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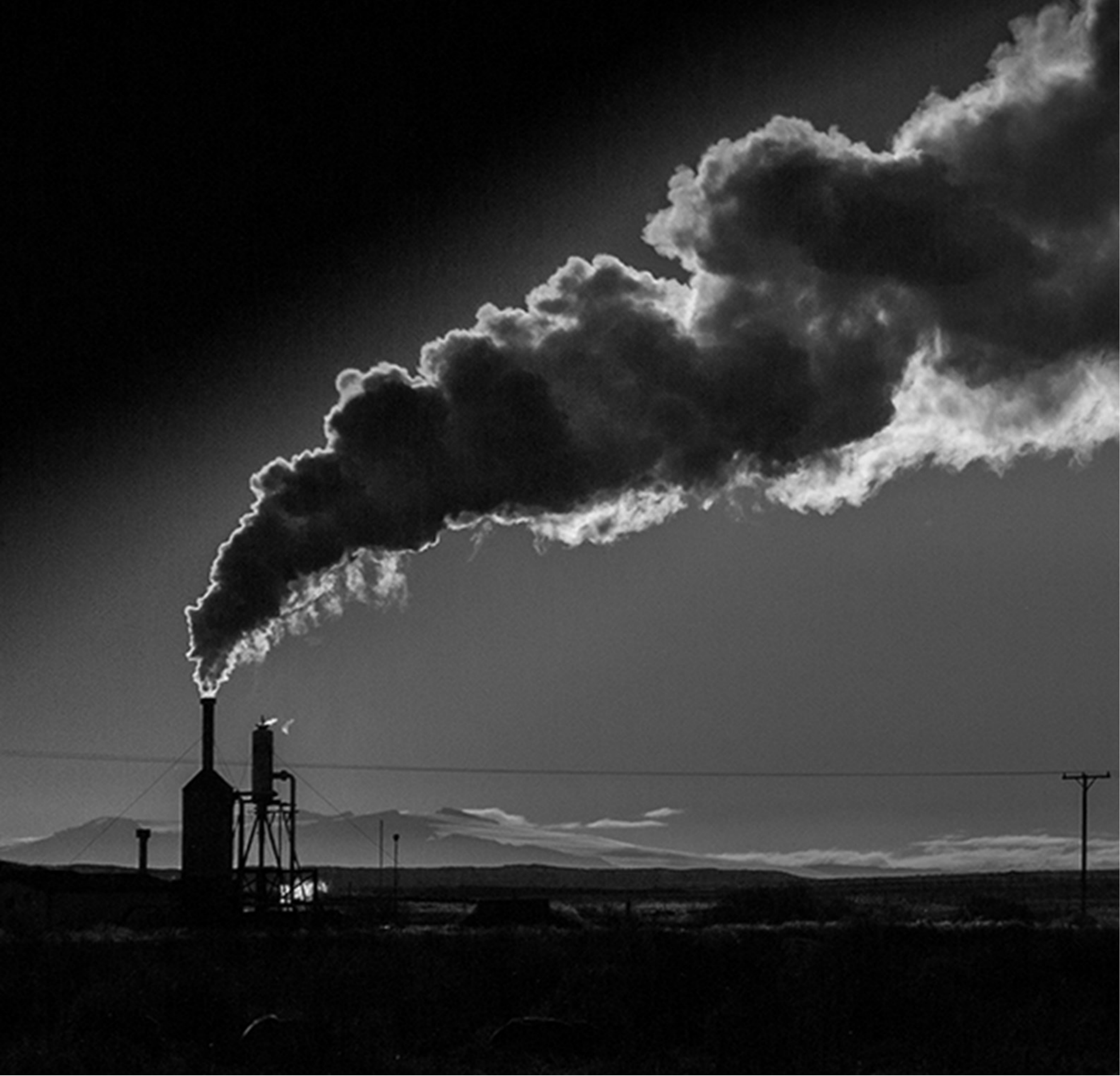
Africa geothermal steams ahead



Geothermal projects in Africa have lagged behind the deployment of other renewable energy sources in recent years. However, whilst a slow starter, we anticipate that geothermal will become a major baseload renewable technology in Africa in the mid-term future. We are seeing increased interest and opportunities for development of geothermal projects in a number of jurisdictions.

The focus of recent Africa geothermal headlines has primarily been on Ethiopia and Kenya – namely the Corbetti and Tulu Moye geothermal projects in Ethiopia and the upcoming Olkaria VI public private partnership (PPP) project in Kenya. However, countries such as Zambia, Tanzania, Uganda, Rwanda and Malawi are also taking steps to unlock their geothermal potential as the pace of project development in the region increases.

