Proceedings World Geothermal Congress 2020+1
Reykjavik, Iceland, April - October 2021

Financing Aluto Langano Geothermal Project Field: an Overview of LA 9D and LA10D

Makda Kinfe

Ministry of Mines Petroleum and Natural Gas

Geological Survey of Ethiopia (G.S.E)

kinfemakda@gmail.com, makda.kinfe@gse.gov.et

Keywords: Project bond, Credit enhancement, FiT, Economics of geothermal technology

ABSTRACT

The project proclamation rules and regulations provide for the granting of concessions to the private sector and requires that public entities also get a exploration and development license prior to commencing any activities on the land. The recently conducted Well LA-9D and LA-10D were both drilled prior to enactment of the Proclamation, Rules and Regulations and Directives. Even before the acceptance of the AUC Code of Practice. The US has used production tax credits successfully-Aluto Langano basically gets the equivalent of about 2 cents per kWh over and above the tariff. Two cent added for a certain number of MWe at each new field. Equity is extremely hard to come-by and there are few sources for private investors and cost of equity is generally high, with a -20+% expected return. Demand does not seem to be a major issue as moving to greater and greater electrification and economic growth. Price on the other hand, is not making development attractive. One bad well, because it was poorly sited and targeted, will cost 10 times the cost of the entire data acquisition and management system. For this reason, the project has planned to purchase software and trainee expertise.

Aim

The paper aims to prepare professionals who want to integrate a robust theoretical training with a strong practical knowledge of emerging trends in the Aluto Langano geothermal project for their careers. This paper offers several examinations of important characteristics of the project finance, in the view of its future and present financial distress, and the role of ARGeo. It also helps the policy makers and donors understand which financing tool to use in order to enable fast and cost-effective development of geothermal energy.

INTRODUCTION

With a load factor of more than 90%, the fact that it can produce a steady output around the clock makes geothermal power competitive with newly built conventional power plants, especially in areas where high-temperature hydrothermal resources are available. However, it is a capital-intensive technology that needs 5-7 years to become operational from the start of the permitting process until commissioning. The significant upfront investment is related to the drilling and to the need to cover the geological risk at the beginning of the exploration. This is true for all deep geothermal projects. In most instances projects by the private sector must be done with equity financing, most geothermal companies are not large enough and financially capable of financing projects on their own books. So, capital has to be raised and that means selling stock. But how do you sell stock when you have not done the exploration? Here is where government programs come into play and there have been probably hundreds of programs made available to provide financing for the first few wells, grants-usually requiring matching funds-maybe as low as 10-20% by the company and the remainder by the government (GRMF provides only 40% and is way too low). Others may be insurance companies or retirement funds that will take some risk. Generally, banks will not take that kind of upfront risk. But even to get a drilling grant you generally have to complete surface studies and the cost of that could be a million dollars, and if a detailed environmental study is also a prerequisite to exploration, it can cost a few hundred thousand. So where does that money come from, generally government sponsored exploration (GRMF provides 80% grants for surface studies).The other alternative is for the government to do the exploration and then tender the project or build it itself. The paper is organized as follows. Section 1 provides a general description of the project finance. Section 2 identifies the economic reasons for using project finance and assesses the role of the project bond market to fund project finance. Section 3 evaluates the proposed financial support (strategies that monitor project risk as an experienced player, and the provided guarantees/sub-debt to obtain ratings uplift). The final section discusses policy implications and conclusions. Through those sections, which share a systematic analytical framework, analyses the type of mechanisms employed by the public sector to catalyze and incentivize investment deals with risk and barriers that impede investment, establish supporting policy and institutional development, and address capital constraints.

1. GENERAL DESCRIPTION OF THE PROJECT FINANCE

With private exploration and drilling, another big need beyond good solid evidence of a resource and even before drilling can start, is knowing that there is an offer for the power at a price that makes it feasible. Realizing the geothermal potential will therefore require massive investment. Indeed, public support for geothermal energy, e.g. through a feed-in tariff, is available today to compensate for market failures and mobilize private financing. This will allow emerging geothermal technologies to progress along their learning curve and reach full competitiveness in the next few years. Against this background, a greater involvement of the private sector is essential. Yet not all financial institutions and private investors are familiar with the complexity of geothermal technology, its challenges, and environmental and economic benefits. A diffident approach towards the sector is need. The lack of capital, notably during the early project- stages, has commonly been a barrier hindering the growth of geothermal power. It should be added that the current capital crunch obstructs the necessary financing even further.

