National Energy Situational and Stakeholder Analysis

KENYA

100% Renewables Cities and Regions Roadmap

ICLEI Local Governments for Sustainability

100% RENEWABLES CITIES & REGIONS ROADMAP

Supported by:

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National Energy Situational and Stakeholder Analysis: Kenya

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Authors:

Dania Petrik, ICLEI Africa
Godfrey Maina, consultant
Modest Muriuki, consultant
Justus Munyoki, SUSTwatch

Reviewers (in Alphabetical Order):

Mr. N. Bukachi, EPRA
Ms. C. Buma, ICLEI Africa
Mr. D. Hoepfl, ICLEI World Secretariat
Ms. P. Kimotho, REREC
Mr. B.K. Kinyanjui, Kenya Power
Ms. N. Majoe, ICLEI Africa
Mr. J. Munyoki, SUSTwatch
Ms. K. Muoki, State Department for Planning
Mr. J. Muthomi, consultant
Mr. K. Olwasi, Ministry of Environment and Forestry
Mr. E. Omwenga, Ministry of Energy
Mr. R. Sen, ICLEI World Secretariat

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List of Acronyms

AfDB	African Development Bank
AFD	Agence Française de Développement
BAU	Business As Usual
CCCF	County Climate Change Fund
CEC	County Executive Committee
CGK	County Government of Kenya
CIDP	County Integrated Development Plan
COD	Commercial Operation Date
CoG	Council of Governors
CS	Cabinet Secretary
CSO	Civil Society Organisations
CSP	Concentrated Solar Power
DfID	Department for International Development
EIB	European Investment Bank
EPP	Emergency Power Producers
EPRA	Energy and Petroleum Regulatory Authority
ERB	Energy Regulatory Board
ERC	Energy Regulatory Commission
FiT	Feed-in Tariff
GDC	Geothermal Development Company
GDP	Gross Domestic Product
GHG	Greenhouse gas
GHI	Global Horizontal Irradiation
GoK	Government of Kenya
GWh	Gigawatt hour
IDA	International Development Association
IED	Innovation Energie Developpement
IPP	Independent Power Producer
ITF	EU Infrastructure Trust Fund
JICA	Japan International Cooperation Agency
KEMP	Kenya Electricity Modernization Project
KenGen	Kenya Electricity Generating Company
KenInvest	Kenya Investment Authority
KETRACO	Kenya Electricity Transmission Company
KNBS	Kenya National Bureau of Statistics
KNEB	Kenya Nuclear Electricity Board
KNES	Kenya National Electrification Strategy
KOSAP	Kenya Off-Grid Solar Access Project
KPLC	Kenya Power and Lighting Company
LCPDP	Least Cost Power Development Plan
Li-ion	Lithium-ion
LULUCF	Land Use, Land-Use Change and Forestry
MoE	Ministry of Energy
MoEF	Ministry of Environment and Forestry

MoU	Memorandum of Understanding
MRV	Monitoring, Verification and Reporting
MTEF	Medium-Term Expenditure Framework
MTP	Medium-Term Plan
MW	Megawatt
NAP	National Adaptation Plan
NCCAP	National Climate Change Action Plan
NCCRS	National Climate Change Response Strategy
NDA	National Designated Authority
NDC	Nationally Determined Contribution
NEMA	National Environment Management Authority
NuPEA	Nuclear Power and Energy Agency
PAYG	Pay-As-You-Go
PIM	Public Investments Management
PPA	Power Purchase Agreement
PPP	Public Private Partnership
PRG	Partial Risk Guarantee
PV	Photovoltaic
RE	Renewable Energy
REA	Rural Electrification Authority
RERAC	Renewable Energy Resource Advisory Committee
REREC	Rural Electrification and Renewable Energy Corporation
RES	Renewable Energy Systems
SHS	Solar Home Systems
SPV	Special Purpose Vehicle
SREP	Scaling-up Renewable Energy Plan
SWH	Solar Water Heater
TWh	Terawatt hour
USD	United States Dollar

Introduction

Country context

Kenya is a country located in the east of Africa, bordered by Somalia (to the east), Ethiopia (to the north), Uganda (to the west) and Tanzania (to the south), with its south-eastern border on the Indian Ocean. It covers an area of about 569,000 square kilometres[1], most of which (80%) is considered either arid or semi-arid (ASAL)[2]. The main spoken languages are Swahili and English. While Kenya has the largest economy in East Africa, the country faces challenges of low infrastructure levels and other developmental issues.

Kenya's primary economic industries include agriculture, forestry, fishing, mining, manufacturing, energy, tourism, and financial services. The economy is the fifth largest in sub-Saharan Africa, but is classified as a newly industrialised, lower middle-income country with a gross domestic product (GDP) of $85 billion (2018).[3] However, the country aspires to be a newly industrialised middle-income country by 2030, as set out in its development blueprint, Vision 2030. Developmental challenges remain and a large proportion (45%) of the population continues to live below the poverty line.[4]

With an economy heavily reliant on rain-fed agriculture, Kenya is extremely vulnerable to droughts, exacerbated by climate change and variability. According to the World Bank, "*poverty and vulnerability to climate change remain the most critical development challenges facing Kenya*".[5]

Population: **47,564,296** or 12.2 million households[6]

Flag:

Climate

Climate variability in Kenya has resulted in significant economic shocks that have had severe consequences for human security, livelihoods and ecosystem services. Periodic droughts and flooding have devastating impacts on the national economy, livelihoods and the natural resource

[1] USAID, 2019.
[2] MENR, 2015.
[3] USAID, 2019.
[4] Luna and Owino, 2017.
[5] World Bank, 2020.
[6] KNBS, 2019.

base on which most of the population relies. Climate variability frequently causes critical downturns in agricultural productivity, affecting food security. It also hampers hydropower generation, which in turn has resulted in energy shortages in the industrial sector. Huge sums of money are spent to meet the resultant shortfalls, including covering the cost of short-term imports of food and expensive thermal-generated electricity from independent power producers (IPPs). A scenario analysis of climate change in Kenya revealed that the future economic costs of climate change on market and non-market sectors may result in a decline of about 3% of GDP per year by 2030 and about 5% of GDP per year by 2050.[7]

Energy landscape

As a developing country, Kenya is still characterised by low access to electricity. However, as espoused in the 2018 Kenya National Electrification Strategy (KNES), the country wants to achieve universal electricity access by 2022[8], through main grid densification, intensification and expansion, as well as off-grid solutions. The strategy has a strong off-grid component and expects to provide approximately two million new connections by the year 2022. Already by 2018, 6.9 million people had been connected to the grid.[9]

In addition to confronting energy access issues, and in support of the Paris Agreement, Kenya has announced its commitment to achieving a 30% reduction in its national greenhouse gas (GHG) emissions by 2030, relative to the business as usual (BAU) scenario of 143 MtCO2e. Kenya's Nationally Determined Contribution (NDC) has identified six main sectors responsible for the country's GHG emissions, where mitigation efforts are focused: energy (electricity generation); transportation; agriculture; land use, land-use change and forestry [LULUCF]; industrial processes and waste. However, this does not necessarily translate into a 30% emission reduction target for each of the individual six mitigation sectors, as each sector has widely differentiated mitigation potential as well as costs.[10] The majority of Kenya's GHG emissions result from the agriculture and land use, land-use change and forestry (LULUCF) sectors, most likely due to the high reliance on wood fuel by a large majority of the population.[11]

With Kenya's Vision 2030, every effort should be made to explore renewable resources to increase energy security for the country.

Historical overview of Kenya's energy sector

The growth and expansion of Kenya's energy sector dates back to 1922 when two power supply companies merged to form East African Power and Lighting Company (EAP&L)[12]. In 1954, Kenya Power Company (KPC) was formed as a subsidiary of EAP&L, whose mandate was the construction of transmission lines to import power from Owen Falls in Uganda to Nairobi in Kenya. In 1983,

[7] SEI, 2009.
[8] USAID, 2019.
[9] Willuhn, 2018.
[10] MENR, 2017.
[11] MENR, 2015.
[12] Mombasa Electric Power and Lighting Company and Nairobi Power and Lighting Syndicate (both established in 1908).

EAP&L was renamed Kenya Power and Lighting Company Limited (KPLC), which later rebranded and changed its name to Kenya Power in 2013.

As part of power sector reforms, the Government of Kenya (GoK) published a policy framework paper on economic reforms in 1996.[13] The intention of this paper was to initialise the unbundling and restructuring of the power sector, and promote participation of private investors. The government passed the Electric Power Act of 1997, which created the Electricity Regulatory Board (ERB) as the sector regulator. It also unbundled the vertically integrated utility KPLC into Kenya Electricity Generating Company Limited (KenGen), a semi-public owned company responsible for the generation assets, and KPLC which remained responsible for all distribution and transmission of electricity. As a result of this 1997 Act, Independent Power Producers (IPPs) have been able to generate electricity and sell it to KPLC under negotiated Power Purchase Agreements (PPAs).

There have been continued reforms taking place in the power sector, especially with the adoption of 'Sessional Paper No. 4 on Energy' in 2004[14] and subsequent enactment of the Energy Act of 2006. While Sessional Paper No.4 introduced feed-in tariffs (FiTs) to promote renewable energy, the Energy Act (2006) established the Rural Electrification Authority (REA) and restructured the Electricity Regulatory Board (ERB) to become the Energy Regulatory Commission (ERC), a single regulatory body. Energy Act No. 12 of 2006 also established the Energy Tribunal that arbitrates disputes and appeals between parties involved in the energy sector. Sessional Paper No. 4 also provided for the establishment of the Geothermal Development Company (GDC) and Kenya Electricity Transmission Company (KETRACO). Legal Notice No. 131 of 2012 provided for the establishment of Kenya Nuclear Electricity Board (KNEB)[15].

More recently, the Energy Act 2006 was repealed and replaced with the revised Energy Act 2019[16], paving the way for the energy sector to take further steps towards its modernisation and development. The Energy Act 2019 has several amendments to the repealed Energy Act 2006, intended to: consolidate the laws relating to energy, properly delineate the functions of the national and devolved levels of government in relation to energy, provide for the exploitation of renewable energy sources, as well as regulate midstream and downstream petroleum and coal activity for the supply and use of electricity, as opposed to the previous law.

The new Act has established several new "energy sector entities" that replaced those existing under the repealed laws and has gone further to restate and expand their mandates so that they may properly discharge their functions. The Act led to the restructuring of the Energy Regulatory Commission (ERC) to the Energy and Petroleum Regulatory Authority (EPRA); the Rural Electrification Authority (REA) to the Rural Electrification and Renewable Energy Corporation (REREC); the Nuclear Power and Energy Agency (NuPEA), which is the successor of Kenya Nuclear Electricity Board (KNEB); and the Energy and Petroleum Tribunal (EPT), which is the successor of the Energy Tribunal.

[13] Government of Kenya, IMF and World Bank, 1996.
[14] Government of Kenya, 2004.
[15] NuPEA, n.d.
[16] Energy Act 2019.

Presently, Kenya's electricity sector remains unbundled in nature with separate entities responsible for power generation, transmission, distribution and retailing.

Chapter 1: Energy governance

Exploring energy governance is essential to understand how the coordination amongst ministries and entities takes place, how they are structured, and how their policies are interconnected to achieve the set goals. This section is divided into two main sub-chapters, which are the energy sector's organisational structure and the policy and legal framework for development purposes.

1.1. The energy sector's organisational structure

1.1.1 Public entities

The **Ministry of Energy (MoE)** is the lead institution at the national level, mandated with policy formulation, and provides a long-term vision to all energy sector players. The Ministry oversees sectoral planning, electrification of rural areas and exploration of indigenous energy sources, promotes the development of renewable energy, and mobilises financial resources for the public sector. The MoE is responsible for overall national policy coordination and development in the energy sector in Kenya. The MoE mandate covers hydropower, geothermal energy, rural electrification, renewable energy, security and conservation. The Ministry is guided by the Energy Act 2019, the Energy Policy 2018, the recently launched National Energy Efficiency and Conservation Strategy (NEECS) 2020, Feed-in Tariff Policy 2012, Kenya National Electrification Master Plan 2018, and the Bioenergy Strategy 2020, amongst others. The main functions of the Ministry are related to the formulation, articulation, implementation and oversight of the energy policy, to develop parameters for energy demand planning, as well as to issue exploration licenses for coal and geothermal energy. In formulation of policy, as well as fiscal, legal and regulatory frameworks for exploration and production of all energy sources, it considers advice from the Energy and Petroleum Regulatory Authority (EPRA) and the Energy and Petroleum Tribunal (EPT). The State Department of Energy has three Directorates namely:

- **Renewable Energy Directorate:** responsible for promoting the development and use of renewable energy technologies (solar, wind, tidal, small hydropower, biogas and municipal waste-to-energy, and biomass - including biodiesel, bio-ethanol, charcoal, fuel wood).
- **Electrical Power Development Directorate:** responsible for electrical energy policy formulation and development, as well as planning for power development to ensure that there is quality and affordable energy for national development.
- **Geo-Exploration Directorate:** responsible for geothermal, coal and nuclear energy activities under the Ministry.

The **Ministry of Environment and Forestry** (MoEF) acts as the focal point for climate change activities and coordinates the Climate Change Action Plan. The Ministry is the focal point for the Global Environmental Facility (GEF). One of its semi-autonomous government agencies, the National Environment Management Authority (NEMA), is the National Designated Authority (NDA) for the Green Climate Fund (GCF) climate finance. As the GCF NDA, the Ministry invites project proposals and endorses them. Priority areas include waste, and the Ministry is the custodian of waste management and gives policy direction: currently, a waste policy is in the process of being drafted. Projects include a Danida-supported Green Growth and Employment project, and a GEF supported and UNIDO-implemented Industrial Waste-to-Energy project, for which the Ministry of Energy is a partner. In addition, the Ministry of Energy and the Ministry of Environment and Forestry are working together to promote the use of bamboo as a cooking fuel. It is a strategy led by the Office of the President and the hope is that it can be scaled up. Bamboo growing is one of

the priorities in the Strategy for Achievement and Maintenance of 10% Tree Cover implemented across ministries and sectors. Currently, the Ministry is trying to come up with four tiered intergovernmental structures, in order to spell out the horizontal and vertical integration required by the Intergovernmental Relations Act 2012, and Gazette Notice of May 2020, as did the Ministry of Agriculture. These include a sector Steering Committee, co-chaired by Cabinet Secretary and Chair of Environment Committee of the Council of County Governors (CoG); a Sector Consultative Forum, co-chaired by the Chief Administrative Secretary in the Ministry, and a senior officer designated for the purpose by CoG; a Sector Technical Committee, co-chaired by Principal Secretary in the Ministry and chair of the environment caucas of the County Executive Committee (CEC) Members; and lastly, thematic working groups jointly identified by the two levels of government to support different themes[17]. This should improve multi-level governance and collaborative efforts across governance levels.

The **Ministry of Devolution** is responsible for intergovernmental relations (specifically related to service delivery), coordination of capacity building, and technical assistance. The emphasis from the department is on technical assistance over capacity building. National government and counties share service delivery but have different roles, policies and implementation responsibilities; however, delivery is completed as one government. This has been a collaborative success and the consultation is well managed. Importantly, there are 17 inter-governmental sectoral forums in place, which the Council of Governors (CoG) attends. These typically meet on an "issue" basis, but the State Department of Devolution would like to have them more regularly and be a positive place for problem solving, not only a place where problems or crises are discussed. There is a need to do a gap analysis for the energy sector, for which actions can be developed in order to bridge any gaps.

The **National Treasury** is responsible for coordinating the national development agenda - Vision 2030 - through medium term plans (MTP3 currently). The **State Department for Planning** within Treasury is divided into seven Directorates: Macroeconomic Planning and International Economic Partnerships; Social and Governance; Sustainable Development Goals (SDGs) projects and programmes coordination; Economic Development Coordination; Monitoring and Evaluation; Infrastructure, Science, Technology and Innovation; and Public Investments Management (PIM).[18]

The Department works with counties through consultation and participatory processes in priority plan development, providing guidelines for the development of County Integrated Development Plan (CIDP) and County Annual Development Plans (CADP), and offers capacity building and technical assistance for development and review of CIDPs to counties on request. PIM coordinates the management of all public investments. Treasury is also the Focal Point for Green Climate Finance (GCF) as part of its mandate to mobilise internal and external resources.[19]

Also housed in the National Treasury, the **Public Private Partnership Unit (PPPU)** became operational in 2010 and, over time, has been strengthened with technical, legal, safeguards, procurement, PPP, and financial expertise. The main function of the PPPU is the coordination of the review and approval process for PPP projects, in order to facilitate the flow of bankable, viable and sustainable projects that further the National Policy on PPP. Primary responsibilities include assisting each contracting authority (e.g. Ministry of Energy, Kenya Electricity Transmission Co. Ltd.

[17] Direct input from Olwasi, K. in review, 2020.
[18] Direct input from Muoki, K. in review, 2020.
[19] Direct input from Olwasi, K. in review, 2020.

(KETRACO)) to identify, select, appraise, approve, negotiate and monitor PPP projects throughout their life cycle. Kenya has a comprehensive legal and policy framework that directly and indirectly affects PPP processes at both national and local levels.

At national government level, the **Energy and Petroleum Regulatory Authority (EPRA)** is an autonomous, independent sector regulator, that works to set, review and adjust consumer tariffs – to provide consumer protection, approve power purchase agreements (PPAs) and power tariffs, promote competition and provide regulation to energy sub-sectors, resolve consumer complaints and enforce environmental, health and safety regulations. The Energy and Petroleum Regulatory Authority (EPRA) was established as the successor to the Energy Regulatory Commission (ERC) under the Energy Act (2019). EPRA is responsible for regulation of the energy sector agencies, oversight, and monitoring and enforcement of sector regulations, ensuring reasonable return on developers' investments, and overseeing licensing and review of power companies. At national level, EPRA delivers technical safety audits of power plants, checks the financial health of generation plants, and advises the national government on turnkey projects - there are tax exemptions for key projects (the MoE applies for this from the National Treasury). There is a PPA Committee in EPRA that provides oversight - and approves initialised PPAs between the off-taker and power generation companies. EPRA is also responsible for tariff negotiations with Kenya Power and additionally works with the Rural Electrification and Renewable Energy Corporation (REREC), regarding power distribution lines.

REREC and other national entities work closely with the **Renewable Energy Resources Advisory Committee (RERAC).** RERAC is an inter-ministerial committee intended to advise the Cabinet Secretary of Energy on matters concerning the allocation and licensing of renewable energy resources areas, management of water towers and catchment areas, development of multi-purpose projects, such as dams, and development and management of renewable energy resources.

Finally, there exist independent legal entities, such as the **Energy and Petroleum Tribunal (EPT)** that arbitrates disputes and appeals between parties in the energy sector, with its main function to hear appeals from decisions made by EPRA. The EPT is the successor to the Energy Tribunal, and has a broader jurisdiction.

