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AFRICAN DEVELOPMENT BANK GROUP
GROUPE DE LA BANQUE AFRICAINE DE DÉVELOPPEMENT

# Fact sheet for geothermal development to promote Public Private Partnerships in East Africa

## PPP models for financing geothermal development

## Public and Private Partnership models for geothermal development

PPP is a partnership between the public sector and the private sector for the purpose of delivering a large infrastructure project like a geothermal power plant. In case of geothermal development, a private sector enters into a contractual agreement with the state or a state agency for the development of the prospect or field according to the licensing conditions. The PPP model has many variations based on the starting point of private sector participation in phase of geothermal development (Figure ).

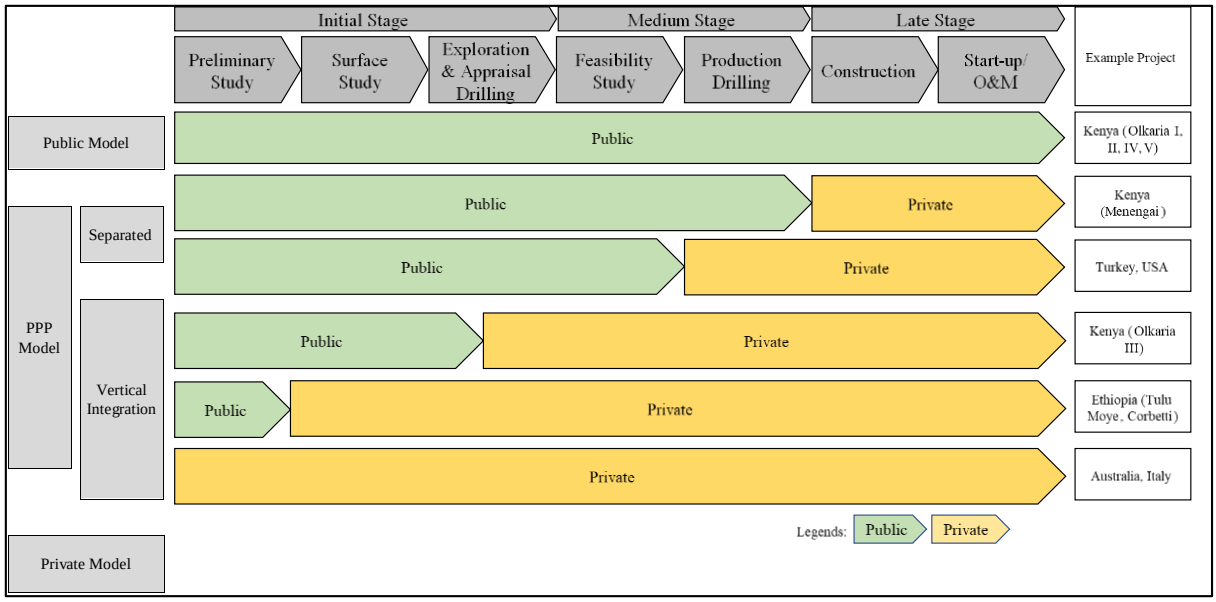



**Figure 1: Geothermal Development Model**

In this report, PPP models are divided into 2 sub-models; namely, separated model and vertical integration models, based on the existence of private sector in steam development as shown in Figure 2. For separated model, steam development (preliminary study ~ production drilling) and construction of power plant are conducted separately by different entity. On the other hand, part of steam development and construction of power plant are conducted same entity for vertical integration model. The detail of these two models is described below.

### Separated Model

Separated model means that steam provider (upstream) and power generator or IPP (downstream) are different entities. Steam provider is responsible for initial phase until construction and O&M of steam production, IPP takes responsibility only for construction of power plants and the rest. Steam provider will sell steam to IPP and get revenue from IPP, while IPP will sell electricity to off-taker and get revenue from off-taker as shown in Figure 2. This model has been implemented in Menengai Project, where GDC is steam supplier for 3 IPPs.

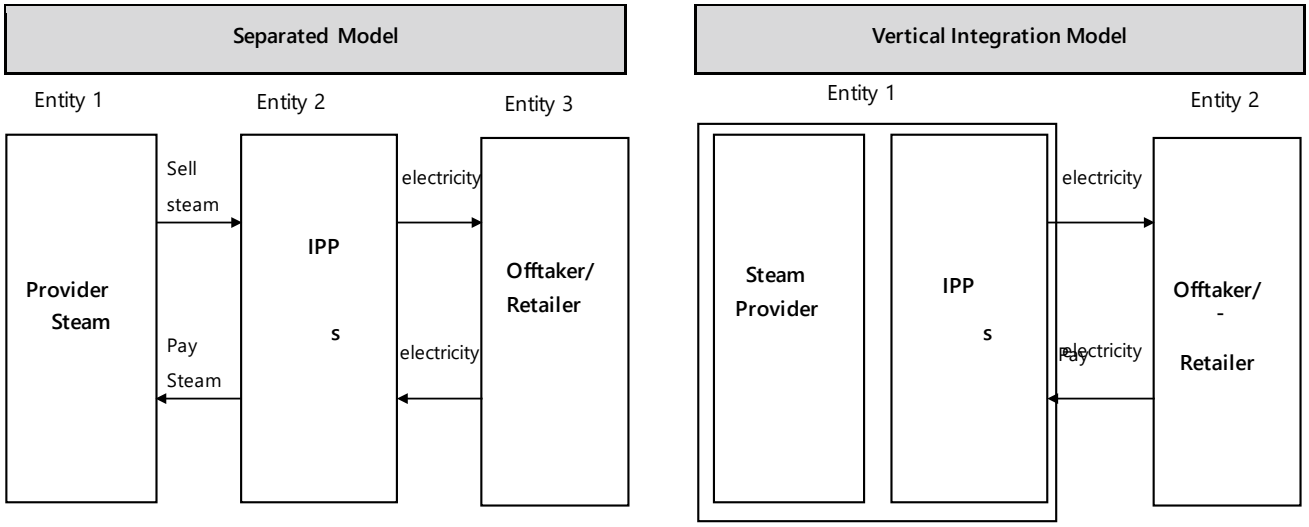



**Figure 2: PPP Development model**

## Vertical Integrated Model

Vertical integrated model means that a single entity (i.e., IPP) is responsible for phases from exploration to construction and O&M of both power plants and steam production facilities. It must be noted that IPP can take this model after a successful exploration and/or appraisal drilling campaign undertaken by a public authority. IPP, therefore, conducts appraisal drilling and digs production wells to develop steam production system, construct a power plant, and undertake O&M under a Build Own Operate (BOO) scheme or a Build Own Operate Transfer (BOOT) scheme. Since steam production system is developed by IPP, IPP does not need to pay steam as shown in Figure 2.

The BOO scheme was used to license OrPower 4 Inc. (private company) for the Olkaria III geothermal project in Kenya. The Olkaria III project is the first privately funded and developed geothermal project in Africa. It was enabled by a phased development strategy and a combination of public and private financing and risk mitigation instruments that ensured the viability of the project. The project having total cost of US$ 445 million was initially financed by equity in the early 2000's and then attracted debt needed for its expansion only in 2009 after renegotiation of the PPA along with the attachment of a government security package to back the payments to the off-taker, Kenya Power and Lighting Company (KPLC).

Another scheme for PPP model used in the region was the BOOT scheme. The BOOT scheme allowed for a contractual agreement between a private developer and the government (joint operating contract) to construct, finance, operate, and maintain a facility for a maximum term (up to 25 years), after which the facility is transferred to the government. This scheme is being implemented in Corbetti and Tulu Moye projects, where licensee (private company) will conduct exploration, drill, construct production wells, steam field, and a power plant; and undertake O&M, within receiving the right to achieve income from the facility under a period of time (e.g., 25 years) and later transferring it back to public ownership. The BOOT scheme was chosen due to the mandate of Geothermal Resources Development Proclamation No. 981/2016 in Ethiopia.

