challenges: Unique risk profile

• Geothermal has a unique risk profile for power generation financing -- very high upfront risk and very long lead time.

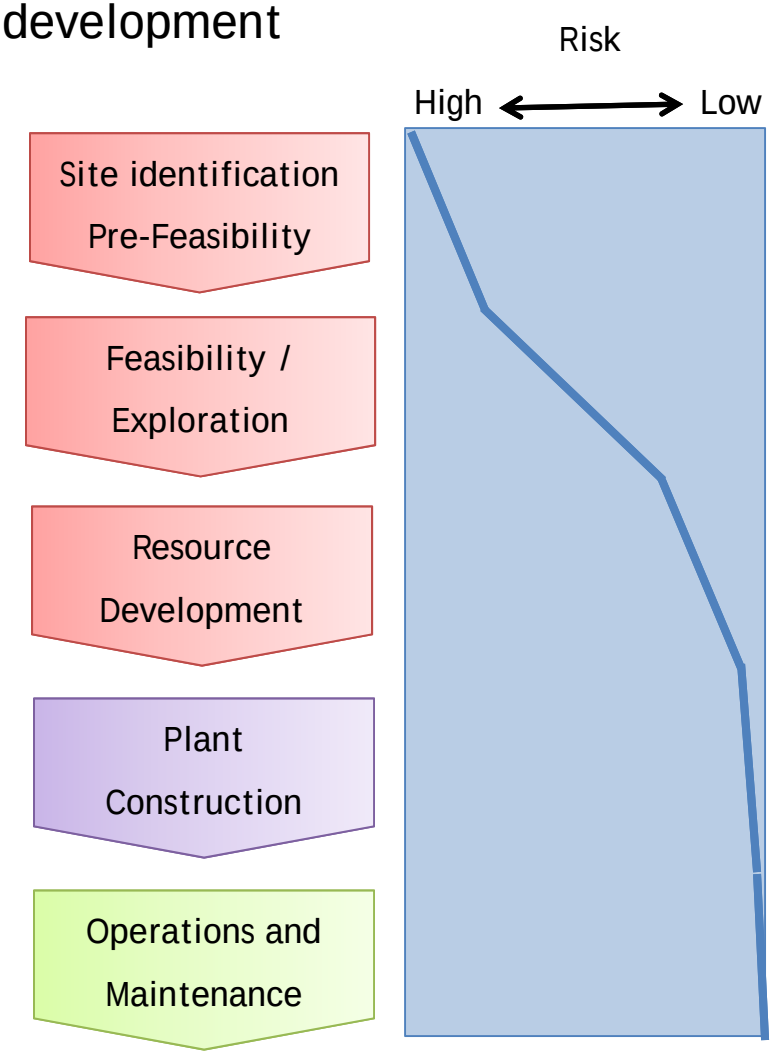


Geothermal financing: IFC experience options



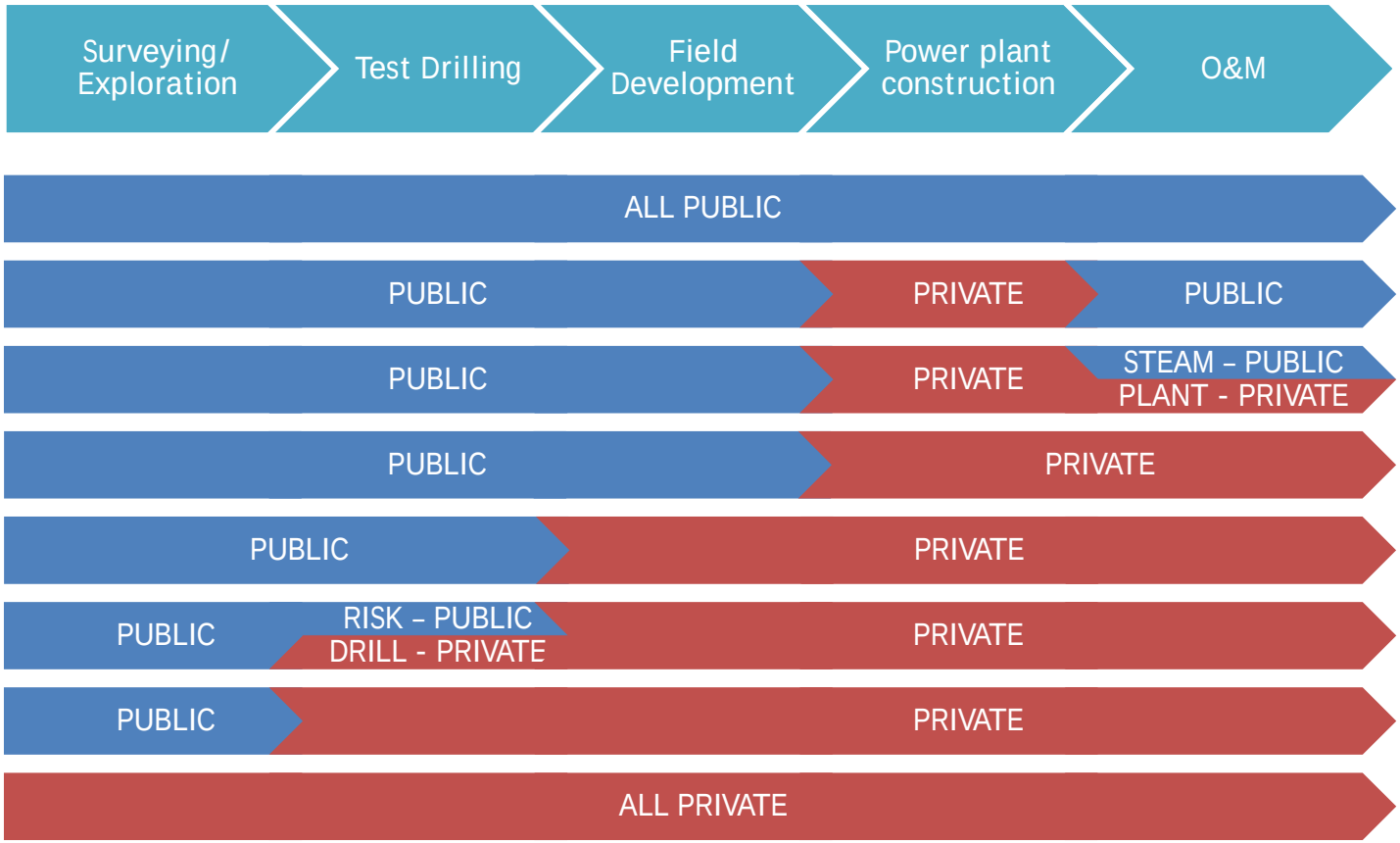
Geothermal Financing

Access to capital remains comparably limited particularly for exploration / resource development



Typical Financing Options	Key Issues
❑ Developer Equity	➢ Lack of developer with financial resource
❑ Developer Equity / (Mezzanine Bridge Debt)	
❑ Private Equity / Public Markets / Financial Partners/ Strategic Partners	➢ Limited access to public equity ➢ Limited # of potential partners
❑ Project Finance	➢ Bankers not very familiar with geothermal
N/A	N/A

Various configurations of public-private partnership are possible



Countries following model

- Kenya (Kengen-Olkaria), Ethiopia, Costa Rica
- Mexico OPF
- Kenya (GDC), Guatemala (Zunil)
- Philippines, Indonesia, Guatemala (Amatitlan)
- Indonesia, New Zealand, Turkey (MTA)
- Germany, France
- USA, Nicaragua, Chile
- Philippines (Chevron), Australia, Italy, Ethiopia

Source: World Bank – Geothermal Handbook: Planning and financing power generation

How can we scale up Geothermal Financing?

Sponsors

- Geothermal Expertise
- Local knowledge
- Financial Resource
- Scale to be able to finance on a corporate/portfolio basis

Regulatory / Sector Framework

- Transparent, predictable and sustainable
- Geothermal Incentives
- Standardized contracts
- Public role in bearing geothermal resource risk?

Scaling up Geothermal Financing

Technologies

- More accurate and faster resource assessment
- Faster and less costly drilling
- Reduction in US$ per MW and equipment lead-time

Lenders

- In-house resource engineer (or close collaboration with outside resource consultant)
- Geothermal financing experience
- Creativity and innovation

Case: Ethiopia Geothermal Development

- High Geothermal potential - 5,000MW with high impl. target for next 20 years
- Geothermal energy cost in parity with Hydro development in 5-10 years
- SREP funded initiative for GoE Geothermal strategy executed and adopted
- GoE moving fast to develop, legal, regulatory, Institutional framework
- Geothermal law in preparation, Institutional following
- Extensive donor support
- Portfolio approach to geothermal development:
  - Green/Brown Field entry – (IPP in final stages)
  - Test Drilling by public sector, then involve private sector - multiple options for PPP, BTO
  - Public Sector 70MW plant development under multi-donors

