

Geothermal Development in Africa: The Corbetti Example



Reykjavik Geothermal

- A Geothermal Development, Consulting and Investment Company
- Founded in 2008 to harness the vast untapped development opportunities in the geothermal sector worldwide
- Focused on developing and emerging markets – and actively investing in Africa



Advantages of Geothermal Energy

Renewable Energy Challenges

Geothermal Advantages

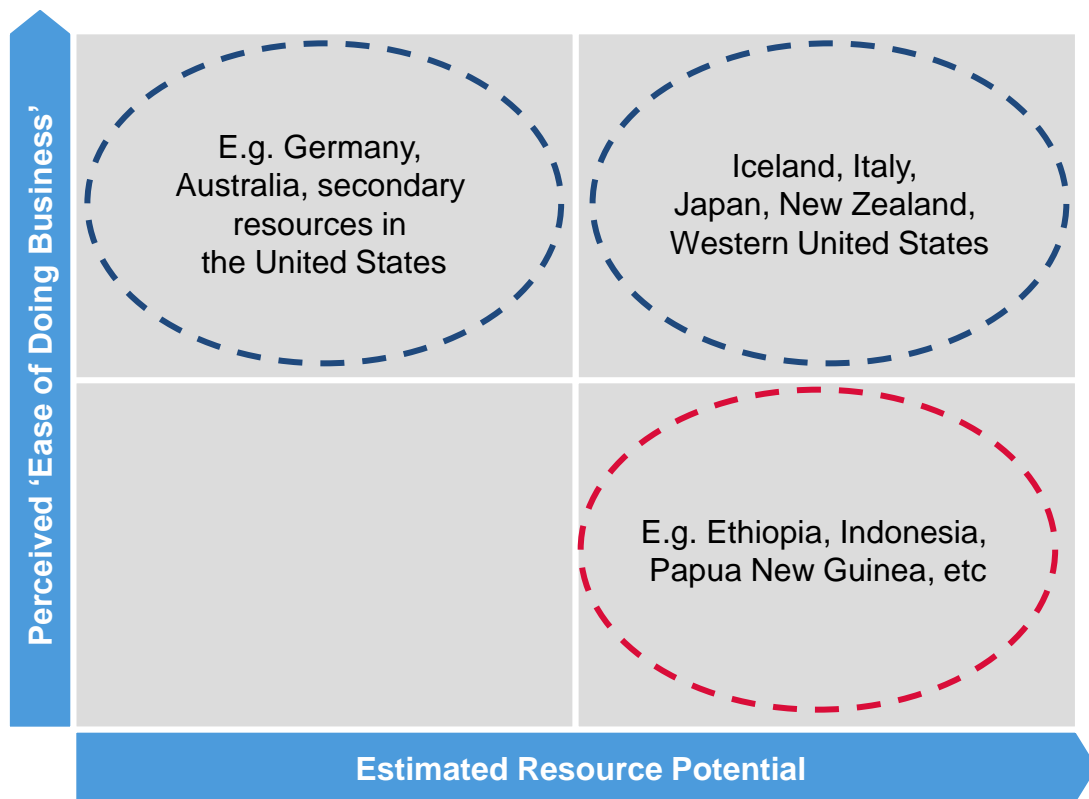
High Costs	◊	Low Cost	Cost-competitive with coal and natural gas, and cost-advantaged to other renewable sources
Unstable Yield	◊	Base-Load Power	Operates at 95%+ capacity factor or “up-time”
Large-Scale Land Needs	◊	Small Geographic Footprint	Lowest land use per MW of any renewable energy source, and minimal environmental impact compared, for example, to large scale hydro
Evolving Technologies	◊	Mature Technology	Well-proven steam power generation technology - the first geothermal plant built in 1904 still in operation today (Lardarello, Italy)
Limited Off-Shoot Industry Potential	◊	High Off-Shoot Industry Potential	In most countries with geothermal development various off-shoot industries have developed, e.g. spas & tourism, food processing, district cooling and industrial heating

Resource potential is fixed, but market attractiveness can be improved

Country Risk Vs. Resource Potential

(Conceptual Illustration of Geothermal Market Characteristics)

Conceptual



- The majority of the world's best resources are located in developing and emerging markets
- Due to perceived country risk, private financing tends to be more difficult to come by and more expensive
- RG targets countries with high resource potential where the authorities have demonstrated a real willingness to help facilitate a geothermal IPP
- **Bottleneck: Finding attractive projects**

