COVER PAGE

Report on the Geothermal Projects Development in East African Countries of Djibouti, Ethiopia, Kenya, Rwanda, Tanzania and Uganda: Opportunities for Private Investments and Public Private Partnerships

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This study was undertaken by Asia External Representation Office of African Development Bank (AfDB) in partnership with UNIDO to elaborate and identify tangible options and windows of opportunities for attracting private sector finance and for promoting non-sovereign projects in the field of geothermal industry including mobilizing private financing through Public-Private Partnership (PPP). The Asia External Representation Office of AfDB initiated this effort to encourage Asian investors to participate in the African Geothermal industry. This report was prepared to highlight the abundance of geothermal resources in East Africa but only limited development has so far been undertaken in the countries of Djibouti, Ethiopia, Kenya, Rwanda, Tanzania and Uganda. Whereas the targeted six east African countries have a large population of more than 298 million as of 2020, only about 12 GW is generated of which about 63% is from renewable energy source comprising hydropower, solar and wind systems. Per capita consumption has remained very low of between 55 and 200kWhr compared to global average of more than 21,000kWhrs in 2021. Part of the causes of low consumption is low generation and lack of adequate transmission infrastructure. The targeted countries have pledged to increase generation from renewable energy sources as part of climate change mitigation. Geothermal resources have been highly ranked for development in the targeted countries.

	Population-2021 (Million)	Generation capacity (MW)	Penetration rate (%)	RE total (%)	Geothermal Generation-%	Per capita KWhr
Djibouti	1.1	164	65.4	26	0	55
Ethiopia	120.3	5275	54.2	98	0.16	95
Kenya	53.1	3037	75	78.7	29.9	200
Rwanda	13.5	276	74	49	0	73
Tanzania	63.6	1898	43	33	0	136
Uganda	45.9	1259	49	90	0	75
Total	**297.5**	**11,909**		**9,497 MW**	**940 MW**	

Geothermal resources widely occur in the targeted countries of Djibouti, Ethiopia, Kenya, Rwanda, Tanzania and Uganda but only a small fraction has been developed due to many challenges that include lack of supportive regulatory and fiscal environment in some countries, inadequate technology and training and lack of financing. However, it is known that high temperature, volcano hosted geothermal resources are located within the eastern branch of East African Rift System while the western branch of EARS has mainly medium temperature, fracture controlled geothermal resources. High temperature geothermal systems have been proven in Kenya, Ethiopia and Djibouti while surveys to identify reservoirs for the resources in the western branch are ongoing with surface studies which will give way for exploratory drilling in the selected sites. It has been estimated that about 20 GW can be developed in East Africa for power generation.Overall, the targeted countries intend to develop more than 5,000 MW of geothermal power projects by year 2035 alongside several direct use projects. Most of the developments are expected to be undertaken in Djibouti, Ethiopia, Kenya and Tanzania where exploration drilling is currently in progress. Rwanda and Uganda are re-evaluating their geothermal systems using a new approach suitable for evaluation of fracture controlled geothermal systems and there is high probability for successful results. East Africa has experience in PPP financing for geothermal projects with important examples being the 155 MW Orpower4 plant and 105 MW Menengai projects in Kenya and the Tulu Moye project in Ethiopia.

Development of all the geothermal projects in the targeted countries will require financing of more than US$ 20 billion over the next seven to twelve years for the 2030-2035 target to be achieved. The required capital for the projects is expected to come from both public and private and PPP financing. Kenya is developing the 100MW Paka project for PPP financing while Tanzania is planning to use PPP model for the development of the Ngozi geothermal project once the planned exploratory drilling confirms a resource. Several geothermal projects in Kenya, Ethiopia and Uganda have also been put on track for PPP development and will be open to international participation. Both vertically integrated and separated PPP models have been successfully used to finance geothermal projects in Kenya and Ethiopia and the new projects are likely to be a mix of the two models.

The East Africa region is one of the fastest growing geothermal market in the World and therefore, opportunities exist for private investors and financiers to engage with the targeted countries of East Africa to develop the geothermal resources for power generation and direct applications. The private developers can be engaged through PPP processes from early stage green field development through appraisal, feasibility studies, power development and operations and supply of generation equipment. Licensing procedures are well developed in Kenya and Ethiopia and are under development in the other targeted countries. Some specific case studies are described below and covered in greater detail in the fact sheets.

