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THE ROLE OF PUBLIC AND PRIVATE PARTNERSHIP MODELS IN THE DEPLOYMENT OF RENEWABLE ENERGY: A CASE STUDY OF KENYAN GEOTHERMAL ENERGY

BY

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Abstract

Kenya stands as a pioneer in renewable energy exploration within Sub-Saharan Africa. A key contributing factor to its success lies in the adoption of effective policies and strategies that encourage private sector involvement in renewable energy projects. Kenya has embraced the Public and Private Partnership model (PPP) to foster the development of its geothermal energy resources, thus achieving a substantial portion of its energy from hydro and geothermal sources. Despite other East African countries' efforts to attract private sector investment in renewable energy through energy law reforms, they have yet to achieve significant progress towards a green energy transition. This study aims to examine the success factors behind PPP implementation in renewable energy projects across East African countries, with a particular focus on Kenya's experiences. To achieve this goal, the research will conduct a comprehensive review of research articles, case study, and utilize the Institutional Analysis and Development Framework (IDA) as an analytical tool to assess the implementation of PPPs in the selected case. The findings of the study indicate that the success factors for the Olkaria III PPP project include a clear delineation of roles and responsibilities among the involved parties, transparency, and a favorable legal and regulatory framework. These findings imply that effective PPP models necessitate well-defined policies, rules, regulations, and clear objectives that can harness the benefits of innovation, technology, managerial expertise, and private financing.

Keywords: *IDA Framework, PPPs, Kenya, Geothermal, Factors.*

1. INTRODUCTION

Kenya, with a population of 57,205,893, inhabits a 569,140 km² area in the East African region, extending from the coastland along the Indian Ocean to the low plains and central highlands. [i]The highlands are intersected by the 6000km-long Great Rift Valley, a landform rich in geothermal energy, with an opulent plateau stretching to the East (Merem et al., 2019). Approximately 27.8% of the population resides in urban areas, and the median age in Kenya is 20.1 years. As the data indicates, much of the population lives in rural areas, making the agricultural sector the cornerstone of the Kenyan economy. Despite the impact of the COVID-19 crisis on the Kenyan economy, the agricultural sector has remained resilient, limiting the contraction in GDP to only 0.3% (World Bank, 2023).

In 2021, the Kenyan economy rebounded, growing by 7.6% after a 0.3% contraction in 2020. This growth was driven by services on the supply side and private consumption on the demand side, both benefiting from supportive policies and eased COVID-19 restrictions (African Development Bank, 2022). As noted by the World Bank (2022), the Kenyan economy achieved broad-based growth, averaging 4.8% per year between 2015 and 2019, significantly reducing poverty from 36.5% in 2005 to 27.2% in 2019 (measured at the $2.15/day poverty line).

Since sustainable energy is crucial for strong economic growth, the government of Kenya has embarked on developing its power sector to increase the supply and access to reliable, affordable, and sustainable electricity. Kenya has one of the most developed power sectors in Sub-Saharan Africa, with active private sector participation, a strong

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national power utility, and abundant renewable energy resources, especially geothermal, wind, and solar. Given its geographical location in the Rift Valley in Eastern Africa, Kenya is endowed with great potential for geothermal energy, which can address the issue of energy poverty that hinders the development of most African countries. For this reason, the government of Kenya has considered the expansion of geothermal energy as a key component of the country's vision to become a newly industrialized middle-income country by 2030 (Government of Kenya 2007; Ministry of Environment and Natural Resources 2015). In recent years, Kenyan geothermal power production has gained momentum, leading to a significant increase in installed capacity across various sites in response to rising demand (Merem et al., 2019). This is the result of parallel efforts from both the public and private sectors to increase investment in optimal geothermal energy supply, subsequently reducing electricity tariffs for consumers and operational costs for firms.

Kenya has become the regional geothermal powerhouse thanks to supportive government policies and the expertise of Kenyan engineers (Payton, 2023). As a result of these initiatives, Kenya is now the eighth-largest producer of geothermal energy in the world, with an installed capacity of around 950 MW, constituting almost half of the country's electricity generation (Payton, 2023, and Kushner, 2021). In line with the role of geothermal power in advancing the socio-economic development of the Kenyan people, the government aims to reach a capacity of just over 1,600 MW through its Vision 2030 program (Payton, 2023). Furthermore, the Kenyan government has elevated its position as a leading African country in geothermal energy technology by providing technical assistance to neighbouring countries. The publicly owned company KenGen secured a $5.8-million contract to drill 12 geothermal wells in Ethiopia, and in February 2021, it won a $6.6-million contract to drill wells in Djibouti. Additionally, KenGen has conducted geoscientific research in Sudan and Rwanda (Onyango, 2022). Moreover, Kenya has set its sights on the Democratic Republic of Congo and Sudan for more geothermal drilling contracts as part of its efforts not only to assist partners across the continent in exploiting green energy resources but also to generate revenue by leveraging its equipment and technical skills over the next decade (Onyango, 2022).

Despite the unprecedented development of geothermal energy in Kenya, only a handful of studies have discussed the factors contributing to such success without systematically analysing the key components that have led to remarkable progress in green energy. Hence, this study aims to fill this gap by scrutinizing the critical factors that enhance cooperation and coordination between the public and private sectors to promote geothermal energy exploration. In providing lessons to neighbouring countries in the region, this paper intends to apply IDA frameworks to determine exogenous variables and interactions between actors that have contributed to the development of geothermal energy in the case of Kenya.