## Framework for PPP

All the targeted countries have established laws that regulate implementation of PPP projects. Among the targeted countries, Kenya has most comprehensive PPP framework, with a clear procedure and timeline for PPP procurement, and greater transparency and openness of PPP-related information. PPP unit in Kenya also has more experience than other PPP units in the targeted countries, indicated by the highest number of managed PPP project pipelines (Table 1).

One of key successes of PPP project in Kenya is sufficient capacity level of PPP unit staff in the country. PPPs are complex contractual and financial arrangements requiring the necessary skills and knowledge to structure the transaction and manage the contract over their life. In addition, geothermal development is a multidisciplinary endeavor that requires not only technical knowledge of the resource but also an understanding of finance, regulation, and policy. In 2013, the Government of Kenya received a credit of US$ 40 million from the World Bank to assist it in creating a bankable pipeline of PPP projects. This support has gone toward creating the necessary capacity of the PPP unit, strengthening the PPP institutions established under the PPP Act (Kamau, 2015). Thus, it is essential for PPP units in other targeted countries to increase their capability through capacity building program.

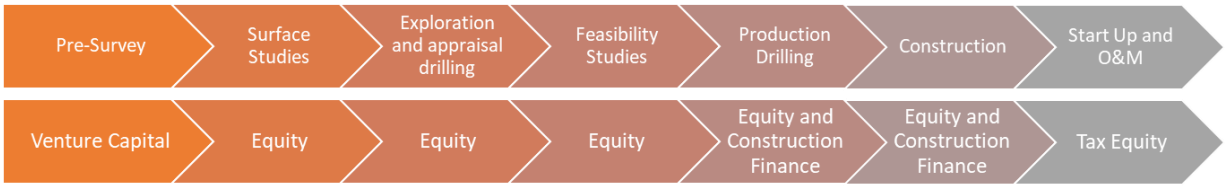
Table 1: Development Status of PPP Framework in the Targeted Countries (Source: (PPP Legal Resource Centre, 2022), PPP unit's site)

| | Kenya | Ethiopia | Uganda | Rwanda | Djibouti | Tanzania |
|---|---|---|---|---|---|---|
| Policy for PPP | PPP Policy 2011 | GTP II and Vision 2025 | PPP Framework Policy 2010 | Rwanda Vision 2020 | - | National PPP Policy 2009 |
| Regulation for PPP | PPP Act 2013 | PPP Proclamation No. 1076/2018 | PPP Act 2015 | PPP Law 2016 | PPP Law 2017 | PPP Act 2010 |
| A clear procedure and timeline for PPP procurement | ○ | △ (Timeline is not clear) | △ (Timeline is not clear) | ○ | (Cannot be identified due to document in French) | △ (Timeline is not clear) |
| **Institution** | | | | | | |
| The existence of PPP unit | ○ | ○ | ○ | ○ | ○ | ○ |
| Year of establishment of PPP unit | 2013 | 2018 | 2015 | 2016 | 2018 | 2011 |
| Total PPP pipeline in 2022 | 64 | 26 | 33 | 15 | 1 | 20 |
| PPP project in geothermal till 2022 | 3 | 2 | - | - | - | - |
| Disclosure PPP project information for public | ○ http://portal.pppunit.go.ke/ | - | ○ https://www.pppunit.go.ug/ | ○ https://rdb.rw/ | ○ https://unite-pppdjibouti.com/ | △ (not updated) https://www.pppnode.go.tz/ |

Potential geothermal projects for PPP are selected from the existing geothermal projects in the targeted countries (Table 1). Potential project is defined as those projects that have relatively high feasibility and high possibility outcomes for active private sector participation. In this section, potential PPP projects in the six targeted countries are presented and potential risks and the mitigation solutions to attract private investors in these potential projects are described. The needs of technical support for potential projects are also provided to give clear information for the private sector regarding what kind of contribution they can provide to accelerate the development of potential projects. The possibility of alternative financing options, including private finance to fill the gap of funding for potential project, was also investigated through case studies. The discussion includes geothermal power plant PPP projects that are in operation and those that are in development phase. The most successful PPP projects are the Orpower4, Inc at Olkaria and Menengai 105MW (Figure 3) projects in Kenya.

**Figure 3: Menengai well MW-1A under discharge test using seven twin separators to handle the large total mass produced. The well produces steam equivalent to 30 MW electric when on full discharge**

Geothermal projects are commonly financed through many schemes depending on the risk factors and the market players. In Africa, most of the successful projects were undertaken through public financing as the governments are able to assume substantial project risks. Lately, there are private investors and venture capital that are willing and ready to undertake the early stages of geothermal projects with hope for substantial returns on success (Figure 4). When risks are substantially reduced then funds for geothermal power projects can be accessed from private equity, public markets and financial partners. Banks and large IPPs typically join during construction and operations phases of the project.




| | | | |
|---|---|---|---|
| • Developers<br>• IPPs<br>• Resource Speculators<br>• Venture Capital | • Private Equity<br>• Public markets<br>• Financial partners | • Private Equity<br>• Strategic Partners<br>• Banks and funds | • Financial Players<br>• Large IPPs |

**Figure 4: Staged financing of geothermal projects**

Geothermal projects in East Africa have been developed by either by public organizations or private sector (Table 2). KenGen and GDC are particular successful developers of geothermal resources for electric energy. KenGen currently generated 755MW of electricity from geothermal resources and accounting for almost 30% of electricity consumed in the country. GDC on the other hand is a resource developer and established to derisk the early stages of geothermal projects. GDC's Menengai project is committed for 105MW in phase one and another 60MW planned for phase 2. The company is currently developing other geothermal sites in Kenya. Kenya also has successful IPP history with Orpower4 generating 150MW grid connected power which accounts for 15% of power dispatched. Other three IPPs have been licensed to generate a total of 105MW from the Menengai geothermal field. The first 35MW is in operation while the second 35MW plant is under construction and will be ready for commissioning in 2024. The last 35MW plan is in the last stages of approval. GDC has proved steam at the Paka geothermal field and has advertised for feasibility study consultants for 100MW power project. The project will be developed under separated model with IPPs developing the power plant under BOO scheme and signing the PPA with the offtaker. It is likely that invitations for IPPs will be made in 2024 after conclusion of the feasibility studies in early 2023. In this project, GDC will be keen to incorporate direct use in the project scope.

In Ethiopia, Ethiopian Electric Power (EEP) is currently developing the Aluto geothermal project for 70MW in two phases of 35 MW each. EEP is also planning to undertake appraisal drilling at Dubti and to drill exploration wells at Alalobeda and Ayrobeda prospects of the greater Tendaho geothermal field. It seems likely that EEP will require participation of IPPs after confirmatory drilling of the Tendaho field and hundreds of MWe is expected from the geothermal resource. Tulu Moye geothermal project was the first privately developed geothermal power project. Whereas the results have not been as good as expected, the project arrangement and financing is good case study. Once the resource risks are managed through contribution of more experienced technical experts then the project can still be successful but may not achieve the targeted production. The other IPP project under development is the Corbetti geothermal project owned by consortium of Reykjavik Geothermal and Berkeley Energy. Reviews indicate that the project has a high chance of success. The project is planned for 500MW in several phases. The Government of Ethiopia has licensed more than ten prospects to private investors. Even though the prospects have high chance of success, no significant progress have been made due to financial constraints and therefore additional resources from private investors and equity partners are required.