Djibouti: Exploration wells drilled in Asal, Gale La Koma and Fiale Caldera have proved the existence of high temperature geothermal system despite the challenges of high salinity, temperature inversion in the wells and low permeability in the reservoir. Private sector technology companies and experienced geothermal project developers are invited to help develop these complicated reservoirs. Greenfield projects are also available in Djibouti including Hanle - Garrabayis, Lake Abhe, North–Ghoubhet, among others. Good returns on investment are expected for the projects since the country offers competitive PPAs for renewable energy projects.

Ethiopia: Is one of the countries with the highest geothermal potential in Africa spanning the entire length of the rift. Ethiopian Electric Power (EEP) is currently focused on development of Aluto-Langano project to power generation phase. Tulu Moye and Corbetti prospects are committed to development by private sector. All the other twenty-six identified prospects including the Greater Tendaho geothermal field are open for new private investment in partnership with EEP or private license holders who are actively engaged in some of the projects. Most of the prospects have high potential for success and are within close distance to power grids. Development cost is expected to be low since EEP has drilling rigs in Ethiopia that can be rented for the projects.

Kenya: Kenya is currently the fastest growing geothermal market in Africa and presents the most successful geothermal PPP projects as well. Whereas the public sector through KenGen currently has the highest installed capacity, generation by private sector using PPP is rapidly increasing with currently installed capacity of 190MW and expected to grow by another committed 70MW (Menengai) by 2025 and by another 200MW (Olkaria) by 2026. GDC has opened up Paka geothermal field for 100MW, PPP project due to be tendered in 2024. GDC is also planning to initiate drilling at Paka and Suswa and which will also be available for PPP financing. There are also several geothermal exploration licenses that have been issued to private developers and which have not made progress due to many challenges including lack of financing for exploration drilling. These projects therefore avail opportunities for new equity investors to inject new capital into the projects.

Rwanda: Geothermal activities in Rwanda slowed down after the drilling of two dry geothermal wells in Karisimbi in 2013-2014. Subsequent technical review recommended a different approach to evaluating resources in the western branch of EARS being fault controlled geothermal systems. Studies are ongoing following the new guidelines. However, it has been established that the prospects

are low to medium temperature and likely to have small reservoirs suitable for modular ORC power generation and direct use applications. The Government of Rwanda is open to private sector involvement in the projects even though there is no specific law guiding private sector entry into geothermal projects.

Tanzania: Geothermal activities took a more aggressive path from year 2012 when TGDC was established to fast track exploration and development of geothermal resources in the country. The best-known site in Tanzania is the Ngozi geothermal prospect that has been modelled as high temperature. Exploration drilling of three slim-holes will commence in year 2023 and if a geothermal reservoir is identified then an IPP will be selected to undertake further appraisal and production drilling and construct a power plant in phases of up to 200MW. Kiejo-Mbaka prospect will also have slim-holes drilled in 2024. TGDC is currently receiving "expression of interest" from interested IPPs for consideration. The other sites in Tanzania including Lake Natron, still require detailed surface studies before the private sector is invited to show interest in any of them for the development of the subsequent phases.

Uganda: Uganda is developing a geothermal policy and act that would guide geothermal projects development in the country. The geothermal sector has participation of both the government and the private sector. Experts in Uganda have embraced the new exploration approach for the exploration of geothermal systems in western branch of EARS with good results. It is anticipated that viable projects will be identified in the near future. The country has also licensed private developers for both power and direct use. Investors are required to undertake subsequent phases of the projects, particularly Kibiro, Buranga and Panyimur prospects.

Based on the baseline review and the analysis of existing projects from a perspective of a PPP combined with the results of stakeholder consultation, four main challenges for accelerating PPP geothermal project in the targeted countries were identified. Several key recommendations are also proposed to address these main challenges.

Challenge #1: Clarity on regulations governing geothermal development and pricing process for geothermal power

Unclear definitions and regulations regarding ownership of geothermal resources, types of development licenses, licensors, licensees and delineation of development areas can be a factor that undermines business predictability and continuity for geothermal developers. In several countries in the region, laws and regulations for geothermal resource development are underdeveloped and/or unclear, which limits the entry of private developers. In addition, the process of pricing electricity generated by geothermal resources is not standardized or transparent in several countries. This also poses a risk to private developers and could be a barrier to the growth of IPP projects.