Box 1: Licensing agencies for energy-related projects

The national agencies that provide licences and/or clearances for energy-related projects include:

- The Ministry of Energy: www.energy.go.ke
- The Kenya Power and Lighting Company: www.kplc.co.ke
- The Kenya Civil Aviation Authority: www.kcaa.or.ke
- The National Environment Management Authority: www.nema.go.ke
- The Ministry of Local Government: www.localgovernment.go.ke
- The Energy and Petroleum Regulatory Authority: www.epra.go.ke
- The Water Resources Management Authority: www.wrma.or.ke

The following agencies are also key in setting up renewable energy projects:

- The Registrar General for information on Company Registration: www.attorney-general.go.ke
- The Ministry of Lands: http://www.ardhi.go.ke

- Ken Invest: www.investmentkenya.com

The electricity sector in Kenya is unbundled, meaning there are separate entities responsible for generation, transmission, distribution and retailing (see **Figure 1).** Strong policy and regulatory reforms have created a supportive environment for the participation of independent power producers (IPPs) in the electricity sector.

1.1.2 Parastatals

The **Kenya Electricity Generating Company (KenGen)** is a parastatal where the government owns 70% and the private sector owns 30% of the company. KenGen is mandated with developing and managing all public power generation facilities, but competes with independent power producers (IPPs). KenGen owns and operates 32 power stations in Kenya, providing 62% of installed capacity and 75% of sales. Geothermal energy is the bread and butter – much investment is made in this sector and capacity is expected to grow by 700MW to a total of 1796 MW in the next 5 years. KenGen is at the forefront of strategy and innovation for energy in Kenya. KenGen has an energy plan and is given projects that can be done by the public sector. KenGen has its own CSI project implemented in counties (i.e. at the local level) for healthcare and educational programmes. Counties need to provide the land for resources to be exploited by private entities. However, KenGen has no structured arrangement in terms of engaging with counties. KenGen is regulated by EPRA and governed by the Ministry of Energy and the National Treasury.

Kenya Electricity Transmission Company (KETRACO) fully belongs to the government and owns, plans, designs, builds, operates and maintains high voltage electricity transmission lines (132kV and above) and associated substations. KETRACO was specifically established to develop new high voltage electricity transmission infrastructure that will form the backbone of the National Transmission Grid, in line with Kenya's Vision 2030 for electrification.

Kenya Power is 51% government-owned, possesses most of the power supply network, and operates all national electricity transmission and distribution systems in Kenya. Kenya Power is the off-taker in the power market, responsible for the purchase of all bulk electricity from all power generators on the basis of negotiated power purchase agreements (PPAs) for onward transmission, distribution and supply to consumers. As the only licenced Public Electricity Supplier, Kenya Power has energy purchase contracts with IPPs and KenGen, and is the sole supplier to end-use customers throughout the country. Kenya Power also operates the majority of the off-grid diesel power plants on behalf of the government's Rural Electrification Programme. It is the system operator and is responsible for generation scheduling and dispatch, frequency control, voltage control, outage management and system security**.**

The **Nuclear Power and Energy Agency (NuPEA)** is the implementing agency mandated with the development of a comprehensive legal and regulatory framework for nuclear electricity generation and use in Kenya. It carries out research, development, and dissemination activities in the energy and nuclear power sector, and develops the human resource capacity to ensure Kenya has the requisite manpower to successfully establish and maintain a nuclear power programme.

The **Rural Electrification and Renewable Energy Corporation (REREC)** is responsible for implementing rural electrification through extension of the grid and off-grid projects, managing the Rural Electrification Programme Fund, establishing energy centres in counties, mobilising funds in support of rural electrification projects, financing project preparation studies for rural

electrification and recommending suitable policies to the government; developing, promoting and managing the use of all renewable energy and technologies excluding geothermal; and coordinating research in renewable energy. Rural electrification is a mechanism for urban-rural economic balance. With the Energy Act 2019, REREC replaces the Rural Electrification Authority (REA), and continues with its mandate to accelerate the pace of rural electrification in the country, in order to promote sustainable socio-economic development. In addition to rural electrification, REREC has an expanded mandate in relation to renewable energy and the green energy drive in Kenya, that will put it at the centre of policy formulation, research and development, international cooperation and, importantly, the promotion of renewable energy use amongst the local population. REREC has installed 26 solar mini-grids, and initiated 19 isolated diesel generators in off-grid counties of Kenya. Garissa 5OMW solar plant is one of REREC's generation plants, which contributes to approximately 2% of the national energy mix.[20]

Geothermal Development Company (GDC) is a state-owned enterprise, with the mandate to accelerate geothermal resource developments in Kenya. It is considered a Special Purpose Vehicle (SPV) intended to undertake surface exploration of geothermal fields, appraisal and production drilling, development and management of proven steam fields, and enter into steam sales agreements with investors in the power sector. The mandate of the GDC covers the following:

- To promote rapid development of geothermal resources in Kenya through surface exploration and drilling for steam.
- To avail steam to power plant developers for electricity generation.
- To manage the geothermal reservoirs to ensure constant supply of steam for power generation.
- To promote alternative uses of geothermal resources other than electricity generation. These include greenhouse heating, drying of grains, pasteurizing milk, cooling and heating of rooms, among others.[21]

[20] Direct input from Kimotho, P. in review, 2020.
[21] GDC, 2020.

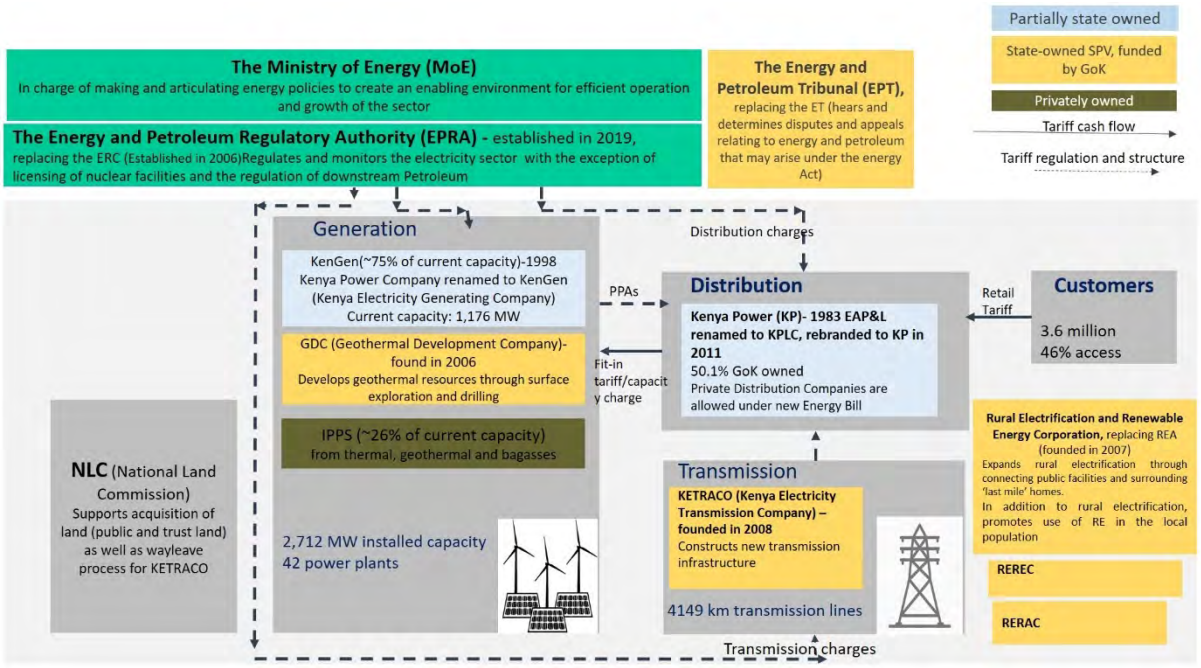

Figure 1 *The organisational structure of Kenya's energy sector (based on USAID, 2015a, updated and verified by ICLEI AS through national bilateral engagements, 2019)*

1.1.3 County governments

Kenya is divided into forty-seven (47) administrative **County Governments,** who prepare their respective County Energy Plans for their energy requirements for the Cabinet Secretary of Energy. Under the Energy Act 2019, the county government's mandate includes reticulation of electricity. This has seen some of the counties provide supplementary funding to rural electrification projects within their counties. The Act sets out clearly defined roles of the national government and the county governments in relation to energy infrastructure. While national government functions continue to include national policy formulation, energy regulation and licensing functions, and operation and development of energy infrastructure, in particular for natural resources-based energy, counties are required to step up in their functions. These include county energy planning and regulation of energy operations such as gas reticulation, charcoal production, biomass and biogas licensing, among others. In sum, since the revised Energy Act 2019 was implemented, the mandate has been passed from the national government to the executive (county) arm of government, who now bear the responsibility to further develop the energy sector.[22]

The **County Governor** develops the portfolio structure for the County Executive Committee (CEC), based on the county context, and in order to respond to the functions and competencies that the law assigns and transfers to each county. The County Governor acts as the head, or chief executive, of the county government, which is the second level (or tier) of government. The governor appoints the CECs, through whom he executes his duties. The Governor is the chairperson of the CEC.

The **County Executive Committee (CEC)** is in charge of managing, coordinating and implementing county government plans and policies, specifically related to development priorities for the county. The committee consists of the County Governor, the Deputy County Governor and

[22] Munyaka, 2019.

the County Executive Committee Members appointed by the County Governor. The CEC has an important role to play in urban area or city planning, as well as determining the organisation of the county and its various departments.

Institutionally, the **Council of Governors (CoG)** is a seven-year-old political institution that operates in a committee system, with 12 in total. The CoG is key to county involvement in projects, such as those required for renewable energy projects or programmes. Each committee is aligned with a devolved or concurrent function comprising six to eight county governors on each committee, bringing together 47 governors. This mode of operation is designed to ensure consultation and cooperation between counties and national government.

1.1.4 Private sector

Independent Power Producers (IPPs) are private investors in the power sector. They are involved in power generation either at large-scale or in development of renewable energy projects under the Feed-in Tariff Policy. Other private electricity suppliers are companies involved in off-grid solutions, who provide mini-grid solutions and standalone renewable energy systems to energy consumers.

Emergency Power Producers (EPPs) are private companies that have quick, readily deployable energy on demand in times of an emergency. EPPs use fossil fuels generators "on demand" for short-term supply. Examples include firms such as Aggreko.

'**Prosumers**' of renewable are operators that produce a portion of their on-site power needs from renewable energy technologies and sell the excess electricity to the national/local grid or local community. This includes renewable energy sources for heating and cooling needs, as well as electricity generation. It also includes the use of certain bio-energy resources such as those from forestry, meat processing, and agriculture, as well as the waste management sector. In Kenya, IPPs play a key role in this; some prosumers who currently supply excess power generated to the national grid include:

- ✔ Imenti Tea Factory owned by Kenya Tea Development Authority (KTDA) that has an installed capacity of 0.283MW and supplied 0.3 GWh to the grid in 2019[23];
- ✔ Strathmore Solar owned by Strathmore University with an installed capacity of 0.25MW and supplied 0.15GWh to the grid in 2019[24];

A stakeholder map (**Figure 2**) summarises the different entities across the energy sector, grouping them according to:

- Policy and regulation
- Generation
- Distribution
- Transmission
- Energy financing

[23] KPLC, 2018.
[24] Ibid.

- Capacity building
- Regulation
- Tariff setting

Key:

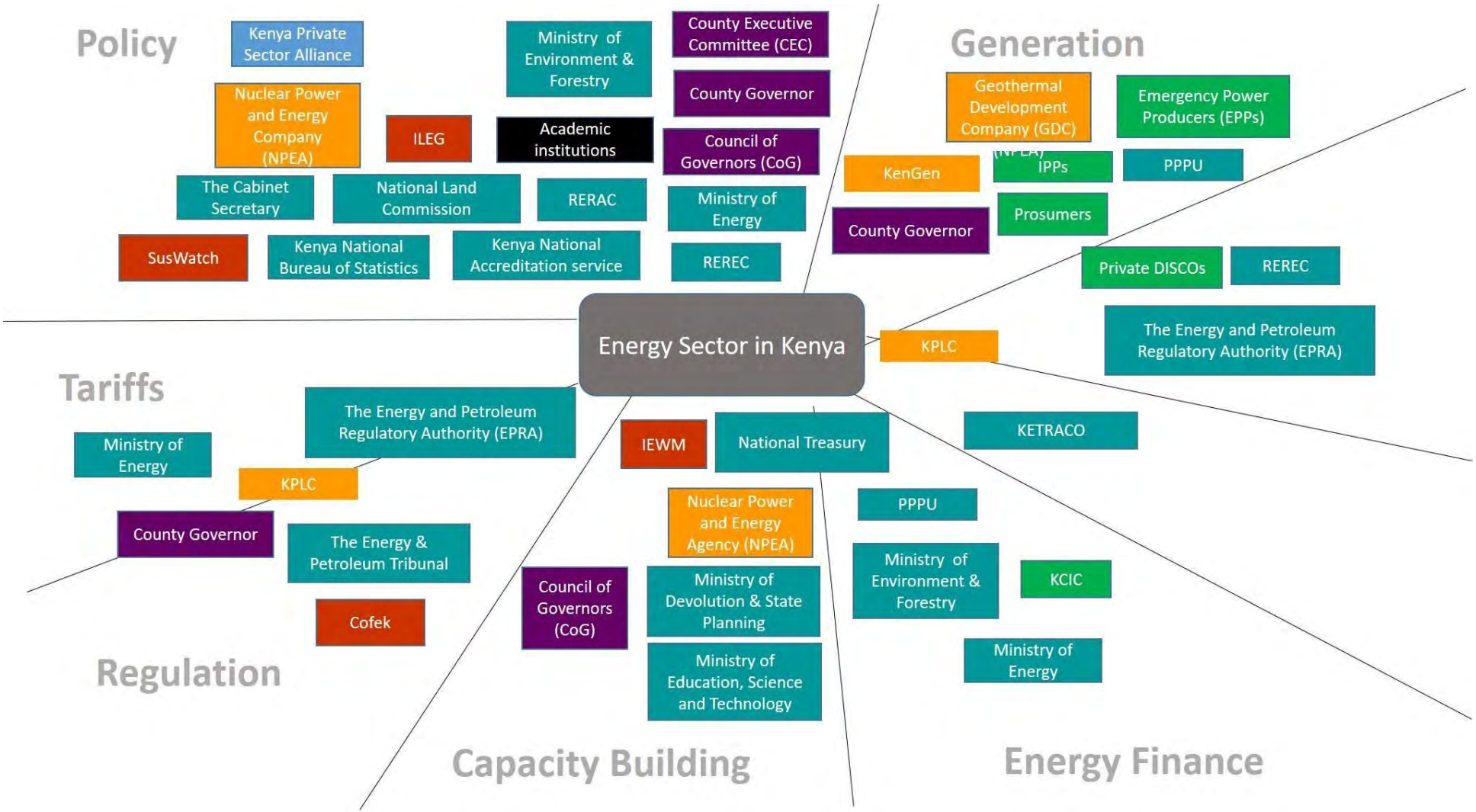

Figure 2 *Stakeholder map of energy sector actors and their main areas of activity [Source: ICLEI AS desktop research]*

1.2 Policy landscape and legal framework for development

1.2.1 Climate change and development policies and targets

1.2.1.1 Vision 2030

Vision 2030 was launched as a vehicle for accelerating transformation of the country with the overall aim to transform Kenya into a newly industrialising, middle-income country providing a high quality of life to all its citizens by 2030, in a clean and secure environment. The Vision was developed through an all-inclusive stakeholder consultative process and aims for 10% economic growth annually. Vision 2030 is implemented through five-year Medium-Term Plans (MTPs). MTP I 2008-2012 and MTP II 2013-2017 have already been implemented. The next phase of Vision 2030 is now being implemented through the Third Medium Term Plan (MTP III) 2018-2022, succeeding the Second MTP (MTP II) 2013-2017, which implemented the policies, programmes and projects as outlined in the Jubilee Manifesto "Agenda for Kenya 2013-2017 and Beyond".[25] MTP III is driven by the Big Four Agenda, and implemented on the foundations that have been put in place during the First and Second MTPs. The envisioned planning process is projected to flow from national to local level as follows: Vision 2030 > MTP3 > CIDP > CEP. Renewable energy technology is a priority: a national resource map is under development, as is a national strategy for resource use - including the research and promotion of municipal waste-to-energy.

1.2.1.2 Green Economy Strategy and Implementation Plan (GESIP 2016-2030)

The Green Economy Strategy is geared towards enabling Kenya to attain a higher economic growth rate consistent with the Vision 2030, which strongly embeds the principles of sustainable development in the overall national growth strategy. The strategy and its implementation plan focus on overcoming the main binding social constraints towards the attainment of Vision 2030. It targets multiple challenges including infrastructure gaps, food insecurity, environmental degradation, climate change and variability, poverty, inequality and unemployment. It will guide Kenya's transition to a sustainable path in five thematic areas, namely: sustainable infrastructure development; building resilience; sustainable natural resource management; resource efficiency; and social inclusion and sustainable livelihoods. GESIP is based on a paradigm shift in the existing development model towards a green pathway, characterised by eco-innovation in all sectors of the economy. GESIP has been mainstreamed in all national and county plans.[26]

The Danida-supported Green Growth and Employment project was developed to implement GESIP. Through the project, important instruments for a greener trajectory and circular economy have been drafted, awaiting validation, including:

i. Waste Management Policy and Bill;

ii. Environmental Sustainability and Circular Economy Awareness Campaigns for urban centres;

[25] Government of Kenya, Third Medium Term Plan (MTP III), 2018

26 Direct input from Muoki, K. in review, 2020.

iii. Green Growth and Circular Economy Toolkit for Policy Makers in Kenya;

iv. Framework for private sector engagement in green and circular economy in Kenya; and

v. Development of Green Public Procurement Framework[27]

1.2.1.3 President Kenyatta's Big Four Agenda (2018)

The Government of Kenya priorities for 2019/20 are referred to as the "The Big Four Agenda" and are prioritised in the Third Medium-Term Plan (MTP3). The Agenda is a national roadmap for economic development, focused on four primary themes[28]:

- **Food security:** Focusing on initiatives that guarantee food security and nutrition to all Kenyans
- **Affordable housing:** Supporting construction of at least 500,000 affordable new houses for Kenyans
- **Universal healthcare:** Providing universal health coverage, thereby guaranteeing quality and affordable healthcare to all Kenyans
- **Manufacturing:** Supporting job creation by increasing value addition and raising the manufacturing sector's share of GDP (to 15%)

1.2.1.4 Kenya's Nationally Determined Contribution (NDC) (2017)

Kenya submitted its Intended Nationally Determined Contribution (INDC) as its Nationally Determined Contribution (NDC) in July 2015, in the lead up to the Paris Agreement under the United Nations Framework Convention on Climate Change (UNFCCC). It ratified the Paris Agreement on 28th December 2016. Kenya's NDC sets out an ambitious mitigation contribution of abating greenhouse gas (GHG) emissions by 30% by 2030 relative to the BAU scenario of 143 MtCO2eq; in line with its sustainable development agenda, and subject to international support (via finance, investment, technology development and transfer, and capacity building).[29] More recently, Kenya submitted its updated NDC in December 2020, with a new increased commitment to abate GHG emissions by 32% by 2030, relative to the BAU scenario.[30]