Geothermal Development in Africa

Opportunities

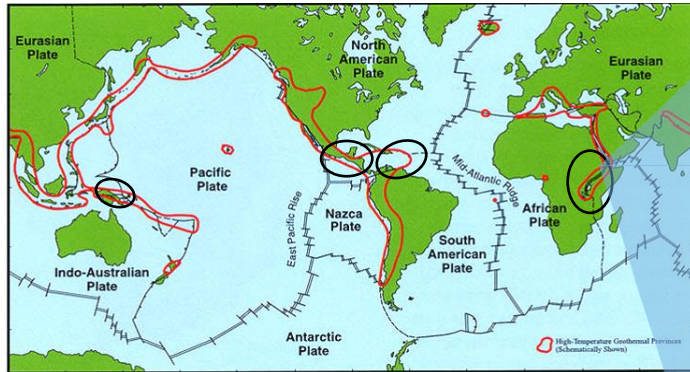
- World-class geothermal sites
 - ➔ **Lower resource risk**
- High demand for power development
 - ➔ **Geothermal frequently least-cost option**
- Project financing generally available for proven resources
 - ➔ **Facilitates capital intensive later stage development**
- Vast majority of resources remain undeveloped
 - ➔ **Market opportunities for developers comfortable with taking exploration and country risk**

Constraints

- Underdeveloped energy markets – frequently single buyer system
 - ➔ **Increased off-take risk – governmental guaranties needed**
- Incumbent investment in generation based on grants or low interest loans
 - ➔ **Market price distortions - power prices subsidized**
- Governmental laws and regulations often unsuitable for geothermal development
 - ➔ **Framework and contract negotiations are cost and time consuming**
- Perceived country and exploration risk
 - ➔ **Difficult to get financing from investors or DFIs for early stage development**

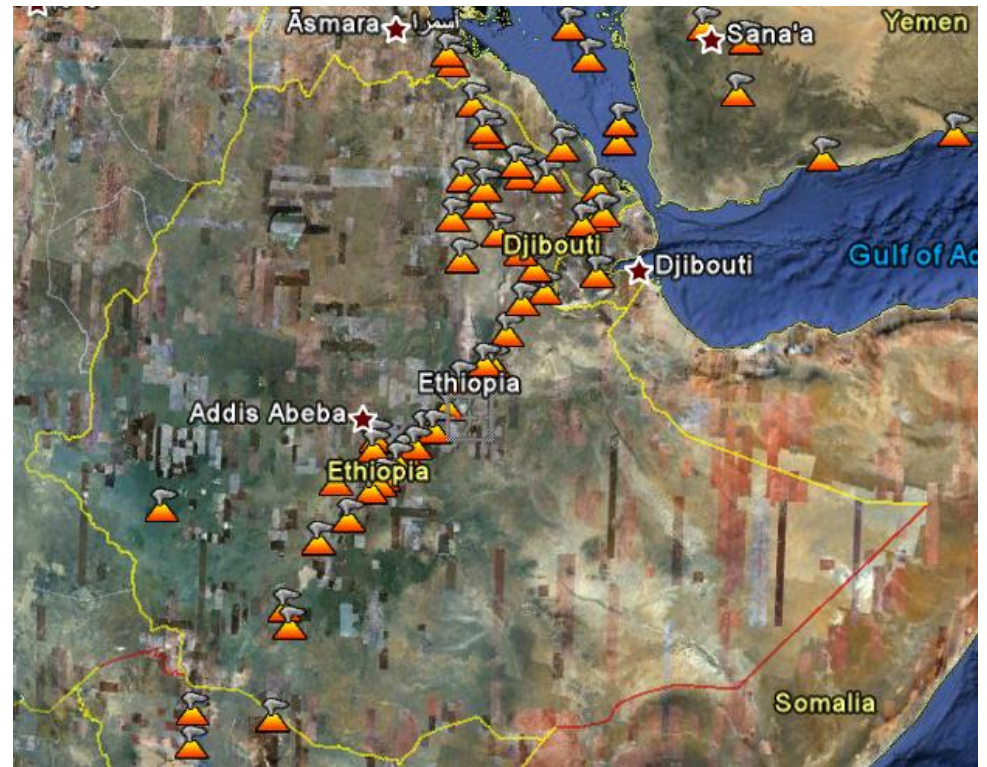
The Corbetti Geothermal Project, Ethiopia