Table 2: Potential Projects for PPP

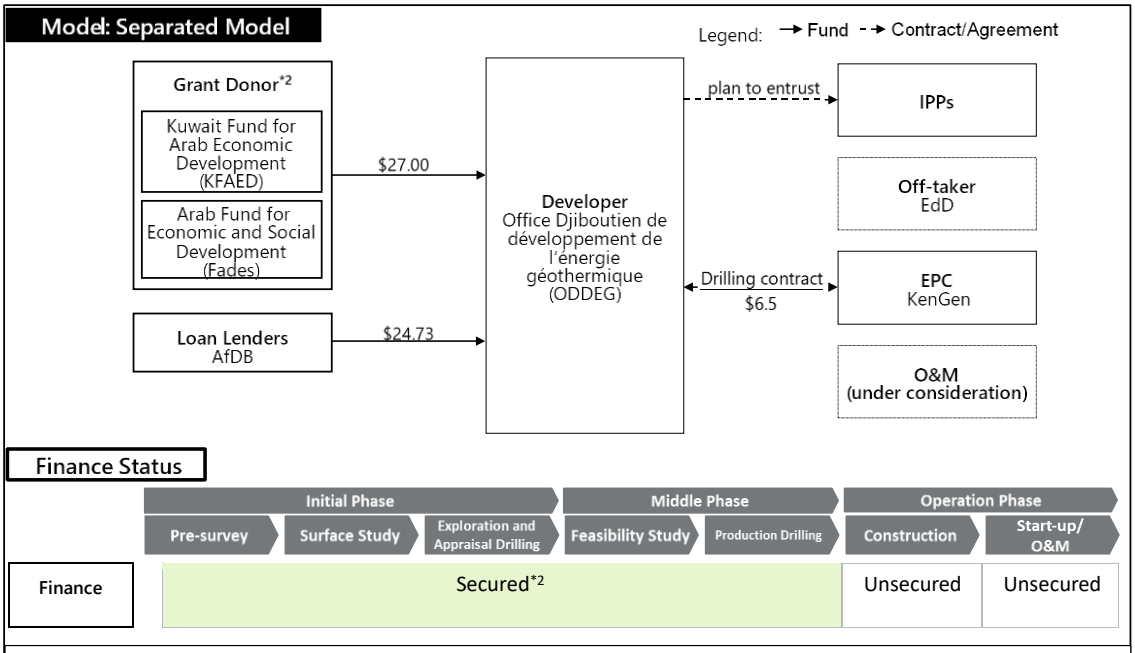
| Country | Project/Field | Estimated Potential | Surface Studies | Exploration and Appraisal Drilling | Feasibility Study | Production Drilling | Construction | Ownership | Installed (MW) | In Operation 2022 (MW) |
|---|---|---|---|---|---|---|---|---|---|---|
| Kenya | Suswa | 500 | Done | Exploration | Pre FS | Ongoing | - | Public | - | - |
| | Longonot | 500 | Done | Exploration | Pre FS | - | - | Private | - | - |
| | Korosi | - | Done | Ongoing | - | - | - | Public | - | - |
| | Paka | 500 | Done | Ongoing | 2023 | - | - | Public | - | - |
| | Silali | 500 | Done | Drill plan | Pre FS | - | - | Public | - | - |
| | Akiira | | Done | Under review | - | - | - | Private | - | - |
| | Lake Baringo | - | Done | Exploration | - | - | - | Private | - | - |
| | Arus | 70 | Done | Exploration | - | - | - | Private | - | - |
| | Homa Hills | 50 | Done | Exploration | - | - | - | Private | - | - |
| | Menengai | 105 | Done | Ongoing | done | ongoing | 35MW | Public/Private | 35 | - |
| | Barrier | | | | | | | Private | | |
| | Emuruepoli | | | | | | | Private | | |
| | Emuruangogolak | | | | | | | Private | | |
| | Namarunu | | | | | | | Private | | |
| Ethiopia | Aluto-Langano (all fields) | 75 | Done | Done | Done | Ongoing | 5MW pilot | Public | 8.5 | - |
| | Dubti | 200 | Done | Done | Ongoing | - | - | Public | - | - |
| | Tulu Moye | 200 | Done | Ongoing | Done | Planned | - | Private | - | - |
| | Tendaho-Alalobeda | 120 | Done | Drill Plan | - | - | - | Public | - | - |

| Country | Project/Field | Estimated Potential | Surface Studies | Exploration and Appraisal Drill | Feasibility Study | Production Drilling | Construction | Ownership | Installed (MW) | In Operation 2022 (MW) |
|---|---|---|---|---|---|---|---|---|---|---|
| | Tendaho-Ayrobera | 200 | Done | Planned | - | - | - | Public | - | - |
| | Corbetti | 500 | Done | Planned | - | - | - | Private | - | - |
| | Dofan | 25 | Done | | - | - | - | Private | - | - |
| | Boku | - | Done | | - | - | - | Private | - | - |
| | Duguna Fango | - | Done | | - | - | - | Private | - | - |
| | Fentale | 100 | Done | Planned | - | - | - | Private | - | - |
| | Abaya | 100 | Done | Planned | - | - | - | Private | - | - |
| | Boseti | 100 | | Planned | | | | Private | | |
| Rwanda | Gisenyi | - | Done | Planned | - | - | - | Public | - | - |
| | Mashyuza | - | Done | Planned | - | - | - | Public | - | - |
| Uganda | Katwe | - | Partial | | - | - | - | Private | - | - |
| | Buranga | - | Partial | | - | - | - | Private | - | - |
| | Kibiro | - | Partial | | - | - | - | Private | - | - |
| | Panyimur | | Partial | | | | | Private | | |
| Djibouti | Asal-Fiale | - | Done | Done | Ongoing | | - | Public | - | - |
| | Gale La Koma | - | Done | Done | Planned | - | - | Public | - | - |
| | Hanle-Garrabayis | - | Done | Planned | - | - | - | Public | - | - |
| Tanzania | Ngozi | 200 | Done | Exploration | - | - | - | Public | - | - |
| | Kiejo-Mbaka | 50 | Done | Exploration | - | - | - | Public | - | - |
| | Songwe | 50 | Done | Exploration | - | - | - | Public | - | - |
| | Natron | 50 | Ongoing | Exploration | - | - | - | Public | - | - |
| | Luhoi | | Planned | Exploration | | | | | | |

## Djibouti

- **Gale La Koma Geothermal Prospect**

Project detail is shown in figure 5. The Gale La Koma project developed by ODDEG is expected to be separated model, but the details on IPP procurement have not been disclosed. The estimated total development cost is not publicly disclosed, but the project has secured US$ 24.73 million loan from AfDB and US$ 27 million grants from Kuwait Fund for Arab Economic Development (KFAED) and Arab Fund for Economic and Social Development (Fades) utilized for drilling of 10 wells (8 production boreholes and 2 reinjection boreholes) and 15 MW capacity power plant as the first stage. ODDEG signed a US$ 6.5 million drilling contract with KenGen for three wells, but EPC and O&M contractor has not been fixed. Although the project has been funded till the phase of production drilling, it still needs funds for the remaining construction phase and O&M phase. Thus, it is potential for private sector (IPPs) to fill this funding gap.




*1: Currency all in million US$.

*2: Grants will be utilized for drilling of 10 wells (eight production boreholes and two reinjection boreholes) and 15 MW capacity power plant as the first stage.