Good luck to Geothermal Development

Thank you

Ahsanteni Sana

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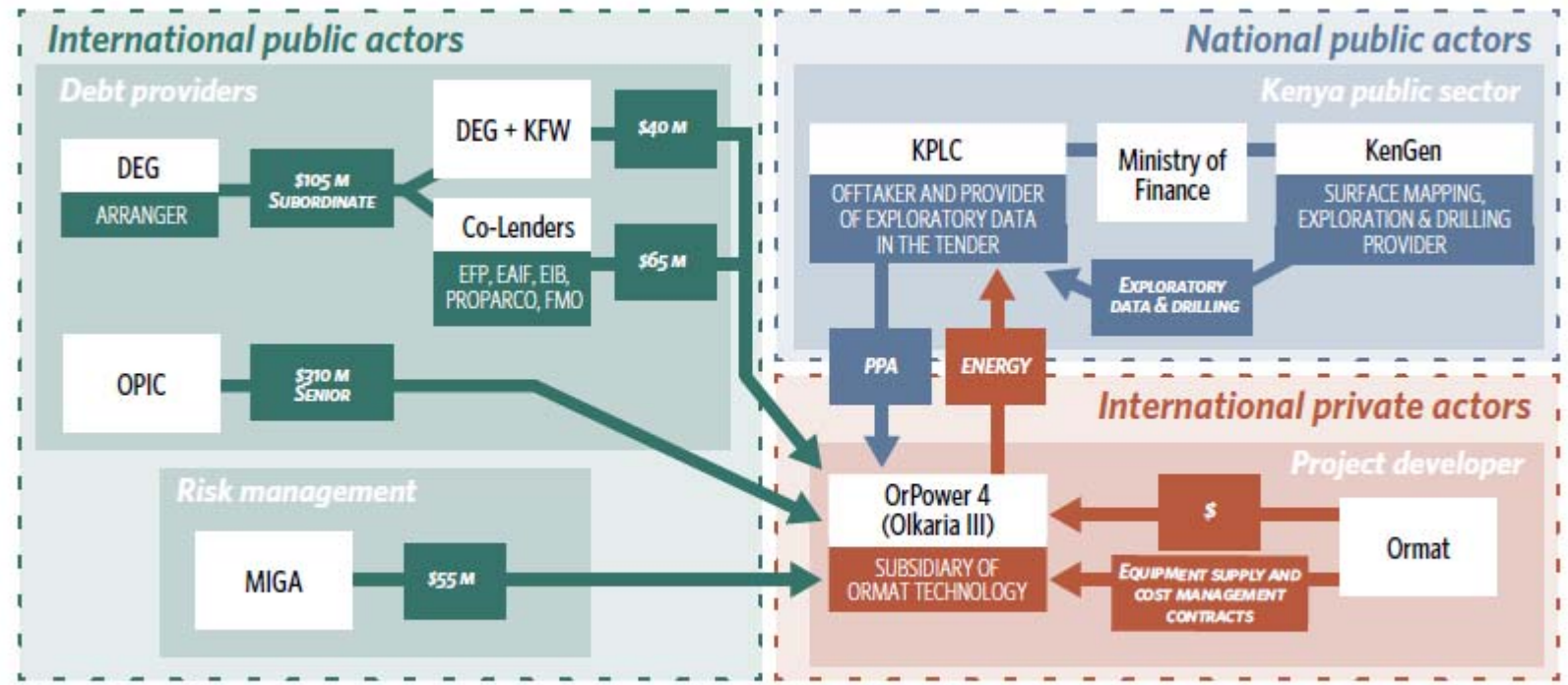
(amesegenallo)

Extras

10 Commandments for unlocking Geothermal

1. Good resource
2. Clear Government commitment -Legal–Institutional – Tax – Currency
3. Government to de-risk development
4. Off taker agreements
5. Good PPP framework
6. Volume of business needs to be sufficient
7. Returns of Investment must be good to atract
8. Capacity in the country must be able to support sector
9. Engage Financing institutes early
10. Look for Major companies – utilities Financiers and investors

Case: Kenya Olkaria III Financing



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.