Of Kenya's total GHG emissions, 75% are from land use, land-use change and forestry (LULUCF), and agriculture sectors, primarily due to the reliance on wood fuel by a large proportion of the population as well as the increasing demand for agricultural land.[31] Pursuing a low-carbon energy development pathway is essential to meet Kenya's 32% emissions reduction target. Kenya's ambitious NDC mitigation goals rely on emission reductions in several sectors (see **Figure 3**), most significantly the LULUCF sector, and include expanding renewable energy sources (e.g., geothermal, solar, and wind), increasing tree cover to at least 10% (from a current level of 6.2%[32]),

27 Direct input from Olwasi, K. in review, 2020.
[28] Development Initiatives, 2019.
[29] Kenya INDC, 2015
[30] MoEF, 2020
[31] MENR, 2015.
[32] World Agroforestry Centre, 2012.

and adopting practices that sustainably increase productivity and build resilience to climate change impacts in the agriculture sector. The NCCAP and Second National Communication (SNC) details the BAU projection methodology, including key assumptions, drivers and methodologies for each sector, with a base year of 2010. The sectors covered by Kenya's mitigation contribution are: Energy, Transportation, Industrial Processes, Agriculture, Forestry and Other Land Use (AFOLU) and Waste.[33]

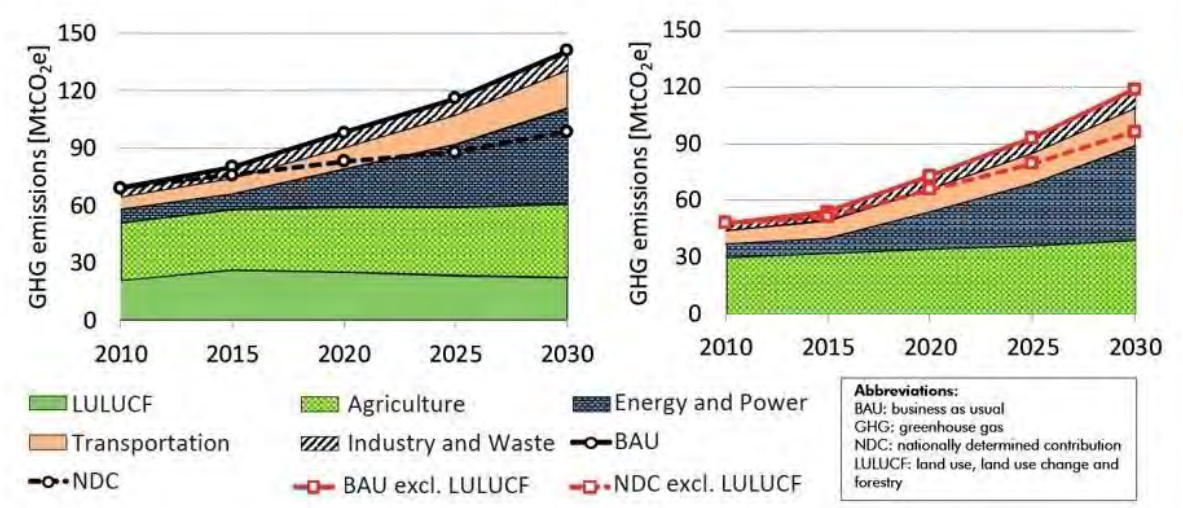

Figure 3 *The contribution of different sectors to greenhouse gas (GHG) emissions in Kenya, including (left) and excluding (right) contributions from land use, land use change and forestry (LULUCF) [Source: SEI, 2017].*

Kenya's programme of action for adaptation aims to ensure enhanced resilience to climate change towards the attainment of Vision 2030 by mainstreaming climate change adaptation into the Medium-Term Plans (MTPs) and implementing adaptation actions. The sectors covered by the MTP includes energy, health, water and irrigation, environment, agriculture, livestock development and fisheries, amongst others.[34] Achievement of the adaptation goals depends on financial, technological and capacity-building support. Kenya's mitigation objectives in the NDC are specific, measurable and time-bound. However, the adaptation objectives are broader and are likely to present challenges in reporting. The analysis underlying the mitigation component of the NDC was based on work undertaken for the National Climate Change Action Plan, 2013-2017 (NCCAP) – since revised. In order to support NDC implementation for climate and development action, Kenya joined the NDC Partnership in 2017, appointing a Focal Point in the Climate Change Directorate of the Ministry of Environment and Forestry, with close engagement with the National Treasury and Planning Department. Achievements in regard to the first NDC have been reviewed in two reports, the Adaptation Technical Analysis Report (ATAR) and Mitigation Technical Report (MTAR), as a basis for making the next NDC commitments in the period beginning 2020. Kenya's NDC has also undergone review based on the two reports and in compliance with new Modalities, Procedures and Guidelines (MPG) for making new commitments. The new NDC has undergone technical validation and is under consideration from the Cabinet.[35]

[33] MENR, 2015.
[34] Ibid.
[35] Direct input from Olwasi, K. in review, 2020.

1.2.1.5 Kenya's Climate Change Act (2016)

Kenya's Climate Change Act seeks to mainstream climate change planning in all sectors and at all levels of government. The Act put in place the structures and framework for implementing the NDC, as well as established a coordinating body for doing so: the Climate Change Directorate. The Climate Change Directorate is the lead agency of the government on national climate change plans and actions, delivering operational coordination and providing technical assistance on climate change actions and responses to county governments. The Act calls for National Climate Change Action Plans (NCCAPs) every five years.

1.2.1.6 National Climate Change Action Plan (NCCAP) (2018-2022)

The NCCAP is the implementation policy document for the NDC. It incorporates the country's priority Sustainable Development Goals (SDGs), the NDC, the National Adaptation Plan (NAP), the Medium-Term Plans (MTPs), and other national policies, including President Kenyatta's Big Four Agenda, into one framework for action. A wide range of actors, including government agencies, the private sector, and civil society organisations (CSOs), contribute to the implementation of the NCCAP. The NCCAP details priority adaptation actions, based on risk and vulnerability assessments across the MTP sectors. In addition, the first five-year NCCAP (2013–2017), a Monitoring, Reporting and Verification (MRV+) system was proposed, in order for Kenya to effectively measure, report and verify its climate actions. This MRV system is incorporated within a wider National Performance and Benefit Measurement Framework. While some of the framework components have been implemented, there are significant challenges to successfully implementing a full MRV+ system, related in particular to defining clear roles and responsibilities for MRV within governance levels. This is notable considering the devolution of power to county level.[36] The NDC Partnership provided support to Kenya in order for the country to prepare and update its National Climate Change Action Plan (NCCAP) to the 2018 to 2022 timeframe. The second of Kenya's NCCAP (2018-2022) covers NDC implementation and builds on the existing elements of the MRV+ system, included within the first NCCAP.

1.2.1.7 National Adaptation Plan (NAP) (2015-2030)

The NAP builds on the foundation laid by the National Climate Change Response Strategy (NCCRS) 2010, and the NCCAP, and consolidates Kenya's vision for adaptation supported by national-level, sectoral adaptation actions and related to county-level vulnerabilities, in order to enhance long-term resilience and adaptive capacity. The NAP is anchored in the Constitution of Kenya and Vision 2030. It is aligned with the Climate Change Act, the Medium-Term Plans (MTPs) and Medium-Term Expenditure Framework (MTEF) planning processes. Planning processes for both mitigation and adaptation hinges on the NCCAP and the NAP, with specific emphasis on adaptation actions in the NAP, and thus the two are reviewed every five years to inform the MTP.

[36] Climate & Development Knowledge Network, 2018.

1.2.1.8 National Climate Change Response Strategy (NCCRS) (2010)

The NCCRS was the first national policy to fully acknowledge the reality of climate change and has been guiding policy decisions since its launch in 2010. The Strategy provides evidence of climate impacts on different economic sectors and proposes adaptation and mitigation interventions. Furthermore, the NCCRS has developed a multidisciplinary and participatory process involving the public sector, the private sector, academia, and civil society to "*enable Kenya to reduce vulnerability to climate change and to improve the country's ability to take advantage of the opportunities that climate change offers*".[37] As part of NCCRS, Kenya has developed a resource mobilisation plan to ensure proposed programmes and projects are fully implemented. The plan targets domestic resources from both local and national government, as well as from the private sector. In addition to international funding agencies, such as the World Bank and International Monetary Fund (IMF), the mobilisation plan also envisages raising external resources from development partners, regional funding agencies and multilateral development banks, such as the African Development Bank (AfDB).

1.2.1.9 County Integrated Development Plans (2018-2022) (2013)

As part of the constitutionalised devolution process, the County Integrated Development Plan (CIDP) is a plan prepared by each county in Kenya to inform development over a five-year period. Within the CIDPs, counties must articulate the sector(s) that will be prioritised and how and why the selected sector(s) will facilitate development in the county, as well as provide strategic priorities within all sectors and detail how these priorities will interact in order to attain the desired development changes.[38]

The Public Finance Management Act of Kenya has the provision that no public funds shall be appropriated outside a county's planning framework. Therefore, the CIDP should contain information on all development priorities that guide the annual budget allocation, and co-ordinate multi-level governance in a coherent plan to contribute towards devolution and county prerogatives. This especially pertains to the preparation of annual development plans, the annual county fiscal strategy papers, and the annual budget estimates. Counties are required to provide programme level information in their CIDPs, making it simple to track expenditure allocations in annual budget estimates. Counties have specific constitutional functions and must collaborate with the national government, which has complementary functions.

CIDPs should be developed in consideration of historical opportunities and threats, and thus are prepared in such a way that they consider and build on successes and challenges from previous years. The CIDP should answer guiding questions that include:

- Were revenue targets achieved, and, if not, what are the reasons for shortfalls?
- Are there ongoing programmes from the previous CIDP-cycle that still require financing, need to be abandoned, or need to be revised?
- What challenging socio-economic issues remain after the implementation of the previous CIDP, and how does the current CIDP address or plan to overcome these?[39]

Each CIDP has an overarching vision and mission that guides strategic activities. For example, Kisumu County's vision is to achieve '*A peaceful and prosperous County where all citizens enjoy a high-*

[37] Government of Kenya, 2010.
[38] International Budget Partnership, 2018.
[39] International Budget Partnership, 2018.

quality life and a sense of belonging', while its mission is '*to realize the full potential of devolution and meet the development aspirations of the people of Kisumu County'*. Different turnkey investments are prioritised in order to achieve the unique, specific vision and mission of each county.

1.2.1.10 Other

- East African Community's Climate Change Master Plan
- National Spatial Plan (2015-2045)
- National Climate Change Framework Policy (2016)
- National Climate Finance Policy (2016)
- Climate Change Bill (2014)
- National Waste Management Strategy, Waste Policy and Climate Change Action Plan (2018-2022)

1.2.2 National energy policies and programmes

1.2.2.1 National Energy Act (2019)

The two new acts of Parliament passed in 2019, the Energy Act 2019 and the Petroleum Act 2019, contain consolidated and updated laws for the energy sector. The Energy Act 2019 repeals the (previous) Energy Act, Geothermal Resources Act and the Kenya Nuclear Electricity Board Order No. 131 of 2012. The Energy Act 2019 has several amendments to the repealed Energy Act and paves the way for the energy sector to take further steps towards its modernisation and development. The new Act has established several new energy sector entities that replace those existing under the repealed laws. The Act has gone further to restate and expand their mandates where this is necessary so that they may properly discharge their functions (see **Table 11, Annex 1**). In essence, the new energy sector entities (EPRA, EPT, REREC, RERAC, NuPEA) are fundamentally the same as those they replace; the transition will primarily be about adopting the full spectrum of their mandates.

The Energy Act's main objectives are to make institutional reforms, encourage more private investment and provide new sources of energy. However, the overarching purpose of the revised Energy Act 2019 is to clearly articulate and pass the energy 'baton' from the national legislature to the executive (or county) government, who now bear the responsibility to develop the energy sector.[40]

The Energy Act of 2019 changed the energy sector landscape through:

- Establishment of a conservation fund to mitigate against hydro risks;
- Provision for the creation of an inventory and resource map for renewable energy resources by the government through the Ministry of Energy (MoE);
- Provision for the exploitation of renewable energy sources;
- Net metering permitted leading to the increase in number of prosumers;
- Open access: KenGen can now sell to anyone, not only Kenya Power;
- Local content requirements for human resources and equipment;

[40] Munyaka, 2019.

- All renewable and geothermal energy resources have been vested in the national government who can develop them for the benefit of all Kenyan people, not only the regional county governments and communities where the resources are located, as resources are not evenly distributed across the country. However, the county governments and communities receive compensation through a proportional allocation of the royalties charged by the national government for the development of the resources.

1.2.2.2 Energy Policy (2018)

The main purpose of the Energy Policy is to accelerate economic growth and to increase productivity in all sectors, through affordable, competitive, sustainable and reliable supply of energy at the least cost in order to meet national and county development needs. To match Vision 2030's focus on economic growth, future energy generation will be needed of at least 2000MW, along with greater electrification of the economy. If geothermal energy cannot come online fast enough, then the country will consider fossil fuels (e.g. clean technology for coal) for this baseload generation, as energy security for Kenya is key.

1.2.2.3 Devolution Policy

The Devolution Policy is anchored in the new Constitution of Kenya 2010, Sessional Paper of Devolved Government 2012, and national values and principles of governance. The Constitution of Kenya ushered in a decentralised system of government wherein the legislature and executive governance of the former eight regional governments were devolved to the 47 political and administrative counties, with the overall objective to devolve power, resources and representation down to the local level. The policy consolidates devolution processes, and clarifies and strengthens roles and responsibilities of both the national and county governments to boost the implementation of devolution, as it is envisaged in the constitution.[41] The devolved governance system includes the allocation of responsibility for energy planning to the county level. In the energy sector, decentralisation affords an opportunity to redress historical imbalances created by the centralised approach to energy planning. Such centralised planning prioritised large-scale centralised energy systems, often with little inclusion of the household sector (despite it accounting for the majority of the country's energy demand), resulting in limited access to modern energy services.[42] Most household energy needs continue to be met through traditional biomass fuels.

1.2.2.4 Least Cost Power Development Plan (LCPDP) (2017-2037)

The Least Cost Power Development Plan is a Kenya Energy Sector Report intended to guide the sector-on-sector status, generation expansion opportunities, and transmission infrastructure target network expansion, as well as resource requirements for the expansion programme. The Updated LCPDP (2017-2037) report was conducted through collaboration between sector utilities under the direct coordination of EPRA (then the ERC). Section 5g of the Energy Act 2006 mandated EPRA to prepare indicative energy plans. The Commission in turn coordinates this function through the preparation of bi-annual Least Cost Power Development Plans (LCPDPs) in conjunction with sector utilities. The LCPDP report covers a comprehensive load forecast,

[41] Commonwealth Local Government Forum, 2018.
[42] SEI, 2016.

addresses the committed generation projects between 2017 and 2024 and also the expansion programme for the period 2025-2037. In transmission, the report covers the target network for the period 2017-2037 ensuring that the target network is adequate, secure and cost effective.

The LCPDP drives all energy projects, and policy guidance is provided by the Ministry of Energy (MoE), while regulatory issues as well as secretariat services are provided by the Commission. LCPDP guides stakeholders on how the energy sector plans to meet the energy needs of the nation for development, at least cost to the economy and environment.[43] Timelines for RE project implementation are driven by the LCPDP, not counties. Thus, county work still needs to be aligned with the national government - all plans must be included in the LCPDP and there must be harmony between county energy plans and the LCPDP. Thus, while the LCPDP is being handled at the national level, training on LCPDP and capacity building on the County Energy Planning (CEP) is needed. Considerations in LCPDP are cost, technical skills, geography. The MoE is responsible for feasibility studies and there is a need to tighten up the process.

1.2.2.5 Kenya National Electrification Strategy (KNES)

The Kenya National Electrification Strategy (KNES) was launched in 2018 and provides a roadmap to achieving universal energy access in Kenya; it is perhaps Kenya's most important target related to energy and a key requirement for meeting Kenya's development goals under Vision 2030. Developed in partnership with the World Bank, the KNES is aligned with the Vision 2030 and the LCPDP – the strategy identifies least-cost options for electrifying homes, businesses, and public facilities. KNES aims to electrify 1,105,000 households in 14 underserved counties by 2022, with two million total new connections expected by 2022, located 15 kilometres from Kenya Power service. The Kenyan government will rely heavily on renewable energy resources to achieve its goal. This target is expected to be achieved through grid and mini-grid intensification, densification, and expansion, along with stand-alone solutions that complement grid extension and intensification.

Using geospatial technology, the KNES aims to develop a mechanism that provides objective planning data in order to assist national and county policymakers in making informed decisions regarding grid and off-grid investments required for electric service provision. In 2018, the Government of Kenya also launched the Electricity Sector Investment Prospectus, which presents the investment opportunities in the energy sector over the next 5 years (2018 to 2022), and finds that the country offers $14.8 billion in energy investment opportunities for power generation, transmission, distribution, off-grid electrification, mini-grids and solar systems for homes and institutions.[44] Primarily driven by the private sector, KNES projects 2.2 million solar home systems (SHS) installations by 2023. In support of this target, the government of Kenya is adopting conducive regulations, such as favourable taxes and facilitating duty exemption requests during procurement and delivery cycles, in order to support private sector operations and growth.[45]

[43] Direct input from Kimotho, P. in review, 2020.
[44] World Bank, 2018.
[45] USAID, 2019.

1.2.2.6 Public Private Partnership (PPP) Act (2013) – amended 2017

Public Private Partnerships (PPPs) are a key element of Kenya's development strategy to become a newly industrialised, middle-income country by 2030, as per the Vision 2030. The private sector plays an important role in reaching that goal. The purpose of the PPP Act 2013 is to create an attractive investment environment that will extend the scope of PPPs to cover economic (including for power generation) and social infrastructure projects (including solid waste management facilities). It provides a clear legal structure for government bodies to enter into contracts with the private sector, improve certainty, reduce risk and create investor confidence, as well as provide a clear approval process for PPPs.[46] The Public Private Partnership Unit (PPPU) was established as a Special Purpose Unit within the National Treasury under the Act. In terms of its institutional framework, the Public Private Partnerships Committee (PPPC) is in charge of PPP policy guidelines formulation, project approvals, monitoring and evaluation oversight, while the actual Public Private Partnerships Unit (PPPU) acts as the secretariat and technical arm of the PPPC. Finally, the Project Facilitation Fund is a public entity that prepares projects for tender.

1.2.2.7 Feed-in Tariff (FiT) Policy (2008) – amended 2010, 2012

In recognition of the significant potential of renewable energy sources in Kenya, the Ministry of Energy (MoE) has encouraged potential Independent Power Producers (IPPs) to carry out feasibility studies on renewable energy generation on the basis of which Power Purchase Agreements (PPAs) with the off-taker can be negotiated. Once a PPA is established, the tariff is secured for 20 years. The FiT Policy offers a framework for electricity generated from renewable energy sources (including solar, wind, biomass and biogas, geothermal, and small hydro) in order to safeguard the investments made by the respective developers in undertaking feasibility studies; to boost the development of Renewable Energy (RE) sources for electricity generation; and specifies the contents of a Standardised PPA for up to and above 10 MW plants. Feed-in tariffs allows power producers to sell renewable energy generated electricity to an off-taker at a pre-determined tariff for a given period.[47] This policy was first issued in March 2008 and has been revised twice to respond to stakeholder experiences: once in January 2010 and again in December 2012.

