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International Outlook on Policy, Legal and Regulatory Aspects and Risk Mitigation Facilities for Geothermal Resource Development

Anna Nakaayi[1] and Ralph K. B. Nyakabwa-Atwoki[2].

[1] Anka Consult, Rofra House, Suite4, Kansanga, Ggaba Road, P. O. Box 31586 Kampala, UGANDA
E-mail: anakaayi@gmail.com

[2] Sustenersol Uganda Limited, 1930 Kateete Close, Kansanga, P.O. Box 71572 Kampala, UGANDA
E-mail: bcwakira@gmail.com

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ABSTRACT

Communities worldwide have over decades past used geothermal as a source for heating, cooking and for its healing properties. Geothermal electric power generation was invented in Italy in 1904 following modernization and advances in science and technology.

Challenges in the form of financing, resource existence and size, sustainability, wayleaves, as well as absence of or inadequate policy, legal and regulatory framework including absence of worldwide standards and codes encompass the development of the resource at all stages. These challenges will be aggravated by today's uncertainty complex operating environment resulting from the devastating manifestations of the Covid-19 pandemic and the war in Ukraine.

The challenges namely large upfront investment costs that engender the capital cost of investment, substantial resource risks regarding conditions of the reservoir the inadequate or absent policy, legal and regulatory framework. Geothermal energy regulation is intricately linked to the capital investment associated with its exploration. Absence or ambiguity in the law causes potential investors investing in other countries with profitable legal frameworks and stable government policies. The inherent resource potential is huge if appropriately exploited but the fallout from inadequate regulation can also be equally daunting. The location of this resource in areas that are primarily remote yet with important natural features creates a double edged sword. The mitigation of the resource development and investment climate is heavily dependent on whether the project field is de-risked to demonstrate its technical and commercial viability.

Two programs the United Nations Framework Classification (UNFC) and Geothermal Risk Mitigation Facility in place to develop specifications and guidelines in geothermal resource countries and accelerate development through provision of costs share grants for exploration and reservoir confirmation drilling. Other programs in place include the Geothermal Risk Mitigation Facility (GRMF) for Africa, the Geothermal Development Facility (GDF) for Latin America and the European Geothermal Risk Insurance Fund (EGRIF).

This paper discusses the development of the geothermal resource and attendant risk mitigation in especially developing nations such as Kenya, Indonesia and Philippines which have taken part in some of the mentioned programs and are among the world's top ten geothermal generating nations.

1. INTRODUCTION

Geothermal energy has the potential to provide reliable cost competitive base load power with a small carbon footprint which is renewable standing at 95,098.40-GWh/year as of 2020. The deployment of geothermal energy is not only in electric power but also used for district heating, for agriculture, aquaculture, light industrial purposes, and numerous other direct uses. (Huttrer, 2021). Taking Agriculture in consideration, Food systems consume a significant amount of energy globally using up to 30% of world energy, accounting for around 30% of the sector's carbon emissions. Geothermal energy will support the world program for carbon dioxide emission reduced as agreed in the COP 21 Paris in 2016 (IRENA, 2022).

A common thread to all geothermal energy producing nations is the abundance of the resource in hard to reach or isolated areas. These are areas with tectonic movements such as rift valleys or underground volcanic activity. This then becomes one of the determinants of the viability of the resource exploitation, and can to an extent point to the end use for the geothermal energy, the means of exploitation (use of deep and shallow geothermal technologies for harnessing the energy) as well as getting it to where it is to be utilized.

This paper focuses on the selected leading geothermal producers irrespective of their positioning on Human Development Index in all categories from very high, high; medium to low human developed geothermal resources endowed nations in world with emphasis on the role played by the risk mitigation facilities, appropriate legal policy and regulatory regimes to the benefit of the geothermal development as exemplified by Indonesia, Kenya and The Philippines.

2. ECONOMIC OUTLOOK OF SELECTED GEOTHERMAL PRODUCING COUNTRIES

The Covid-19 pandemic and the war in Ukraine are devastating manifestations of today's uncertainties and complexities. It exposed the limits of and cracks in current global governance and has battered global supply chains, driving up price volatility in energy,

commodities and other goods. But it is their interaction that, at the time of this writing, is transforming shocks into an impending global catastrophe, cording to United Nations Human Development Report (HDR) (HDR, 2021-2022).

France, Indonesia, Kenya, Mexico, New Zealand, Philippines, Rwanda, Uganda and United States of America were selected to illustrate these countries' development level ranking from Very High, High, Medium, to Low Human Development Index, as per (HDR, 2021-2022).

The Doing Business Index (DBI) (administered by the World Bank group is a valuable tool that governments can use to design sound regulatory policies by giving policymakers a way to benchmark progress. The Index recognizes the important work countries have done to improve their regulatory environments. It serves as the basis for ranking economies on their business environment and is a measurement of the ease of doing business ranking of above country, (World Bank, 2020).

While corruption takes vastly different forms from country to country, this year's scores reveal that all parts of the globe are at a standstill when it comes to fighting public sector corruption. Country corruption perception levels determine regional and international competitiveness with discerning investors shunning countries with low scores, the scores of countries in this paper are as per this CPI, 2020. The results of the above countries positioning determined by DBI and CPI benchmarking against their respective human development index are shown in Table 1, below.

of Regional, Bilateral and Multilateral agencies and the national geothermal development specific respectively as indicated in composite Table and Table 1, below.

Table 1: Ranking of geothermal resource countries in respect of human development index, ease of doing business and country corruption index.

