KENYA COUNTRY STUDY **2020**

CLEAN CAPTIVE INSTALLATIONS FOR INDUSTRIAL CLIENTS IN SUB-SAHARA AFRICA

120 kW grid tied, Burn Manufacturing, Factory.
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CICSA
CLEAN CAPTIVE INSTALLATIONS FOR INDUSTRIAL CLIENTS IN SUB-SAHARA AFRICA

Frankfurt School
FS-UNEP Collaborating Centre
for Climate & Sustainable Energy Finance

UN environment programme

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The electronic copy of this report can be downloaded at *www.captiverenewables-africa.org*

DISCLAIMER

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SUMMARY OF PUBLICATION

This country report presents the state of the clean captive installations market in Kenya as of year-end 2019, with a focus on the commercial and industrial market and solar photovoltaic (PV) technology.

The project team collected stakeholders' views on their experiences with: a) the current clean captive installations for the commercial and industrial sector; b) the perceived barriers for its development; c) potential synergies between their activities and the project; and d) industry sectors and technologies to be targeted under this project (for modelling support and to initiate a pilot project). For the purposes of confidentiality, the names of persons and/or institutions have not been included in this report.

The information presented in this report was collected during the last quarter of 2019 and is valid as of that date. The Kenyan energy and captive market and its regulatory framework are changing rapidly. Readers are invited to consider any evolution that may have taken place since year-end 2019.

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1/ ABBREVIATIONS AND ACRONYMS

AFD	Agence Française de Développement
CAPEX	Capital expenditure
CBK	Central Bank of Kenya
CEEC	Centre for Energy Efficiency and Conservation (at KAM)
CI	Commercial and industrial
DC	Domestic consumer
DNSP	Distribution network service provider
EPC	Engineering, procurement and construction
EPRA	Energy and Petroleum Regulatory Authority
ERC	Energy Regulatory Commission (now EPRA)
ESCO	Energy service/supply company
FCC	Fuel cost charge
FERFA	Foreign Exchange Rate Fluctuation Adjustment
FMO	Netherlands Development Finance Company
FS	Frankfurt School
GDC	Geothermal Development Corporation
GDP	Gross domestic product
GDS	Generation, distribution and supply
GWh	Gigawatt-hour
IA	Inflation adjustment
IDA	Investment deduction allowance
IFC	International Finance Corporation
IKI	International Climate Initiative
IPP	Independent power producer
ISIC	Industrial Standard Industrial Classification
KAM	Kenya Association of Manufacturers
KBA	Kenya Bankers Association
KenGen	Kenya Electricity Generating Company
KETRACO	Kenya Electricity Transmission Company
KNBS	Kenya National Bureau of Statistics
KNES	Kenya National Electrification Strategy
KPI	Key performance indicator
KPLC	Kenya Power and Lighting Company
Ksh	Kenyan shilling
KTDA	Kenya Tea Development Agency
kVA	Kilovolt ampere
kW(p)	Kilowatt (peak)
kWh	Kilowatt-hour
LCPDP	Least Cost Power Development Plan
LTP	Long-Term Plan
MTP	Medium-Term Plan
MTP III	Third Medium-Term Plan
MVA	Megavolt ampere
MWp	Megawatt (peak)
MWh	Megawatt-hour
NEMA	National Environment Management Authority
O&M	Operations and maintenance
PGTMP	Power Generation and Transmission Master Plan
PPA	Power purchase agreement
Proparco	Promotion et Participation pour la Coopération économique
PV	Photovoltaic
REP	Renewable Energy Programme
RERAC	Renewable Energy Resource Advisory Committee
REREC	Rural Electrification and Renewable Energy Corporation
RTAP	Regional Technical Assistance Program
SC	Small consumer
SEforALL	Sustainable Energy for All
SUNREF	Sustainable Use of Natural Resources and Energy Financing
UNEP	United Nations Environment Programme
VAT	Value-added tax
WARMA	Water Resource Management Authority

1.2 MW gri-tied Spinners and Spinners; Factory.
Sebastian Noethlichs/Shutterstock.com

2/ INTRODUCTION

This report is published under the project titled "Clean Captive Installations for Industrial Clients in Sub-Sahara Africa" developed in four partner African countries: Ghana, Kenya, Nigeria and South Africa.

The project aims to demonstrate the economic and financial viability of clean captive energy installations for industries and to enhance their adoption in the four partner countries and beyond to the entire continent. Captive energy installations are electricity generation facilities that are used and sometimes also managed by a commercial or industrial energy user for their own energy consumption. Captive power plants can be operated off-grid or can be connected to the grid to feed in excess generation wherever regulations allow for it.

Renewable energy captive installations alleviate the pressure to generate electricity from national grids and reduce industrial clients' needs to rely on private supplementary fossil-fuelled generators, which are expensive to run. These clean captive installations are frequently referred to as the second generation of renewable energy business models, as they do not rely on national governments' incentivizing policies to enhance the deployment of clean energy technologies.

The project will strengthen the ability of partner countries to move towards low carbon-emitting development strategies. It also contributes to several Sustainable Development Goals, including Climate Action (SDG 13), Responsible Consumption and Production (SDG 12), Affordable and Clean Energy (SDG 7) and Industry, Innovation and Infrastructure (SDG 9). The project will raise awareness among industry players, financiers and governments, and will support the dissemination of clean modern energy technology through business models tailored to the national contexts and beyond throughout sub-Saharan Africa.

This project is part of the International Climate Initiative (IKI) of Germany. The Federal Ministry for the Environment, Nature Conservation and Nuclear Safety supports this initiative based on a decision adopted by the German Bundestag.

The implementing team of the project comprises the United Nations Environment Programme (UNEP) in partnership with its collaborating centre at Frankfurt School of Finance & Management (Frankfurt School), together with locally hired consultants who provide local market and captive power expertise.

THE PROJECT

The project's activities fall under four components:

Component 1	Baseline studies and awareness raising
Component 2	Economic and financial tools and assessments
Component 3	Realization of one pilot project per country
Component 4	Knowledge dissemination and outreach.

This country report is part of Component 1. Initial desktop research was conducted followed by extensive consultation by the project team of local public and private sector stakeholders through a week-long scoping mission.

In Kenya, the scoping mission took place from 16 September 2019 to 20 September 2019. The official kick-off meeting held at the United Nations office in Nairobi on 16 September gathered 18 stakeholders from 11 institutions. Following this in-depth discussion of the Kenyan market with public stakeholders, the project team met with 26 private sector stakeholders throughout the week.

The project team collected stakeholders' views on their experiences with: a) the current clean captive installations for the commercial and industrial sector; b) the perceived barriers for its development; c) potential synergies between their activities and the project; and d) industry sectors and technologies to be targeted under this project (for modelling support and to initiate a pilot project). For the purposes of confidentiality, names of persons and/or institutions have not been included in this report.

The information collected during the desktop research and in-person interviews in the four partner countries will inform the overall design and guide the implementation of the project. This country report presents the state of the clean captive installations market in Kenya as of year-end 2019 with a focus on the commercial and industrial market and solar photovoltaic (PV) technology.

The information collected will also support the development of a robust financial model to be used as a tool to prove the financial viability of clean captive PV technology installations. Relevant and key information about the clean captive energy markets in the four partner countries and the project progress will be shared through the project website, *www.captiverenewables-africa.org*.

The information presented in this report was collected during the last quarter of 2019 and is valid as of that date. The Kenyan energy and captive market and its regulatory framework are changing rapidly. Readers are invited to consider any evolution that may have taken place since year-end 2019.

60 kW grid-tied Golden Tulip Flower Farm.
Sebastian Noethlichs/Shutterstock.com

3/ KEY FINDINGS

Kenya has an oversupply of electricity.	The current and projected electricity demand-supply balance in Kenya indicates a situation of oversupply. To address this, the government is delaying new generation projects and is promoting growth in electricity demand, including incentives targeting growth in industrial production.
Captive solar PV is currently competitive, and some potential users of captive PV may bxenefit from changes in grid electricity supply.	Captive solar PV is currently competitive, and grid tariffs will likely increase in the future to the benefit of potential captive PV users, albeit at a slower pace than has been forecasted. Captive power plants with levelized costs below US$0.12 per kilowatt-hour (kWh) will likely be attractive to industrial users based on current electricity tariffs, especially users operating six or seven days per week. However, 60 of the largest industrial customers may receive dedicated electricity supply in the future, and new special economic zoning for some manufacturers could lead to lower electricity rates.
Uncertainties exist during the transition period under the new Energy Act. Although a simplified regulatory environment for self-consumption plants below 1 MW is likely to be maintained, electricity supply to third parties requires review and approval.	Under the Energy Act of 2019, the government is updating existing electricity sector regulations and developing new ones. The target date of March 2020 for completion of the new regulatory energy framework was not met, leading to a transition period of uncertainty. Currently, captive power plants for self-consumption with an installed capacity below 1 megawatt (MW) do not require electricity licencing or regulatory approval, although building and environmental permits may be required. The new legislation, however, sets a 1 MW threshold for the total installed capacity at a facility, including back-up diesel generators. Projects above 1 MW do require an electricity licence, and power purchase agreement (PPA) tariffs need to be approved by the regulator. The procedure for licencing is heavily regulated but is fairly straightforward and inexpensive. As of August 2018, there were 22 existing licenced captive plants in the country. Possibilities to feed in surplus power to the grid exist in principle but in practice might prove difficult: a PPA under the feed-in tariff scheme is not easy to obtain, and the tariff is generally lower than the avoided cost of power. Net metering is legally allowed, but regulations have not been approved for implementation, and grid code requirements need to be met.

A good potential market exists for captive PV in manufacturing industry in Kenya.	The total number of KPLC customers in the commercial and industrial tariff categories in June 2018 was 3,912. These tariff categories are of most relevance for clean captive power in industrial installations. The potential number of clean captive power users in the manufacturing sector based on market size (those with a turnover of at least US$1 million per year) was just above 800 in 2016. The regions of Kenya with the largest captive power markets are likely to be (in order of size) Nairobi, Mombasa, Kiambu, Nakuru, and Kisumu counties. The manufacturing sub-sectors with the greatest number of high-turnover businesses are food products, chemicals, rubber and plastics, textiles, print and media production, fabricated metal and paper products, among others. Although there is potential in non-manufacturing industrial sectors such as mining, water and waste, and construction, the likelihood of uptake and replication potential is considered the greatest among manufacturers. In terms of energy demand and consumption in manufacturing sub-sectors, only outdated, high-level and indicative data are publicly available. Better data would enable a more detailed analysis of the highest potential sub-sectors. Regardless, there is likely to be broad potential across multiple sub-sectors for industrial facilities that have common characteristics that make captive power competitive, including consistent daily load profiles and continuous operations 6-7 days a week throughout the year.
Clean captive power uptake in Kenya is strong and growing.	At least 100 captive power solar PV systems exist at commercial, industrial and institutional/non-profit establishments in Kenya. At least 17 of these with a capacity of more than 50 kilowatts-peak (kWp) are found in the industrial sector (manufacturing) including at factories and at food and tea processing facilities. The total installed capacity of the 17 plants is more than 10 megawatts-peak (MWp). In the industrial sector, the largest identified captive PV system is 1,500 kWp at Kapa Oil Refineries. The first projects were implemented in 2011, while the bulk of the capacity has come online since 2016. There are also around 20 captive small hydropower and bioenergy plants in industry.
Some bank financing is available, but with stringent conditions and thanks largely to donor support.	An ongoing AFD/Proparco-funded programme called SUNREF that includes a green credit line for commercial banks has enabled more than US$70 million in lending to 37 renewable energy and energy efficiency projects in East Africa. The vast majority of these are in Kenya, and a high proportion is either clean captive plants or involves process improvements and efficiency in manufacturing facilities. Bank financing of captive plants is limited, however, due to reduced risk appetite, full-recourse terms and foreign exchange exposure, among other factors.
An active ecosystem of captive power players exists including private financiers and ESCOs.	A number of quality developers; energy service/supply companies (ESCOs); engineering, procurement and construction (EPC) companies; and equipment suppliers and installers are active in Kenya, many of which focus on solar PV captive power. Since 2014, private financiers have emerged and have built partnerships with ESCOs and EPC companies to offer financing for end users. In terms of financing models for captive solar PV, outright purchase by owners predominates with an estimated 70-80 per cent or more of systems being implemented under this model. However, operating leases (including "rent-to-own") and PPA arrangements are also being offered and adopted on the market.

1MW grid-tied, Tatu City, Industrial park.
Sebastian Noethlichs/Shutterstock.com

4/ KENYA KEY SOCIO-ECONOMIC INDICATORS

SOCIO-ECONOMIC INDICATOR	RESULT	DATE	SOURCE
Population	52.6 million	2019	UN World Population Prospects
Population growth	2.27%	2019	World Bank
Female population share	50.3%	2019	UN World Population Prospects
Youth population share (<15 years)	40.1%	2018	UN Statistics Division
Gross domestic product (GDP)	US$95.5 billion	2019	World Bank
GDP growth	5.36%	2019	World Bank
Average GDP growth	5.45%	2004-2019	Trading Economics
Contribution to GDP growth	- Service (43.22%) - Agriculture (34.15%) - Industry (16.15%)	2019	World Bank
GDP per capita	US$1 816	2019	World Bank
Total labour force (share of total population >15 years)	74.6%	2019	World Bank
Female labour force (share of female population >15 years)	72%	2019	World Bank
Unemployment rate	2.64%	2019	World Bank (modelled by International Labour Organization)
Inflation rate	6.3%	July 2019	Central Bank of Kenya
Corruption perception index	28 points 137/180 ranking	2018	Transparency International
Ease of doing business	56/190 ranking	2019	World Bank

294kW grid tied Eco Roses, Flower Farm.
Lidia Daskalova/Shutterstock.com

5/ ELECTRICITY MARKET

This section provides an overview of the electricity market in Kenya, including the current situation and forecasts for the country's generation, transmission and distribution networks. The section highlights the strong potential of captive power generation to address the current barriers facing the electricity market. The concluding text further analyses the market potential for clean captive installations in Kenya.

Table 1: Key energy indicators

ENERGY INDICATOR	RESULT	DATE	SOURCE
Access to electricity	75%	2018	World Bank
Electrification – urban areas	81%	2017	World Bank
Electrification – rural areas	58%	2017	World Bank
Electricity generation	10 531 GWh	Jul 2017 – Jun 2018	KPLC 2018
Geothermal	3 868 GWh (37%)		
Hydropower	3 186 GWh (30%)		
Independent power producers	2 495 GWh (24%)		
Thermal	888 GWh (8%)		
Wind	47.5 GWh (0.5%)		
Off-grid	47 GWh (0.5%)		
Average cost of generation	US$0.11 per kWh	2018	ERC 2018a
Electricity consumption	8 435 GWh	Jul 2017 – Jun 2018	KPLC 2018
Electricity exports	24 GWh	Jul 2017 – Jun 2018	KPLC 2018
Electricity imports	171 GWh	Jul 2017 – Jun 2018	KPLC 2018
Electricity total installed capacity	2 716 MW	December 2018	KPLC 2018, LTWP 2020; IGADWAH 2019

Kenya Vision 2030 is the national economic development blueprint that seeks to transform Kenya into a newly industrializing middle-income country providing a high quality of life to its citizenry. This vision identifies provision of energy as one of the catalytic sectors to attain sustainable development. The Kenyan power sector has been undergoing reforms in recent years aimed at accelerating sectoral development, supporting the realization of Vision 2030 and aligning the sector with changes in the country's governance structure.

As per the Sustainable Energy for All (SEforALL) Action Agenda, Kenya has also committed to achieving 80 per cent of its electricity generation from renewable energy by the year 2030 and a 2.79 per cent reduction in total energy intensity annually by 2030 from the baseline year 2012 (SEforALL 2016).

Kenya's electricity access rate rose from 32 per cent in 2014 to 75 per cent in 2018 (both on-grid and off-grid). The Kenya National Electrification Strategy (KNES 2018a), launched in December 2018, outlines a threefold approach to achieving universal access to electricity for all Kenyans by 2022: 1) grid extension (grid intensification and densification), 2) mini-grids and 3) deployment of solar home systems.

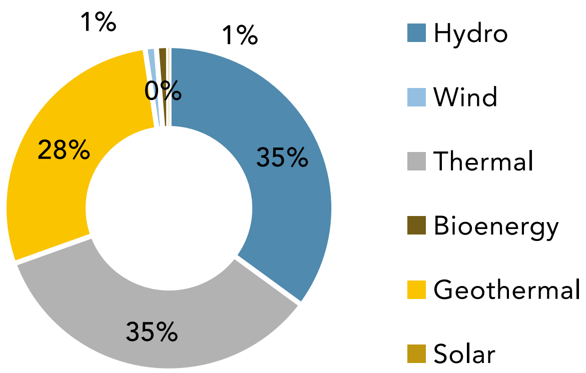
5.1/ ELECTRICITY GENERATION

This section explores the current and projected electricity generation mix in Kenya, which currently comprises a high share of renewable energy sources.

5.1.1/ CURRENT SITUATION

Electricity Generation Installed Capacity: As of December 2018, 81 per cent of the installed generating capacity in Kenya was from renewable energy. The total installed generating capacity of power plants connected to the national grid was 2,716 megawatts (MW)[1], out of which 1,610 MW was from the government majority-owned Kenya Electricity Generation Company (KenGen). A further 1,019 MW was owned by independent power producers (IPPs), and 87 MW was in off-grid areas under the government's Rural Electrification Programme. Figure 1 shows the electricity generation installed capacity by technology.

Figure 1: Electricity generation installed capacity mix as of December 2018



TECHNOLOGY	MW
Hydropower	826
Fossil fuel-based thermal	807
Geothermal	663
Wind*	336
Solar**	56
Bioenergy	28
TOTAL	**2 716**

** Including the 310 MW Lake Turkana Wind Power Project (commissioned in September 2018).*
*** Including the 55 MW Garissa Solar Power Plant (commissioned in November 2018).*
Source: KPLC 2018; LTWP 2020; IGADWAH 2019.

Electricity Imports: The Kenya Power and Lighting Company (KPLC or Kenya Power) purchased 10,702 gigawatt-hours (GWh) of electricity in the financial year ending June 2018, out of which 77.8 per cent was from renewables, 20.6 per cent was from thermal generation, and 1.6 per cent (171 GWh) was imported from Uganda and Ethiopia. The average cost of generating each unit of electricity is estimated at US$0.11 per kWh (ERC 2018a).

1 *Effective capacity was 2,278 MW.*

5.1.2/ FUTURE PROJECTION

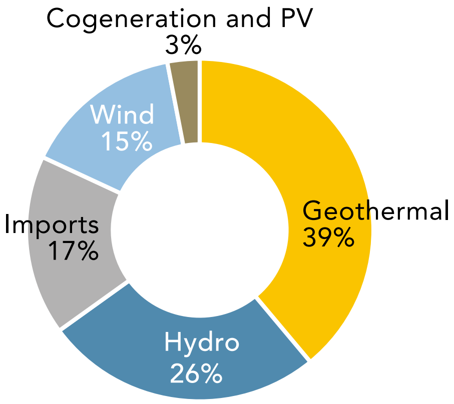
The electricity generation plan for Kenya is included in the Power Generation and Transmission Master Plan for 2015-2020 (PGTMP) (GoK 2016a) and in the Least Cost Power Development Plan for 2017-2037 (LCPDP) (GoK 2018a).

The total installed generating capacity is projected to grow to around 7,000 MW by year 2030 (GoK 2018a). The pipeline of projects includes 4,000 MW from renewable energy IPPs, out of which more than 400 MW have already signed power purchase agreements (PPAs) and are expected to come online in the near future (SEforALL 2015). In addition, a 1,050 MW coal power plant in Lamu signed a PPA, although in June 2019 Kenya's National Environment Tribunal (NET) revoked the licence granted to Amu Power Company.

According to the PGTMP, thermal electricity generation is expected to drop significantly in the near future as renewable energy reaches almost 100 per cent by 2020. Renewable energy generation will come mostly from geothermal, wind, solar photovoltaic (PV), and increased electricity import from Ethiopia (mainly hydropower-based). The PGTMP and LCPDP do not include captive power generation in their analyses of both short- and long-term power development plans.

Figure 2 shows the estimated electricity generation mix (GWh) by year 2020.

Figure 2: Projected generation mix (percentage of GWh) by year 2020



TECHNOLOGY	MW
Hydropower	826
Fossil fuel-based thermal	807
Geothermal	663
Wind*	336
Solar**	56
Bioenergy	28
TOTAL	**2 716**

Source: Derived from GoK 2016a, p. 7.

5.2/ ELECTRICITY TRANSMISSION AND DISTRIBUTION

This section explores the current situation of the transmission and distribution system in Kenya. Although most of the country's population centres have electricity coverage, the grid infrastructure is experiencing difficulties, resulting in system losses. The western part of Kenya is the most affected by poor grid infrastructure, and future plans target new transmission and distribution lines, including inter-country transmission lines, to mitigate the situation.

5.2.1/ CURRENT SITUATION

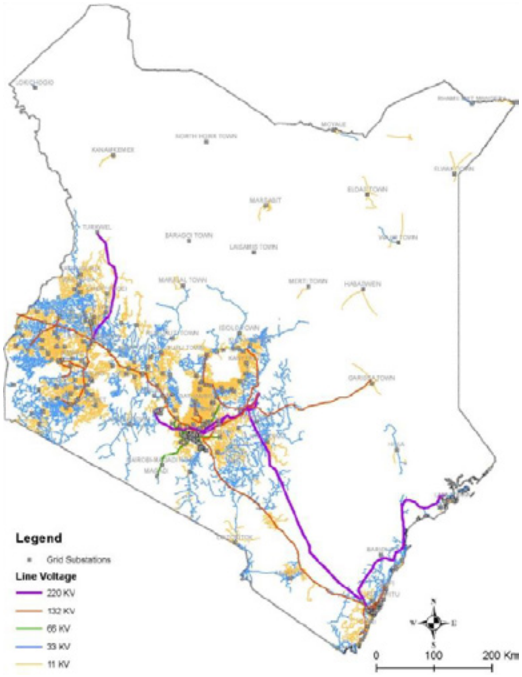
The electricity transmission and distribution network in Kenya – including mini-grids in remote areas – covers most of the main population centres. Almost all, if not all, of the country's industrial facilities are connected to the grid. Table 2 and Map 1 show the extent of the existing grid network in Kenya.

Table 2: Extent of transmission and distribution lines in Kenya

LINES	LENGTH (KM)
Transmission	
400 kV	1,244
220 kV	1,686
132 kV	3,322
66 kV	1,168
Distribution	
33 kV	34,508
11 kV	38,968

Source: KPLC 2018, p. 219.

Map 1: Transmission and distribution network up to 220 kV (2018)



Source: KNES 2018b

System losses, both technical and non-technical, were recorded at 2,244 GWh, or 28 per cent[2], for the financial year ending in June 2018. Losses increased every year between 2013/14 and June 2018, a rise of 30 per cent during this period (KPLC 2018), contrary to policy statements aimed at reducing such losses.