With programmes such as the Geothermal Risk Mitigation Facility seeking to reduce the risks and costs of the exploration phase for geothermal and governments seeking to establish their geothermal sectors, we anticipate that the development of further geothermal projects is imminent.

As a technology, geothermal is more complex than most renewable technologies deployed in Africa and there are therefore many issues which are key for a potential investor in geothermal to understand.

Dealing with exploration risk

The major risk associated with geothermal development is the possibility that a project may not locate sufficient resource to produce electricity and, even if it does, it can be difficult during the development phase to quantify how much electricity will be produced by the power plant.

Test drilling is required in order to confirm the viability of a resource, but is a complicated and capital intensive process, with each well drilled likely to cost a few million US dollars (the cost of development of geothermal resources for power generation being estimated in the region of US$ 2 to 5 million per megawatt installed and drilling costs representing up to 40% of this amount). The risk of no viable resource being found and investment being lost as a result is therefore significant (although higher temperature resources will require lower capital expenditure and may have lower drilling failure rates). Even if drilling is successful, ongoing capital expenditure in the form of further wells (to confirm resource size and output), in addition to the construction and commissioning costs, must be incurred before a geothermal power plant is able to commence operations.

These costs present a significant barrier to the development of geothermal projects – regardless of whether test drilling is conducted by the private sector or the public sector. Commercial banks are unlikely to provide loans for the drilling phases of development (as mentioned, resource risk is high and, therefore, inherently difficult to price) and whilst developers may be willing to fund drilling through equity, this will require a high premium in return which will impact a project's economics. As a consequence, various forms of support are typically required to mitigate resource risk.

On geothermal IPPs, we have seen a number of different structures used by African governments and utilities which look to modify the resource risk allocation in a way that enhances bankability. Inevitably, there is sliding scale of support that governments may offer, from more limited provision of exploration data and offer of licences for steam field development (with the private sector still being expected to conduct test drilling) through to the offer of fully developed steam fields on which the private sector develops power plants and effectively tolls steam provided by the public sector.

Kenya provides good examples of different approaches that can be taken. For example, the various Olkaria projects (and we expect the Olkaria VI PPP project) have been developed on a greenfield basis with the IPP being responsible for appraising the resource and developing the steam field under a geothermal resource licence made available by the government. Alternatively, the Kenyan parastatal Geothermal Development Corporation raised US$ 746 million in loans, grants and equity to fund the development of wells, steam gathering systems and grid interconnection for the development of at least 200 – 400 MW of new steam field capacity at Menengai, with the anticipation that power plants will be developed on an IPP basis.

Increasing insurance and financial support availability

The availability of insurance specifically covering exploration risk should also be considered by developers as alternative means to improve the bankability of geothermal energy projects.

Developers would expect to pay a premium upfront, or in instalments as drilling progresses, to insure against the risk of lower than expected production capacity of wells. Insurance is likely to cover a defined portfolio of wells with a defined drilling and testing schedule. The insurance policy will respond if the test results fall outside a defined range of successes based on geological parameters, including temperature, flow rate and fluid chemistry etc.. Notable recent examples of this include Munich Re's insurance package which provided insurance for a series of up to eight drillings for the Akiira project in Kenya.

Alternatively, we are increasingly seeing the availability of grant schemes offering concessional financing to help lower costs and mitigate risks associated with geothermal energy development. The Geothermal Risk Mitigation Facility (GRMF) is a recent example of a grant scheme that has been established by the African Union Commission (with funding being provided by the German Federal Ministry for Economic Cooperation and Development, together with the EU-Africa Infrastructure Trust Fund via KfW Development Bank and the UK Department for International Development)). The GRMF provides grants for surface studies, exploration wells and reservoir testing, and related infrastructures.

GRMF launched its first application round in 2012 where it targeted five countries as pilot countries (being Ethiopia, Kenya, Rwanda, Tanzania and Uganda). In 2013, the application rounds were expanded to include Burundi, The Comoros, Djibouti, the DRC, Eritrea and Zambia. To-date the GRMF has awarded grants to 26 projects in six countries, which relates to a planned aggregate installed capacity of 2,900MW and a planned aggregate project investment value of US$9.3 billion. With projects benefitting from grants under the GRMF currently in their infancy, the effects of the GRMF grant funding will increase incrementally in the coming years.

The importance of an appropriate regulatory framework

A regulatory framework which is supportive of geothermal and takes into account the long development period of a geothermal project from surface studies through to financial close is crucial, particularly considering the baseload technologies which could compete with geothermal during this time period (such as gas-fired power and large hydropower in respect of Tanzania) and intervening power sector policy which inevitably affects IPPs with far shorter development periods than geothermal.

