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Analyzing Kenya's Electricity Sector Financing: Vision 2030

Brian Nyaware

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THE KENYA INSTITUTE FOR PUBLIC POLICY RESEARCH AND ANALYSIS (KIPPRA)

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KIPPRA in Brief

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Abstract

The significance of electricity in improving livelihoods globally is undisputed. This is mainly attributed to the interlinkages with socio-economic activities; for example, electricity is a major enabler for economic growth by powering industries, economic sectors and social amenities. Access to electricity in Sub-Saharan Africa (SSA) is still low, which slows down economic development and lengthens the poverty cycle lifespan. Kenya is among the top performers in the region when it comes to electricity access rate, having a rate of 75 per cent against SSA overall rate at 47 per cent. As Kenya strived to have universal electricity access by the year 2022, the Ministry of Energy identified inadequate financing as a major barrier to achieving this goal. This study analyses electricity sector value chain in exploring the financing options. The value chain components include: electricity supply (generation), electricity transportation (transmission and distribution) and demand/customers. Some of the threats to financing electricity generation include land issues such as compensation and ownership disputes that delay project implementation, and intermittency of weather patterns especially for hydroelectricity, solar and wind that affect the stability of electricity capacity produced. The challenges to electricity transportation are poor grid systems, while the challenges in demand include tariff settings. These threats increase risk and reduce investor confidence. Untapped generation potential, cheap decentralized energy solutions, increasing demand, and supportive government policies and incentives are opportunities that encourage financing in the sector. The study proposes various financial options that Kenya could use to fill the financial gap. For electricity generation, Power Purchasing Agreements (PPAs) with local currency, adoption of the auction system, and more local financing for investment into electricity projects are options suggested. For electricity transport, the study proposes long concessions such as private management of government entities to improve on management and service delivery, Merchant line model and Build Own Operate and Transfer (BOOT) model. Finally, for the customers, net metering, wheeling and corporate PPAs are suggested. To facilitate some of the proposed financial options, the development of policy and legislative framework is critical especially for net metering, wheeling, PPAs and wayleave acquisition. Other policy recommendations include having balanced renegotiations for PPAs and putting in place incentives and programmes to further boost local financing, such as institutional investors (e.g. insurance companies and pension funds).

Abbreviations and Acronyms

AFD	Agence Française de Développement
AfDB	Africa Development Bank
EIB	European Investment Bank
EU	European Union
EPC	Engineering, Procurement and Construction
EPPs	Emergency Power Producers
EPRA	Energy and Petroleum Regulatory Authority
FDI	Foreign Direct Investment
FiTs	Feed-in-Tariffs
GDC	Geothermal Development Corporation
GoK	Government of Kenya
IEA	International Energy Agency
IPPs	Independent Power Producers
JICA	Japan International Cooperation Agency
KenGen	Kenya Electricity Generating Company
KETRACO	Kenya Electricity Transmission Company
KNES	Kenya National Electrification Strategy
KPLC	Kenya Power and Lighting Company
KOSAP	Kenya Off-grid Solar Access Programme
LAPSSET	Lamu Port-South Sudan-Ethiopia Transport Corridor
LTWP	Lake Turkana Wind Power
LMCP	Last Mile Connectivity Programme
MIGA	Multilateral Investment Guarantee Agency
MTP	Medium-Term Plan
MoE	Ministry of Energy
NuPEA	Nuclear Power and Energy Agency
PPA	Power Purchasing Agreements
PPP	Public Private Partnership
REREC	Rural Electrification and Renewable Energy Corporation
RE	Renewable Energy
SREP	Scaling Up Renewable Energy Programme
SDG	Sustainable Development Goal
SHS	Solar Home System
SREP	Scaling up Renewable Energy Programme
SSA	Sub-Saharan Africa
UN	United Nations
USAID	United States Agency for International Development
V2030	Vision 2030
WARMA	Water Resources Management Authority
WB	World Bank

Table of Contents

List of Tables

List of Figures

1. Introduction

1.1. Background and Problem Statement

Electricity is a vital component for economic development, mainly because of its interlinkages with various socio-economical activities and the environment. Electricity is also key in poverty eradication, the improvement of livelihoods and addressing climate change. In Sub-Saharan Africa (SSA), access to affordable and reliable electricity is still a challenge. The electricity access rate in SSA is at 47 per cent, with the rural electrification access rate being 27 per cent, according to the energy progress report 2020 (IEA et al., 2020). By 2030, it is estimated that about 665 million people in SSA will not have electricity (IEA, 2014). This presents a major barrier in the path of economic development, and thus extending the vicious poverty cycle in the region. The recognition of the importance of electricity access extends globally, with the United Nations (UN) having a target of electricity access to all by the year 2030, as stated in Sustainable Development Goal (SDG) 7. Magnification of energy access has positive synergies with 10 of the 17 SDGs (UN, 2015; Schwerhoff and Sy, 2016). To fast-track the attainment of universal electricity access, the UN's Sustainable Energy for All (SE4All) initiative strives towards universal energy access, more renewable energy and better energy efficiency (SE4All, 2021). Currently, 44 African countries have joined the initiative. The African Union also recognizes energy as a priority area in its development strategy - The African Union Agenda 2063.

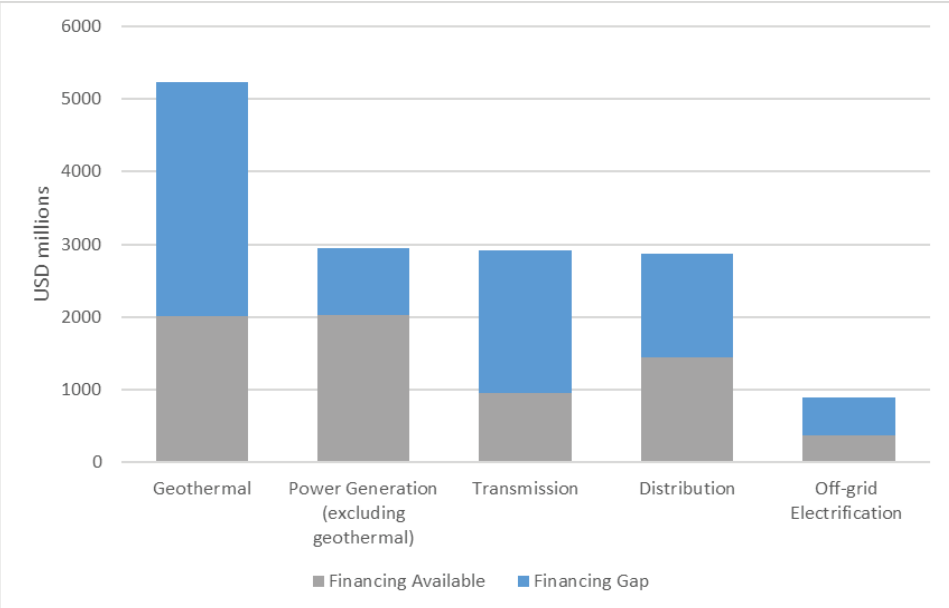
Despite the overall rating for the SSA region being below 50 per cent, South Africa and Kenya have electricity access rates of 91 per cent and 75 per cent, respectively. Kenya has a much better rating compared to her neighbours: Uganda (43%), Tanzania (36%), Rwanda (35%), Ethiopia (45%) and South Sudan (28%) (IEA, et al., 2020). Kenya's urban electricity access rate is at 84 per cent and the rural rate is 72 per cent. This good rating can be attributed to the intense efforts, by the Government of Kenya (GoK) and stakeholders in coming up with interventions aimed at scaling up electricity connectivity to Kenyans and generation over the recent years. Energy has been identified as a key enabler in realizing Kenya's development agenda – Vision 2030 (V2030). The V2030 (Government of Kenya, 2007) is Kenya's development outline that is implemented through 5-year Medium-Term Plans (MTPs) and seeks to make Kenya a middle-income industrialized country by the year 2030. The Government is currently implementing the MTP 3 (Big Four Agenda) that focuses on universal health, affordable housing, manufacturing, and food security and nutrition. The affordable housing targets to have 500,000 new affordable homes built by 2022. Manufacturing will raise the national GDP to 22 per cent by 2022. Food security and universal healthcare will have a positive impact on the health and socio-economic aspect of Kenyans. The success of the "Big Four" agenda heavily relies on adequate supply of affordable electricity. Due to this, the government has put forward several initiatives to improve electricity access and affordability. Some of these initiatives and polices include: Scaling up Renewable Energy Programme (SREP), Energy Act 2019, electrification for all public primary schools, the Rural Electrification Programme, Kenya Off-grid Solar Access Programme (KOSAP), the Last Mile Connectivity Programme (LMCP), Kenya National Electrification Strategy (KNES), among others.

The KNES, developed in partnership with the World Bank, was launched by the Ministry of Energy (MoE) in 2018. The strategy is a roadmap for Kenya to reach universal electrification by 2022. Even with all these initiatives, Kenya electricity access rate is still at 75 per cent against its target of 100 per cent by the year 2022. One of the key attributes to the deficit is the lack of finance in the electricity sector, as highlighted in the KNES (Ministry of Energy, 2018). Appropriate financing of electricity projects can result to lower cost and tariffs, improved affordability, increased demand and higher access rates. Other factors that affect electricity accessibility and affordability include urbanization, rapid population growth, and changes than alternate demand patterns and markets, such as inflation (Gertler et al., 2017). The current high electricity costs and supply demand imbalance are linked to the tariff rates in the existing Power Purchasing Agreements (PPAs) and delays in full implementation of government development projects such as the Lamu Port-South Sudan-Ethiopia Transport Corridor (LAPSSET), Standard Gauge Railway (SGR) electrification and the "Big Four" agenda that slows down electricity demand growth (Nderitu et al., 2020). To address the high cost of electricity in Kenya, the President of Kenya appointed a taskforce in March 2021 to review the electricity sector with an aim of lowering cost (*Business Daily*, 20211a). The COVID -19 pandemic has also had a negative impact on the sector, with global energy investments declining by 34 per cent within the first half of 2020 (IRENA and CPI, 2020).

Among the challenges delaying the achievement of universal access listed in KNES is inadequate incentives to attract private investors, hence the financing constraints. The high cost of grid extension and energy infrastructure *vis a vis* the low revenue generated due to low demand in rural areas slows the electricity access rate in developing countries (Williams et al., 2015). The Electricity Sector Investment Prospectus 2018-2022 (Ministry of Energy, 2018) also launched alongside the KNES estimates the total investment cost for the period 2018-2022 for all energy projects in the MTP III pipeline as US$ 14.8 billion based on electricity demand forecast. The main areas of investment are geothermal, power generation (excluding geothermal), transmission, distribution and off-grid electrification. The financing gap requires US$ 8 billion, which takes up over

50 per cent of the total investment needed. This gap is spread across the various areas of investment in the energy sector as seen in Figure 1.1. With an adequately filled financial gap, the expectation would be that all Kenyans would have access to reliable and affordable electricity. Therefore, Kenya would achieve universal electricity access.

Figure 1.1: Total electricity sector investment (2018-2022) by sub-sector



Source: Ministry of Energy (2018), The Electricity Sector Investment Prospectus 2018-2022

Most studies on the electricity sector and finance look into finance sources, risks, financial actors, models and instruments but few address financing in Kenya's electricity sector value chain within the Kenya Vision 2030. Among the key concerns within Kenya's electricity sector currently are the high cost of electricity compared to neighbouring countries and likelihood of having excess energy generated in relation to short-term demand (Government of Kenya, 2018). Of greater concern is still the continued drive to increase generation capacity through development of large energy projects despite the current demand levels. The challenges facing universal electricity access revolve are issues regarding security, environmental sustainability and costs, also referred to as the energy trilemma (Ojiambo et al., 2020). To attain universal electricity access, paramount electricity projects need adequate financing that balances the investors' incentives, interests of energy sector players, climate change concerns and affordability and reliability for the end-consumers. With Kenya's rising debt levels, the COVID-19 impact, the SDGs, development agendas and the the ambition to achieve universal electricity access, a study looking into Kenya's electricity sector value chain and financing seems fitting.

This paper seeks to explore financing options along the electricity sector value chain in addressing the existing financing gaps that are constraining achieving universal access.

1.2 Objectives

The overall objective of the study is to explore financing options for the electricity sector along the value chain. Specifically, the study aims to:

- Analyse characteristics of the electricity sector value chain in identifying specific challenges and opportunities for closing the financing gap.
- Explore potential financing options that Kenya can use along the value chain, drawing examples from experiences of other countries.
- Examine the existing policy framework for its appropriateness in implementing potential financing options.