Insufficient investment in grid network infrastructure has resulted in transmission and distribution constraints and overloaded substations. The existing transmission system capacity is severely constrained, particularly during peak hours, due in part to inadequate reactive power in major load centres and to transmission constraints, particularly in the western and Nairobi regions. The western part of Kenya is the most affected, leading to unstable power supply in the region.

5.2.2/ FUTURE PROJECTION

To address the issue of power supply in the western part of Kenya, the government has been constructing a transmission line to deliver power directly from the Olkaria geothermal fields to the western region (Ogega 2019). The new line, targeted for completion in April 2020, was expected to face delays, and in the meantime other interventions might be needed, including supporting investments in captive power systems[3].

Kenya Electricity Transmission Company (KETRACO) is also increasing investments in transmission infrastructure development in line with the PGTMP and the LCPDP[4]. Nearly 6,000 kilometres (km) of planned transmission network, grid upgrading and reinforcement measures are expected to improve network reliability and performance. By 2031, a projected 16,000 km of transmission lines and associated substations will have been constructed (MoE 2018).

As part of developing the Eastern Africa Power Pool, a number of regional inter-country high-capacity transmission lines are also planned or under construction. This will improve the ability of Kenya to import and export electricity with neighbouring countries. The 612 km Ethiopia-Kenya bi-directional 500 kilovolt (kV) transmission line with a capacity to transfer up to 2,000 MW has been under construction since 2010 and is expected to be commissioned soon. Other plans include the construction of a 127 km, 400 kV interconnector with Uganda and a similar line between Kenya and Tanzania (100 km, 400 kV). Ultimately, the objective is to connect the Eastern Africa Power Pool with the Southern African Power Pool.

Map 2 shows the existing and planned transmission network.

Map 2: Existing and planned transmission network 66 kV – 400 kV (2017)

Source: KETRACO 2017

2 *Of the losses, 20.5 per cent were technical (energy dissipation) due to rapid expansion of the power network and the number of customers (many long lines far from generation sources), and 7.5% were non-technical (theft, broken meters, meter tampering).*

3 *Interview with Ministry of Energy officials, September 2019.*

4 *Comments made during the official launch of the project in September 2019.*

5.3/ ELECTRICITY DEMAND OF COMMERCIAL AND INDUSTRIAL CLIENTS

This section explores the electricity demand of commercial and industrial clients in Kenya in the context of the overall supply situation. Demand is expected to continue to increase as the government pushes for growth in manufacturing, agriculture and other economic sectors under Vision 2030. However, Kenya is in a situation of oversupply, and with commercial and industrial clients accounting for half of all electricity demand, clean captive power systems are not being encouraged as a means to address any electricity supply shortfall at the national level.

5.3.1/ ELECTRICITY SALES AND CONSUMPTION

KPLC had 6,761,090 customers as of June 2018, up 9 per cent from 2017. The vast majority of these customers (95 per cent) are domestic consumers, and the remaining 5 per cent are small commercial, large commercial, and industrial customers, in addition to street lighting.

Although larger commercial and industrial entities comprised only a fraction of connected customers, they accounted for 50 per cent of electricity consumption, or 4,232 GWh, as of June 2018.

The total number of KPLC customers in the commercial and industrial (CI) tariff categories was 3,912 in June 2018. These are the tariff categories of most relevance for clean captive power in commercial and industrial installations[5]. Table 3 shows the number of customers by CI tariff code from 2014 to 2018. Of these, 82% are part of the tariff category CI1 (low voltage).

Table 3: Number of customers in CI tariff categories, 2014-2018

TARIFF CATEGORY	CONNECTION VOLTAGE	VOLTAGE CATEGORY*	YEAR				
			2013/14	2014/15	2015/16	2016/17	2017/18
CI1	415 V	Low	2 728	2 940	3 087	3 150	3 227
CI2	11 kV	Medium	333	348	378	405	527
CI3	33 kV		36	43	43	57	64
CI4	66 kV	High	24	31	35	41	53
CI5	132 kV		27	32	32	33	41

** As per the Kenya Grid Code, less than 1 kV is low voltage, 1-33 kV is medium voltage, and 33-150 kV is high voltage.*
Source: KPLC 2018, p. 216.

Table 4 shows KPLC energy sales by CI tariff category and by geographical distribution of electricity consumption in the industrial sector (KPLC 2018). Nairobi region has the highest consumption at 2,013 GWh. CI1 (low voltage) and CI2 (medium voltage) customers recorded the largest consumption, at 1,590 GWh and 1,321 GWh respectively. Electricity Consumption for Categories CI2 and CI4 has been stagnant since 2016/2017, while categories CI3 and CI5 have experienced an increase of 8.70 per cent and 12.90 per cent respectively during the same period. Only CI1 customers have decreased their electricity consumption by 6.10 per cent, as shown in the table below.

5 A large number (339,688) of small commercial customers are part of the SC (small commercial) tariff code category (240-or 415 V), but they are not considered in this study given the low potential for clean captive power among very small enterprises.

Table 4: Distribution of CI tariff customer consumption by electricity supply region, 2017/2018

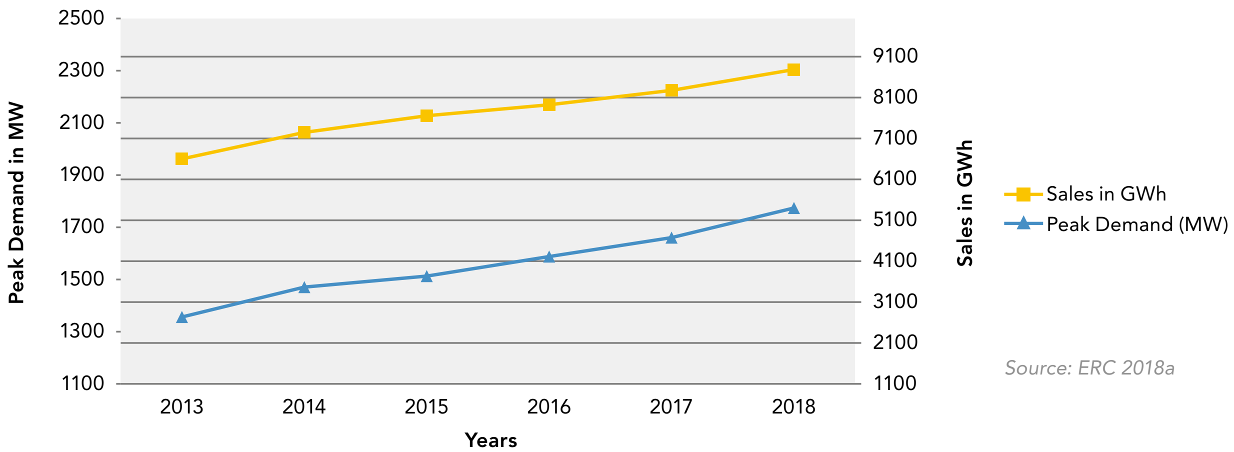
KPLC SUPPLY REGION	KEY COUNTIES	CONSUMPTION BY TARIFF CATEGORY (GWH)					
		CI1	CI2	CI3	CI4	CI5	TOTAL
Nairobi North	Kiambu	237	206	0	81	0	524
Nairobi South	Nairobi, Machakos	292	441	13	346	69	1 161
Nairobi West		184	82	29	25	8	328
Nairobi		**713**	**729**	**42**	**452**	**77**	**2 013**
Coast	Mombasa, Kwale	**160**	**166**	**110**	**7**	**211**	**654**
Central Rift	Nakuru, Kericho	213	106	101	11	102	533
West Kenya	Kisumu	58	29	16	0	20	123
North Rift	Uasin Gichu	105	91	19	63	14	292
South Nyanza	Kisii	49	14	8	0	0	71
West		**425**	**240**	**144**	**74**	**136**	**1 019**
Mt Kenya	Nyeri, Meru	154	33	24	4	0	215
North Eastern	Garissa	138	154	0	37	1	330
Mt Kenya		**292**	**187**	**24**	**41**	**1**	**545**
Total		**1 590**	**1 321**	**321**	**575**	**425**	**4 232**
% change 2016/2017		*-6.10%*	*-0.50%*	*8.70%*	*-0.90%*	*12.90%*	

Source: Derived from KPLC 2018, pp. 211-13.

5.3.2/ ELECTRICITY DEMAND

Demand for electricity in Kenya has increased steadily over the past few years, although at a much slower pace than was initially projected under the Vision 2030 forecasts. Peak electricity demand was recorded at 1,802 MW as of 30 June 2018, which represents an increase of 146 MW (8.8 per cent) from the previous year. Figure 3 shows the steady growth in electricity demand between 2013 and 2018, reflecting both the increase in the number of customers and growing consumption in the commercial and industrial sectors.

Figure 3: Peak demand and customer consumption, July 2013 – April 2018



Source: ERC 2018a

Based on the number of customers in the CI tariff category and on total sales per category, the average annual electricity consumption per customer can be estimated. These figures, presented in Table 5, provide a good reference point for understanding potential system sizing for clean captive power in the industrial sector in Kenya. Average consumption in megawatt-hours (MWh) per customer ranges from 493 MWh for CI1 customers to 10,849 MWh for CI4 customers.

Table 5: CI tariff category customer average annual consumption and demand

PARAMETER	TARIFF CATEGORY				
	CI1	CI2	CI3	CI4	CI5
Number of customers (2017/2018)	3 227	527	64	53	41
Total consumption in MWh (2017/2018)	1 590 000	1 321 000	321 000	575 000	425 000
Average consumption in MWh per customer	493	2 507	5 016	10 849	10 366
Average kVA demand per customer (2013 – latest data available)	168	815	1 881	4 190	1 113

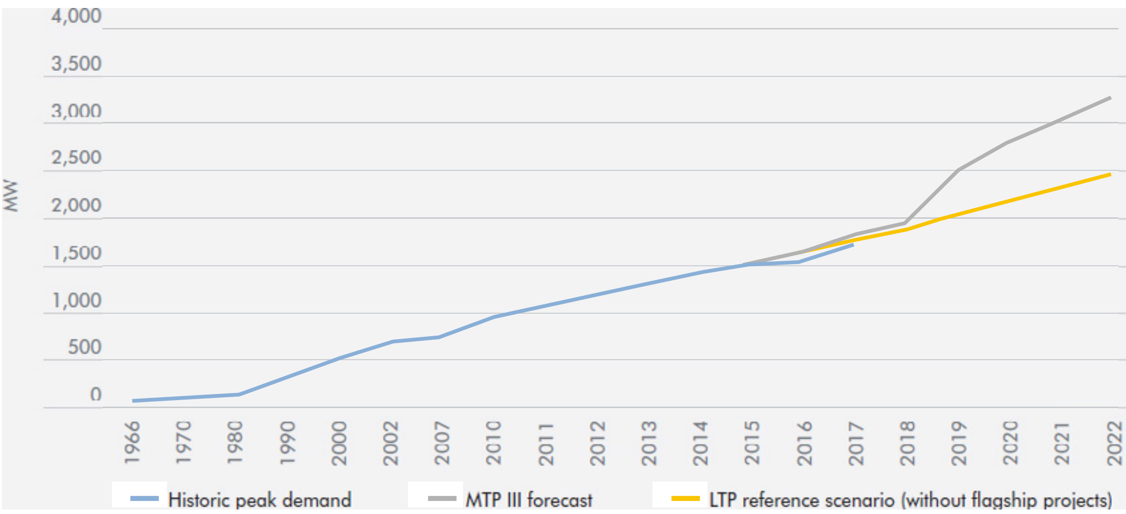
Source: Derived from KPLC 2018, pp. 211-13, 216, and from ECA and Carbon Africa 2014, p. 41.

5.3.3/ ELECTRICITY DEMAND FORECAST

Vision 2030's Third Medium Term Plan (MTP III) for the period 2018-2020 forecasts electricity demand to grow by 12 per cent annually, based on an ambitious sustained GDP growth of 10 per cent annually and on the completion of major Vision 2030 flagship projects[6]. The PGTMP Long Term Plan (LTP) forecast is more conservative, projecting 7 per cent growth under a reference scenario without the Vision 2030 flagship projects. This growth rate scenario is more realistic since most of the Vision 2030 projects are experiencing delays and are not expected to be completed before 2022.

Figure 4 shows historical peak demand, the demand forecast under Vision 2030 MTP III and the LTP reference scenario without the Vision 2030 flagship projects. Peak demand has grown by around 6 per cent annually on average over the past 15 years (SEforALL 2016). Demand is expected to continue to increase as the government pushes for growth in manufacturing, agriculture and other economic sectors under Vision 2030 MTP III, commonly referred to as "the Big 4 Agenda". It is projected to grow from 1,802 MW as of June 2018 to 2,421 MW by 2022 and then to 2,989 MW by 2025 and 4,244 MW by 2030. Annual energy consumption is projected to increase from 8,272 GWh in 2016/17 to 14,334 GWh in 2021/22 (MoE 2018).

Figure 4: Historic peak demand and demand forecast, 1966-2022



Source: SEforALL 2015

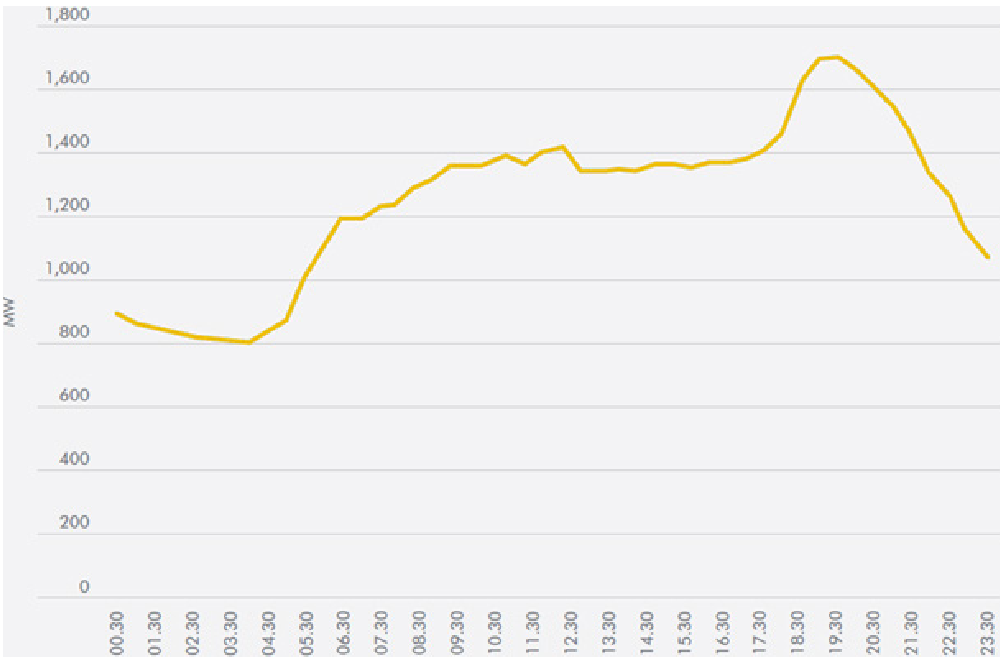
6 *Envisioned major flagship projects for economic development include industrial parks, Lamu Port-South Sudan-Ethiopia Transport (LAPSSET) Corridor projects, resort cities, iron and steel smelting industry, the standard gauge railway and light rail.*

5.3.4/ DEMAND / SUPPLY BALANCE

With an electricity peak demand of 1,802 MW against an effective capacity of 2,278 MW, the power system has a comfortable reserve margin of around 476 MW (21 per cent). Although peak demand is increasing, the projected increase in installed capacity is expected to ensure no shortage of supply. In fact, with average demand growth of 6-8 per cent annually against a power project pipeline of over 4,000 MW by 2024 (GoK 2018a), Kenya will continue to face a situation of oversupply in the near future. In recognition of this, the signing of new PPAs is being delayed, and some projects, such as Lamu Coal Power Plant, may be rescheduled until after 2030.

The daily load curve of the national grid[7] in Figure 5 shows flat daytime demand from 9 a.m. to 7 p.m. before the evening peak starts from 7 p.m. to 10 p.m., followed by low overnight demand from 10 p.m. to 6 a.m.[8] The minimum demand occurs at around 4 a.m. and the maximum demand at around 8 p.m. During the load trough, the generation output from geothermal power plants is usually reduced to avoid excessive production from power plants that have take-or-pay PPA clauses (SEforALL 2015). To help alleviate the issue, the government is encouraging industry to shift production to off-peak times and weekends through time-of-use tariffs and other incentives (see section 6.1.3).

Figure 5: Daily load curve, 2017



Source: SEforALL 2015

The demand/supply situation means that – and although energy efficiency and conservation measures in industry are required by law (see section 5.1.5) – the government is trying to increase and stimulate demand during daytime off-peak periods, especially targeting commercial and industrial customers who represent 50 per cent of the total demand. For this reason, clean captive power systems are not being encouraged as a means to address any electricity supply shortfall at the national level.

7 *All KPLC customers.*

8 *A daily load curve for industry or selected industrial segments was not available as of the time of writing.*

5.4/ GRID DOWNTIME

This section explores the consequences of grid downtime for commercial and industrial clients. Based on a survey from the World Bank, a vast majority of firms own diesel generators as back-up systems and have reported that grid downtime has a negative impact on their annual sales. This is why the government is encouraging clean captive power installations as private sector interventions to address the challenge of unreliable power.

5.4.1/ CURRENT SITUATION

Kenya experiences frequent grid downtime, caused by factors such as weather conditions, equipment failure, vandalism and planned interruptions, among others. At 35 per cent of the total installed capacity, hydropower comprises a significant proportion of Kenya's electricity generation mix. This exposes the country to decreased electricity production, leading to a risk of power rationing during dry seasons (January-March, August-October) when water levels at the hydropower dams are low. However, in recent years the country has been diversifying from hydropower to geothermal, wind and solar, as well as commissioning additional thermal capacity to allow for emergency generation.

Efforts are ongoing to improve electricity reliability through investments in the transmission and distribution networks. Improving power supply reliability is part of the government's strategy to promote growth in the manufacturing sector, and grid downtime has been reduced in most parts of the country, including in targeted industrial areas[9].

5.4.2/ IMPACT ON COMMERCIAL AND INDUSTRIAL CLIENTS

According to the World Bank Enterprise Survey Report 2018, more than 80 per cent of 1,011 surveyed manufacturing and service firms reported experiencing power outages an average of 3.8 times in a typical month (World Bank 2019). The outages have led to losses equivalent to 5.4 per cent of annual sales (World Bank 2019).

Table 6 presents data on electricity supply and grid outages in Kenya from the latest Enterprise Survey (2019), with the firms categorized by number of employees. Medium and large firms are likely to be the main market for clean captive power in industry.

Table 6: Electricity grid outages and back-up power among firms in Kenya

PARAMETER	UNIT	SMALL FIRMS (5-19 EMPLOYEES)	MEDIUM FIRMS (20-99 EMPLOYEES)	LARGE FIRMS (100+ EMPLOYEES)	AVERAGE
Firms experiencing electrical outages	%	81.4	85.8	86.6	82.8
Number of electrical outages in a typical month	#	3.5	4.5	5.2	3.8
If there were outages, average duration of a typical electrical outage	hours	6.0	4.7	6.9	5.8
If there were outages, average losses due to electrical outages	% annual sales	5.3	5.8	4.6	5.4
Firms owning or sharing a generator	%	57.1	80.5	93.7	65.6
If a generator is used, average proportion of electricity from a generator	%	15.4	22.3	18.3	17.8
Firms identifying electricity as a major constraint	%	20.2	23.8	19.2	21.0

Source: World Bank 2019

9 *KETRACO noted during the project kick-off workshop that 60 high-consumption industrial consumers have been earmarked for dedicated supply of electricity as a way to improve power reliability in the manufacturing sector.*

More than half of the firms, and 94 per cent of the large enterprises, use generators as power back-up. Outages last on average 5.8 hours. Back-up generators were reported to meet around 20 per cent of the electricity needs of the medium and large businesses. This largely reflects the findings of the 2010 national study on energy consumption patterns in Kenya, which estimated that back-up standby generation was 22 per cent of electricity supply in the manufacturing sector (KIPPRA 2010).

All manufacturing sectors report a high percentage of back-up generator ownership, ranging from 52.6 per cent for the chemicals, plastics and rubber sector to 74.2 percent for the textiles and garments sector (see Table 7). The textiles and garments sector also reported the highest losses from electricity outages (8.7 per cent of annual sales) even though the sector had on average fewer and shorter outages[10], which shows that profitability in manufacturing is tied to electricity availability. For this reason, the Ministry of Energy views clean captive power installations as key private sector interventions to address the challenge of unreliable power[11].

Table 7: Back-up generator ownership and losses of sales due to electrical outages

MANUFACTURING SECTOR	OWNING OR SHARING A GENERATOR (%)	AVERAGE LOSSES (% OF ANNUAL SALES)
Manufacturing (all)	69.6	7.2
Food	70.0	6.8
Textiles and garments	74.2	8.7
Chemicals, plastics and rubber	52.6	5.6
Other manufacturing	74.2	7.8

Source: World Bank 2019

Section 7.1.3 provides further information on back-up generators, including the average genset size by tariff customer category.

5.5/ CONCLUSION

The electricity market in Kenya is characterized by a strong share of renewable energy in the energy mix (81 per cent). With 2716 MW of installed capacity, Kenya is currently in situation of oversupply which is likely to continue according to government plants. Forecasts indicate a steady growth in both electricity demand and increase in generation capacity. For this reason, captive installations are not encouraged to address any supply shortfall.

However, captive power plants are encouraged as private sector interventions to address the challenge of the reliability of the grid. Indeed, power outages last on average 5.8 hours and 94 per cent of the large enterprises using generators as power back up. Commercial and Industrial entities represent only a small share of the connected customers, but their consumption represents 50 per cent of the total electricity consumption of the country, making them prized customers for the utility KPLC. Nairobi has the highest concentration of C&I customers, and the highest electricity consumption of these customers.

10 *Textiles and garments manufacturers are mostly located in special economic zones, which may have arrangements for priority electricity supply.*

11 *Comments made during project kick-off workshop and interview with the Ministry of Energy, September 2019.*

0,5 MW grid-tied Danco Plastics, Factory.
Lidia Daskalova/Shutterstock.com

6/ ELECTRICITY TARIFFS

The retail[12] electricity tariff framework in Kenya is in principle cost-reflective. Tariffs are generally set so that the main utility (KPLC) is able to meet its revenue requirements. The cost-reflectivity is achieved in part through:

- a tariff cross-subsidy for low-consumption domestic users and customers in off-grid areas supplied by KPLC diesel-hybrid mini-grids, and
- a pass-through charges for fuel costs, foreign exchange adjustments and inflation.

Some factors can, however, make it difficult for KPLC to actually meet its revenue requirements, such as increasing new low-consuming rural connections and associated high electricity losses, and regulatory caps on tariff increases, among others.