**Figure 5: Project details for Gale La Koma**

Since this project is in phase of exploration and appraisal drilling, resource risk and drilling risk is expected to be main potential risks. Resource risk has been mitigated by government-lead exploration and drilling through ODDEG and the use of DFI funds from AfDB, KFAED and Fades. On the other hand, the selection of credible drilling company such as KenGen is being used to mitigate drilling risk since the country doesn't has experience on geothermal exploration. In addition, since this project uses separated model like Menengai project, it needs to address organizational risk, particularly credit risk of steam provider (ODDEG) and off-taker (EdD). This risk can be mitigated by using sovereign guarantee combined with guarantee (e.g. PRG) from bank or insurer. Gale La Koma project is one of the nearly mature geothermal projects in Djibouti for PPP entry (Figure 6). An experienced partner could contribute to the accurate sitting of the subsequent exploration and appraisal wells for drilling and also plan for production from the high salinity geothermal fluids. Low permeability is also a

challenge in the prospect and technologies could deployed to enhanced permeability of target fracture zones during drilling.

Figure 6: Drilling operation at Gale La Koma in November 2022

Private sector could also enter through greenfields by obtaining exploration licenses for the other prospects that include Hanle Garrabayis, Hanle, and Lake Abhe that have been explored and committed for drilling by ODDEG.

## Ethiopia

- **Tulu Moye project**

The Tulu Moye project is a primary example of vertical integration model which IPP is responsible for phases from exploration to construction and O&M of both power plants and steam production facilities. This project is under PPP scheme with the ownership of a private developer – TMGO – but it must be transferred back to the Government of Ethiopia under the BOOT scheme after PPA contract with Ethiopian Electricity Power ends. A 25-year take-or-pay PPA was signed between TMGO and EEP in December 2017. The tariff is US$ 6.95 cents/kWh equivalent in Ethiopian Birr subject to an exchange rate reconciliation mechanism that will be detailed as a condition precedent to the effectiveness of the PPA. This mechanism will be further reassessed to ensure that AfDB, other senior lenders, and CTF are not exposed to currency exchange risk. The annual rate of tariff escalation is 2.4% for years 1-5 dropping gradually thereafter to 2% at year 20 and beyond.

This project has successfully secured all finance needed for development of steam fields and construction of geothermal power generation. One of the reasons that Tulu Moye project could attract private finance was the involvement of well-known geothermal professionals. For example, Reykjavik Geothermal Ltd. (RG), one of the shareholders of TMGO, is a geothermal business based out of Iceland, and KenGen was appointed as the drilling contractor which has 300 successful geothermal wells over 40 years. TMGO also highlighted the supportive attitude of Ethiopian government regarding attracting investment for major infrastructure projects by organizing the legislative framework in place for PPPs and foreign direct investments.

Finance structure of Tulu Moye project is shown in figure 7. Meridiam, Inc. and RG provide equity totaling US$ 27.94 million to the project. Grants funding from GRMF, USTDA, Private Infrastructure Development Group (PIDG), and Sustainable Energy Fund for Africa (SEFA) is considered as part of project financing plan. RG already received US$ 1.3 million grant from GRMF to conduct surface studies for the project, and TMGO signed a US$ 10.7 million grant contract with USTDA in support of drilling exploration of three geothermal wells (AfDB, 2020). In December 2022, TMGO received US$ 10 million grant from SEFA to support drilling program to achieve the first financial close.

TMGO also will receive US$ 209.97 million loan from AfDB, CTF, and other DFIs. It must be noted that loan from DFIs will be provided after completion of date or first financial close. The construction risk will be fully allocated to TMGO as these costs will be fully funded by their own equity. Since this project is still in phase of exploration and appraisal drilling, resource risk and drilling risk are expected to be the main risks for this project. Resource risk is being mitigated by the use of grant from GRMF and climate finance such as SEFA from AfDB. However, the project experienced drilling risks associated with collapsing formations which took time before the drilling contractors could master handling of the situation. The project has also suffered resource risk which is currently the main challenge for the project as low output and tight reservoir has been realized from most of the wells so far drilled.

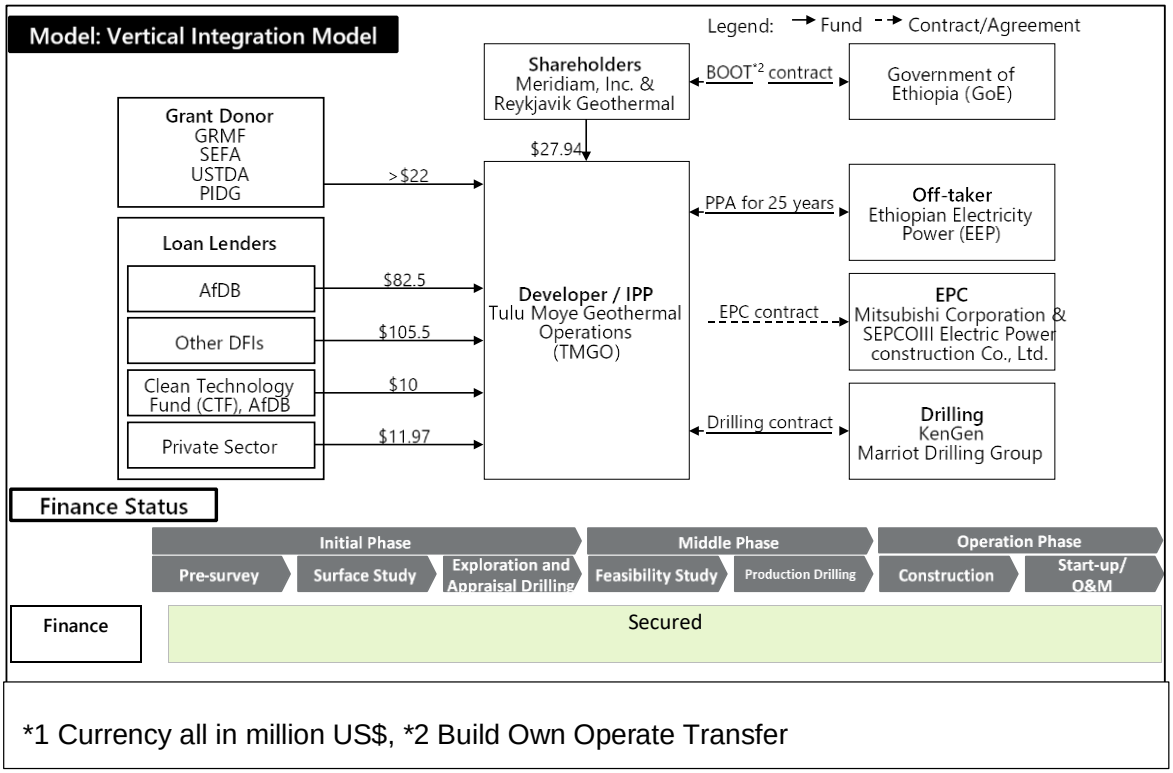



**Figure 7: Tulu Moye project details**

## Kenya

- **Olkaria III Geothermal Project**

The Olkaria III power project is owned and operated by Orpower4, Inc under BOO scheme. Olkaria III was the first privately financed and developed geothermal project in Kenya. The project was developed in phases corresponding to confirmation of adequate resources. The first three phases were developed from 2003 to 2014 and produces 100MW (Figure 8). The first pilot phase of 12 MW was commissioned in 2003 with full equity funding from Ormat Technologies, Inc. Subsequent phases of the project and refinancing of equity came from development partners including DEG and KFW, IFC and OPIC. Multilateral Investment Guarantee Agency (MIGA), the World Bank Group, issued a guarantee to Ormat Holding Corp. for its equity investment in OrPower 4, Inc (Figure 9).