Recommendations:

(a) Develop geothermal law for clear and transparent ownership, licensing and administrative procedures

A clear and transparent ownership, licensing and administrative procedures for geothermal exploration or development in accordance with geothermal law are important to attract private developers and investors. This law will give certainty and reduce risks for investors and developers by making licensing and administrative procedures predictable in terms of cost and timeline. A clear ownership of geothermal resource will avoid conflict between geothermal developers and landowners. In addition, transparent procedures also will prevent the private sector from doing an act against law such as bribery. It should be noted that the capability of central and local/regional

governments to carry out geothermal law is also important to make sure the law is well implemented in the field.

Kenya enacted Geothermal Resource Act in 1982 (Repealed). This law clearly defines geothermal resource and set out in greater detail on the ownership of geothermal resource, the application procedure for both the exploration authorization and the geothermal exploration license. This act also allows the private sector to participate in geothermal exploration. By implementing this act, not only public or state companies but also many private developers were given geothermal exploration licenses by the Ministry of Energy. The PPA should reflect the project costs as the preconditions of a geothermal project varies depending on for example location and technology.

(b) Standardize PPA contract and tariff for geothermal power plant

Standardization of PPA contract and determination of electricity tariff methodology for geothermal power plant is necessary to give certainty and shorten long PPA negotiation process for private developers and investors. Kenya, particularly the EPRA, has created standard PPA contract and tariff for power plant. In terms of tariff, when FiT tariff policy still existed, tariff was determined based on FiT tariff for geothermal power plants. In terms of contract, EPRA provides standard PPA contract for large-scale generators (more than 10 MW) and small-scale generators (lower than 10 MW). PPA contract for geothermal power plant can include off-taker obligation to reduce foreign currency risk by paying electricity in US dollar, force majeure risk for IPP. In case of Olkaria III expansion project, KPLC as off-taker undertook to pay capacity and energy payments in USD dollars, reducing foreign currency risk for IPP (OrPower4). KPLC also has the obligation to make capacity payments to the IPP in the event of both natural and political force majeure events regardless of the availability of the plant.

Challenge #2: Institutional framework and capacity for the implementation of laws and regulations related to geothermal resource development, and the technical capacity of local workforce

Clear institutional framework and capacity of government organizations are crucial to the realization the geothermal development project (e.g., human resource capacity to implement laws and regulations, and ability to negotiate and coordinate with numerous stakeholders including local stakeholders and foreign institutions). There is a lack of skilled technical staffs at all stages of geothermal development for most of the targeted countries. Several projects in the region are stuck in the exploration stage. Stakeholders working in the region have also concerned about the capacity and workforce of local technical staff, which could lead to project delays and higher costs. For the stable continuity of the project, it is important not only to accumulate knowledge and experience related to geothermal development within government agencies, but also to properly take over past negotiations with private sectors when there is a reorganization in the government. According to the stakeholder consultation, however, the local stakeholders point out that there are challenges in these areas and they are barriers to project progress and entry into the geothermal development business. While all of the targeted countries have enacted laws related to PPP, there are few realized examples of PPP for geothermal power generation in the region. This suggests that there is a gap in the capacity to sufficiently operationalize PPP units to manage and operate PPP projects especially for geothermal power generation.

Recommendations:

(a) Build continuous and sustained capacity building program

Continuous and sustained capacity building program is indispensable to address the issue of human resource in geothermal development and to implement law or regulation related with geothermal. Capacity building program is not only targeted for geothermal developers but also for government officials such as ministries, regulators and PPP units. A sufficient number of skilled engineer or

technical staff will accelerate the development of geothermal site in the targeted countries. High capability and knowledge of government officials on geothermal will enable the creation of investor-friendly framework, laws and regulations and their implementation and accelerate PPP geothermal project. For example, Kenya has implemented continuous capacity building program for geothermal development. Through international training program such as UNESCO-GRO, JICA and other programmes. A study to evaluate skills gap in East Africa which was undertaken in 2015 revealed that for geothermal projects to be effectively developed and managed, more than 15,000 trained staff would be required across the region. In this regard, the African Geothermal Centre of Excellence was established under the auspices of African Union and physical structures to be established in Kenya. The centre will admit students from all countries in Africa including the six targeted countries.