2. Overview of Kenya's Electricity Sector and Financing

The Sessional Paper No. 10 (1965), the Electricity Power Act (Cap 314) (1972, revised 1986), the National Energy Policy and Investment Plan (1984) and other policies prior to 1984 were used for energy regulation, resource management, distribution, generation and development. However, they were weak on environmental, technological and consumer involvement and interest (KIPPRA, 2007). The enactment of the Restrictive Trade Practices, Monopolies, and Price Control Act in 1989 opened the economy, allowing for more competition and private sector participation in sectors such as energy and trade. Following this, Kenya Power and Lighting Company (KPLC) in the 1990s was authorized to change tariffs. In 1996, power generation was formally liberalized by the Government of Kenya. Afterwards, the electricity sector continued to evolve, and more players (public and private) became part of it following the enactment of the Electric Power Act No. 11 of 1997. This facilitated the establishment of the Electricity Regulatory Board (ERB) and Kenya Generation Compmany (KenGen). The creation of Geothermal Development Corporation (GDC) and Kenya Electricity Transmission Company (KETRACO) was provided for in Sessional Paper No 4 of 2004 on energy (Government of Kenya, 2004). This paper endorsed the liberalization of the electricity sector. It is a policy framework covering the period 2004 to 2023 and aims at providing affordable and quality electricity to Kenyans.

The Energy Act (2006) brought reforms and saw the establishment of various bodies charged with various tasks in the energy sector dealing with generation, regulation, transmission, distribution and supply (Government of Kenya, 2006). The Sessional Paper No. 4 of 2004 was the basis of this Act. The Electricity Regulatory Board became the Energy Regulatory Commission (ERC). This Act allowed for the formation of the Rural Electrification Authority (REA), and the Energy Tribunal. The role of REA was to fasten rural electrification. A Rural Electrification Plan was therefore developed. It is updated annually and has three phases: 2008-2012,2013-2022 and 2022-2030. The goal is to have 100 per cent connectivity by 2030. The Geothermal Development Corporation (GDC) was formed in 2008. This Act was later revised to align with electricity laws with the Constitution of Kenya 2010. This enabled the integration of county and national energy plans. The amended version was signed in 2019 and is now the Energy Act 2019 (Government of Kenya, 2019). It consolidated and expanded the mandates of different entities. The ERC became Energy and Petroleum Regulatory Authority (EPRA), the Kenya Nuclear Electricity Board (KNEB) changed to Nuclear Power and Energy Agency (NuPEA), REA to Rural Electrification and Renewable Energy Corporation (REREC), and the Energy Tribunal to the Energy and Petroleum tribunal. The Renewable Energy Resource Advisory Committee and consolidated energy fund were also established. The National Energy and Petroleum Policy (2015) was used as a basis for the Energy Act 2019. The policy specifies the county and national government roles with regard to energy planning and development.

The Feed-in-Tariffs (FiTs) policy in Kenya became effective in 2008 following approval by the Public Procurement Oversight Authority. It included biomass, wind and small hydro power plants with capacity limits of 10MW, 50MW and 40MW, respectively. The policy was later reviewed and revised to include solar PV, biogas and geothermal. The revised version was published in 2012 (Government of Kenya, 2012). The publication incudes rules on connection and standardized Power Purchasing Agreements (PPAs). This policy assures market and returns for investors looking to venture into identified renewable energy sources - wind (0.5 MW-100 MW), biomass (0.5-100 MW), biogas (0.5-40 MW), solar PV (0.5-10 MW), small hydro (0.5-10 MW) and geothermal (up to 70 MW). The Solar Photovoltaics Systems Regulations (Government of Kenya, 2012) help in regulating the solar market by dictating guidelines for licensing vendors, technicians, importers and manufacturers of these systems. There is also the Renewable Energy Auctions Policy (Government of Kenya, 2021) that aims to promote Kenya's renewable energy generation.

Kenya's Public Private Partnerships Act was enacted in 2013 (Government of Kenya, 2013). Under this Act, a Public Private Partnership (PPP) is defined as an arrangement in which a private party performs a public function and is compensated using public funds, fees collected from the use of the service provided or a combination of both. Private, in this case, refers to non-government. The Act stipulates the procedures to be followed for a PPP to be lawful. The PPP Unit, Committee and the Cabinet are involved in the approval of projects. Various energy projects have been done through the PPP scheme by IPPs since 1996. The Act provides regulatory, legal and institutional frameworks for private sector engagement in energy sector development. Table 2.1 shows the PPP energy projects in the pipeline. There is also a standardized PPA for systems below 10MW capacity.

Table 2.1: PPP energy projects in the pipeline in Kenya

PPP energy Project	Stage	Contracting Authority	Value (Ksh/US$ millions)	Status last updated on
35MW Menengai Phase I (Sosian)	Post-procurement	GDC	Ksh 8,009.98 - US$ 79.15	21/04/2020

Menengai 35MW Geothermal Energy Project (Quantum)	Post-procurement	GDC	Ksh 8,009.98 - US$ 79.15	12/06/2018
140MW Geothermal PPP project at Olkaria	Procurement	KenGen	Ksh 64,113.6 - US$ 637.3	12/06/2018
The Transmission Grid Expansion Programme	Pre-procurement	KETRACO	Ksh 44,492.3 - US$ 434.92	10/06/2018
1,050MW Lamu Coal-Fired Power Plant Project	Post-procurement	Ministry of Energy	Ksh 182,750.1 - US$ 1833	10/06/2018

Source: Public Private Partnership (PPP) Unit Website, National Treasury, Kenya (extracted in March 2021)

Least Cost Development Plan 2017-2037 (Government of Kenya, 2018) is a 20-year energy development plan. It is a merger of the updated version of the 2015-2035 Electricity Sector Masterplan and the FiT, focusing on the "Big Four" agenda. It was done through collaborative effort of multiple energy sector players, with the Ministry of Energy providing policy guidance. The plan contains load forecasts, generation and transmission planning and recommendations moving forward to enable the fast tracking of the Kenya Vision 2030. Assessments of energy resources and investments costs, population growth scenarios, implications of climate change and losses during transmission are also considered in this plan.

In Kenya, the electricity sector is under the Ministry of Energy and Petroleum. There are several entities within the sector that are involved with electricity at different levels. With the passing of the Energy Act 2019 (Government of Kenya, 2019), there were adjustments of roles for some and introduction of new ones.

The Ministry of Energy steers the sector and comes up with policies since its formation in 1979. The policies are meant to create an enabling environment for all stakeholders, planning and resource mobilization. The Energy and Petroleum Tribunal handles appeals and disputes within the sector. The Energy and Petroleum Regulatory Authority (EPRA) regulates, monitors, provides approvals, customer education and promotes fair competitiveness in the sector. It started off as the Electricity Regulatory Board following the updating of the Electrical Power Act in 1997. It then transformed into Energy Regulatory Commission (ERC) and later EPRA following the enactment of the Energy Act (2006) and Energy Act (2019), respectively. KenGen, partially owned by the government (70%) and the remaining shares owned by the public, is mandated to generate electricity. It was initially the Kenya Power Company (KPC). The GDC is a state corporation that develops geothermal resources, drills for steam, avails steam to power plant developers, manages geothermal reservoirs and promotes other use of geothermal resources. The Nuclear Power and Energy Agency (NuPEA), formerly the KNEB, is responsible for promoting and implementing Kenya's Nuclear Power Programme, carrying out research and development for the energy sector. NuPEA does this by policy development and legislation, carrying out public awareness programmes, site identification and research. KPLC/Kenya Power in the main off-taker. An off taker is a buyer of electricity with the intention of selling it to customers (Government of Kenya, 2012). Majority of Kenya's electricity transmission and distribution systems are owned and operated by KPLC. As of June 2020, over 7.5 million customers buy electricity from Kenya Power and Lighting Company (KPLC). KETRACO plans, designs, builds, owns, operates and maintains Kenya's high voltage electricity transmission grid and facilitates regional power trade. The Rural Electrification and Renewable Energy Corporation (REREC), formerly REA, oversees the implementation of the Rural Electrification Programme and renewable energy promotion. With the enactment of the Energy Act (Government of Kenya, 2019), County governments are also key players in the electricity sector as they now collaborate with the National government in the formation and implementations of energy plans. The private sector is also a key player in the sector. Private sector players who own and operate power producing companies are called Independent Power Producers (IPPs). Emergency Power Producers (EPPs) are companies that sell power to stabilize power supply to the grid. However, the last existing EPPs contracts in Kenya were terminated in 2016 as seen in appendix 1. The other private sector players are private mini-grid developers (<100kW) and Solar Home System (SHS) companies. SHS are stand-alone systems that produce electricity for appliances and lighting. They are mostly used in off-grid, rural and remote areas. Figure 2.2. shows a map of Kenya's energy sector players.

The financing of public energy projects has been done by the Government of Kenya, foreign governments, development partners and the private sector. Examples of development partners include the World Bank (WB), Africa Development Bank (AfDB), Japan International Cooperation Agency (JICA), European Investment Bank (EIB), Agence Française de Développement (AFD), United States Agency for International Development (USAID), Department for International Development (DfID), China Exim Bank, European Union (EU) and

German KfW. Investment support has been mainly in form of grants and loans in the generation, transmission, distribution and off-grid electrification areas of electricity. Over US$ 3 billion in form of grants and loans has been invested into generation projects and US$ 770 million in the Government's last mile project by donors (World Bank, 2019). Britta and Chigozie (2020) explore the financing of LTWP as an example of energy financing of projects. Equity (€125 million) and debt (€496 million) financing structures were used. Under equity, the investors were: KP&P Africa B.V., Aldwych Turkana Limited, Vestas Eastern Africa Ltd, IFU-Danish Development Bank, Norfund, Finnfund and Sandpiper. Those in debt were African Development Bank (AfDB), European Investment Bank (EIB), Eksport Kredit Fonden of Denmark (EKF), Netherlands Development Finance Company (FMO), EU Africa Infrastructure Trust Fund (EU-AITF), PROPARCO, Trade and Development Bank (TDB), formerly the PTA Bank, East African Development Bank (EADB), Interact Climate Change Facility (ICCF) and Triodos Bank. The Kenyan government has issued 17 outstanding infrastructure bonds as at mid-2020 to help finance projects (Government of Kenya, 2020). Table 2.2 shows an example of an electricity project with its types of investors, actors and amounts for the Baringo-Silali geothermal project in Kenya.

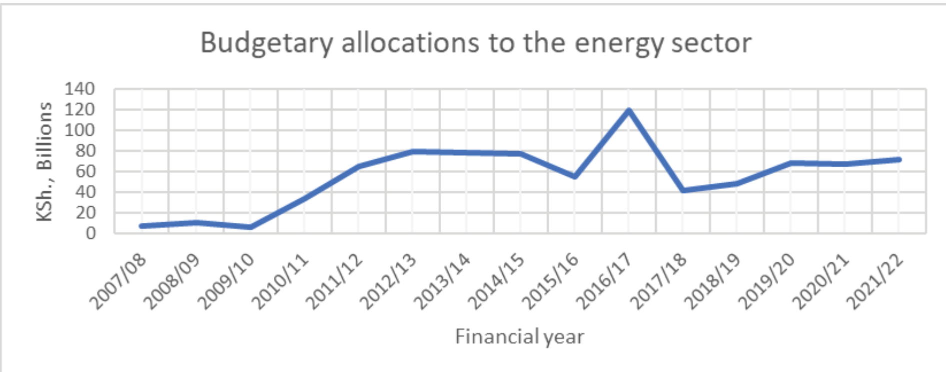
Table 2.2: The types of investors, actors and amounts for the Baringo-Silali geothermal project

Capital Investment	Name of	Types of	Country of Origin	Sum of Invested capital
	Capital/Grant Providers			
Equity	GDC	Government	Kenya	€17.4 million
Debt	German Development Agency (KfW)	Development Finance	Germany	€80 million
Grant	African Union Commission (AUC) through the Geothermal Risk Mitigation Facility (GRMF)	Green Finance	Africa	US$17.3 million

Source: Britta and Chigozie (2020)

Most electricity developments require financial planning as infrastructure projects are generally expensive to develop. In all the MTPs, there were indicative budgets to the electricity projects. The estimated totals were Ksh 112 trillion, Ksh 4.113 quintillion and Ksh. 1.5964 quintillion in MTPs 1, 2 and 3, respectively. To execute these plans, the Government of Kenya has had annual budgetary allocations towards the electricity sector to facilitate development. The annual energy sector budget allocation was Ksh 8 billion in 2008, Ksh 65.7 billion in 2012, Ksh 120.2 billion in 2017 and Ksh 67.8 billion in 2020. Figure 2.1 and Appendix 2 show the budgetary allocations to the electricity sector annually from 2007. There is an overall rise in energy expenditure by the government, with the energy budgets only decreasing in 4 out of the 14 financial years. The 2016-17 financial year had the highest sector budgetary allocation of Ksh 120.2 billion. The actual total budget allocations during the MTPs were lower compared to the estimated budgets in the MTPs. The tentative totals are Ksh 198 billion, Ksh 373 billion and currently at Ksh 257 billion for MTPs 1, 2 and 3, respectively (Government of Kenya, 2018). The high difference between the estimated and actual budgets allocations echo the challenges of financing in the electricity sector.

