



WORKING PAPER



Innovative risk finance solutions: Insights for geothermal power development in Kenya and Ethiopia

By Paula Rolffs, Julian Richardson and Amal-Lee Amin



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About this working paper

Accelerating the shift to climate compatible development is CDKN's business and improving the lives of the most climate-affected people is our mission. A multi-year, US\$130 million programme funded by the British and Dutch governments and many others, CDKN works to support climate compatible development in Asia, Africa, Latin America and the Caribbean.

Our programme provides focused technical assistance to governments, as well as research-into-action projects that fill gaps in our understanding of climate change impacts and solutions. Ultimately, we want to make life more stable, secure and fulfilling for those most affected by climate change.

A crucial part of CDKN's strategy is the exchange of honest learning about which approaches are (and are not) working in terms of climate compatible development. The rapid, deep shift in policies and behaviour that are needed will rely on innovation and experimentation - not least in the arenas of climate finance. We want to help exchange and build on experience in mobilising resources for climate compatible development so that decision-makers, investors and practitioners everywhere can learn and assimilate lessons quickly for a low carbon, more resilient world. This working paper is a contribution toward that effort.

About the authors

Paula Rolffs is a researcher in the climate finance team of E3G; and Julian Richardson is CEO of Parhelion, a specialty risk and insurance business. At the time of writing, Amal-Lee Amin was an associate director at E3G and led the climate finance programme.

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Geothermal power plant in Menengai Crater, Nakuru, Kenya

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Key messages

Geothermal development is on the rise in many regions of the world. However, the high costs of field development, coupled with the high risks associated with resource exploration and drilling, still pose a significant barrier to private sector financing.

Insurance can mitigate the risks to investors and increase flows of private finance to the industry.

A project by Parhelion, a private sector insurance and risk company focused on climate finance, funded by CDKN, aimed to improve the technical capacity of Kenya's and Ethiopia's local insurance industries for using geothermal risk mitigation instruments.

A consultative process with relevant stakeholders in these countries yielded insights and recommendations for international, multilateral and bilateral institutions that are looking to support geothermal resource development. The analysis was enriched by E3G's expertise in analysing climate finance flows.

The study found that international, multilateral and bilateral institutions should:

- **Support technical assistance and capacity building**, which takes into account the needs of all relevant stakeholders involved within specific country and market contexts.
- **Provide targeted concessional finance** by taking into account all possible risk mitigation instruments during project development, and by envisioning the leverage of private finance as early as possible.
- **Use insurance instruments** to target specific, well defined risks: this can offer very high leverage ratios on the use of public funds, and crowd in private sector insurance capital.

Introduction

Geothermal development is on the rise in many regions of the world, and its role in providing affordable low-carbon energy is central for the shift towards decarbonising economies.¹ However, the high costs of field development, coupled with the high risks associated with resource exploration and drilling, still pose a significant barrier to private sector financing. Insurance can mitigate the risks to investors – if the number of megawatts (MW) forecast is not achieved – and so increase private finance flowing to the industry.

Risk mitigation instruments, such as insurance mechanisms, are still in their infancy for the private sector. However, the insurance capital used to support innovative risk transfer mechanisms has a large potential to support climate compatible development, offering leverage potential of up to 60:1 on public funds. Public sector entities are not yet very familiar with using insurance structures to support inclusive green growth. Therefore, effective public–private collaboration to leverage public finance has a major role in attracting insurance capital from the private sector. By operating together, the public sector can remove risk barriers and the private sector can mobilise new forms of debt and equity capital to support climate compatible development. Ideally, such partnerships are designed in ways that strengthen domestic markets by engaging the local insurance sectors, allowing some of the commercial value to be captured in-country.

A project by Parhelion, a private sector insurance and risk company focused on climate finance, funded by CDKN, aimed to improve the technical capacity of Kenya's and Ethiopia's local insurance industries for using geothermal risk mitigation instruments. It engaged and informed local geothermal stakeholders in Kenya and Ethiopia on geothermal risk mitigation – including insurers, project developers, financiers

and public bodies. The project provided valuable insights and recommendations for the development of support instruments of international, multilateral and bilateral institutions which could help build up and strengthen local stakeholder participation in geothermal resource development through public-private cooperation.