Section 11(c) of the Energy Act of 2019 gives EPRA the power to set, review and adjust electric power tariffs and structures and investigate tariff charges, whether or not a specific application has been made for a tariff adjustment. Tariff and tariff structure changes must undergo a public consultation process before enactment.

Electricity tariffs in Kenya have been reviewed five times since 2013: in December 2013, June 2014, June 2015, November 2017 and the latest in June 2018.

6.1/ BASE TARIFF

In June 2018, the Energy Regulatory Commission (now EPRA) approved a new tariff schedule effective 1 July 2018 for post-paid customers and 1 August 2018 for pre-paid customers for the billing period 2018/19.

The revised tariffs were further adjusted in October 2018 after complaints of increased bills by consumers in the domestic and small commercial tariff categories. The new tariff regime introduced the following changes:

- A new domestic consumer (DC) lifeline category for customers with consumption up to 100 kWh per month;
- Two distinct categories under the small commercial (SC) tariff code for customers consuming above and below 100 kWh per month;
- Elimination of monthly fixed charges for all consumer categories, the costs of which are now harmonized in the energy charge; and
- Revised time-of-use tariffs (peak/off-peak; see section 6.1.3) for larger commercial and industrial customers.

12 Retail in the sense of final end users (households but also industrial, commercial, institutional), as opposed to "bulk" tariffs, for instance when KETRACO sells to Kenya Power.

Table 8 shows the tariff categories and structure that was reviewed in June 2018, became effective in July and August 2018, and was adjusted for DC and SC customers in November 2018. The November tariff adjustment saw the largest increase in the energy charge out of the last five tariff reviews, due in part to the fixed-charge component being incorporated into the energy charge.

Table 8: Electricity tariff categories and structure

CODE	CUSTOMER TYPE	ENERGY THRESHOLD KWH/MONTH	VOLTAGE LEVEL (V)	TARIFF	
				ENERGY CHARGE/KWH IN US$ (AND KSH)	DEMAND CHARGE/KVA (IN US$)
DC1	Domestic Lifeline	0-100	240 or 415	0.10 (Ksh 10.00)	n/a
DC2	Domestic Ordinary	>100	240 or 415	0.15 (Ksh 15.80)	n/a
SC1	Small Commercial 1	0-100	240 or 415	0.10 (Ksh 10.00)	n/a
SC2	Small Commercial 2	>1–0 - 15 000	240 or 415	0.15 (Ksh 15.60)	n/a
CI1	Commercial/industrial	>15 000	415	Peak 0.12 (Ksh 12.00) Off-peak 0.06 (Ksh 6.00)	7.79
CI2	Commercial/industrial	No Limit	11 000	Peak 0.11 (Ksh 10.90) Off-peak 0.05 (Ksh 5.45)	5.06
CI3	Commercial/industrial	No Limit	33 000	Peak 0.10 (Ksh 10.50) Off-peak 0.05 (Ksh 5.25)	2.63
CI4	Commercial/industrial	No Limit	66 000	Peak 0.10 (Ksh 10.30) Off-peak 0.05 (Ksh 5.15)	2.14
CI5	Commercial/industrial	No Limit	132 000	Peak 0.10 (Ksh 10.10) Off-peak 0.05 (Ksh 5.05)	2.14
SL	Street Lighting	No Limit	240 or 415	0.07 (Ksh 7.50)	n/a

Note: Exchange rate from Kenyan shillings to US dollars of 102.75:1 (Central Bank of Kenya exchange rate as of 10/07/2017)
Source: Adapted from ERC and KPLC tariff documents.

6.2/ ADJUSTMENTS, LEVIES AND SURCHARGES

Various adjustments, levies and charges are applied to every unit of electricity consumed, which, together with the energy charge, the demand charge and a power factor surcharge for commercial and industrial consumers, make up the full electricity bill payable. Overall, the surcharges add substantially to the total electricity bill.

Current electricity tariff surcharges and levies are summarized in Table 9.

Table 9: Current electricity tariff surcharges and levies

CHARGE	DESCRIPTION
Fuel cost charge (FCC)	Billed per kWh on every unit consumed per month, as an added cost or rebate. It covers the cost incurred by KPLC because of fluctuation of fuel costs of thermal generation. Being a variable rate, it is published monthly by KPLC in the Kenya Gazette.
Foreign exchange rate fluctuation adjustment (FERFA)	Variable rate per kWh that covers the cost incurred through foreign currency costs (e.g., US dollar-denominated PPAs). KPLC publishes it monthly.
Inflation adjustment (IA)	Variable rate per kWh that caters for underlying Consumer Price Index changes as posted by Kenya National Bureau of Statistics and the average Consumer Price Index for US cities.
WARMA levy	Variable rate per kWh billed as a levy by the water regulator for use of water resource in generating electricity. KPLC publishes it monthly.
ERC levy	ERC levy at a rate of US$0.0003/kWh (0.03 Ksh/kWh)
REP levy	Rural Electrification Programme levy at 5 per cent of the base rate. Goes to the Rural Electrification Fund.
Power factor surcharge	Applicable in the event of the consumer's power factor* going below 0.9. A 30-day notice is given before the surcharge becomes applicable.
Value-added tax (VAT)	A 16 per cent VAT on tariff and all charges paid with the exception of WARMA, ERC and REP levies.
Security support facility	Charged on every unit of electricity consumed as a security for KPLC's payment obligation to the Lake Turkana Wind Power Project.

** The Power Factor is an indicator of the quality of design and management of an electrical installation. It relies on two very basic notions, active and apparent power, and ranges between 0 and 1, with 1 being the best.*

Source: ERC 2018b; Regulus 2020

In addition to the various surcharges, any customer with electric welding equipment must pay a fixed charge of US$0.49 (50 Ksh) per kVA per month of nameplate capacity.

6.3/ TIME-OF-USE TARIFFS

The government introduced time-of-use tariffs in December 2017 as a pilot targeting commercial and industrial customers. The tariffs are aimed at stimulating growth in the manufacturing sector through discounted electricity tariffs during off-peak hours to incentivize increased hours of production. By providing cheaper electricity during the hours of the day when demand is low, the time-of-use tariffs are expected to boost off-peak consumption for commercial and industrial customers through load shifting.

Around 818 customers (26 per cent) of the then 3,120 eligible customers under the CI tariff category opted for the discounted time-of-use tariff throughout the seven-month period ending in June 2018, during which 91 GWh was sold through the scheme (KPLC 2018). The slow uptake can be attributed to several factors:

- Unwillingness by manufacturers to shift production to off-peak hours due to other associated costs, for example, night-time security and employee transport;
- Difficult and vague eligibility terms and conditions (Munda 2019);
- Poor awareness and understanding of the time-of-use tariff, which was not widely promoted since it was only a pilot project)[13].

13 Interview with EPRA, September 2019.

The Schedule of Tariffs 2018 revised the time-of-use tariffs as shown in Table 8 (section 5.1). The energy charge for off-peak consumption is 50 per cent of the applicable peak-hour tariff. The applicable off-peak period is as shown in Table 10. Off peak periods are concentrated around night time for weekdays, while Sundays are considered entirely off-peak. The discount is applicable only to units consumed over and above the energy threshold as set out in the tariff schedule and applies only to the base energy charge and not to the total tariff unit cost (ERC 2018b).

Table 10: Time-of-use tariff off-peak hours

DAY	START TIME	END TIME
Weekdays	10 p.m.	12 a.m.
	12 a.m.	6 a.m.
Saturday/holidays	2 p.m.	12 a.m.
	12 a.m.	8 a.m.
Sunday	12 a.m.	12 a.m.

Source: ERC 2018b

In addition, any CI1-CI5 customer operating at 100 per cent of production capacity 24 hours a day 7 days a week will be given a 5 per cent discount on its energy charges for the period when it produces during off-peak.

The application and future uptake of the time-of-use tariff is important to assess the ramifications for clean captive power systems for commercial and industrial clients. For example, time-of-use on weekends is applied during daylight hours, which directly competes with solar captive installations. Furthermore, by promoting load shifting during weekdays, daytime demand in the industry might decrease, resulting in smaller captive installations needed, unless there is an overall increase in production. However, this situation could be offset if net metering is implemented.

6.4/ ELECTRICITY REBATES

The government introduced an electricity rebate programme in July 2019 (GoK 2019) in response to continued demand by manufacturers to lower the cost of production in Kenya. The rebate programme allows manufacturers to claim up to an additional 30 per cent of the total electricity cost incurred against income tax payable. The 30 per cent is subject to key performance indicators (KPIs) based on a 10 per cent increase in electricity consumption, capital investment and sales revenue, weighted at 0.3 and 0.4 respectively.

However, the set KPIs and their weighting show that it will be difficult for manufacturers to claim the maximum 30 per cent tax rebate available. Furthermore, the rebate is not applicable to manufacturers involved in generation, transmission and distribution of electricity. As the programme is aimed in part at increasing grid electricity uptake, implementation of a captive power system could reduce the rebate amount (also depending if it is the manufacturer or a third-party ESCO that invests in the system assets).

Indeed, private sector players interviewed during this study expressed their dissatisfaction with the aspects of the programme design that discourage captive power installation. However, even with the rebates, captive power systems remain competitive, especially with mature businesses where the maximum 30 per cent benefit will be difficult to meet given the KPIs.

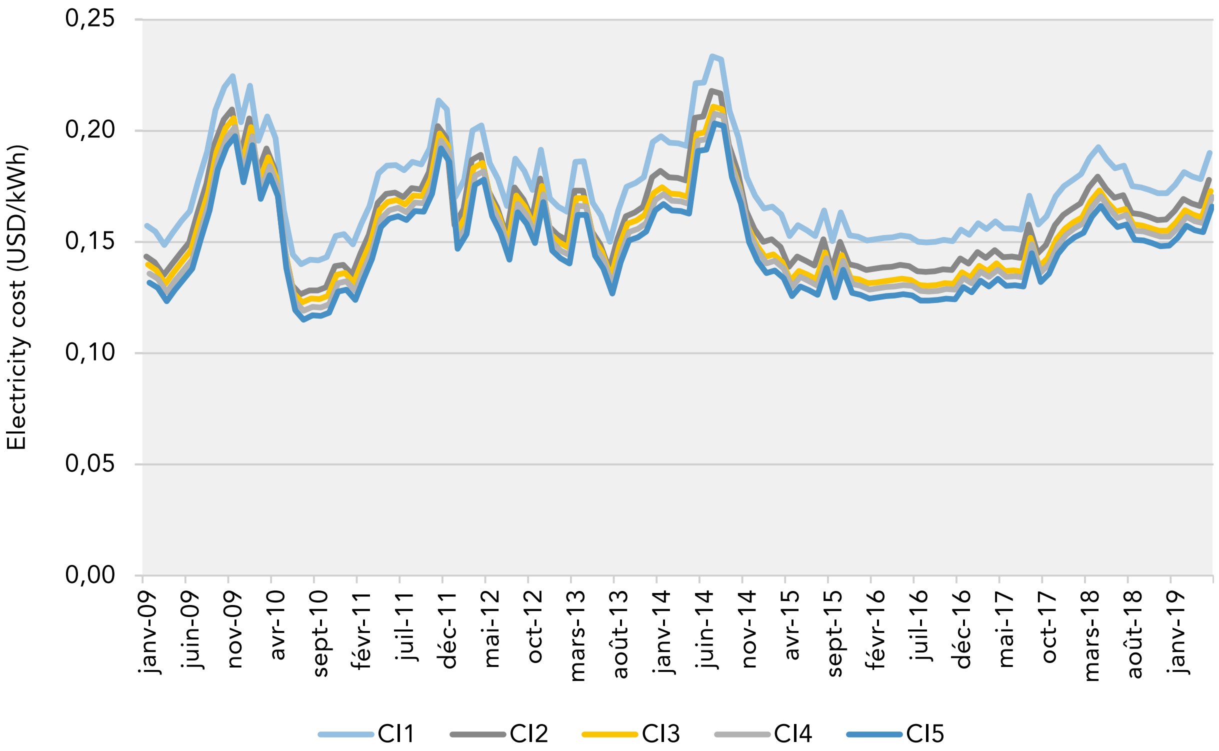
6.5/ HISTORICAL ELECTRICITY TARIFFS

Historically, customer electricity bills have varied from month to month depending on the tariff schedule in force and on the variable charges that are applied on consumption. The fluctuation in electricity prices is caused mainly by a monthly fuel cost charge, which is impacted by global oil prices; by a monthly foreign exchange rate fluctuation adjustment, which is impacted by economic shocks and other currency risks; and by monthly inflation adjustment, which is based on the prevailing consumer price indexes (see Table 9).

Electricity costs for large commercial and industrial consumers have ranged between around US$0.12/kWh and US$0.20/kWh over the last 10 years.

Figure 6 shows the total electricity cost per kWh for the CI1-CI5 tariff categories from November 2008 to May 2019, inclusive of energy charges, demand charges and the applicable surcharges. A monthly fixed cost charge is also included up to July 2018, when it was removed. The energy charges for the period from December 2017 when the time-of-use tariff was introduced are calculated using peak tariffs.

Figure 6: Historical electricity prices for CI tariff categories including surcharges



Note: Monthly average historical currency exchange rate data from the Central Bank of Kenya used in converting Kenyan shillings to US dollars. In Kenyan shillings, the fluctuation is the same because of the foreign exchange rate fluctuation adjustment on the tariff.

Source: Derived from Regulus 2020.

As can be seen from the figure, the typical electricity charges paid by CI category consumers means that any captive plants with levelized costs of between US$0.12/kWh and US$0.14/kWh or less should be competitively priced for industrial facilities.

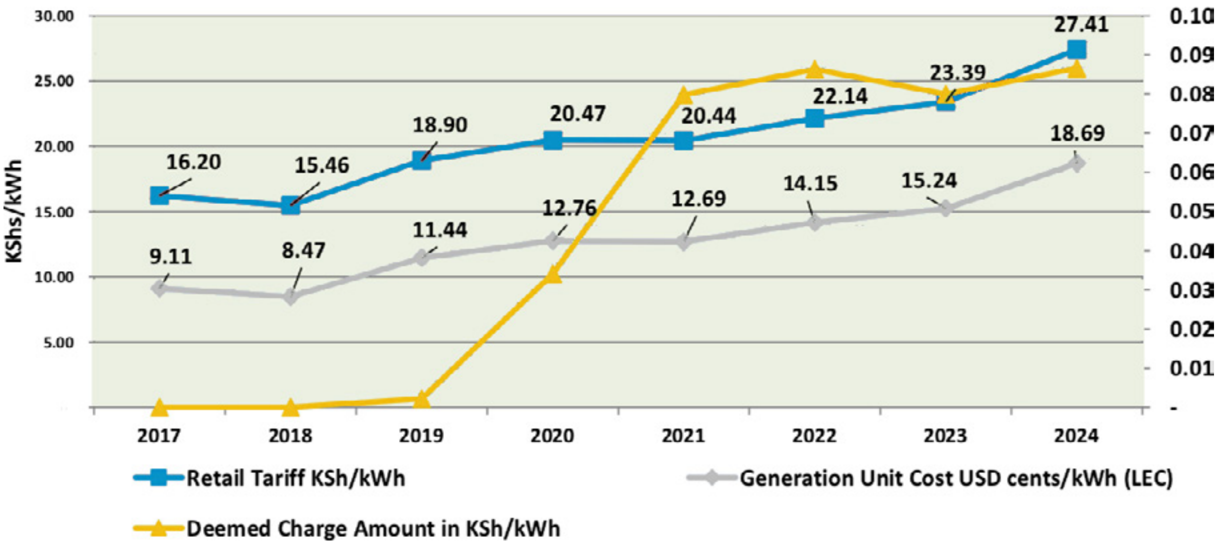
6.6/ PROJECTED ELECTRICITY TARIFFS

The 2017 Least Cost Power Development Plan 2017-2037 (LCPDP) provides medium-term electricity tariff projections based on power system costs for the 2017-2024 period under three scenarios:

- Reference case (17 per cent annual demand growth),
- Vision 2030 case (27 per cent annual growth)
- Low-demand case (5.6 per cent annual growth). The low-demand case is likely the most realistic based on the historical growth rates indicated in section 4.3.3.

Under the low-demand case, the average retail tariff including surcharges across all consumer categories (DC, SC and CI) will need to increase from an average of US$0.1588/kWh (16.20 Ksh/kWh) in 2017 to US$0.2687/kWh (27.41 Ksh/kWh) in 2024. This implies a total average retail tariff increase of 69 per cent over the eight-year period. The cost increase is foreseen to be due largely to increases in generation costs (including capacity charges and deemed energy payments[14] for over-capacity). The year-by-year projection in Kenyan shillings is shown in Figure 7.

Figure 7: Projected retail tariff evolution (low-demand growth case), 2017-2024

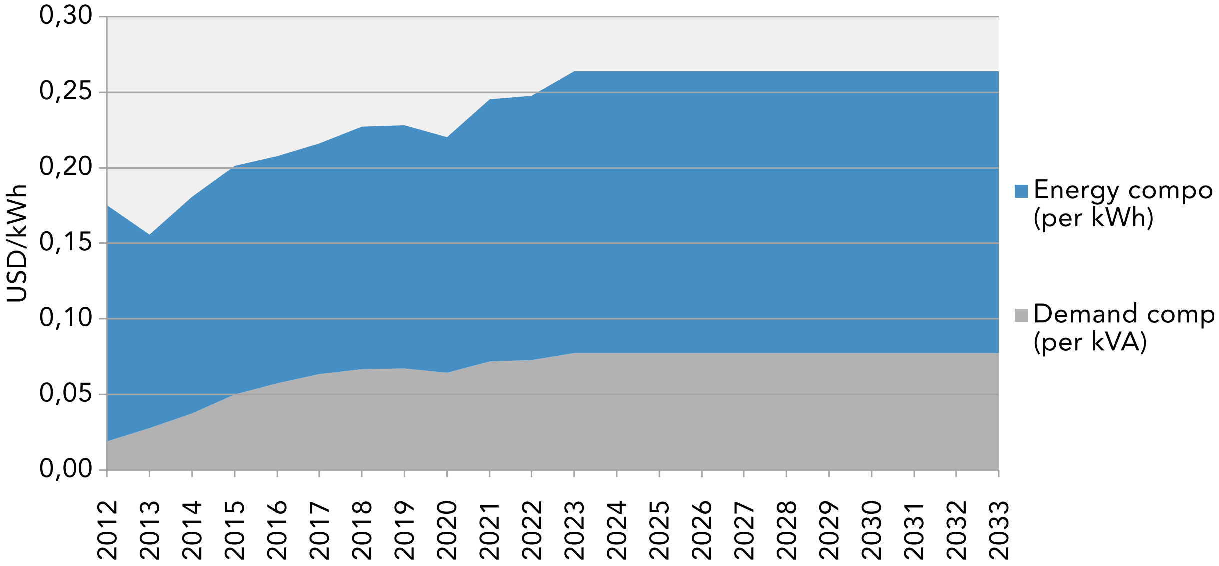


Note: The retail tariff projections include all adjustments, surcharges and levies apart from VAT.
LEC = Levelized electricity cost of generation. Deemed Energy Charge units are on the right axis.
Source: GoK 2018a, p. 214.

A breakdown of the average retail tariff projection by customer category is not available. However, estimates for retail tariffs for CI tariff code customers were made in the 2013 Cost of Service Study, and were reviewed as part of the 2014 assessment of a net metering programme in Kenya. From the assessment report, Figure 8 presents the example projection for the CI1 customer category (>15,000 kWh/month, 415 V).

14 *Deemed energy payments are negotiated in each PPA and calculated following typical methods. They represent payment power plants receive for the energy they would have generated in the case of them being curtailed because of oversupply, for example. As per the 2017 Least Cost Development Plan, there were no deemed energy charges designed and/or paid before 2019. With the commissioning of two solar power plants in 2019, deemed energy charges are expected to be put in place, hence the sharp increase for the future years.*

Figure 8: Projection for CI1 retail tariff evolution based on 2013 Cost of Service Study



Note: The energy component represents the potential increase in energy price themselves (variable). The demand component represents the projected increase in demand charge (fixed).

Source: ECA and Carbon Africa 2014

The tariff projections are subject to uncertainty, especially in the longer term, due to various factors, such as the actual demand and consumption; the actual power system costs (which can change with investments in transmission and distribution infrastructure); inflation rates, exchange rates, fuel costs and other adjustments; and the tariff review periods (BNEF, 2019).

It is also highly likely that, as in the past, political and consumer pressure on the Ministry of Energy, KPLC and EPRA will succeed in limiting future retail tariff increases. Part of the government's strategy to contain the cost of power includes a phased-out shut-down of expensive thermal power generation, seeking cheaper electricity from renewable energy resources, a moratorium on new thermal PPAs and spurring electricity demand. There are also plans to offer subsidized electricity to industries situated in special economic zones[15]. In September 2019, the regulator rejected a request by KPLC for upward review of electricity tariffs, in line with the government's policy of not increasing the cost of electricity.

6.7/ CONCLUSION

Grid electricity retail tariffs in Kenya comprise base charges and adjustments, levies and surcharges. For CI1-CI5 tariff code customers, i.e., larger commercial and industrial customers, the base charges ranged between US$0.10/kWh and US$0.12/kWh as of 2019. When adding all levies and surcharges to the base charges, historical electricity costs ranged between US$0.12/kWh and US$0.23/kWh over the last 10 years.

At these levels, captive solar PV systems and any other clean captive installation type with levelized costs at or below the US$0.12/kWh and US$0.14/kWh will be competitive, as is confirmed by the number of captive PV plants being built.

The attractiveness of captive power in Kenya for industrial users is expected to continue to improve as the retail tariff is projected to increase, while solar PV costs are continuously decreasing. However, if there is increased uptake of the time-of-use tariffs introduced in 2017, deployment of clean captive power would most likely slow down.

The electricity rebate programme, on the other hand, may not have much effect on the market due to key performance indicators that will be difficult for mature manufacturers to meet.

15 *Interview with the Ministry of Energy, September 2019.*

175 kW grid-tied, Black Petals, Flower Farm.
Lidia Daskalova/Shutterstock.com

7/ ENERGY POLICY AND REGULATORY FRAMEWORK

This section provides an overview of the policies, laws and regulations governing the energy sector in general and captive installations in particular, including key sector actors. It further analyses the current areas of uncertainty relevant for captive power, and their impact on the uptake of clean captive power in Kenya.

7.1/ ENERGY POLICIES AND LAWS

Many of the general policies and legislation related to the energy sector in Kenya are of relevance to the installation of captive power systems. These are summarized briefly in the sub-sections below.

7.1.1/ NATIONAL ENERGY POLICY, 2018

The National Energy Policy is the overarching framework that guides the energy and petroleum sector and forms the basis under which the Energy Act of 2019 was developed. In October 2018, the policy underwent a review to align it with the constitution promulgated in 2010 and with Vision 2030. The policy outlines electricity sector reforms as Kenya seeks to realize a clean, sustainable, affordable, reliable and competitive power supply; to increase access to electricity; and to improve the efficiency of power distribution and supply. The functions of energy policy fall under the national government, while the planning and development fall under both the national and county levels of government.