Figure 2.1: Budget allocations to the energy sector



Source: Government of Kenya (Various), Annual financial budget statements (Government of Kenya, 2007-2021)

Continued financial investments into the electricity sector has resulted into numerous positive results. Firstly, Kenya's total installed capacity has been on the rise significantly. Appendix 3 shows the trend of Kenya's total installed capacity for over a decade since the year 2008, currently standing at 2840 MW against a peak demand of 1926 MW (KPLC, 2021). Geothermal is the leading source of electricity, providing 30 per cent of the total installed capacity. Secondly, the total circuit length of the transmission and distribution lines has expanded from 40,274 kilometres (km) in 2008 to 243,207 km in 2020 (Appendix 4). Also, there has been an additional average of 542,890 new customers annually from the year 2008 to 2020. In the year 2020, there were a total of 7,576,145 customers. The increase in customers translated to an increase on sales (as seen in Appendix 5 and 6) with commercial and industrial customers buy the most electricity from the off-taker. These and other improvements in the electricity sector were implemented by investments.

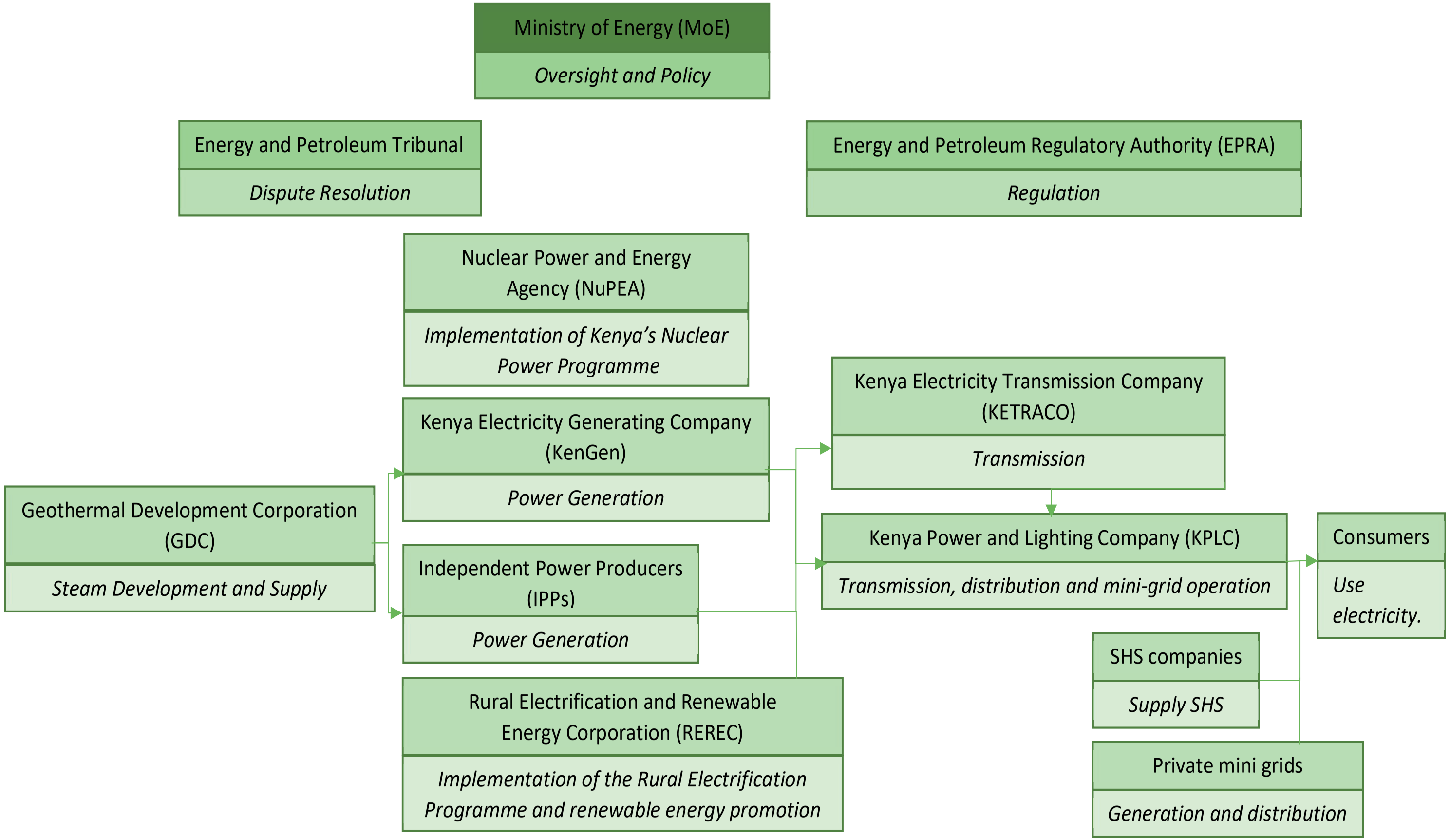
The Kenya Electricity Sector Investments Prospectus 2018-2022 identifies the types of finance and financing models in Kenya's electricity sector. Financing in Kenya's electricity sector can be categorized into three: private, Government of Kenya, and development partners and engineering, procurement, and construction (EPC)-financing. Private finance are funds from non-government actors for fully private or PPP projects. These are mostly in generation and electrification, represented by the IPPs, private mini grids and SHS companies. EPC-financing is where a contractor is financially supported by his or her government or state- owned financial institution. It also be called government to government financing. The models are: PPPs, private models, balance-sheet financing, EPC-financing, public from the Government of Kenya and concessional financing from development agencies. Table 2.3 shows the models used in the electricity sector. Public, concessional and EPC financing models have been used to fund projects in all the electricity sectors. Concessional financing is done by DFIs. Balance sheet financing in this case refers to issuance of bonds and taking debt by electricity parastatals. It has not been implemented in the transmission and off-grid sector. The PPP model is only absent in the distribution sector. Solely private models have only been used in the off-grid electrification sector. This has been done by IPPs setting up SHSs and mini-grids without solicited government proposals (Ministry of Energy, 2018).

Table 2.3: Financing models and electricity sectors

	Financing models					
Sectors	**Public**	**Concessional**	**EPC-Financing**	**Balance-sheet financing**	**PPPs**	**Private**
Geothermal	*	*	*	*	*	
Power Generation (excluding geothermal)	*	*	*	*	*	
Transmission	*	*	*		*	
Distribution	*	*	*	*		
Off-grid Electrification	*	*	*		*	*
	*	Financing model implemented				
		Financing model NOT implemented				

Source: Ministry of Energy (2018), The Electricity Sector Investment Prospectus 2018-2020

Figure 2.2:Kenya's electricity sector's stakeholder map



Source: Ministry of Energy (2018), The Electricity Sector Investment Prospectus 2018-2020

3. Literature Review

3.1 Theoretical Review

Theory for diverse energy generation sources and financing

The modern portfolio theory is used to study the selection of financial portfolio assets considering the relationship between risk and returns (Markowitz, 1952). The theory assumes that investors prefer a less risky portfolio than riskier ones when both have the same returns. Diversification of portfolios may help with the spread of risk, increase returns and reduce negative effects form shocks. Some studies have applied this theory in the energy sector (Cucchiella et al., 2016; Pérez Odeh et al., 2018; Marrero et al., 2015). The theory has also been used as a tool for investment decision making in energy planning. Ojiambo and Tsuyoshi (2020) applied this theory to study Kenya's electricity generation portfolio. They conclude that Kenya's portfolio on energy generation sources is not optimal and recommend diversification to lower power costs and be more environmentally friendly.

Theories for financing energy projects

Various theories can be used to explain consolidation of finance by firms to meet operational costs and acquire assets. Joseph Schumpeter highlights the importance of finance to organizations and their business cycles in the theory of economic development. He focuses on banks as sources of finance for investment in form of credit over savings from income. Schumpeter's theory argues that the role of money is to ease the spread of commodities. Innovations and risks are factors that may lead to the quest for different investment horizons for firms seeking development (Schumpeter, 1983). Transactional cost theory explains the collaborative relationship of parties that are jointly carrying out a transaction, usually in monetary or non-monetary terms (David et al., 2004). Risk factor, opportunism, rationality and uniqueness of assets can cause these parties to come together. Arnold and Kehl (2010) adopt this theory as they explore Germany's public private partnerships (PPPs) that are mainly used for financing infrastructure development. PPP arrangements are made to acquire finance for transactional costs from the private sector and spread risk between the partners.

3.2 Empirical Review

Lack of adequate finance is a key barrier to universal electricity access in African countries, despite them being richly endowed with energy resources. The continent's annual financing gap is between US$ 33 billion to US$ 47 billion in energy investment and infrastructure (IRENA and CPI, 2020). For the region to have universal electricity access by 2030, the annual electricity generation capacity growth needs to increase from 2 per cent to 13 per cent (Johnson et al., 2017; Gujba et al., 2012). Despite numerous investments such as the World Bank spending close to US$ 62.5 billion in the region since 1951, more needs to be done to improve electricity access (Blimpo et al., 2019). Since financing is mostly done through governments and governments tend to lean towards large scale on-grid projects, small-scale projects in rural areas are usually left neglected. Small scale energy financing has received less than 5 per cent of energy project funds through the World Bank and other Multilateral Finance Institutions - MFIs (Hemen et al., 2021).

The annual US$ 47 billion needed to achieve universal electricity access by 2030 in SSA amounts up to about 45 per cent of the annual tax returns in SSA. A large percentage of these taxes is used for recurrent government expenditure and loan repayments (Johnson et al., 2017; World Bank, 2018). Therefore, taxes alone cannot finance universal electricity access. Eberhard and Shkaratan (2012) interrogate the reasons why African energy utilities are unable to independently come up with finances and find the reasons being their low retail tariff rates and inability of some customers to pay. Most capital markets and banks in SSA are unable to fully finance the development of electricity infrastructure as they are not advanced (IFC, 2016). International and private investments are therefore needed to fill this gap (Eberhard et al., 2016). To help overcome the inadequate finance barrier, various types of finance, models and finance actors have come into action over the years.

Financing can have either private or public actors and be from either domestic or foreign sources. Foreign Direct Investment (FDI) and foreign aid are common examples of foreign sources. Public actors consist of state actors such as State banks, utilities, corporations and agencies. Private actors can be energy firms, private utilities, industries, banks, institutional investors, donors and charities/non-profits (Mazzucato et al., 2018). Gregor et al (2016) highlight the major roles of development finance institutions (DFIs) and climate funds as financial actors active in the existing effort to finance energy projects and the financial instruments used. Financial instruments include subsidized forms of borrowing such as concessional loans, green bonds and PPPs and non-subsidized forms such as hard loans, asset-backed securities and equity finance. The financial sources can also be either private, domestic, bilateral or multilateral. Project finance has non-limited or limited resource structures availed through special-purpose vehicles (SPVs) and repayments are limited to profits earned. SPVs are project companies with multiple shareholders, public and/or private. The other form is corporate finance. Gujba et al (2012) investigate on the financing and development of low carbon energy access in Africa. Using a desktop approach, they assess the various financial instruments and funds that can be used in Africa specific to low carbon developments (clean power). They give examples of the Clean Technology Fund (CTF), Scaling Up Renewable Energy in Low Income Countries Programme (SREP) and Sustainable Energy Fund for Africa (SEFA). Programmes such as the Clean Development Mechanism (CDM) are also meant to encourage building and financing of renewable power. Chirambo (2018) unveils the synergies between the Power Africa, SE4All and climate finance aimed at the achievement of SDG 7 in SSA. The Power Africa initiative and SE4All work hand-in-hand and complement each other. The SE4All's framework consists of undertaking a Rapid Assessment and Gap Analysis (RAGA), followed by presenting an Action Agenda and lastly preparing an investment prospectus. The Power Africa is more project based, focusing on identification, financing, environment, development and completion. He concludes by recommending renewable energy focused development banks and mechanisms to be established, effective monitoring of use of climate funds in the energy sector and creating linkages between rural electrification and economic activities such as the linkages of electrification with agriculture and irrigation in Vietnam. Chirambo (2016) suggests the establishment of funds consolidated from environmental taxes to promote the development of renewable energy (RE). The environmental tax are taxes on activities that negatively impact the environment. Examples may include: China's Carbon Credit Tax, Ghana's plastic packaging materials and products tax, vehicle carbon tax in Zimbabwe and carbon emissions tax in South Africa.