(b) Establish Clear Institutional Framework and Coordination

Establishing clear roles and responsibilities of the entities involved in geothermal development and PPP project is key to effective delivery for government target on geothermal development. Since many stakeholders involved in geothermal project, inter-agency coordinator will play a major role to coordinate among governmental agencies (including national park or wild-life agency) at all levels related with geothermal project. Inter-agency coordinator also works closely with local communities, local governments, industry and other public entities to ensure that a proposal by developers meets the requirements of all regulations. With clear institutional framework and the existence of inter-agency coordinator, the time for administrative process related with geothermal development can be shortened. Kenya has clear institutional framework of geothermal development and PPP project as described earlier. For example, Kenya established the Geothermal Development Company (GDC). To undertake upstream development of geothermal projects while KenGen concentrates on power plant development. Steam developed by GDC is then availed to either KenGen or IPPs for electricity generation.

Challenge #3: Risks that are difficult for private developers to undertake and undeveloped capabilities to coordinate the sharing of these risks between the public and private sectors.

There are risks that are difficult for private developers to undertake in implementing geothermal development and power generation projects, such as exploration risk in initial stages of development (risk of not having sufficient resources or low steam productivity) and credit risk (risk of IPPs not receiving payment from off-takers on time) in geothermal power generation. While it is important for specialized government agencies to take on the initial stages of geothermal resource development as well as for the public and private sectors to share the risk and cost associated with overall geothermal resource development and power generation, the policy and institutional frameworks are not fully capable or developed to make such arrangement in several countries

Recommendations:

(a) Establish Government Scheme for Cost or Risk Sharing

Risk sharing between private and public sectors is a key for successful geothermal projects with PPP scheme. For geothermal development, exploration risk is one of main barrier and drilling cost is one of the main cost components. Particularly, at the initial stage of geothermal development with high cost and high risk, it is important to establish cost or risk-sharing scheme to attract participants from the private sectors. The cost or risk sharing scheme will decrease exploration risk and cost for private developers, increasing the appetite of private developers to join geothermal exploration. Cost-sharing scheme for private developers was implemented successfully in Japan as described earlier. Japanese private developers benefitted immensely from a cost-sharing scheme that included a cost share of up to 40% for exploration wells and 20% cost share on production and injection wells. In East Africa, the

Geothermal Risk Mitigation Facility (GRMF) managed by the African Union Commission and financed by KFW finances up to 80% of detailed surface exploration costs and 60% of exploratory and appraisal drilling costs for up to four wells.

(b) Provide Government Guarantee combined with Guarantees from Banks/Insurers

Government guarantee can address concern of private investors about the capability and creditworthiness of steam provider and off-takers which are mainly state-owned company. Government guarantee can be combined with guarantee from banks or insurers to mitigate risks that can't be handled by private developers and investors, such as political risk and regulatory risk. The Menengai Project in Kenya put in place a security package in the form of a partial risk guarantee (PRG) from African Development Fund (ADF) combined with a support letter from government as described in chapter 4. The PRG set up with AfDB support and backed by the government, covers non-payment by the off-taker (KPLC), and non-delivery of steam by GDC. This approach successfully addressed the issues of creditworthiness of steam providers and off-takers. Private developer also can use either Multilateral Investment Guarantee Agency (MIGA) of the World Bank Group which covers political risk and termination risk or insurance from private sector such as Re Munich. MIGA's political risk insurance has been used in Tulu Moye Geothermal project in Ethiopia and provides an extra layer of financial security to a government guarantee by the Government of Ethiopia, which supports the original 25-year fixed price offtake agreement. On the other hand, Re Munich's exploration risk insurance has been provided for Akiira geothermal project in Kenya to cover the risk of insufficient output due to exhausted geothermal resources.

Challenge 4: Lack of financial support for private developers

Geothermal development requires huge financial resources at each stage. In several targeted countries, financial incentives such as tax exemptions are not clearly defined in the regulations. This will be a barrier to the entry of private developers and the progress of the project. In addition to the transparency of the process mentioned in Challenge 1, challenges exist in setting the purchase price of generated electricity at a certain level (above the development cost) in order to increase the investment profitability and predictability of the project. Such a scheme is not secured by policy in several targeted countries and it may also become a barrier to the entry of private developers.