Reykjavik Geothermal's Focus Areas



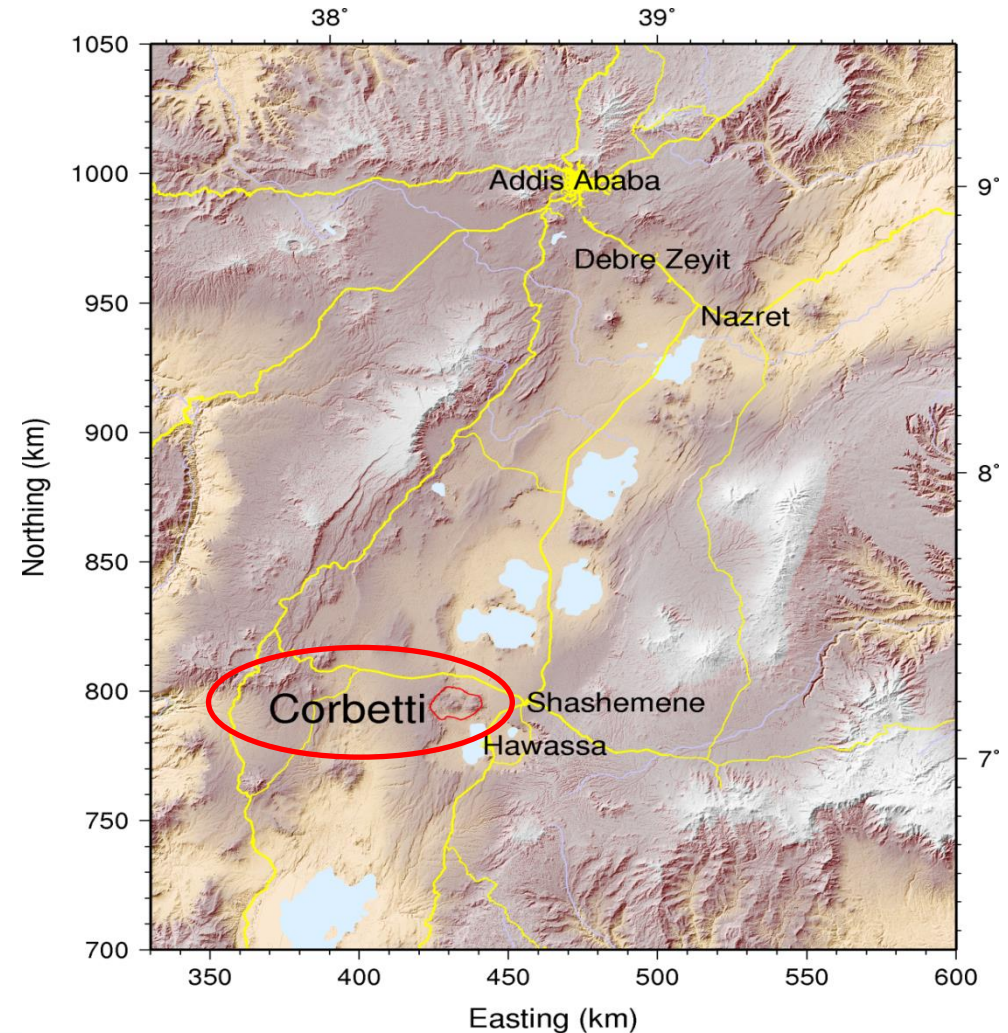
- Ethiopia has potential for thousands of MW of clean, sustainable and affordable power from geothermal sources
- Geothermal power generation can:
 - Provide thousands of MW of base load power
 - Be highly compatible with existing hydro-electric power infrastructure, as demonstrated by the Icelandic example