Some of the main advantages of FiTs are that:

i. They limit the investment risk for the power producers[48];
ii. They only cost ratepayers money if projects are in operation;
iii. They lower transaction costs;
iv. They settle uncertainties related to grid access and interconnection;
v. They enhance market access; and
vi. They encourage the use of technologies at different stages of maturity[49].

[46] US Commercial Service, 2013.
[47] Feed-in Tariff Policy, 2012.
[48] This risk is shifted to other participants, such as ratepayers or taxpayers.
[49] Couture et al., 2010.

1.2.2.8 *Kenya Off-Grid Solar Access Project (KOSAP)*

The Kenya Off-Grid Solar Access Project (KOSAP)[50] is a flagship electrification project by the MoE, financed by the World Bank, in the off-grid sector. KOSAP is designed to increase energy access in 14 of Kenya's least-electrified counties, targeting 1.3 million households in north-eastern and northern Kenya. This will primarily be via stand-alone solar systems for households and public facilities, mini-grids, solar water pumps, and efficient cooking solutions. While KOSAP is the largest such project, there are numerous other programmes funded by bilateral and non-governmental organisations that support last-mile distribution of solar solutions in the off-grid areas and play a pivotal role in extending energy access. The project will go a long way in contributing to the KNES targeted universal access to electricity by 2022.[51] This project is important towards achievement of Vision 2030.[52]

1.2.2.9 *Bioenergy Strategy (2020)*

Through the MoE, the government of Kenya recently launched the Bioenergy Strategy (18 November 2020), two years ahead of schedule as set out in the SE4All Action Agenda. The Strategy outlines the targeted improvements to be made in the bioenergy sector, which include the sustainable production and efficient use of biomass, waste-to-energy conversion, and the development of biofuels. As an energy source, bioenergy plays a crucial role in meeting cooking and heating needs for a vast proportion of Kenya's population. The Bioenergy Strategy was developed through a multi-stakeholder consultative process, and partners include the Kenya Private Sector Alliance (KEPSA), the World Bank, GIZ, ICRAF, as well as representatives from academia and civil society.[53] Specific objectives, as outlined in the Strategy, include:

- To promote sustainable production and consumption of bioenergy;
- To accelerate the transition to clean cooking technologies and fuels;
- To provide requisite information to potential investors on relevant opportunities for bioenergy development in Kenya; and
- To serve as an appropriate framework for regional and international cooperation and trade, specific to bioenergy and related feedstock.

1.2.2.10 *Kenya National Energy Efficiency and Conservation Strategy (2020)*

The Kenya National Energy Efficiency and Conservation Strategy (KNEECS, or The Strategy) was launched in September 2020 by the MoE in Kenya. Developed through partnerships with the UNEP DTU Partnership, as well as local and international institutions (such as Kenya Association of Manufacturers (KAM)), and reviewed by the World Bank, the KNEECS seeks to further the achievement of the country's established energy efficiency (EE) goals within the defined period (2020 to 2025).

Overarching goals of the KNEECS include:

- To reduce the national energy intensity by 2.8% per year;

[50] Ministry of Energy, 2019.
[51] Ibid.
[52] Government of Kenya, 2008.
[53] ACCESS Coalition, 2020.

- To promote the use of technology that requires minimum energy to perform the same function;
- To enable the country to achieve a 30% GHG reduction by 2030 relative to BAU (143 MtCO2e);
- To meet its national targets for Sustainable Development Goal 7 (Affordable and Clean Energy) by 2030; and
- To encourage changes in behaviour that lead to reduced daily energy use.

Within the KNEECS, targets have been set across five key sectors: Households, Power Utilities, Transport, Buildings and Industry & Agriculture. In parallel to sector targets, the Strategy aims to strengthen the implementation of EE and conservation measures, with a focus on mobilising resources to improve access to finance for EE projects.[54]

1.2.2.11 Scaling-up Renewable Energy Plan (SREP)

The country also has in place the Scaling-Up Renewable Energy Plan (SREP), which is under implementation. The SREP aims at supporting Kenyan initiatives towards a low greenhouse gas (GHG) emission development pathway by harnessing renewable energy sources (RES) in the country. It has a specific focus on decentralised energy systems, especially mini-grids and solar systems.

1.2.2.12 Kenya Electrification Modernization Project (KEMP)

Funded by the World Bank, and implemented by the Rural Electrification Authority, Kenya Power and Lighting Company (KPLC), Ministry of Energy and Petroleum, the overall aims of Kenya's Electricity Modernization Project are:

i. to increase access to electricity;
ii. to improve reliability of electricity service; and
iii. to strengthen KPLC's financial situation.

The electrification programme supports the government's objective of 70% household connectivity by 2018, through providing grant financing for the connection of new households, thereby introducing a more cost-effective and suitable source of funding for electrification investments. KEMP is primarily focused on peri-urban and rural development, with the main purposes being electricity services for the poor, through infrastructure and service delivery.

1.2.2.13 County energy plans

As outlined in the Energy Act 2019, it is a requirement that counties develop county energy plans outlining their contextual energy requirements, incorporating petroleum, renewable energy and electricity master plans. Thus, counties are mandated to take over energy planning from the legislature, and include the following details:

- Physical planning relating to energy resource areas such as dams, solar and wind farms, municipal waste dumpsites, agricultural and animal waste, ocean energy, woodlots and plantations for production of bio energy feedstock.
- Provision of land and rights-of-way for energy infrastructure.

[54] AfricaNews, 2020.

- Facilitation of energy demand by planning for industrial parks and other energy consuming activities.
- Preparation and implementation of disaster management plans.[55]

In line with the national strategy set out in the Least Cost Power Development Plan (LCPDP), counties are obliged to promote and initiate investigation into renewable energy resources and incorporate this into the CEPs. However, currently counties only have draft energy plans.

1.2.2.14 Other:

- Rural Electrification and Renewable Energy Corporation (REREC) Strategic Plan (2017-2021)
- Sustainable Energy for All (SE4All) Action Agenda
- Kenya Electricity Distribution Master Plan (2013)
- Kenya Electricity Sector Investment Prospectus (2018-2022)

[55] Energy Act 2019.

Chapter 2 National energy status

2.1 Energy consumption and demand

Both the demand and consumption of electricity in Kenya has been increasing over time. Key driving factors are:

i. **Demographic pattern**: This includes population growth, which has an explicit effect on domestic consumption and connectivity level. Over the past 20 years, Kenya's population has doubled with a marked improvement in life expectancy. Although Kenya's extreme growth is expected to slow in the coming years, it will still be significant. The population is expected to grow from 47.6 million to 66.9 million in 2030.[56] As the population grows, so does the need for services – a significant one of these being a need for energy. Based on historical analysis, power consumption in Kenya is expected to grow between 1.0 to 1.2 times GDP growth.[57]

ii. **Urbanisation**: This includes the growth of urban centres which have an impact on the demand for electricity and connectivity levels. The current urban population is 27.5% of the total population, as recorded in the 2019 National Census. The rate of urbanisation in Kenya stands at 4.23% and 50% of the population is projected to be urbanised by the year 2030.[58,59] Industrial growth around the urban centres has resulted in an increasing demand for energy to drive the growth of the commercial and industrial (C&I) sector (which in turn has attracted high power tariffs for industries).

iii. **GDP growth**: This directly impacts on household income and activity of the productive sector, which translates into electricity consumption by commercial and industrial customers. Electricity consumption has a direct correlation to GDP.

iv. **Vision 2030 flagship projects**: These projects have an impact on GDP growth and contribute to demand growth based on their specific load requirements. The impact of these projects has, however, been tempered with the reality that not all the proposed projects will be realised in the planned timeframe; hence only those likely to be implemented in the near future have been considered. Growth in manufacturing, food security and housing sectors would lead to increased business opportunities. Connectivity to competitively-priced, reliable and safe electricity and ease of access to electricity will promote business growth and achievement of the Big Four Agenda. Vision 2030 recognises energy as one of the key enablers of sustained economic growth and a key foundation of Kenya's envisaged national transformation. The vision identifies projects that have a significant bearing on future GDP growth as well as an effective spike in energy demand **(Table 1).**

Table 1 *Flagship projects and their respective assumptions*[60]

Project	Reference scenario				High scenario			
	First year of operation	Initial load (MW)	Year of total load	Total load (MW)	**First year of operation**	Initial load (MW)	**Year of total load**	Total load (MW)

[56] Worldometers.info, 2020.
[57] USAID, 2015a.
[58] Institute of Economic Affairs, 2017.
[59] Indexmundi.com, 2020.
[60] Government of Kenya, 2008.

Electrified mass rapid transit system for Nairobi	**2024**	15	2030	50	**2022**	15	**2027**	50
Electrified standard gauge railway Mombasa - Nairobi	**2022**	98	2030	130	**2021**	100	**2028**	300
Electrified standard gauge railway Nairobi - Malaba	**2026**	61.74	2035	61.74	**2024**	63	**2032**	189
Electrified LAPSSET standard gauge railway	-	-	-	-	**2035**	30	**2037**	30
Oil pipeline and Port Terminal (LAPSSET)	**2025**	50	2037	150	**2022**	50	**2032**	150
Refinery and Petrochemical Industries (LAPSSET)	**2028**	25	2037	100	**2025**	50	**2030**	200
Konza Techno City	**2024**	2	2037	190	**2022**	2	**2034**	200
Special Economic Zones	**2021**	5	2037	110	**2020**	30	**2028**	110
Integrated Steel Mill					**2030**	100	**2035**	200

2.1.1 Consumption

Compared to the rest of the world, Kenya is a relatively low emitter of carbon; the vast majority of which (75%) are from the land use, land-use change and forestry (LULUCF) and agriculture sectors[61]; mostly from deforestation driven by wood harvesting for cooking and heating, and land clearing for agriculture[62]. Energy consumption in Kenya is largely dominated by biomass (68% of the national energy consumption), electricity (9%) and imported petroleum (21%), with biomass (wood fuel, charcoal, and agricultural waste) providing the basic cooking and heating energy needs of the rural communities, urban poor and the informal sector. About 55% of the biomass consumed for primary energy consumption is derived from farmlands in the form of woody biomass, as well as crop residue and animal waste, and the remaining 45% is derived from forests.

In 2017, the consumption of biomass equated to 724 PJ, and equates to 69% of the total, national primary energy consumption. This is followed by petroleum products (22%), electricity (9% - about a third based on the fossil fuels, heavy fuel oil (HFO) and gasoil products, the remaining based on renewable energy sources), and coal (1%).

[61] MENR, 2015.
[62] Ibid.

The commercial and industrial category remains the largest consumer of electricity generated (see **Table 2**). This can be attributed to growth in the manufacturing sector and large commercial establishments driven by the growth in GDP.

Table 2 *Consumption of electricity in GWh for various categories of customers (2014/2015 to 2018/2019)*[63]

Tariff	**Types of customers covered by this tariff**	**Consumption in GWh**				
		2014/15	**2015/16**	**2016/17**	**2017/18**	**2018/19**
DC	Domestic	1,866	2,007	2,138	2,335	2,366
SC	Small Commercial	1,143	1,153	1,201	1,222	1,250
CI	Commercial and Industrial	4,030	4,104	4,266	4,225	4,462
IT	Off-peak	15	26	41	33	N/A
SL	Street Lighting	35	40	55	66	68
	REP System (DC, SC, SL)	525	537	549	554	595
	Export to Uganda	38	43	20	22	27
	Export to TANESCO	2	2	2	1	0.01
	TOTAL	**7,655**	**7,912**	**8,272**	**8,459**	**8,769**
	% INCREASE P.A.	**5.70%**	**3.40%**	**4.50%**	**2.30%**	**3.70%**

2.1.2 Demand

The demand for electricity has shown an upward trend in the last 5 years (see **Figure 4**). While the demand was 7,655 GWh in 2014/15 it increased to 8,769 GWh in 2018/19. Total electricity demand increased by 3.9% from 11,182 GWh in 2018 to 11,620.7 GWh in 2019. In addition, domestic demand for electricity increased from 8,702.3 GWh in 2018 to 8,854.0 GWh in 2019[64]. Current electricity peak demand is 1,947MW[65] and is projected to grow to 2,600-3,600 MW by 2020.

[63] KPLC, 2018.
[64] KNBS, 2020.
[65] Direct input from Kinyanjui, B. in review, 2020.

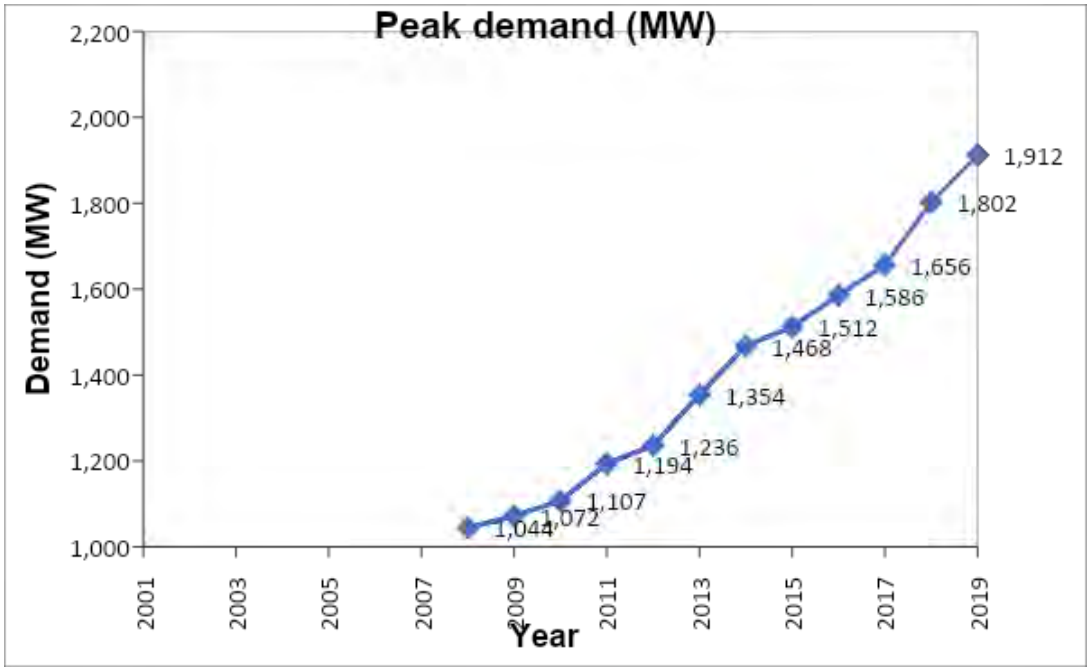

Figure 4 *Peak demand (MW) from 2007 to 2019*

Historical peak demand, in MW, has been steadily increasing (**Table 3**). This growth represents an average annual percentage increase of 3.92%, with the highest growth recorded in 2014/15 (5.7%).

Table 3 *Peak demand from 2008 to 2019*[66]

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Peak demand (MW)	1,044	1,072	1,107	1,194	1,236	1,354	1,468	1,512	1,586	1,656	1,802	1,912

The growth in power demand was largely driven by an increase in the number of customers and growing consumption in the commercial and industrial sectors (see **Table 1** above)**.** This is largely attributed to the increased effort in attaining universal access to electricity by 2022.[67]

2.1.2.1 Forecast demand

An electricity demand forecast is carried out and updated biennially through the LCPDP[68] by the relevant stakeholders[69] in the power sector, whose main objective is to develop an accurate and acceptable assessment of future electricity demand for an optimal power expansion plan. The most recent demand forecast was carried out in 2017 to cover the next 20 years (2017–2037), and the report was made public in June 2018.[70] Energy planning now falls under the MoE, as per the Energy Act 2019.

Specific objectives of the electricity demand forecast are to:

[66] KPLC, 2018.
[67] EPRA, 2020.
[68] The Least Cost Power Development Plan is a Kenya Energy Sector Report intended to guide the sector-on-sector status, generation expansion opportunities and transmission infrastructure target network expansion as well as resource requirements for the expansion programme.
[69] EPRA, KPLC, KenGen, REREC, GDC, KETRACO and NuPEA
[70] EPRA, 2020.

i. Analyse the current and future context of the economy and the power sector;
ii. Update some of the assumptions used in the previous demand forecast;
iii. Review key demand-driving factors from the previous plans;
iv. Update the status of the flagship projects.

In calculating the projected demand over the next seventeen years, three growth scenarios have been used, namely:

- **Reference scenario:** This is the best-case scenario and applies key assumptions for probable development based on historic development and actual plans (technical, demographic and economic issues diligently assessed).
- **High scenario:** A normative scenario. This scenario applies the wide range of ambitious government plans such as achieving 100% electricity connectivity level by 2022 and implementing Vision 2030 growth projections through flagship projects.
- **Low scenario:** This scenario presents a low growth trajectory in which most of the government plans and projects are not implemented as planned. It is assumed that in this scenario, economic development will be at the existing rate with no expected increase during the planning period.

Annual electricity demand and peak load are expected to grow for all scenarios over the forecasting and planning period. For the **reference scenario**, the gross electricity consumption grows from 10,465 GWh in 2017 to 14,334 GWh and 39,187 GWh in 2022 and 2037 respectively**.** This represents an average annual growth of 6.7% per annum.

Electricity demand is expected to grow to 9,790 MW in 2037 which is more than five times the peak demand of 1,754MW in 2017 in the **high (Vision) scenario**. This is as a result of utilisation of the load that is achieved through implementation of less challenging (easily implemented) planned Vision 2030 flagship projects. In this scenario the energy consumed grows from 10,465 GWh in 2017 to 57,990 GWh in 2037 which is approximately 8.8% growth per year.

In the **low scenario**, the electricity consumption growth is gradual over the planning period, averaging 5% per annum. The energy consumed increases to 27,945 GWh by the year 2037 from 10,465 GWh in 2017. The results from the three forecast scenarios are summarised in **Table 4** below.

Table 4 *Summary of demand forecast results (MW)*[71]

Scenario	2017	2018	2019	2020	2021	2022	2023	2024	2025	2028	2030	2033	2035	2037
Low	1,754	1,842	1,928	2,021	2,114	2,207	2,319	2,438	2,563	2,975	3,293	3,872	4,305	4,763
Reference	1,754	1,866	1,978	2,103	2,234	2,421	2,586	2,764	2,989	3,720	4,244	5,148	5,859	6,638
Vision (High)	1,754	1,917	2,088	2,293	2,516	2,766	3,027	3,342	3,705	4,854	5,780	7,272	8,468	9,790

[71] EPRA, 2020.

2.2 Installed capacity and generation mix

2.2.1 Installed capacity

Kenya's current effective installed (grid-connected) electricity capacity is 2,712 MW. Electricity supply is predominantly sourced from hydro, geothermal and fossil fuel (thermal) sources. Hydropower constitutes approximately 37% of installed capacity (**Figure 5**) and accounts for 32.74% of the total sales, while thermal, geothermal, cogeneration and wind generation account for nearly 70% of the total national sales.