7.1.2/ ENERGY ACT, 2019

The Energy Act of 2019 was enacted in March 2019 as a revision to the Energy Act of 2006. It consolidates the main laws related to energy and aims to establish properly functioning energy sector entities, to promote the use of local energy resources including geothermal and other renewables, and to create an enabling environment for economic development (Rödl and Partner 2019). The new law gives devolved governments a legal platform to participate in planning and development of the energy sector.

Key highlights of the Energy Act of 2019 are as follows:

- Makes changes to the institutional framework in the energy sector, including reviewing and expanding the mandate of the energy regulator (EPRA), adding renewable energy to the responsibilities of the rural electrification agency and establishing a new renewable energy advisory committee.
- Anchors the renewable energy feed-in-tariff mechanism into law, which gives legal backing to the existing Feed-in-Tariffs Policy to help promote private sector investment and distributed generation and stimulate technology development.
- Sets the stage for the introduction of net metering by providing the legislative backing needed to allow consumers with generators of up to 1 MW to supply any excess generated electricity to the grid. This can only happen once the necessary regulations are developed and if a licenced distributor or retailer makes available a net metering service to a consumer upon their request[16].
- Mandates the regulator to establish specific energy consumption benchmarks for commercial, industrial and institutional electricity customers and to promote energy conservation and efficiency measures, in conjunction with local (county) governments.
- Provides for local content requirements for all electricity sector undertakings and works.

Regulations necessary for the implementation and actualization of various provisions in the Energy Act of 2019 are to be developed by relevant agencies as provided in the law. In some cases, existing regulations will need to be updated to align them with the new law, while in other cases new regulations are required (see section 6.2). The Energy Act had set a deadline of March 2020 by when all relevant regulations should be in place, giving a one-year transition period from the date of enactment. However, due to delays and the duration needed to develop such regulations (including the public consultation period), the target date was missed, and as of April 2020 the regulations were not yet in place, including those relevant to captive power systems[17].

7.1.3/ FEED-IN-TARIFFS POLICY, 2012

Kenya introduced its Feed-in-Tariffs Policy in 2008 to promote investment in renewable energy technologies such as wind, small hydropower and biomass (municipal waste and sugarcane bagasse) for capacities not exceeding 50 MW, 10 MW and 40 MW respectively. The revisions in 2010 and 2012 focused on updating these tariffs and added geothermal and grid-connected solar technology. The current policy distinguishes between projects above 10 MW and those below 10 MW. For clean captive installations, mainly projects below 10 MW are of interest. The regulation is summarized in Table 11.

Table 11: Feed-in tariff values for small renewable projects up to 10 MW plant size

TYPE	INSTALLED CAPACITY (MW)	STANDARD FEED-IN TARIFF (US$/KWH)	SCALABLE PORTION	MIN. CAPACITY (MW)	MAX. CAPACITY (MW)
Wind	0.5 – 10	0.11	12%	0.5	10
Hydropower	0.5	0.11	8%	0.5	10
	10	0.08			
Biomass	0.5 – 10	0.10	15%	0.5	10
Biogas	0.2 – 10	0.10	15%	0.2	10
Solar (grid)	0.5 – 10	0.12	8%	0.5	10
Solar (off-grid)	0.5 – 10	0.20	8%	0.5	1

Source: MoE 2012

16 Net metering regulations were drafted in 2014, but, according to EPRA, even with the new law, the adoption and entry into force of the regulations is likely to be delayed due to various factors including preparedness and agreement on the level of compensation.

17 Interview with EPRA, September 2019.

Under the Feed-in-Tariffs Policy, a 20-year PPA is available. Over 4,000 MW of renewable energy IPP projects have expressed interest in developing projects under the policy, and of these around 250 MW of projects have signed PPAs and are at different stages of development (SEforALL 2015). Seven feed-in tariff projects (10.5 MW total) have been commissioned: 5 small hydropower, 1 bioenergy and 1 solar PV. Five of these are captive power plants feeding excess power to the grid.

In theory, the Feed-in-Tariffs Policy is an option for clean captive installations in industry. In practice, however:

- The PPA process is lengthy, time consuming and not necessarily standardized (for example, the tariff might have to be negotiated), and the single buyer (KPLC) does not give priority to small PPAs. Some existing captive feed-in tariff projects took 1-2 years to secure a PPA.
- There is essentially a moratorium on new PPAs from variable sources (solar and wind) due to the new draft Energy Auction Policy (see next section).
- A solar PV captive plant must have a capacity of at least 500 kW to be eligible under the Feed-in-Tariffs Policy (the existing Strathmore University captive PV plant of 600 kWp capacity with only 250 kW available for feeding to the grid was given an exception and allowed to sign a PPA under the feed-in tariff).
- In some cases, the avoided retail cost of grid power might provide better financial returns than the negotiated feed-in tariff.

7.1.4/ ENERGY AUCTION POLICY (DRAFT)

Kenya has proposed introducing energy auctioning with the aim of procuring renewable energy capacity through competitive bidding. The proposed policy is applicable to solar and wind and to any biomass, biogas and small hydropower projects above 10 MW.

As part of moving to the auction system, the third revision of the Feed-in-Tariffs Policy has been drafted and is expected to be approved soon. Under the draft revised policy, the feed-in tariff is only applicable to small hydropower, biomass and biogas power plants not exceeding 10 MW. Solar and wind of any size and any other renewable energy project greater than 10 MW are to transition from the feed-in tariff scheme to the auction policy (SEforALL 2015).

Preliminary feed-in tariff values in the third revision of the policy are in the range of US$.082/kWh to US$0.092/kWh for hydropower (depending on capacity) and US$0.095/kWh for biomass and biogas projects.

7.1.5/ ENERGY EFFICIENCY

- Energy efficiency and conservation are a component of Kenya's National Energy Policy, but no specific national plan or targets exist for energy efficiency. To date, the government has helped establish and support the Centre for Energy Efficiency and Conservation (CEEC) hosted by the Kenya Association of Manufacturers (KAM) and has promulgated the Energy (Management) Regulations of 2012, with energy efficiency requirements for larger electricity consumers (see section 5.2.2). Since 2006 and as of January 2020, the Ministry of Energy in collaboration with KAM has carried out energy efficiency audits at over 1,200 companies, resulting in an identified total energy savings potential in industry of more than 390 GWh and 10 billion Kenyan shillings (MoE 2018)[18]. In many cases, recommendations made by KAM included installing captive solar.

18 Personal communication, Kenya Association of Manufacturers, January 2020.

7.2/ ENERGY REGULATIONS AND CODES RELEVANT FOR CAPTIVE POWER

Several of the regulations related to the new Energy Act of 2019 are of specific relevance to captive power installations. However, most of these regulations are under review to align them with the provisions of the new law. The extension of the transition period beyond March 2020 has meant prolonged uncertainty for industrial facility owners and the captive power sector, and project implementers will need to liaise with EPRA to obtain updates and seek clarity. Although the existing regulations will likely continue to apply in the absence of new regulations, developers should already take into account the anticipated changes to regulations (based on the Energy Act of 2019), as highlighted below.

7.2.1/ ENERGY (ELECTRICITY LICENSING) REGULATIONS, 2012

The Energy (Electricity Licensing) Regulations of 2012 (GoK 2012a) are applicable to any entity that engages in the generation, transmission, or distribution and supply of electricity in Kenya. The regulations stipulate the requirements and processes needed to obtain an electricity permit or licence and authorize persons to engage in the production and supply of electrical energy in Kenya. The regulations are being reviewed for updating to reflect the provisions of the Energy Act of 2019.

The following considerations are of relevance to captive power systems:

On capacity licencing: No licence or permit is required for a self-generator for own supply where the installed capacity does not exceed 1 MW. Between 1 and 3 MW a permit is required, and above 3 MW a licence is required. Obtaining a permit requires no application fee, whereas a licence costs US$100. Under the Energy Act of 2019, however, permits would likely no longer be available for electrical energy undertakings[19], and anything above 1 MW will require a licence.

According to EPRA, the threshold of 1 MW will now include all installed generation capacity at a premise[20]. This means that the installed capacity of any diesel generator will be considered when determining whether or not a clean captive system requires an electricity licence. Since many industrial facilities already have large diesel generators, those intending to install a captive PV plant may find that an electricity licence application must be made even where the system size is less than 1 MW. It is unclear whether the new capacity threshold definition applies already during the transition period or only after the updated regulations are adopted

On types of licencing: Licences can be obtained for generation only (for example, for those investing in a plant themselves), for supply only (for example, those buying electricity from a distributor for onward sale) and for a combination of generation, distribution and supply (for example, for a third-party owned captive system generating and supplying power to a user under a PPA)[21]. The upfront and annual fees vary depending on the type of licence, and regulatory requirements (such as reporting) also need to be factored in to the cost.

On new provisions implications: Certain provisions under the Energy Act of 2019 may have important implications depending on how they are applied. For instance, a retail supply licencee will need to meet minimum technical and financial criteria and must use an approved form of contract for electrical supply[22]. Furthermore, where a licencee enters into a contract to supply electrical energy to a consumer that previously was receiving electrical energy from another licencee, the new licencee must assume all obligations of the previous licencee. The applicability of these provisions to captive power projects under new regulations needs to be confirmed with EPRA.

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19 Electrical energy undertakings comprise any installation works or services for the commercial generation, transmission, wheeling, distribution or supply of electricity, which is owned or operated by a licensee.

20 Comments made by EPRA during project launch workshop and interview done in September 2019.

21 As of February 2019, most third-party owned captive PV plants in Kenya had used a leasing arrangement to provide electricity to the customer to avoid the need for an electricity supply licence, even if the contracts were sometimes publicly called "PPAs" or were based on performance/energy charges.

22 Retail supply licensees in the context of the Act refers to companies licensed to sell electricity to consumers, for example Kenya Power and mini-grid companies. It is unclear if this also applies to an ESCO selling to a single buyer (industrial facility). Likely this will not apply to captive power with a 2-3 party contract, but uncertainty remains until further discussions are held with EPRA or until new regulations are published.

On types of contracts: Amendments to the regulations are likely to cover PPA and potentially leasing arrangements offered by energy service/supply companies (ESCOs). This will not affect back-up diesel generators but will apply to clean captive power installations, where electricity tariffs will need to be approved by the regulator (similar to the mini-grid regulations). Already one operational captive power project with a PPA has undergone the tariff approval process[23].

On grid connections: Where any electricity could be spilled into the grid, a plant must meet the requirements of the grid operator.

On timeline: The official timeline for applying for and obtaining an electricity licence is between 60 and 90 days. The energy regulator generally adheres to this time frame. The requirements for an electricity licence application are listed in the annex in section 11.2.

An official list of licenced captive power plants in Kenya as at February 2019 is found in Table 14, Section 7.1

7.2.2/ ENERGY (ENERGY MANAGEMENT) REGULATIONS, 2012

The Energy (Energy Management) Regulations (GoK 2012b) require all industrial, commercial and institutional users of energy consuming above a fixed threshold ("designated facilities") to conduct energy audits and undertake conservation and efficiency measures. As per the Designation of Industrial, Commercial and Institutional Energy Users Rules (2013) (Kenya Gazette 2013), this applies to facilities using more than 180 MWh annually of electrical and/or thermal energy – effectively all CI tariff category customers. The facilities are required to implement at least 50 per cent of the energy audit recommendations within three years. The regulations also stipulate the process and content of energy audits and require the use of licenced energy auditors.

Although aimed at energy conservation and efficiency, the Energy Management Regulations can provide an incentive to industrial establishments to consider clean captive power.

7.2.3/ ENERGY (SOLAR PHOTOVOLTAIC SYSTEMS) REGULATIONS, 2012

The Energy (Solar Photovoltaic Systems) Regulations (GoK 2012c) were adopted in 2012 to streamline and professionalize the solar PV industry. The regulations provide for licencing of manufacturers, importers, vendors, technicians and contractors involved in solar PV systems. Any person involved in the design or installation of solar PV systems needs to be licenced by the Energy Regulatory Commission (ERC) (now EPRA) as per three categories (Technician 1, 2 and 3), and any business that imports, distributes, promotes, sells or installs solar PV systems needs to be licenced as a vendor as per three categories (Class 1, 2 and 3). Those regulations would also apply to any solar PV captive installation.

It is unclear whether an ESCO selling complete PV systems or electricity from captive PV plants needs to be licenced as a vendor/contractor under the regulations apart from or in addition to any electricity permit or licence. It seems that solar PV licencing would be advisable, but the May 2019 register of solar PV contractors, for example, does not include any of the main actors in the captive PV market.

7.2.4/ KENYA NATIONAL DISTRIBUTION CODE, 2016

Under the Kenya National Distribution Code (GoK 2016b), any party seeking to connect a generating plant to the distribution network is now required to submit an application to the Distribution Network Service Provider (DNSP). The Code lays down the procedures for users seeking to connect to the distribution system and provides the criteria for assessing a connection application by the DNSP. These are dependent on the size of the plant (<50 kW, 50 kW to 10 MW, >10 MW).

To date, all captive PV systems except one (Strathmore University 600 kWp) either have been sized to not spill over into the grid or have put in place equipment or other measures to curtail any potential spill-over. However, at least five captive bioenergy and hydropower captive plants have been connected to the distribution grid and feed in excess power under a PPA.

23 Interview with EPRA, September 2019. Note that these are proposed amendments and will undergo an assessment and consultation process before being adopted.

7.2.5/ OTHER RELEVANT ENERGY SECTOR REGULATIONS AND CODES

- The Electric Power (Electrical Installation Work) Rules, 2006 (GoK 2006) set out the requirements for the licencing of electricians and electrical contractors in Kenya.
- The Energy (Complaints and Dispute Resolution) Regulations, 2012 (GoK 2012d) provide a means through which the regulator can help resolve complaints and disputes between a power retailer (KPLC and others) and its customers.
- The Energy (Local Content) Regulations, 2014 (GoK 2014) were developed to ensure local content – the use of local (Kenyan) expertise, goods, services, people, businesses and financing – in power sector private undertakings. A licencee, contractor or its sub-contractor, or any other entity carrying out operations in the energy sector must ensure that local content is a component of their operational energy activities. The Energy Act of 2019 has draft local content provisions that will likely be elaborated in the future.

7.3/ NON-ENERGY REGULATIONS AND CODES RELEVANT FOR CAPTIVE POWER

The following non-electricity sector regulations and permits are applicable to captive power systems:

- Under the Environmental Management and Coordination Act, 2018 (GoK 2018b) (revised from 1999), any project must before financing submit an environmental impact report to the National Environmental Management Authority. An electricity generator (i.e., any developer, ESCO or IPP with the licence to generate electricity) may also be required to undertake a full environmental impact assessment study. The Act is operationalized by subsidiary legislation such as the Environmental (Impact Assessment and Audit) Regulations, 2003.
- Under the Physical Planning Act (and the Local Government Act and the Energy Act of 2019), county governments must approve infrastructure development in their jurisdiction before construction may begin and any electricity licence can be approved. A captive power project may need to obtain an installation licence from the physical planning department of the local authority (county government). Construction should be undertaken by contractors approved by the National Construction Authority, who must adhere to the Occupational Safety and Health Act, 2007 (GoK 2007).
- System design and equipment used must meet relevant Kenyan standards (as issued by the Kenya Bureau of Standards) or in some cases the relevant international standard.

Captive power systems also can potentially benefit from the following tax incentives and rebates:

- The East Africa Community Customs Management Act 2004 – domesticated in Kenya through the Value Added Tax Act – provides for import duty and value-added tax (VAT) exemptions on applicable solar PV products and systems. Tax-exempt status, avoiding standard import duty rates of 0-25 per cent and VAT of 16 per cent, is available for imports of equipment used to develop or generate solar power or to store solar energy. The exemption applies to solar panels, charge controllers, deep-cycle batteries and invertors but not mounting structures (Tetra Tech / Coffee International 2019).
- Under the Income Tax Act, Kenya allows for an investment deduction allowance (IDA) as an incentive (tax deduction) granted against the cost of a building and machinery installed by a manufacturer. The IDA amount is a percentage of the total cost incurred and varies by project location (currently at 100 per cent for capital investments in Nairobi and 150 per cent outside of Nairobi, with a maximum of Ksh 200 million). According to one company, at the current rate, the IDA on solar PV investments can reduce the solar levelized cost of electricity by up to 20 per cent assuming a deduction of 100 per cent over a period of four years[24]. This makes the IDA a key consideration when making investment decisions on solar PV systems for commercial and industrial clients. Application of the IDA has likely had some impact on captive power uptake due to the tax benefit for the owner of the building and machinery.
- In July 2019, an electricity rebate programme was implemented to allow manufacturers to claim additional income tax deductions against key performance indicators (for details, see section 6.2).

24 Interview with private sector stakeholder in Kenya, September 2019.

7.4/ CURRENT REGULATORY UNCERTAINTIES REGARDING CAPTIVE POWER

Table 12 summarizes the current uncertainties that require further clarification by EPRA for a more regulated development of the captive power segment.

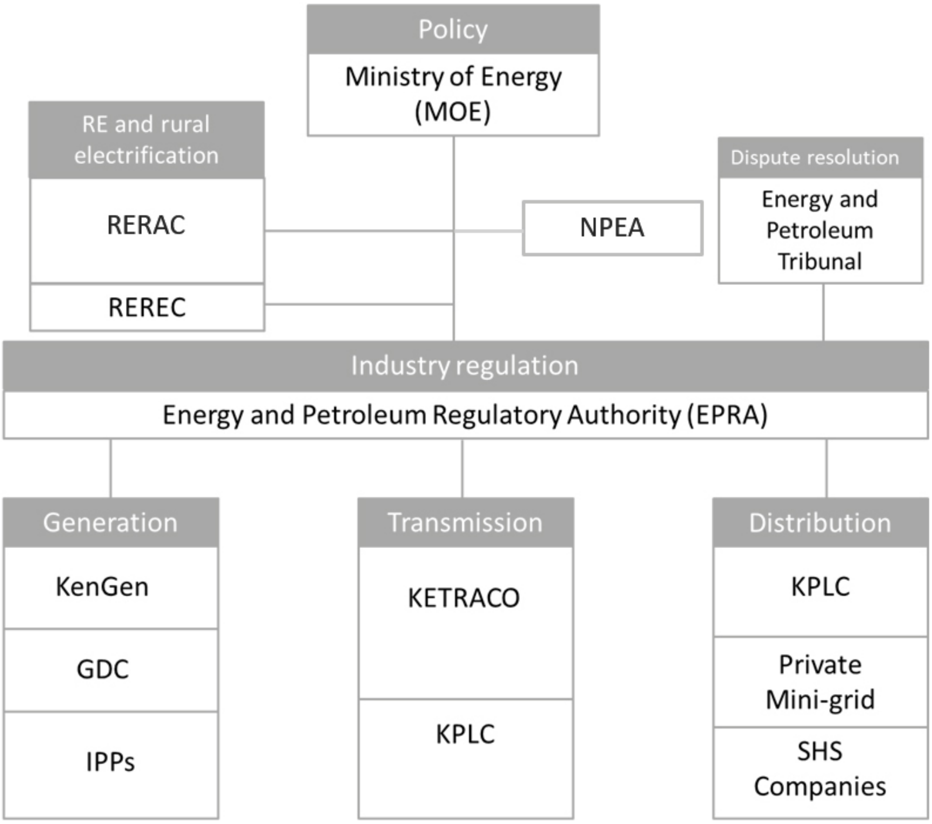
Table 12: Summary of regulatory uncertainties regarding captive power

LEGISLATION OR REGULATION	WHAT IS UNCLEAR?	WHY IS CLARIFICATION REQUIRED?
Energy Act, 2019	When will the new energy regulations be finalized and approved? Are certain regulations being prioritized, and if so which ones?	The March 2020 transition period deadline was exceeded.
	In the absence of new regulations, do the existing regulations still apply, and how will new projects developed in the absence of new regulations be treated?	Regulatory clarity is needed for project planning and implementation.
	Do the requirements for "retail supply licencee" apply to captive power projects or not?	Clarity is needed to understand the potential regulatory burden.
Energy (Electricity Licensing) Regulations, 2012	Do industrial facilities with an existing combined captive threshold of diesel back-up power and >1 MW of renewable captive energy such as solar PV need to apply for a licence under the new Energy Act 2019? Is this Energy Act 2019 capacity threshold applicable only for newly installed capacity?	A number of facilities currently have combined capacitixes of >1 MW, although the clean captive capacity may be <1 MW. This will increase the regulatory burden for the regulator and could potentially delay and/or slow the uptake of clean captive solutions.
	Will PPA contracts between private entities need regulatory approval? If yes, what would need to be approved? (e.g.: • the form of contract • the tariff • the terms and conditions) Will all PPA contracts need approval, or only those where the aggregate capacity is above 1 MW (because below 1 MW does not need to apply for a licence)?	Since PPA contracts between private entities are normally negotiated among themselves, it would be interesting to understand how the PPA market would develop once the regulator is involved.

7.5/ INSTITUTIONAL FRAMEWORK

The newly enacted Energy Act of 2019 has brought about several changes in the governance of the power sector in Kenya by introducing new entities and changing the mandate of others. An overview of the electricity sector institutional structure and key actors is shown in Figure 9. Key public entities relevant to the captive power sector are briefly described in the following sections.

Figure 9: Kenya's electricity sector institutional structure and key actors



In addition to these public sector actors, 15 independent power producers were operational in Kenya as of June 2018. A number of multilateral, regional and bi-lateral development cooperation partners and development financing institutions also support Kenya's energy sector development. The main public and private sector stakeholders for captive power development are summarized in annex 11.1 of this report.

7.5.1/ MINISTRY OF ENERGY

The Ministry of Energy – formerly the Ministry of Energy and Petroleum – is the government ministry in charge of the overall governance of the power sector. It is responsible for the formulation, development and articulation of energy policies that govern the sector, including promoting renewable energy development, mobilising financial resources for the public sector, sector planning, electrification of rural areas and exploration of indigenous energy resources such as coal and geothermal.

7.5.2/ ENERGY AND PETROLEUM REGULATORY AUTHORITY

Under the Energy Act of 2019, the Energy and Petroleum Regulatory Authority (EPRA) – formerly the Energy Regulatory Commission (ERC) – has been strengthened from a commission to an authority governed by a board of directors. EPRA is responsible for economic and technical regulation of the energy and petroleum sub-sectors, and is supposed to protect consumer interests and ensure reasonable return on investment for developers/utilities. It engages in tariff setting, review, licencing, enforcement, dispute settlement and resolution, and approval of PPAs and network service contracts, among other activities.

EPRA is the main electricity sector entity, if any, with which a captive PV system supplier, developer or owner will be engaged.

7.5.3/ KENYA ELECTRICITY GENERATING COMPANY LIMITED

The Kenya Electricity Generating Company Limited (KenGen) is a Nairobi Securities Exchange-listed company that is 70 per cent owned by the Kenyan government. It develops and manages most of the public power generation facilities in the country, ranging from large and small hydropower to geothermal, wind and thermal, both grid-connected and off-grid. KenGen accounts for around 70 per cent of the total installed generating capacity, with its only off-taker being KPLC.