Volcanoes of Ethiopia



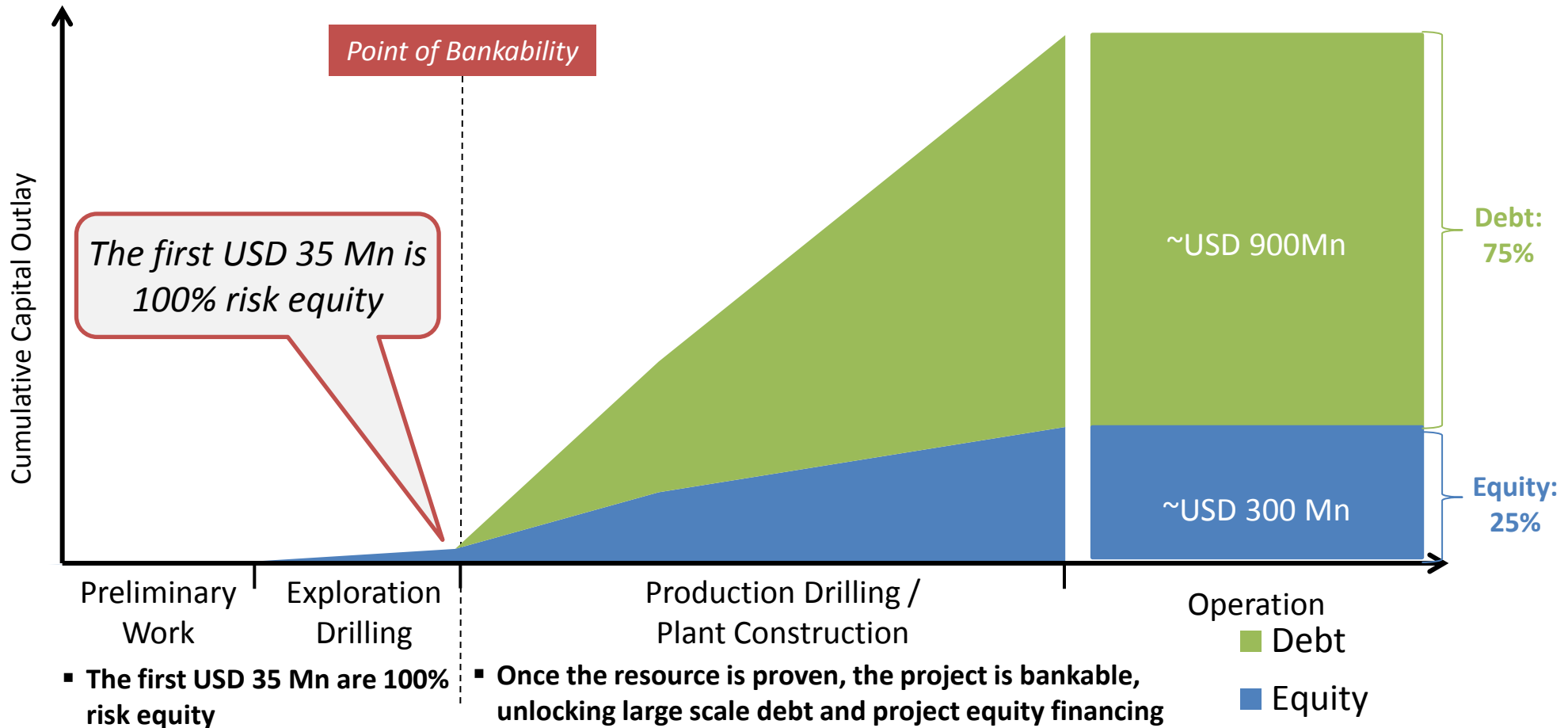
Corbetti: Project Highlights

- 300 MW development (site is believed to have potential exceeding 1,000 MW)
- Set to become the first IPP in Ethiopia
- Developed by RG and Sithe Global, part of the Blackstone Group
- Close collaboration with the Government of Ethiopia, EEPKO and the Geological Survey of Ethiopia