Geothermal risk and financing

Geothermal energy for electricity generation has been growing steadily over the past decades, with a recently increased growth rate totalling close to 13.2 gigawatts (GW) of installed capacity by the end of 2015.² By generating clean, flexible and base-load electricity^a it is a central technology for future power systems.³ However, numerous barriers still exist to further development of geothermal power. In addition to those risks generally faced by newer and unfamiliar low-carbon technologies, such as technological, market, policy and regulatory risks, geothermal projects face two other major risks: first, the resource risk related to geothermal resource availability and capacity; second, the financing risk resulting from long timelines between initial investment and revenues.⁴

In the case of geothermal power, each project relies on a combination of financial instruments, depending on the stage of the project and the respective activities and risks, as can be seen in Table 1.

Insurance mechanisms can play a significant role during the feasibility and development drilling stage. During these activities, resource risks are still very high but are easier to assess than in the earlier exploration and pre-feasibility stages.

Table 1. Geothermal development phases and activities, associated risks and financial instruments

Phase	Actions	Min. time cost (%)	Specific geothermal risks	Typical financial instruments
Exploration	<ul style="list-style-type: none"> Geologic mapping and geochemical sampling Site survey and plan for detailed exploration 	~1 year (5%)	<ul style="list-style-type: none"> Validating existing data Engaging local stakeholders 	<ul style="list-style-type: none"> Grants Concessional finance Seed capital
Pre-feasibility	<ul style="list-style-type: none"> Focused exploration, first drilling activities Environmental assessment Production capacity estimate Targeting of first full-diameter wells 	~2 years (15%)	<ul style="list-style-type: none"> Site access Positive indication from exploratory drilling Obtaining sufficient data to justify development 	<ul style="list-style-type: none"> Grants Concessional finance Public and private equity
Feasibility and development drilling	<ul style="list-style-type: none"> Development drilling Well logging and testing Power plant design/costing PPA/transmission plan 	~1 year (35–40%)	<ul style="list-style-type: none"> Proving geothermal resource Physical drilling risks PPA framework 	<ul style="list-style-type: none"> Grants, soft loans, guarantees Concessional finance Private equity Insurance
Plant design and construction	<ul style="list-style-type: none"> Detailed design and construction of power plant Transmission interconnect 	~1 year (40%)	<ul style="list-style-type: none"> Ongoing drilling risks Plant construction and linking up wells Grid connectivity 	<ul style="list-style-type: none"> Project finance Guarantees Senior and subordinated debt
Operation and maintenance	<ul style="list-style-type: none"> Power plant maintenance Reservoir monitoring and management 	20–30 years	<ul style="list-style-type: none"> Maintaining geothermal resource Normal operation and maintenance issues 	<ul style="list-style-type: none"> Senior debt

Source: Parhelion and GeothermEx (2014), unpublished

^a 'Base-load' is electricity generation that operates continuously, 24 hours a day.

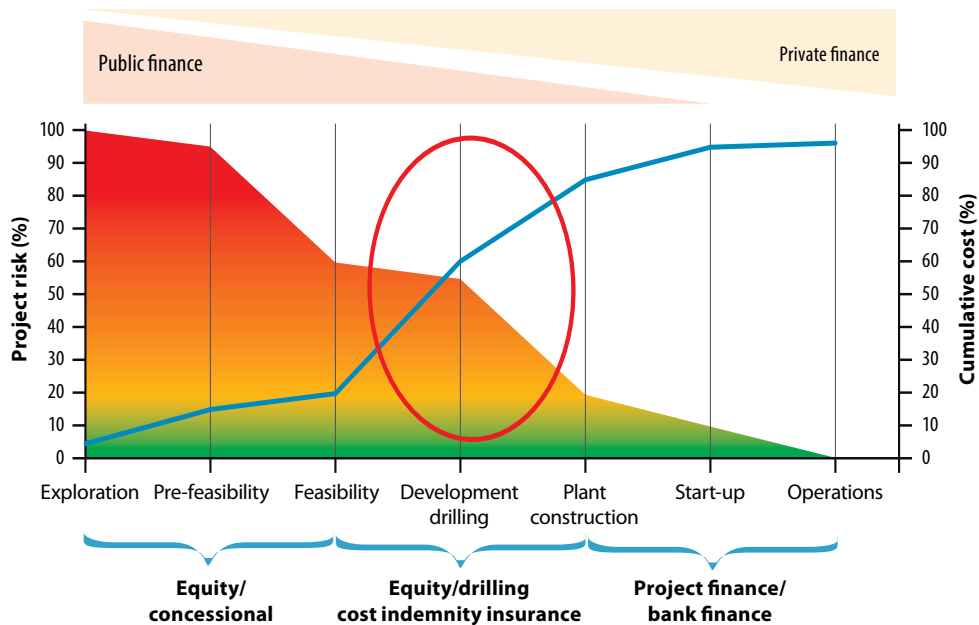
Figure 1 shows which types of finance may be most appropriate to manage project risks and costs at different stages of geothermal project development. As can be seen, significant equity finance is needed over a long period of time as traditional bank and project financiers are reluctant to come in until a geothermal resource is proven. Hence, the financing gap during development drilling can be a significant bottleneck, preventing many geothermal projects from proceeding. Insurance can play a crucial role in plugging this gap and leveraging private finance at earlier stages of the project.