HUMAN DEVELOPMENT INDEX		EASE OF DOING BUSINESS RANKING			CORRUPTION INDES	
Rank	**Country**	**DB Rank**	**Economy**	**DB score**	**Country**	**Score**
13	New Zealand	**1**	New Zealand	86.8	New Zealand	88
21	U.S America	**6**	U.S. America	84.0	U America	67
28	France	**32**	France	76.8	France	71
86	Mexico	**38**	Rwanda	76.5	Rwanda	53
114	Indonesia	**56**	Kenya	73.2	Kenya	30
116	Philippines	**60**	Mexico	72.4	Mexico	31
152	Kenya	**73**	Indonesia	69.6	Indonesia	38
165	Rwanda	**95**	Philippines	62.8	Philippines	33
166	Uganda	**116**	Uganda	60.0	Uganda	27
-	Somalia	**190**	Somalia	20.0	Somalia	13

Source: Unites Nations HDR 2021-22, World Bank 2020 and Transparent International CPI Report 2021.

The role-played by Regional, Bilateral and Multilateral agencies and the national geothermal development specific policies in geothermal resource development thus positioning Indonesia from High, Philippines and Kenya from Medium human development groups among top ten in the World, according Schlumberger (2021) is shown in Figure 1.

Figure 1: Top 10 Geothermal Countries 2020 Installed Capacity in Me Year End 2020,
*S*ource: Geothermal Schlumberger New Energy.

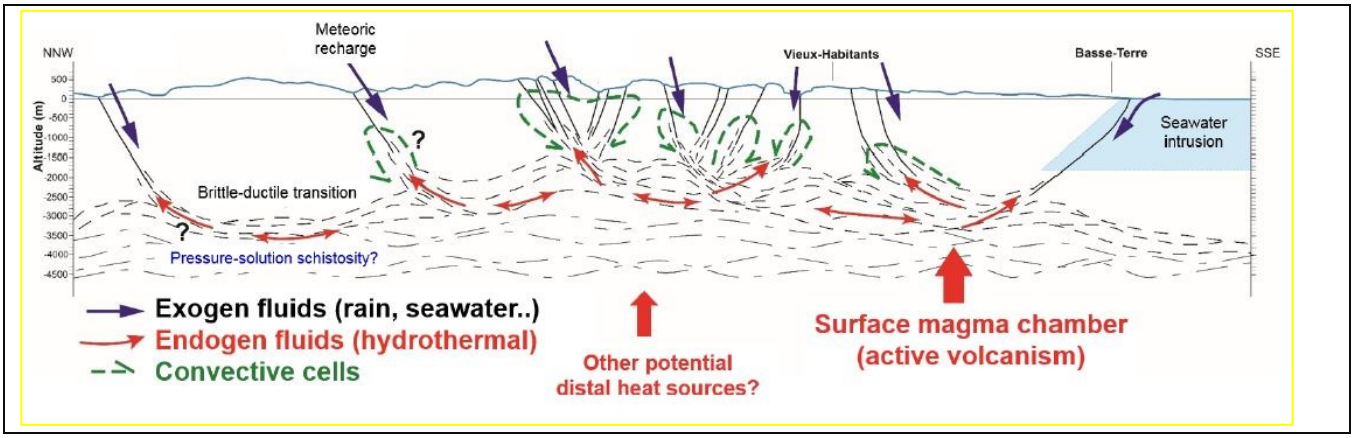
3. THE NATURE, EXPLORATION AND DEVELOPMENT OF GEOTHERMAL IN THE RESOURCES

The thermal energy contained in geological structures can be used directly for heating or indirectly for generating electrical energy. A common thread to all geothermal energy producing nations is the abundance of the resource in hard to reach or isolated areas. These are areas with tectonic movements such as rift valleys or underground volcanic activity. This then becomes one of the determinants of the viability of the resource exploitation, and can to an extent point to the end use for the geothermal energy, the means of exploitation (use of deep and shallow geothermal technologies for harnessing the energy) as well as getting it to where it is to be utilized.

3.1 The nature of geothermal resource

Geothermal energy has several advantages compared with other sources of renewable energy, which very often face storage issues to match production and needs. Geological risk remains the main issue, however, to interest investors in financing exploration well drilling that must provide complementary subsurface information to confirm the existence of a resource and decide about the way it can be exploited at best.

In reality, geothermal systems are geologically and dynamically complex systems that are not accommodated by simple reservoir models and their detailed discussion outside the scope of this paper. A conceptual model of one type of a geothermal reservoir is given in Figure 2 with Figure 3 showing actual reservoir models showing complex geothermal systems, of a) two-phase geothermal system showing compartments and convective cells and b) single (liquid) phase geothermal system of complex hot fluid flow paths, respectively. The two reservoir models that can be summarized to equivalent homogeneous bloc-shaped reservoir models associated with average reservoir temperatures.