Over the years, there have been shifts in the major investment trends and direction in the electricity sector. Climate concerns, SDGs, promotion of specific types of technologies and renewable energy are some reasons behind these shifts in financing. Mazzucato and Semienuk (2018) focus on the direction of investments that may result in some energy areas being over- or under-financed. They imply that finance type and directionality influence the direction of energy innovations. Focus on the relationship between directionality and finance is important because it can lead to widening of the energy portfolio and diversifying the energy supply. This, in turn, ensures spread of risk and energy security. Risk appetite, public policies, technology type and the nature of the financial actor influence the choice of where to invest. Polzin et al. (2019) state that an investor's decision to finance a project takes an investment risk and/or returns approach. Ghosh and Nanda (2010) state that the direction of investments and the financial actors in the energy sector is dependent on the capital-intensity and risk of the associated technologies. Ojiambo and Tsuyoshi (2020) recommend direction of finance to be portfolio based to reduced portfolio risk, diversify the energy sector and improve energy security in Kenya. As the world moves to make the energy transition, more challenges in financing arise. Renewable energy (RE) projects usually have high initial investments and lower costs later. This is compared to the lower initial investments of non-renewables such as fossil fuels, and higher operational costs (UNDP, 2013; Collier et al., 2012). For example, solar farms located in remote arid areas incur transportation costs and construction of long distribution lines for power evacuation before commencing operations. Therefore, potential RE investors face a higher risk of projects success at the initial stages, and that may influence where to direct their finances. The decreasing cost of off-grid RE technologies, especially solar photovoltaics (PV), has led to the rapid increase in off-grid electricity start-ups and scaling up of solar energy in SSA. It is spread into SSA's rural areas is fast due to the low initial costs, low risk potential, energy demand aggregation and mobile-enabled pay-as-you-go financing schemes (Rolffs et al., 2015). To improve energy access in rural areas in SSA, Hemen et al. (2021) propose inclusion of community-based organizations such as unions in hybrid energy financing that are private-sector led and distributed as opposed to the common government-led, project-based and large-scale.

Africa's full energy potential remains unexploited because potential low returns, long term nature and complex risk structures linked to energy projects. This, in turn, makes the projects unattractive to finance. Risks are defined as unforeseeable factors that may have a negative impact on investment outcomes (Bessis, 2015). Risks in the energy sector can be broadly categorized into market, country and technology risks (Mazzucato et al., 2018; Torvanger et al., 2016). The UNDP (2013) breaks down country specific risks in the cases of Kenya and South Africa as being governance related, political, macroeconomic and financial sector related. Governance related risks are the most dominant in the African energy sector (Baker, 2013). Gregory and Sovacool (2019a) analyse risk in the East Africa region focusing on Kenya, Mozambique and Tanzania. They systematically review literature and group risks using two approaches. The bottom-up approach, that has risks categorized into three: micro (project specific), meso (country specific) and macro (global dynamics specific), and the linear approach that looks at risks at different phases: planning, construction, operation and stakeholder risk. Construction and planning risks are moderate risks, whereas planning, operating, meso and macro are high degree risks. Gregory and Sovacool (2019b) also investigate the cause of energy poverty in SSA from the angles of governance and its impact on investments. They analyze governance in three perspectives: financial investment, political and technological. Financial investment governance deals with the investment environment and the presence or absence of rules and institutions that affect it. Examples include uncertain property rights, huge planning costs, reallocation of projects ownership or control, ownership restrictions, unstable exchange rates and monopoly control of electricity supply. Political governance risks look at the impact on investment by how governments govern. Here, issues of risks of policy fluidity and 'rent seeking' by the political class arise. Lastly, technological governance covers governance within the electricity delivery side and its effects on investments. Under technological governance, matters of concern may be: expensive electricity services, operational challenges, utility insolvency and subsidy dependence. Budzianowski et al. (2018) add theft or vandalism of electricity infrastructure and socio-cultural risks such as traditional beliefs against certain energy technologies as risks that may scare away investors. Pueyo (2018) uses Green Investment Diagnostics to identify energy investment constrains in Kenya and Ghana. Other than the already mentioned risks, she adds off-taker and resource and technology risks to the categories of risks. Off-taker risks are linked to the purchaser of electricity and its performance, liquidity, credit and financial structure. The findings show that Ghana has more constrains to investment than Kenya. Kenya's risks are low demand, land property issues, lack of grid infrastructure in some areas, governance and social risks. Over-reliance on hydro, unstable off-taker, macroeconomic and regulatory risks and costly domestic finance are some of the investments constrains in Ghana.

To lure private sector investment into the energy sector, stakeholders (mainly public) take up policy approaches to either increase returns, lower risk or combination - increase returns and lower risk - for investors (Probst et al., 2021). Risk management or de-risking is usually done with an overall goal to create a more suitable investment environment (Schmidt, 2014). De-risking can be in form of policies, institutions and incentives such as tax breaks, guarantees and sale of carbon credits used to address risks that foster financing energy access. De-risking measures can either be financial or policy-based at national and international levels. Flexible rules, increased transparency, robust policy design, political economy and distribution, institutional capacity building and guaranteed grid connection are examples of the policy de-risking measures. Under financial de-risking, we may have loan guarantees, policy risk insurance and preferential loans, interest rate subsidies, green bonds and Power Purchasing Agreements - PPAs (Steckel et al., 2018; Probst et al., 2021). Komendatova's (2011) examples of financial de-risking are: Public and Private Partnerships (PPPs) that help mitigate governance risks while raising capital, agencies that provide insurance against political risk such as Multilateral Investment Guarantee Agency (MIGA) and Feed-In-Tarrifs (FiTs) that guarantee sale of energy at a fixed price to the off-taker independent from the rules of supply and demand. Budzianowski et al., 2018) identify the FiTs and tenders (auctions) as common economic incentives used in Africa. The Power Sector Recovery Programme was launched in Nigeria by the World Bank with the aim of de-risking the sector and attracting private investment (World Bank, 2018). Using a multi-level approach to study institutional influence on power sector investment in both Kenya and Tanzania, Sergi et al. (2018) discover that Kenya's privatization of the energy sector and Tanzania's low regulation levels favour both on-grid and off-grid investments by reducing risks. Beizley (2015) and Bear (2017) critic privatization by saying it may result into under-investment in projects and/or over-pricing of electricity to gain more profits. Klagge and Nweke-Eze (2020) study the financing of RE projects in Kenya using case studies of Lake Turkana Wind Power (LTWP), Menengai geothermal and Baringo-Silali geothermal projects. They find that wind power has lower risk compared to geothermal power in the development phase. Provision of grid connection, PPAs or FiTs, transfer of risk to state utilities such as GDC, KETRACO and KenGen were some of the risk mitigation measures undertaken in these projects.

African countries, including Zambia, Uganda (2008) Kenya (2008, revised-2012), Rwanda (2011) and Tanzania (2009) have implemented the FiT scheme. FiTs are majorly used in solar and wind energy sources (Kazimierczul, 2019). Meyer (2013) evaluates the FiTs in African countries and concludes that they do not work well in most African countries because of low tariffs, implementation challenges and unsupportive institutional designs. Rickerson et al. (2013) attribute the slow growth of FiTs in developing countries to financial, technical and regulatory barriers. Pueyo (2018) suggests that simple replication of successful policies from one country to another is highly improbable to have the same results and hence a contributing factor to FiTs not being as successful in SSA. She proposes adoption or improvements on policies whose approach targets the needs and constraints of that specific country. In developed countries such as Germany and China, FiTs have been successfully implemented (Hoppmann, J., et al., 2014). The determination of rates, rate adjustments and effective stakeholder engagement during the formulation are the key determinants of the success or failure of FiTs. The FiTs in Ghana and Tanzania have not been successful with regard to RE and financing. (Sakah et al., 2017; Rickerson et al., 2013). The introduction of the Global Energy Transfer FiT (GET FiT) in Uganda led to a significant improvement in private investment and decline in power outages (Probst et al., 2021). A viable alternative to FiT is auctions with Brazil and South Africa dropping the FiT in preference for auctions. Just over 11 countries in SSA have adopted the auctions that majorly focus on solar, including Ghana, Ethiopia, Namibia, Zambia and Uganda (Kruger et al., 2016). Kenya might soon join this list because it has a draft RE auctions policy (Ministry of Energy, 2018). Kruger et al., (2019) compare and analyse developer-led and government-led approaches in auctions using South Africa and Zambia as case studies. The risks that hinder the optimal success of auctions are land ownership, permitting, site specific, technical, political and process-related risks. Bose and Sumit (2019) while assessing the e-reverse solar auction in India recommend strict enforcement of PPAs and safeguarding the market to protect it from sub-standard goods.

4. Methodology

4.1. Analytical Framework

This study employs the Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis and an exploratory approach across the electricity sector value chain. The analysis of the value chain is majorly used in businesses but has now been adopted and accepted in the energy sector management and research (Mwakubo et al., 2007, Chen et al., 2014, Jaber et al., 2015; Agyekum, 2020; Agyekum et al., 2020; and Kamran et al., 2020). The electricity value chain components are electricity supply, transport and consumption. Neimane (2001) when exploring development planning of electricity distribution network in Sweden finds that the electricity value chain features to be electricity generation, transmission and distribution and supply to the end customer. Close to similar categories are highlighted in Electricity Sector Investment Prospectus 2018-2022 (Ministry of Energy, 2018): geothermal, generation (without geothermal), transmission, distribution and off-grid electrification. This paper looks at the general categories of most value chains, including supply and demand. The supply-side covers generation and transportation of electricity. Under transportation is transmission and distribution. Transmission is electricity's delivery from generation sources to substations, and distribution refers to electricity transportation from substations to the customers. Electricity's end-customers will form the demand-side. Off-grid features in both demand and supply as it involves generation, transmission and consumption, all in one.

SWOT analysis is usually intended to identify internal and external factors that are advantageous and disadvantageous towards achieving the objectives of an organization or sector. The weaknesses and strengths are internal, while opportunities and threats are external. The results are then used to bring out the characteristics that would influence financing in the sector. We will analyse the electricity value chain to identify the strengths, weaknesses, opportunities and threats in each of the value chain categories (supply and demand). This will be done using a qualitative approach, investigating already existing literature such as government documents, strategic plans and other relevant literature. These results will be used to further identify the opportunities and threats towards financing in Kenya's electricity sector.

An exploratory approach is used to draw lessons from experiences of other countries on potential finance options that are applicable to filling the financing gaps. This is achieved through literature retrieved from governments, financial institutions, electricity sector players and stakeholders and practices in other countries.

Finally, on the appropriateness of the existing policy framework, this is aimed at enabling implementation of the potential financing options. This is achieved through accessing the current electricity and financing policies on whether or not they support the implementation of the suggested potential financing options.

5. Results and Discussions

5.1. SWOT Analysis of the Electricity Sector Value Chain

Strengths

Kenya's tactical location and favourable climate avails her good resource potential to harnessing renewable energy, especially solar and wind. The equatorial position facilitates ample insolation throughout the year, with potential daily 5-7 peak hours providing 4-6 kWh/m^2/day. Kajiado, Laikipia, Samburu and Marsabit are among the counties with great wind sites. They are part of the almost 90,000 square kilometres of areas possessing wind speeds of 6m/s and beyond. Approximately 10,000MW of geothermal energy has been estimated to be along the Rift Valley (Government of Kenya, 2018). Biomass also has a huge potential. Given the high dependence of Kenya's economy on agriculture, there is large availability of biomass resources. The vast area Kenya covers translates to land resources that can be used to set up electricity infrastructure. Government incentives, policies and an enabling environment for sector players have greatly contributed to the sector. Initiatives such as LMCP, REP and KOSAP and political commitment have led to an increase in electricity customers and generation capacity. For example, over 4 million households were connected to the electricity grid and there was an additional 568MW new power generation capacity during the period of MTP II (Government of Kenya, 2018). Polices such as the FiT have increased energy investments, leading to increased renewable energy generation capacity (Nderitu and Engola, 2020).

