

Alternative Design of Geothermal Support Mechanisms and Risk Mitigation Funds

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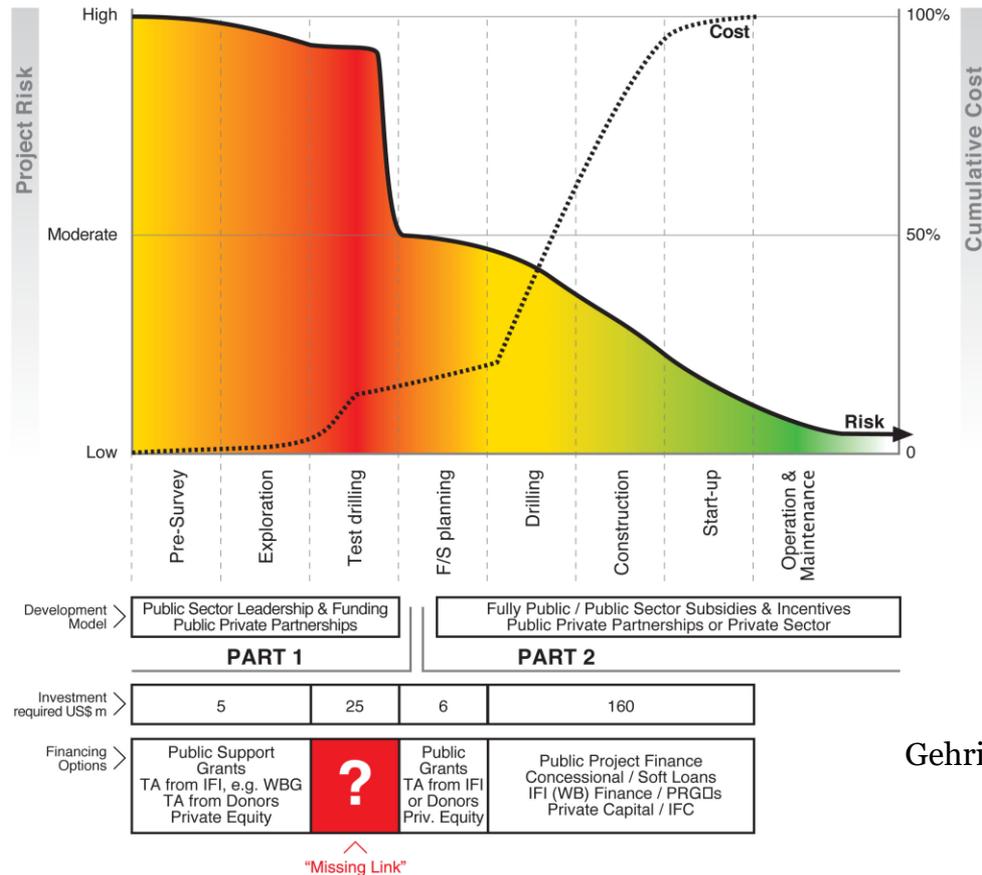
Magnus Gehringer, CEO (M.Sc.)

***Consent Energy* LLC**

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Special Challenges of Geothermal Resource Development

Financing a Typical Medium Size Geothermal Power Project (50MW)



Gehring, 2013

Challenges

- The first two project phases can often be financed by the IPP or state-owned dedicated agency / parastatal.
- The power plant construction phase can usually be financed through commercial banks, since risk is at an acceptable level.
- Due to the high risk of test drilling (with estimated average success rate around 60%) and the relatively high investment cost of US\$20–30M, commercial banks are not able to fund test drilling.
- As a result, the entry point for the private sector is usually not until after the resource potential has been confirmed through test drilling and a feasibility study has been completed.