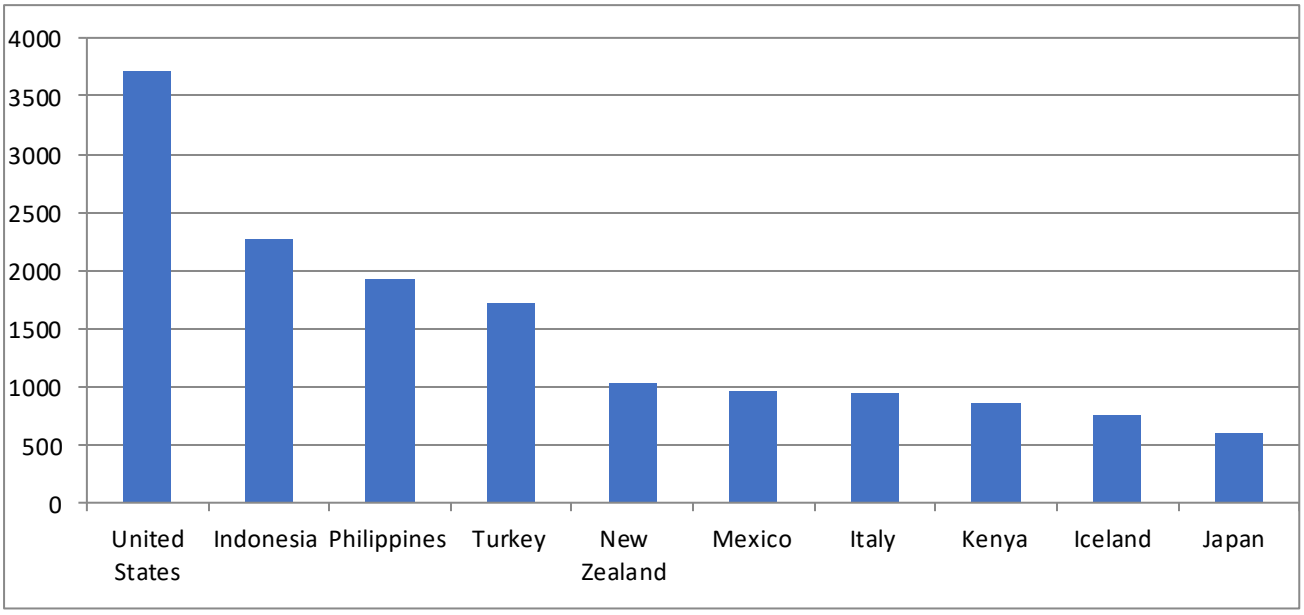


Figure 2: understanding and questioning about the geothermal system as illustrated in the conceptual model of the deeper part of the Basse-Terre island geothermal reservoir. Source: Garcia et al, 2021

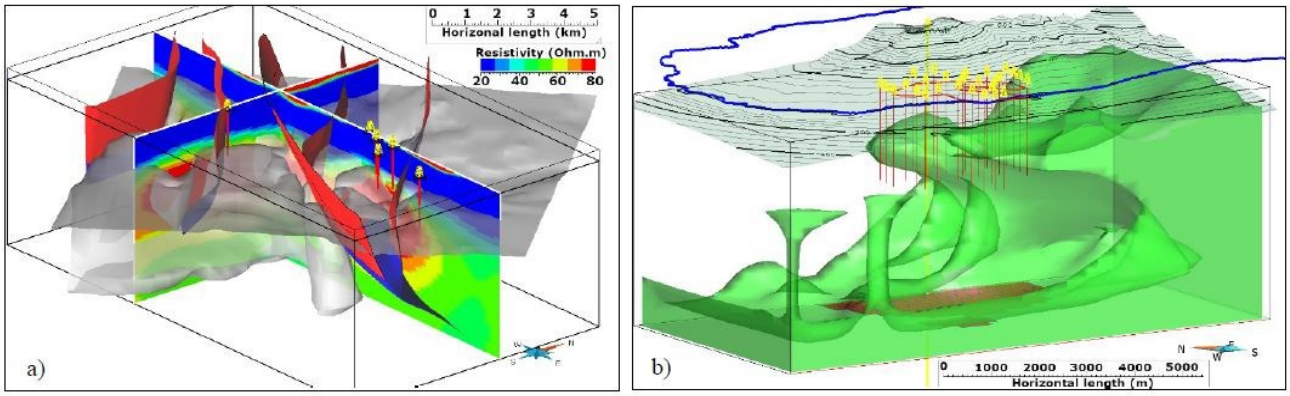


Figure 2: Examples of actual reservoir models showing complex geothermal systems, a) two-phase geothermal system (Andean Altiplano) showing compartments and convective cells (iso-surface of T = 240°C), b) single (liquid) phase geothermal system (Caribbean island) showing complex hot fluid flow paths (iso-surface of T = 180°C).

4. CHALLENGES TO GEOTHERMAL RESOURCE DEVELOPMENT

4.1 Challenges

The main challenge geothermal development relates to financing. Raising capital in especially developing countries is nearly impossible for local communities who may own the land. They often have nothing else to offer as collateral for the loans provided by financial institutions, other than the land. There is a long lead time from concept to production ranging from five to seven years. According to the World Bank, (2020), "validating the presence of commercially viable geothermal resources through drilling requires around 15 percent of the total investment costs to be spent upfront, with no certainty of return. Commercial debt is often not available to finance this step and it usually takes over two years for exploratory drilling to provide investors with confidence to proceed with development of a geothermal field (i.e., through capacity drilling) and construction of the power plant. These 'upstream' costs and risks were identified as the main barrier to geothermal development and required heavy reliance of the geothermal on scarce public funds for upstream investments.

By vesting the resource in the national government and requiring compensation for the land owners, this in a way resolves part of the problem of access to finance as it creates room for the Government, its agencies or an international consortium to take the lead in developing the resource. There however still remains the issue of resistance of communities to relocate from identified project sites despite compensation.

Remoteness of locations in terms of both distance and topography render establishment of transmission lines to larger populated clusters uneconomic. It can be argued that this makes the use of energy generated there from only viable for close economic/mining activities with any excess electricity reserved for consumption only by the neighboring local community. As Mark Chrisp et al (2015,6) note, "any party embarking on a program of exploration or development of geothermal resources …will need to have a clear understanding as to the end use of the electricity generated…including the ability of the intended end user(s) to be able to pay for the electricity." This is the ultimate justification for any investment; market access. Significant risk capital can be raised where there are government assurances of a more or less guaranteed market for the energy derived from the exploitation of the geothermal resource. There is however the option where possible of connecting to an already established grid as has been used by Kenya for instance to recently increase its geothermal supply on the energy grid by 6 MW (CGTN NEWS 26 July 2022)

Exploitation of the resource is of no use without attendant capital gains. It is therefore imperative for governments and authorities to ensure this market to an extent. This can be done through power purchase agreements that could obligate "the energy purchaser to buy enough power or thermal energy from the project to support acquired project debt. Incentive programs can also be adopted with aspects varied such as shared risk between the government and private investor, risk mitigation through insurance against failure of exploration or reservoir confirmation drilling; guaranteed loans, supportive tax policy as well as an investment climate overhaul.