Here we had a great example of high demand and attractive price, we called it the gold rush of the geothermal industry. At Aluto geothermal project, demand does not seem to be a major issue as countries move to greater and greater electrification and economic growth. Price on the other hand is not making development attractive. A study of a few years ago in Indonesia pegged the needed price at between 11 and 15 cents per kWh. Price was somewhat dependent upon where the power was most needed and difficulty of producing.

In the US we had an incentive program by California Utilities that was called Standard Offer Number 4. You could simply walk in the door and sign up to deliver 50 to 100 MWe and you received a contract that paid you 10+ cents per kWh for the first 10 years and then price went down to the prevailing rate at that time, but the plant and well field was generally paid for by that time. This made it easy to get equity financing from selling stock, and once you had a sound discovery it was then possible to get some bank financing, but at a fairly high rate. Once the project was built and commissioned, you could refinance at a lower rate

So to really finance a project by the private sector based on most sources of financing, you really need a discovery. A PPA for the output and then a series of contracts for work that are covered by guarantee clauses that protect the project, equipment, construction etc. etc. Governments should have the same guarantees, but governments are generally "self-insured", so that is another issue as self-insured really means nothing.
Getting a price of 10 cents in Ethiopia(Aluto project) I think would be very difficult as some of the new solar is coming in at 2 cents. Corbetti contract is for around 7 cents but has unrealistic escalators, I'm not sure how that has been resolved. Setting a feed-in-tariff is an attractive way to move developments, but so far Ethiopia has not set a feed in tariff. I believe Kenya has, I do not know the level at which it is now set, but it has different prices for different levels of output. Other things can also be done. The US has used production tax credits successfully, the Aluto project basically get the equivalent of about 2 cents per kWh over and above the tariff. So, if you sell for 8 cents, you get the equivalent of 10. However, Ethiopia has waved all taxes so there is nothing to give as a carrot. We have also used a 2 cent adder for a certain number of MWe at each new field. Say 2 cents per kWh added to the price for the first 50 MWe. That could also be time limited to 10 years for example.

In order to realize the full potential of geothermal energy, to the benefit of Ethiopian economies and citizens alike, it needs increased and dedicated support now. With the accelerated deployment of geothermal energy and added requirement for investments, it is clear that it cannot solely rely on public funds. Hence, the engagement of the private sector will become increasingly more crucial. It is also clear that geothermal projects are a less attractive option than other renewable energy technologies in ways that make obtaining financing more challenging. It is especially the significant investment required to find and prove the geothermal resource, an activity akin to oil and gas exploration, which is unique to geothermal among renewable energy resources. This facet substantially changes the power project's level of certainty in its early stages, as well as, the development time required relative to other renewable energy resources.

Well LA-9 and LA-10 were both drilled prior to enactment of the Proclamation, Rules and Regulations and Directives. Even before the acceptance of the AUC Code of Practice. The only thing that had some relevance to the project was the Mineral law that provided access to the land. And of course, environmental law!! The Proclamation provides for the granting of concessions to the private sector, it also requires that public entities get a exploration and development license prior to commencing any activities on the land. There is a reconnaissance license, but it gives only access and no long-term security to the applicant. The development license gives the developer 20 years, but prior to that the exploration license requires that drilling begin in 5 years; there are some provisions for extensions. There is more detail in the Rules and Regulations promulgated by EEP. There are also a number of directives that have been adopted by EEA and should also be reviewed. Some have provisions that are real deterrents to development, such as depositing money in an Ethiopian bank prior to initiating exploration, which was taken out. The project itself has not been contributor towards better funding of geothermal as well business projects. The levelized cost of energy methodology is described and calculated with the following equation. The average LCOE for geothermal project is between 30 -145 USD/MWh. So, this project has rather low LCOE