In jurisdictions such as Tanzania and Ethiopia, geothermal licensing and regulation has been historically dealt with under a mix of mining, hydrocarbon, energy sector and water legislation. This has resulted in over-complexity and poor governance of geothermal. Whilst it is not essential for a separate geothermal development act to exist (for example, Kenya is consolidating its geothermal resources legislation in the 2017 Energy Bill), there should ideally be a clear and streamlined set of provisions in place which deal with geothermal and resolve any legislative conflict (for example, by amending mining legislation to exclude geothermal fluids). Over-regulating geothermal, which is essentially a small part of a power sector portfolio, is also a risk to the sector, as has been seen in markets such as Chile.

A solid institutional framework comprising a geothermal regulator, licensing authority, policy-maker, data aggregator and promoter is key. Where government institutions are established as state geothermal companies – such as the Geothermal Development Corporation in Kenya or the Tanzanian Geothermal Development Company – their role in geothermal exploration and development must be clearly delineated. This is so as to avoid any conflict of interest in a government entity which is a participant in the sector as well as a promoter of it, and which could potentially have access to geothermal data collected by private sector developers.

There should be a licensing framework in place which grandfathers developers through the various stages of surface studies, exploratory drilling and development. Essentially it must ensure that a developer which makes a discovery under an exploration licence then has pre-emption rights to obtain the development licence for that geothermal resource area, and that there is no requirement to relinquish one form of licence in order to apply for the next stage of licence.

Competitive tendering of geothermal resource areas, as compared to unsolicited proposals being accepted on geothermal resource areas, must be managed appropriately. In Ethiopia, unsolicited proposals will only be accepted after re-tendering to benchmark their competitiveness. Where tenders are run, the financial and technical criteria must be carefully prepared in order to filter out opportunistic or speculative developers with no track record in geothermal, for example, the tender must not simply be determined by a PPA tariff price.

Other key geothermal risk factors

The usual risks and mitigation measures that apply to development of any African IPP will also typically apply in the case of geothermal energy projects, including construction and commissioning risk, operational risk and offtake risk. That said, there are unique features of geothermal energy projects that merit consideration.

Offtake risk

The levelised cost of electricity generated from geothermal energy is estimated to range from US$ 0.5 / kWh to US$ 0.15 / kWh. The range reflects the number of variables inherent in the development of geothermal energy projects, for example in relation to capital costs, O&M, plant capacity factor and the weighted average cost of capital. At the lower end of the range, geothermal energy should compare favourably to other sources of baseload generation. However, the upper end of the range compares less favourably, therefore increasing the IPP’s exposure to dispatch risk (although logically this should be mitigated against through the PPA tariff including a capacity charge payable on the basis of availability of the power plant) and it being a less-attractive technology to an offtaker as compared to other forms of baseload generation.

Consideration should also be given to whether the IPP is able to use residual heat produced by its power plant as a means of enhancing the economics of the project, for example by selling it to nearby industries. A pilot direct use cascade project has been established by GDC in collaboration with USAID in Menangai, Kenya where hot water which has been heated via heat exchanger with geothermal fluids is used to pasteurise milk, in a laundry (with geothermal heat used for drying) and in an aquaculture project and greenhouse. Geothermal heat may be used in many industrial processes in Africa, such as heating greenhouses at night or in rainy season, in breweries and drying processes for millet, coffee, fish and timber production.

Construction risk

Oversizing the power plant as compared to the capacity of the underlying resource can result in unsustainable extraction rates, leading to pressure drops (thereby reducing the performance and stability of a resource) or even resource depletion. Logically, this should be mitigated through incremental development of a resource and under lump sum turnkey construction contracts with a clear design basis for the power plant being constructed.

Operational risk

In addition to the usual operational risks that may affect a power plant, the requirement for steam field operation and maintenance (e.g. drilling make-up wells and maintaining steam pipelines) will need to be considered and allocated. To the extent this risk is borne by the IPP, these additional activities can significantly affect the O&M costs and, therefore, the tariff charged by the IPP under its PPA.

Similarly to oversizing of power plants, over-exploitation of geothermal resources through improper operation practices (e.g. a lack of integration between multiple IPPs using a single resource or through poor reinjection strategies) may lead to pressure drops and reduce the performance and stability of a resource. Where multiple IPPs rely on a single resource (such as Olkaria in Kenya), developers will want to ensure that the risk of other IPPs being dispatched in excess of a pre-agreed amount where their steam flow may be adversely affected is properly allocated under their PPA.

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