In 2019, Kenya's installed power generation capacity grew by 3%, from 2,629 MW in 2018 to 2,712 MW (an increase from 0.8% growth in 2017). This additional 361 MW capacity includes 310 MW from Lake Turkana Wind Power (LWTP) Farm which was commissioned in September 2018[72] and 50MW[73] Garissa Solar Power developed by REREC, commissioned in November 2018[74] (see **Figure 5**).

Generation Source		Installed Capacity (MW)	NCC Dispatch Projection (MWh) (A)	Actual Generation (MWh) (B)	Dispatch Deviation (%) (B-A)/A	Generation Mix Contribution (%)
Hydros		826.23	8292.12	10363.88	24.98	37.21
Geothermal	KenGen	513.00	11640.40	12606.14	8.30	45.26
	OrPower	150.00	3197.50	2986.56	-6.60	10.72
Thermals		776.32	0.00	99.60	-	0.36
UETCL Imports		-	0.00	192.40	-	0.69
Wind	KenGen	25.50	376.80	107.17	-71.56	0.38
	LTWP	310.00	4190.95	1183.50	-71.76	4.25
Solar (Garissa)		50.00	250.38	262.37	4.79	0.94
Others		61.00	37.40	48.19	28.85	0.17
Total		**2,712.05**	**27985.55**	**27849.80**	**-0.49**	**100.00**

Figure 5 *Installed capacity for electricity by generation source, and analysis [Source: EPRA, 2020]*

In November 2019, the government commissioned Olkaria V geothermal power plant with an installed capacity of 165 MW[75]. Once operational, Kipeto wind power, as the country's second largest wind farm located in Kajiado county, will supply 100 MW of clean energy to the national grid as a significant contribution to Kenya's Vision 2030 and Big Four Agenda.

[72] Lake Turkana Wind Power, n.d.
[73] The Solar farm has an installed capacity of 54.5 MW, while 50MW is the maximum that can be exported to the grid; direct input from Kimotho, P. in review, 2020.
[74] REREC, n.d.
[75] KNBS, 2020.

In 2019, Kenya's installed power generation capacity was 2,712 MW (**Table 5**). Electricity generated increased to 11,493 GWh in 2019, up from 10,702 GWh in 2018, representing a 6.9% increase (up from 4.9% in 2018). This marked positive growth in power generated and is a result of growth in the commercial/industrial electricity consumption (**Table 1** refers).

***Table 5** Installed and effective capacity (MW) in 2019*[76]

Technology	**Capacity (MW) at 30.06.2019**			
	Installed (MW)	**Effective (MW)**	**Installed (%)**	**Effective (%)**
Hydro	826	805	30.46%	30.62%
Geothermal	663	655	24.44%	24.91%
Thermal	808	769	29.79%	29.26%
Cogeneration	28.0	23.5	1.03%	0.89%
Solar	50.94	50.87	1.88%	1.93%
Wind	336	326	12.39%	12.38%
Total	**2,712**	**2,629**	**100%**	**100%**

Total installed capacity from IPPs rose to 1,020 MW in 2019. As of 2019, IPPs accounted for 1,020 MW of grid installed capacity, up from 709 MW the previous year, which equates to a 30.5% increase in contribution.

Additional capacity of 513 MW has been added through KenGen-Geothermal. The solar sector has attracted a large number of active players, especially within the solar home system (SHS) market: Azuri, Barefoot Power, BBOXX, Bidhaa Sasa, BioLite, Bright, d.light, Fosera, Givewatts, Greenlight Planet, Mibawa, M-Kopa, Mobisol, Mwezi Energy, Orb Energy, Pawame, Solar Kiosk, Solar Panda, Solinc, Sollatek, and Spark Possibilities.

2.2.1.1 Electricity connectivity

As of 2018, 6.9 million people in Kenya have been connected to the grid i.e. three quarters of the total population. In 2017/18, a total of 578,808 new customers were connected to the grid, growing the overall customer base by 9.4% to 6,761,090 million. In 2019, the total number of customers increased to 7,067,861 in 2019, representing another 4.5% growth overall. This was attributed to the government-funded Last Mile Connectivity Project (LCMP) which was launched in 2015 to scale up connectivity in rural and peri-urban areas by providing a subsidy for grid extension, to enable customers to access affordable electricity. As a result, the national electricity access from both grid and off-grid solutions at the end of June 2018 had risen to 73% compared to 29% five years ago.

In addition, through the Kenya Off-grid Solar Access Project (KOSAP), Kenya Power aims at connecting 277,000 households, 1,097 community facilities and 380 boreholes using solar mini-grids. The KOSAP project is at the development phase and will be implemented in 14 least electrified counties in the country.[77] These counties are: West Pokot, Turkana, Samburu, Marsabit, Isiolo, Mandera, Wajir, Garrisa, Tana River, Lamu, Kilifi, Kwale, Taita Taveta and Narok. The project is jointly implemented by Ministry of Energy, KPLC and REREC.[78]

[76] KPLC, 2018.
[77] KPLC, 2018.
[78] Ministry of Energy, n.d.

2.2.2 Energy mix

Indigenous energy production in Kenya is from biomass (wood and agricultural waste), and electricity produced from hydropower, geothermal and other renewables (wind, biomass and solar). This is complemented by imported electricity, coal, crude oil and oil products.

2.2.2.1 Electricity generation mix

Electricity generation sources are mainly renewable, of which the majority is from geothermal energy, and the remainder from hydropower, wind, and solar power. The contribution of various sources of energy in the electricity generation mix is presented in **Table 6**.

***Table 6** Electricity generation mix in GWh in 2018/2019*[79]

Technology	**Capacity (GWh)**	**Percentage %**
Hydro	3,741	32.55%
Geothermal	5,033	43.79%
Thermal*	1,298	11.29%
Cogeneration**	0.27	0.00%
Solar	60	0.52%
Wind	1,192	10.37%
Imports***	170	1.48%
Total	**11,493**	**100%**

** Thermal energy is an expensive source of energy, as it is generated through diesel-powered generators. Moving away from thermal plants is part of the Kenyan government's gradual plan for the phase-out of expensive diesel power generators as it moves to provide cheaper and cleaner energy.*

*** Cogeneration, or combined heat and power (CHP), is a highly efficient process that generates two forms of useful energy (electricity and heat) simultaneously, from a single energy source in a combustion engine, typically a gas turbine or diesel engine. In Kenya's case, some cogeneration is from bagasse. The heat generated as a result of the process is captured and recycled to provide hot water or steam for other applications, such as heating or cooling for the facility itself.*

**** Net energy imports are estimated as energy use less production, both measured in oil equivalents. Kenya imports both crude and refined petroleum oil products.*

The total electricity generated increased from 2.49 GWh in 2018 to 2.9 GWh in 2019 - accounting for 25.5% of the total energy mix. Access to electricity is estimated to be 75% from both grid and off-grid electrification[80], with the target of universal access by 2022.

A detailed statistical breakdown of the contribution of various sources of energy, including from IPPs, in the generation mix (for the period 2012/2013 to 2018/2019) is presented in Table 7.

[79] KPLC, 2018.
[80] Ministry of Energy, 2019

Table 7. Contribution from various energy sources over the period 2012/2013 to 2018/2019 [Source: Kenya Power and Lighting Company Limited - Annual Report and Financial Statements 2017/2018]

COMPANY	Capacity (MW) as at 30.06.2019		Energy generated in GWh						
	Installed	Effective[81]	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19
KenGen									
Hydro									
Tana	20.0	20.0	108	69	108	109	71	96	96
Kamburu	94.2	90.0	520	421	358	434	384	321	399
Gitaru	225.0	216.0	1,036	830	710	862	775	724	869
Kindaruma	72.0	70.5	252	201	165	208	183	179	193
Masinga	40.0	40.0	148	206	138	127	169	107	199
Kiambere	168.0	164.0	1,129	979	718	996	938	751	1,026
Turkwel	106.0	105.0	545	719	551	426	402	458	545
Sondu Miriu	60.0	60.0	393	351	376	419	282	388	258
Sangóro	21.0	20.0	110	109	125	140	90	129	82
Small Hydros	11.7	11.2	57	59	60	63	44	33	42
Hydro Total	**818**	**797**	**4,298**	**3,944**	**3,308**	**3,784**	**3,339**	**3,186**	**3,707**
Thermal									
Kipevu I Diesel	74	60	185.2	219.9	156.5	128.6	211.3	238.3	197
Kipevu III Diesel	120.0	115.0	320.7	524.2	299.0	181.4	512.1	583.8	490
Embakasi GT	30.0	28.0	27.3	41.3	4.1	0.6	0.2	0.0	0.0
Muhoroni GT	30.0	27.0	-	-	-	-	108.0	65.5	67.0
Garissa & Lamu	-	-	26.9	27.6	11.7	12.4	-	0.0	0.0
Garissa Temporary Plant (Aggreko)	-	-	-	-	21.0	18.6	-	-	0.0
Thermal Total	**254**	**231**	**560**	**813**	**492**	**342**	**83**	**888**	**754**
Geothermal									
Olkaria I	45.0	44.0	369	352	333	331	195	247	285
Olkaria II	105.0	101.0	696	712	756	814	791	832	796
Eburru Hill	2.54	2.2	9	7	11	10	0	6	10
Olkaria Mobile Wellheads	80.6	77.8	23	53	196	357	472	518	492
Olkaria IV	140.0	140.0	0.0	32	1,064	976	852	1,132	1,095
Olkaria I 4 & 5	140.0	140.0	0.0	0.0	744	1,055	968	1,133	1,096
Geothermal Total	**513**	**505**	**1,096**	**1,156**	**3,104**	**3,542**	**3,279**	**3,868**	**3,747**
Wind									
Ngong	25.5	25.5	13.9	17.6	37.7	56.7	63.2	47.5	67.4
KenGen Total	**1,610**	**1,558**	**5,968**	**5,931**	**6,943**	**7,725**	**7,513**	**7,987**	**8,276**
Government of Kenya, Rural Electrification Programme									
Thermal	31.4	21.3	26.0	29.8	35.1	39.9	40.8	46.9	57.6
Solar	0.69	0.62	0.6	0.8	0.9	0.8	0.5	0.0	0.06
Wind	0.660	0.494	0.7	0.4	0.0	0.000	0.003	0.124	0.0
Off-grid Total	**27**	**18**	**27**	**31**	**36**	**41**	**41**	**47**	**58**
Independent Power Producers (IPPs)									
Iberafrica I&II	108.5	102.5	592	550	198	128	252	186	74

[81] Contracted output from the station under normal operating conditions.

Tsavo	74.0	74.0	178	454	233	70	168	215	131
Thika Power	87.0	87.0	-	454	233	70	168	215	107
Biojule Kenya Limited	2.0	2.0	-	-	-	0.0	0.7	0.4	0.3
Mumias - Cogeneration	26.0	21.5	71	57	14	0.0	0.0	4	0.0
OrPower 4 - Geothermal I, II, III and IV	150	150	503	851	955	1066	1172	1,186	1,285
Rabai Power	90.0	90.0	443	633	609	536	606	562	120
Imenti Tea Factory (Feed-in Plant)	0.283	0.283	0.7	0.1	0.5	0.7	0.3	0.6	0.3
Gikira small hydro	0.514	0.514	-	0.4	1.6	1.9	0.9	1.4	1.1
Triumph Diesel	83.0	83.0	-	-	4.8	81.8	83	28	16
Gulf Power	80.32	80.32	-	-	60	8	61	80	37
Regen-Teremi	5.0	5.0	-	-	-	-	1	18	20
Gura hydro	2.0	2.0	-	-	-	-	-	17	12
Chania hydro	0.50	0.50	-	-	-	-	-	0.8	0.3
Strathmore University	0.25	0.25						0.2	0.15
Lake Turkana Wind Power	310.0	300.0	-	-	-	-	-	-	1,124
IPPs Total	**1,020**	**999**	**1,788**	**2,698**	**2,160**	**1,934**	**2,466**	**2,495**	**2,930**
Emergency Power Producers (EPP)									
Aggreko Power	0	0.0	261	94	63	50	0.0	0.0	0.0
EPP Total	**0**	**0**	**261**	**94**	**63**	**50**	**0.0**	**0.0**	**0.0**
Garissa Solar									
REREC Garissa	50	50	-	-	-	-	-	-	60
Garissa Solar Total	**50**	**50**	-	-	-	-	-	-	**60**
Imports									
UETCL	-	-	41	83	76	65	180	168	168
TANESCO	-	-	1.2	1.3	0.6	0.0	0.0	0.0	0.0
EEPCO-Moyale	-	-	-	2.1	2.8	2.6	3.4	3	1.8
Total Imports	-	-	**42**	**87**	**79**	**67**	**184**	**171**	**170**
SYSTEM TOTAL	**2,712**	**2,629**	**8,087**	**8,840**	**9,280**	**9,817**	**10,205**	**10,702**	**11,493**

The contribution from IPPs equates to 25.5% of the total energy mix from thermal, geothermal and bagasse energy sources.

In 2019, the electricity generation mix remained relatively stable, with the contribution of geothermal sources reducing from 47% in 2018 to 43.79%. Hydro's contribution rose to 32.55% in 2019, up from 30.12% in 2018. Overall, hydropower generation increased from 3.2 GWh in 2018 to 3.7GWh in 2019, representing a 14% increase. This is a result of increased rainfall in 2019 which boosted generation from most of the hydroelectric dams. Thermal power plants' contribution decreased from 20.6% in 2018 to 11.29% in 2019 as a result of increased renewable energy connections to the grid.

Total generation from wind power rose significantly from 25.5GWh in 2018 to 1,192 GWh in 2019 marking a 97.9% increase, which in turn accounted for 10.4% of the total energy mix in the country.[82] Solar power's annual generation on the other hand rose from 0.15 GWh in 2018 to 60.15 GWh in 2019, translating to 99.8% increment (up from less than 1% in 2018), representing 0.52% of the total energy mix. These sources of renewable energy mitigated the increase in electricity costs by minimising dispatch of expensive thermal sources.

In 2020, the electricity generation mix comprised of 52.1% hydro, 13.2% geothermal and 0.4% wind[83], in terms of total contribution to baseload power.

2.2.3 Generation planning

In Kenya, electricity generation expansion is achieved through the national generator KenGen, IPPs, steam development by GDC, and power import contracts with Uganda and Ethiopia. The current energy mix has reduced contribution generation from thermal sources as attention shifts to renewable energy sources. The predicted generation projects that will come online are those with approved PPA and Commercial Operation Date (COD), and those making significant progress in implementation or prioritised in the strategic plans of KenGen and GDC. These projects are to be developed through public or private companies. A comprehensive list of committed projects for the period 2018-2024 is presented in **Table 13** (**Annex 1**).

2.2.4 Transmission planning

The objective of transmission planning is to plan the system assets in a way that a reliable, secure and cost-effective transmission of power between generation and load centres is ensured. A total of 8,478km is planned for the period at an approximate cost of USD 5.876 billion. This includes the related substation costs.

[82] This is as a result of injecting 310 MW from Lake Turkana Wind Power into the national grid.
[83] Direct input from Kimotho, P. in review, 2020.

Chapter 3 Renewable energy potential and status

3.1 Assessment of renewable energy resources in Kenya

Kenya has a promising potential of generating its power from the renewable energy resources it is endowed with. The country has ample renewable resources, which include solar, hydro, geothermal and wind. This has led the government to focus on the expansion of renewable energy generation, supported by a reduction in the contribution of thermal power plants to the country's total energy mix.

The newly enacted Energy Act 2019 places priority on the development of renewable energy resources in the country. The Energy Act 2019[84] (Part IV, Section 74, sub-sections 1-3 on renewable energy) mandated the Cabinet Secretary (CS) of Energy to carry out the following within 12 months of the Act coming into force. It requires the CS to:

i. Commence a countrywide survey and assessment of all renewable energy resources;
ii. Prepare a renewable energy resources inventory and resource map in respect of each renewable energy resource area and thereafter prepare updates biennially which shall be published in the Gazette;
iii. Prepare the renewable energy resources inventory and resource map.

The Act further mandates the CS of Energy to promote the development and use of renewable energy technologies, including but not limited to biomass, biodiesel, bioethanol, charcoal, fuelwood, solar, wind, tidal, hydro, biogas and municipal waste.

In support of the Energy Act, the Scaling-up of Renewable Energy Plan (SREP) identifies the need to accelerate the development of renewable energy projects[85]. This vision for green energy is further emphasized in the Government's Vision 2030, which identifies reliable, clean and affordable energy as a foundation for Kenya's long-term economic and social development. Through the government-supported Least Cost approach, the development of geothermal and wind energy plants as well as solar-fed mini-grids intended for rural electrification have been prioritised.

In addition, consumers in the commercial and industrial sector who are seeking lower power costs and increased energy efficiency have resorted to adopting renewable energy, energy storage and energy efficiency measures, increasing the demand and driving the market for RE technology.

[84] Energy Act 2019.
[85] AfDB, 2021

3.1.1 Hydro

Kenya has considerable hydropower potential, estimated in the range of 3,000-6,000 MW; however, the overall potential of hydropower generation in Kenya has dramatically reduced in the past 20 years. Climate change is likely to further limit hydropower production, leading to erratic electricity supply. Another key risk related to a hydro-dominated power system, like Kenya's, is its vulnerability to large variations in rainfall and climate change. This has proven to be a challenge in the recent past, with the failure of long rains that resulted in power and energy shortfalls.

Currently, over 750 MW has been harnessed for electricity generation, mainly in large installations owned by the national power generation utility, KenGen. In 2019, the existing hydropower plants contributed 32.55% towards the annual generation mix. Average energy production from these potential projects is estimated to be at least 5,605 GWh per annum. There are eight power stations with capacity of more than 10 MW each, that have reservoirs. This hydropower potential is located in five geographical regions, representing Kenya's major drainage basins: Lake Victoria basin – north and south (total 329 MW), Rift Valley basin (305 MW), Athi River basin (60 MW) and Tana River basin (790 MW) (**Table 8**).

Table 8 *Hydropower potential of major catchment areas*[86]

Catchment area	**Area (Km^2)**	**Major Rivers**	**Identified hydropower potential (MW)**
Lake Victoria North	18,374	Nzoia R., Yala R.	151
Lake Victoria South	31,734	Nyando R., Sondu R., Kuja R., Mara R.	178
Rift Valley	130,452	Turkwel R., Kerio R., Ewaso Ng'iro South R.	305
Tana	126,026	Tana R.	790
Athi	58,639	Athi R., Lumi R.	60
Ewaso Ng'iro North	210,226	Ewaso Ng'iro North R., Daua R.	0
TOTAL	**575,451**		**1,484**

In total, more than 3,740 MW of hydropower has been exploited, consisting of both small and large installations. The implementation of some of these schemes is undertaken by both the Government and IPPs.

It is estimated that the undeveloped large hydroelectric power potential of economic significance equates to 1,449 MW, of which 1,249 MW (or approximately 86%) is suitable for large projects whose capacity is 30 MW or above. Small, mini and micro hydroelectric systems (with capacities of less than 10 MW) are estimated to have a generation potential of 3,000 MW. As of 2019, small hydropower schemes run by KenGen had a total installed capacity of 11.7 MW, while those run by private developers was 8.3 MW.