2. Literature Review

"Geothermal energy is the natural heat from the earth's interior stored in rocks and water within the earth's crust" (Mariita, 2002, p. 1). One of the unique features of geothermal energy is that it is harnessed from underground reservoirs consisting of hot water and steam that are naturally replenished, making it both renewable and sustainable (S. Kong'ani and M. Kweyu, 2022). Geothermal energy development comprises seven phases. It begins with geo-exploration through surface studies followed by exploratory drilling, involving drilling three to six narrow wells to depths of about 2000–3000 meters to test the existence of a geothermal reservoir capable of sustaining commercial rates of fluid production and injection (W. Johnson and Mbeo, 2018). Confirming the existence of a viable geothermal reservoir substantially reduces the geological uncertainty and financial risk of the project, enabling the preparation of a robust feasibility report (IFA, IGA, 2014). In the subsequent phase, the remaining production wells and reinjection wells for the planned power plant are drilled based on the numerical model for the geothermal system (IFA, IGA, 2014). When the expertise confirms the presence of an exploitable geothermal reservoir, the project moves from the feasibility study to the final investment decision stage (IFA, IGA, 2014). In the power plant phase, the steam gathering system is coordinated with necessary civil works and infrastructure to facilitate power plant construction, accompanied by further testing of the wells. The gathered steam is primarily used in a steam turbine for power generation. The generated power is then transmitted and distributed through the national grid to end users, including residential, commercial, and industrial sectors (W. Johnson and Mbeo, 2018).

2.1. Kenya's Geothermal Energy Development

Kenya's geothermal resources are located within the East African Rift Valley area, with an estimated potential of up to 10,000 MW spread across 14 potential sites (Ngugi, 2012 & S. Kong'ani and M. Kweyu, 2022). Geothermal development in Kenya comprises six key steps: 1) exploration. 2) test drilling. 3) project review and planning. 4) field development. 5) power plant construction. 6) commissioning. 7) operation (Battistell, 2020). Geothermal exploration in Kenya traces back to the 1950s when a consortium of companies, including the East Africa Power and Lighting Company Limited and Balfour Beatty Company, undertook exploratory drilling of two wells in Olkaria (Mariita, 2001 and Nyokabi et al., 2022). However, these initial exploration wells, being only a few hundred meters deep, did not yield successful results (Nyokabi et al., 2022). Nevertheless, pre-feasibility studies continued through Kenya's independence a decade later.

In the early post-independence period, the newly formed government signed an agreement with the UNDP to extensively undertake a new exploration study on geothermal resource assessment in the expansive Great Rift Valley (Saitet and Muchemi, 2015). Exploration in the Olkaria steam field commenced in the late 1960s to mid-1970s, carried out by the state-owned Kenya Power Company Limited and supported by UNDP (S. Kong'ani and M. Kweyu, 2022). This project led to more geoscientific activities, primarily consisting of

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geological mapping, hydrogeological surveys, gravity studies, and infra-red imagery surveys (Mangi, 2017). By 1972, the resource within Olkaria was deemed the most prospective, leading to a decision to concentrate on Geothermal Development in the Olkaria area (80km^2) (Mangi, 2017). Subsequently, six deeper exploration and appraisal wells were drilled in Olkaria, confirming the existence of exploitable geothermal energy (Saitet and Muchemi, 2015). Consequently, the first geothermal power plant, Olkaria I, with an electric power capacity of 45 MW, was constructed by Kenya Power Company (predecessor of KenGen) between 1981 and 1985 (S. Kong'ani and M. Kweyu, 2022). The funding for exploration, drilling, and development of Olkaria I[1] was contributed by the World Bank and the European Investment Bank through government grants, which were also used to develop local human capacity in geothermal exploration (Saitet and Muchemi, 2015). Following the remarkable success of Olkaria I (Olkaria East field), drilling efforts shifted to the Olkaria Northeast field immediately north of the Olkaria I field (Nyokabi et al., 2022).

Between 1986 and 2003, thirty wells were drilled, with most of them producing sufficient steam for power production (Omenda et al., 2021). Due to prevailing political and economic circumstances, the Kenyan government was unable to secure adequate funds to connect these wells, as the donor community had withdrawn support, and the local economy could not sustain such development (Saitet and Muchemi, 2015). Consequently, the thirty wells remained inactive for an extended period, pending the development of a power station (Saitet and Muchemi, 2015 and Omenda et al., 2021). Nevertheless, the Kenyan government established a special-purpose vehicle to further exploit geothermal energy at other sites within the Olkaria field. Accordingly, the power station was finally developed and commissioned by KenGen in 2003 as Olkaria 2, featuring 2x35MWe condensing-type turbines (Nyokabi et al., 2022). Additionally, Olkaria II, III, and IV were commissioned in 2003, 2009, and 2014 respectively, with plans for the construction of Olkaria VI and VII (S. Kong'ani and M. Kweyu, 2022). Apart from Olkaria, Menengai and Eburru are other well-developed geothermal prospects in Kenya, expected to contribute significantly to geothermal energy production (refer to Table 2.1).

Before 1996, the development of geothermal resources was solely the responsibility of Kenya Power Limited Company (KPLC). However, this approach considerably slowed down geothermal development. Therefore, the Kenyan government reformed energy laws, revised feed-in tariff policies, and established the Public and Private Partnership Act (PPPA) to spur geothermal energy development. These amendments incentivized independent power producers (IPPs) to participate in geothermal energy generation. The government of Kenya issued the first IPP license to ORMAT International company to generate 48 MWe from Olkaria III. Since then, thirteen IPPs have been licensed by the Kenyan government to undertake greenfield projects such as Barrier, Longonot, Akiira, Menengai North, and Elementaita (S. Kong'ani and M. Kweyu, 2022 and Omenda et al., 2021). The current installed geothermal capacity consists of 706.8 MW by Kenya Electricity Generating Company (KenGen), 155 MW by OrPower4, Inc., and 3.6 MW by Oserian Development Company Ltd, with an additional 45 MW added by Orpower4 between 2015 and 2018 (S. Kong'ani and M. Kweyu, 2022).