The absence of policies and regulations suitable for the particular country may pose another challenge. It is all well and good to have a well drafted policy in place. Its implementation is equally important if it is to enable accelerated development of the resource. Tapping geothermal energy is a long and expensive process that requires special expertise. Creating a …positive climate that encourages development is essential if geothermal development is to realize its potential" according to Bloomquist (2010,2). Developers are unwilling to invest large amounts of money in projects that carry undue legal, institutional, regulatory and environmental risks." The issue access then rises risks." Who owns the resource and how the resource is reached by those willing to exploit risks? "This requires appropriate statutes in place addressing leasing, concessions, exploration as well as project development rights. All these have to clearly defined and articulated.

Geothermal resource development cuts across various governmental departments such as energy, environment, and finance. Coordination amongst all the relevant departments is vital for sustainable resource exploitation yet it is common to find responsible government bodies working in silos from each other developing agendas for the same resource in an un coordinated manner. Limited capacity and experience especially with regard to resource management and associated processes such as monitoring effectiveness of the policy and reviews whenever necessary exacerbate the issue.

Despite the difficulties involved in finding a suitable production site/geothermal field, once a proper one has been identified/ found, production costs decrease over time compensating for the initial investments. The costs even out over time when compared to other methods of energy production.

There is however is continuing conflict between the need to preserve the environment as the resource exploitation often happens in fragile ecosystems gifted with abundant flora and fauna. In Kenya for instance KenGen, conducts environmental assessments and tries to mitigate impact. It considers wildlife migration and behavior in its development plans. KenGen has refrained from drilling in parts of Hell's Gate that would compromise the flora and fauna, even where there is major geothermal potential (Mwangi-Gachau, (The Independent,2018). Regardless, numerous environmentally friendly projects have been developed worldwide such as in Iceland, USA which therefore makes this a challenge that can be ably resolved.

Depending on the type of power plant, the equipment in geothermal is subjected to water and steam containing corrosive impurities. Therefore, repair and maintenance of geothermal turbines is especially challenging. Recently, Sulzer Turbo services have overhauled a number of geothermal power plants in several tectonically active regions, (Everson and Delfgauw, 2005).

5. THE NEEDS OF LEGAL, POLICIES AND FRAMEWORK FOR GEOTHERMAL RESOURCES

5. 1 Policy Considerations

Having an abundance of geothermal energy is of no value where appropriate safeguards/steps are not put in place to facilitate optimal resource exploitation. One of the initial steps to this realization is the development of a conducive policy for geothermal energy policy to guide the entire development process.

A geothermal energy policy should relate to exploration, development, production, use and management (including preservation) of the geothermal resource in the select country. An optimal policy ought to seek promotion of, or the adoption of best practice for the management of the resource while taking into consideration the specific local conditions. Chrisp Mark (2015, 2) notes that it "should adequately serve the interests and aspirations of the government and the people of the nation." Safety and sustainability are always key drivers of any geothermal energy policy to be consistent with international best practice. Chrisp Mark further postulates that the policy should also encourage investment in the exploration, production, use and management of the resource as a renewable source for electricity generation; and allow for potential identification of land owners and how exploitation of the resource will affect them in addition to identification of tangible benefits to the local communities. The local communities should ideally be involved in the exploration activities in order to gain maximum benefit.

Environmental protection and management of adverse effects are key considerations for any geothermal energy policy to meet requisite international standards. Considerations about the local environmental protection law and international best practices in all aspects of geothermal exploration should underpin a sound geothermal energy policy. This can cover provision of mitigation against adverse effects to the environment (natural and physical), especially to valued geothermal features and use of best industry technologies, practice, standards and codes in the management regime.

The policy should cater for identification and exploitation of geothermal systems during the exploration process, whereas during the production management phase the policy should cater for the Management of geothermal systems, have a system management plan as well as provision for decommissioning of the geothermal power plant and rehabilitation. Reporting, monitoring and auditing have to be incorporated at all stages of the resource development.

The policy also ought to advocate for the use of industry best practices with standards, codes and safety adhering to international health and safety standards. Provision has to be made for prevention of discharge of water from the exploration process into fresh or clean water sources. According to Sovacool (2014), the thermal energy sector consumes and contaminates water sources imposing costs on all water users from households to commercial users/enterprises, to farmers to recreational users. Sovacool (2014,20) Extra land may… be required to dispose of waste salts from geothermal brines and contamination of groundwater and fresh water can occur if plants are poorly designed.

5.2 Legal and Regulatory aspects in select countries

The legal framework for geothermal investment, sitting and licensing in any country plays an important role in the development or hindrance of development of the geothermal resource. The role played by the risk mitigation facilities, appropriate legal policy and regulatory regimes to the benefit of the geothermal development are exemplified by Indonesia, Kenya and The Philippines.

5.2.1 Indonesia

Indonesia is an emerging market that turned to geothermal energy market to meet its increasing demand for electricity; at 10% per annum, on the back of population growth, causing economic expansion, new investments and industrialization. Geocap () geothermal exploration has been ongoing in Indonesia since 1918 though only one of the original five drilled wells KMJ.3 still exists and flows.