LCOE = Equity share(USD) − discount relevant(USD) / Discount energy sales (MWh)

Value	**Activities-benefits in general**	**EEP**	**Nation**	**GSE**
Policy Coordination	Better equity policy and success	relevant	relevant	relevant
Cooperation on different topics	More national and international activities	partial	partial	partial
Building network information cooperation	More networks working with additional bodies	relevant	relevant	relevant
Economic benefits	Economic of sales and more competitiveness	partial	partial	partial
Technical and financial issues	Funding from WB	relevant	relevant	partial
Climate contribution	Less CO_2, less climate risk, and raising quality of life	relevant	relevant	relevant

As for the development of the regulatory environment, IFC played an initial role in helping to identify needs of the regulatory, institutional, and legal environment. The United States Energy Association funded the development of the Proclamation and the work

was carried out by the team put together by me, and the work was managed by a friend of mine from the US, the lawyer Kathy Callison. The proclamation was developed with interaction between the team and MoWIE and with some input form EEA and EEP, GSE also played a small role early on when Corbetti was trying to get a "sweetheart deal" going around the law. Industry players were also consulted, but were never in the room when things were being discussed and drafted. They did make their concerns known, but the role was to protect the integrity of the process and to protect the resources of the people of Ethiopia . The Rules and Regulations were drafted as the lead and was funded by IFC, who played a major role in that development. Once drafted, there was too much pressure put on EEA by the private sector to give them special treatment and minimal EEA oversight. There are many things in the R and R's that I do not like, but even with that the private sector managed to get a PPA that waived many of the requirements of the Rules and Regulation and stripped oversight from EEA. In general it is an ok document and truly is the best in East Africa and as good as most in the world, but I think it could be made even better. Incorporation of the AUC Code of Practice into both the Proclamation and the Rules and Regulations is a major plus.