[1] Financing Of Olkaraia (I,II,) In Appendix (Table 1&2)

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Table 2.1: Geothermal energy fields and status of development in Kenya.

Station and licensee	Year commissioned	Installed capacity	Status
Olkaria I,	Unit 1 (1981)	15 MW	Generation and production
KenGen	Unit 2 (1982)	15 MW	drilling
	Unit 3 (1985)	15 MW	
	Unit 4 (2014)	70 MW	
	Unit 5 (2015)	70 MW	
	Unit 6 (2022)	83 MW	
		Total = 185 MW	
Olkaria II,	Unit 1 (2003)	35 MW	Generation and production
KenGen	Unit 2 (2003)	35 MW	drilling
	Unit 3 (2010)	35 MW	
Olkaria III,	Unit 1 (2000)	48 MW (total)	Generation and production
Orpower4	Unit 2 (2009)	36 MW	drilling
	Unit 3 (2014)	26 MW	
	Unit 4 (2016)	29 MW	
		Total = 139 MW	
Olkaria IV,	2014	140 MW	Generation and production
KenGen			drilling
Olkaria V,	2019	2 × 82.7 MW = 165.4 MW	Generation and production
KenGen			drilling
Olkaria VI,	2022 (expected)	140 MW	Surface exploration and
KenGen			production drilling
Suswa, CYRQ	2024 (expected)	2 × 37.5 MW	Surface exploration and
Energy		6 × 42.5 MW	production drilling
		Total = 330 MW	
Eburru, KenGen	Unit 1 (2012)	2.5 MW	Generation and Pilot
	Unit 2 (2019,	22.5 MW	generation
	expected)	Total 25 MW	
Akira, AGL[a]	2022 (expected)	1 × 70 MW	Exploration and surface
			studies
Oserian, ODCL[b]	2003	2.5 MW	Production under steam sale

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Longonot, AGIL[c]	2019 (expected)	140 MW	Production drilling
Bogoria-Silali, GDC[d]	2021 (expected)	200 MW	Production drilling
Menengai, GDC	2020 (expected)	3 × 35 MW	Production and exploration

Akiira Geothermal Limited.
[b] *Oserian Development Company Limited.*
[c] *African Geothermal International Limited.*
[0] [d] *Geothermal Development Company* source: Adapted from Namuma S. Kong'ani & M. Kweyu, (2023)

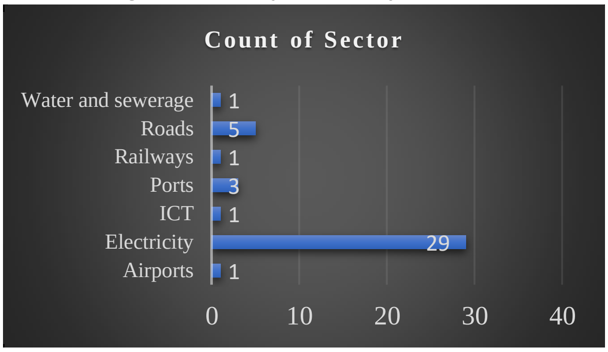
1.2 *Kenyan`s Public-Private Partnership*

Public-Private Partnership is becoming a novel mechanism to address the investment gap associated with sustainable energy in the case of Sub-Saharan Africa. For that, PPP allows governments that are already struggling to generate resources to meet their sustainable infrastructure need by using alternative private sector sources of finance while at the same time benefiting from private sector expertise in terms of skills and management (Ismail & Ajija, n.d). The significance of PPP lies in the fact that it offers a flexible arrangement, which enhances the government`s access to capital, enable the government to take on fewer risks due to risk allocation, and opens the door for innovation (Nsouli, 2022, Munyao, 2019 and Gheewalana,2019).

Since 1996, the government of Kenya has successfully attracted private investment into the country`s economic infrastructures such as telecommunications, energy, water, and road, without an explicit PPP policy (Fortune of Africa, 2018, Tshombe et al., 2020). In 2013 the Kenyan government established Public-Private Partnership Act, as a milestone for PPP application. The Public Private Partnership (PPP) Act, 2013 defines PPP as "an arrangement between a contracting authority and a private party under which a private party undertakes to perform a public function or to provide a service on behalf of the contracting authority and receives a benefit for performing a public function by way of compensation from a public fund; charges or fees collected by the private party from user or combination of compensation and charges or fees." Based on the above definition, the Kenyan government will entrust the private sector to finance, construct, design, and operate the infrastructure or projects through concessional or other contractual arrangements that deem fit for the chosen project. The (PPPA) defined concession *"as a contractual license formalized by a project agreement, which may be linked to a separate interest or right over real property, entitling a person who is granted the license to make use of the specified infrastructure or undertake a project and to charge user fees, receive availability payments or both such fees and payments during the term of the concession"* (P.1). In addition to the concessional agreement, there are also other arrangements authorized by contracting authorities, for example, (I) management contracts and (II) output-based contracts (PPPA,2013). Accordingly, the 2013 PPP act had put in place a body of laws, policies, and regulatory framework to regulate, monitor, and supervise the implementation of project agreements on infrastructures or development projects. To further reinforce the private sector participation into socio-economic development projects, the PPPA, 2021 (Public Private Partnership Act) widens scope of PPP arrangements to include (I) annuity-based design, build, finance, and operate, (II) strategic partnerships and (III) joint Venture Partnerships. Hence, there are upward shift towards PPP application in varies socio-economic development projects mostly energy sector.