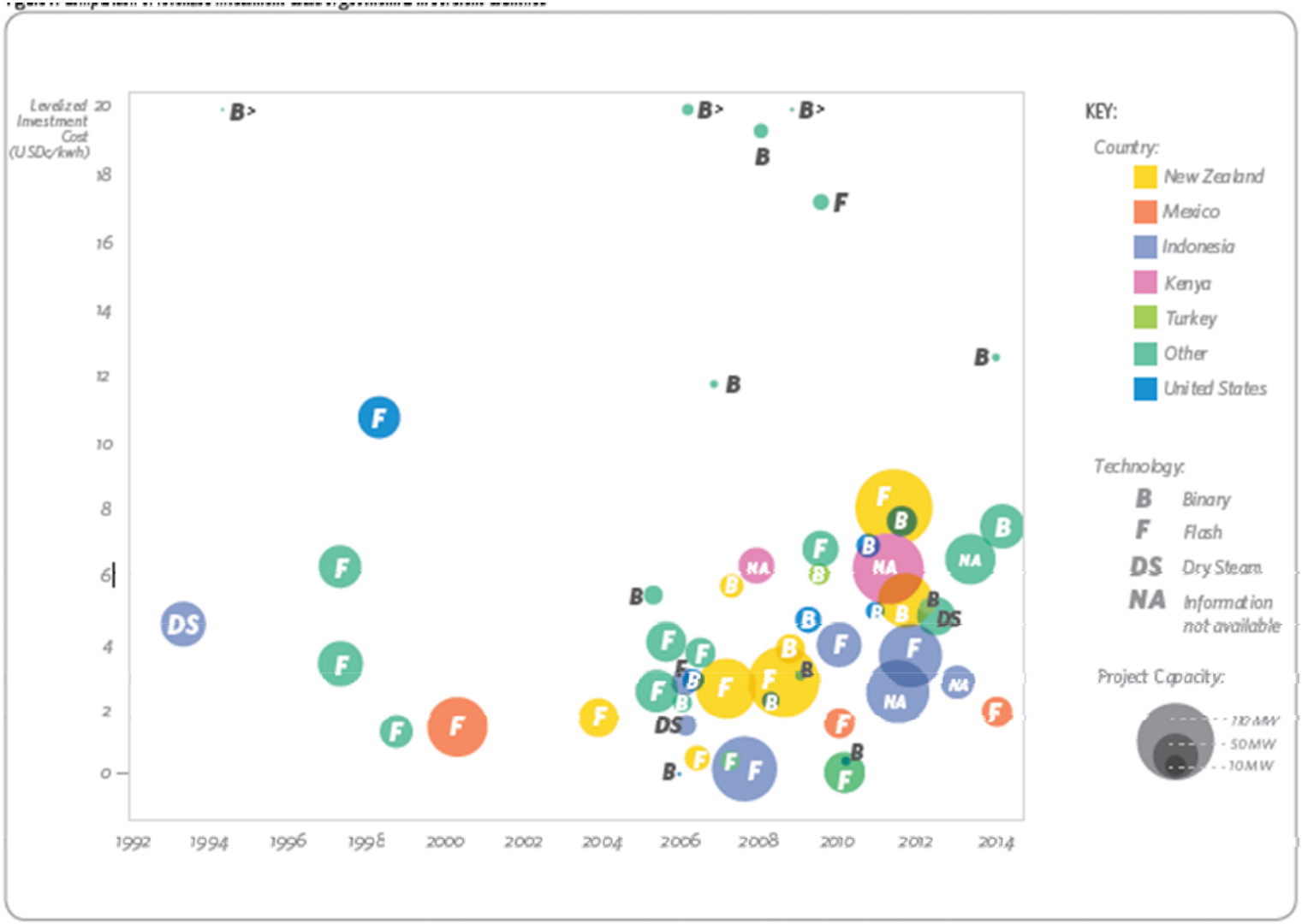
http://clmtp.lc/1AKepFU

Financing the 280MW Olkaria IV Power Plant
Source: Kengen Financing Mechanisms for Geothermal Projects in Kenya
Proceedings World Geothermal Congress 2015, Melbourne, Australia, 19-25 April 2015

Project Component	GOK	KenGen	JICA	WB	AfD	EIB	KfW	Total (US$
Drilling Costs	313						15	328
Steamfield Development		7		107			54	168
Power Plants		35	323		210	135		703
Transmission	3.4					31.6		35
Consultancy Services							30	30
Admin & Local Infr.		29		12				41
RAP		10						10
BoC				1				1
IDC		57						57
TOTAL	316.4	138	323	120	210	167	99	1,373

Table 8.1: SREP Investment Plan for Ethiopia (US$ Million)

Project	Total Cost	GoE	SREP	MDBs	Others
Aluto Langano Geothermal Field Development	231.6	80.6	24.5	60.0	66.5
Geothermal Sector Strategy	2.0	0.5	1.5	-	-
Assela Wind Farm Project	250.0	40	20.0	140.0	50.0
Clean Energy SMEs Capacity Building and Investment Facility	12.0	-	4.0	4.0	4.0
Total	**495.6**	**121.1**	**50.0**	**204.0**	**120.5**



Note: Levelized investment costs expressed in constant 2010 USDc/kWh, assuming 10% discount rates; substantial early exploration costs are not available. Colors are associated to different countries; grey dots refer to "other" countries; squares represent projects >10MW, while diamonds represent projects less than 10 MW in size.

Utilization of geothermal energy 2005