2. THE ECONOMIC REASONS FOR USING PROJECT FINANCE AND THE ROLE OF THE PROJECT BOND MARKET TO FUND PROJECT FINANCE.

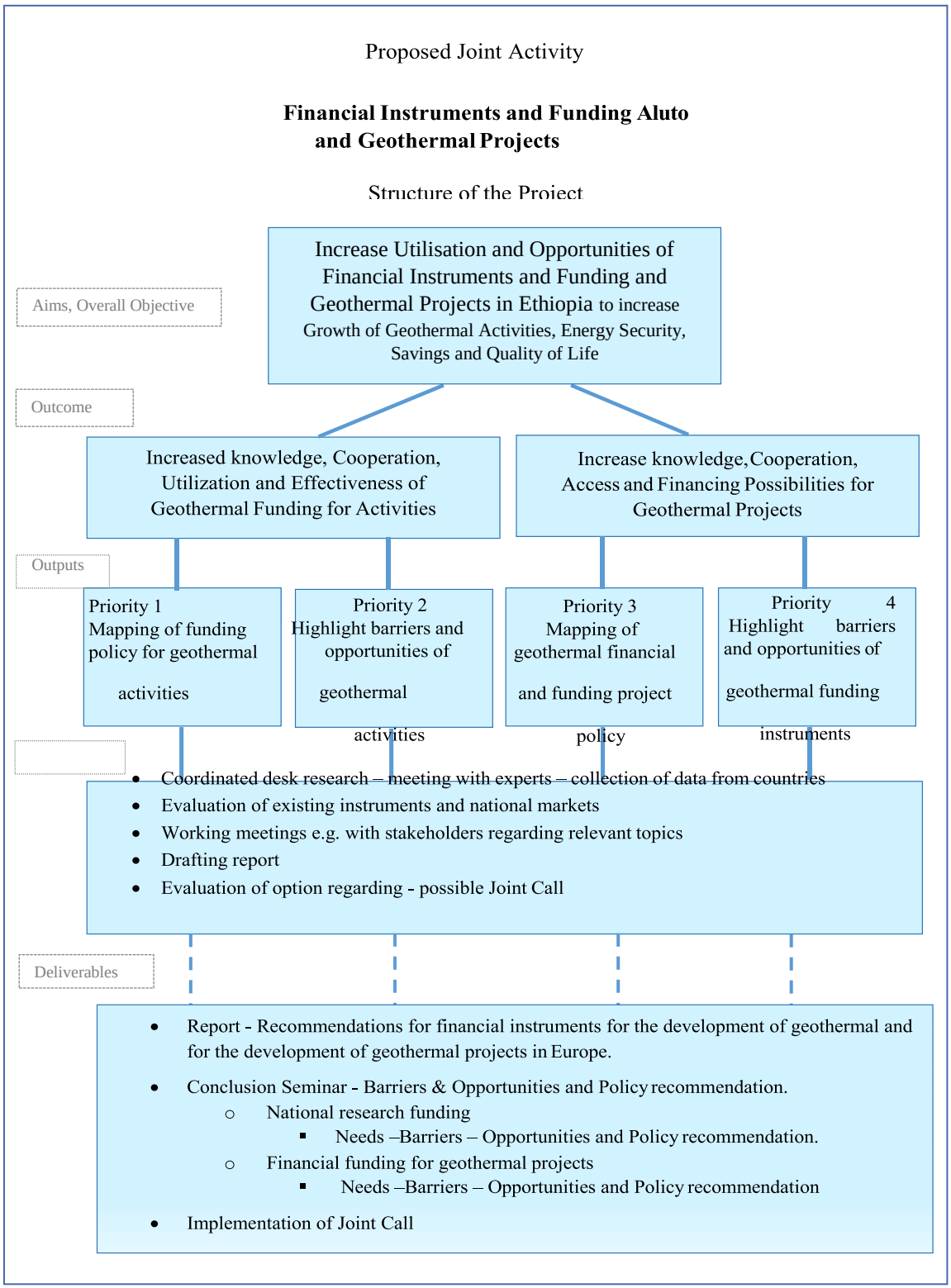
Aluto's project equity is extremely hard to come by, there are few sources for private investors and the cost of equity is generally high with 20+% expected return. The project sold lots of stock at around 1.00$ per share. So if the stock would go to 1.20 that would be a good investment. But, to sell stock it has to have a good story to tell and that requires good sound exploration, and hopefully encouraging results and a willing offer to pay a reasonable price for output. The new public/private partnership law does provide some level of comfort for the investor by guaranteeing that the power will be paid for. This is sometimes a problem in Aluto project. However, it does little to help in the early stages, it helps encourage a bank to loan money as output will be covered. But, the part not covered is reservoir risk and what happens if the reservoir declines, there is no money for make up wells etc. Reservoir insurance is very pricey and I have yet to see a policy I would recommend. Setting up a reserve account where a portion of the revenue goes into a dedicated account can be attractive, as that does provide a source of funds for new drilling, but there are cuts back on the return on investment. There are no large companies in geothermal these days. Most all of the oil and gas companies have opened geothermal divisions. Unical, Cheveron, Sun, Anadarko etc. I do not believe that any are still in the game. Largest now is ORMAT

Well returns on most geothermal projects with information expect a rate of return of 15-20 percent. Maybe not as high as some other types of projects, the trick is to get a PPA price that will allow for that. All KW hours are not created equal. Solar and wind MWs are intermittent at best and almost impossible to schedule. Some resources can only be built dependent upon different factors, hydro for example has to be near a large river. So what are you selling when you sell geothermal power, first of all it is base load, but it can be, in many instances dispatchable, and used to fill in the gaps left by intermittent power sources. It has minimal emissions; it has no impact on rivers. The trick is to be able to account for the externality benefits that geothermal brings. Where that is done, price is generally satisfactory, but must be recognized by policy makers and by power purchasers. As for example, most business and industrial complexes in Ethiopia have to have their own backup power, and it is fossil fueled. What is the value of being able to not have that back up generation and to not have to burn that fossil fuel?? Probably a couple cents per kWh. What is the value to the grid to have stability?? Does the cost of intermittent resources fully recognize the cost of building a 300 MWe transmission line that only has 300 MWe of load delivered to it 40% of the year??? The high up-front cost is a deterrent no doubt, but as I mentioned earlier, some benefit for the first 50 to 100 MWe could really change the game.