Mitigation of Resource Risk - Four Important Approaches

1. **Portfolio exploration**, in which the country, to some extent, explores and evaluates multiple geothermal fields simultaneously, thereby increasing the probability of finding at least some viable sites and reducing the chance of overlooking significant development opportunities.
2. **Parallel development** of the fields selected from the portfolio, so as to multiply the pace of development while reducing time and costs.
3. **Stepwise expansion**, reducing the risk of reservoir depletion and pressure drops by developing a geothermal power project in cautiously sized increments and steps based on reservoir data. As a rule of thumb, a pilot power plant (e.g., a 2–10 MWe wellhead generator) should be installed to gain solid geophysical data about the reservoir over a period of 1–2 years. Thereafter, and based on this information, a utility-scale power plant can be built in incremental steps of 25 or 50 MWe, depending on field potential and observed pressure decline.
4. The country's **minimum system demand** for electricity will determine the maximum amount of geothermal capacity that can be installed in a given country or region, since geothermal is base load. Unlike the oil and gas industry, which serves the global market, demand for geothermal power is localized and limited by a specific minimum system demand of a country or region (base load). This means that the entire demand for base-load geothermal power may be met by a relatively small number of productive geothermal fields.

Indicative Overview of Existing Geothermal RMFs (Gehring, 2017)

No.	Lead Institution	Name	Est. capital Million US\$	Target
1	CTF	DPSP	>100	early stage
2	EU	INTERREG	>8	R&D Caribbean
3	EU	GEOTREF	68	Fract Res. Caribbean
4	France	ADEME	n/a	in preparation
5	ICEIDA	WB-Iceland Compact	> 10	exploration
6	IDB	Latin America	n/a	n/a
7	Indonesia	Geothermal Fund	30 / project	soft loans
8	ITF EU	Africa Infrastr. Trust Fund	n/a	n/a
9	KfW	GRMF Africa	> 60	40% early stage
10	KfW	GDF South America	> 50	40% early stage
11	NDF	n/a	> 5	support other funds
12	UNEP	ArGeo	n/a	TA
13	US Government	Power Africa	n/a	early stage
14	USAID	EAGP	>1	TA
15	World Bank	Caribbean Fund	n/a	in preparation

Current Funding Systems and Risk Mitigation Funds

Besides several small regional geothermal funding and support schemes that provide grants, often on a political or bilateral basis, the overview above mainly shows two kinds of RMFs:

1. Insurance policies covering test wells; and
2. Combinations of grants and loans for geothermal exploration and test wells, available by application on a case-by-case basis.

Both approaches have been used for decades, but neither has had unbridled success.

The Insurance Scheme

- ... is based on subsidizing the insurance premium for one or more test wells for a project developer. The developer can usually be a private-sector company or a public utility or power company. The rationale behind the insurance scheme is that with test drillings de-risked, developers should be able to receive financing for drilling costs from commercial banks.
- Developers might not have the capital for the equity share, e.g. 30% of \$30m.
- While test drilling might confirm steam availability, it does not ascertain or confirm the long-term production capability of the reservoir and, hence, the investor/developer is still unsure of whether to invest long-term funding in the project.
- Even if the developer would get reimbursed for the drilling cost of failed wells, he still has wasted time (e.g. 2 years) and diluted his company's balance sheet.

The Grant and Loan Support Scheme

- Government geothermal agencies but also IPPs may have limited technical and financial capacity (proof of funds).
- Grants and soft loans attract IPPs focusing on speculation (reselling concessions after minor activities) and license hoarding.
- Large and strong companies do not apply since they cannot be sure about the reservoir potential. As long as they cannot be sure about a minimum reservoir potential of several hundred MW, they will prefer investing elsewhere.
- In summary, we believe that sufficient drilling, long-term well testing, and resource evaluation with a pilot power plant are needed to provide interested parties with sufficient scientific data about the megawatt potential of a geothermal reservoir to incentivize investment. Currently, existing RMFs do not provide this kind of funding or risk mitigation, which explains these schemes' failure to facilitate geothermal development.