3.1.2 Geothermal

Geothermal power provides reliable baseload power at low operating cost. The Great Rift Valley section of Kenya is endowed with rich geothermal resources. A map showing potential prospects

[86] EPRA, 2016.

locations in Kenya is shown in **Figure 6**, while geothermal resource potential is estimated at 10,000 MW **(Table 9)** along the Kenyan Rift Valley.

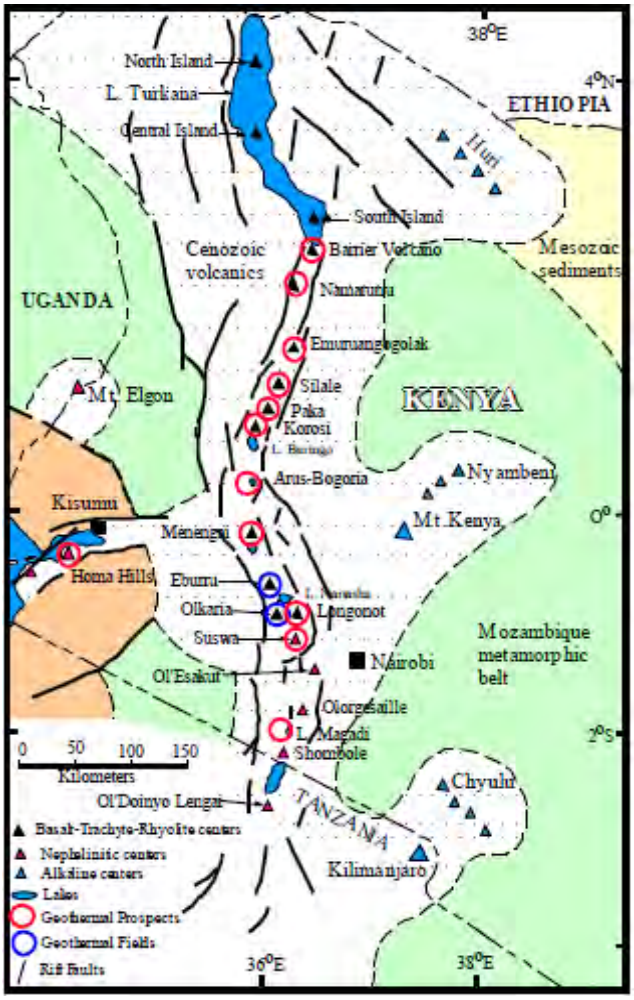

Figure 6 *Geothermal prospect locations in Kenya*[87]

Table 9 *Geothermal potential in Kenya*[88]

Region	Potential (MW)
I. RIFT REGION	
1. Central Rift	
a) Menengai	1,600 MW
b) Eburru	250 MW
c) Arus Bogoria	400 MW
Sub-total	**2,250 MW**
2. South Rift	
a) Olkaria	2,000 MW
b) Longonot	750 MW
c) Suswa	600 MW
d) Lake Magadi	100 MW
Sub-total	**3,450 MW**
3. North Rift	
a) Lake Baringo	200 MW
b) Korosi	450 MW
c) Paka	500 MW
d) Silali	1,200 MW
e) Emuruangogolak	650 MW
f) Namarunu	400 MW
g) Barrier	450 MW
Sub-total	**3,850 MW**
II. NYANZA REGION	
a) Homa Hills	100 MW
b) Akira	350 MW
Sub-total	**450 MW**
TOTAL POTENTIAL	**10,000 MW**

Presently, geothermal resources account for 745 MW[89] of the total installed generation capacity, and geothermal capacity provides nearly 50% of total power generation. Nakuru County is endowed with the majority of geothermal resources; Olkaria, Menengai, Ebburu and Suswa are all in Nakuru County. KenGen accounts for 513 MW of the total installed capacity and most of its plants are equipped with single-flash steam technology, while the remaining capacity is owned and operated by independent power producers (IPP), which use binary steam-cycle technology. Geothermal is still the near- to medium-term baseload option; however, geothermal development has long timeframes and high capital expenditure due to drilling and skills development.

[87] EPRA, 2020.
[88] Ibid.
[89] Kahlen, et al. 2019.

3.1.3 Solar

Kenya has great potential for the use of solar energy throughout the year because of its strategic location near the equator with an average of 4-6 kWh/m^2 per day (or above)[90] levels of insolation (irradiance). This results in a continuously good and relatively stable potential for electricity generation from solar energy for institutions, households and industry.

As a result of dispersion and conversion efficiency of solar photovoltaic (PV) modules, 10% to 14% of this energy can be converted into electricity. This translates to an approximate generation of 23,046 TWh/year for PV installations; meaning that Kenya has the potential to meet **all its electricity needs** from solar resources.

It is estimated that 200,000 PV solar home systems (SHS) - most of which are rated between 10We and 20We estimated at a cost of Kshs 1,000/We - are currently in use in Kenya, generating 9 GWh of electricity annually, primarily for lighting and powering television sets. However, this is only about 1.2% of households in Kenya. To reduce energy bills and have an efficient and economical way of heating water at home, most Kenyans are now adopting the use of solar water heating systems (SWH). Since July 2014, reported sales of off-grid solar products in Kenya have exceeded five million units[91]. In 2018, EPRA enforced regulations that commercial and residential buildings with hot water requirements of more than 100 litres must be fitted with a SWH system.[92]

This has promoted the use of clean energy and a reduction in energy-related costs. The SWH market currently supports an estimated 960 direct and indirect jobs.

However, for the SWH market, inadequate technical skills, high upfront costs, lack of innovative business models, limited financing options, unclear policy requirements, intermittent water supply, disjointed institutional mandates, inadequate technical standards, limited enforcement capacities among mandated institutions, low quality products and services and the owner-occupier mismatch[93], prevent more immediate take-up of the technology, despite the huge potential of the market.

In Kenya, PV stand-alone systems for households and public institutions have been subsidised. The Government of Kenya (GoK) has zero-rated the import duty and removed Value Added Tax (VAT) on renewable energy equipment and accessories. In addition, the GoK is planning to install an additional 500 MW and 300,000 domestic solar systems by 2030.

Commercial and industrial applications of solar are becoming increasingly important. Some of the 'big' customers for Kenya Power that were not satisfied with high energy costs have resorted to generating their own electricity on-site for their consumption through embedded power in the form of solar PV systems.

[90] Global Solar Atlas, 2020.
[91] USAID, 2019
[92] Direct input from Kimotho, P. in review, 2020.
[93] EED Advisory Limited, 2017.

Malls, factories, tea estates and universities are taking up embedded solar systems because of reliability, controlled costs, the ability to meet growing consumer demand for green power, and increased productivity. Flower and vegetable farms have also already pioneered and installed captive renewable energy systems to contribute to power supply on their premises.[94] Selected embedded solar PV projects in Kenya include: Dormans Coffee, Tatu City (1.0 MW), Galleria Mall (0.56 MW), Bidco Thika (1.2 MW), Waridi Flowers (0.22 MW), Penta Flowers (0.25 MW), Kilaguni Serena (0.3 MW), International School of Kenya (0.15 MW) and Two Rivers Mall (1.3 MW).

In addition, hybrid PV-diesel island grids are multiplying: 18 MW of existing diesel-run stations will be retrofitted for the use of solar power in the next few years.

3.1.4 Wind

Kenya has vast untapped wind energy resources; however, awareness and interest is steadily growing. In recent years, there has been a sharp decrease in wind energy development costs, and the government of Kenya (GoK) supports wind development for boosting energy potential and electricity production. As per the LCPDP, "*Within an integrated energy planning approach, the wind power potential should also be exploited for substituting fossil fuels and developing the energy sector in line with the national economic, social and environmental policies*".

On average, the country has an area of approximately 90,000 square kilometers[95] that has excellent wind speeds of 6 m/s and above, that is suitable for wind power generation. A wind energy data analysis and development programme conducted in 2013 (WinDForce Management Services Pty. Ltd) indicates a total technical potential of 4,600 MW. This represents approximately double the present total installed power generation capacity in Kenya.

The existing highland and mountainous areas, the Rift Valley, the northwest and along the Indian Ocean, as well as other geographical features have been highlighted by the Kenya Renewable Energy Association (KEREA) as ideal locations for the high wind speeds required for commercial wind energy generation. The best wind sites in Kenya are located in Marsabit, Samburu, Laikipia, Meru, Nyeri, Nyandarua and Kajiado counties. Other areas of interest are Lamu, off-shore Malindi, Loitokitok, at the foot of Kilimanjaro, and Narok plateau. The most recent investment in wind energy in Kenya is KenGen's 25.5 MW farm in Ngong comprising thirty 850 kW turbines. The 310 MW Lake Turkana Wind Power Farm in Loiyangalani, Marsabit County, comprises of 360 turbines, each with a capacity of 850 kW[96].

Local production and marketing of small wind generators has started and a few pilot projects are under consideration. However, only very few small and isolated wind generators are in operation so far.

[94] Get.invest, n.d.
[95] This is a portion of the entire country suitable for wind power generation.
[96] Power Technology, 2019.

3.1.5 Biomass, biogas and waste-to-energy

In 2020, biomass is estimated to make up two-thirds of Kenya's primary energy supply, primarily due to the reliance on wood fuel by a large proportion of the population - up to 80% of Kenyan households depend on firewood for cooking and heating.[97] Wood fuel provides the basic energy needs of the rural communities, urban poor, and the informal sector. Substantial potential for power generation using alternative biomass resources exists, such as animal waste by agro-based industries, bagasse by the sugar industry (co-generation), and municipal waste by the local authorities for own consumption and export to the grid.

- The sustainable potential of solid biomass has been estimated to be 15 million tons per year, equal to 243 PJ with an expected energy content of 4.5 kWh/ton.
- With current official plans for energy forest plantations of 4.1 million ha (41,000 km2), the potential will be increased.[98]

Biogas potential in Kenya has been identified in municipal waste, sisal and coffee production. The total electricity capacity potential of all sources ranges from 29 to 131 MW, generating 202 to 1,045 GWh, which is about 1.3% to 5.9% of the total electricity purchased from the system. Biogas can also replace firewood and charcoal for cooking, which is mostly done with small-scale biogas plants. Biogas plants, including small plants for cooking, are included in Kenyan climate plans with up to 500,000 biogas stoves in operation by 2030.[99]

There is huge potential for waste-to-energy (using mixed waste, sewage, industrial waste, biogas) in Kenya. The MoE has implemented a domestic and institutional biogas system using cattle waste, and REREC also undertook two institutional biogas systems, which are to be rehabilitated.[100]

However, waste-to-energy requires sustainable feedstock. Technical skills needed for modelling are important to understand how to ensure reliability within the waste-to-energy value chain. In addition, there are significant barriers to entry in the waste-to-energy market; people lay claim to waste as a resource, and there are powerful cartels operating in waste management systems.

In some counties in Kenya, power generation from sugar bagasse is underway. Power generation for grid supply was taking place at Mumias sugar mill; Mumias Sugar Company was exporting 26 MW of power to the national grid. However, their PPA has subsequently expired.[101] Besides sugar bagasse, there is potential in the tea industry as well, which could co-generate about 1 MW in the 100 factories using their own wood plantations for drying.

3.2 Opportunities and challenges

In furthering the discussion on renewable energy potential, it is important to understand the unique opportunities and challenges that each type of resource presents in the Kenyan context (**Table 10**). While some significant opportunities may exist across different renewable energy resource types, particular challenges may interfere with the ease with which these may be

[97] Welfle et al. 2020.
[98] Direct input from Munyoki, J. in review, 2020.
[99] Ibid.
[100] Direct input from Kimotho, P. in review, 2020.
[101] The Kwale project stalled before commissioning. Direct input from Kinyanjui, B. in review, 2020.

implemented. Table 10 provides a brief summary of both opportunities and challenges of the respective resources.

Table 10 *Summary of opportunities and challenges to renewable energy development in Kenya*

Type of RE resource	**Opportunity**	**Challenges**
Hydropower	• Substantial hydropower potential, especially through small hydropower schemes which offer vast generation options. • Supportive legal and policy framework	• High economic risk in undertaking hydropower projects, because they are capital intensive. • Uncertainty with regard to power prices in the future • Costs of building and producing hydropower vary significantly, depending on variables such as the size and location of the plant. • Vulnerability to climate change impacts, such as low rainfall or drought. • Inadequate storage capacity in existing power generating reservoirs. • Relocation and resettlement of affected persons to create room for the construction reservoirs. • Long lead time of between 7-10 years. • Inadequate hydrological data within the region. • Water levies that have a direct effect on the cost of hydro-generated electricity. • Conflicting and competing land and water uses between various sub-sectors of the economy with regard to development and utilisation of the same for electricity generation. • Absence of synergies and competing interests in the management of hydropower generating infrastructure leading to delays in implementation of viable energy projects.
Geothermal	• Can run as reliable base load power due to the low short-run marginal costs (in operation). • Good knowledge and expertise in geothermal exploration, drilling, power plant implementation and operation is already present in the country. • Binary systems provide flexible power - opportunities for further exploration and deployment. • Supportive legal and policy framework	• High drilling risks, upfront costs and long implementation period. • Single flash technology is restricted in providing flexible power. • Relatively long lead time of between 5-7 years from conception to production of electricity. • The resources are site specific. • Heavy investment in transmission and other support infrastructure due to long distances to existing load centres. • Land use conflict.
Wind	• Mature technology in terms of commercial development. • Decrease in wind energy development costs in recent years due to increased take-up.	• Wind turbines do not produce power constantly, thus investment in battery storage is necessary. • High upfront costs for wind power generation equipment. • High capital investment for transmission lines due to wind power potential areas being far away from the grid and load centres. • Inadequate wind regime data. • Inadequate skilled capacity for wind power technology. • Inadequate wind energy industry standards due to fast-changing technologies. • Competing interest in land use with other activities.

		• Inadequate R&D in wind technologies.
Solar	• Substantial opportunities for rural electrification and decentralised applications. • Increased potential for domestic and commercial solar water heaters, solar water pumps, solar-based refrigeration and solar drying. • PV systems typically have a fairly consistent exploitable solar potential throughout the year in Kenya, due to high insolation rate.	• Uncoordinated approach in policy implementation and promotion of solar energy projects. • High upfront capital cost for plant and equipment. • Weak enforcement of standards and regulations. • Rampant theft of solar photovoltaic panels, which discourages installation. • Lack of awareness of the potential, opportunities and economic benefits offered by solar technologies. • Proliferation of sub-standard solar energy technologies and equipment.
Bioenergy	• Energy crop briquettes favoured to provide renewable fuels. • Kenyan agriculture could provide 15.6 Mt (odt) crop residue and 7.9 Mt (odt) animal waste for bioenergy by 2050.	• Unsustainable use of biomass with attendant negative impacts on the environment. • Widening gap between supply and demand for wood fuel. • Emissions from wood fuel leading to health hazards among users. • Weak enforcement of the legal and regulatory framework for sustainable production, distribution and marketing of biomass. • Insufficient promotion of sustainable afforestation programmes. • Inadequate data on biomass production and consumption. • Uncoordinated approach in policy formulation and implementation by the relevant ministries and organisations to reduce overreliance on biomass as a primary source of energy. • Inadequate recognition of alternative clean modern energy sources to reduce overreliance on biomass energy sources. • Lack of efficient technologies for production, conversion and consumption of biomass energy. • Competing interests over land use between biomass production, food production and other commercial uses. • Insufficient feed-stocks to produce biofuels for blending. • Limited research data/information for the use and sustainable production of biofuel. • Insufficient legal and institutional framework to support sustainable generation, utilisation, production, distribution, supply and use of liquid biofuels. • Inadequate R&D on alternative biofuel feed-stocks and technologies. • Lack of knowledge among the stakeholders on the importance of biofuels for complementing energy needs in the country. • Competing uses of ethanol.

Chapter 4 Energy financing

4.1 Financing and funding landscape

Kenya remains one of the few African countries that has been able to mobilise private investment into its power sector.

Historically, investors in green energy have been cautious regarding the bankability of power purchase agreements (PPAs) signed by the Kenya Power and Lighting Company (KPLC). This uncertainty was occasioned by KPLC's monopoly in the energy sector as the country's sole bulk power purchaser. Both international and Kenyan financiers were hesitant to invest in capital-intensive projects without security of regulation and purchase. For this reason, national government has often been requested to act as guarantor for KPLC, even when a PPA is signed.[102] For this reason, Kenya's power sector used to utilise concessional financing from development partners and finance institutions to obtain capital for the construction of large-scale energy infrastructure, including the construction of power plants and installing national transmission lines.

The Kenyan electricity supply industry has gone through several reforms, particularly during the 1990s and early 2000s. Kenya has shown remarkable commitment and political will to support climate action and mobilise adequate finances, primarily demonstrated through its progressive policy landscape. Kenya has an impressive and robust climate finance policy setting and strong corresponding regulatory mechanisms, and in the last two decades, Kenya has begun to effectively mobilise private investment to meet its financing needs. The regulatory environment is underpinned by Kenya's Climate Change Act 2016, the National Climate Finance Policy 2018, and the National Climate Change Action Plan 2013–2022. It has been estimated that financing Kenya's Climate Change Action Plan will cost US$2.75 billion per year. Currently, it has been estimated that both public and private sectors from international and domestic sources have invested cumulatively around US$3.2 billion in climate-related projects and programmes (for both adaptation and mitigation).[103]

The clear political will behind policy reforms has led to a relatively stable and attractive power market to foreign investors. In addition, Kenya's "lightly regulated" approach to private sector engagement in the energy sector has allowed the sector to flourish and grow unencumbered, and supported the general consensus that Kenya is a leading country for off-grid solutions in Africa.[104] Key to the giant strides that Kenya has taken in the energy sector are two iconic renewable energy projects, the Turkana Wind Farm and OrPower Geothermal Power Station, which have signalled to investors both a 'safe' market and the huge potential for investment.

4.1.1 Roadblocks to private investment

Challenges remain in driving private sector participation for building generation, transmission and distribution capacity. This is due to a challenging financial ecosystem for commercial capital, in which commercial banks are often crowded out by multilateral banks regarding both loan tenure and interest rates. Processes related to project selection, negotiation of PPAs, securement of land and the provision of Letters of Support by the Kenyan government remain difficult to navigate,

[102] Nzau, 2014.
[103] Ibid.
[104] USAID, 2019.

leading to increased costs and time delays, especially for private off-grid developers. For the public sector, state-owned enterprises often encounter inadequate financing models, and the government of Kenya continues to carry significant financial exposure when it comes to the energy sector. Once financing is secured, high infrastructure development costs are faced, and a long lead-time is required for implementation.[105]

4.1.1.1 Loan guarantees

Despite these obstacles, one of the ways in which Kenya has succeeded in attracting private investment is by providing a financial backstop for IPPs. In sub-Saharan Africa, governments often provide subsidies to offset the high cost of power generation. However, these subsidies can reduce the bankability of power projects, reducing return on investment in the process. As a result, the Kenyan government has turned to alternative financing to back IPP projects. For example, the country received a Partial Risk Guarantee (PRG) from the World Bank to backstop IPP projects, and in April 2018, received a US$180 million International Development Association (IDA) Guarantee to mobilise private sector financing and strengthen the financial position of KenGen. Guarantee instruments from the IDA, the concessionary arm of the World Bank Group, promote private sector involvement in the generation sector, further enhanced by risk mitigation instruments from the Multilateral Investment Guarantee Agency and equity and debt support from the International Finance Corporation. With financial guarantees in hand and a stable, government-backed regulatory environment, Kenya has been able to draw substantial private investment into its power sector, with at least US$3 billion in private capital mobilised in the power sector between 1997 and 2018.[106]

4.2 Actors

4.2.1 National actors

Ministry of Energy (MoE) is responsible for overall national policy coordination and development in the energy sector, that create an enabling environment for the efficient operation and growth of Kenya's energy sector, covering hydropower, geothermal, rural electrification, renewable energy, and energy regulation, security and conservation. In formulation of policy, fiscal, legal and regulatory frameworks for the exploration and production of all energy sources, it considers advice from EPRA and the Energy and Petroleum Tribunal. The Ministry supports mobilisation of financial resources for the public sector. The Ministry also sets strategic direction to facilitate the growth of the sector while providing long-term vision for all sector players.