Commercial production was however only first in 1983 in Kamojang. The Geothermal Roadmap until 2030 has a target of installed capacity up to 10 GW by 2019, but only 20136 GW had been installed.

Initial development was based on Presidential Decree number 16 of 1974 which authorized the state-owned oil and gas company Pertamina Geothermal Energy's (PGE) to carry out geothermal energy survey and exploration, but only in Java Bali. Areas outside of this were reserved for government. PGE was initially at the forefront of all Indonesia's efforts to scale up geothermal.

Decree number 22 of 1981 then allowed Pertamina to exploit and sell electricity and also form a Join Operating Contract (JOC) with private developers.

Law 27 of 2003 on geothermal energy gave local governments authority to do the tendering process for indirect utilization of geothermal energy but excluded exploitation of conserved forest areas. This was revoked by law number 21 of 2014 which omitted geothermal activities as a mining activity therefore allowing it to be developed in conservation forest. The authority essentially reverted to the central government.

Government Regulation No.79 of 2014 on the Energy Mix Policy states that by 2025, 23% of the energy mix in the country should come from renewable energy. Specifically, it is projected that 12%, about 7000Mw of this will come from geothermal energy sources

It has 40% of the world's geothermal reserves, the largest in the world; yet uses only 4-5%of this reserve, generating only 1,197Mwe, yet remaining the third largest geothermal generating country in the world.40% of the electricity demand is supplied from geothermal energy. The legal framework of Indonesia was a major hindrance to the effective development of the geothermal resource. Under law number 27 of 2003geothermal activities were termed as mining activities and therefore could not be conducted in protected areas despite its minimal impact on the environment. The anomaly was rectified by law number 21 of 2014, The Geothermal Law which separated geothermal activities from other mining activities.

There other hindrances that played a part in the delayed progression of the Indonesian Geothermal development such as uncompetitive power tariffs that was resolved through government subsidies which kept tariffs low. All independent power producers were also required to sell their power to the national power company, Perusahaan Listrik Negara (PLN) which holds a monopoly on electricity distribution in Indonesia. Additional hindrances include Poor infrastructure development in the isolated areas, there was also opposition from some local communities and bureaucracy that led to lengthy and expensive permit procedures.

The government issued both fiscal and non-fiscal incentives to encourage geothermal development. One of the non-fiscal policies was non-fiscal the Fast Track Program II in 2010 which was specific to renewable energy. (Geo Cap Project, 20) This is a program to accelerate the development of generations by giving a guarantee to investors or lenders. Decree number 45 of 1991 improved Decree 22 of 1981 by allowing the contractor to develop the resource in Indonesia and sell it either in the form of steam or electricity to PLN (Persero). The program was implemented through the MEMR Decree No.15 of 2010 as amended by MEMR Decree no.21 of 2013 targeting an increment in the installed geothermal energy capacity.

Presidential Decree No.5 of 2006 mandated that Indonesian Energy sources coming from renewable energy constitute 17% by 2025, as the most abundant renewable energy automatically is expected to meet this target.

Pertamina Geothermal Energy's (PGE) monopoly rights over the resource were repealed through presidential decree number 76 of 2000, thereby fully opening up the field to any business through auction to explore geothermal activities in Indonesia.

The fiscal policies included giving business engaged in geothermal activities tax holidays if they were able to meet the requirements under the Income Tax regulations PMK 21/2011.These requirements included investing at least one trillion MAh, placing funds in Indonesian banks of at least 10% of the Investment made and the company had to be an Indonesian legal entity. The exemptions (Hadi, 22) provided include income tax exemption for a minimum of five years and a maximum of ten years from start of commercial production, reduction of 50% on tariffs for two years after the income tax emption period expired.

In 2010 under PMK no.21 of 2010, an exemption was made for the geothermal industry from VAT as well as import duties. Guaranties are also provided under the minister of finance Decree No.139 of 2011; in essence actualizing FTP II. The guaranty is in the form of assurance on the feasibility of PLN to buy electricity from the independent power producers (IPP) based on the Power Purchase Agreement (PPA.)

A revolving fund, Geothermal Sector Infrastructure Financing Fund(PISP) for geothermal exploration was stipulated in PMK No.3 of 2012.It's aim is to encourage optimization of the utilization of geothermal potential in Indonesia, which is the second largest in the world. The PISP fund facility is expected to be one of the solutions to the high risks and costs in the exploration stage which have been hampering the participation of business entities in the development of geothermal power.

The initial fund was amended by PMK number 80/PMK.08/2022 regarding Geothermal Development Support through the Use of Geothermal Sector Infrastructure Financing Funds in Company Companies (Persero) PT Sarana Multi Infrastructure. This new PMK is intended to improve the quality of PISP Fund management in various aspects so that it can be utilized effectively and fulfills the principles of accountability, transparency, planning, and sustainability (Think Geo Energy, 2022).

The changes contained in PMK number 80/PMK.08/2022 include:

1. Strengthening the PISP Fund as a funding and financing platform that can synergize various domestic and international funding sources in various types of instruments, and channel them for financing geothermal development projects;

2. Expanding the scope of PISP Fund facilities not only for Government Drilling and SOE Drilling/Public Window, but also including Private Drilling/Private Window to encourage the involvement of private developers;

3. Expansion of the types of risk carried out by de-risking to include Exploration Risk, Political Risk, and Gap Risk;

4. Strengthening coordination between the Ministry of Finance, Ministry of Energy and Mineral Resources, and other relevant agencies in the context of geothermal development in Indonesia, particularly through the Joint Committee forum which plays a role in supervising and making strategic policies related to the management of PISP Funds; Strengthening the roles and synergies of PT SMI, PT GDE, and PT PII as fiscal agencies of the Ministry of Finance in managing PISP funds, implementing technical activities to support geothermal development, as well as risk assurance; and

5. Increased collaboration with domestic and international institutions in order to improve financial capacity and quality of PISP Fund

6. Providing a more flexible option for the government and business entities in carrying out geothermal exploration activities in a more massive, effective and measurable manner. Collaboration between domestic and international stakeholders can also be improved, particularly in increasing the financial capacity and quality of PISP Fund management as well as encouraging the implementation of blended financing/creative financing schemes in financing geothermal infrastructure to reduce the burden on the State Budget and fiscal risks.