Weaknesses

The intermittent nature of weather patterns makes weather-dependant energy sources unreliable. This has, therefore, led to persistent use of fossil fuels and lower uptake of renewable energy sources. Fossil fuels negatively affect the environment by the large amounts of carbon emissions. Other forms of pollution, such as noise, are also witnessed. Environmental, social and land issues are major concerns within the sector. Habitats of animals, fish, birds and people's livelihoods have been disrupted in development and operation stages of electricity. The development stages are at times long and high risk. The Kinangop wind project was halted due to unresolved land issues (Eberhard et al., 2016). The same reason caused delays in connecting the LWTP to the grid by KETRACO. The proposed Lamu Coal Power plant received opposition from Lamu residents because of its unclean characteristics, causing the project to stall. The MTP III also identified wayleave acquisition and high construction cost as bottlenecks in infrastructure development (Government of Kenya, 2018). These and use of foreign investments result in high electricity costs as tariffs and PPAs are set with the intention of recovering the cost. High poverty levels influence customers' willingness and ability to pay for electricity. Over the past decade, the distributor has had annual system losses higher than the regulator's acceptable level of 15.9 per cent as seen in Table 3.1 (Government of Kenya, 2018). These losses are at times causes of the numerous power interruptions experienced by customers. EPRA's Statistics Report 2020 (2021) shows that reliability on Kenya's power supply power supply still needs improvement. The System Average Interruption Frequency Index (SAIFI) and Customer Average Interruption Duration Index (CAIDI) were at 1.98 and 4.37, respectively. These, compared to the international best practices of 1.0 for SAIFI and 2.5 for CAIDI, reflect poorly on Kenyan power supply. SAIFI is the ratio between the number of customer interruptions and total customers and CAIDI is the ratio of sum of interruption durations and total customers (EPRA,2021). Other causes of interruptions are power and equipment theft and vandalism (Boamah et al., 2021). Revenue losses resulting from such activities affect KPLC's operations. The high costs and frequent interruptions have led to lower customer confidence (KPLC, 2020). Bureaucracy and existing weaknesses in the policy frameworks, delayed project implementation and sector progress and untapped generation potential are other weaknesses. Others include long PPA processes and electricity connection periods, and overlapping roles in the sector. For example, both KenGen and the GDC are key players in geothermal development and dominance of one many affect the other. The enactment of the Energy Act (2019) and previous policies has opened the sectors to private players. However, their presence is still low, with the transmission and distribution dominated by government entities (KPLC and recently KETRACO). Adoption of complex technologies associated with energy sources such as nuclear and geothermal is hindered by barriers such as lack of skilled capacity and finances (Government of Kenya, 2018).

Table 4.1: System losses as % of total energy purchased

Period (year)	2007/ 08	2008/ 09	2009/ 10	2010/ 11	2011/ 12	2012/ 13	2013/ 14	2014/ 15	2015/ 16	2016/ 17	2017/ 18	2018/ 19	2019/ 20
Loss %	16.6	16.3	16	16.2	17.3	18.6	18.1	17.5	19.4	18.9	21	23.7	23.5

Source: KPLC (Various), Annual reports (2008 to 2020)

Opportunities

Research and Development (R&D) has delivered advancements in the various generation sources. Wind and solar generation have seen great evolution and now have more efficient and cheaper technologies. Global concerns on climate change have led to more awareness and international cooperation. Since energy is a major contributor, countries, international programmes and agendas have gained momentum in promoting clean energy development. The SREP has been funded by various development partners under the Climate Investments Funds (CIF). CIF seeks to promote reduction of greenhouse gases emissions and response to climate change. Support for clean energy and emerging technologies such as tidal energy and nuclear has also been on the rise. International cooperation also extends to generation, transmission and skills exchange. Kenya is a member of the East Africa Power pool and import and export power. As such, countries in the region share amenities such as the Kenya-Ethiopia 1,068km-long power transmission line. KenGen worn tenders to drill geothermal wells in Ethiopia and Djibouti in 2019 and 2021, respectively. There is projected gradual increase in both energy demand and supply over the coming years (Government of Kenya, 2018). This is because of implementation of development plans (such as increasing RE capacity, construction of affordable housing and industrial parks), increasing number of prosumers (customers who produce electricity), higher use of e-transport and the high rate of population growth and urbanization. Expansion of the electricity sector will enable more job creation along relevant value chains and spur economic growth.

Threats

Kenya's electricity sector has a low carbon footprint compared to other countries. In 2019, Kenya's net grid emissions was at 0.33 $kgCO_2/kWh$ (EPRA, 2021). Despite the low number, it is still a contribution to climate change. The effects (some of which are irreversible over short periods) are already occurring. Examples of such includes drastic weather patterns that destroy infrastructure and disrupt economies and livelihoods. These represent shocks in the sector. In 2018, the Patel Dam in Kenya burst following heavy floods. This disaster led to loss of lives and displacement of people. Inadequate rainfall patterns and inconsistent seasons have interrupted the operations of hydropower plants. The COVID-19 pandemic is also a shock that had ripple effects in the electricity sector. The imposed lockdowns and travel restrictions caused a drop in demand for goods, resulting to less production. The electricity sector shrunk by 0.5 per cent in 2020, partly caused by reduced energy demand by consumers - mainly industrial and commercial (KNBS, 2021). Fuel usage and the PPA terms make the electricity cost vulnerable to changes in international exchange rates and fuel prices. Red tape and high confidentiality associated with PPAs, complex processes and corruption within Kenya's electricity sector are other examples of threats. Cases of cost inflations, contractual irregularities and bribery were witnessed during the commissioning of the Turkwel Gorge Dam project (Hawley, 2003). Similar cases have been witnessed in distribution and transmission through taking brides to reconnect power, and irregular procurement of faulty transformers, for example. Hacking of power grids, rising terrorism threats and effects of technical malfunctions (such as tripping of generators and the Chernobyl disaster) are among the electricity sector safety concerns. Table 4.2 shows the strengths, weaknesses, opportunities and threats in Kenya's electricity sector value chain categories.

Table 4.2: Strengths, weaknesses, opportunities and threats in Kenya's electricity sector value chain

<table>
<tr><th></th><th colspan="2">Supply</th><th>Demand</th></tr>
<tr><td>Electricity:</td><td>Generation (including off-grid)</td><td>Transportation (networks)</td><td>Customers (including off-grid)</td></tr>
<tr><td rowspan="2">Strengths</td><td>• Geographical location and favourable climate
• Good resource and generation potential, including land resources
• Shorter construction/ installation periods for off grid solutions</td><td></td><td>• Cheaper decentralised energy solutions</td></tr>
<tr><td colspan="3">• Initiatives and political commitment
• Government incentives and policies</td></tr>
<tr><td rowspan="3">Weaknesses</td><td>• Presence of fossil fuels that emit GHGs
• Intermittency of weather patterns</td><td>• Public sector dominance
• Poor grid system
• Equipment vandalism and theft</td><td rowspan="2">• Frequent power interruptions
• Long waiting periods for electricity connection
• Low customer confidence
• Tariff setting and high electricity prices
• Unwillingness to pay for electricity
• Rise in prosumers -consumers who turn to self-producers, thus reduced revenues</td></tr>
<tr><td colspan="2">• High risk and long construction periods
• High construction costs and inadequate investments
• Bureaucracy that delay process like construction, grid connection periods and PPA processes
• Environmental, social and land issues</td></tr>
<tr><td colspan="3">• Weaknesses in policy frameworks-overlapping roles, inefficiencies in FiTs and PPAs
• Demand-supply imbalance
• Infiltration of sub-standard materials</td></tr>
<tr><td rowspan="2">Opportunities</td><td>• Adoption of new energy sources-nuclear and tidal</td><td></td><td></td></tr>
<tr><td colspan="3">• Research and development- cheaper and more efficient energy advancements
• Circular economy opportunities: e'g reuse and recycling of e-waste
• Increased global awareness on climate change
• International programmes and collaborations
• Increased demand and supply
• Job creation and expansion industries</td></tr>
<tr><td>Threats</td><td colspan="3">• Shocks. E.g: COVID-19, earthquakes and weather catastrophes
• E-waste mismanagement
• Change in political cycles and interruption of policies
• Safety concerns – insecurity, hacking of power grids and technical malfunctions
• Corruption and red tape-lack of transparency
• Susceptibility to oil prices and foreign exchange rate fluctuations</td></tr>
</table>

From the SWOT analysis of the value chain characteristics, various opportunities and challenges for financing can be identified. One opportunity for financing is the untapped generation potential due to Kenya's geographical resources, favourable climate and unexploited resources. Financing opportunities also arise in the renewable energy sources and off-grid solutions because they are cheaper and faster to construct and install and some are new with great potential (such as tidal energy). Due to the public sector dominance in transmission and distribution, private sector players could have an opportunity in gaining access to these sub-sectors. Political commitment, initiatives and government incentives boost investor confidence and hence increase financing prospects. As global issues and trends such as climate change, universal electricity access, e-mobility and the green and circular economies gain traction, the interest and opportunities to finance electricity projects associated with these issues also increase. With the implementation of the government's development plans, expansion of industries and job creation, industrialization, rapid urbanization and rising population, it is expected that demand and supply will increase. The same will go for financing opportunities.

Low confidence, unwillingness and the inability of customers paying for electricity may hinder financiers from investing due to fear of lack of return on capital. This is partly caused by the high prices of electricity. The growing trend of customers turning to self-producers is also a growing concern for those selling and financing electricity due to a decline in demand. Additionally, there has been low private sector presence in the transmission and distribution sub-sectors, among other challenges such as equipment vandalism and theft. Other challenges include land wayleave issues, high construction costs, corruption, weaknesses in policy frameworks, demand-supply imbalance and susceptibility to global oil prices and foreign exchange rates that increase risk for potential investors (Table 4.3).

Table 4.3: Kenya's electricity sector value chain opportunities and challenges for financing

	Supply		Demand
Electricity:	*Generation (including off-grid)*	*Transportation (networks)*	*Customers (including off-grid)*
Opportunities	• Exploitation of untapped generation potential, e.g: RE and off grid solutions • Adoption of new energy sources, e.g tidal energy	• More private sector involvement	• Cheaper decentralised energy solutions • Rise in prosumers (consumers who turn to self-producers)
	• Global issues like climate change, universal electricity access and the green economy • Increased demand and supply • Initiatives and political commitment • Government incentives and policies		
Challenges	•	• Public sector dominance • Poor grid system causing power losses, equipment vandalism and theft	• Low customer confidence • Unwillingness to pay for electricity • Tariff setting and high electricity prices • Rise in prosumers, thus reduced revenues for the off taker
	• High risk and long construction periods • High construction costs and inadequate investments • Bureaucracy that delay process like construction, grid connection periods and PPA processes • Environmental, social and land issues		
	• Shocks. e.g: COVID-19, sanctions • Change in political cycles and interruption of policies • Corruption • Weaknesses in policy frameworks and implementation-overlapping roles, inefficiencies in FiTs and PPAs • Demand- supply imbalance • Susceptibility to oil prices, inflation and currency risk		

5.2. Potential Financing Options

There are financial gaps along the electricity sector's value chain, as seen in Figure 1.1. The cause of these gaps can be linked to the value chain characteristics that may hinder or fail to attract investments. Globally, governments have come up with ways to attract more investments through various interventions such as incentives, policies and risk management. In Kenya, policy development, separation of functions (generation, distribution and regulation to be carried out by different entities), use of FiTs, PPPs and PPAs are examples of initiatives made to attract investments and foster development. To close the financing gap, we shall explore other options applied in other countries or still very nascent in Kenya, that can be implemented or improved upon to fit Kenya's specific challenges and opportunities.

Generation

Kenya's major generation players are KenGen, Rural Electrification Programme, REREC, IPPS and EPPs (see Appendix 1). The challenges and opportunities in generation vary depending on factors such as the source and capacity of electricity. For example, risks associated to geothermal sources may differ from solar sources, or larger capacity sources may face higher construction periods and more challenges in rising investments than smaller ones.