7.5.4/ KENYA POWER AND LIGHTING COMPANY LIMITED

Kenya Power and Lighting Company Limited (KPLC or Kenya Power) is a Nairobi Securities Exchange-listed company, with a 50.1 per cent government-controlling stake, that transmits, distributes and retails electricity to customers in Kenya. It owns and operates most of the transmission and distribution assets in the country and reached more that 6.2 million customers as of June 2018. It has PPAs with KenGen and IPPs from whom, as the sole off-taker, it purchases electricity and retails it to end users. KPLC is currently also the national grid system operator, although this function is foreseen to be transferred to an independent entity under the Energy Act of 2019.

A captive power system owner, developer or ESCO will need to interact with KPLC if it wishes to feed power into the grid.

7.5.5/ OTHER KEY PUBLIC ACTORS

Other key public entities in the electricity sector in Kenya are summarized in Table 13.

Table 13: Other key public entities in the electricity sector in Kenya

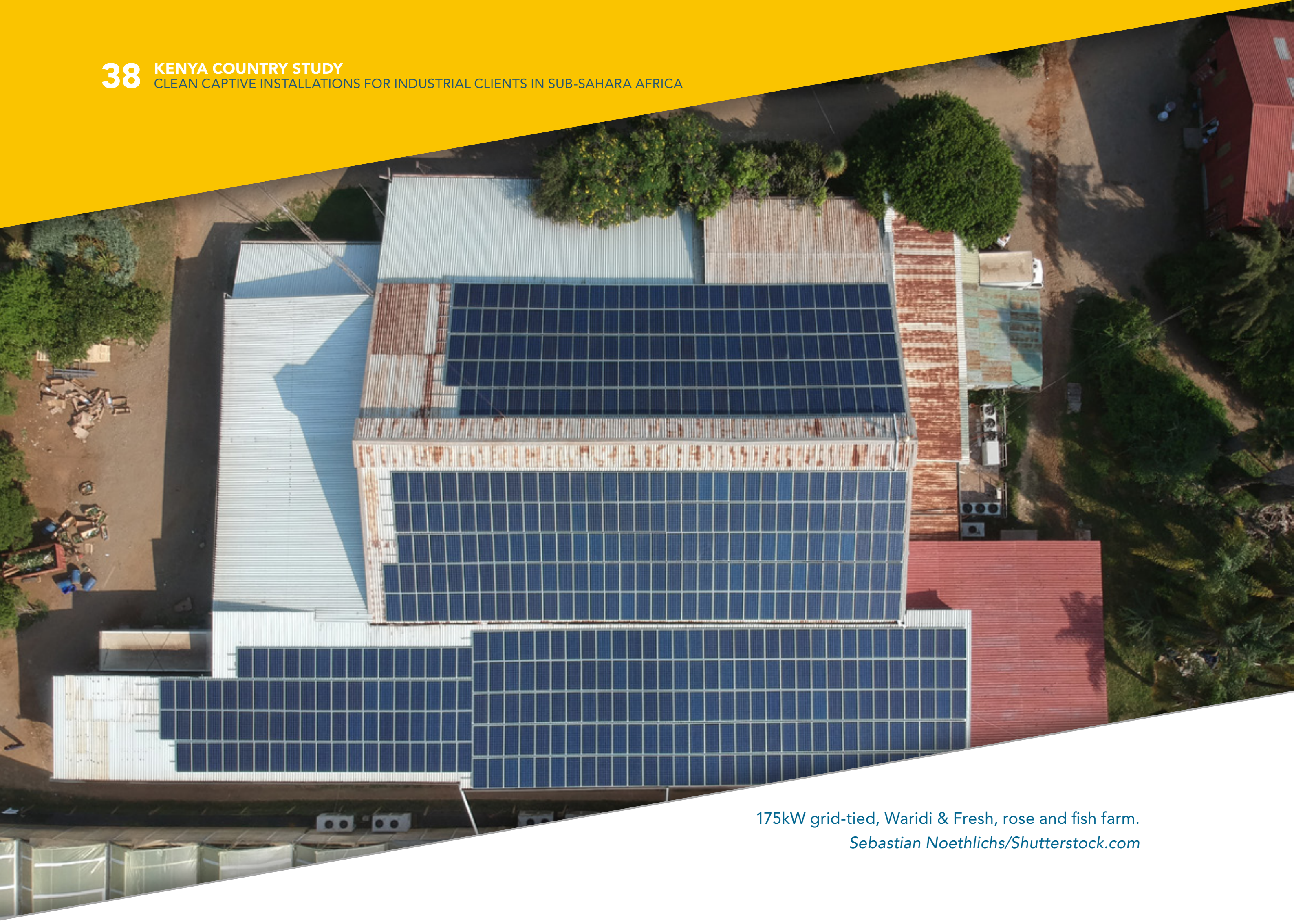
PUBLIC ENTITY	DESCRIPTION
Energy and Petroleum Tribunal	As the successor to the Energy Tribunal under the Energy Act of 2019, the tribunal's mandate is now expanded to hearing and determining disputes and appeals in the energy and petroleum sector that may arise under the Energy Act and any other written laws.
Rural Electrification and Renewable Energy Corporation (REREC)	Formerly the Rural Electrification Authority, REREC has a newly expanded mandate to oversee rural electrification and renewable energy in Kenya, including managing and sourcing funds and developing and updating the master plans in these areas. REREC is responsible for promoting renewable energy development, including through feasibility studies, research and international cooperation. REREC has no regulatory power over captive plants.
Renewable Energy Resource Advisory Committee (RERAC)	RERAC is a newly established inter-ministerial committee set up to advise the cabinet secretary responsible for renewable energy resources on, among other things, criteria for allocating these resources and licencing renewable resource areas. Although unlikely to be relevant for captive solar PV plants, RERAC could be engaged in the case of hydropower, geothermal or bioenergy plants to ensure optimal use of site-specific renewable resources.
Nuclear Power and Energy Agency (NPEA)	NPEA is charged with promoting and implementing Kenya's Nuclear Power Programme, carrying out research and development for the energy sector. It also is mandated to support activities outside of nuclear energy such as general research in energy, promotion of local energy technologies, identification of human resource and training needs, and information dissemination in energy efficiency.
Kenya Electricity Transmission Company Limited (KETRACO)	KETRACO is a 100 per cent government-owned entity that is responsible for planning, designing, building and maintaining all new high-voltage electricity transmission lines and associated substations
Geothermal Development Company (GDC)	GDC is a state-owned company established by the government as a special purpose vehicle to develop geothermal resources in Kenya.

Source: Author compilation

7.6/ CONCLUSION

Kenya's institutional and regulatory framework for energy is well established, and includes provisions tailored to captive power projects in the country. Although the rules and requirements are generally clear, some grey areas persist with regard to private power supply to end users under contract. Available tax incentives also aim to stimulate clean captive installations.

However, the promulgation of the Energy Act of 2019 has resulted in uncertainty, as the stipulated transition period during which new enabling regulations were to be implemented was exceeded. In addition, the Act introduces provisions such as aggregate installed capacity limits for licencing exemption, possible regulatory approval of private contracts, local content requirements and net metering opportunities. These provisions need to be carefully considered by captive power developers and where relevant clarified by EPRA.



175kW grid-tied, Waridi & Fresh, rose and fish farm.
Sebastian Noethlichs/Shutterstock.com

8/ OVERVIEW OF EXISTING CAPTIVE POWER FACILITIES

This section explores the variety of captive power technologies that are operational across Kenya's various industrial and manufacturing, agricultural and service sectors. These captive technologies are from both renewable energy sources – including solar PV, small hydropower, bioenergy and geothermal – and non-renewable sources such as thermal back-up solutions that use diesel and petrol.

8.1/ LICENCED CAPTIVE POWER PLANTS

Table 14 provides an overview of licensed captive power plants as of early 2019, including the technology, licence type, size and date of licence granted. These captive power plants obtained a licence because they were either over 1 MW, or because they were supplying to the grid.

Table 14: Captive power plant electricity licence holders as of February 2019

LICENCEE	COUNTRY	TECHNOLOGY	LICENCE TYPE	SIZE (MW)	DATE
Oserian Development Co. Ltd	Naivasha	Solar PV	Generation	1.0	Aug 2018
Ofgen Power Ltd***	Nairobi & Taita Taveta	Solar PV	Generation	0.455	Apr 2017
Strathmore University**,***	Nairobi	Solar PV	Generation	0.6	Apr 2017
Two Rivers Power Company Ltd****	Nairobi	Solar & diesel	Generation, distribution and supply (GDS)	12	Sep 2015
Kenya Petroleum Refineries Ltd*	Mombasa	Diesel	Generation	8.5	Feb 2011
Sotik Highlands Tea Estate Ltd	Kericho	Diesel	GDS	1.5	Apr 2005
James Finlay** [tea estate/factory]	Kericho	Hydro & diesel	GDS	6.7	Apr 2005
Unilever Tea Kenya Ltd	Kericho	Hydro & diesel	GDS	4.66	Dec 2008
Imenti Tea Factory Company Ltd**	Meru	Hydro	GDS	0.92	Apr 2010
Metumi Power Co. Ltd*,**	Murang'a	Hydro	GDS	5.6	Mar 2016
Nyakwana Power Company Ltd*,**	Kisii	Hydro	GDS	2.0	Jun 2017
Gura Power Company Ltd**	Nyeri	Hydro	GDS	5.8	Jun 2017
Pan African Paper Mills (E.A.) Ltd	Webuye	Cogeneration	Generation	9.0	2004
Kwale International Sugar Co. Ltd**	Kwale	Cogeneration	Generation	18	Feb 2016
Butali Sugar Mills Ltd	Kakamega	Cogeneration	Generation	11	Dec 2016
Chemilil Sugar Co. Ltd	Kisumu	Cogeneration	Generation	3.0	Dec 2016
Sony Co. Ltd [sugar mill)	Migori	Cogeneration	Generation	8.7	Apr 2017
Pwani Oil Products Ltd	Kilifi	Biomass	Generation	1.5	Jan 2018
Biojoule Kenya Ltd**	Naivasha	Biogas	GDS	2.6	Dec 2015
Oserian Development Co. Ltd	Naivasha	Geothermal	GDS	3.7	Apr 2017
Cemtech Ltd* [cement factory]	West Pokot	Coal	Generation	30	Jul 2015
Devki Energy Co. Ltd [steel maker]	Kajiado	Coal	Generation	15	May 2016

** Defunct, not operational or not yet built; ** Also supplying excess to the national grid; *** It is not known why Ofgen Power obtained a generation permit or licence for a captive plant below 1 MW, as it is not required. Strathmore University obtained a permit or licence because it also supplies the grid under a PPA; **** Two Rivers is a shopping mall and commercial and residential complex. The facility has a licence for 2 MW solar PV and 10 MW diesel captive power as well as a licence to purchase 35 MW from Kenya Power for sale to its tenants and residents.*

Source: EPRA 2019

8.2/ SOLAR PV

In complement to the list of licenced captive power plants listed in section 7.1, at least 100 captive solar PV systems with a capacity of more than 15 kWp each are installed or under construction at commercial, industrial and institutional/non-profit establishments in Kenya. Most of the systems are grid-tied and do not have battery storage. However, the opposite applies for tourist lodges, which typically have off-grid PV installations with storage. The first (non-commercial) captive PV projects were implemented in 2011, but the bulk of the capacity has been commissioned since 2016.

As of July 2019, the largest captive solar PV system in the country was the 2,000 kWp system at the Kenya School of Monetary Studies in Nairobi (under construction). In the industrial sector, the largest installation is the 1,500 kWp system at Kapa Oil Refineries (edible oils and soaps) in Nairobi.

A summary of existing captive PV systems above 15 kWp by type of establishment, capacity and average system size is provided in Table 15.

Table 15: Existing captive PV systems above 15 kWp in Kenya by user type

TYPE OF FACILITY	NO. OF SYSTEMS	PV CAPACITY (KWP)	AVERAGE SYSTEM SIZE (KWP)
Food processing	6	5 675	946
Flower farm	25	3 445	138
School	6	2 977	496
Shopping mall	5	2 763	553
Factory (non-food)	7	2 711	387
Tea factory	4	1 904	476
Non-profit (mostly office building)	7	1 845	264
Tourist lodge	12	1 494	124
Warehouse/office	2	1 024	512
Warehouse	3	1 011	337
Industrial park	1	940	940
Airport	2	605	303
Institution (mostly office building)	4	212	53
Flower and fish farm	1	202	202
Office	3	127	42
Bank	1	103	103
Water pumping	3	86	29
Hospital	2	55	27
TOTAL	**94***	**27 178****	**289**

** The total number of captive PV projects double counts some projects where an expansion system was later added at the same premises. At least 13 additional captive PV systems are known to exist on schools, factories, offices and other facility types, but they are not included here because no details are publicly available.*

*** Installed capacity does not include systems where the size is known but the facility type is unknown.*

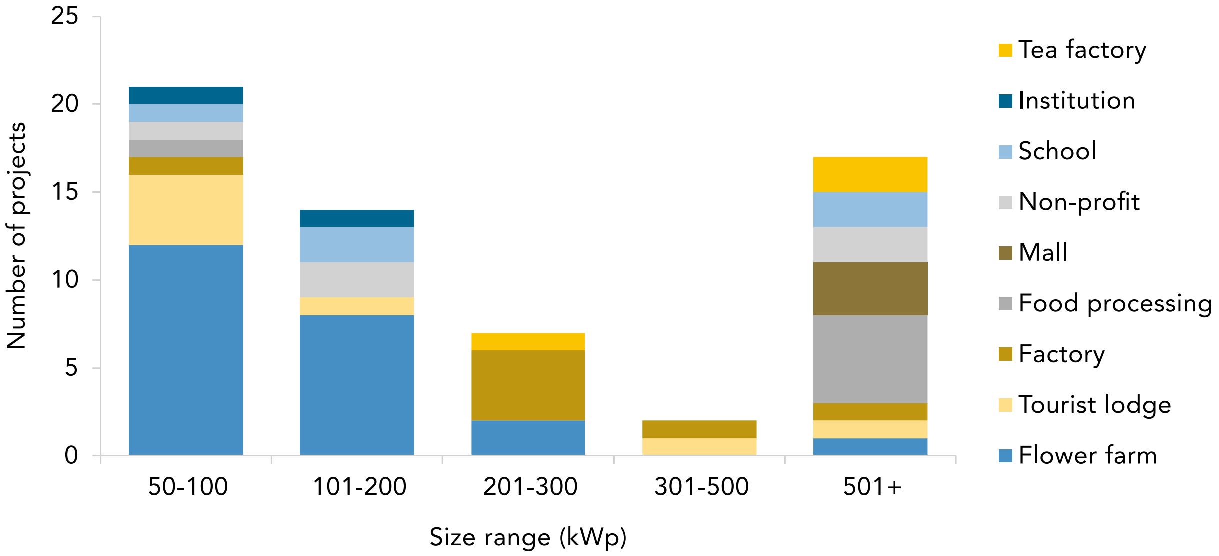
Source: Author calculation based on available data.

Of the 100 or so captive solar PV plants in Kenya of more than 15 kWp, many are above 50 kWp. At least 17 systems above 50kWp are installed in the industrial (manufacturing) sector, including at factories and food and tea processing facilities, for a total exceeding 10 megawatts-peak (MWp).

In general, most of the country's captive PV systems are below 200 kWp, but another 17 systems have capacities of more than 500 kWp each, of which 9 are in the industrial sector.

An overview of captive PV systems greater than 50 kWp is shown in Figure 10, broken down by project size range and covering establishment types that have more than four captive projects each.

Figure 10: Number of captive PV systems above 50 kWp by size and facility type with more than 4 projects



Source: Author calculation based on available data.

8.3/ OTHER RENEWABLES

In addition to captive solar PV installations, a variety of captive small hydropower, bioenergy and geothermal installations exist in the country. Table 16 provides a summary of known plants, including their status and capacity. Many micro-hydro captive systems also have been installed by businesses across Kenya.

Hydropower: The Kenya Tea Development Agency (KTDA) has invested heavily in captive small hydropower plants to power the country's energy-intensive tea factories; any excess electricity is sold to the national grid through a PPA with KPLC. In 2015, KTDA and the International Finance Corporation in partnership with the Global Agriculture and Food Security Program, the French Development Finance Institution (Proparco) and the Netherlands Development Finance Company (FMO) signed a loan agreement to fund the construction of seven more captive small hydropower plants in tea-growing regions.

Bioenergy: Most of the existing bioenergy captive systems are located at sugar factories, which use bagasse for cogeneration. As of February 2019, the Energy and Petroleum Regulatory Authority (EPRA) had licenced six power plants owned by sugar factories, two of which have contracts to supply electricity to the grid, while a seventh company, Transmara Sugar Company, has applied for a licence. Other sugar companies with cogeneration for self-consumption included Kibos Sugar, which plans to use its captive plant to also power a distillery and a paper mill. Additional enterprises that have installed bioenergy captive plants include a paper mill, a large farm, an oil company, a sisal and cattle farm, and Olivado, the world's main producer of avocado oil, which recently built a small captive biogas system.

Geothermal: There is one 3.2 MW captive geothermal plant that provides heat and electricity to the Oserian flower farm on Lake Naivasha.

Table 16: Existing captive small hydropower, bioenergy and geothermal systems

CAPTIVE PLANT	DESCRIPTION/STATUS	INSTALLED CAPACITY (KW)
Small hydropower		
KTDA – Gura	Operational	5 800
KDTA – North Mathioya	Under construction	5 600
KDTA – South Mara	Under construction	2 200
KTDA – Chania	Operational	2 000
KTDA – Nyambunde	Under construction	2 000
KDTA – Lower Nyamindi	Under construction	1 800
KDTA – Iraru	Under construction	1 500
KTDA – Imenti	Operational	950
James Finlays Tea Company	Operational	700
Unilever Kenya	Operational	630
Diguna missionary station	Operational	400
Tenwek missionary station	Operational	320
Eastern Produce	Operational	90
Mujwa missionary station	Operational	70
Small hydropower total		**24 060**
Bioenergy		
Mumias Sugar	Licenced; contracted for grid supply	34 000
Kwale International Sugar	Licenced; contracted for grid supply	18 000
Kibos Sugar	Operational	18 000
Butali Sugar Mills	Licenced	11 000
Pan African Paper Mills	Under revitalization	9 000
Sony Co. Ltd	Licenced	8 700
Transmara Sugar Company	Applied for licence; captive use and grid supply	8 500
Nzoia Sugar Co. Ltd	Licenced	7 000
Chemilil Sugar	Licenced	3 000
Biojoule Kenya (Gorge Farm Energy Park)	Operational; captive use and grid supply	2 600
Pwani Oil Company	Operational	1 500
Olivado	Operational	330
Kilifi Plantations	Unlicensed biogas plant for self-consumption	150
Bioenergy total		**103 780**
Geothermal		
Olkaria geothermal project (Oserian flower farm)	Operational	3 700
TOTAL		**131 540**

Note: Totals include known captive plants and may exclude other smaller (unlicenced) captive systems installed by businesses in Kenya.
Source: Author compilation from various sources.

8.4/ THERMAL BACK-UP POWER

A 2011 study on back-up power systems in Kenya, based on a representative national sample, found that the commercial, industrial and government sectors had an aggregate installed capacity of 417 MW of thermal back-up power (predominantly diesel but also petrol). This represented around 26 per cent of the national power system's 1,524 MW of generation capacity at the time (UNFCCC 2012). The study also extrapolated estimates by CI tariff category for (a) the average capacity of back-up gensets and (b) the total number of users with back-up systems. The findings are presented in Table 17.

Table 17: Estimated back-up generation capacity for CI tariff categories, 2011

SECTOR AND TARIFF CODE	CAPACITY RANGE	AVERAGE GENERATOR CAPACITY	NO. OF USERS PER CAPACITY CLASS	SHARE OF GENERATORS PER CAPACITY RANGE
Small (SC)	0-10 kW 10-50 kW	3.1 kW 28.1 kW	32 259 17 607	43% 23%
Medium (CI1)	**50-100 kW 100-200 kW**	**76.8 kW 164.5 kW**	**599 1 097**	**7% 14%**
Large (CI2-CI5)	**200-400 kW 400-1 000 kW**	**340.6 kW 591.2 kW**	**262 49**	**11% 2%**

** The average generator capacity (n=908) included the assumption of zero capacity for all generators with insufficient data to classify the type and capacity, hence the reason for the lower average than the smaller sample with sufficient data (n=368), which latter is considered to be more reflective of actual generator size.*

Source: UNFCCC 2012, p. 40.

The average generator capacity in the CI tariff categories ranges from about 75 kW to 600 kW. The average generator size and number of users provides indicative – albeit slightly dated – information on typical facility power demand and the universe of companies that could be interested in clean captive power to displace (some) thermal back-up generation.

The typical generator size and number of users gives an indication of (a) captive PV system sizing (by inferring the typical power demand of a user based on generator size) and (b) the total potential market for captive PV as of 2011

8.5/ CONCLUSION

Electricity supply in Kenya has come predominantly from domestic renewable sources and is sufficient to meet demand. Electricity consumption is growing at a slower pace than projected. Although new transmission lines are planned to distribute electricity further, the current situation of oversupply is likely to continue in the future. Captive power is therefore not being encouraged as a means to meet any supply gap at the national level. Grid downtime, however, is forcing commercial and industrial customers to install back-up capacity, most of it fossil-fuelled. For this reason, clean captive power installations are viewed as key private sector interventions to address the challenge of unreliable power.

The 3,912 customers in the CI tariff category accounted for half of total electricity consumption and represent the potential market for clean captive power. Most of the CI tariff code electricity demand is in Nairobi, followed by the West, Coast and Mt Kenya regions. The indicative reference average maximum demand for CI tariff users ranges from around 170 kVA for CI1 customers to between 800 kVA and 4,200 kVA for CI2-CI5 users. Due to power outages, 70 per cent of industrial users rely on back-up thermal generators. The average back-up generator size for CI1-CI5 customers ranges from 75 kW to 600 kW. The average maximum demand and average size of back-up generators provide guidance for typical clean captive system sizing.

In total, Kenyan commercial, industrial and institutional users have installed more than 100 solar PV captive plants (27-plus MW combined), at least 14 small hydropower captive plants (24-plus MW), at least 13 bioenergy captive systems (100-plus MW) and 1 geothermal captive plant (4 MW), in addition to at least 417 MW of back-up thermal capacity (UNFCCC 2012). While this indicates that the country has some experience with captive power, it also reveals large remaining potential for clean captive installations – a theoretical market of around 3,800 customers out of KPLC's 3,912 CI tariff code customers. This includes good potential for solar PV captive generation to supplement some of the existing thermal back-up facilities, at least during the daytime.