This fund is used for the provision of data, information as well as loans. Data is provided to local governments so that they are able to transmit accurate information to potential developers who rely on this information during the preparation of the documents used for auctioning Geothermal Working Areas in PPP.

Indonesia is part of the Geo Fund Facility (GFF) which provides support to mitigate risks as well as provides information about the high upfront costs for geothermal development.

Despite these advances the development of the resource could potentially have reached even higher level but for some challenges as below.

Inadequate information available at time of auction increased the bid prices to uneconomical levels therefore making the investments un-bankable leading to investor distress in seeking finance. There are high initial investment outlays which potentially lost if the initial exploration fails. The monopoly in the market created by the presence of a single buyer of power leaves sellers in a very weak bargaining position. Tariffs imposed are still considered unattractive despite numerous reductions. PLNs average electricity generation cost (BPP) tariff and the PPA terms have led to unattractive economics. Bureaucracy coupled with inconsistency in rules, permit complexity. There is minimal awareness among consumers about the benefits of green energy couple with a high dependency on fossil fuels.

5.2.2 Kenya

Kenya, the first African country to tap geothermal power, began its programs in the late 1970s and early 1980s under Kenya Electricity Generating Company (KenGen) with funding primarily from the World Bank and guidance from the UN Development Programme, (The Independent 2018). Prior efforts in 1957 by the Kenya Power and Lighting Company (KPLC) stalled.

By the end of 2020, Kenya had an installed capacity of 821Mw with an estimated potential of between 7,000 to 10,000 Mw with 14 prospective sites. The July 2022 opening of Olkaria V with a 258 MW capacity, and the addition of a sixth turbine to Olkaria I brought the country's total capacity to 882-MW (Krebs, 2022) and unveiled its mission to add 3000 MW of renewable energy to national grid (The Independence, Jan 6th 2023).

(Energy geek 2021) mentions that as of 2020/2021, geothermal energy is the major source of generated energy in Kenya providing up to 48.4% of the energy needs of the country. This has greatly alleviated the national shortage providing 77% of Kenyans with access to electricity (Borgen Project). Kenya's location on the rift valley on tectonic plates is prime candidate for deep reservoirs of steam and hot water. The Government of Kenya 2008-2028 least cost power development plan indicates that a geothermal power plant has the lowest unit cost and is therefore ideal for additional base load expansion.

The Kenya Electricity Generating Company (KenGen), a public company under the Ministry of Energy is in charge of the geothermal resource in the country. KenGen recognized the importance of implementing geothermal energy in sustainability efforts as it is not affected by drought or Abdas climatic variability has no adverse effects on the environment and is readily available. Its continuous investments in exploration works to harness geothermal energy have placed Kenya as a key leading hub in clean energy use. KenGen is also driving Kenya's Climate Change Agenda by leading initiatives that will reduce Greenhouses Gas emissions by 30 % by year 2030 and global effort to keep warming below 1.5 degrees. The company is currently implementing six Clean Development Mechanisms projects which offset a cumulative 4 million tons of CO2 equivalent annually. These are the Olkaria II geothermal expansion,

redevelopment of Tana Hydro power station, Optimization of Kiambere Hydro Power, Olkaria IV and I [units 4 and 5] geothermal and the Ngong wind.

The Geothermal Development Company (GDC) carries out the exploration of geothermal sources. DC is a 100% state-owned corporation established in 2008 as a Special Purpose Vehicle (SPV), to de-risk the commercial development of geothermal resources in Kenya for electricity generation and direct use applications. The specific roles include: geothermal resource exploration and assessment; drilling of geothermal wells; development and management of proven steam-fields; early generation and sale of steam to power producers and promotion of direct utilization of geothermal resources. The company is also mandated to support the Government of Kenya (GoK) in resource mobilization and capacity building through the Ministry of Energy, (EPRA, 2019).

The Kenya geothermal policy and legal framework was developed in various stages over several years. The Kenyan government through the National Energy Policy2018 committed to providing clean, sustainable and reliable energy services while protecting the environment While providing incentives for renewable energy. Some of these include; removal of restrictions on conversion or transfer of investment funds, Guarantee of capital repatriation and remittance of dividends and interest for investors, government issues letters of support for project companies and their financiers. There is also a 100% investment deduction for power generating plants and equipment as well as exemption from stamp duty at incorporation and for instruments related to loans from foreign sources for investment in the sector.

The current legal basis of Kenya's Geothermal Policy is stated in The Energy Act No. 1 of 2019.It lays out elaborate provisions relating to geothermal resources aimed at controlling the exploitation, development thereof, and also vests the resources in the government. It sets out the steps that a developer of the geothermal resource needs to follow prior to extraction of the resource. There are however multiple licensing /approval requirements given that additional clearance is also required from the Energy and Petroleum Regulatory Authority, Kenya Power, Kenya Forest Service, County Government and Ministry of Energy.

The Energy Act vests all unexploited renewable energy resources under or in any land in the National Government subject to any rights which, by or under any written law, have been or are granted or recognized as being vested in any other person. This means that private persons who identify potential renewable energy resources need to apply to the National Government to utilize them.