Ministry of Petroleum and Mining: The Ministry is responsible for the promotion of sustainable development of the extractives sector, that includes enhancing commercialisation of discoveries, developing the requisite skills and infrastructure for production in the oil, gas and other mineral sectors, and improve access to competitive, reliable and secure supply of petroleum products.

Ministry of Environment and Forestry: The Ministry is the focal point for the Global Environment Fund (GEF). There is opportunity to continue work on the trans-boundary Lake Victoria Project Environmental Management (World Bank, GEF, SIDA) programme. Other programmes include engaging the private sector in green growth, the Kenya National Cleaner Production Centre,

[105] Direct input from Munyoki, J. in review, 2020.
[106] Ibid.

chemical waste (with FAO), and working with industries to improve efficiency through industrial symbiosis.

National Treasury - State Department of Planning: The Department engages with the National Treasury as the source of finance for achieving the mandates under each of its Directorates.

Parastatals: KenGen and KPLC, as the two parastatals and publicly listed companies operate on commercial principles and are able to tap into capital markets for financing needs. Thus, these parastatals have the responsibility of raising finance needed for system expansion, with or without state guarantees.

Credit Bureas include Metropol, Creditinfo, Transunion Africa.

4.2.2 Intermediaries

Kenya has a strong and active donor community, with multilateral and bilateral financiers contributing significantly to the evolution across the energy sector value chain: from generation, to transmission, distribution and electrification. Monthly donor meetings help coordinate investments and technical work, while joint presentations to the Ministry of Energy occur quarterly. Overall, donors have contributed more than US$3 billion in grants and loans to support the development of new generation capacity, while the Government of Kenya's flagship Last Mile electrification programme has attracted US$770 million from the donor community.[107] Thus, Kenya boasts many actively involved development partners in the energy sector.

In 1996, electricity reached only about 8% of the population in Kenya. Realising the significant investment needed in the sector, the **World Bank** has been supporting the Government of Kenya to pioneer the use of commercial financing to meet energy infrastructure needs, through the support of major reforms to sector regulations and institutions.

Projects include:

- Energy Sector Reform and Power Development Project (1997)
- Kenya Private Sector Power Generation Support Project (2012)
- KPLC Guarantee Program (under Kenya Electricity Modernization Project - KEMP) (2015)
- Kenya Electricity Modernization Project – KEMP (2015)
- Kenya Off-Grid Solar Access Project (KOSAP) (2017)
- KenGen Guarantee Project (2018)
- Financial Advisory Services for Kenya Energy Utilities (2018)
- The Kenya Climate Innovation Center (KCIC): KCIC provides country-driven support to accelerate the development, deployment and transfer of locally relevant climate and clean energy technologies, mainly through incubation, capacity building services and financing for innovative solutions in energy, water and agribusiness to address climate change challenges. The Kenya CIC is the first in a global network of CICs being launched by the World Bank's infoDev's Climate Technology Program (CTP).

The **African Development Bank (AfDB)** has worked closely with the Government of Kenya and key development partners such as the **French Development Agency (Agence Française de**

[107] World Bank, 2019b.

Développement [AFD]) and the **European Investment Bank (EIB)** in order to ensure the diversification of Kenya's energy supply, with a focus on clean, reliable and low-cost energy sources. In partnership with the World Bank, these same agencies have been involved in Kenya's flagship Last Mile Connectivity Program, which addresses the affordability barrier for connections in rural areas. Acting as an implementing partner on DfID's Green Mini-Grids (GMGs) programme (2014 to 2020), AFD has also been successful in raising €5m of funding for Kenya's Green Mini Grid Facility from the **EU Infrastructure Trust Fund (ITF)**.

In Kenya, Britain's **Department for International Development (DFID)'s** Green Mini-Grids (GMGs) programme signed £9.6m worth of funding agreements and established the Kenya Green Mini-Grid Facility, managed by **Innovation Energie Developpement (IED).** This Facility provides both technical assistance and financial support to developers, such as Powerhive, Powergen and RVE.Sol, which together are expected to deliver 15,000 connections in three sites in Western Kenya.[108]

German Development Bank (KfW) supports the Kenyan government in securing an affordable, environmentally friendly and reliable electricity supply, mainly through the promotion of renewables (geothermal, solar, wind and hydro) in partnership with the private sector. KfW also supports the Kenyan government in increasing access to electricity in rural areas of the country. In addition, through financial cooperation KfW has been involved in the construction of geothermal power plants and rehabilitation of hydro power stations, to a total base-load capacity of 470 MW, with a saving of 1.3 million tons of CO_2 emissions annually.[109]

Japan International Cooperation Agency (JICA) JICA's support to Kenya is primarily focused on economic infrastructure and private sector development, as well as agriculture, environment and water, human resource development, and health. Notable JICA projects in Kenya's energy sector include the Olkaria I Units 1, 2 and 3, the Geothermal Power Plant Rehabilitation Project, Olkaria V Geothermal Power Development Project, and the Olkaria-Lessos-Kisumu Transmission Lines Construction Project.

Other development partners:

- United Nations Environment Program (UNEP)
- United Nations International Development Organization (UNIDO)
- United States Agency for International Development (USAID)
- European Union
- German GIZ
- United Nations Development Program (UNDP)

4.2.3 Private sector

Independent Power Producers (IPPs)

In contrast to most sub-Saharan African countries in which electricity is often 100% state-owned, generated and distributed, Independent Power Producers (IPPs) now make up a sizable share of Kenya's electricity supply mix. IPPs in Kenya represent approximately 30% of generation capacity

[108] Hunt, 2019
[109] KFW, n.d.

and 53% of incremental generation capacity.[110] Entering the market through a mix of directly negotiated and competitively bid projects, IPPs began to supplement power production through regulated power purchase agreements (PPAs). IPPs are considered attractive due to their tendency to exceed the technical and operational performance of their public counterparts, as well as to reinvest in technology and innovation, and re-coup the cost of investment through the retail sale of electricity, thereby reducing the burden of public sector financing.

Potential 'prosumers'

In Kenya, industrial prosumers have the potential to contribute significantly to social inclusiveness of industrial development, as the possibility of a self-supplied low-cost energy option allows local households in rural communities to maximise their productivity and add value to their products. Industrial prosumers can give rise to decentralised energy system providers.

In Kenya, agro-industrial prosumers in areas without grid electricity access can act as rural energy entrepreneurs, adding electricity to their product line by generating additional revenue while offering local energy benefits to the surrounding community. EPRA estimates that Kenya-based sugar millers in the western region could generate a total of 150 MW to the grid by 2022. The State is offering a feed-in tariff of 10 US cents per kilowatt hour to help the struggling sugar industry to expand their income generation portfolio. This move is also aimed at stopping expensive importation of power from Uganda and may potentially decommission the costly thermal back-up plant in Muhoroni.[111] The tea growing and production industry not connected to the national grid is another potential sector where prosumers can actively take part. In addition, Kenya generates a lot of waste (industrial, agricultural and domestic) that could be harnessed to generate electricity.

Some of the barriers facing potential prosumers in the Kenyan energy landscape include:

i. Lack of policies governing the sale of excess energy;
ii. Opposition from incumbent energy system owners; and
iii. Limited local capacity around renewable energy technologies.

4.3 Funding mechanisms

Compared to its neighbours on the African continent, Kenya is notable for its ability to access multilateral and bilateral funds, most prominently through its strong institutional framework, and open and transparent dialogue between national and county governments. Various sources of climate finance, including international public and private sources, domestic public and private sources, and carbon finance have been used (**Table 11**).

Table 11 *Kenya's financial landscape for climate change [Source: Nzau, 2014]*

Sources of climate finance	Intermediaries	Economic and financial instruments	Financial planning systems and institutional arrangements	Uses and users of climate finance

[110] Direct input from Munyoki, J. in review, 2020.
[111] Nyabundi, 2019.

- International and national public finance - International and national private finance - Carbon finance - Voluntary climate finance	- Multilateral banks - Bilateral agencies - National agencies - National financial institutions	- Power purchase agreements - Warranties - Guarantees - Insurance - Carbon offset flows - Grants - Concessional loans - Capital: equity, debt financing	- Expenditure and budgetary frameworks, without budget code - Ministry of Environment, Water and Natural Resources (coordinating agency) - Climate Finance Unit	- Adaptation - Mitigation (including for green energy) - Government - Development partners - Private sector - Non-governmental - organisations (NGOs)

Public sources of international finance have stemmed from both bilateral development partners and multilateral agencies.[112] Mainstreaming climate finance with the National Treasury's Climate Finance Unit provides a suitable institutional framework for managing climate change financing, specifically through Treasury's established systems for mobilising, allocating and tracking climate funds.[113]

- Kenya is one of six pilot countries that have benefited from the Climate Investment Facility's (CIF) Scaling-Up Renewable Energy Programme (SREP), in addition to the Special Climate Change Fund (SCCF), the Global Environment Facility Trust Fund and the Forest Carbon Partnership Facility's Readiness Fund, which had each disbursed resources to Kenyan projects by 2014.
- In order to ensure returns on investment and to facilitate borrowing by private sector investors, the Government of Kenya has introduced special (RE) tariffs and Power Purchase Agreements (PPAs).
- The government provides Partial Risk Guarantees (PRG) in order to de-risk investment - e.g. for RE generation projects - for investors, by undertaking resource assessment and feasibility studies. Additionally, national government provides the necessary grid infrastructure to distribute power to consumers.[114]
- The World Bank is financing electrification under the ongoing Kenya Electricity Modernization Project (KEMP) and Kenya Off-grid Solar Access Project (KOSAP) which targets to connect 235,000 new beneficiaries.
- In partnership with the World Bank, Kenya has committed US$150 million towards KOSAP for six years, expected to be completed in 2023.[115] The project aims to encourage solar service providers to expand their services from more urban areas to underserved counties; KOSAP will provide incentives including a results-based financing facility. This

[112] Nzau, 2014.
[113] Odhengo et al, 2019.
[114] MoEP, 2016.
[115] Kenyatta, n.d.

financing facility will compensate the providers through competitive awards for initial, ongoing incremental, and opportunity costs associated with service expansion.[116]

- The Kenyan private sector alone had invested close to US$150 million in renewable energy projects (2012), mostly geothermal, biomass and small hydroelectric projects.
- Kenya has also grown to be the market leader in solar home system (SHS) sales in Africa, largely due to the favourable regulatory environment, government support, and the adoption of business models such as pay-as-you-go (PAYGO).
- The attractive SHS sector in Kenya has become competitive and diverse, with many active players, including Azuri, Barefoot Power, BBOXX, Bidhaa Sasa, BioLite, Bright, d.light, Fosera, Givewatts, Greenlight Planet, Mibawa, M-Kopa, Mobisol, Mwezi Energy, Orb Energy, Pawame, Solar Kiosk, Solar Panda, Solinc, Sollatek, and Spark Possibilities.
- Kenya has also registered a number of Clean Development Mechanism (CDM) projects.

4.3.1 An innovative model at national level

In partnership with the Kenyan government, the World Bank spearheaded the utilisation of commercial financing through the initiative known as 'Maximizing Finance for Development', to meet energy infrastructure needs in the country. This approach has resulted in progressive reforms in sector policies, laws, regulations and institutions to create conditions that foster private sector investment and establish effective planning, tendering and contracting capabilities since 1997.

- The first phase of reform: In this stage, policy and regulatory functions were differentiated from commercial interests, generation activities were liberalised, generation was unbundled from transmission and distribution activities, the national sector regulator was established, and cost-reflective tariffs were introduced. Two major utilities in the country - Kenya Power and KenGen - are now publicly listed companies that are able to tap into capital markets for outside investment.
- The second phase of reform: this stage involved ameliorating the operational and financial performance of sector utilities, establishing a close relationship between generation and distribution utilities through dynamic PPAs, and establishing new entities with directives for developing transmission, geothermal resources and rural electrification.

4.3.2 Innovative models at local level

4.3.2.1 County Climate Change Funds (CCCFs)

County Climate Change Funds (CCCFs) are devolved financing mechanisms that promote mainstreaming of climate change adaptation into local planning and budget systems, and operate under the authority of each individual county government. CCCFs can enable county governments to strengthen and reinforce national climate change policies while delivering on local adaptation priorities. In addition, CCCFs identify, prioritise and finance investments to reduce climate risk and achieve adaptation priorities.

[116] World Bank, 2019a.

CCCFs are key coordination mechanisms for climate change action, specifically focused on adaptation activities, and work through the government's established planning and budgeting systems, as detailed within the CIDPs. CCCFs are specifically structured to blend financial resources from international climate finance, multilateral development banks, the private sector, central government and their own county budgets. The CCCFs are aligned with national priorities set out in Kenya's National Adaptation Plan (NAP). However, as of 2017, only five counties (Garissa, Isiolo, Kitui, Makueni and Wajir) had established their CCCF.[117]

4.3.2.2 Pay-as-you-go for solar home systems

Pay-as-you-go (PAYG) is an innovative business model that harnesses technology to provide 'one-stop-shop' solutions for consumer finance and renewable energy products. PAYG is a technology-driven method that allows consumers to pay the least amount for a given energy system or pay a fee for the service of using the system. It uses information technology to enable remote activation with payment receipt.[118] PAYG solar home system (SHS) companies typically provide basic lighting and mobile phone charging services. It has since been replicated by M-KOPA and Angaza Limited due to its wider acceptability in the market. The technology is playing an important role in expanding access to electricity services in remote and low-income populations.

The standalone solar home system comes with an energy storage battery, a charge controller, solar panel and light emitting diode (LED) bulbs, and a mobile charger. Larger systems (typically 50W and above) can potentially connect direct current (DC) appliances such as a television and refrigerator. Households with SHSs have reported lower kerosene usage, which in-turn lowers GHG emissions (both from carbon dioxide and black soot). Other benefits include increased household disposable income due to reduced spending on kerosene and candles; health benefits from reduced in-door pollution; and increased evening study hours for school children.[119]

This business model addresses key challenges of extending end-user finance and collecting payments from remote customers, who often have erratic and limited cash flow, through a "payment by installments" software application that protects the service provider and ensures paid-for services to the consumer. Pioneering PAYG companies have successfully raised grant, equity, and more recently, debt finance to pilot, develop, and scale up their businesses. This has been raised exclusively from international investors. There has been hesitance from local institutions to finance these PAYG customers, as they perceive PAYG companies as early-stage, higher-risk businesses and are unfamiliar with the technology, as well as the creditworthiness of rural consumers.

Barriers to PAYG:

The absence of local capital sources to some extent explains the fact that almost all the successful PAYG companies are foreign-owned and -managed. Market leaders such as Azuri, M-KOPA, Mobisol, D.Light, and Sumac have begun expanding into regional markets. For these companies

[117] Murphy and Orindi, 2017.
[118] Alstone, et al., 2015.
[119] Kaufman et al., 2000.

to scale up and have a broader impact in the sector, there is a need to raise more capital from donors and DFIs and introduce products that have larger energy generating capacities, if they are to provide more than basic lighting and mobile charging services.

Technological barriers to the PAYG business are falling, and the sector is likely to see the entry of a larger number of companies, but access to finance remains a key entry barrier, particularly for locally owned and managed companies. Finance is most critically needed to build out marketing, sales, and service infrastructure and to provide customers with financing. New entrants in the PAYG sector will lead to increased competition and lower prices and allow products and services that offer higher levels of electricity access at affordable prices.[120]

[120] Sanyal et al., 2016.

Chapter 5 Energy Situational Analysis

The Kenya energy supply sector is unbundled in nature and over the years has undergone policy and some regulatory reforms, making participation attractive to IPPs. Through the Feed-in Tariff Policy, a number of projects have been procured. The policy is supported by other guidelines such as Standardised PPA, Guidelines for Grid Connection of Small Scale Renewables, and Feed-in Tariff Application and Implementation Guidelines (FiT Policy). Kenya is committed to an ambitious plan of universal electricity access by 2022; this will be made possible by grid densification, intensification and expansion, in particular opening up the rural, off-grid regions through mini-grids and storage systems. The Big Four Agenda of Vision 2030 is also expected to elevate Kenya to a middle-income economy. Plans are underway to generate 100% of electricity from abundant renewable energy resources in the country. Commitment to this has been exhibited by the decommissioning of some of the expensive thermal plants, and the generation expansion plan does not include any fossil fuel sources. This will reduce the emission of GHGs responsible for climate change. In rural areas with an over-reliance on kerosene for basic lighting, an innovative pay-as-you-go was invented and has enabled most rural homes off the grid to access energy through solar home systems. Prosumers in the agro-industrial sector have the potential to electrify households and businesses in rural areas, boosting their revenues by supplying excess power to the grid.

However, barriers to the establishment of renewable energy remain, and create a number of challenges that the energy sector still needs to overcome. While the Kenyan Constitution and Devolution Policy creates the policy space for citizen participation in energy planning, there is no clear path for county energy planners to follow to actually undertake participatory energy planning. Thus, a clear energy mandate at county level is not always present. This means there is a timely opportunity to support county governments in developing a framework for ensuring citizen participation in their energy planning processes.

5.1 Enablers and opportunities for county-led renewable energy development

Kenya is endowed with rich renewable energy resources like hydro, solar, wind and geothermal sources. The use of renewable energy for electricity production will result in affordable electricity - due to less reliance on the deployment of expensive diesel generators that pollute the environment and increase greenhouse gases emissions (GHGs) – as well as meet Kenya's overarching policy goals of both adapting to and mitigating against climate change. Due to Kenya's progressive approach to the energy sector, a variety of enablers and opportunities exist for county authorities to take advantage of in the development of locally-led renewable energy development.

5.1.1 Investment and policy framework

There is a strong national policy landscape in Kenya for renewable energy. The Constitution provides capacity to counties to enable and empower local level governance towards achieving overarching developmental and energy targets. A number of opportunities present themselves as

'low-hanging fruit', i.e. opportunities that can readily be realised, primarily by making use of the strong investment and policy framework.

5.1.1.1 Feed-in Tariff (FiT)

The government promotes investment in renewable resources through the Feed-in Tariff (FiT) Policy as it intends to generate all of its electricity from renewable sources. Huge potential still exists for the use of solar - through PV systems, mini off-grid hybrid systems, and solar water heaters (SWHs) - and wind energy in meeting Kenya's energy needs. Due to the intermittency of both solar and wind power, energy storage will play a critical role in ensuring that Kenya has safe, reliable power across the country. Following the implementation of incentives, for example through the FiT, the Kenyan biogas market presents large opportunities that can be developed quickly but requires careful management, due to strong actors in the area of waste-to-energy, who can dominate the market.