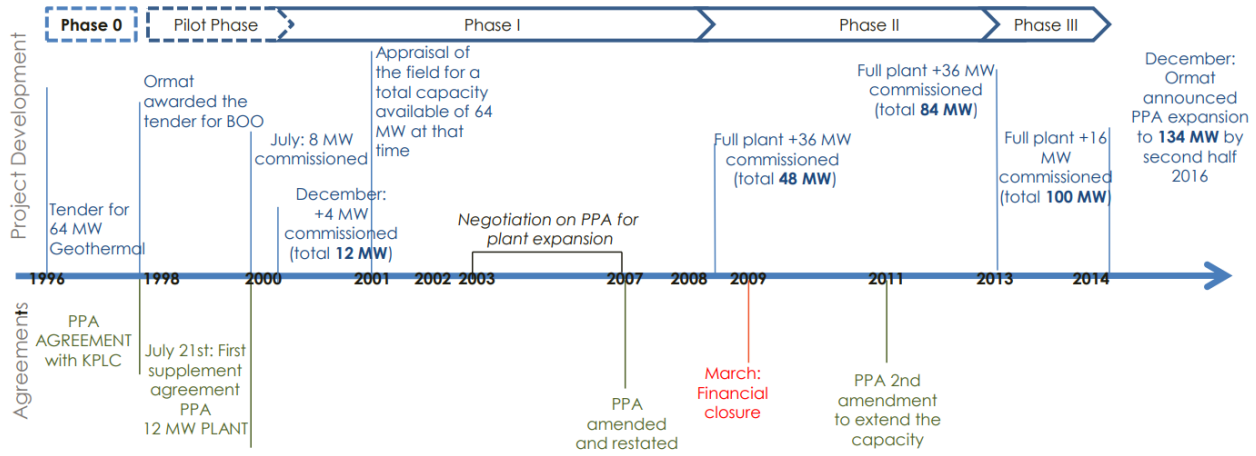



**Figure 8: Development of Phases I-III of Orpower4 power project**

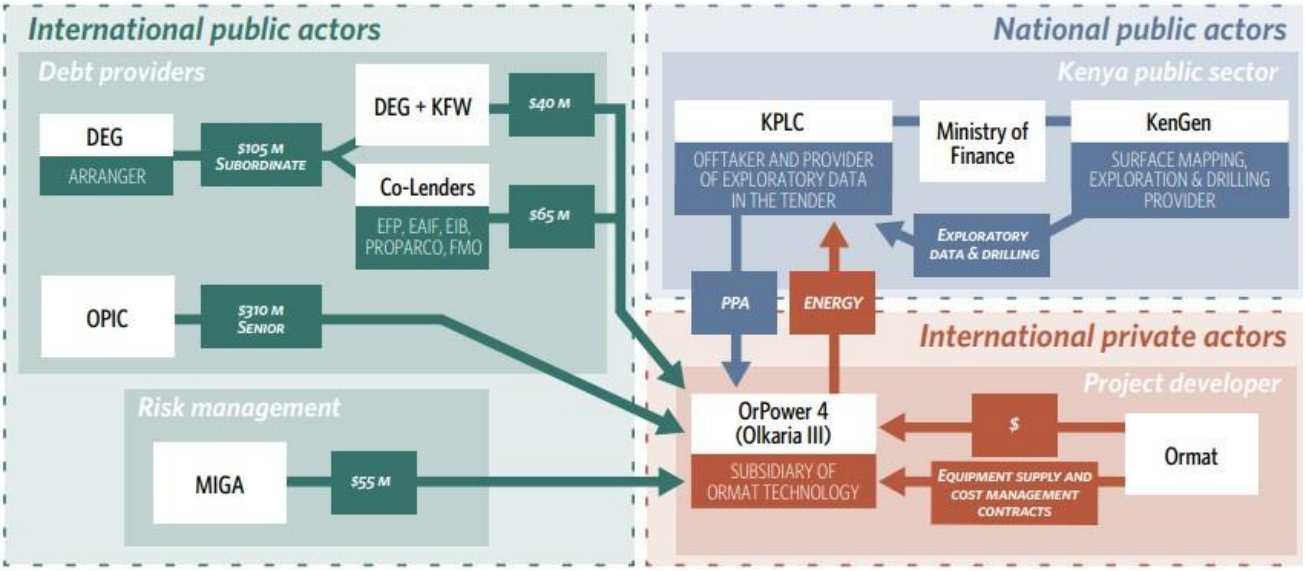



**Figure 9: Financing scheme and stakeholders for the Olkaria III project**

(Micale, Trabacchi, & Boni, 2015)

The guarantees issued in 2000 (US$ 43.3 million exposure for the 12 MW plant and extended in 2007 (US$ 88.3 million exposure for US$ 98.1 million equity investment to increase the plant capacity to 48 MW – Phase II and in 2012 (US$ 134 million for Phase III – 26 MW to cover Ormat Holding Corp.'s equity investments against equity risks. Subsequently, the project raised debt from DFIs including DEG, KFW and the Overseas Private Investment Company (OPIC) for an overall amount of US$ 445 million to complete phase III of the project (Micale, Trabacchi, & Boni, 2015; (Table 3; Figure 10). In-kind contribution from the Government of Kenya in terms of assets (wells) transferred to Orpower4, Inc was estimated at USD24 million. Additional 55MW capacity was added in phases from 2014-2019 during phase IV of the project for total installed capacity of 155MW (Table 3).

Table 3: Financing plan for Orpower4, phases I-III geothermal power project in Kenya

| Financial structure Olkaria III | | | Detail per Phase, USDm | | | | Total contribution, USDm |
|---|---|---|---|---|---|---|---|
| | | | Phase I | | Phase II | Phase III | |
| | | | 12 MW | 36 MW expansion | 36 MW expansion | 16 MW expansion | |
| *Kengen* | *In Kind donation* | *Public* | 24 | | | | **24** |
| Ormat Technologies | Equity | Private | 40 | 110 | 43 | 27 | **220** |
| DEG and KfW | Syndicated Loan - Refinancing | Public | 105 | | | | **105** |
| OPIC | Senior Loan - Refinancing | Public | 85 | | | | **85** |
| OPIC | Senior Loan | Public | | | 180 | 45 | **225** |
| **Total Finance mobilized, USDm** | | | | | | | **635** |
| **Total Project Costs (excluding refinancing), USDm** | | | | | | | **445** |

Key success factors for the project were the participation of both the public and private sectors where the risks during the early resource confirmation phase were solely borne by KenGen (Government). The risk during the development phase were borne by both the lenders and the developer while the risks during the operation phase were shared between the government (offtake, payment and forex risks) while the lenders and developer assumed the loan repayment risk, resource risk and part of forex repayment risk. The modular approach to the development further made it easier to finance and develop the project.

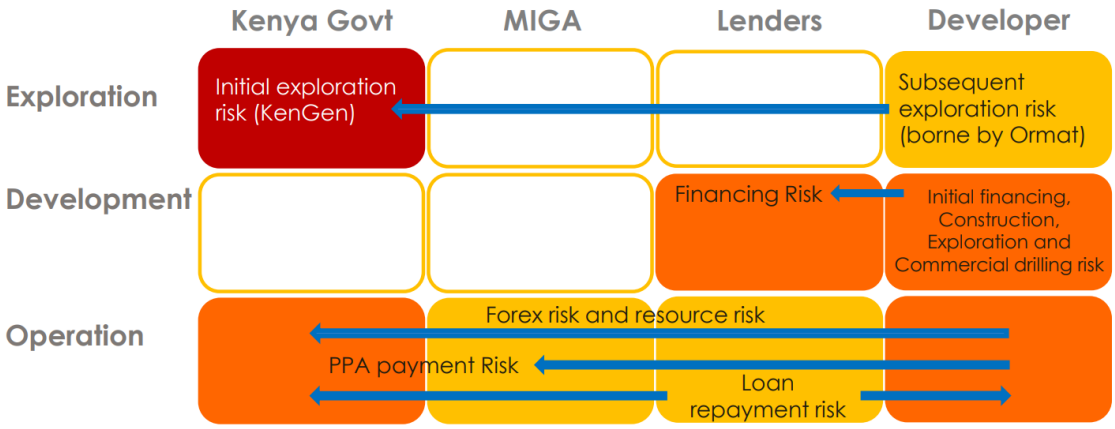



Figure 10: Orpower4 Olkaria geothermal project risk distribution

- **Menengai Geothermal Project**

Menengai Phase I project is a more recent geothermal project structured as a PPP. The Menengai Geothermal Development Project is to be developed by GDC in five phases with the first phase planned for 105MW. The first phase of this project involves the development of three power plants by three independent power producers - QPEA GT Menengai Limited, Sosian Menengai Geothermal Power Limited, and OrPower22 Limited, all special purposes vehicles (SPVs) incorporated in Kenya as required under the PPP Act. The Quantum Power East Africa Ltd (QPEA) Geothermal project has since been bought by Globeleq Ltd while Orpower22 was bought by Symbion and which was subsequently bought by Kaishan.