The electricity cost in Kenya is a sum of various charges and the non-fuel charge rates. There charges are the Value Added Tax (VAT), Forex Charge, Fuel Energy Charge, EPRA charge, WARMA charge, REP charge and inflation adjustment. The REP charge is passed to the REREC for implementation of rural electrification projects. The Fuel Energy Charge is passed to power generating companies to offset their fuel cost the previous month. The WARMA charge is passed to the Water Resources Management Authority (WARMA) as power supplied also comes from hydro. The Forex Charge accounts for the fluctuations in relation to the Kenyan Shilling and other currencies as agreed upon in PPA between KPLC and power producers. Therefore, electricity prices may fluctuate depending on factors such as foreign exchange rates. To address foreign currency risks, inflation risks and high tariffs, there has been adoption of long-term PPAs dominated in local currency in a several developing economies. Some of these countries include Brazil, India, Indonesia and South Africa. Other than reducing vulnerability to external shocks and local currency fluctuations, local currency dominance can increase local investor participation and promote growth of local developer and industries (Dalberg and Leadwood Energy, 2018).

Another option of increasing local finance is by developing local financial systems and utilizing institutional investors (insurance companies and pension funds). South Africa's developed local financial systems enables IPPs to mobilize investments. In Senegal, the Sovereign Fund for Strategic Investments (FONSIS) has been used for solar development. In Germany, models involving citizen participation financing though unions such as cooperatives, pension funds and closed ended funds are used in the energy sector (Özgür, 2014). Energy cooperative models have been used in the US, Austria, Argentina, India, Bangladesh, Columbia, Bolivia and Brazil to finance, operate and manage projects. Most of the energy cooperative projects provide cost effective electricity and promote RE. These models can be appropriately implemented in rural and remote areas (ILO, 2013).

Auctions offer market guarantee to investors and therefore foster more exploitation of untapped resources, accelerate access and improve demand and supply. South Africa's Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) is an auction-based programme aimed at boosting electricity generation to replace the REFiT after 2009. The programme's success in attracting investments is evident from the attracted 245 billion Rand (US$ 19 billion) worth of private investments between 2011 and 2016 (Visser et al., 2019) and the 141 billion Rand (US$ 11 billion) worth from domestic sources across 92 projects in 2018 (Amsterdam and Thopil, 2017). Renewable energies also increased by 3,876 MW by the year 2019 (Ayamolowo et al., 2022). Despite the success of the auctions, it is important to develop the auction policy in new markets, cognizant of the specific market characteristics. Rego's (2013) study of the Brazilian power auctions recommends new markets not to adopt the alternative approach used in Brazil's power auctions as the results may not be the same. Among the challenges with auctions is projects not being completed by bid winners. As an example, in Brazil's case, from the first eight auction rounds, only 14 per cent of wind auction projects were completed on time (Bayer, 2018).

Table 4.4: Potential financing options for electricity generation

Options	Main opportunities and challenges addressed	Examples of countries where it is applied
Long-term PPAs dominated in local currency	Foreign currency and inflation risks Tariff setting Government incentives and policies	Brazil, Philippines, Indonesia, India and South Africa
Competitive auctions	Construction risks Tariff setting Increase demand and supply Government incentives and policies	Brazil, Ghana, Ethiopia, Namibia, South Africa and Zambia
Local financial systems and local Institutional investors (eg: insurance companies and pension funds)	Foreign currency risks Inadequate finances Initiatives and political commitment	South Africa, Senegal

Transportation

KETRACO and KPLC are the major electricity network operators dealing with transmission and transmission and distribution, respectively. High system losses contribute to making transmission and distribution less alluring to financiers.

With poor cost recovery due to tariff setting issues and low private participation, finance mobilization is crucial. Private sector participation in transmission is majorly for raising capital for new infrastructure, while in distribution, it is to improve operation and financial performance of already existing networks (ESMAP, 2015).

Long term concessions have been used to rally private investments for transmission and distribution. They have been applied in the UK, Uganda and Philippines, where management and operations of existing infrastructure are handled by a private company for a long period of time. With private sector participation, there usually is higher standards of service and efficiency. In 2005, a private company (Umeme Ltd) won a 20- year concession to operate Uganda's state-owned Uganda Electricity Distribution Company Ltd main distribution network. The increased investments facilitated rehabilitation of Uganda's electricity sector (Meyer et al., 2018). A similar case is in the Philippines where a private consortium got a concession to operate, maintain and expand government-owned transmission infrastructure from 2009 to 2034 (IEA, 2021). The EPRA Statistics Report 2020 (2021) shows that about 86 per cent of the current licensed and approved power undertakings in Kenya have durations of 20 years and above each (Appendix 7). Whereas the long-term nature is good for attracting investors and boosting confidence, it may also be constricting for the other players.

The Build, Own, Operate, Transfer (BOOT) model has also been used and the private companies build and operate new network lines before transferring them to the government. Australia, Brazil, Chile, India and the US are some of the countries where this has been applied. There are 30-year BOOT contracts implemented in Peru for new transmission assets. Brazil's transmission expansion projects have been dominated by concessions such as BOOT. Brazil's case demonstrates that transmission systems with multiple owners can operate efficiently without compromising on security or efficiency (ESMAP, 2015). Models that involve construction, operation and maintenance of infrastructure by private companies and the assets are never transferred to the government fall under the merchant line model. They are implemented in Germany and Denmark (IEA, 2021).

Table 4.5: Potential financing options for electricity transportation (transmission and distribution)

Options	Main opportunities and challenges addressed	Examples of Countries where it is applied
Long term concessions	Poor grid system causing power losses, equipment vandalism and theft More private sector involvement Inadequate finances	Uganda, Philippines, UK, Philippines
Build, Own, Operate, Transfer (BOOT) model	Poor grid system causing power losses, equipment vandalism and theft More private sector involvement Inadequate finances	Australia, Brazil, Chile, India and the US
Merchant line	Poor grid system causing power losses, equipment vandalism and theft More private sector involvement Inadequate finances	Denmark and Germany

Customers (including off grid)

Customers form the core of electricity's demand-side. Kenya's commercial and industrial customers buy the most electricity from the off-taker. They are followed by domestic, small commercial, street lighting and interruptible, respectively (KPLC, 2020). Investors may shy away from financing the sector due to capital return risks caused by customer risks and tariff setting issues, among others. In Kenya, several larger electricity consumers have switched to self-generation and some are selling the excess electricity to the off-taker. Nairobi's Garden City Mall, Strathmore University, Kenyatta University, Williamson Tea, London Distillers Ltd, Mombasa's Moi International Airport, Africa Logistics Properties, the International Centre of Insect Physiology and Ecology (ICIPE) are some of the customers that have gone the self-generation route, opting for solar power installation. KPLC has already raised alarm over this growing trend as it signals a drop in their revenue and expressed interest in venturing in the solar market space (*Business Daily*, 2020 and 2021b).

Among the examples of self-generating customers mentioned, some have PPA agreements to sell power to the off-taker. PPAs guarantee markets for power providers and investors. In other instances, corporate customers buy electricity directly from producers. In such scenarios, Corporate PPAs (CPPAs) are implemented. A CPPA is a power purchasing contract between a corporate customer and the power generator. CPPAs are used to increase investments in the electricity sector since there is a guaranteed seller (producer) and buyer (corporate customer), thus having a higher bankability due to long-term income streams (WBCSB, 2016). A global growth of solar PV and wind by 20GW by 2020 from 2015 may be attributed to corporate PPAs (IEA, 2021). India and Brazil are examples of countries that have implemented corporate PPAs. As at 2019, Brazil had a 0.59GW growth of wind power attributed to signed corporate renewable PPAs (WBCSB, 2020).

Net metering and wheeling are policies also being used to attract investment and increase use of renewable energy. The Energy Act (2019) defines wheeling as use of transmission system, distribution system and associated facilities to convey electricity by another person other than the transmission licensee or distribution licensee, upon payment of charges. Net metering is a contract between a self-generating customer and a distributor to exchange the excess electricity with credit that can be in the form of cash or billing. Bangladesh and India use net metering and has become appealing for Bangladesh's textile and garment industries (IEA, 2021). Wheeling is being implemented in South Africa, Philippines and Germany. All these options provide revenue stability and, therefore, boost investor confidence.

Table 4.6: Potential financing options for electricity customers

Options	Opportunities and challenges being addressed	Examples of countries where it is applied
Corporate PPAs	• Increase supply and demand • Tariff setting • Low customer confidence • Bureaucracy	Brazil, Philippines, Indonesia, India and South Africa
Net metering and wheeling	• Tariff setting • Increase demand and supply • Rise in prosumers	Bangladesh, India and Brazil (net metering). South Africa, Philippines, Japan and Germany (wheeling)

5.3 Policy Framework Appropriateness

Demand, financial, legal and regulation, political land, tariff, competition and system risks are some of the risks being faced in Kenya's energy sector (Pueyo, 2018; KPLC, 2020). The Government of Kenya and relevant stakeholders have put up several policy interventions over the years to lower risks and boost investor confidence in the electricity sector. This has been in various forms such as policy development, separation of functions (generation, distribution and regulation to be carried out by different entities), use of FiTs, PPPs and PPAs. Nderitu and Engola (2020) using an exploratory approach seek to determine the effectiveness of FiTs in Kenya. They identify tariffs and private investments as the main drivers of FiTs in Kenya. However, the challenges and barriers in the Kenyan FiT policy identified are ineffective policy design, delays in the process, lack of financial and technical capacity, high tariffs, and gaps in regulation within the FiT policy and laws. Some of those interviewed in this study acknowledged that FiT opened the sector by attracting private investors on board, but recommended a switch to auctions. Despite increased financing, they concluded that the FiT implementation is not successful as was hoped for in promoting RE and recommend restructuring involving stakeholders in the process, auctions and net metering. The Updated Least Cost Power Development Plan recommends renegotiation of PPAs, adoption of energy auctions over FiTs, delay in new energy generation development and demand creation (Government of Kenya, 2018). The Presidential taskforce, in its findings concluded that IPPs tariffs are high and high and there is need to reduce electricity costs, refrom KPLC reforms, standardize PPAs, renegotiate PPAs, and ensure more transparency and system loss audits.

Kenya plans to implement auctions soon, following the recommendation of the Least Cost Development Plan 2017-2037 (Government of Kenya, 2018). In 2021, the Renewable Energy Auction Policy (Government of Kenya, 2021) was published. For all wind and solar projects and other RE projects exceeding 20MW, auctions will be used as stated in the Renewable Energy Auction Policy (REAP). This can be interpreted to say that the FiT policy will no longer be applicable for the RE, wind and solar projects under REAP. Land issues will seem to be a challenge under the REAP as the Ministry of Energy will set the site selection requirements, to mean that bidders will bear the responsibility of land acquisition. This might potentially discourage investors. Government led site-selection approach in Zambia's energy auctions has lowered the projects risk (Kruger et al., 2019) and can be an approach adopted by Kenya. Studies also another energy auctions risk associated with auctions are use of sub-standard materials due to low bid, demand risk and lack of penalties (Bose and Sumit, 2019). There is also the issue of REREC's mandate of exploring renewable resources and how it is factored in.

With the enactment of the Energy Act (2019), more private sector and financing along the electricity value chain was facilitated. The Act defines an eligible consumer as "a consumer that is allowed to choose any licensee to be his supplier and with whom he may contract for the purchase of electrical energy for his own use, in accordance with regulations made under this Act". This therefore gives some leeway for implementation of corporate PPA structures. However, there is a gap in the legal and regulatory framework that expressly caters for CPPAs. When it comes to the generator transmitting and distributing electricity to the consumers, they are required to have separate licenses for both. This is according to sections 136 and 140 of the Energy Act (2019), which expresses the conditions for transmission and distribution licenses, respectively. Long-term concessions are already operational in other forms of infrastructure such as roads under the PPP Act (2013), which enables private sector participation in infrastructure investments. The private sector in this Act encompasses both local and international enterprises, groups and individuals with the financial, technical and legal capacity. With the issuance of distribution and transmission licenses in the Energy Act (2019) to operators who fulfil the conditions, the implementation of BOOT and the merchant line in these sectors is possible. However, further development of regulations around merchant lines in electrical networks and CPPAs is needed as they are still new concepts in Kenya (DLA Piper, 2022).