Bonds, or in some cases forgivable bonds, or loans or loan guarantees, are all ways to reduce risk. But most African countries nor African Banks have the financial capability to use these. When a geothermal project fails it is generally due to geologic conditions, it might be reservoir draw down, cold water intrusions, earthquake damage to well, or a volcanic eruption that impacts the wells or steam fields, as happened at a power plant in Hawaii a couple of years ago that has yet to come back on line. One of the primary reasons that GDC has been unsuccessful (in my opinion) is that developers are not comfortable buying steam from anyone and not having complete control over the entire project. Thus, developers want the African Dev. Bank to back stop the project, and if GDC/Gov. of Kenya is unable to maintain the steam supply then the project is made whole.

Data is so critical. It has to begin with the first field survey and has to continue uninterrupted through the duration of the exploration, drilling, construction and operation of the project. But it has to be matched by an ability to manage that data and to be able to extract the level of data that is required for any given purpose. Detailed drilling reports are one of the most critical. You may have to go back to what happened during the drilling of a given well, 10 or 20 years after completion and the drilling supervisor may be long dead and gone by that time, but that should not matter everything has to be there. Reservoir engineering/numerical models are another extremely important data requirement and new models should be completed on a regular basis and not only when you begin to see a problem.

As for the challenge, EEP has no appreciation for the usefulness and dependence the project has on data and data management to purchase LeapFrog and RIMBase. As far as I am concerned, without a good conceptual model you are drilling blind and that model should be updated to include what you learned from each and every well. They will not spend a half million dollars on a complete data system including training, which is the equivalent of 10 days drilling of drilling program initially conceived to be at a minimum of 1200 days, and probably considerably longer since that would be 20 wells at 60 days per well. One bad well because it was poorly sited and targeted, will cost 10 times the cost of the entire data acquisition and management system. But, I should add that you get the same pushback from the developer when it comes to exploration cost, a 100,000$ geophysical survey will be axed from the program because it is too expensive, that equals about 2 days of drilling!! For this reason, the project has planned to purchase software and trainee expertise.

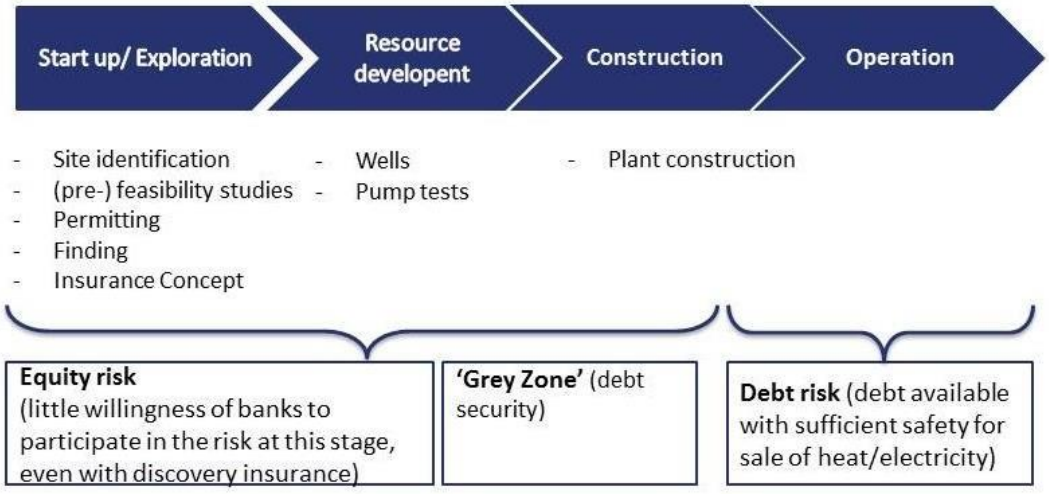


3. EVALUATION OF THE PROPOSED FINANCIAL SUPPORT

One important element of geothermal is the link between research pillar and policy pillar, there is a need to increase cooperation and consultation between these and stockholders