Each plant is to have a generation capacity of 35MW making an overall total capacity of 105MW. The project is being undertaken through a steam sales model where GDC supplies the steam to the power plants for conversion to electricity under a Build-Own-Operate arrangement. GDC, as the state-owned entity is responsible for financing the early phases of steam resource development in the geothermal field including drilling activities, and development of the steam gathering system and management of waste brine. The IPPs finances the construction and operation of the power plants and buy the steam supplied by GDC under a Project Implementation and Steam Supply Agreement (PISSA). The IPPs signed a Power Purchase Agreement with KPLC as the single off-taker of all the electricity to be generated by the three power plants (Figure 11).

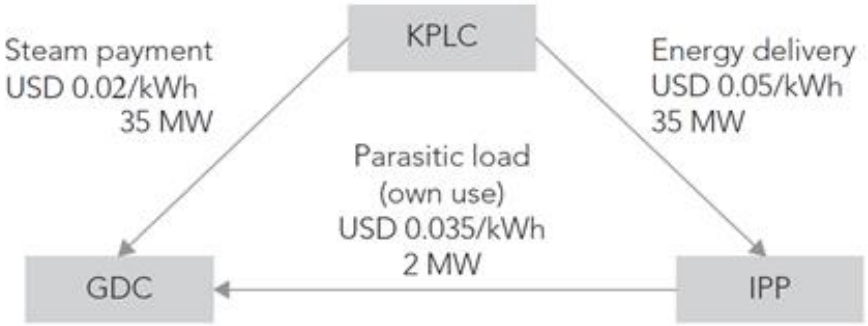
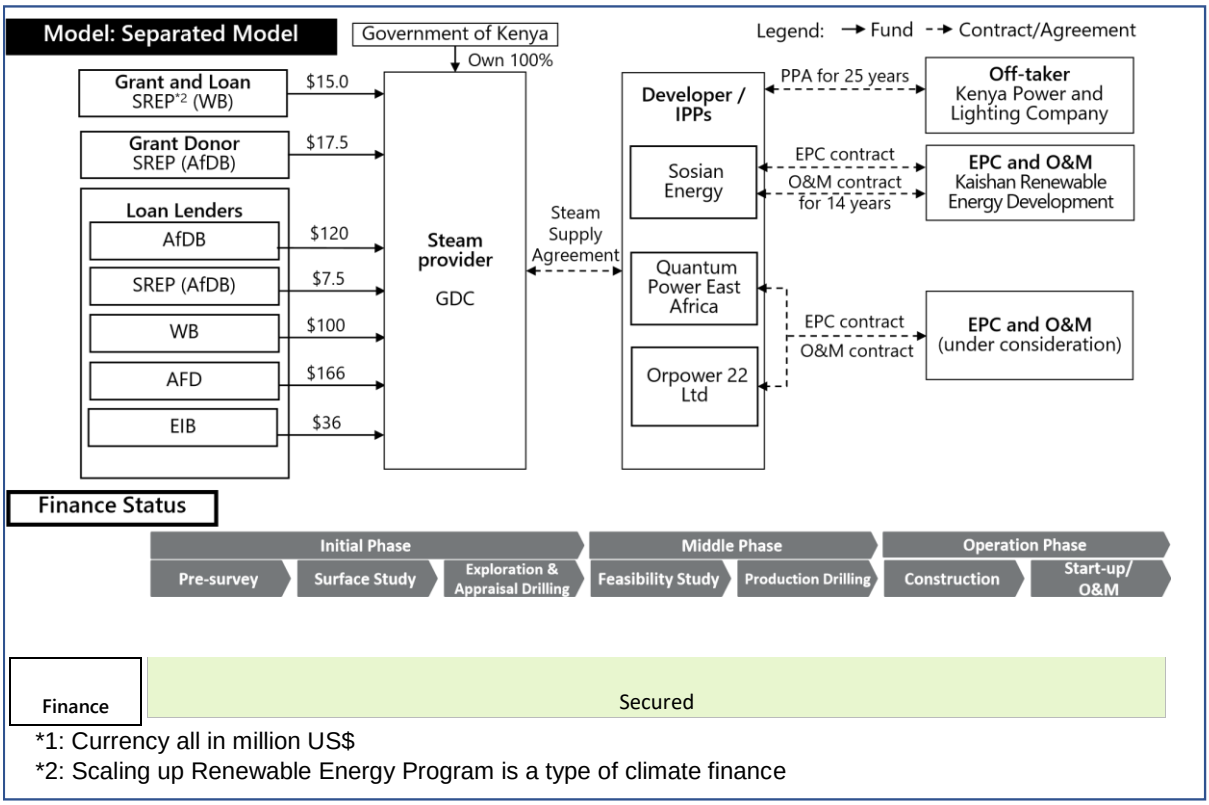



**Figure 11: Menengai Geothermal Field Development model**

The Menengai project is considered as one of the best examples separated PPP project models for development (Figure 12). The field development was wholly undertaken by GDC though financial support from the Government of Kenya, AfDB, World Bank, CIF, AFD and EIB through different instruments. In particular, AfDB and AFD provided three and two high capacity drilling rigs, respectively. The project is now fully financed by US$ 17.5 million grant, US$ 15 million hybrid of grant and loan, and US$ 7.5 million loan from Scaling-up Renewable Energy Program (SREP) that is one of the climate finances. Loan total is US$ 422 million from AfDB, World Bank, AFD, and EIB.




*1: Currency all in million US$
*2: Scaling up Renewable Energy Program is a type of climate finance

**Figure 12: Menengai project details (Separated Model)**

The Sosian Menengai Geothermal Power Limited was financed through equity from Sosian Energy Ltd and equipment debt from EPC contractor (Kaishan Renewable Energy Development Co.) who has also signed an O&M agreement for 15 years with Sosian Energy Ltd during which they will recover the construction debt. Through a similar arrangement, Kaishan Ltd will build the recently acquired 35MW from Orpower22/Symbion using equity funds and construction debt from the parent company. It is likely that the power plant will be a replica of the Sosian Menengai Geothermal Power plant.

The 105MW project was to come online in 2016 but faced long delays attributed to many risk factors including creditworthiness of KPLC as off-taker, GDC as steam developer and lack of sovereign guarantee to cover KPLC and GDC contractual financial obligations. To address credit risks of off-taker and steam provider, AfDB provided PRG of approximately USD 11.27 million to cover KPLC against default in payment to the IPPs and also cover GDC against default in steam supply to the IPPs. Under the PRG, at the request of KPLC and GDC, a commercial bank issues Letter(s) of Credit (L/C) which the IPPs will have the right to draw upon in the event of non-payment under the PPA or inability to generate electricity due to GDC default under the PISSA (steam purchase agreement). For its part, the bank signed an reimbursement and credit agreements with KPLC and GDC, through which these would repay the bank any amounts drawn by any of the IPPs, within a specified agreed reimbursement period. Meanwhile, the Treasury of the Government of Kenya enters into an indemnity agreement in which it undertakes to repay the AfDB on demand for any reimbursement made to the L/C bank under the PRG. The total guarantee period is 15 years (Climate Investment Funds, 2018). A financing model for Quantum Power East Africa/Globeleq power project is shown in Figure 13.