Our Approach for an Effective RMF Structure

- What makes this RMF structure unique is mainly the deployment of a small geothermal pilot power plant (e.g. 5 MWe) that needs to be operated for at least one year, with all reservoir data collected and scientifically interpreted. The conceptual model would be refined as data becomes available. A package containing all permits and licenses for future operations, combined with a “bankable” technical, financial and environmental (ESIA) feasibility study will put a firm price tag on each pre-developed field. Next steps like continued drilling and power plant can be realistically planned and financed. The right size developers get attracted to each field. Finally, the power plant can be moved to the next field and the sales value of the field will provide funds for further development, either back to the RMF or the state geothermal agency.
- It is also very important that all raw data acquisition and processing should be up to international best practices, so potential future developers would not doubt their quality or dispute the value of the field.

Features of an Effective Alternative RMF I

1. Builds in-country geothermal capacity (manpower and institutional) and a resource database by focusing on cooperation with the public sector (usually, a country's dedicated geothermal agency). The access point for private-sector companies is at a later stage, when the resource potential and commercial viability of a reservoir have been proven by long-term operation.
2. Provides full grant support for exploration and test drilling. At least two active wells (one production and one reinjection) will be needed to retrieve appropriate long-term and interference data from the reservoir. These data should prove the viability of installing a small pilot plant to utilize the resource for power generation.
3. Makes grant funding available for Environmental and Social Impact Assessment (ESIA) and pre-feasibility studies, looking at market issues, tariffs, off-takers, transmission, and other issues that might determine and influence project viability at a later stage.

Features of an Effective Alternative RMF II

4. Provides a country's dedicated geothermal agency with debt financing for a modular pilot plant (e.g., ~5 MWe capacity) to be connected to the two or more test wells that have been drilled. The power from this plant can be used on- or off-grid. Experienced technical consultants support the project development, while the country's agency participates in planning, installation and operation the project. The pilot wellhead power plant generates power over a timeframe of at least one whole year. Data received from this operation, along with volumetric assessments and simulations, will reveal significant amounts of data about the reservoir leading to a firm understanding of the conceptual model of the project, reservoir interference, and, most importantly, the overall sustainable potential of the reservoir. At this stage, the availability of steam for an initial power plant (see our discussion on the Stepwise Approach above) can be guaranteed and, at the same time, a strong indication of the future total capacity of the steamfield will be obtained. This will allow future developers to make an informed decision about whether to bid for the field.

5. Allows the pilot power plant to be moved and the process repeated at the next developed geothermal field, after the initial field has been fully tested and gets expanded.

Features of an Effective Alternative RMF III

6. Produces a “bankable” full feasibility study for each geothermal field (consisting of technical, financial, and environmental components) to provide scientific facts about the reservoir potential and commercial viability to IPPs and/or state-owned power companies. These parties can now make informed decisions about further developing the field, or they might choose to put the project out for bidding by tendering out the geothermal field. Since the resource risk has been removed, the parties can use their bankable project documentation to obtain funding through commercial banks and funding institutions as if for a construction project. Furthermore, the bidding parties should be supplied with a full package of all licenses and permits needed to move directly into financing the first phase of the power project (e.g., a 25–50 MWe power unit).
7. Provides consultancy and supervision to the project developer through all project phases, to ensure that the feasibility study results in project financing and to guide the developer through any legal, institutional, or technical problems that could arise.
8. The (possibly rotating) RMF should have a total endowment of around US\$100–150M in order to support 3 to 4 countries.

Thank You for Your Kind Attention

- For more info and details, please read the entire report in the GRC 2017 Annual Meeting's proceedings, or
- Contact me:

***Consent Energy* LLC**

Expertise for Geothermal, Hydro, Oil & Gas

Magnus Gehringer M.Sc.
CEO

Project Development & Consultancy
Geothermal & Hydro

magnus@consentenergy.com

1254 Van Buren Street, NW
Washington, DC 20012 USA
Office +1-202-291-0363
Mobile + 1-202-569-4109
www.consentenergy.com