0,5 mW grid-tied Danco Plastics, Factory.
Lidia Daskalova/Shutterstock.com

9/ KENYA MARKET POTENTIAL FOR CAPTIVE POWER

This section presents an overview of the industrial sector in Kenya and screens sub-sectors to identify those that might have highest potential for the adoption of clean captive installations. Information on company numbers, company size and electricity demand is provided based on the limited data available.

The Kenya National Bureau of Statistics Report on the 2017 Kenya Census of Establishments (COE) (KNBS 2018), with data from 2016, provides the most recent publicly available national statistical data on the number and size of enterprises and establishments (facilities, factories, workshops, etc.). In the report, industry sectors are categorized in accordance with the International Standard Industrial Classification (ISIC) reference code for classification of economic activities.

The scope of the present study is on clean captive power potential for private industrial clients. Therefore, the focus of the analysis was on secondary industries that produce tangible, processed goods. Special attention was given to the manufacturing sector, although mining, electricity and related industries, water and waste processors, and the construction sector were also considered.

Primary industries (agriculture, fishing and forestry) and the commercial and service sectors (including transport, warehousing and vehicle repair) were excluded from the review.

9.1/ INDUSTRIAL SECTOR OVERVIEW

9.1.1/ NUMBER OF EMPLOYEES AND TURNOVER

Table 18 presents an overview of the main industrial sectors in Kenya as of 2016. Operations in the mining and quarrying, manufacturing and construction sectors were almost exclusively privately owned. The breakdown by number of employees and annual revenue gives an indication of the number of medium- and large-size businesses in each industrial sector. The focus of the analysis is on businesses with more than 10 employees and with annual turnover of more than 10 million Kenyan shillings (US$100,000).

Table 18: Overview of main industrial sectors in Kenya, 2016

Economic sector	**Operations (no.)**	**Privately owned (%)**	**Employees (No. and % of total)**			**Turnover* (No. and % of total)**		
			10-49	**50-149**	**150+**	**US$100-US$500,000 (Ksh 10-50 million)**	**US$500,000-US$1 million (Ksh 50-100 million)**	**US$1 million+ (Ksh 100 million+)**
Mining and quarrying	297	99.3	56 (18.8%)	22 (7.4%)	16 (5.4%)	35 (11.7%)	12 (4.0%)	20 (6.7%)
Manufacturing	6 019	98.5	1143 (19.0%)	573 (9.5%)	424 (7.0%)	699 (11.6%)	218 (3.6%)	805 (13.4%)
Electricity and related	84	89.3	21 (25.0%)	8 (9.4%)	7 (8.3%)	1 (1.2%)	1 (1.2%)	22 (26.2%)
Water and waste	598	84.4	104 (17.4%)	54 (9.3%)	18 (3.0%)	58 (9.7%)	17 (2.8%)	40 (6.7%)
Construction	11 843	99.9	1 422 (12.0%)	178 (1.5%)	118 (1.0%)	592 (5.0%)	95 (0.8%)	215 (1.8%)

Note: Exchange rate from Kenyan shillings to US dollars of 100:1 used for simplicity.
Source: Derived from KNBS 2018.

For the purpose of this study, turnover is taken as a reasonable proxy for potential uptake of clean captive power. Higher turnover may be indicative of, for example, the ability to pay for captive power system or electricity; business sustainability; more capability and/or experience with capital investments, maintenance, contracts and financing; higher spending on electricity and/or back-up power; and overall interest in reducing costs.

The study assumes a target minimum captive system size of 500 kW for the pilot projects (estimated installed cost of US$500,000 in 2021[25]); thus, it is inferred that establishments with a turnover of more than 100 million Kenyan shillings (US$1 million) are likely to have the most potential for viability.

Based on the data provided in Table 18, the potential universe of clean captive power users in the manufacturing sector was 805 in 2016. Even with the economic downturn in 2017 due to the national elections and the threatened relocation of some manufacturers to Ethiopia or elsewhere (for lower electricity costs and wages), the number of manufacturing establishments is likely to be greater in 2019 than it was in 2016, as the number of CI tariff code customers has since increased.

9.1.2/ GEOGRAPHICAL DISTRIBUTION OF INDUSTRIES

Of the 18,864 total establishments in the industrial sector, the majority are concentrated in Nairobi City County (8,509 or 45.1 per cent), followed by Mombasa County, Nakuru County, Kiambu County [Ruiru and Thika] and Uasin Gishu County [Eldoret] (see Table 19).

25 Assumption based on experience/expectations in Kenya for fixed-tilt captive systems without energy storage. Already in 2019 some projects have reached this threshold (100,000 Ksh (US$1,000) per kWp) for EPC wrap all in, but others have not (some at US$2,000/kWp).

Table 19: Top 10 counties by industry size

RANKING	INDUSTRIES OF ALL SIZES		INDUSTRIES WITH 50+ EMPLOYEES	
	COUNTY	NO. OF ESTABLISHMENTS	COUNTY	NO. OF ESTABLISHMENTS
1	Nairobi	8 509	Nairobi	706
2	Mombasa	734	Kiambu	113
3	Nakuru	701	Mombasa	103
4	Kiambu	638	Kisumu	52
5	Uasin Gichu	622	Machakos	48
6	Kiisi	468	Nakuru	47
7	Garissa	368	Kericho	29
8	Nyeri	356	Muranga	23
9	Kisumu	329	Kilifi	23
10	Turkana	293	Meru	22

Source: Derived from KNBS 2018, p. 33.

When industrial establishments are considered by size based on the number of employees, the greatest number of larger establishments (50-plus employees) is still found in Nairobi, but Kiambu overtakes Mombasa, and Kisumu hosts larger industrial enterprises than Nakuru. The counties of Uasin Gichu and Kisii (each having only 21 establishments with 50-plus employees) as well as Turkana and Garissa do not even appear in the top 10 list by size.

Overall, Nairobi, Mombasa, Kiambu, Nakuru, and Kisumu counties could be expected to have the highest number of industrial establishments that may be interested in clean captive power. This largely reflects the regional distribution of electricity consumption by CI tariff category customers as shown in Table 4: Distribution of CI tariff customer consumption by electricity supply region, 2017/2018.

9.2/ INDUSTRIAL SECTORS EXCLUDED FROM FURTHER SCREENING

Of the five main industrial sectors in Kenya, four were considered to have low potential for clean captive power installations and thus were excluded from further screening: mining and quarrying, electricity and related, water and waste, and construction.

Mining and quarrying sector: The mining and quarrying sector grew 9.7 per cent between 2017 and 2018 (KNBS 2019), and the sector generally has good potential due to high electricity and/or fuel consumption, weekend production, foreign currency income and typically longer-term investment time frames. However, of the 297 mining and quarrying businesses operational in 2016, only 20 had a turnover of more than 100 million Kenyan shillings (US$1 million) (KNBS 2018). The overall potential for and replicability effect of clean captive power in the sector is expected to be low (5-15 users), even though this could translate to a multi-megawatt installed capacity.

Electricity and related sector: Out of the 84 entities in the electricity and related sector in 2016 (including establishments for gas, steam and air conditioning supply), 22 enterprises had an assumed turnover of more than 100 million Kenyan shillings (US$1 million) (KNBS 2018). Most of these are either publicly owned (for example, KenGen, KPLC, KETRACO, GDC) or IPPs, and the potential market for clean captive power is not likely to be substantial.

Water and waste sector: Out of the 598 entities in the water and waste sector, 205 were in the sub-category of water collection, treatment and supply, and of these only 31 (15.1 per cent) had turnover exceeding 100 million Kenyan shillings (US$1 million) (KNBS 2018). Although the water supply industry grew 7.3 per cent in 2018 (KNBS 2019), it was excluded from further screening because most of these entities are likely publicly owned.

Construction industry: Out of the 11,843 active enterprises in the construction industry in 2016, 215 establishments had annual revenue of more than 100 million Kenyan shillings (US$1 million) (KNBS 2018). Growth in the construction sector was slower in 2018 (6.3 per cent) than in 2017 (8.5 per cent) (KNBS 2019). The sector was excluded from screening for clean captive power potential as establishments are expected to be either office-based or temporary construction sites.

9.3/ MANUFACTURING SECTOR

Among the five main industrial sectors in Kenya, the manufacturing sector is the most likely to have the greatest potential for clean captive power uptake. This section identifies the manufacturing sub-sectors that have the greatest potential for clean captive installations, their share in Kenya's economic activity, as well as assumptions regarding their electricity demand.

9.3.1/ OVERVIEW

Table 20 shows the number of enterprises in the manufacturing sector by economic activity and size as of 2016. In total, 805 manufacturing establishments had turnover exceeding 100 million Kenyan shillings (US$1 million). Out of the 24 manufacturing sub-sectors assessed, half of them (12, as highlighted in the table) had at least 20 enterprises exceeding the revenue threshold, with the food products sub-sector having the most such enterprises (285). The food products sub-sector consists of activities such as meat and fish processing, dairy, sugar, grain milling, bakery, fruits and vegetables processing and preservation, manufacture of animal and vegetable fats and oils, animal feed, and cocoa and chocolate confectionary, among others.

Table 20: Number of businesses by manufacturing sub-sector in Kenya, 2016

Economic activity (manufacturing)	Total number of enterprises	Employees			Turnover*		
		10 – 49	50 – 149	150+	US$100 – 500,000 (Ksh 10-50 million)	US$500,000 –1 million (Ksh 50-100 million)	US$1 million+ (Ksh 100 million+)
Food products	2 688	511	196	183	314	67	285
Beverages	166	61	10	12	36	3	20
Tobacco products	2	0	0	2	0	0	2
Textiles	139	30	28	34	24	9	47
Wearing apparel	600	24	27	17	16	8	28
Leather and related products	38	12	10	7	8	3	12
Wood, straw, plait and related products (except furniture)	210	74	13	9	33	10	12
Paper and paper products	59	14	20	15	9	7	31
Printing and recorded media reproduction	274	72	36	13	55	12	44
Coke and refined petroleum products	7	5	0	0	0	3	3
Chemicals and chemical products	173	67	40	21	40	12	68
Basic pharmaceutical products	31	9	11	9	2	6	16
Rubber and plastics products	210	43	45	29	24	22	60
Other non-metallic mineral products	78	19	17	9	15	8	16
Basic metals	43	9	6	20	8	2	20
Fabricated metal products (except machinery and equipment)	422	55	28	14	34	15	35
Computer, electronic and optical	4	1	0	0	0	0	2
Electrical equipment	23	9	7	2	4	0	12
Machinery and equipment not elsewhere classified	33	11	7	3	6	4	5
Motor vehicles and trailers	64	25	19	6	16	9	19
Other transport equipment	5	4	0	0	1	0	1
Furniture	496	31	25	8	26	6	24
Other manufacturing	94	16	11	10	13	6	13
Machinery and equipment repair and installation	160	41	17	2	14	6	30
Total	**6 019**	**1 143**	**573**	**424**	**699**	**218**	**805**

Note: Exchange rate from Kenyan shillings to US dollars of 100:1 is used for simplicity.

Source: Derived from KNBS 2018, pp. 37-38 and KNBS 2019, p. 162.

9.3.2/ ECONOMIC GROWTH IN THE MANUFACTURING SECTOR

In 2018, the manufacturing sector contributed around 7.7 per cent of Kenya's GDP. By comparison, the agricultural sector contributed 32.9 per cent, the tourism sector 8.8 per cent and the transport and storage sector 8.0 per cent.

Total manufacturing output in Kenya grew 5.1 per cent in 2018 after declining 0.8 per cent in 2017 (due to uncertainty around the national election that year) (see Table 21). The improvement in 2018 was boosted by the increased production of manufactured food products (led by sugar, dairy products, other food products not elsewhere classified, and meat and meat products). The pharmaceuticals, electrical equipment and motor vehicles, trailers and semi-trailers sub-sectors also saw significant growth, above 8 per cent (KNBS 2019).

As shown in Table 21, the output of the manufacturing sector grew every year between 2014 and 2018, with the exception of election year 2017. During the four-year period, the average production growth was above 5% in six key sub-sectors: beverages (7 per cent), wearing apparel (10.8 per cent), basic pharmaceutical products (13.5 per cent), electrical equipment (9.8 per cent), furniture (6.7 per cent) and other manufacturing (9.2 per cent). Due to their stability, these sub-sectors have the highest potential for uptake of clean captive installations in the manufacturing sector.

Overall, the production output in manufacturing either increased slightly or declined during the 2014-2018 period. In 2018, the World Bank projected that Kenya's industrial sector (including manufacturing) would grow 4.1 per cent in 2019 and 5.2 per cent in 2020 (World Bank 2018).

Table 21: Manufacturing sub-sectors index of production (per cent change), 2014-2018

MANUFACTURING SUB-SECTOR	2014	2015	2016	2017	2018	AVERAGE 2014 - 2018
Food products	5.0	1.6	6.3	-10.5	8.6	2.2
Beverages	-1.5	25.2	5.7	0.0	5.6	7.0
Tobacco products	20.5	-4.4	-16.2	-4.4	-1.4	-1.2
Textiles	1.6	14.1	-7.1	-2.2	1.5	1.6
Wearing apparel	12.0	13.8	17.3	5.6	5.1	10.8
Leather and related products	-12.4	-15.7	11.4	-7.1	4.1	-3.9
Wood, straw, plait and related products (except furniture)	16.2	4.6	-13.9	-13.2	-2.5	-1.8
Paper and paper products	-3.3	0.2	9.4	10.3	4.9	4.3
Printing and recorded media	-2.9	-0.1	-1.3	-0.3	-0.8	-1.1
Coke and refined petroleum products	-1.2	-1.7	1.7	-0.9	4.6	0.5
Chemicals and chemical products	11.2	7.5	-0.2	-0.2	0.5	3.8
Basic pharmaceutical products	18.3	21.9	20.6	-1.1	8.0	13.5
Rubber and plastics products	6.1	6.1	5.1	6.0	-3.8	3.9
Other non-metallic mineral products	15.5	8.9	5.8	-7.9	-1.4	4.2
Basic metals	1.9	-1.2	13.9	4.0	2.7	4.3
Fabricated metal products (except machinery and equipment)	13.4	-6.4	-20.2	-2.5	6.2	-1.9
Computer, electronic and optical	-	-	-	-	-	-
Electrical equipment	8.8	6.5	3.5	20.5	9.9	9.8
Machinery and equipment not elsewhere classified	-15.1	-44.7	-27.1	11.0	5.0	-14.2
Motor vehicles and trailers	23.1	6.0	-31.9	-24.2	11.2	-3.2
Other transport equipment	-	-	-	-	-	-
Furniture	14.8	22.5	0.0	-4.4	0.8	6.7
Other manufacturing	25.1	20.4	-2.9	0.1	3.4	9.2
Machinery and equipment repair and installation	6.9	3.6	4.9	2.0	2.6	4.0
Overall	**6.4**	**5.0**	**4.6**	**-0.8**	**5.1**	

Source: KNBS 2019, p. 163.

Total capital investment in the manufacturing sector averaged around US$145 million (Ksh 15 billion) per year over the period 2014-2017, although it fell to US$136 million (Ksh 14 billion) in 2017 (KAM 2018) because of the economic slowdown during the election year.

9.3.3/ US$ELECTRICITY DEMAND

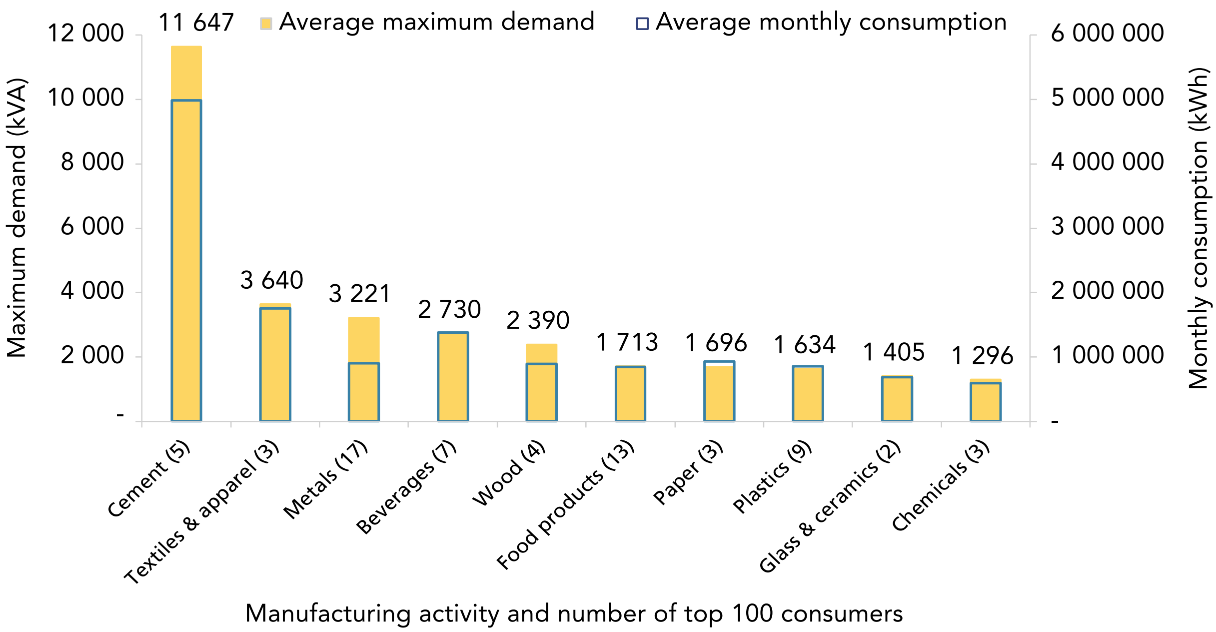
Relatively few and recent data are publicly available on energy demand and consumption in the manufacturing sector in Kenya[26]. Electricity demand and consumption is available by CI tariff category, as presented in sections and 4.3.2. However, uniform and representative data disaggregated by industry type were not found as of the time of writing. Nevertheless, certain available information can be used to gain insights on energy demand in the manufacturing sub-sectors.

Top electricity consumers

Out of the top 100 electricity consumers in Kenya in 2011[27] (total non-coincident maximum demand of 280 MVA), 73 were manufacturing enterprises. Their average maximum demand[28] ranged between 1.3 MVA and 3.6 MVA, except in the cement sector where average demand was 11.6 MVA. Average monthly consumption was between 593 MWh and 1,751 MWh but reached 4,984 MWh in cement factories.

Metal fabricators and food processors had the greatest prevalence among the top 100 electricity consumers, whereas cement manufacturers had by far the highest average demand and consumption.

Figure 11: Top manufacturers' maximum demand and monthly consumption, 2011



Note: The seven businesses lumped under "other manufacturing" (basic minerals, rubber, tobacco, motor vehicles and trailers, others) were removed from demand and consumption averages but were included in the total number of manufacturing business in the top 100 consumers. Demand figures were only available in kVA and not kW.

Source: Derived from KPLC 2011.

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26 The Kenya Association of Manufacturers has subsidized, supported and conducted a number of energy audits in the manufacturing industry (out of more than 2,000 energy audits in total); however, these reports and data are not publicly available. The Ministry of Energy, KPLC, EPRA and KNBS do not publicly provide data on electricity use disaggregated by industry type.

27 Latest data available from KPLC at the time of writing.

28 The average maximum demand was calculated across the 73 manufacturing enterprises, minus the businesses lumped under "other manufacturing" (basic minerals, rubber, tobacco, motor vehicles and trailers, others).

Since 2011, there will have been a few changes to the list, but the average maximum demand and consumption per manufacturing sub-sector are expected to be at similar levels today. Notably, at least six of the manufacturers in the plastics, metals, food products and textiles sub-sectors have or are implementing captive PV power systems.

The 2016 Power Generation and Transmission Master Plan (GoK 2016c) provides figures from 2012/2013 on total electricity consumption by top consumer category. The Master Plan confirms that the cement sector consumed the most electricity annually at around 285 GWh, followed by the metal products sector at around 120 GWh. Other significant manufacturing sectors with more than 50 GWh of total consumption in 2012/2013 were plastics, tea processors, basic metal industries, grain mills, industrial chemical plants and one large mineral extraction operation (Magadi Soda).

Energy consumption and intensity in selected manufacturing industries

In 2013 the Energy Regulatory Commission (now EPRA) published a study on energy baselines and benchmarks in Kenya based on a survey of low, medium and high energy consumers (including industry users), using data from 2008-2012 (ERC 2013). Although a small sample size and significant data gaps limit the applicability of the study, it provides indicative data on energy use and energy intensity in selected manufacturing sub-sectors, as summarized in Table 22.

Table 22: Energy consumption and intensity in selected manufacturing sub-sectors, 2013

Manufacturing industry	No.	Total production (tons)	Total electrical (MWh)	Total thermal (MWh)	Total biomass (MWh)	Total energy (MWh)	Energy intensity (kWh/ tonne)	Average annual electricity consumption (kWh
Tea	5	32 381	15 420	-	282 704	298 124	1 841	3 084 024
Plastics	8	15 466	29 700	717	-	30 417	246	3 712 469
Steel	2	55 548	4 695	-	-	4 695	42	2 347 399
Cement	4	13 710 080	109 994	494	-	110 488	2	27 498 577
Edible oil	3	256 718	39 821	141 453	118 709	299 982	390	13 273 649
Food, beverage	6	53 031	6 726	11 324	-	18 050	57	1 120 928
Grain milling	4	159 510	23 386	2 174	-	25 560	40	5 846 584

Note: (a) numbers may not add up due to rounding, (b) "No." is the sample size; (c) thermal energy combines fuel oil, furnace oil, industrial diesel oil and heavy fuel oil. Because the sample included low-, medium- and high-consuming businesses and because the manufacturing sub-sectors were in some cases classified differently, the values are not directly comparable with the information from the top 100 consumers list.

Source: Derived from ERC 2013, p. 23.

For three of the sub-sectors reviewed in the study – plastics, steel and cement – electricity was the major source of energy as of 2013. However, in the food and beverages and edible oil industries, thermal energy predominated. The tea and edible oil industries also use a substantial amount of biomass energy. During the 2008-2012 period, Kenya experienced significant power shortfalls and load shedding, and biomass resources were more readily available than is the case today (although the tea sector has its own plantations).

9.3.4/ POTENTIAL OF THE MANUFACTURING SECTOR FOR CLEAN CAPTIVE POWER

As a component of the industrial sector, manufacturing has the most enterprises with more than 50 employees (998 enterprises) and with annual revenue exceeding 100 million Kenyan shillings (US$1 million) (805 enterprises) – the two characteristics, all else being equal, that indicate the best prospects for captive power. Twelve manufacturing sub-sectors had at least 20 companies that met the turnover threshold. Details on the top 10 of these sub-sectors are provided in Table 23, along with an assessment of their potential for clean captive systems.