STAKEHOLDER	INPUTS/COSTS	OUTPUTS/BENEFITS
PUBLIC DEVELOPER		
EEP	$12m in project equity	10% return on investment
	6.5 years development time	Significant learning and in-house capacity built, development of competitive drilling technology 2-3 years development time reduced new clients for drilling technology and exploratory services
FINANCIERS		
WB	$9.6m lease finance $24.9m limited recourse loan at longer tenor and competitive market rate	$13m in interest payments (estimated)
	Due diligence for loan approval	Understanding of geothermal project financing
WB	Base funding for $24.9m loan decreasing project costs and providing access to finance	Support for IPP development of sustainable energy projects and carbon emission reductions
	Support on environmental and social assessments	Potential scalable solution for NCG emissions
GOVERNMENT		
MINISTRY OF MINES PETROLEUM AND NATURAL GAS; EEA	Revenue support mechanism of $10.5c/kWh increasing project revenues	Meeting geothermal deployment and carbon emission reduc- tions targets
	Licensing and permitting regulatory framework	Private sector capacity development for geothermal exploration
	Value Added Tax (VAT) paid during construction can be deducted from VAT for electricity sales in first years of operation	Improves equity IRR by more than 150 basis points
	Initial high level surveying data	

Because of the varying level of risk implied, diverse financial tools are used to fund the different phases of a geothermal project.



Makda Kinfe

Risk rating of the recently drilled LA9D AND LA 10D

Technical risk…….…….. high

Loan repayment risk……. moderate to high

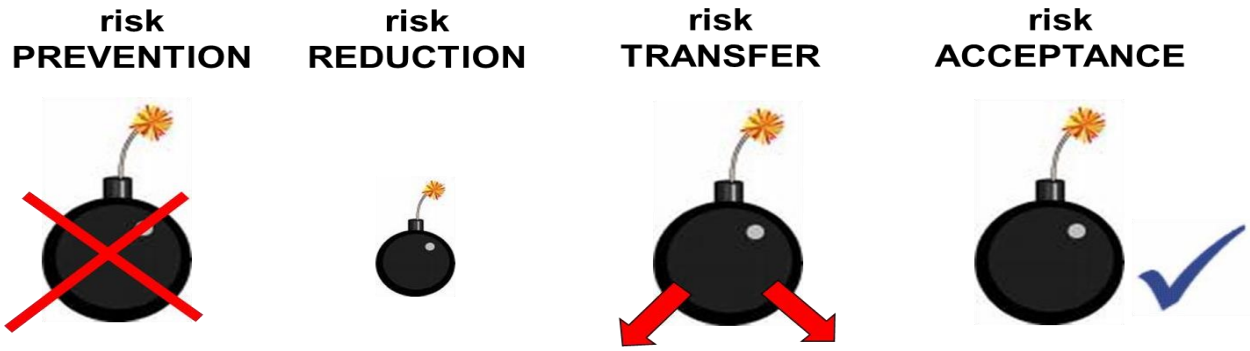
Drilling risk in production…… .high

Financing risk……. high

Political barriers……low to moderate

Economical barriers…….moderate to high

Risks have to be identified and evaluated in terms of their probability and the (economic) consequences of their occurrence. Once these assessments have been made, strategies for risk management need to be developed. Sometimes, it will not be possible to avoid risks by means of appropriate and "affordable" measures. Often, risk reduction is satisfactory. Some risks may be passed on to third parties, for example through insurance.



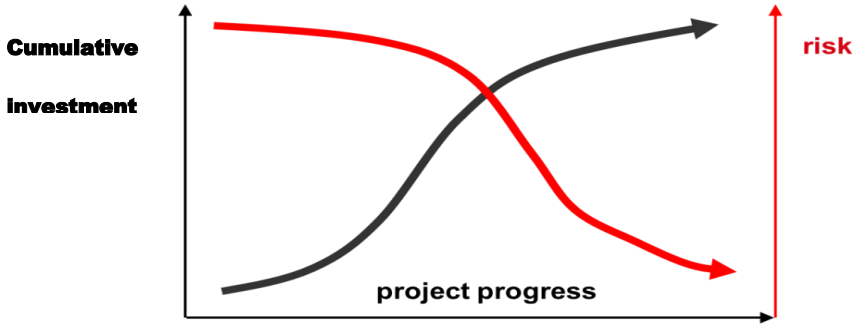
Lastly, there are risks that the company will categorize as (financially) acceptable and cover with equity capital directly. Most of the investment falls into the high-risk phase of the geothermal project. While the project is being developed, the required budget changes successively. And with increasing effort in exploration, more and more knowledge about the resource is acquired and the risk of failure decreases accordingly