Generally, public sector finance plays a significant role in the form of public debt or equity support for geothermal projects, mainly during the first stages; whereas private capital may be accessible at mature phases of the project cycle⁵. Climate Policy Initiative estimates that public finance for geothermal implementation in developing countries needs to increase 7–10-fold (from US\$7.4 billion in 2015 to US\$6–73 billion) in order to drive enough private investment to meet these countries’ geothermal deployment targets of 23 GW by 2030.⁶ However, there are concerns over public finance being used inefficiently and potentially crowding out local private sector finance such as commercial banks and insurers.

Using public finance to facilitate insurance products is increasingly considered to target specific risks or barriers to investment more effectively.⁷ New donor finance initiatives such as the Kreditanstalt für Wiederaufbau (KfW)-led Geothermal Development Facility⁸ and the European Bank for Reconstruction and Development Early Stage Geothermal Support Framework⁹ are emerging. Also the Climate Investment Funds are largely involved in financing geothermal projects and programmes, and the World Bank has mobilised funds for critical early stage investment in geothermal energy projects, with further expansion envisioned at 36 geothermal fields across 16 countries, including Kenya¹⁰. At the UN Climate Summit in 2014, the IRENA-facilitated Global Geothermal Alliance (GGA) was launched. At COP21 in Paris the GGA declared its mission to consolidate government, industry and other stakeholder efforts in order to boost global use of geothermal energy. Its goal is to achieve by 2030 a fivefold increase in geothermal power capacity and a more than twofold increase in geothermal heating compared with 2014 levels.¹¹

However, there seems to be little focus on involving the local private sector in risk mitigation and bridge financing through insurance mechanisms. This is both important for strengthening local markets, and often required by insurance regulations across the globe, under which projects need to be insured in the host country before being reinsured in the international re/insurance market.

Figure 1. Project risk and cost during geothermal development



Source: Parhelion and GeothermEx (2014) and ESMAP (2012), unpublished

Geothermal power development in Kenya and Ethiopia: drivers and barriers

Ethiopia and Kenya are currently the only countries in Africa with significant geothermal capacity.

Kenya currently ranks fourth in terms of new geothermal power-generating capacity.¹² In 2014 alone, the country added 358 MW, more than doubling its capacity to about 600 MW, representing over 50% of global geothermal power capacity added in 2014.¹³ Kenya developed a National Climate Change Action Plan in 2013, which identified geothermal power expansion as a mitigation option with large greenhouse gas reduction potential and highly positive co-benefits. Embodied in Kenya's *Vision 2030*, geothermal expansion of up to 5,000 MW is to support the country's ambitions to become a middle-income country by 2030.¹⁴ There is great anticipation for expanded geothermal activity in East Africa, beyond Kenya.

Ethiopia aims to achieve carbon-neutral middle-income status before 2025, as set forth in its national Growth and Transformation Plan. A key pillar of Ethiopia's plan to develop its green economy is "expanding electric power generation from renewable sources of energy fivefold over the next five years for markets at home and in neighbouring countries".¹⁵ Ethiopia hopes to overcome structural barriers and a lack of funding to exploit its geothermal resources to meet rapidly growing electricity demand. Recently, Icelandic and Japanese development agencies have provided assistance for new geothermal plans in Ethiopia, but development has been slow, due not only to high upfront costs and project risk but also to limited local technological capacity.¹⁶

In Kenya, the bulk of finance for geothermal projects comes from the public sector, followed by a small proportion of public-private and private finance. In Ethiopia, it is also mostly public finance that is flowing into geothermal project development, but at a much lower level overall than in Kenya.¹⁷ In both countries, the shares of public finance for geothermal exploration are much larger than in many other countries, underscoring the potential and need for mobilising private sector finance.