Provision of net metering and wheeling are stipulated in the energy Act 2017, allows for their implementation in Kenya. However, not much is given with regard to the two that would sufficiently guide their implementation. For net metering, the cap on capacity from pro-consumers is at 1MW. Further policy and regulation development would help investors and sector players navigate around issues such the metering system, tariffs and compensation. A foreseeable challenge with the implementation of these two policies would be a potential revenue for the off-taker and tariff setting. In South Africa, there are regulatory rules on network charges of third part transportation of energy (2012), provides guidance on network charges, connection charges, wheeling arrangements, and legal basis. Net metering is done at municipal and national levels in South Africa and Ghana, respectively.

Increasing access to domestic financing and savings for electricity investments will reduce foreign currency risk. There are already versions of this in Kenya that incorporated community and business models, like the Pay-As-You-Go models used in the off grid solar space. The current policy environment supports access to domestic funding, as an example of the 2009 issuance of KenGen bonds. The Energy Act (2019) proposes the establishment of the Consolidated Energy Fund that will be used for energy projects, such as the construction of appropriate energy infrastructure, promotion of renewable energy initiatives and energy efficiency and conservation, and construction of infrastructure. The fund will be managed as per the Public Finance Management Act.

6. Conclusions and Policy Recommendations

This study finds that the electricity value chain components share and have different strengths, weaknesses, opportunities and threats. These components are electricity: generation, transportation and customers. When looking at financing, some of these strengths, weaknesses, opportunities and threats form opportunities and challenges for financing. Among the key overall opportunities for are: increased demand and supply, initiatives and political commitment, government incentives and policies and global issue such as climate change. Customer risk, shocks such as COVID-19 and sanctions, change in political cycles and interruption of policies, corruption, weaknesses in policy frameworks and implementation and currency risk are examples of the challenges for financing.

The KNES targets for Kenya to have universal energy access by the year 2022, and this has not been achieved mainly due to lack of incentives that attract needed investments to fill the financial gap. Under generation, PPAs with local currency, competitive auctions and tapping into more local financial systems and local institutional investors are examples of financial options put forward. The use of long concessions and the BOOT model may boost investments in the transmission and distribution sub-sectors. Lastly, financing in the demand side could be improved by implementing CPPAs, net metering and wheeling. A close look at Kenya's energy policy environment and their appropriateness for the suggested financial options shows that whereas some options are accommodated, others still require further development of polices and regulations for them to be implemented. The challenge of land acquisition also seems to be a challenge within the new energy policies.

The following recommendations are made:

- Given that local financing reduces the foreign currency risk, thus stabilizing electricity prices, the Government of Kenya could continue coming up with more innovative programmes and incentives of tapping into local financing, financial institutions and savings. This can be done by establishing energy specific development banks and facilities (local or regional) that have the expertise to lead to more concentrated focus in development and energy finance.
- Since some financing models such as corporate PPAs, net metering and wheeling are new to Kenya, hastening further development of related polices and regulations by the government will facilitate implementation and more financing in the electricity sector.

- Developing compensation methodologies for land use to develop infrastructure, better legal frameworks and land value index bill adoption can be solutions to the land issues. Wayleave acquisition is still a challenge for project development and attracting financing.
- Balance renegotiation of existing PPAs to lower the cost of electricity to ensure prices adjustments reflective of current market status and at the same time retain investor confidence in Kenya's energy sector is necessary.

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Appendices

Appendix 1: Kenya's energy generation installed capacity (MW) statistics from the year 2008

Company and type	Installed Capacity (MW) as at 30 June of												
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
KenGen													
Hydro													
Tana	14.4	14.4	14.4	20	20	20	20	20	20	20	20	25.7	25.7
Wanjii	7.4												
Kamburu	94.2	94.2	94.2	94.2	94.2	94.2	94.2	94.2	94.2	94.2	94.2	94.2	94.2
Gitaru	225	225	225	225	225	225	225	225	225	225	225	225	225
Kindaruma	40	40	40	40	44	72	72	72	72	72	72	72	72
Small Stations	6.3	13.7	14.7	13.7	13.7	13.7	14.7	13.2	13.7	11.7	11.7	11.3	11.3
Masinga	40	40	40	40	40	40	40	40	40	40	40	41.2	41.2
Kiambere	144	156	164	164	164	164	164	168	168	168	168	168	168
Turkwel	106	106	106	106	106	106	106	106	106	106	106	106	106
Sondu Miriu	60	60	60	60	60	60	60	60	60	60	60	60.7	60.7
Sangoro					21.2	21.15	21.15	21	21	21	21	21.2	21.2
Hydro Total	737	749.3	758	763	788	816	817	820	820	818	818	826	826
Thermal													
Kipevu I Diesel	75	75	75	75	75	75	75	73.5	73.5	73.5	73.5	74	74
Kipevu III Diesel				115	115	115	120	120	120	120	120	120	120
Fiat - Nairobi South	13.5	13.5											
Kipevu Gas Turbines	60	60	60										
Embakasi Gas Turbines				60	60	60	60	60	60	30	30		
Muhoroni Gas Turbine										30	30	60	60
Garissa & Lamu	5.2	5.2	5.4	8.9	8.7	8.9	8.6	5.7	5.7				
Garissa Temporary Plant(Aggreko)								3.4	3.4				
Thermal Total	154	154	140	259	259	258.9	264	263	263	254	254	254	254
Geothermal:													
Olkaria I	45	45	45	45	45	45	45	45	45	45	45	45	45
Olkaria II	70	70	105	105	105	105	105	105	105	105	105	105	105
Eburru Hill					2.5	2.44	2.4	2.5	2.5	2.5	2.4	2.4	2.4
OW37 Olkaria Wellhead					5	5.37	5.4	5	5	20	15	20.5	22
OW37 kwg 12 Wellhead									5				
OW37 kwg 13 and OW 39 Wellheads													
OW43 Olkaria Wellhead							12.8	12.8	12.8	12.8	12.8	12.8	14

OW914 and OW915 Olkaria Wellhead							12.8	37.8	37.8	47.8	52.8	47.8	52.5
OW919 Olkaria Wellhead													
Olkaria IV							70	140	140	140	140	149.8	149.8
Olkaria I units 4 & 5								140	140	140	140	150.5	150.5
Olkaria V													172.3
Geothermal Total	115	115	150	150	157	158	253	488	493	513	513	534	713
Wind													
Ngong	0.4	0.4	5.1	5.3	5.3	5.3	5.3	25.5	25.5	25.5	25.5	25.5	25.5
KenGen Total	**1006**	**1019**	**1054**	**1177**	**1210**	**1238**	**1339**	**1596**	**1601**	**1610**	**1610**	**1639**	**1818**
GoK (Rural Electrification Programme)													
Off-grid stations:													
Thermal	9	11.7	11.7	9.1	9.4	16	18	18	18	26.2	30.4	31.4	31.9
Solar					0.6	0.5	0.7	0.569	0.569	0.55	0.69	0.55	2.3
Wind					0.1	0.6	0.6	0.55	0.55	0.66	0.55	0.69	0.6
Total Off-grid					10.1	17	19	19	19	27	31.6	33	35
GoK (Rural Electification Authority- REA)													
REA Garissa Solar Plant												50	50
REA Total												50	50
Independent Power Producers (IPPs)													
Iberafrica	56	56.3	108.5	108.5	108.5	108.5	108.5	108.5	108.5	108.5	108.5	108.8	52.5
Tsavo	74	74	74	74	74	74	74	74	74	74	74	74	74
Thika Power							87	87	87	87	87	87	87
Biojule Kenya Limited									2	2	2	2	2
Mumias -Cogeneration	2	2	26	26	26	26	26	26	26	26	26	26	
OrPower 4-Geothermal I,II & III	13	48	48	48	52	92.4	110	110	110	110	121	121	121
OrPower 4-Geothermal (4th plant)										29	29	29	29
Rabai Power			90	90	90	90	90	90	90	90	90	90	90
Imenti Tea Factory (Hydro)			0.6	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.283	0.283

Power Technologies Solutions/Gikira (hydro)							0.514	0.514	0.514	0.514	0.514	0.514	0.514
Triumph Diesel								77	83	83	83	83	83
Gulf Power								80	80.32	80.32	80.32	80.32	80.32
Regen- Terem Hydro										5	5	5	5
Gura											2	2	2
Chania											0.5	0.5	0.5
Strathmore											0.25	0.25	0.25
Lake Turkana Wind Power												310	310
IPPs Total	145	204	347	347	351	391	497	654	691	696	709	1030	937
Emergency Power Producers (EPP)													
Aggreko energy to Kenyan Market	150	150	60	60	120	120	30	30	30	0	0	0	0
EPP Total	150	150	60	60	120	120	30	30	30	0	0	0	0
SYSTEM TOTAL	1310	1361	1473	1593	1691	1765	1885	2299	2341	2333	2351	2741	2840
Increase (%)	9	4	8	8	6	4	7	22	2	-0.3	0.7	17	3.6

Source: KPLC (Various) Kenya Power and Lighting Company annual reports (2008 to 2020)

Appendix 2: Energy Sector allocations in the annual national financial budgets

	Allocation Budget (in Ksh billions)														
Financial Year:	***2007/08***	***2008/09***	***2009/10***	***2010/11***	***2011/12***	***2012/13***	***2013/14***	***2014/15***	***2015/16***	***2016/17***	***2017/18***	***2018/19***	***2019/20***	***2020/21***	***2021/22***
Project/ programme															
Power transmission and distribution				15.6			23.8	23	21.1	*		12.6	54.3	50.8	50.1
Geothermal energy		4		11.6	16.1		12.5	10	13.2		16.4	12.7	8.6	9.3	11.3
Wind power generation		0.2													
Solar electricity		0.3									1.53				
Rural electrification programme		6.8	7	5.4	5.6			10.6	14.9	*		5.9			
Street lighting									4.5	*	3.1	1			
Last mile connectivity									1.5	*	9.7	6.7			
Public facilities electrification											7.3		4.5	6.8	6.4
Transformer and substations installations											3	1	1.5	0.9	
Connectivity subsidy											1.3				
Eastern Electricity Highway Project (Ethiopia - Kenya Interconnector)												5.5			
Nairobi 220KV ring												3.1			
Nuclear energy and coal mining															1.3
Energy sector total	**8**	**11.3**	**7**	**34.1**	**65.7**	**79.9**	**78.5**	**77**	**55.2**	**120.2**	**42.33**	**48.5**	**68.9**	**67.8**	**71.9**
Totals during the MTPs						198					373.23				257.1
Annual average during MTPs						39.6					74.65				64.28
Infrastructure bonds (roads, water, energy and ICT)		52													
Infrastructure investment (roads, rail, ports, broadband and energy)		140		182	221.4	268.1	213.7	255.9				404.633	406.8		
Grant import duty exemption on equipment and inputs excluding motor vehicles imported by a licensed company for direct and exclusive use in oil, gas or geothermal exploration and development.			*												
Zero rate VAT on power generators and generating sets			*												
Duty exemption on inputs-used for solar panel production					*										
Equipment used for solar and wind energy generation to be exempted from VAT															*

Source: Government of Kenya (Various) Annual financial budgets (2008 to 2020)

Appendix 3: Kenya's total installed (MW) capacity of different energy sources and system peak demand from 2008 to 2020

Source/Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Hydro	737	749	759	763	788	816	817	821	821	824	826	826	835
Thermal	443	446	484	601	657	666	672	827	833	803	807	806	751
Geothermal	128	163	198	198	209	250	364	598	632	652	663	663	863
Wind	0	0	5	5	5	6	6	26	26	26	26	336	336
Solar	0	0	0	0	1	1	1	0	1	1	0	51	53
Co gen	2	2	26	26	26	26	26	26	26	26	26	28	
Bio									2	2	2	2	2
Total installed capacity (MW)	1310	1360	1472	1593	1686	1765	1885	2299	2341	2333	2351	2712	2840
System Peak demand (MW)	1044	1072	1107	1194	1236	1354	1468	1512	1586	1656	1802	1882	1926

Source: KPLC (Various) Kenya Power and Lighting Company annual reports (2008 to 2020)

Appendix 4: Kenya's circuit length (in Kilometres) of transmission and distribution lines from the year 2008