Finally, beyond exploration, the bankability of a geothermal project is threatened by the geological risk. Risk insurance funds for the geological risk already exist. The geological risk is a common issue all over the Ethiopian projects. Collaboration between Member States is desirable; it can allow them to save money and trigger the uptake of a valuable technology alike.

- business liability insurance
  - inkl. mining regulations
- constructors all risk insurance
  - damage-related costs for lost in hole of equipments, by-pass etc.
  - damage-related giving up of the borehole
- discovery insurance
  - coverage of the thermal capacity / energy potantial

⇨ necessary: agreement of insurance coverage

⇨ helpful: supporting throught experienced broker



The rig rent is usually paid on a daily rate. It depends on its specifications such as load and depth capacity. A drilling rig with larger progress of the well entails a decrease of the term of lease. Therefore, the choice of the drill rig must be a compromise between rig capacity, drilling progress, and technical reliability. The material costs include the expenses especially for casing and cementation. These costs depend on the borehole design (aperture, depth and well course), as well as on the site-specific geological strata set. Also, the investments for the drilling site preparation must be budgeted. The energy for the operation of the drilling rig and the drilling mud pumps must be considered. The service costs include the borehole-related services (e.g. installation of the casings, cementation, mud logging) and drilling-site activities (e.g. installation and dismantling of the drilling rig, drilling site preparation).

The challenge of this project was not rig rent nor material cost, rather down time due wait on water supply and low rig drill capacity due to long service times.

Success for the geothermal sector in the concerning countries is not only based on geothermal resources, but also on these factors for competitiveness. The competitiveness model can be used in many different ways to increase competitiveness and growth of companies.

Factors for Competitiveness Aluto **Project states**

Authorities and regulation (clear vision). …….……. weak
Geothermal resources. ……moderate
Scientific & technical factors……weak
Companies, management, expertise - industry, clusters assessment (lack of cooperation). ……weak
Education & human factors……..weak
Access to capital……high
Infrastructure and access to markets, sectors and other clusters…….……..high
Access to international markets and services, and finally…….……high

RECOMMENDATION

As an equity investor, someone who has or is looking to purchase stock in the company, my first concern would be the capability of the team and the experience of the team. Not only the technical and scientific team, but the board of directors of the company that may have much more experience in project development than the actually company staff.

Then what is the status of the project, do they have a secure land position, do they have all the approvals, licenses, ESIA approvals, - legal, institutional and regulatory risk is as least as much a deterrent as is resource risk. Given that all the above checks out as ok, then where does the project stand technically and scientifically, have they completed the surface studies, mapped the thermal manifestations, completed geophysical surveys, and geochemical surveys?? Has there been a conceptual model completed and what does it indicate?

Then if that checks out, then what about drilling capability?? Do they have a contract with a good drilling contractor with a good reputation for work, what about the contract with that company, does it have the correct guarantees, limits on down time etc. Do they have the required consumables or is the drilling contractor responsible for the consumables. Do they have an off take agreement , PPA or some other form of guarantee that the power will be purchased, and does the purchasing utility or receiving entity have a sound track record of actually paying for the power produced. Is it a take or pay contract. Who backs up the purchaser, government, World Bank etc.

If all those things check out, I would be willing to purchase some stock in the company, not a lot but some, and I would probably purchase more, as more and more is found out about the resource.

Now if I were a lender (not a bank), then I would do all of the above, but would not be looking to provide a loan until the discovery was made. And then only after a determination of the conversion technology and a certain number of wells were successfully completed. With the completion of a number of additional wells and contracts for completion of the well field, contracts for the design and construction of the power plant and gathering system, I would consider full funding for the project and then I would be very interested in contractual terms related to power plant, steam gathering system, and power evacuation systems. If I were a Bank, I would be willing to refinance at a better rate only once the project was commissioned, and I had a good reservoir report in hand that indicated that the output envisioned could be maintained for the life of the loan, and that there was a reserve fun to guarantee ability to work over or drill additional well.