The recent data showed that PPP become an engine for developing the Kenyan renewable energy sector. Figure (2.1) indicates that twenty- eight out of thirty-nine PPP base projects are for renewable energy projects. According to the World Bank Private Participation in Infrastructure (PPI), database, PPP project investments totalling US$5.407 billion were invested between 1990 and 2022, with above three billion US$ allocated to the electricity sector, which has the lion's share of total project investment. Moreover, the Kenyan government is gearing up to build more than 35 MW of Menengai geothermal power projects through PPP mechanisms. As the evidence indicated, the Kenyan government has widely implemented PPPs to deliver its development projects.

Figure 2.1: Kenya PPP Project Sector



Source: World Bank Private Participation in Infrastructure (PPI) database the perceptions of Kenyan public and private stakeholder's concerning the CSFs to the implementation of PPPs in infrastructure and housing projects. A quantitative approach using survey-based que

3 Theoretical Framework

Institutional Analysis and Development (IAD) is a framework commonly used by social scientists to examine how institutional arrangements affect human behaviour patterns in

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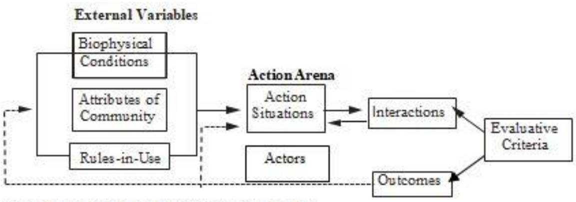
complex tasks involving multiple stakeholders. The IAD framework involves analysing actors, norms, institutional settings, incentive structures, and rules. It also serves as the criteria for evaluating whether an institutional outcome is satisfactory or not. Therefore, the IAD framework is valuable for explaining individuals' operational choices in various collective action settings, including the development of geothermal resources. As a result, this study adopts the IAD framework to analyze the surrounding environment, rules, policies, norms, and values that have contributed to the expansion of geothermal sources in Kenya.

3.1 Institutional Analysis and Development Framework (IAD)

In 1994, Elinor Ostrom introduced the IAD framework, focusing on the pivotal issue of institutional analysis. Ostrom defines institutions as "the prescribed associations used to organize all forms of repetitive and structured interactions, including those within families, neighbourhoods, markets, firms, private associations, and governments at all scales" (Ostrom, 2005, p. 3). In essence, institutions encompass the rules and norms that individuals employ to structure their recurrent activities. It's important to note that the rules and norms employed in these repetitive activities can vary based on physical and cultural factors. The Institutional Analysis and Development Framework (IAD) serves as a method or tool for comprehensively analysing the complexity of the circumstances in which society formulates these rules and norms. The IAD framework doesn't provide solutions to problems but rather proposes a series of questions to systematically investigate the issues at hand. An analyst using the Institutional Analysis and Development Framework (IAD) focuses on action situations in which multiple actors or participants interact to achieve a desired outcome. These action situations are defined by the norms and values associated with them. Interestingly, different actors' interactions within the same action situation can lead to diverse outcomes. The combination of the action situation and participants is referred to as the action arena. The behaviour of participants in an action situation is influenced by three sets of exogenous variables: the biophysical and material world, the community, and the rules in use (see Fig. 3.1) (Whaley & Weatherhead, 2014).

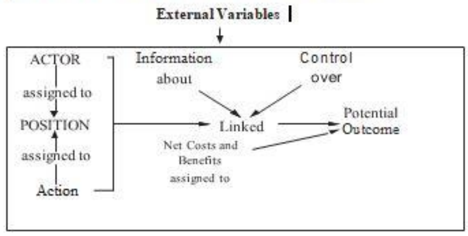
According to McGinnis (2011), these variables encompass "all aspects of the social, cultural, institutional, and physical environment that create the context within which an action arena is situated" (p. 172). Action situations are categorized into seven working components (see Fig. 3.2) consisting of actors who take on various positions. Each position allows participants to assume certain actions, dependent on factors such as their information about existing actions, the relationship between actions and potential outcomes, the level of control individuals have over these outcomes, and the costs and benefits they associate with these actions (Ostrom 1990). Four features characterize these actors: (1) the preference evaluations actors give to potential actions and outcomes; (2) how actors obtain, process, retain, and utilize knowledge contingencies and information; (3) the selection criteria actors use to decide on a specific course of action; and (4) the resources an actor brings to a given situation (Ostrom et al. 1994, p. 33). The rules represent a set of explicit regulations governing individual behaviour, dictating "required, prohibited, or permitted actions and the sanctions authorized in case of rule violations" (Ostrom et al. 1994, p. 38). The authority is responsible for establishing and enforcing these rules to manage, organize, and control the actions of the actors. In the IAD framework, the biophysical and material conditions illustrate the physical environment in which an action situation occurs (Ostrom, 2005). This environment includes the physical and human resources needed for producing and supplying goods and services, such as capital, labour, technology, sources of finance, and distribution channels (Polski & Ostrom, 1999). According to the IAD framework, the physical environment significantly influences the possible actions taken in action situations (McGinnis, 2011). Additionally, the community plays a substantial role in affecting individual actions, including generally accepted norms of behaviour, the level of common understanding about action arenas, the degree of preference homogeneity, and the distribution of resources among members (Ostrom et al. 1994, p. 45).

Figure 3.1: A Framework for Institutional Analysis



Source: Adapted from E. Ostrom (2005, p. 15)

Figure 3.2: The Internal Structure of an Action Situation



Source: Adapted from E. Ostrom (2005, p. 33).