Financing a \$1.2 Bn geothermal project

Assumed Financing of Geothermal Power Development (300 MW Plant)⁽¹⁾



1) All numbers rounded estimates

Developmental Impact of the Project

Element	Impact of Large Scale Geothermal IPP Development
<i>Power Sector</i>	Adding a cost-competitive base-load renewable power source operating at 95%+ capacity factor or “up-time” would diversify Ethiopia’s power generation system, making it more reliable, more environmentally friendly, more competitive, and more attractive to industry
<i>Government Finances</i>	Reykjavik Geothermal/Sithe Global are willing to finance 100% of the USD 1.2 Bn+ project using private capital and external debt, freeing up Ethiopian Government resources for hydro and other development priorities
<i>Future Power Development</i>	Once the first privately financed power project is up and running, other private power developers will likely be attracted to Ethiopia (similar to what has been seen in the country’s mining sector), giving the GoE options for future development
<i>Capacity Building</i>	A world-class, utility scale geothermal project, along with developments in Aluto-Langanot and Tendaho, will have an immense effect on sector capacity building. Similarly, Ethiopia’s first IPP project will build important managerial, technical, administrative, financial and legislative capacity
<i>Industrial Development</i>	In most countries with geothermal development various off-shoot industries have developed using the plentiful thermal energy and mineral resources available, e.g. spas & tourism, food processing, district cooling, aquaculture, and various industrial processes using thermal energy

Progress to date

1. Foundation

- ✓ Form strategic partnership with local partner company
- ✓ Develop close working relationship with the Ethiopian Geological Survey and the Ministry of Mines
- ✓ Complete initial site surveys
- ✓ Complete Environmental and Social Impact baseline
- ✓ Secure optimal first geothermal concession for initial development
- ✓ Attract strong investors
- ◻ Negotiate PPA / IA

2. Quick Wins

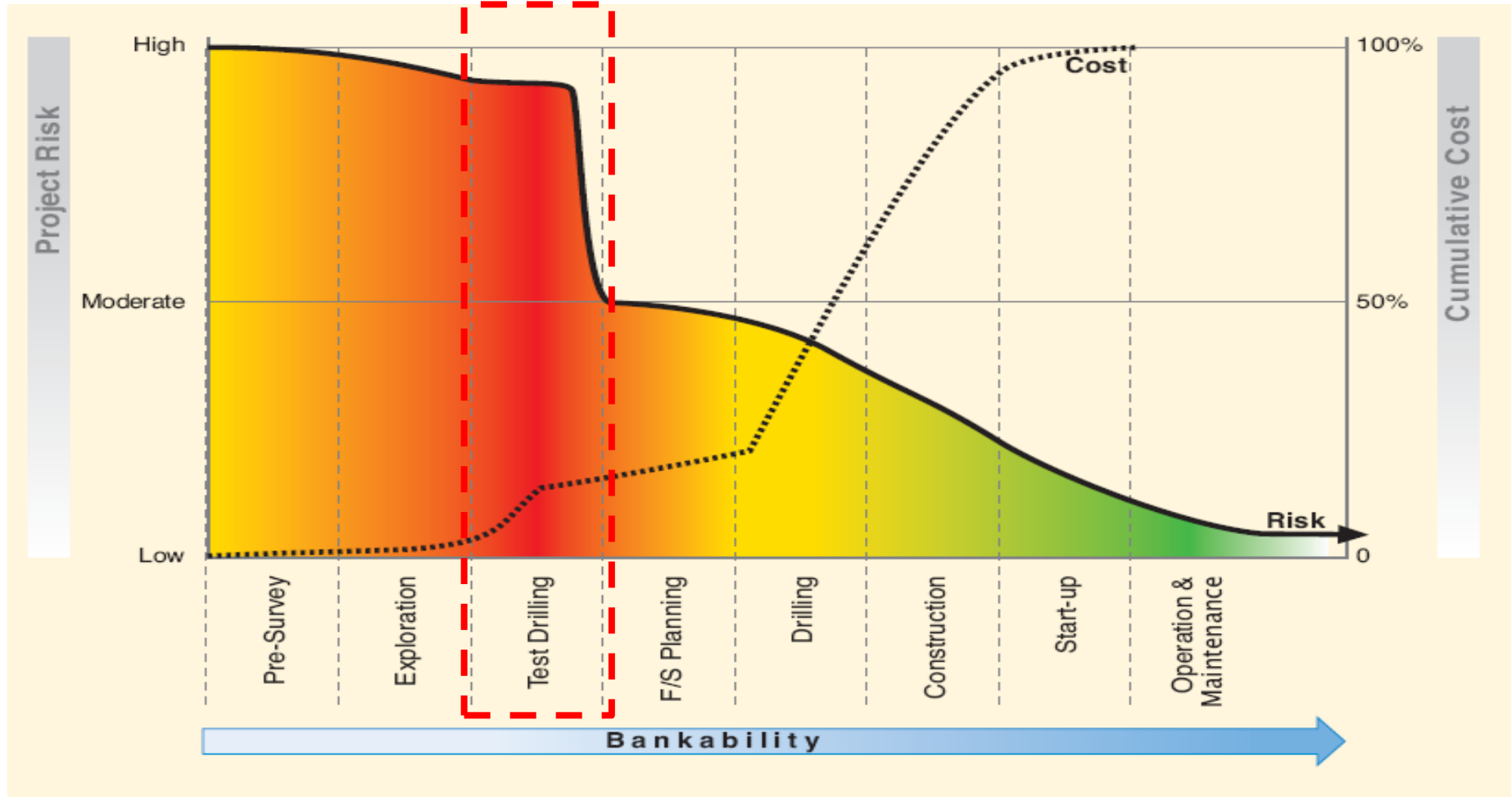
- Establish momentum through quick wins, e.g.:
 - ✓ Complete surface exploration work in three months
 - Start exploration drilling within 6-9 months
 - 5-10 MW online within 18-24 months
 - 300 MW online within 4-5 years
- ✓ Start build-up of local capacity by training local RG and Geological Survey employees
- ✓ First Ethiopian experts hired for overseas projects