5.1.1.2 Leadership and governance

Regulations to govern county and national mandates are still under development; the county role in the energy sector is not always clear. Counties are responsible for reticulation of gas and electricity, and awareness that it is no longer only the national government which is responsible for generation, is needed. Energy in counties is often only concerned with street lighting. However, they increasingly own generation capacity too.

Strong leadership at county level is key: a renewable energy department with technical staff and dedicated budget lines is critical. However, even expert leaders that can support the development of renewable energy strategies at county level is beneficial. For example, Kisumu County has an excellent County Executive Committee (CEC) for energy, and a well-developed CIDP, that supports renewable energy development at county level. The Nakuru Governor is the chair of the energy committee at the Council of Governors (CoG), and Kisumu County sits on the energy committee. This already makes both these governors energy champions.

5.1.1.3 Entry points for civil society and non-governmental organisations

At the county-government level, there are various entry points for civil society organisations (CSOs) and non-governmental organisations (NGOs) already working to directly support the development of inclusive county energy plans, that are responsive to needs on the ground. These organisations have the unique opportunity and placement to work with stakeholders to build capacity on planning and implementation, as well as support policy makers within the county government to develop and enact policies and regulations that accelerate access to modern energy services.

For example, the World Resource Institute (WRI) is working in collaboration with Population Service Kenya in implementing the solarisation of health facilities across a number of counties, including Kisumu, Nakuru and Mombasa. Another example is the Kenya Private Sector Alliance which is

lobbying for appropriate standards and regulations for renewable energy products and fiscal instruments at a national scale.[121]

Other important CSOs and NGOs which can facilitate county energy development aims include:

- **SusWatch Kenya** is a registered NGO and member of the East African Sustainability Watch (EASUSWATCH) group. Its mandates include the expansion of the national platform through the participation of existing networks and stakeholders, as well as supporting the establishment of new linkages to strengthen joint decision making for effective implementation of environmental sustainability outcomes in Kenya. Focus areas include climate change, gender and green energy, and water, sanitation and waste management. SusWatch Kenya convened and continues to convene a number of key development processes; for example, in the past it has acted as Secretariat for the Sustainable Energy (SE) supported "Devolution in Climate Change Adaption (DaCCA)" project in Homa Bay and Kisumu counties. It has also been involved in the implementation of East African CSOs for Sustainable Energy and Climate Action (EASE-CA) project (2019-2022) which mainly targets the development of the 100% Renewable Energy plans and strategies for Kenya and the East African Catalog for sustainable local energy solutions, together with Ugandan and Tanzanian partners.
- **Institute of Law and Environmental Governance (ILEG):** ILEG is an independent, non-profit public interest law and policy organisation that works with local communities, governments, the private sector and CSOs to ensure fair, balanced and equitable sustainable development policy choices that improve peoples' lives and protect the environment. ILEG seeks to work in a participatory manner to transform governance decisions that affect the environment and natural resources on which livelihoods depend.
- **Interwaste Research and Development East Africa Trust:** The Trust is a non-profit, welfare-based organisation that focuses on collaboration, shared learning, advocacy, and the promotion of innovative technologies to deal with issues associated with urban solid waste, wastewater, WASH, chemical and hazardous waste sectors. Importantly, the Trust helps facilitate waste-to-energy schemes for sustainable developments in cities, as well as urban and rural water, sanitation and hygiene initiatives.
- **Institute of Environment and Water Management (IEWM):** IEWN is an NGO which aims to strengthen governance in the water and environmental sector, and build climate change resilience by supporting communities and institutions in managing their natural resources equitably and sustainably. IEWM's interventions are aligned with national policies and guidelines, and the Institute uses technical experience to bridge the gap between local action and policy/decision making through lobbying and advocacy.
- **Consumers Federation of Kenya (Cofek):** Cofek is an independent, multi-sectoral, non-profit organisation committed to consumer protection, with the main aim of working towards a fair, just and safe marketplace for all Kenyan and regional consumers in all sectors of the economy. EPRA must consult Cofek regarding regulations.

5.1.1.4 Good practices

Counties need to communicate their energy demand to the national government through their County Energy Plans (CEPs). Ideally, the CEP should be aligned with National Energy Plans, so

[121] ACCESS Coalition, 2020.

counties plan first according to their needs, and then align these with the development of the national energy plans under the MoE.[122] The Energy and Petroleum Regulatory Authority (EPRA) can guide implementation regarding technology for technical feasibility and legal issues such as legislation and contracting. The role of EPRA at local level is to defend consumers as the electricity and renewable energy Directorate, as well as to plan and develop standards for energy efficiency for industry and appliances, regulate generation, importation, exportation, transmission, distribution, supply, storage, sale and use of electrical and other energy products (petroleum, renewable energy, coal, etc). It is also responsible for licensing of power generation projects. Projects for own use below 1 MW do not require licensing. However, if projects below 1 MW are related to the sale of electricity, then the tariff needs to be approved and generation and supply licence issued.[123] EPRA is also responsible for EIAs and undertaking Regulatory Impact Assessments, which are public participation processes whereby stakeholders are consulted. EPRA further engages at the local level through the EPRA Strategic plan whereby the aim is to build capacity in counties, offering training for engineers.

EPRA expects more requests from counties with the implementation of the Energy Act 2019, and wants to encourage more generation in the western side of the country. While EPRA can delegate an enforcement role to counties, there can be a conflict of interest here as counties can be competitors in the market. There is a strong need to make clear the role of counties in the energy sector. In Kisumu, a Memorandum of Understanding (MoU) exists between the county governance and EPRA, which can help facilitate a more streamlined approach between the two entities, and outline roles and responsibilities as well as terms and conditions of working together. Such an agreement can be used as best practice and replicated in other counties.

The Council of Governors (CoG) also offers support to the promotion of best practice and dialogue between counties. The main functions of the CoG are to promote visionary leadership; sharing of best practices; offer a collective voice on policy issues; and promote inter-county consultations.

In addition, other organisations or entities that can support energy development can be consulted in developing a roadmap towards energy provision at county level. The Kenya Renewable Energy Association (KEREA) is one such entity; an independent non-profit association of 31 organisations (mainly from the private sector), dedicated to facilitating the growth and development of renewable energy business in Kenya. KEREA provides a platform for the exchange and adoption of best practices and standards among the members, as well as advocates for the protection of consumers of renewable energy products and services in all aspects. KEREA should be brought on board or consulted where necessary in the development of county-led renewable energy planning.

Other good practices that can be scaled up, replicated, or lessons taken forward include:

[122] Direct input from Bukachi,N, 2020.
[123] Ibid.

- Regarding PPP governance, a non-layered and direct reporting line to the PPP Committee and the Principal Secretary/National Treasury allows for transparency and effective reporting[124], supporting energy development at county level.
- Captive power (on-site generation): smart solar used for auxiliary power requirements at sites which require stable supply, such as for manufacturing or industrial processes. Captive generation involves on-site generation by energy consumers to meet their own needs as an alternative to the grid. The generated output does not currently feed back to the grid due to the absence of a net-metering framework.

5.2 Barriers for counties in the development of renewable energy

5.2.1 Institutional barriers

Energy is a shared mandate between the national government and counties. The passing of the Energy Act 2019 signals the passing of full responsibilities from the legislature to the executive arm of government who now bear the responsibility to further develop the energy sector.[125] Counties need to implement national policy and standards; however, counties are unique and have varying contexts and resources, so policies require domestication (through County Integrated Development Plans (CIDPs), for example).

In addition, the county governance structure is not always clear, with some counties still believing that the national government is responsible for all energy generation and misunderstanding the county's role in production of energy. Human resource issues also add to political problems – not only with staff turnover, but where skillsets are not necessarily aligned with technical competency requirements needed in the energy sector, such as for feasibility studies. Energy has not been a high priority at the local level: counties may have a person assigned to this sector, but they may not be an energy professional.

Limited local technology options, the availability of bankable projects and the complexities around the procurement, project preparation and PPP process adds to the confusion. Related to capacity building, county-level authorities still require awareness and understanding on concepts around the sustainability of energy and electricity processes, so that they do not only consider short-term solutions that meet immediate needs, but rather look at long-term solutions such as energy efficiency measures and renewable energy opportunities. Counties are struggling to prioritise actions, with most financial resources going to wages.

While there is no clear policy for solid waste management related to separation versus the disposal of waste in the waste-to-energy sector, dominant cartels in the waste sector make it difficult to engage in waste-to-energy processes. Project sustainability is a challenge in terms of feedstock reliability, meaning that there are limitations on implementation.

[124] Kamau, 2015.
[125] Munyaka, 2019.

5.2.2 Policy barriers

5.2.2.1 County Integrated Development Plans (CIDPs) and County Energy Plans (CEPs)

County Energy Plans (CEPs) must be developed alongside the County Integrated Development Plans (CIDPs), as a starting (or entry) point in planning for sufficient energy generation from renewable resources to meet local needs. These plans must be used in conjunction with national policies in order to localise the country's strategic priorities at local level. A major shortcoming is that CIDPs are not spatialised, nor is any spatial planning required within CIDP development. Only one county has a Spatial Development Framework (SDF), although the Council of Governors (CoG) has received requests from several counties to technically support them in various stages of their county spatial planning work. If these existed, then all other plans contained within the CIDP could emanate from this.

Developing the CEPs separate to the CIDPs is difficult. Within the CEP, counties must do a sector plan, but there is confusion about what defines a sector, and in many cases, counties currently lack the knowledge, tools and human resources to undertake this critical function. Without the establishment of CEPs – which are not yet developed or in place across the majority of counties - there is no set vision, dedicated timeframe or resources for renewable energy planning at the county level.

5.2.2.2 Feed-in Tariff (FiT) Policy

The Feed-in Tariff Policy aims to support renewable energy investment by Independent Power Producers, as described in **Chapter 2**. The amended Feed-in Tariff Policy includes implementation guidelines to include a standardised application form, progress reporting and monitoring frameworks, as well as updated feed-in tariff levels. These revisions have been acknowledged in the Energy Act 2019.

Any grid-connected project has to be aligned with the LCPDP.[126] All FiT projects have to be in the LCPDP, regardless of the project stage, e.g. those with PPAs negotiated and agreed, and those that do not have PPAs but are in the process of negotiating. Counties cannot guarantee the deal; only the national government can. There is a need to review the due diligence process as the quality of feasibility studies does not always meet the requirements of investors, and the Least Cost Power Development Plan (LCPDP) must be fully engaged with in the PPA process. In terms of monitoring and evaluation, there are cost- and time-extension implications if the feasibility study is not done right. Counties must understand what a good feasibility study looks like and what the requirements are, as well as have the capacity to evaluate projects. Feasibility studies must bring together FiT (technical) and PPP (value for money test). PPP Treasury feasibility studies include questions around affordability, whether the project meets a need, and whether the public sector is able to do the project.

126 Direct input from Omwenga, E. in review, 2020.

5.2.3 Battery storage

Energy generation from solar and wind sources is characterised by intermittency – but battery energy storage is the solution to this problem. Energy storage retains energy and releases it depending on demand, thereby stabilising the grid. In Kenya, the majority of storage batteries are utilised in off-grid PV systems, which require batteries to store electricity generated during the day for use at night.

Energy storage can be utilised in off-grid rural power supply systems, the transport sector, integration into the renewable energy grid, and for industrial activities that require uninterruptible supply of electricity. Utility-scale energy storage is being adopted in the country, but the lack of affordable financing and limited local technological expertise restrains the renewable energy storage market in Kenya.

The Kenyan market is generally dominated by lead acid battery options as the preferred storage for off-grid systems. The cost of lead acid batteries is relatively low and provides an acceptable, well-established form of energy storage. As a result, it currently dominates the storage market in Kenya, with a prevalence rate of 95%. However, the disadvantages of the lead acid battery are that it is characterised by a slow charge regime, low weight-to-energy ratio, low power and energy density, relatively short life cycle, and high maintenance requirements.[127] Proper disposal of lead acid batteries can be problematic, leading to the possibility of severe contamination of the environment and even fatal poisoning of individuals. The only manufacturer of lead acid solar batteries in Kenya is ABM under the brand name Chloride Exide. The threats facing this battery manufacturing industry in Kenya are a scarcity of raw materials, and the influx of low-cost batteries imported from other countries.[128]

5.3 Recommendations:

- At county level, energy is often hidden in other mandates. It is imperative that counties are aware of the revised regulatory environment that enables and empowers local level actors towards improving and delivering a much-needed diversified energy supply, that would meet household needs for clean and affordable energy, and improve economic opportunities. By prioritising energy mandates at county level, both the CEC and CoG can be strengthened and capacitated to act alongside and support county-led energy development projects and programmes that meet the most pressing development needs related to energy access, reliability and availability.
- There is a recognised need for guidelines for CEP that are gazetted and must include how a CEP looks, how a CEP links to national policy, and how a CEP links to the CIDPs. Such guidelines are a 'low-hanging fruit' in terms of an opportunity that could catalyse county-level renewable energy development, and would provide much-needed, specific detail in enabling counties to build understanding towards developing, planning and executing their local energy strategies. An understanding of each respective counties' unique

[127] Frost and Sullivan, 2017.
[128] Ng'etich, 2018.

challenges and opportunities is needed in taking the CEPs further, and in institutionalising energy planning and projects.[129]

- The foundation of successful devolution is the equitable distribution of resources - CIDPs should provide information that demarcates the least developed areas (using various parameters, e.g. access to improved water, health care, etc.) and the intended steps to reduce inequalities.
- There is a strong need for qualified members to be integrated into County Executive Committees (CECs) and for functional energy units to be established at the local governance level that can support cross-cutting issues between the environmental and energy sectors for planning purposes.
- The Ministry of Energy has supported preliminary studies on energy storage in Kenya. Although lead acid batteries are the most popular in Kenya, lithium-ion batteries are gaining market share because they are lightweight, last longer and have a high discharge and charge rate compared to lead acid batteries. It is worth-noting that nickel-based batteries are not in use in Kenyan projects currently. A national study to analyse the potential demand and draft a sector policy on energy to regulate and effectively drive this technology is necessary.

[129] Njoroge, 2019.

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Annex 1

Table 12 *New energy sector entities established under the Energy Act 2019*

Entity	Repealed entity	Role
1. Energy and Petroleum Regulatory Authority (EPRA):	Energy Regulatory Commission (ERC)	- The objects and functions specified for EPRA will remain fundamentally the same as those of the ERC. It will still retain regulatory control over the energy sector as a whole, with the exception of licensing of nuclear facilities and the regulation of downstream petroleum.
2. The Energy and Petroleum Tribunal (EPT)	The Energy Tribunal	- The Energy Tribunal was a quasi-judicial body whose mandate was to hear appeals that may be made to decisions made by the ERC in accordance with the repealed Energy Act. The EPTs jurisdiction is wider; the new Act provides that it may hear and determine disputes and appeals relating to energy and petroleum that may arise under the Energy Act 'and any other written laws.
3. Rural Electrification and Renewable Energy Corporation (REREC)	The Rural Electrification Authority (REA)	- The new Act has carried over the proposals in the Bill for the establishment of REREC and RERAC. - REREC will, in addition to rural electrification, have an expanded mandate in relation to renewable energy that will put it at the centre of policy formulation, research and development, international cooperation and the promotion of renewable energy use amongst the local population.
4. Renewable Energy Resource Advisory Committee (RERAC)	n/a	- RERAC is an inter-ministerial committee intended to advise the responsible cabinet secretary on matters concerning the allocation of renewable energy resources, the licensing of renewable energy resource areas, the management of water towers and catchment areas, the development of multi-purpose projects such as dams and reservoirs and the management and development of renewable energy resources.
5. Nuclear Power and Energy Agency (NPEA)	Kenya Nuclear Electricity Board	- The NPEA will continue the Board's mandate to develop and implement Kenya's nuclear energy programme.

Table 13 *List of committed generation projects from 2017 to 2024*[130]

COD	Plant name	Type	Capacity [MW]
2018	Orpower IV plant 1	Geothermal	10
2018	Lake Turkana - Phase I, Stage 1	Wind	100
2018	Strathmore	PV	0.25
2019	HVDC Ethiopia	Import	400
2019	Olkaria 5	Geothermal	158
2019	Olkaria Modular	Geothermal	50
2019	Olkaria 1 - Unit 1 Rehabilitation	Geothermal	17
2019	Lake Turkana - Phase I, Stage 2	Wind	100
2019	Lake Turkana - Phase I, Stage 3	Wind	100
2019	PV grid Garissa	PV	50
2019	Marcoborero	PV	2
2019	Kopere	PV	40
2020	Menengai 1 Phase I - Stage 1	Geothermal	103
2020	Olkaria 1 - Unit 6	Geothermal	70
2020	Olkaria 1 - Unit 2 Rehabilitation	Geothermal	17
2020	Olkaria 1 - Unit 3 Rehabilitation	Geothermal	17
2020	Kipeto - Phase I	Wind	50
2020	Kipeto - Phase II	Wind	50
2020	Alten, Malindi, Selenkei	PV	120
2020	Quaint Energy, Kenergy	PV	50
2021	Olkaria Topping	Geothermal	47
2021	Ngong 1 - Phase III	Wind	10
2021	Chania Green	Wind	50
2021	Aperture	Wind	50
2021	Eldosol	PV	40
2021	Makindu Dafre Rareh	PV	30
2021	Gitaru solar	PV	40
2022	Olkaria 6 PPP	Geothermal	140
2022	Menengai I - Stage 2	Geothermal	60
2022	Prunus	Wind	51
2022	Meru Phase I	Wind	80
2022	Ol-Danyat Energy	Wind	10
2022	Electrawinds Bahari	Wind	50
2022	Hanan, Greenmillenia, Kensen	PV	90
2023	Orpower4 plant 4	61	
2023	Olkaria 7	Geothermal	140
2023	Eburru 2	Geothermal	25
2023	GDC Wellheads	Geothermal	30
2023	Wellhead leasing	Generic back-up capacity	50
2023	Karura	Hydropower	89
2023	Electrawinds Bahari Phase 2	Wind	40
2023	Sayor, Izera, Solar joule	PV	30
2023	Belgen, Tarita Green Energy Elgeyo	PV	80
2024	Lamu Unit 1	Coal	327

[130] EPRA, 2020.

2024	Lamu Unit 2	Coal	327
2024	Lamu Unit 3	Coal	327
2024	Olkaria 8	Geothermal	140
2024	Menengai III	Geothermal	100
2024	Baringo Silali - Paka I	Geothermal	100
2024	Marine Power Akiira Stage 1	Geothermal	70
2024	Meru Phase II	Wind	100
2024	Tarita Green Energy Isiolo, Kengreen	PV	50
2024	Asachi, Astonfield Sosian, Sunpower	PV	81
TOTAL	**4419.25**		

100% RENEWABLES CITIES & REGIONS ROADMAP

The 100% Renewables Cities and Regions Roadmap project is implemented by ICLEI – Local Governments for Sustainability and funded by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) through the International Climate Initiative (IKI).

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