The IAD framework is multi-dimensional, and it commonly recognizes three nested levels: operational, collective choice, and constitutional choice (Kiser and Ostrom 1982; Ostrom et al. 1994; Whaley & Weatherhead, 2014). The operational tier is where actors interact while considering the incentives, they face to directly produce outcomes in the real world. The collective choice level is where decision-makers establish a set of collective choice rules that impact the activities at the operational level. The constitutional level is where decision-makers determine who is eligible to participate in policymaking and the rules that will govern policymaking. Constitutional choice outcomes, in this context, influence decision-making at the collective choice level, which, in turn, impacts activities at the operational level. Actors can move between these different levels of actions, either striving for

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their best outcomes within a given set of rules or attempting to change collective or constitutional choice rules to their advantage (Schlager and Blomquist, 1996). The IAD framework recognizes the interdependency of these three exogenous variables. For instance, any set of rules in use heavily depends on the prevailing biophysical conditions and the shared norms and values of those for whom the rules are intended (Whaley & Weatherhead, 2014). As a result, the IAD framework provides a structured and consistent approach for analysing various phenomena (Whaley & Weatherhead, 2014). In terms of evaluation criteria, Ostrom (2005) outlines the following factors for consideration: (1) economic efficiency, (2) equity, (3) adaptability, resilience, and robustness, (4) accountability, and (5) conformance to general morality, as examples of evaluation criteria.

3.2 Olkaria III Geothermal PPP Case Study

Olkaria III is in the Olkaria geothermal field in the Rift Valley, situated 90 kilometers northwest of Nairobi. It is part of a series of geothermal developments. Ormat Olkaria III holds the distinction of being the first privately funded and developed geothermal project in East Africa. In 1996, the Kenyan Government initiated an international Build-Own-Operate bid for the Olkaria III concession. After two years of deliberation, the bid was awarded to Ormat, a large publicly listed alternative energy provider. Ormat then signed a power purchasing agreement with the state-owned energy distributor, Kenya Power and Lighting Company Limited. The Kenyan Government conducted initial exploration, significantly reducing the risk for the private sector by establishing proven geothermal capacity. Further risk mitigation was achieved through successful negotiations between the Kenyan Government and Ormat, resulting in the first power-purchasing agreement in the same year, 1998.

In August 2000, Ormat, through its local subsidiary, OrPower4, developed an initial 8 MWe capacity, which was subsequently increased to 12 MWe through a combined binary cycle pilot plant (Mwangi 2017 and UN, 2018). The success of the pilot wells prompted additional drilling activity carried out by Ormat at various times, culminating in Olkaria III reaching a total production capacity of 110 MW in February 2014. Furthermore, a fifth unit with a capacity of 29.6 MWe was commissioned in February 2016, bringing the total plant capacity to 139.6 MWe (see Fig 3.3). The electricity produced is sold under a 20-year power purchase agreement (PPA), which is renegotiable with the public company Kenya Power and Lighting Company Limited (KPLC). The financing of the Ormat Olkaria III project involved several stakeholders, from early exploration to the current project capacity. KenGen contributed an estimated value of 24 million for initial exploratory drilling activities, along with 8 MW capacity production wells, enabling Ormat to begin the pilot phase of the Olkaria III project using its equity to finance the first phase. Ormat's initial cost was USD 40 million, but this cost escalated to USD 220 million by 2014. Additionally, the Multilateral Investment Guarantee Agency (MIGA) provided insurance against political risk by extending the insurance coverage of Ormat's equity to USD 110 million. Furthermore, the Overseas Private Investment Corporation (OPIC) financed the second phase of the project with a 19-year tenor senior loan of USD 310 million in 2012. This OPIC financing was disbursed in three tranches to finance Phase II and Phase III and to refinance part of Ormat's initial equity investment. To enable the full development of the plant, Germany's DEG and KFW Development Bank led a financing consortium that refinanced Ormat's equity in Phase I (Refer to Table 3.1).

The project yielded positive outcomes for both the private and public sectors. According to a report by the Climate Policy Initiative (2015), Ormat Olkaria III provides electricity at a 13% lower cost compared to similar geothermal projects in Kenya. Additionally, Olkaria III is estimated to reduce emissions from Kenya's power sector by 3 to 4% (Climate Policy Initiative, 2015). Ormat's equity internal rate of return (IRR) increased from 13% to 16% over the lifetime of the project. It's noteworthy that without the initial exploration conducted by the Kenyan government, Ormat's equity IRR would have remained at 13%. Despite the initial exploration carried out by KenGen, Ormat was required to use its equity to demonstrate the project's capacity before securing two rounds of financing. This highlights the importance of partnership synergy between the public and private sectors in reducing the initial risks associated with the early development of geothermal projects. Ormat Olkaria III sets an example of the successful implementation of the PPP model based on the Build-Own-Operate structure, showcasing how risk-sharing between the private and public sectors enhances project bankability, leading to further expansion.

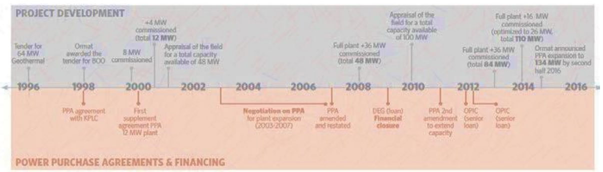
Table 3.1: Financial inputs at each phase of expansion (USD million)

FINANIAL SOURCES				PHASE OF EXPANSION (MW ADDED)				TOTAL FINANCIAL INPUTS	
ACTORS	TYPE	INSTRUMENT	YEARS DISBURSMENT	PHASE I		PHASE II	PHASE III	Finance Mobilised	Project Costs (Excluding Refinancing)
				12 MW	+36 MW	+36 MW	+16 MW (OPTIMIZED TO 26 MW)		
ORMAT	**Private**	**Equity**	1998 – 2014	**40**	**110**	43	**27**	**220**	**220**

DEG AND CO-LENDER	**Public**	Senior (/Subordinated-) Loan (Refinancing)	**2009**	**105**	-	-	**105**	-
OPIC	**Public**	Senior loan (Refinancing)	**2012**	**85**	-	-	**85**	-
OPIC	**Public**	**Senior Loan**	**2012-2013**	-	**180**	**45**	**225**	**225**
TOTAL							**635**	**445**

Source: Climate Policy Initiative, 2015

Figure 3.3 Development Timeline of Ormat Olkaria III



Source: Climate Policy Initiative, 2015

4 Discussion

The IAD framework primarily classifies the background setting into three categories: physical and material conditions, community attributes, and rules-in-use (Altomonte & Guinto, 2022). In the case of the Olkaria III Geothermal PPP Project, it encompasses a diverse range of contexts and institutional arrangements. This study will commence by delineating the exogenous variables, which include physical and material conditions, community attributes, and rules-in-use, while also presenting key questions and considerations.