3. Transformation

- Build on initial successes to achieve a large-scale buildup of geothermal power capacity:
 - Establish infrastructure to attract other developers
 - Lower prices to levels seen in countries with mature geothermal industries
 - Develop other sites totaling up to 1,000+ MW
 - Provide baseload compliment to hydroelectric sector, laying groundwork for large scale exportation of power
- Establish local center for geothermal training to transfer knowledge to the people of Ethiopia

- ✓ Completed
- ◻ Currently Ongoing

Geothermal Project Risk vs Cost



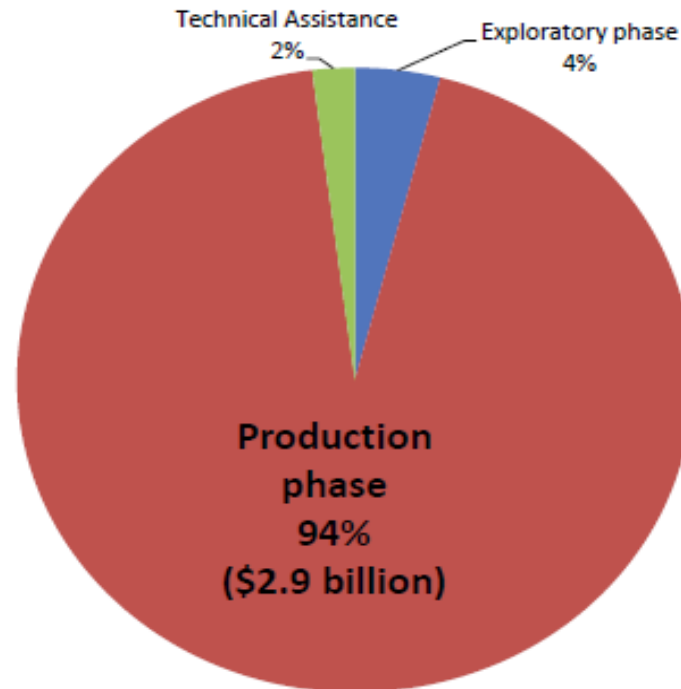
- Once the resource is proven, the project is bankable, unlocking large scale debt and project equity financing

In the World Bank's words:

Are MDBs focusing on mitigating resource risks?

(well,... not really)

(Three Decades of Cumulative Multilateral Development Bank Lending for Geothermal Energy Development)



The Geothermal Risk Mitigation Facility

- Unlike most other development finance institutions, the EU-Africa Infrastructure Trust Fund and the German Federal Ministry for with Economic Cooperation and Development via KfW Entwicklungsbank (KfW) on the one side and the African Union Commission (AUC) on the other side are making a serious effort to fund geothermal exploration in Africa through the Geothermal Risk Mitigation Facility (GRMF)

If the Corbetti project were to receive support from GRMF, this would:

- Provide several million Euro in grants to mitigate the risk of exploration drilling, covering up to 40% of the first and riskiest geothermal wells
- Make it significantly easier to attract initial private risk capital to “prove” resources
- Help deploy significant private investment and debt capital through “blending”:
 - ~USD 30 Mn of private investment initially to prove the resource and bring it to financial close
 - ~USD 1.2 Bn of total debt and equity financing for a 300 MW project