Table 23: Potential top 10 manufacturing sub-sectors for captive power in Kenya

Sub-sector	No. of enterprises with annual turnover of US$1 million+ (Ksh 100 million+)	Five-year average % change in volume of output (2014-2018)	No. of companies among top 100 electricity consumers (2011)	Total GWh consumed 2012/2013 based on PGTMP	No. of known installed clean captive systems (solar PV / bioenergy)	Potential for clean captive systems (High/ Medium)
Food products	285	2.2	13	215	PV – 6 Bio – 11	H
Chemicals and chemical products	68	3.8	11	210	PV – 2	H
Rubber and plastics products	60	3.9	9	135	PV – 3	H
Textiles	47	1.6	2	15	PV – 2	M
Printing and recorded media	44	-1.1	0	-	0	M
Fabricated metal products (except machinery and equipment)	35	-1.9	17	120	PV – 3	H
Paper and paper products	31	4.3	3	25	Bio – 2	H
Machinery (and equipment) repair and installation	30	4.0	0	-	0	M
Wearing apparel	28	10.8	1	25	0	M
Furniture	24	6.7	0	25	0	H

Source: author's own elaboration based on KNBS 2018, ERC 2013 and KPLC 2011

Out of the 10 sub-sectors with the best prospects for clean captive installations, 4 were ranked medium for the following reasons:

- The *textiles* sub-sector has recorded lower electricity consumption.
- *The printing and recorded media* and *machinery (and equipment) repair and installation* sub-sectors also record lower or unknown electricity consumption. In the case of the latter, there has been a sector shrinkage.
- In the *wearing apparel* sub-sector, some of the companies are located in export processing zones; this could make captive power and third-party contracting less attractive, although special treatment for this was not assessed.

Based on Table 23, the sub-sectors that may have the most prospective users with potential to adopt captive power and that have good opportunities for replication are as follows: food products, chemicals and chemical products, rubber and plastics products, fabricated metal products (except machinery and equipment), paper and paper products, and furniture.

That said, the specific characteristics of manufacturing sub-sectors to assess the competitiveness of clean captive power could not be fully assessed due to limited data availability. These characteristics include:

- The typical daily electricity load profiles (and load patterns) or tariff category: For instance, generally a daytime peak demand can mean that solar PV has good potential, while consistent loads (rather than spikes and drops) are preferred for captive plants where excess electricity cannot be fed into the grid. With regard to flower farms, for example, PV technical potential is generally good due to cold room, lighting, water pumping, fans, misting equipment and other loads that run consistently or periodically during the day.
- The number of typical facility operational days in a week: Industries that operate six or seven days a week continuously throughout the year or that have non-stop firm base loads will generally find more economic benefit from investing in captive power than those that operate five days a week or have seasonal operations, for example, some coffee factories.
- The matching of manufacturing sub-sectors with typical tariff codes, in order to understand in more depth the cost of electricity that would be offset by clean captive installations.

In addition, depending on the perspective of the captive power developer and/or financier (as discussed in the subsequent section) as opposed to the industrial user, other manufacturing sub-sector characteristics not covered in this study might be relevant to consider when assessing potential, such as:

- Typical sub-sector industrial facility ownership structures (for decision making) and liquidity (cash availability for payments);
- Foreign currency income (for example, flower farms, tea factories) if PPAs or leases are denominated in foreign currency.

It should also be noted that captive power potential is always case specific, depending on the location, space and energy resources available, facility operating characteristics, the specific cost of electricity, back-up power usage and cost, the system type and design, the implementation arrangements and the captive system cost (including financing, maintenance, equipment replacement and other costs)[29].

Therefore, while the higher-potential sub-sectors listed in Table 23 can be emphasized as having good prospects for clean captive installations, industries with similar operating characteristics that make them attractive (for example, consistent loads, 6-7 days/week production, higher electricity costs) across the manufacturing sector as a whole should still be considered – for uptake or replication. This point is reinforced by the findings from interviews with ESCOs and EPC companies, which indicated that developers are generally sector-agnostic – that is, they target the opportunities with the highest potential regardless of the sector, including agricultural, service, industrial and institutional customers.

9.4/ CONCLUSION

Geographically, the markets with the greatest total potential for clean captive installations in the industrial sector in Kenya are expected to be Nairobi, Mombasa, Kiambu, Kisumu and Nakuru counties due to the number and size of industrial establishments and the demand for electricity by CI tariff code customers in these regions.

Identified manufacturing sub-sectors with the biggest potential for clean captive power installations include food products, chemicals and chemical products, rubber and plastics products, fabricated metal products (except machinery and equipment), paper and paper products, and furniture.

However, other characteristics of industries such as daily load profiles, operating days of a facility, ownership structure and foreign currency income could not be retrieved to analyse further the market. For this reason, most of the ESCOs and EPC companies are generally sector agnostic, and other sub-sectors could also present higher opportunity on a case-by-case basis.

29 A captive project may also best considered as part of a comprehensive energy management strategy, which would include energy efficiency measures.

180 kW grid-tied, Laurel Flower farm.
Sebastian Noethlichs/Shutterstock.com

10/ FINANCING CAPTIVE POWER

This section starts with a review of the banking sector in Kenya and delves into the captive power financing landscape, closing with a discussion of financing models being used in Kenya for captive solar PV systems[30].

10.1/ BANKING SECTOR OVERVIEW

The Kenyan banking sector is regulated by the Central Bank of Kenya (CBK). As of 31 December 2017, the sector had 42 commercial banks, 9 representative offices of foreign banks and 13 microfinance banks. Forty banks are privately owned, out of which 25 are locally owned while 15 are foreign owned (CBK 2018). Most lending is in Kenyan shillings, but it is also possible to obtain commercial financing in US dollars, Euros and British pounds as well as other currencies.

Kenya introduced an interest rate cap law in 2016 that puts a ceiling on lending rate by banks and other financial institutions to at most 4 per cent above the CBK base rate, known as the Central Bank Rate. The Central Bank Rate set by a monetary policy committee at least every two months, has oscillated between 9 per cent and 10 per cent since the interest cap law was passed. This means that loan interest rates have been between 13 per cent and 14 per cent in that period, a significant reduction from previous Kenyan shilling rates, which ranged around 16-21 per cent or more.

The interest rate cap has put a significant damper on commercial bank lending to the private sector due to the higher risks versus lending to the government (Treasury bond coupons start at around 10-12 per cent). However, this has mostly affected small and medium-sized enterprises, and commercial banks remain willing to lend to larger corporates including manufacturers. Indeed, credit advanced to manufacturers by commercial banks and industrial financial institutions went up 6.5 per cent to US$3.23 billion (Ksh 335.7 billion) in 2018, from US$3.03 billion (Ksh 315.3 billion) in 2017 (KNBS 2019).

30 A case-by-case analysis should be applied to each technology. The cashflow pattern, for example, is relatively different from one technology to the other. Transactions in general must be bespoke. However, for energy and for captive generation, solar PV offers the highest level of potential for harmonization and standardization.

As of October 2019, the interest cap law was under review, following pressure from different stakeholders and a court order issued in March 2019, although a decision was expected soon (Mutai 2019).

Typical commercial lending terms in Kenya involve relatively short tenors (for example, 3-7 years) and requirements for collateral or guarantees.

10.2/ CAPTIVE POWER FINANCING LANDSCAPE

10.2.1/ COMMERCIAL BANKS

To date only a few commercial banks in Kenya are involved in financing commercial and industrial renewable energy captive power installations, as the projects are not well understood and are perceived as high risk. The perception of high risk is further compounded by the interest rate cap, which has reduced the bank's headroom for structuring finance deals with small and medium-sized enterprises. Many stakeholders interviewed for this study cited a risk-averse local banking sector with limited experience in financing corporate energy projects as a key constraint in the adoption of clean captive systems[31].

The pioneering commercial banks lending to clean captive projects have done so in partnership with an Agence Française de Development (AFD) / Proparco-funded programme and green credit line called Sustainable Use of Natural Resources and Energy Financing (SUNREF) – described in the next section. Five commercial banks have participated under SUNREF and its predecessor the Regional Technical Assistance Program (RTAP, 2011-2013). However, two are no longer active: CFC Stanbic Bank, which decided to focus on larger renewable energy projects (IPPs), and Chase Bank, which went bankrupt. The three active banks are Diamond Trust Bank, Commercial Bank of Africa and Co-operative Bank of Kenya.

Tables 24 through 26 provide details on the closed projects and the disbursed money to captive power and energy efficiency projects by the SUNREF-participating local commercial banks in Kenya as of 2016 (CEEC 2017).

Table 24: Co-operative Bank disbursements under SUNREF, 2016

PROJECT NAME	TYPE	TECHNOLOGY	SIZE (MW)	LOAN AMOUNT (US$ MILLION)	CAPEX (US$ MILLION)
KTDA Gura	RE	Mini-hydro captive and grid	5.00	10.1	16.0
KTDA Chania	RE	Mini-hydro captive and grid	1.00	1.6	4.3
KTDA North Mathioya / Metumi	RE	Mini-hydro captive and grid	5.00	9.9	15.9
Strathmore University	EE	Solar PV captive and grid	0.50	1.3	1.2
Gen Pro Terem	RE	Mini-hydro grid	5.00	11.6	13.4
Meru Central Dairy	EE	Industrial process improvement and retrofits	0.17	2.3	3.0
Alpha Knits Ltd	EE	Industrial process improvement and retrofits	0.08	1.1	1.1
Lean Energy Solutions	EE	Biomass captive	5.30	1.0	1.5
Total			**22.05**	**39.0**	**56.4**

Note: RE = renewable energy, EE = energy efficiency (SUNREF classification); CAPEX = capital expenditure
Source: CEEC 2017, pp. 21-22.

31 Stakeholder interviews, September 2019.

Table 25: Chase Bank disbursements under SUNREF, 2016

PROJECT NAME	TYPE	TECHNOLOGY	SIZE (MW)	LOAN AMOUNT (US$ MILLION)	CAPEX (US$ MILLION)
Olivado	RE	Biogas captive	0.33	1.7	2.1
Redland Roses	RE	Solar PV captive	0.33	0.3	0.33
Alpha Fine Foods	EE	Equipment retrofit and production expansion	0.22	0.7	0.97
Total			**0.88**	**2.7**	**3.4**

Note: RE = renewable energy, EE = energy efficiency (SUNREF classification); CAPEX = capital expenditure
Source: CEEC 2017, pp. 21-22.

Table 26: Commercial Bank of Africa disbursements under SUNREF, 2016

PROJECT NAME	TYPE	TECHNOLOGY	SIZE (MW)	LOAN AMOUNT (US$ MILLION)	CAPEX (US$ MILLION)
Thika Cloth Mills	EE	Energy efficiency measures	-	0.1	0.2
Mt. Elgon Orchards	RE	Mini-hydro captive	0.30	0.9	1.4
Two Rivers Mall	RE	Solar PV captive	1.28	1.3	2.7
Total			**1.58**	**2.3**	**4.3**

Note: RE = renewable energy, EE = energy efficiency (SUNREF classification); CAPEX = capital expenditure
Source: CEEC 2017, pp. 21-22.

The three tables do not include the latest projects that have been funded by commercial banks under SUNREF, for which details were not available at the time of writing. For example, Co-operative Bank announced in 2019 that it has 10 operational renewable energy projects and a portfolio of over US$100 million under the SUNREF programme. As of mid-2019 around 5 MW was in the project pipeline and was expected to be commissioned soon[32].

There are indications that other commercial banks (for example, Equity Bank, Kenya Commercial Bank) are becoming interested in renewable energy captive power. If this materializes it will be due to factors such as growing awareness, demonstration of technology and financing models by the first movers, internal capacity building, advancements in technology and plummeting costs (for solar PV and batteries).

Although most banks active in financing captive power projects have done so through SUNREF, other renewable energy and energy efficiency projects have been financed outside of the SUNREF programme.

Financing by local banks is usually through full-recourse loans that require guarantees and collaterals. One of the banks interviewed for this study indicated that it does not take a captive power system as collateral, which means that the bank needs other assets attached to cover the loan. The bank also lends against revenue cash flows without taking into consideration savings from the system. One related factor is foreign currency risk on assets financed in hard currency for businesses with revenue in Kenyan shillings. In addition, long-term business credit history is often assessed.

Such requirements end up locking out small and medium customers that usually struggle to pass the stringent risk assessment and requirements. To potentially address this, third-party institutions work with the SUNREF programme and offer guarantees. Banks, however, expressed their discomfort with guarantees, which they see as inadequate and the providing institutions as too bureaucratic.

32 Personal communication, Co-operative Bank representative, Nairobi workshop, 27/06/2019.

10.2.2/ FINANCING PROGRAMMES

- **SUNREF**

Sustainable Use of Natural Resources and Energy Financing (SUNREF) is an AFD/Proparco programme established to promote the development of a low-carbon economy in the region by financing renewable energy and energy efficiency activities in the private sector. The programme was established in 2011 (rebranded in 2014) and is active in eastern, western and southern African countries. In Kenya, SUNREF is hosted by the Kenya Association of Manufacturers.

The programme offers long-term debt denominated in US dollars at 5-6 per cent interest, channelled through participating banks. The banks receive a line of credit from SUNREF for on-lending to the private sector developing renewable energy and energy efficiency projects. Technical analysis of an applicant project is initially carried out by SUNREF, including looking at the financial parameters. If feasibility is assessed positively, the project is given a certificate as a green light to apply for debt financing through the participating banks.

The participating banks also carry out their own due diligence, which includes analysing the EPC contractor (quality of work, ability to deliver, etc.) and the ability to service the loan through cash flows. Previously SUNREF could also offer modest technical assistance to project developers. It is not known if this service will continue in the future.

In addition, SUNREF offers internal capacity building to banks to encourage uptake of renewable energy and energy efficiency projects. So far, more than 250 bank staff across the East Africa region have received training that enables them to carry out due diligence and understand technologies and business models (Githaiga 2019a).

In total, as of September 2019, SUNREF participating banks had facilitated over US$70 million in deals for more than 37 projects across the East Africa region[33] (Githaiga 2019a).

After securing funding from the Green Climate Fund through AFD, the third phase of SUNREF financing is expected to be launched soon. In June 2019, SUNREF announced that it was planning a local currency facility to make the programme attractive to businesses earning in Kenyan shillings (Githaiga 2019b).

- **Joint Crediting Mechanism**

The Joint Crediting Mechanism (JCM) is a Japanese government-funded programme offering capital subsidies to low-carbon technology projects as a way of delivering greenhouse gas emission reductions. In Kenya, the programme has focused mostly on solar PV projects at the IPP or captive system level. Financing is done through a subsidy that covers up to 30 per cent of capital expenditures on solar modules, inverters and monitoring equipment, disbursed through the Japanese project counterpart as results-based finance and in exchange for emission reduction certificates. One of Kenya's larger captive PV projects, the 991 kWp Kaysalt Malindi project, received the JCM subsidy in 2015.

- **Powering Agriculture**

Powering Agriculture, led by the US Agency for International Development (USAID), is a global funding competition focused on supporting new and sustainable approaches to accelerating the development and deployment of clean energy solutions in the agriculture sector. In East Africa, the programme has a technical assistance component that provides an end-to-end, cost-effective, low-risk renewable energy generation and energy efficiency service to flower and horticultural farms in Kenya, Tanzania and Uganda.

Grantees of Powering Agriculture include a biomass captive power plant in Ethiopia, a micro-steam turbine firm, a solar agro-processing company and a renewable energy leasing company (Ariya Capital) targeting solar PV in the horticultural sector including in Kenya.

- **Green bonds**

Two institutions in Kenya are preparing to issue the country's first green bonds. As part of increasing interest, the Kenya Bankers Association has led the establishment of a Green Bonds Programme – Kenya in partnership with the Climate Bonds Initiative, Nairobi Securities Exchange, FMO and others. Although unlikely in the short term, in the longer term it could be possible for an issuer to launch a bond aimed at financing clean captive power.

33 SUNREF interview, September 2019.

10.2.3/ PRIVATE FINANCING

- **Private financiers of captive power in Kenya**

Given the good potential for clean captive power in commercial and industrial facilities in Kenya and the relative lack of accessible bank financing or interest to date by domestic leasing firms, specialized captive solar PV financing firms entered the market in around 2014. Most of the companies have a base or strong presence in Kenya. As of October 2019 there were around 10 main private solar PV financiers/ESCOs in Kenya (see Table 27). Other private financiers – such as Berkeley Energy, Actis Energy, Inspired Evolution, and Mettle Solar – are exploring the market, but have not disbursed funds yet for commercial and industrial applications.

Table 27: List of main captive PV financing / ESCO firms active in Kenya

NAME	LOCATION	OVERVIEW
Ariya Capital	Based in Kenya	Provides leasing finance and fund management, and invests in IPPs. On the leasing side, has partnered with African Solar Designs.
Crossboundary Energy	Based in the United States, with head office in Kenya (and offices in other countries)	Part of the Crossboundary Group. US$8 million in equity raised for Crossboundary Energy Fund 1 in 2015. US$6 million debt facility with Overseas Private Investment Corporation since 2018. Has financed and manages 1.5 MW of captive PV in Kenya to date. Has a partnership with leading EPC Solarcentury. Also has operations in Ghana and Nigeria, with Nairobi acting as the main office.
Ecoligo	Based in Germany, with history in Kenya	Crowd-funded debt sourced in Euros for individual projects under leasing/ PPA. Financed 700-plus kW in Kenya. Often works with Kenyan EPC Harmonic Systems.
Faber Capital	Based in Dubai, with presence in Kenya	Part of an international group of companies, including Premier Solar Solutions (Kenyan EPC), and can offer financing.
Maris	Based in Mauritius, office in Kenya	Diversified holding company. Co-owns Equator Energy (Kenyan/German EPC), which enables EPC to offer financing.
responsAbility	Based in Switzerland, large office in Kenya	Global development fund manager with more than US$3 billion of assets under management. Provides both equity and debt through various vehicles and has a renewable energy project development arm in Kenya. Has financed a captive power developer in Ghana but not in Kenya (yet). Captive power division is based in Zurich.
SolarAfrica / NVI Energy	Based in South Africa	Captive PV financing platform and partner of Crossboundary.
Solarise Africa	Based in Kenya	Private financier and ESCO. So far has financed up to around 3 MW of solar PV in Kenya: 1 MW in agro-businesses, 850 kW in large industrial clients and the remainder spread across other smaller industries. Solarise Africa offers turnkey solutions under three types of long-term flexible funding solutions: asset financing, operating lease (with ownership option) and PPA. Partner of Premier Solar Solutions (Kenyan EPC).
SunFunder	Based in the United States, with presence in Kenya	Provides exclusively debt. Established US$1.2 million working capital debt facility for Questworks (Kenya developer/EPC) in June 2018.

Source: Author compilation from various sources.

Most established private financiers do not engage in project development, leaving this role to EPC companies or ESCOs. A number of financing firms have, however, established strong partnerships with EPCs and/or ESCOs. There is also at least one instance of a private financier buying a stake in an EPC in an arrangement that has evolved into an ESCO, and at least two private financiers that also provide ESCO services (i.e., offering both project financing and energy supply). In a similar vein, some EPCs are establishing their own ESCO business lines. This is being done to offer a wider breadth of solutions to customers to help increase market penetration, reduce costs and standardize the processes of developing captive projects.

As the captive power market in Kenya grows, more integration, both vertical and horizontal, should be expected. European utility companies are also eyeing the captive power market and looking to move in using the ESCO model. With strong financial backing and experience from other markets, entry of such players is likely to have a significant impact in the market. One European utility interviewed for this study is assessing the opportunity before setting up a captive power business in the region.

- **Currency exchange**

Many of the private financiers and ESCOs/EPCs have raised funds from overseas through pension funds, private capital funds and venture capitalists looking to invest in emerging markets. In addition, one Kenyan commercial bank interviewed for the study mentioned that it is financing one local ESCO business and is in talks with two more. This may point to an emergence of local ESCOs financed by local banks in local currency.

At present, however, because of foreign funding in hard currencies, financing is usually in US dollars or Euros. This means that most of the commercial and industrial captive power installations that have been financed in Kenya are export-oriented businesses (flower farms being predominant, as shown in Table 15), firms backed by international parent companies or companies that have access to international lines of credit.

Hard currency financing limits lending to businesses that earn in Kenyan shillings by adding foreign exchange risks. As a result, local currency financing is highly touted by some stakeholders as a way to unblock funding to local businesses. SUNREF has announced plans to introduce a line of credit in Kenyan shillings in its third round of financing that is expected to be launched in year 2020, as a way of addressing foreign exchange risk[34].

However, other stakeholders noted that local currency financing was not a major consideration. This is because, as with private financing for a PPA or leasing agreement offered by ESCOs, KPLC customers are exposed to foreign exchange risk because the utility company's PPAs are based on US dollars / Euros, and exchange rate impacts are passed through on electricity bills. As a result, most ESCOs and private financiers contacted for this study did not see their financing in US dollars / Euros as a big barrier to customer uptake. Nevertheless, as most captive power project costs, including large proportions of capital expenditure, are footed in hard currencies, a mixed-currency financing arrangement could be more appropriate, depending on how a financing deal is structured.

Private financiers / ESCOs appear to have some advantages over commercial banks in financing captive PV projects in Kenya, in that they offer a number of different implementation models and specialized solutions to customers (for example, longer loan tenors, acceptance of the PV plant itself as collateral, system performance guarantees) and can close deals more quickly.

34 Interview with SUNREF, September 2019.

10.3/ FINANCING MODELS FOR CAPTIVE POWER DEPLOYED IN KENYA

All the main financing models for clean captive power can in principle be (and in some cases already are being) implemented in Kenya, including in the industrial sector. Those financing models can be applied to all renewable energy technologies.

- **Outright purchase/asset finance**

Under this model, the owner purchases the solar PV or other system upfront, financed with either company capital or debt. Once purchased, the user can either take on the responsibility of operations and maintenance (O&M) or enter into an O&M contract with the EPC contractor or system supplier. In Kenya in some cases, the EPC contractor will include 2-3 years of O&M and training for the company's staff in its price offer. The outright purchase model in Kenya has in some cases been facilitated with grants or subsidies to specific projects, and commercial bank financing has come predominantly through the SUNREF green credit line participating banks.

The majority (an estimated 70 per cent-plus) of commercial and industrial captive solar PV systems in Kenya have been implemented under this model. Even with the availability of other financing models, most family-owned businesses in Kenya prefer to purchase outright, due in part to a tendency to be conservative with finances[35].

- **Rent-to-own (financing lease)**

With rent-to-own, a third party finances the captive plant either fully or partially. The client makes a small upfront capital investment (usually 20 to 30 per cent in Kenya) and thereafter a monthly lease payment for the duration of the contract. The client effectively pays off the value of the solar plant through the monthly payments, and ownership is transferred to the client at the end of the contract. The contract may have a long duration (for example, up to 15-25 years). Under this model, system O&M is usually the responsibility of the developer for the duration of the lease contract. Some rent-to-own contracts have an early buy-out option where the client can purchase the system at an agreed residual value.

In Kenya it is assumed that some projects may have been financed under a rent-to-own arrangement (for example, Ecoligo projects), but the operating lease model (below) seems predominant.

- **Operating lease**

With this model, an end user makes little or no upfront payment and the lease period spans several years, the term of which is largely dependent on the financing institution. The developer is responsible for plant O&M during the lease period. In some contracts, the developer/financier provides performance guarantees to the end user in terms of energy production. At the end of the lease period, the end user may be given the option to purchase the system at residual value or to extend the lease, or the developer removes the plant from its premises.