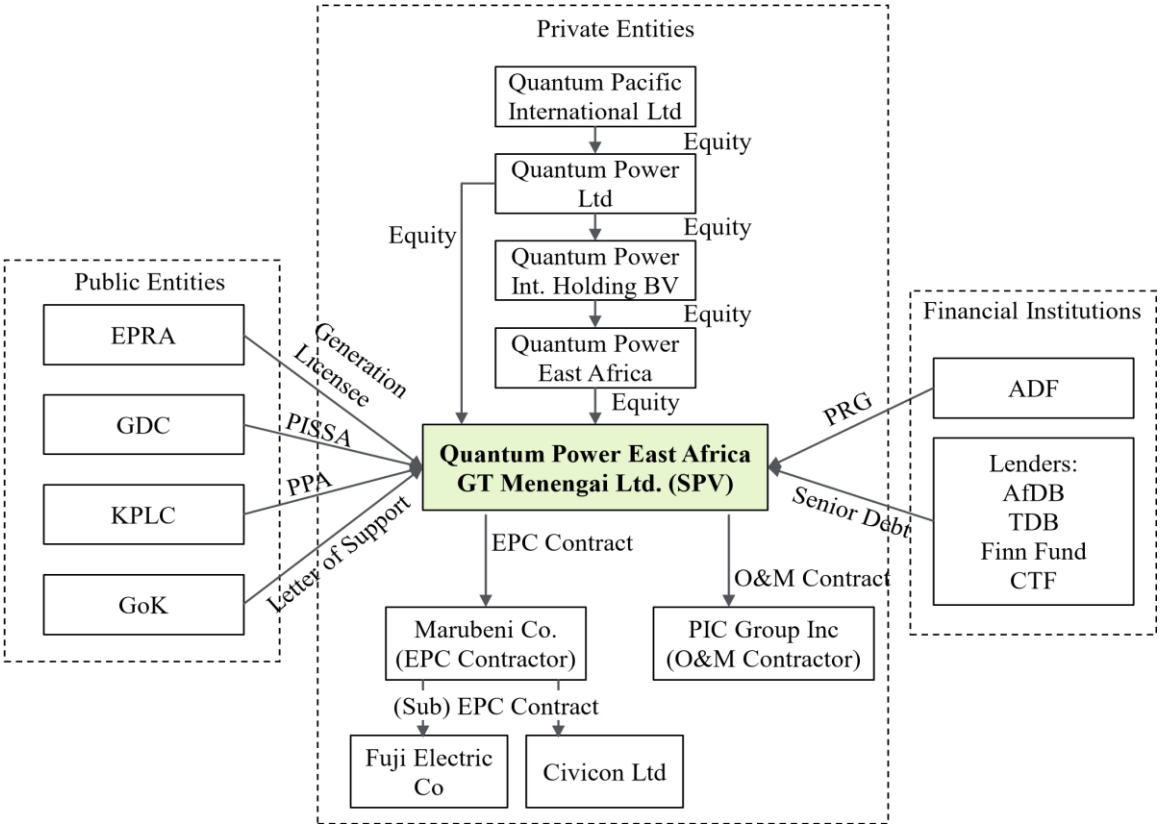



Figure 13: IPP Structure and Agreements in Menengai Project

The other challenge was to achieve an attractive return on investment for private developers and lenders. As part of risk guarantee analysis, the IPPs produced financial models showing a 12% internal rate of return (IRR) on equity. However, 12% of IRR was not considered sufficient by project sponsors for sourcing debt that would make the IPP projects bankable. Therefore, the project developers accessed concessional loans through the Dedicated Private Sector Program of CIF's CTF. CTF provided a concessional lending program of US$ 29.7 million via AfDB for two IPPs (US$ 15 million in CTF concessional debt per power plant -Orpower22 and Quantum Power). This CTF investment was expected to lower the cost of capital to make the two IPP projects bankable (Climate Investment Funds, 2018). GDC has undertaken additional drilling within the Menengai field with plans to develop Menengai phase with capacity of 60MW. The project plans will be concluded in due course and will involve steam sales to the private sector through PPP arrangement.

- **Paka Geothermal Field**

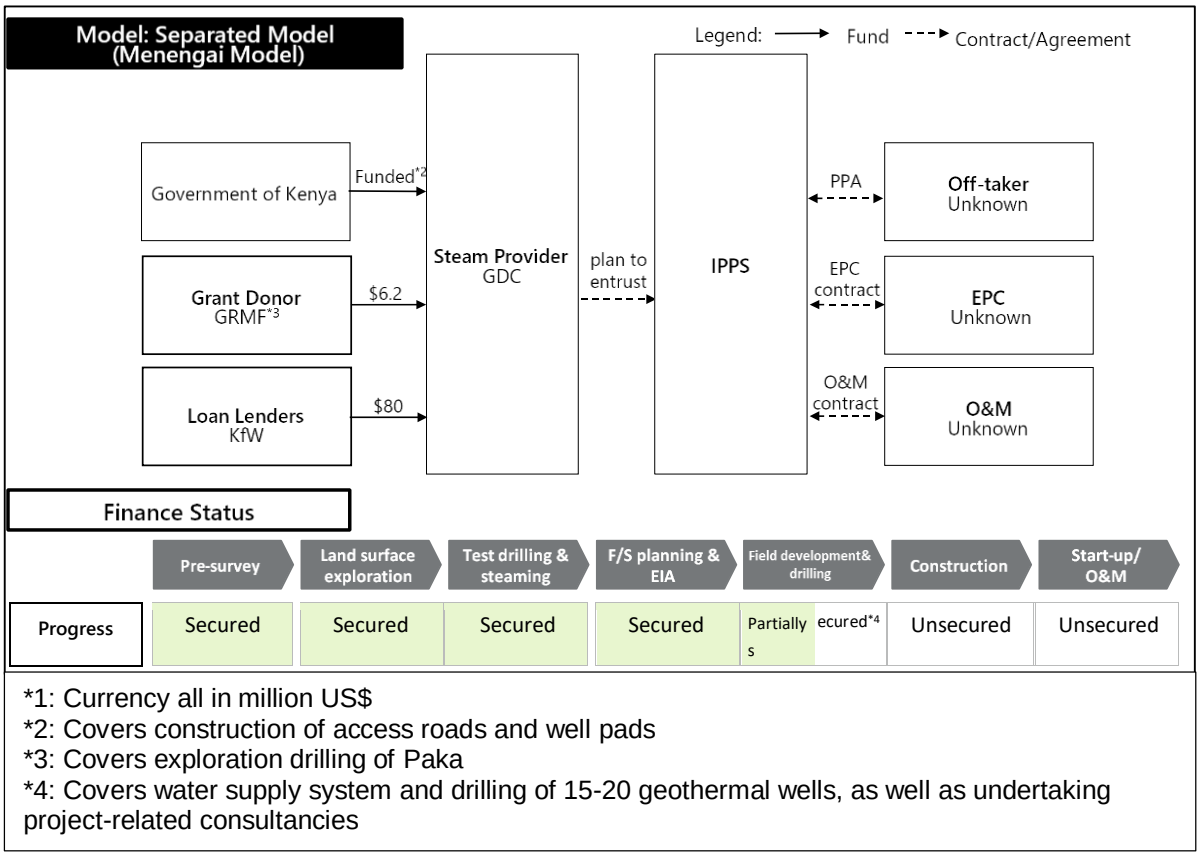
The Baringo – Silali project includes three sites named Korosi, Paka, and Silali with total estimated potential power of more than 3,000 MW, according to GDC when full developed at high success rate (Figure 14). The first phase of the project was estimated cost US$ 80 million for drilling exploration wells at Paka and Korosi geothermal prospects. Exploration and Appraisal drilling undertaken at Paka realized thirteen wells which have confirmed the presence of a viable high temperature system with output of more than 60MWe. Currently, only Paka has been successfully drilled while drilling at Silali is planned for the near future. Korosi prospect is still under detailed evaluation after the three drilled exploration wells failed to encounter a viable geothermal resource.