County and national governments are also required to facilitate land acquisition for any energy infrastructure developments which eases the process of land access to potential investors in the sector.

Authority is granted to the responsible Cabinet secretary, with advice of the Renewable Energy Resource Advisory Committee to grant a license, for not more than thirty (30) years, to any person upon application for surveys, investigations, tests and measurements in search of geothermal resources. All such operations have to be conducted in such a manner as to afford protection of fish, wildlife, and natural habitat. Compensation for land acquisition also fall upon the license holder with the Kenyan government granting rights of way, easements, temporary occupation or other permissions within and without the license area as are necessary for the conduct of operations.

Allocation of geothermal blocks is coupled with incentives to accelerate geothermal development. Licensees are granted incentives to encourage investment to develop geothermal energy. The Private Partnership Act No.15 of 2013 for instance provides for a feed in policy that allows producers of renewable energy to sell to an off taker at a pre-determined rate over a twenty-year period. This is reinforced by the Renewable Energy Feed in Tariff System provided for by the Act for especially renewable energy producers encouraging its uptake.

The Energy and Petroleum Regulatory Authority created under the Act is mandated to among others issue and renew licenses and permits for all activities in the energy sector and ensure supply, marketing and use of renewable energy as well as impose appropriate sanctions and fines for any violations.

The Rural Electrification and Renewable Energy Corporation (RERC) also created under the Energy Act spearheads the development of renewable energy sources in Kenya. This it does by undertaking feasibility studies, maintaining data there from and availing the same to developers of renewable energy resources. It is also to create an enabling framework for the efficient and sustainable production, conversion, distribution, marketing and utilization of renewable resources in Kenya.

The licensee will be given the right to ingress to and egress from the license area as required for the conduct of his operations. Entry permits for technicians and managers employed in operations under the license will be issued and or renewed by the Government of Kenya subject to the Immigration Act.

The licensee will be free to import all material, equipment and to be used in carrying out operations under the license. All these imports will be exempt from all custom duties.

The expatriate employees of the licensee will be permitted to import household goods and personal effects. All these will be exempt from all custom duties. The employees are free to sell these items in Kenya if they are no longer needed but the seller should fulfill all formalities required in connection with payment of duties, taxes, fees and charges imposed on such sale. If the items are re-exported from Kenya, they will be exempt of all taxes, duties, fees and charges.

The licensee will be free to open and maintain external accounts inside Kenya and foreign bank accounts outside Kenya subject to the Exchange Control Act.

The licensee will be free to pay directly outside Kenya for purchases of goods and services necessary to carry out his operations.

The licensee will be free to receive, retain outside Kenya and freely dispose of foreign currencies received outside Kenya and not obligated to remit such proceeds to Kenya with the exception of those proceeds as may be needed to meet expenses in Kenya and payments to the Government.

Expatriate employees in Kenya may be paid in foreign currencies outside Kenya. Such employees shall only be required to bring into Kenya such foreign exchange as may be required to meet their personal living expenses and to meet payments of Kenyan taxes.

The licensee will be free to repatriate abroad all proceeds from the geothermal operations in Kenya, including but not limited to proceeds from the sale of assets. The licensee has the freedom to have rates of exchange for the purchase or sale of currency in Kenya, not less favorable to him than those granted to any investor in Kenya.

Reliable energy is a vital driver of economic growth. as it stimulates economic development by creating jobs and powering businesses. Businesses such as horticulture for which Kenya is world renown have been given a big boost by the development of this energy source. At Oserian, one of Kenya's largest flower exporters based near Lake Naivasha, geothermal steam warms greenhouses and generates electricity at its two power plants, (The Independent ,2018). Kenya also has the only natural geothermal spa in Africa, the Olkaria Spa, located at the Hell's Gate National Park in Naivasha, constructed and opened to the public by KenGen.

Kenya has set a precedent for building green infrastructure and implementing sustainable poverty reduction

This expertise has been garnered over years and is potentially to be passed along to its neighbors Ethiopia and Uganda that are in the early throes of geothermal resource exploration and exploitation.

5.2.3 The Philippines

The drive for geothermal development in Philippines is being driven by an increase in energy demand coupled with the need for cleaner energy given that geothermal resources produce electricity with very little pollution. The country Philippines is one of the world's top producers of geothermal power, with favorable geological conditions, located on the tectonically active pacific ring of fire site, all of which (will) favor growth in the deep geothermal system and energy market. The potential dangers resulting from climate change such as hurricanes create a direct threat to the country's population given its location. This has encouraged the leadership to actively target use of greener energy sources that produce no harmful greenhouse gases. to mitigate disastrous climatic change effects.

The lead agency is the Department of Energy which implements provisions in renewable energy laws and their rules and regulations. It reclassified geothermal energy as a mineral resource therefore allowing 100% foreign investment in geothermal projects. Renewable energy legislation passed in 2008 under the National Renewable Energy Board.

According to the ASEAN, geothermal energy constitutes 22% of the energy mix in the Philippines making it the second largest geothermal energy producer in the world after the United States of America.

Philippines has developed favorable government policies and incentives to drive the exploration and development of geothermal energy in the country. The Philippines currently has seven geothermal fields which supply about 12 percent of the nation's energy, with a long-term plan to nearly double capacity by 2040, (Athira, 2022).

The green Energy Options program has varied options that allow end users to choose renewable energy as their source of energy These include grant tax holidays of up to seven years (7), duty free importation of renewable energy machinery, equipment and materials as well as giving 100% tax credit on domestic capital equipment.