The operating lease model is being used in Kenya for captive projects by companies such as Solarise and Astonfield. In some instances, what is publicly announced as a "PPA" may in fact be an operating or financing lease arrangement.

Solar leasing (financing and operating leases) appears to have a high potential for growth based on the interviews with private sector players. One ESCO noted that Kenya recently passed a law that streamlines the commercial leasing business, making the model more attractive to investors. The interviewee also indicated that depending on how the lease is designed, leasing a solar PV system can now qualify as a capital investment by the customer, allowing them to claim the investment deduction allowance (see section 5.3), as is the case with the outright purchase / asset finance model. This reduces the levelized cost of electricity, which can make solar leasing more attractive to industrial clients.

35 Private sector stakeholder interviews, September 2019.

- **Power purchase agreement (PPA)**

  This model differs from the rent-to-own and operating lease arrangements in that monthly payments are not fixed but based on the energy consumed (X amount / kWh consumed) over a long-term contract (for example, 15 years or more) by an end user from a third-party-owned captive plant on either the end user's premises or a nearby premises. The plant owner is responsible for developing, financing, building and operating the plant.

  In Kenya, Crossboundary Energy has publicly announced at least two 15-year PPAs for captive PV systems at clients' facilities. At least one of these is a "pure" PPA and not a leasing arrangement presented as a PPA. As of September 2019, Crossboundary was the only company in Kenya known to have used the PPA model. The reason behind the limited use so far seems to be because with PPAs – and certainly for any system above 1 MW – adherence to the energy regulations may be required, as EPRA might have to review and approve the tariff and other contract terms, thereby increasing the regulatory burden and commercial uncertainty of the transaction.

  To date Crossboundary (via SolarAfrica), Maris (via Equator Energy), Ecoligo and Solarise Africa have been most active in providing financing solutions (lease or PPA) for captive solar PV installations. Faber Capital (via Premier Solar Solutions) and SunFunder appear to be increasing their activities. In some instances, different financing firms have teamed up on specific projects (for example, Ecoligo and Ariya Capital).

10.4/ CONCLUSION

Commercial bank lending to clean captive power project owners in Kenya has been fairly limited to date due to a number of factors including stringent lending terms, perceived poor risk-reward profile, lack of bank experience with such projects and in some cases foreign currency risks. The commercial bank financing that has been provided to clean captive users has come mostly from three banks that participate in the SUNREF green credit line programme. The commercial lending situation seems to be improving, with other banks becoming interested in the sector and one bank having financed an ESCO company. Nevertheless, lack of bank financing is still a significant barrier to clean captive power uptake in Kenya.

Three development cooperation partner programmes in Kenya support financing of clean captive power. The main one is the SUNREF programme, which has been instrumental in encouraging commercial bank lending to renewable energy captive power, small renewable energy projects and energy efficiency in industry, including captive hydro, biomass, biogas and solar PV plants.

Since 2014, private financiers have been assuming a greater role, with around 10 financing/ESCO firms now active in the market with an almost exclusive focus on captive solar PV. In some cases private financiers have entered into partnerships with ESCOs and EPCs, and in other cases ESCOs have raised their own capital. The private financiers/ESCOs are providing tailored and flexible solutions to end users, which is one reason for the growth in the captive solar PV power market since 2016.

These entities have made all captive financing models available in Kenya: outright purchase/asset finance, rent-to-own (financing lease), operating lease and PPA. Remaining challenges include a lack of awareness and understanding of potential captive power end users, conservativeness and preferences of facility owners (for example, risk adversity to long-term contracts), capital constraints and still-limited financing, and the cost associated with financing.

Installation of a 1.2 MW captive solar plant on the roof of a factory in the town of Ruiru, snearby Nairobi, Kenya.
Lidia Daskalova/Shutterstock.com

11/ CONCLUSION

This Kenya country report for clean captive installations for industrial clients in sub-Saharan Africa has presented and analysed information on the electricity sector of the country, regulatory considerations, electricity tariffs, market potential, the financing landscape and stakeholders relevant to captive power in industry. The study was based on reports and data available at the time of writing and on interviews with key stakeholders.

While data limitations did not allow for in-depth analysis of specific industrial sub-sectors, the study has highlighted important findings and areas for consideration and, in some cases, further investigation. This will inform the design of interventions for the scale-up of clean captive installations in the industrial sector in Kenya, including the preparation of case studies, business models and financing structures, awareness raising, and identification and implementation of a pilot project.

The current energy situation of Kenya offers a good potential for clean captive installations. Although the country has and will continue to have an oversupply of electricity, grid downtimes are frequent and negatively impact the operations and revenues of commercial and industrial clients. For this reason, captive power is not being encouraged as a means to address any shortfall of supply, but rather is seen as a private sector solution to address the challenges of unreliable supply of power.

Current KPLC electricity prices vary between US$0.10/kWh and US$0.20/kWh for CI customers and are projected to continue increasing. This is why captive power in Kenya, especially solar PV, is currently competitive with grid electricity at levelized costs below US$0.12/kWh. Recent and proposed changes – such as time-of-use tariffs, energy rebates and dedicated electricity supply for the largest customers – are unlikely to curtail the market in the short and medium terms. Captive power uptake in Kenya has been strong and growing, especially since 2016, with at least 100 captive PV systems and 20 captive hydropower and bioenergy plants at commercial (including agricultural), industrial and institutional establishments in the country.

The manufacturing sector has been identified as one of the industrial sectors with the strongest potential for clean captive power, in terms of the size of enterprises, annual turnover, average output growth and electricity consumption. More than 800 manufacturing companies have a turnover of at least US$1 million, and these are expected to have the highest prospects for captive uptake in the industrial sector. Key sub-sectors identified were food products, chemicals, rubber and plastics, fabricated metal, and paper products, among others. However, broad potential for captive power is likely across multiple sub-sectors for industrial facilities that have common characteristics that make such systems competitive, including consistent daily load profiles and continuous operations 6-7 days a week, year-round. Geographically, the regions of Kenya with the largest potential for captive power markets are Nairobi, Mombasa, Kiambu, Nakuru and Kisumu counties.

A key barrier to the uptake of clean captive installations in Kenya is the uncertainty surrounding the country's energy regulatory framework. Until 2019, Kenya benefited from a straightforward regulatory regime for captive systems. The new Energy Act 2019 has brought a period of uncertainty during the transition of regulations from the previous framework. The new regulations may also place more stringent rules on captive system sizing thresholds for licencing exemption and on captive power PPAs. However, the energy institutional framework is well established.

Financing of clean captive installations in Kenya has proved to be the main barrier to the uptake of clean captive installations. Commercial bank financing is available, thanks in large part to the SUNREF green credit line programme through three commercial banks. However, bank financing is limited due to risk adversity of those banks and stringent terms from both SUNREF and the Central Bank of Kenya. This is the reason why private financiers have entered the market early to satisfy the growing demand for capital for clean technologies. Many captive power developers, ESCOs, EPC companies and equipment suppliers and installers are active in Kenya, some of which in the last five years have begun working with private financiers to provide dedicated solutions for captive power users. Most captive projects are implemented solely with capital from facility owners, but other business models such as financing, operating and financing leases and PPA arrangements are being offered and adopted in the market.

Overall, Kenya has an emerging clean captive power market with strong potential and an active ecosystem of actors, which may benefit from specific, well-designed interventions to help increase the scale-up.

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12/ ANNEX

12.1/ STAKEHOLDER MAPPING

12.1.1/ KEY STAKEHOLDERS FOR CAPTIVE SOLAR PV

With a focus on solar PV captive power, key stakeholders in Kenya include a number of government entities, banks and related institutions, industry associations, financiers/ESCOs, EPCs/ESCOs, equipment suppliers and current industrial captive renewable energy users.

- **Government entities**

Government entities of relevance include the Energy and Petroleum Regulatory Authority (EPRA), the Ministry of Energy and the Kenya Power and Lighting Company (KPLC). For anything to do with tax treatment and equipment importation, technical standards, and environmental approvals, the Kenya Revenue Authority (KRA), the Kenya Bureau of Standards (KEBS) and the National Environmental Management Authority (NEMA) are also important (see Table 28).

Table 28: Key government entities

NAME	RELEVANCE
Energy and Petroleum Regulatory Authority	Sector regulator, approves licences, tariffs and PPAs, oversees compliance with energy management laws.
Ministry of Energy	Sets energy sector direction and policy.
Kenya Power and Lighting Company Limited	Concerned about reduced demand, counterparty to any feed-in tariff, PPA or net metering arrangement, would absorb any spill-over.
Kenya Revenue Authority	Tax authority that applies levies on equipment imports and sales (including sales of electricity) and that adheres to decisions on investment incentives made by the Ministry of Finance (e.g., investment deduction allowance).
Kenya Bureau of Standards	Sets – in conjuction with the EPRA and other bodies – technical design and operational standards for systems and equipment.
National Environmental Management Authority	Regulatory body for environmental approvals that has discretion to decide if a captive project requires a full environmental impact assessment or only an environmental audit report.

Source: Author compilation

- **Commercial banks and related**

There are three key commercial banks for captive power in Kenya and 2-3 that are known to potentially be interested (see Table 29).

Table 29: Key commercial banks and related institutions

NAME	RELEVANCE
CFC Stanbic	Previously active under SUNREF.
Commercial Bank of Africa	Presumed to be the second most active bank.
Co-operative Bank	Most active bank. 10 operational renewable energy projects (mostly captive) and a portfolio of over US$100 million under the SUNREF programme.
Diamond Trust Bank	A more recent participant in the SUNREF programme. Might have a tendency to only finance existing customers, some of which will be manufacturers.
Equity Bank	Previously had some interest in captive power.
Kenya Commercial Bank	Previously had some interest in captive power.
SUNREF	Green credit line, technical assistance and capacity building has led to participating banks making US$70 million in deals for more than 37 projects across East Africa.

Source: Author compilation

- **Industry associations**

Industry associations of relevance include the Kenya Association of Manufacturers (KAM), Kenya Private Sector Alliance (KEPSA), Kenya Renewable Energy Association (KEREA) and Kenya Bankers Association. The associations are listed in Table 30.

Table 30: Key industry associations

NAME	RELEVANCE
Kenya Association of Manufacturers	Main industry association for manufacturers. Advocates for industry (e.g., cheaper power). Hosts both the Centre for Energy Efficiency and Conservation (CEEC) which supports energy audits in industry, and the SUNREF programme.
Kenya Bankers Association	The umbrella body of banking institutions in Kenya, with 47 members.
Kenya Private Sector Alliance	Main industry body for the private sector. Has various committees and working groups including on renewable energy and bankable PPAs.
Kenya Renewable Energy Association	Represents the renewable energy industry. However, currently focuses on household-scale solar and solar products.

Source: Author compilation

- **Financiers**

Financiers of relevance include Ariya Capital, Crossboundary Energy, Ecoligo, Faber Capital, Maris, responsAbility, SolarAfrica / NVI Energy, Solarise Africa and SunFunder (see Table 31).

Table 31: List of main captive PV financing / ESCO firms active in Kenya

NAME	LOCATION	OVERVIEW
Ariya Capital	Based in Kenya	Provides leasing finance and fund management, and invests in IPPs. On leasing side, has partnered with African Solar Designs.
Crossboundary Energy	Based in the United States, with head office in Kenya (and offices in other countries)	Part of the Crossboundary Group. US$8 million in equity raised for Crossboundary Energy Fund 1 in 2015. US$6 million debt facility with Overseas Private Investment Corporation since 2018. Has financed and manages 1.5 MW of captive PV in Kenya to date. Has a partnership with leading EPC Solarcentury. Also has operations in Ghana and Nigeria, with Nairobi acting as the main office.
Ecoligo	Based in Germany, with history in Kenya	Crowd-funded debt sourced in Euros for individual projects under leasing/PPA. Financed 700-plus kW in Kenya. Often works with Kenyan EPC Harmonic Systems.
Faber Capital	Based in Dubai, with presence in Kenya	Part of an international group of companies, including Premier Solar Solutions (Kenyan EPC), and can offer financing.
Maris	Based in Mauritius, office in Kenya	Diversified holding company. Co-owns Equator Energy (Kenyan/German EPC), which enables EPC to offer financing.
responsAbility	Based in Switzerland, large office in Kenya	Global development fund manager with more than US$3 billion of assets under management. Provides both equity and debt through various vehicles and has a renewable energy project development arm in Kenya. Has financed a captive power developer in Ghana but not in Kenya (yet). Captive power division is based in Zurich.
SolarAfrica / NVI Energy	Based in South Africa	Captive PV financing platform and partner of Crossboundary.
Solarise Africa	Based in Kenya	Private financier and ESCO. So far has financed up to around 3 MW of solar PV in Kenya: 1 MW in agro-businesses, 850 kW in large industrial clients and the remainder spread across other smaller industries. Solarise Africa offers turnkey solutions under three types of long-term flexible funding solutions: asset financing, operating lease (with ownership option) and PPA. Partner of Premier Solar Solutions (Kenyan EPC).
SunFunder	Based in the United States, with presence in Kenya	Provides exclusively debt. Established US$1.2 million working capital debt facility for Questworks (Kenya developer/EPC) in June 2018.

Source: Author compilation

- **Captive PV project developers, ESCOs and EPCs**

There are a number of captive PV power project developers, ESCOs and EPCs. Some companies provide both ESCO and EPC/O&M services for outright purchase, while others are focused purely on EPC (see Table 32).

Table 32: Key solar PV captive power developers, ESCOs and EPCs

NAME	RELEVANCE
African Solar Designs	Based in Kenya. EPC for smaller PV systems on opportunistic basis. Partner with Ariya Capital for Powering Agriculture PV assessments.
Astonfield Solar	Based in Kenya, offices in India and Oman. Developer and EPC. At least 3-plus MW installed, many in large industry but also many in schools.
Azimuth Power	Originally based in Kenya, now in the UK. Purchase, lease or PPA arrangements are possible, likely through partnership with Berkeley Energy. Captive 1.7 MW installed in Kenya.
Chloride Exide	Based in Kenya. Battery manufacturer but with sister company Chloride Solar also a PV panel importer and leading distributer and installer. Can build captive PV projects 20 kW-500 kW (e.g., for General Motors Kenya) for which it can provide financing. Partnership with Solinc, first PV product manufacturer in Kenya.
Crossboundary Energy	Apart from providing financing, Crossboundary also acts as a project developer and ESCO.
Equator Energy	Based in Kenya. Operations in other countries. Joint venture between Maris and Nvision Energy of Germany. Purchase, lease or PPA arrangement (discounted kWh versus grid purchase price). Financing provided through Maris. Captive 3.3-plus MW installed in Kenya.
Equatorial Energies	Based in Kenya. EPC and O&M. Captive 3.9-plus MW installed to date (most as sub-contractor to other companies Solarcentury and Astonfield).
Greenspark	Based in Kenya. Office in Netherlands. Mostly developer and EPC, also sells modules. Captive 900-plus kW installed in Kenya.
Harmonic Systems	Based in Kenya. Primarily EPC/O&M. Captive 1.5-plus MW installed in Kenya, with a focus on tourism and horticultural sectors although also manufacturing.
Imexolutions Ltd	Based in Kenya. EPC on captive PV projects (focus on information technology aspects).
Knights Energy	Based in Kenya. Sister of an information and communication technology company. EPC/O&M. Captive 600-plus kW installed in Kenya.
Ofgen	Based in Kenya. Spin-off of Strathmore University. Primarily EPC/O&M but can provide solar leasing (pioneered solar leasing in 2014). Captive 750-plus kW installed in Kenya.
Oloidel Engineering	Based in Kenya. EPC on captive PV projects.
PowerGen	Based in Kenya. Mini-grid business but does captive EPC on request.
Premier Solar Solutions	Based in Kenya. Part of a larger group of companies. Captive 1.6 MW installed and 5 MW signed. Financing can be provided by group member Faber Capital.
Questworks	Based in Kenya. Spin-off of Strathmore University. Primarily EPC. US$1.2 million debt facility from SunFunder. Captive 2.7-plus MW installed in Kenya.
Solar Works	Based in Kenya. Primarily EPC. Focuses on public tenders.
Solarcentury	Based in UK. Office in Kenya. Primarily EPC/O&M. Partner with Crossboundary for financing. Captive power 8.8-plus MW installed in Kenya including at manufacturing facilities.
Sustainable Power Solutions (SPS)	Based in South Africa. Office in Kenya. EPC/O&M but also provides equipment rental or joint venture options. Captive 1.1-plus MW in Kenya.
Technoelectric	Based in Kenya. EPC on captive PV projects.
Others	For example: Urbasolar (based in France), Bosman van Zaal (based in Netherlands, agriculture sector only), GoSolar Systems (mostly tenders), among other including EPCs not necessarily specialized in solar PV.

Source: Author compilation

- **Equipment suppliers and installers**

For many, especially larger captive PV systems, project-specific equipment is often purchased directly by developers, ESCOs and in some cases EPCs from original manufacturers and imported to reduce costs. However, for smaller projects, equipment might be bought directly from local suppliers, and small installation companies could act as sub-contractors to the larger EPC companies.

As of 2015, there were more than 50 importers and installers of solar PV equipment in Kenya licenced under the Energy (Solar Photovoltaic Systems) Regulations, 2012. Among these are some of the EPC companies listed earlier (e.g., Solarcentury, African Solar Designs, Azimuth Power, Harmonic Systems). According to one stakeholder interview, there are more than 300 EPCs and installation companies in Kenya[36].

Most major global PV module, inverter, battery and other equipment component brands either are represented in Kenya or have their equipment being used in projects in Kenya.

Examples of PV and related equipment and genset suppliers and installers are listed in Table 33.

Table 33: PV and related equipment and genset suppliers and installers in Kenya

PV MODULES, INVERTERS, BATTERIES, CONTROL EQUIPMENT, ETC.	DIESEL AND GAS GENERATOR SUPPLIERS
East Africa Solar Group	Ferguson Power East Africa Ltd
Davis and Shirtliff (focused on PV pumping)	F.G. Wilson Generators
Windgen Power East Africa	Generators Kenya Ltd
Winafrique Technologies	Gaston Kenya Ltd
Riwik East Africa	Blackwood Hodge
PowerPoint Systems	Rift Valley Machinery Services Ltd
Sollatek	Hyperteck Electrical Services Ltd
Power Technics (Schneider Electric)	Famiar Generating Systems Ltd
Linksoft Communications	Aksa Power Generation
Center for Alternative Technologies	PowerPoint Systems
Kenelec Supplies	Gilfield

Source: Author compilation

36 *Private financier stakeholder interview, September 2019.*

12.1.2/ GENDER BALANCE IN THE CLEAN CAPTIVE POWER SECTOR

Online research on captive PV and clean captive power industry actors revealed indicative information on male and female representation in senior management and staff roles, as presented in Table 34.

Table 34: Estimated number of male and female employees in selected captive power entities

ORGANIZATION	SENIOR MANAGEMENT		STAFF	
	Male	Female	Male	Female
Ariya Capital	6	2	-	-
Astonfield Solar	6	1	7	6
Berkeley Energy	17	5	-	-
Burn Manufacturing	8	3	6	3
Co-operative Bank	33	3	-	-
Commercial Bank of Africa	9	0	-	-
Crossboundary Energy	4	0	6	3
Diamond Trust Bank	16	8	-	-
Ecoligo	3	2	-	-
Equator Energy	1	1	-	-
Faber Capital	6	0	-	-
Harmonic systems	2	0	3	0
KAM	19	8	-	-
Ofgen	3	0	1	1
Premier Solar Solutions	5	0	2	2
Questworks	4	0	33	20
responsAbility	22	5	-	-
solarAfrica	9	4	3	3
Solarcentury	13	3	-	-
Solarise Africa	3	0	-	-
SunFunder	3	3	12	8

Source: Author compilation

12.2/ ELECTRICITY LICENCING REQUIREMENTS AND FEES

In line with the Energy (Electricity Licensing) Regulations, 2012, the following information must be submitted by an applicant for an electricity permit or licence.

- **Information for all applications:**
  - Application form with company details, including registration documentation and shareholding, type of licence requested and start date of activity.
  - Applicant financial information, including 2-3 years of audited accounts, most recent management financial statem ents, financial projections, sources of finance and capital.
  - Proposed business/project financial information, including demonstration of financial security and feasibility, annual forecasts of sales and revenue for five years, estimated capital outflows including decommissioning costs.
  - Statement of expertise of the firm and any sub-contractors and a report for a competent engineer on the proposed undertaking.
  - Environmental approval, in the form of an environmental impact assessment licence or an environmental audit report where a full environmental impact assessment is not required. A preliminary report may instead be submitted at the time of application, but the electricity licence will not be approved until environmental approval is confirmed.

- **Information specific to a generation licence:**
  - Details on the generation plant, including location, technology/fuel source, commissioning date, gross and net generation capacity, efficiency, expected lifetime, five-year electricity generation forecast.
  - Details of energy provision, including the off-taker(s) and associated infrastructure.
  - Statement on land acquisition, in the case of any compulsory acquisition by the applicant.

- **Information specific to a generation, distribution and/or supply licence:**
  - Generation licence requirements as above.
  - Details on supply network, including location, use of any distribution system for conveyance of electricity, layout of electrical lines, supplied premises (with an accompanying map if needed).
  - Details on customer(s), including for any customers in the next five years their details, the arrangements for distribution and supply, the point(s) of connection, forecast maximum demand and consumption, details of voltage level(s), type(s) and frequency(ies).
  - Statement on safety of operations of the distribution and/or supply network.
  - Statement on compliance with (a) measures to address illegal electricity supply (e.g., theft by customers), (b) the Kenyan grid code and (c) ensuring continuity of supply.

Current electricity licencing fees are presented in Table 35.

Table 35: Current electricity licencing fees (Kenyan shillings)

SYSTEM SIZE (KW)	1 000 OR LESS	1 001 – 3 000	3 001+
Licence type (own use only)	Not required	Permit*	Licence
Application fee	n/a	0	10 000
Generation only – upfront fee	0	10 000 per MW	10 000 per MW
Generation only – annual fee	0	5 000 per MW	5 000 per MW
Distribution and/or supply – upfront fee	0	1 000 per GWh supply projected	1 000 per GWh supply projected
Distribution and/or supply – annual fee	0	1 000 per GWh actually supplied	1 000 per GWh actually supplied
Generation, distribution and supply – upfront fee	0	20 000 per MW	20 000 per MW
Generation, distribution and supply – annual fee	0	10 000 per MW	10 000 per MW
Supply only – upfront fee	0	1 000 per GWh supply projected	1 000 per GWh supply projected
Supply only – annual fee	0	500 per GWh actually supplied	500 per GWh actually supplied

** Electricity permits do not seem to exist under the Energy Act of 2019 and are thus likely to no longer be available.*

Source: GoK 2012a

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CLEAN CAPTIVE INSTALLATIONS FOR INDUSTRIAL CLIENTS IN SUB-SAHARA AFRICA

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