Providing insurance to cover parts of the risk would help extend private sector financing and increase technical capabilities currently lacking among the domestic insurers and brokers in both countries. Technical training and the means for increasing access to the international reinsurance markets would enable them to offer such products.

Risk insurance for geothermal development drilling: insights from stakeholder training

Parhelion, together with GeothermEx (a consultancy in geothermal resource exploration, development and operation), has developed an innovative risk finance solution to reduce the risk associated with the development drilling phase.

As part of CDKN's Climate and Development Business Network, this project was funded to address the barriers to private sector financing of geothermal project development, while supporting the local geothermal market. The project was designed to encourage insurers and other geothermal market actors to share their experiences in order to strengthen local markets.

Parhelion and GeothermEx have engaged directly with, and provided training to, a wide range of local stakeholders, including the private sector insurance markets, private sector project developers and financiers, government departments, and international multilateral organisations in Kenya and Ethiopia to introduce the concept of geothermal resource insurance mechanisms. A local partner, Kenbright (a Kenyan insurance broker) helped with the outreach to relevant actors via its network.

The knowledge exchange and training programme built an evidence base for the specific market and established a foundation for sustainable private sector risk finance solutions that includes domestic insurers and brokers. Another element of the project has been a call for projects, with the objective of operationalising and demonstrating the opportunities for involvement of the local insurance industry. Project developers were invited to submit project proposals for further technical review and risk assessment.

The costs of this work were covered by the CDKN programme, removing a potential barrier to developer engagement. One project was selected for further analysis and will benefit from a detailed pre-underwriting report, enabling it to be market-ready to engage with both domestic and international insurance markets.

The knowledge exchange and training on risk mitigation instruments in Kenya and Ethiopia took place through meetings, discussions and workshops with local brokers, insurers,¹⁸ investors and financiers,¹⁹ project developers,²⁰ and drilling managers; public institutions;²¹ and international development cooperation agencies and development finance institutions.²²

When the project started, there was little or no understanding of geothermal risk mitigation instruments within the Kenyan and Ethiopian domestic insurance markets, government or private sector project

Table 2. Stakeholders – results from the consultations

Stakeholder	Perspective	Points for consideration / next steps
Geothermal project developers	Developers had limited awareness of the availability of drilling cost insurance. They gained a good understanding of the product. Developers in both Kenya and Ethiopia signalled that they could be interested in using the drilling cost insurance.	Developers expressed interest in learning what would constitute a well structured project. This would help developers capture the right information from drilling in order for projects to be bankable and applicable for insurance, for the benefit of project developers, insurers and financiers.
State-owned geothermal development companies	Detailed consideration of how products would be of value to both private and public sector developers in their roles as resource developers. Increased understanding of how the insurance would be applicable to encouraging earlier debt financing or whether to de-risk equity.	Developers expressed the need to involve technical consultants and options for multilateral development banks and international cooperation to support the insurance going forward, either through funding due diligence costs and/or premium buy-down mechanisms. ^b Developers were interested to see if pure exploration wells could be included in the insurance. This is most likely a role for donor funding (e.g. Geothermal Risk Mitigation Facility for East Africa) rather than private sector insurers.
Local insurers	Starting from a low base, insurers increased their understanding of the product and widened their understanding of the local geothermal sector.	Local insurers expressed their interest in providing geothermal resource risk instruments. They signalled an interest in learning more about opportunities in the sector and possibly participating in (or fronting) drilling cost indemnity cover.
Commercial banks	Naturally conservative lenders who do not wish to take exploration risk and therefore concentrate on projects where the resource is 'proven'. They understood the potential of financing projects at earlier stages through risk mitigation via insurers.	International commercial banks showed interest in bankable insurance-backed projects, not only in East Africa but also in other regions such as South-East Asia and Latin America.
Government ministries	Increased understanding on the role of insurance, after equity and/or some form of concessional funding as the appropriate capital form for exploration activity. Increased awareness of the attractions of a geothermal development risk insurance project as an important part of the policy mix.	Insurance is well embedded within government policy generally, so geothermal insurance would fit in well. All ministries recognised the importance and value of involving the local insurance community.
Multilateral agencies	Increased understanding of how geothermal drilling insurance can be of value in assisting the de-risking and financing of geothermal projects.	Additional consideration about how the proposed private sector offering would dovetail with donor support. This may include offering technical support to applicants, due diligence finance facility and premium buy-down facilities. Consideration should be given to extending access to the Geothermal Risk Mitigation Facility for East Africa.