The government has targeted the year 2040 to phase out coal and emphasize renewable energy and plans to generate about 500 gigawatt hours (GWh) of electricity from the geothermal energy by 2030.The Philippines' Department of Energy has set a target of an additional 66 MW of geothermal power generation capacity by 2023. This will contribute to the longer-term target of 35% renewable energy in the country's power mix by 2030 and 50% by 2040. (Think Geo Energy, the Manila Standard) The country has seven production fields producing approximately 1848 Mwe;12% of the energy requirements of the country's Energy Development Corporation (2021). It has 1,928 Mw of installed geothermal capacity

There are however still obstacles to the maximum exploitation of the resource such as a hugely privatized energy sector, long permitting process, few potential investors willing to take the risk as well as unattractive incentives when compared to other countries.

6. STRATEGIES AND PROGRAMS FOR GEOTHERMAL RESOURCE DEVELOPMENT

6.1 The Global Geothermal Development Plan (GGDP)

The World Bank through the Energy Sector Management Assistant Program (ESMAP) in 2013 launched this plan to scale up the use of geothermal power. It is focused on the cost, particularly upstream cost and risk of exploratory early stage drilling. The beneficiaries of the GGDP are the World Bank client countries with geothermal resources.

Two other World Bank interventions in the form of loans are aimed at middle income countries to promote climate friendly investments. These are the Global Clean Technology Fund (CTF) and lending through the International Bank for Reconstruction and Development (IBRD)

6.2 The Geothermal Thermal Mitigation Facility for Eastern Africa (GRMF)

It is a grant program designed to cost share exploration work leading to the sitting of one or more reservoir confirmation wells as well as grants for the actual drilling of up to two reservoir confirmation wells in one prospect (). Grant applicants can request for grant assistance related to the establishment of infrastructure required in order to carry out exploration activities or drilling.

The African Union Commission (AUC)/KfW Development Bank (KfW) GRMF program was initiated by the German KfW in the second quarter of 2010.The GRMF has two primary elements, the first being grants for surface studies that lead to the sitting of wells for reservoir confirmation drilling. The second major element of the facility is grants for reservoir confirmation drilling. Grants cover up to 40% of eligible expenses related to the drilling of up to two reservoir confirmation wells. The grant will continue only in the event that upon completion of such drilling, the grant recipient commits to taking the project forward in which case, a "continuation premium" of 30% of the eligible expenses incurred during drilling operations is made available to the developer.

6.3 Geothermal Risk Transfer Facility

This is specific to Kenya and Ethiopia under the auspices of the FSD Africa for the period 2021 to 2025.Its aim is to leverage local insurance capital to de-risk renewable energy development and thereby catalyze private investment into green energy projects by establishing a joint underwriting facility, backed by East African insurers, to initially cover the early-stage development drilling risk for investors in geothermal projects.

6.4 The Geothermal Development Facility (GFF)

The Geothermal Development Facility (GDF) is similar and serves the same purpose as 6.3 above and specifically for Latin America and just as 6.5, below,

6 5 The European Geothermal Risk Insurance Fund (EGRIF).

This fund Is specifically for European Geothermal Resource Investors.

7. CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

Strasbourg is the frontrunner in the development of deep geothermal power in France and its case study has revealed the limits of some existing national and local energy policies. This study's main purpose was to find ways to integrate this local resource to a local reality, but its conclusions could be useful to fine-tune the approach to deep geothermal power at a national level (Chatenay, et al.).

The analysis of the geothermal projects under development in the EMS perimeter has highlighted the importance of this renewable resource for the territory's local energy transition. The EMS estimates that deep geothermal energy should account for at least 20% of the city's energy demand in 2050.

The exploitation of Alsatian geothermal resource, however, requires very high upfront investments (deep wells, ORC turbines). To promote the industrial development of the deep geothermal sector, the French national government proposed a generous feed-in tariff scheme for electric production that regrettably backfired on local heat demands. Effectively, local district-heating systems cannot compete financially with electricity prices during the duration of the feed-in tariff agreement.

This study highlighted the fact that there is a way of satisfying both industrial and territorial needs: coproduction. The model of heat production directly from the geothermal resource, in parallel to the production of electricity, seems the most favorable scheme from an economic point of view. Nevertheless, this alternative mode of exploitation asks for a series of adaptations from a multi-level perspective:

Central government, as deep geothermal projects and feed-in tariffs regulations should be coordinated with host territory's local government,

Industrial stakeholders, as their exploitation schemes should be compatible with the energy transition strategy of the host territory,

Local governments should be empowered as a major energy transition stakeholder and provided with financial capacity to make strategic investments (such as heat feeders connecting geothermal power plants and existing district heating). This bottom-up governance could assist national governments in drafting more accurate policies to effectively deploy Energy Transition measures such as the promotion of deep geothermal energy;

Local energy planning, as all of these geothermal projects share fact that potential direct users of geothermal energy are essentially users connected to an existing or potential heat network. Stakeholders are numerous and the missing link to allow the implementation of a

local use of geothermal energy is the connection between geothermal projects and distribution heat networks via feeders. The establishment of an interconnection system between all heat networks as well as with the geothermal power plants could help to overcome this problem but calls for changes of governance in many levels.

7.2 Recommendations

To enable win-win solutions for all stakeholders and investors in the renewable energy space:
Governments should design incentive structures at national and sub-national levels to create an enabling environment for renewable energy investments.

Both governments and development partners should develop innovative financing models that enhance strategic partnerships among multiple stakeholders to pool financial resources for enhanced affordability, lower risk and increased investment flows for renewable energy.

Development partners should provide technical assistance and capacity building support to African governments towards developing an enabling environment for private sector energy investments.

Private sector investors should expand on investment models that focus on sustainable development outcomes such as universal access and affordability for consumers at the bottom of the pyramid. This in turn creates economic opportunities and improves the overall quality of life for all citizens.

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