4.1 Physical and material conditions

Kenya is currently experiencing rapid developments in the field of geothermal energy, thanks in part to its well-trained workforce, encompassing expertise in geology, geochemistry, geophysics, reservoir engineering, drilling engineering, power plant engineering, and environmental and social sciences (Omenda et al., 2021). Kenya's favourable geographic location, situated within the East African Rift System (EARS), endows it with significant geothermal potential. The country is strategically developing its geothermal resources along the rifts, leveraging the involvement of both state-owned corporations like KenGen and GDC, as well as private investments, to expedite the expansion of these resources (Omenda et al., 2021). This collective effort has led to the current installed capacity of Olkaria III reaching 155MW (Omenda et al., 2021). The financing of geothermal projects in Kenya has relied on a mix of private investment, public funding, and grants. The Kenyan government is making substantial investments, supporting scientific research, drilling activities, and the generation of geothermal-sourced electricity. Notably, private investors have funded exploration drilling and detailed surface studies in geothermal fields such as Akiira and Barrier (Omenda et al., 2021). Geothermal energy has emerged as a cost-effective and reliable source of electricity in Kenya, resulting in a growing demand for geothermal generation and consumption. The Kenyan government has implemented various strategies to mitigate risks and reduce the overall cost of geothermal energy, thereby attracting private investments.

4.2 Rules-in-use

The Kenyan government has made significant strides in its commitment to providing reliable, sustainable, and affordable electricity. To facilitate this, it has implemented regulatory measures and legislative frameworks supporting Public Private Partnerships (PPPs) in geothermal energy development, operation, and maintenance.

Kenya's constitution, known for its robustness, forms the basis for project development in the country. Part 2 of Chapter 5 of the constitution grants the government the authority to sustain, exploit, utilize, and manage the nation's natural resources (Constitution of Kenya, 2010). It also recognizes the granting of rights or concessions for the exploration of natural resources, either by the national government or on its behalf, to other entities for the exploitation of Kenya's natural resources. Furthermore, it empowers the parliament to enact legislation to enforce these provisions (Constitution of Kenya, 2010). This solid constitutional framework facilitated the liberalization of Kenya's power sector.

In 1996, the Kenyan government embarked on the liberalization of the power sector and subsequently restructured the state-owned utility in 1997 (Boampong and Phillips, 2016). In the same year (1997), Kenya established the Electricity Regulatory Board (Republic of Kenya, 2011). The key institutions involved in Kenya's electricity sector include the Ministry of Energy, Energy Regulatory Commission, Energy Tribunal, Rural Electrification Authority, Kenya Electricity Generating Company, Independent Power Producers, and Kenya Power and Lighting Company. Legislative acts, such as the Energy Act of 2019, which repealed the Energy Act of 2006, the Kenya Nuclear Electricity Board Order No. 131 of 2012, and the Geothermal Resources Act of 1982, have played a pivotal role in promoting the renewable energy sector. The Energy Act of 2019 consolidates the laws pertaining to energy, outlines the functions of both National and County Governments concerning energy, and establishes the powers and functions of various energy sector entities. These entities work towards the promotion of renewable energy, exploration, recovery, and commercial utilization of geothermal energy, regulation of midstream and downstream petroleum and coal activities, regulation, production, supply, and use of electricity, and

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other energy forms, among other functions. In 2008, the Ministry of Energy Petroleum introduced a feed-in tariff system, offering long-term contracts to renewable energy producers, allowing them to supply energy to the grid at a predetermined rate (Boampong and Phillips, 2016). In addition to these reforms, the Kenyan government also enacted the Public and Private Partnership Act.

The Public and Private Partnership Act of 2021 repealed the Public-Private Partnerships Act of 2013. This legislation is designed to facilitate the private sector's participation in financing, constructing, developing, operating, or maintaining infrastructure or development projects through public-private partnerships (PPPA, 2021). The objectives of the Public and Private Partnership Act 2021 encompass prescribing procedures for private sector involvement in public-private partnerships, harmonizing the institutional framework for PPP project implementation, aligning with Article 227 of the Constitution regarding procurement in PPPs, streamlining and rationalizing the regulatory, implementation, and monitoring mandates for relevant agencies, and providing for county government participation in PPPs (No.14, P. 9). The Directorate of Public-Private Partnerships will be responsible for originating, guiding, and coordinating the selection of public-private partnership projects. It will oversee appraisal and development activities of contracting authorities, provide technical expertise in project implementation, and guide and advise contracting authorities in project structuring, procurement, and tender evaluations (PPPA, 2021). In summary, the legal reforms of 1996, the repeal of the Energy Act, the enactment of the Public and Private Partnership Act, feed-in tariff, and power agreement policies have created an enabling environment for the successful implementation of the Olkaria III PPP Project.