Recommendations:

(a) Provide fiscal incentives for geothermal development

Financial incentives for geothermal projects (power generation and direct use) are necessary to promote geothermal resource development. These incentives include attractive land use fees, tariff exemptions on imports of materials and equipment, and other tax exemptions. These incentives will benefit developers to reduce costs of geothermal exploration and improve profitability of project. In addition, land rates should be removed during exploration stages which should be paid after confirmation of a viable resource. For example, Kenya offers many fiscal incentives that include tax and duty exemption for imported equipment, ten years tax holiday for geothermal plants of at least 50MW, exemption from stamp duty, the issuance of letter of support or government guarantee (for Olkaria project), etc. These fiscal incentives have benefited developers and improved profitability of geothermal projects in Kenya. Ethiopia also provides some fiscal incentives to private developers.

(b) Provide stable rate of return on geothermal investment for private sector

Stable rate of return on investment for the private sector is a key requirement for investor to participate in geothermal development. It will give certainty and make easy for investor to predict the profitability and improve the bankability of geothermal projects. Stable rate of return can be in form of fixed tariff, bidding or auction tariff and actual levelized cost of generation plus a targeted return

set by the regulators or policymakers. In addition, access to low-cost finance (low interest rate and long-term debt), such as climate funds and DFIs funds, is also important to further increase return on investment for private developers. For example, Kenya had implemented Feed in Tariff (FiT) Policy for geothermal power plant from 2010 to 2021 to provide stable rate of return for geothermal development. FiT tariff for geothermal power plant with maximum capacity of 70 MW is US$ 0.088/kWh for 20 years. After the implementation of FiT tariff, the installed geothermal power capacity surged from 200 MW in 2012 to around 600 MW in 2017. Private developers also participated in development of several sites in the country. Low-cost finance access also benefited IPPs, particularly at Menengai project in Kenya. Menengai project reached an agreement to access concessional loan from climate finance through the Dedicated Private Sector Program of Clean Technology Fund (CTF). CTF provided a concessional loan via AfDB for two IPPs.

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Mr. Naoshige Kinoshita currently holds the position of Officer in Charge (OIC) at the Asia External Representation Office of the African Development Bank (AfDB). He has been in this role since 2021 and brings with him over 25 years of professional experience in the private sector and Multilateral Development Bank (MDB). Mr. Kinoshita specializes in the energy and infrastructure business in Africa. Prior to his current position, Mr. Kinoshita served as the Chief Investment Officer at the Power, Energy, Climate and Green Growth (PEVP) complex of the AfDB. During his tenure at the AfDB headquarters since 2011, Mr. Kinoshita worked on private sector transactions. His responsibilities included originating and closing debt financing for energy and infrastructure projects, as well as providing equity investments in private equity funds. Additionally, Mr. Kinoshita represented the AfDB at advisory boards in private equity funds such as ARM-Harith Infrastructure Investment Limited (ARMHIF), Climate Investor One Fund (CIO), and African Renewable Energy Fund (AREF). Notably, he played a crucial role in promoting Independent Power Producer (IPP) geothermal projects as a lender, including the Menengai projects in Kenya and the Corbetti project in Ethiopia. Before joining the AfDB, Mr. Kinoshita worked for a Japanese satellite company, where he held responsibilities for implementing business strategy and managing mergers and acquisitions (M&A) and business development in Asia. He also supported Enron's initial entry into the Japanese electricity market in the early 2000s. In the 1990s, Mr. Kinoshita worked for ITOCHU Corporation, one of Japan's largest trading firms. Mr. Kinoshita holds a Master of Business Administration (MBA) from the University of California, Irvine, USA, and a Master of Science in Global Energy and Climate Policy from the School of Oriental and African Studies (SOAS), University of London, UK.

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Dr. Peter Omenda is a geothermal project development expert of more than 30 years' experience and who has pioneered several geothermal exploration and development projects in Eastern Africa. Dr. Omenda is currently a geothermal energy resources development consultant and researcher with Scientific and Engineering Power Consultants Ltd based in Nairobi, Kenya; former Director of the International Geothermal Association (IGA), President of the African Geothermal Association and member of the Geothermal Association of Kenya and Geological Society of Kenya. Dr. Omenda previously worked with the Geothermal Development Company and the Kenya Electricity Generating Company, PLC (KenGen) at senior management. He graduated with B.Sc. and M.Sc. degrees in geology from the University of Nairobi, post graduate Diploma in Geothermal Energy Technology from University of Auckland, New Zealand and PhD in Geological Sciences from University of Texas at El Paso, USA. He also has a Master in Business Administration degree of Jomo Kenyatta University of

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