The Paka project is a "separated model" and is expected to follow the model of the Menengai project in which GDC is taking the lead as shown in figure 15. The Government of Kenya has funded

development of infrastructure, such as construction of access roads and well pads and thirteen wells which have proved steam of more than 38 MWe. GRMF allocated US$ 6.2 million grant for exploration drilling while US$ 80 million loan was provided by KfW. Although IPPs, EPC, and O&M contractors are not identified yet, the current funding covers drilling of 15-20 geothermal wells as well as undertaking project-related consultancies including feasibility studies. For the rest of funding, the use of private finance from IPPs, loan/grant from DFIs, and climate finance will be considered.

**Figure 14: Photo of drilling operations at Paka Geothermal field, Kenya**

Since this project is still in phase of exploration and appraisal drilling, resource risk is expected to be one of the main risks for this project. This risk has been mitigated by government-lead exploration and drilling through GDC. The use of grant from GRMF and soft loan from KfW are also expected to reduce the resource risk. Similar with Menengai project, private sector can participate in this project as IPPs for constructing geothermal power plant.




*1: Currency all in million US$
*2: Covers construction of access roads and well pads
*3: Covers exploration drilling of Paka
*4: Covers water supply system and drilling of 15-20 geothermal wells, as well as undertaking project-related consultancies

Figure 15: Baringo-Silali project details

- **Other Projects**

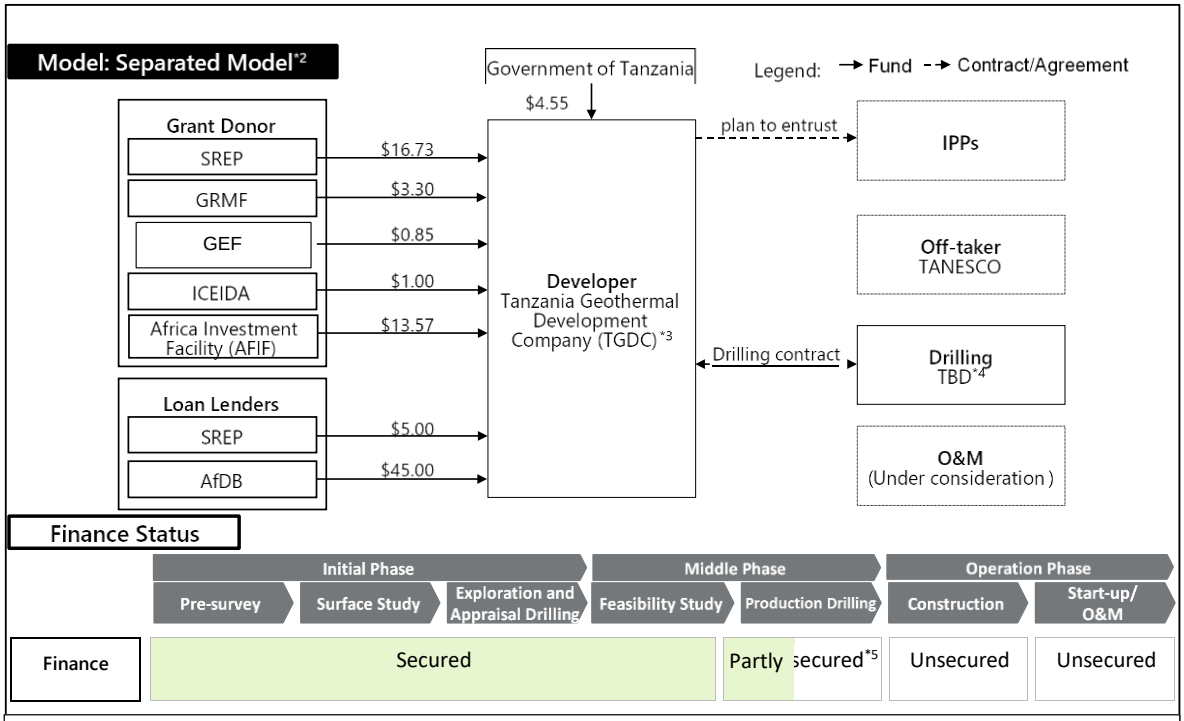
The Kenya Government has issued eight geothermal exploration licenses for Akiira, Elmenteita, Arus, Emuruangogolak, Emuruepoli, Namarunu, Barrier, Menengai North, and Homa Hills prospects to private developers. The licenses were issued between 2013 and 2018. Only Akiira project was drilled but the two exploration wells turned dry. The other projects are at early stages of exploration from own sources and from development aid, e.g. GRMF. These projects are all available for partnership with international organizations to undertake well siting and drilling of exploration wells. For these projects, the project development would be commercial arrangements between the private sector investor players for vertically integrated development models.

Silali and Suswa prospects are licensed to GDC and detailed studies and ESIA have been undertaken and completed. GDC is awaiting funds to develop infrastructure and drill exploration wells. These projects are ripe for PPP since detailed studies have been concluded and have high chance of success. The private investor would be required to contribute to infrastructure development, drilling of exploration, appraisal and production wells and construct power plants. This would be a typical separated model where GDC undertakes surface studies phase and private sector finances drilling and power development. GDC would also provide drilling services while the investor finances the drilling and materials.

## Tanzania

- **Ngozi geothermal project**

The project is located in southern Tanzania is one of the promising geothermal prospects in the country. The project is being developed by TGDC which is a state owned power project developer. The project will be undertaken under a separated PPP model. (Figure 16). Out of estimated total development cost being US$ 821 million, US$ 21.73 million grants and loans from SREP being one of the climate finances; US$ 18.70 million grants from GRMF, GEF, ICEIDA, and Africa Investment Facility (AFIF); and US$ 45 million loan from AfDB have been secured. Detailed surface exploration for the project has already been finished, and TGDC will now proceed to drilling. TGDC received the drilling rig and accessory equipment, financed by the Government, to the project site. Since the project is still in phase of exploration drilling, resource risk and drilling risk are expected to be main potential risks. Resource risk is being mitigated by government-led exploration and drilling of slim holes through TGDC using grant from the government, GRMF and climate finance (SREP). TGDC tendered for drilling services companies to support it in the drilling of the four initial slim holes. When the development of steam reservoir is confirmed through drilling of the four planned slim holes, private sector (IPPs) will be allowed to take over the project and drill appraisal and production wells and construct the power plant through BOOT. In addition, since this project uses separated model like Menengai project, it will need to address organizational risk, particularly credit risk of the partial steam provider (TGDC) and off-taker (TANESCO). This risk could be mitigated by using sovereign guarantee combined with other guarantees (e.g. PRG) from bank or insurer. Creditworthiness analysis of steam provider and off-taker is also needed to address this risk. However, it could be possible that TGDC could hand over the project fully to the IPP after drilling of the first four slim holes and therefore it could revert to be a vertically integrated model.




*1: Currency all in million US$.
*2: Planned according to consultation with TGDC.
*3: 100% state-owned company.
*4: ICT closed on August 29, 2022.
*5: Current funding will cover until installation of the steam gathering system

**Figure 16: Ngozi Project details**