4.3 Community Attributes

Community attributes significantly influence individual actions, encompassing factors such as "generally accepted norms of behaviour, the level of common understanding about action arenas, the extent of preference homogeneity, and the distribution of resources among members" (Ostrom et al., 1994, p. 45). The Kenyan community has enthusiastically embraced the production and utilization of geothermal energy, recognizing it as a means to access clean and sustainable energy that can help alleviate poverty, enhance health, create employment opportunities, improve transportation, and contribute to the development of more sustainable, inclusive, and resilient communities (Dmitriy et al., 2022). Furthermore, a study by Kiraison (2017) revealed that the positive socio-economic impacts of geothermal energy exploration in Olkaria III encompass various aspects, including but not limited to stabilizing electricity supply in Kenya, promoting economic growth, contributing to government revenue, increasing employment opportunities, fostering corporate social responsibility, boosting tourism, and creating potential for carbon trading. Moreover, Kenya's long-term development strategy for 2030 aims to ensure the provision of reliable, affordable, and sustainable energy, while concurrently reducing greenhouse gas emissions and dependence on fossil fuels. These factors collectively foster community acceptability, thereby generating interest among diverse stakeholders, all of which have a positive impact on the expansion of geothermal energy in Kenya.

4.4 Actors or Participants in Action Situation

Key stakeholders in the development of geothermal energy in Kenya include the Energy and Petroleum Regulatory Authority (EPRA), Kenya Electricity Generating Company (KenGen), Kenya Power and Lighting Company, Kenya Electricity Transmission Company (KETRACO), and Geothermal Development Corporation (GDC). In addition to these stakeholders, the project also involves private sector entities and international development financial institutions (DFIs). Legal reforms, policies, and strategies implemented by the Kenyan government have facilitated effective collaboration among these actors, resulting in positive outcomes. As per the Climate Policy Initiative Report (2015), Ormat Olkaria III is capable of supplying electricity at a cost 13% lower than comparable geothermal projects in Kenya. Furthermore, Olkaria III is expected to reduce emissions from Kenya's power sector by 3 to 4% (Climate Policy Initiative, 2015). This underscores how constitutional choice outcomes influence collective choice decision-making, subsequently impacting operational-level activities."

4.5 Evaluation Criteria

This study employs Kenya's Vision 2030 as a pivotal evaluation criterion. The fundamental pillars of Kenya Vision 2030 encompass macroeconomic stability, sustained governance reforms, improved equity, and the creation of wealth opportunities for underprivileged segments, infrastructure development, advancements in energy, science, technology, and innovation (STI), land reform, human resources development, enhanced security, and public sector reforms. Given the increased energy requirements of development projects under Vision 2030, the Kenyan government has recognized the significance of geothermal energy as a cost-effective solution to reduce the country's reliance on expensive fossil fuel-based power generation and weather-dependent hydropower generation (Government of Kenya, 2007; Climate Policy Initiative, 2015). Consequently, Kenya has set an ambitious target to increase its geothermal power capacity from 600 MW to 5,000 MW by 2030. However, Kenya's budgetary allocations alone may not be sufficient to sustainably cover the costs required to expand the installed power capacity. As a result, the Kenyan government has actively promoted public-private partnerships through institutional reforms in the energy sector, including regulatory frameworks and incentives for private sector participation (Munyao, 2019; Nsouli, 2022; Tshombe et al., 2020). Olkaria III serves as an exemplary model of a phased development strategy that successfully combines various financing and risk mitigation instruments made available by the public sector. The successful implementation of Olkaria III has led to a substantial increase in geothermal production, raising it to 139.6 MWe. Furthermore, Olkaria III is expected to contribute to a reduction in emissions from Kenya's power sector by 3 to 4% (Climate Policy Initiative, 2015). The

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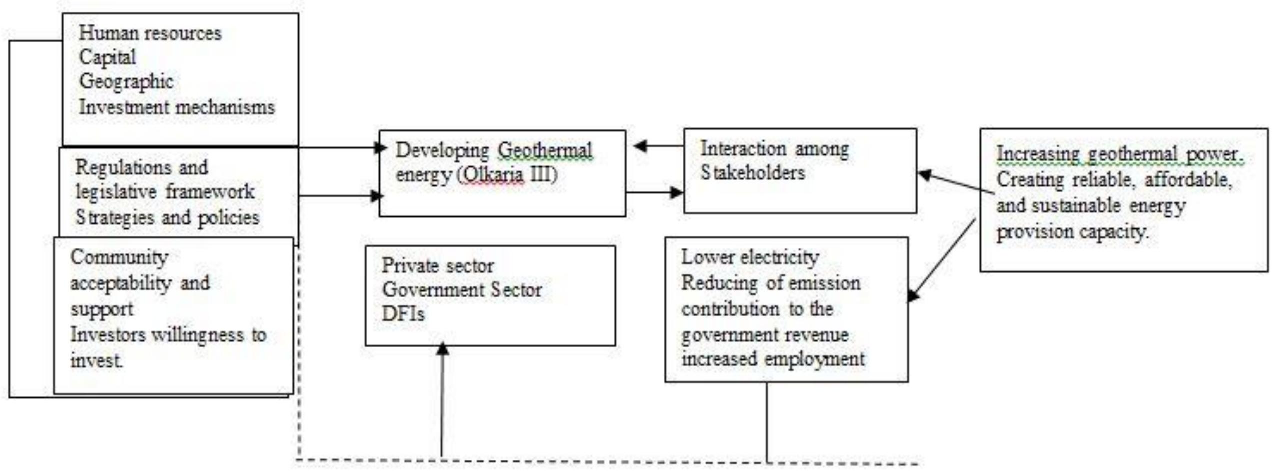
outcomes of Olkaria III have provided incentives for other private investors to venture into the geothermal energy sector. Consequently, other geothermal fields are being developed based on PPP structures, such as Menengai, Akiira, and Barrier.