^b Premium buy-down is where public funds are used to reduce the cost of the premium, through either grants or forgivable loans.

developer community. However, the key stakeholders expressed significant interest in Parhelion's insurance mechanism and a desire to understand its function.

Overall, the process demonstrated significant interest in learning more about insurance products among all stakeholders. The insurance industry was particularly keen to increase its understanding of the products necessary for the geothermal development sector, providing them with an opportunity to use their capital and develop the necessary technical understanding to support this form of low-carbon development. However, direct donor-funded projects effectively bypass the domestic insurance industry, missing an opportunity to engage with the wider economy and to transfer skills and knowledge.

Discussions and training successfully built much greater understanding of project structures and applicability, and their value in assisting in the financing of geothermal development projects.

The call for projects resulted in two submissions from private sector developers and none from government-sponsored entities. The lack of response from the public sector was a disappointment. The private sector developers clearly recognised the value an insurance mechanism can bring. However, due to the inherently unpredictable timelines of the geothermal development process – caused, in part, by the difficulty in obtaining finance – there are very few private sector projects at the right stage of development to be able to apply for development drilling insurance.

Recommendations for international cooperation and climate finance

This CDKN project provides valuable lessons and insights for the international development cooperation and climate finance sphere. Generally, there is a central role for technical assistance and the targeted use of international public finance in increasing the role of local market actors for scaling up private sector investment in geothermal development. Building on the project's key insights, the following recommendations can guide development agencies and finance providers such as multilateral, bilateral and national development banks, as well as the Green Climate Fund. Our recommendations are also informed by E3G's broader work on designing smart incentive schemes for green finance. The project demonstrated the importance of the following aspects.

1. **Technical assistance and capacity building** which takes into account the needs of all relevant stakeholders involved within specific country and market contexts.
 - **Disseminating market studies and knowledge-sharing.** Given the lack of knowledge on risk mitigation finance for geothermal development, many countries' markets would benefit from technical training, knowledge-sharing and stakeholder dialogues.
 - **Facilitating business-to-business approaches** for sharing experiences in different regions of the world on risk mitigation mechanisms that can help mobilise private finance, before the construction and operation of geothermal projects. Business-to-business approaches can offer a good space to prototype new risk-mitigation mechanisms and other instruments and to disseminate learning. As prototyping of innovative instruments can showcase the feasibility of investments, it can help in building a track record and scaling-up bankable projects.
2. **Providing targeted concessional finance** by taking into account all possible risk mitigation instruments during project development, and by envisioning the leverage of private finance as early as possible.
 - **Avoiding market distortion** by ensuring the stability of the public finance incentive provided and tailoring concessional care carefully to provide just enough incentive for the investments to take place. Transparency and predictability of the incentive provided should be ensured, including the extent to which the incentive can be monitored and evaluated with respect to who benefits and how.
 - **Helping to strengthen the domestic market.** The overall goal of a green incentive scheme should be the development of a domestic green market for the production and consumption of

green technologies and/or services. International public support mechanisms should take into account the role of national development banks that understand the local context, while also considering the role of commercial banks.

Innovative public-private risk-sharing instruments are crucial for scaling-up low-carbon investments. However, demonstration of new instruments is necessary to show public financial decision-makers and the private sector how climate finance can effectively mobilise new sources of private capital. Prototyping triggers innovation and learning which will be accelerated when shared across a wide range of actors in order to inform future design of financial instruments. It builds an experience base between the public and private sectors that helps create transparency and predictability and enhances integration with policy. Examples of prototyping new instruments often derive from dedicated government agencies such as national green funds or green investment banks that have a mandate to test new instruments and demonstrate their feasibility.

3. **The use of insurance** instruments to target specific, well defined risks can offer very high leverage ratios on the use of public funds, and crowd in private sector insurance capital.
 - **Insurance capital** is a largely untapped source of capital that can be used to support the deployment of other forms of capital to deliver climate compatible development.
 - **Domestic insurance markets** can be mobilised to both provide insurance capital and develop domestic technical capabilities, capturing value in the host country.

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The Climate and Development Knowledge Network (CDKN) aims to help decision-makers in developing countries design and deliver climate compatible development. We do this by providing demand-led research and technical assistance, and channelling the best available knowledge on climate change and development to support policy processes at the country level.



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www.cdkn.org

[e: enquiries@cdkn.org](mailto:enquiries@cdkn.org)

[t: +44 \(0\) 207 212 4111](tel:+442072124111)

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