As at 30 June	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Voltage													
400 kV										96.8	1244.4	2116.4	2116.4
220kV	1,323	1,331	1,331	1,331	1,331	1,331	1,434	1,527	1,527	1,555	1,686	1,686	1,686
132kV	2,085	2,112	2,211	2,343	2,343	2,436	2,513	2,527	2,874	3,208	3,322	3,372	3,372
66kV	632	649	655	655	758	1097	1212	1212	1212	1,000	1,168	1,187	1,187
40kV	29	29											
33kV	12633	13031	13812	15271	15384	16136	20778	21,370	27,497	30,846	34,508	35,177	35,703
11kV	23573	24334	25485	26250	27219	28818	30860	32,823	35,383	37,234	38,968	39,797	40,616
Total HV and MV									68,493	73,940	80,897	83,335	84,681
425/240V or 433/250V									110,778	139,642	143,331	152,799	158,527
Total	40274	41486	43494	45850	47035	49818	56797	59,459	179,271	213,582	224,228	236,134	243,207
% Increase P.A	8.4	3	4.8	5.4	2.6	5.9	14	4.8	15.2	19	5	5	3

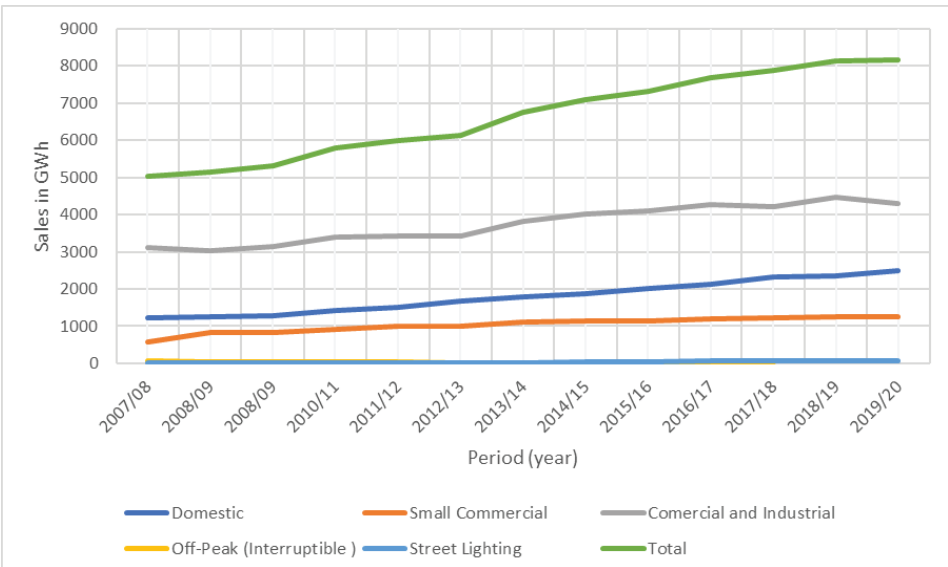
Source: KPLC (Various) Kenya Power and Lighting Company annual reports (2008 to 2020)

Appendix 5: Number of electricity customers (2008-2020)

Region/ Year	Nairobi	Coast	West	Mt. Kenya	KPLC customers	R.E.P customers	Total	% Increase P.A.
2008	505,414	121,864	168,608	103,143	899,029	161,354	1,060,383	14.7
2009	595,010	139,245	200,266	127,390	1,061,911	205,287	1,267,198	19.5
2010	669,128	157,731	235,291	150,433	1,212,583	251,056	1,463,639	15.5
2011	814,251	178,095	275,033	176,682	1,444,061	309,287	1,753,348	19.8
2012	9,215,48	201,425	322,885	210,136	1,655,994	382,631	2,038,625	16.3
2013	1,042,216	221,410	368,800	244,992	1,877,418	453,544	2,330,962	14.3
2014	1,258,555	248,058	438,998	293,820	2,239,431	528,552	2,767,983	18.7
2015	1,334,390	297,985	607,824	668,515	2,908,714	703,190	3,611,904	30.5
2016	1,700,152	400,679	952,354	865,170	3,918,355	972,018	4,890,373	35.4
2017	2,099,574	490,290	1,264,730	1,058,178	4,912,772	1,269,510	6,182,282	26.4
2018	2,235,010	543,009	1,417,269	1,233,593	5,428,881	1,332,209	6,761,090	9.4
2019	2,632,703	537,383	1,486,273	1,285,246	5,658,605	1,409,256	7,067,861	4.5
2020	2,482,707	580,873	1,620,951	1,479,671	6,073,202	1,502,943	7,576,145	7.2

Source: KPLC (Various) Kenya Power and Lighting Company annual reports (2008 to 2020)

Appendix 6: KPLC sales by customer category



Source: KPLC (Various) Kenya Power and Lighting Company annual reports (2008 to 2020)

Appendix 7: Licensed and approved power undertakings

Licensee	Technology	Location of Power Plant(s)	Capacity (MW)	Date Granted	Duration (Years)	Supply To	Remarks	Total (MW)
KenGen[1]	Geothermal	Olkaria I	185	2nd Oct 2008	25	Grid	Modified on 6th Dec 2012	760
KenGen		Olkaria II	105	2nd Oct 2008	25	Grid		
KenGen		Olkaria IV	140	2nd Oct 2008	25	Grid		
KenGen		Mobile wellheads [2]	70	6th Dec 2012	15	Grid		
KenGen		Mobile wellhead [3]	5	6th Dec 2012	15	Grid		
OrPower4[8]		Naivasha	150	24th Nov 2000	25	Grid	Modified on 16th July 2015	
QPEA Menengai [17]		Nakuru	35	4th Dec 2014	25	Grid		
Sosian-Menengai [20]		Nakuru	35	4th Dec 2014	25	Grid		
Orpower 22 [21]		Nakuru	35	16th July 2015	25	Grid		
Total Geothermal	**760**							
KenGen	Hydro	Masinga	40	2nd Oct 2008	25	Grid		835.99
KenGen		Kamburu	94.2	2nd Oct 2008	25	Grid		
KenGen		Kindaruma	72	2nd Oct 2008	25	Grid		
KenGen		Gitaru	225	2nd Oct 2008	25	Grid		
KenGen		Kiambere	164	2nd Oct 2008	25	Grid		
KenGen		Sagana	1.5	2nd Oct 2008	18	Grid		
KenGen		Ndula	2	2nd Oct 2008	6	Grid		
KenGen		Tana	20	2nd Oct 2008	12	Grid		
KenGen		Wanjii	7.4	2nd Oct 2008	15	Grid		
KenGen		Mesco	0.38	2nd Oct 2008	12	Grid		
KenGen		Turkwel	106	2nd Oct 2008	25	Grid		
KenGen		Gogo	2	2nd Oct 2008	7	Grid		
KenGen		SonduMiriu	60	2nd Oct 2008	25	Grid		
KenGen		Sosiani	0.4	2nd Oct 2008	12	Grid		
Kengen		Sangoro	21	26th Jul 2017	25	Grid		
Hydro project services peters Ltd		Meru	0.51	11th Apr 2018	20	Grid		
Tindinyo Falls Resort Limited [19]		River Yala, Nandi County	1.5	4th Dec 2014	25	Grid		
RegenTerem [15]		Mt. Elgon	5.2	27th Feb 2014	20	Grid		
Mt Kenya Power [18]		Meru	0.6	4th Dec 2014	25	Grid		
Kleen Energy [22]		Embu	6	16th July 2015	25	Grid		
Greater Meru Tea Power Co Ltd		Meru County	1.5	30th Mar 2016	25	Grid		
Greater Meru Power Co Ltd		Tharaka-Nithi County	2	30th Mar 2016	25	Grid		
Kirinyaga Power Co Ltd		Kirinyaga County	1.8	30th Mar 2016	25	Grid		
Chania Power Co Ltd		Murang'a County	1	30th Mar 2016	25	Grid		
Total Hydro	**835.99**							

Licensee	Technology	Location of Power Plant(s)	Capacity (MW)	Date Granted	Duration (Years)	Supply To	Remarks	Total (MW)
KenGen	Thermal, MSD [4]	Kipevu I	60	27th April 2011	20	Grid		746.8
KenGen		Kipevu III	120	27th April 2011	20	Grid		
KenGen		Muhoroni	30	29th April 2010	5	Grid	Decommissioned in July 2016	
KenGen		Garissa	3.4	2ndOct 2008	10	Mini Grid	Decommissioned in April 2016	
KenGen		Lamu	2.1	2ndOct 2008	8	Mini Grid	Decommissioned in April 2016	
Tsavo Power[6]		Mombasa	74	21st Mar 2000	23	Grid		
Iberafrica[7]		Nairobi	108.8	20th July 2005	27	Grid		
Rabai Power		Mombasa	90	15th July 2008	15	Grid		
KPRL [12]		Mombasa	8.5	24thFeb 2011	20	Captive		
GulfPower Ltd		Athi River	80	14thSept 2011	20	Grid		
Triumph[13]		Athi River	83	14thSept 2011	20	Grid		
Thika Power		Mang'u Area	87	9th Feb 2012	20	Grid		
Total Thermal	**746.8**							
KenGen	Gas Turbine	Embakasi	60	27th April 2011	20	Grid	30 MW relocated to Muhoroni. The remaining 30MW at Embakasi is not being dispatched due to expired PPA	90
Kengen		Muhoroni	30	26th July 2017	20	Grid		
Total	**90**							
KenGen	Wind	Ngong I Phase I	5.1	6thDec 2012	20	Grid		566.5
Chania Green Generation Ltd		Kajiado	50	11th April 2018	20	Grid		
Lake Turkana[10]		Marsabit	300	16th Dec 2010	20	Grid		
Kinangop[14]		Kinangop	61	9th Feb 2012	20	Grid		
Kipeto Energy Limited		Kajiado	100	16th Sep 2015	20	Grid		
Ol-ndanyat Power Ltd		Kona Baridi, Kajiado County	30	3rd December 2015	25	Grid		
Kengen		Ngong I wind I phase II	6.8	26th July 2017	25	Grid		
Kengen		Ngong II	13.6	26th July 2017	25	Grid		
Total Wind	**566.5**							
Pwani oil products limited	Biomass	Kilifi	1.5	24th Jan 2018	20	Captive		11.34
Cummins[16]		Marigat	8.4	29thJan 2014	20	Grid		
DWA ESTATE LIMITED		Makueni	1.44	25th March 2020	20	Grid		
Total Biomass	**11.34**							
Nzoia Sugar Co. Ltd	Cogeneration	Bungoma	7	11th April 2018	20	Captive		94.7
Mumias Sugar		Mumias	38	24th Apr 2008	25	Grid		
Butali Sugar Mills Limited		Kakamega County	11	1st Dec 2016	25	Captive		
Chemelil Sugar Co Limited		Kisumu County	3	1st Dec 2016	25	Captive		
SONY Co. Ltd		Migori County	8.7	26th Apr 2017	20	Captive		
Kwale International Sugar Co Ltd		Kwale County	18	25th Feb 2016	20	Grid and Captive		
Pan Paper[9]		Webuye	9	2004	15	Captive		
Total Cogeneration	**94.7**							

Licensee	Technology	Location of Power Plant(s)	Capacity (MW)	Date Granted	Duration (Years)	Supply To	Remarks	Total (MW)
Oserian Development Co.ltd	Solar	Nakuru	1	22nd Aug 2018	20	Captive		212.055
Alten Energy		Uasin Gichu County	40	3rd Mar 2017	25	Grid		
Radiant Energy		Uasin Gichu County	40	3rd Mar 2017	25	Grid		
Eldosol Energy		Uasin Gichu County	40	3rd Mar 2017	25	Grid		
Ofgen Power Ltd		Nairobi & Taita Taveta Counties	0.455	26th Apr 2017	20	Captive		
Strathmore University		Nairobi County	0.6	26th Apr 2017	20	Grid		
						& Captive		
Malindi solar		Kilifi	40	26th July 2017	20	Grid		
KOPERE SOLAR PARK LIMITED		Nandi County	40	30th Jan 2019	20	Grid		
HANNAN ARYA ENERGY (K) LIMITED		Kajiado	10	27th Mar 2029	20	Grid		
Total Solar	**212.055**							
Homabay Biogas One	Biogas	Homabay	8	11th Apr2018	20	Grid		8
Bidco[11]	Biothermal	Thika	2.125	18th Aug 2011	20	Grid		2.125
CemtechLtd	Coal	West Pokot	30	16th July 2015	30	Captive		1095
Devki Energy Co Ltd		Merrueshi, Kajiado County	15	25th May 2016	20	Captive		
Amu power		Lamu County	1050	3rd Mar 2017	20	Grid		
Total	**1095**							
Overall Total (MW)	**4422.51**							

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