Figure 4.1: Institutional Analysis Framework for the Olkaria III PPP Project

Exogenous Variables **Action Areana** **Evaluation Criteria**



Conclusion

Kenya is touted as one of the leading countries in the application of Public-Private Partnerships (PPPs). This distinction is attributed to Kenya's well-established PPP market, which is one of the most mature in Africa and supported by a comprehensive legislative framework. With this conducive environment, the Kenyan government has successfully implemented PPPs across various sectors, including transportation, infrastructure, water, housing, and energy. The Olkaria III PPP project serves as a prime example of how the sharing of risks between the private and public sectors enhances the bankability of projects, ultimately leading to the further expansion of geothermal energy. Key success factors for the Olkaria III PPP project encompass well-defined roles and responsibilities among the involved parties, clear objectives, mutual benefits, transparency, a favourable legal and regulatory framework, incentives, government guarantees, political support, appropriate risk allocation, project identification, involvement of a private consortium, sound economic policies, and stable macroeconomic indicators. Consequently, other East African countries can emulate from Kenya's PPP structure by developing a well-crafted framework that prioritizes accountability and transparency. This approach will prove instrumental in attracting private sector participation in the development of geothermal energy.

APPENDIX

Table 1: Financing sources for Olkaria I

	Financier Description	Year of disbursement	Original Currency	Amount	USD Equivalent	Total USD Equivalent
Olkaria II Unit 1 & 2	IDA 2966KE	1997-2003	US$	125,000,000.00	125,000,000.00	
	EIB	1997-2003	Euro	41,000,000.00	41,000,000.00	
	KFW	1997-2003	Euro	12,782,000.00	11,734,880.00	
	KENGEN	1997-2003	KSH	2,785,421,295.39	37,138,950.61	214,873,830.61
Olkaria II Unit 3	IDA 3958KE	2007-2010	US$	27,600,000.00	27,600,000.00	
	EIB	2007-2010	US$	50,000,000.00	50,000,000.00	
	KFW	2007-2010	Euro	20,000,000.00	25,200,000.00	
	KENGEN	2007-2010	KSH	1,554,735,000.00	18,291,000.00	121,091,000.00

Source: Adapted from Saitet, and Muchemi (2015)

Table 2: Financing sources for Olkaria II

Institution	Description
Ministry of Energy	Establishes energy policies, sets strategic direction for the sector.

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Energy Regulatory Commission	Regulates the energy sector. Sets tariffs and oversight, coordinates thedevelopment of energy plans, monitors and enforces sector regulations.
Energy Tribunal	Arbitrates disputes.
Rural Electrification Authority	Implements the Rural Electrification Program.
Kenya Electricity Generating Company	Main electricity generator (installed capacity of 1,176 MW). Ownership is 70% government, 30% private investors. It accounts for roughly 75% of installed capacity from hydropower, thermal,geothermal, and wind sources.
Independent Power Producers	Private investors involved in generation under Kenya's feed in tariff. They account for roughly 26% of the country's installed capacity from thermal, geothermal, and bagasse.
Kenya Power and Lighting Company	Off-taker in the power market. Buys power from all power generatorsunder Power Purchase Agreements for transmission and distribution. Ownership is 50.1% Government of Kenya and National Social Security Fund and 49.9% private investors.

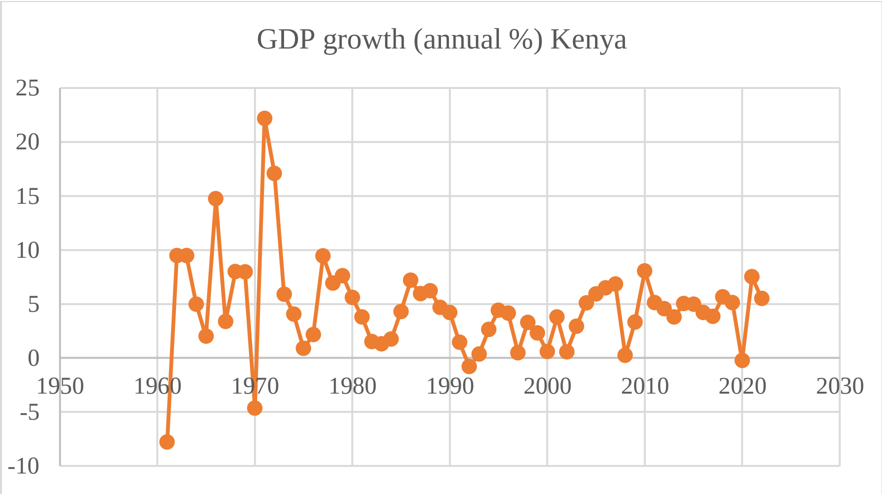
Source: Adapted from Saitet, and Muchemi (2015)

Table 3: Electricity Sector Institutions in Kenya

	Financier Description	Year of disbursement	Original Currency	Amount	USD Equivalent	Total USD Equivalent
Olkaria I	IBRD 1799KE	1977-1981	US$	38,704,960.00	38,704,960.00	
	IBRD 2237KE	1977-1981	US$	7,456,757.00	7,456,757.00	
	EIB	1977-1981	ECU	478,589.60	420,709.56	
	EIB	1977-1981	FF	4,847,146.23	836,497.98	
	EIB	1977-1981	GBP	79,898.20	135,201.78	
	EIB	1977-1981	ITL	956,249,842.00	566,013.88	
	EIB	1977-1981	BF	162,875,894.00	4,578,738.24	
	EIB	1977-1981	DUTCG FLORIN	1,987,016.82	1,019,420.62	
	EIB	1977-1981	DRACHMAS	90,915,738.00	332,955.18	
	EIB	1977-1981	US$	405,746.35	405,746.35	
	EIB	1977-1981	JPY	293,242,671.00	2,348,048.06	56,805,048.66

Source: Adapted from Boampong and Phillips (2016)

Figure 1: Kenya Annual GDP Growth



Sources: World Bank Kenya GDP Growth

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