So, it is all dependent upon risk tolerance and expected return on investment. Early investment brings the greatest potential for considerable upside and at the same time considerable risk that there will be no return on that investment.

Because participation in this, another project is building the local bank capacity to assess the environment and technical risk of geothermal project. Activities have to be done on channeling long term, low cost debt through a local bank so as to be an effective way of building the capacity of local private lender in geothermal finance. Though Aluto geothermal project have no public financer, there is more cost savings likely in the future.

CONCLUSION

In those conducted wells neither GSE nor The EEP Project Office was almost totally incompetent for the production of the estimated 10MW. The leader does not effectively work with staff, support staff growth, delegate duties and authority etc. This is a highly

technical business with a need for a strong and experienced staff that works well together. As for example, a conceptual model is a team effort, it is not a reservoir engineer doing it in his or her office in isolation. The entire team should be involved, geologist, geochemist, geophysicist, reservoir engineer and the drilling supervisor. As they often say, put 6 experienced geologist in a room and you will get at least 7 answers because as you go around the room, some will alter their opinions based on what others present. Data is to be shared and not held as private property!! Ideas have to be freely expressed and debated until consensus is reached. If staff are not available, then sound scientific and technical expertise has to brought in from the outside and integrated into the organization.

There are many lessons from the projects in Ethiopia, both public and private. The lack of the legal, institutional, and regulatory framework in Ethiopia has been a major problem for the private sector. The lack of a drilling industry is also a major problem as everything must be brought in, and customs and taxes are a major problem causing delays and uncertainty. And of course low price for power does not help.

For the public sector it has been a government that does not seem to care very much, does not have a strong organization managing the project, does not provide support to that organization especially in terms of procurement and staffing. There is inadequate management capability in the PIU of EEP, inadequate staff capability, and poor relations with the scientific and technical consultants. The WB has not been a good partner and often causes significant delays. Local opposition or lack of cooperation in and around Aluto has also caused delays. The lack of cooperation between EEP and GSE is another major problem. The contribution of ARGeo to Aluto's project financing scheme was no longer than conducting conferences and insignificant. I am sure that there are some really competent people in GSE that would love to work on a project of this magnitude. That I see as a quick fix to many things as we prepare for drilling.

REFERENCE

J. Pater Salmon, J. Meurice, N. Wobus, F. Stern, and M. Duaime (2011): Guidebook to Geothermal Power Finance, NREL

Atkins. 2014. 'Gurmat 2 Geothermal Power Plant, Turkey'. Atkins Water and Environment: Surrey. Available at: http://ifcext.ifc.org/ifcext/spiwebsite1. nsf/0/D9BE90A0B7941E7C85257D72005D0215/$File/

Gurmat%202%20NTS%20(English).pdf

ESMAP. 2012. "Geothermal Handbook: Planning and Financing Power Generation". World Bank: Washington

D.C. Available at: http://www.esmap.org/sites/esmap. org/files/DocumentLibrary/FINAL_Geothermal%20 Handbook_TR002-12_Reduced.pdf

European Bank of Reconstruction and Development (EBRD). 2014. 'Early stage geothermal support framework'. EBRD: London. Available at: http://www. ebrd.com/work-with-us/projects/psd/early-stage- geothermal-support-framework.html

IGA. 2013. 'Geothermal Exploration Best Practices: A guide to resource data collection, analysis, and presentation for geothermal projects'. IGA Service

GmbH, Bochum. Available at: http://www.geothermal- energy.org/fileadmin/user_upload/documents/ best_practice_guide/IFC-IGA_Geothermal_Exploration_ Best_Practices-March2013.pdf

International Energy Agency (IEA). 2013. 'CO2 emissions from fuel combustion. Highlights'. Paris: IEA.

International Energy Agency (IEA). 2014. 'IEA/IRENA Global Renewable Energy Policies and Measures Database.' Paris: IEA. Available at: http://www.iea.org/ policiesandmeasures/renewableenergy/