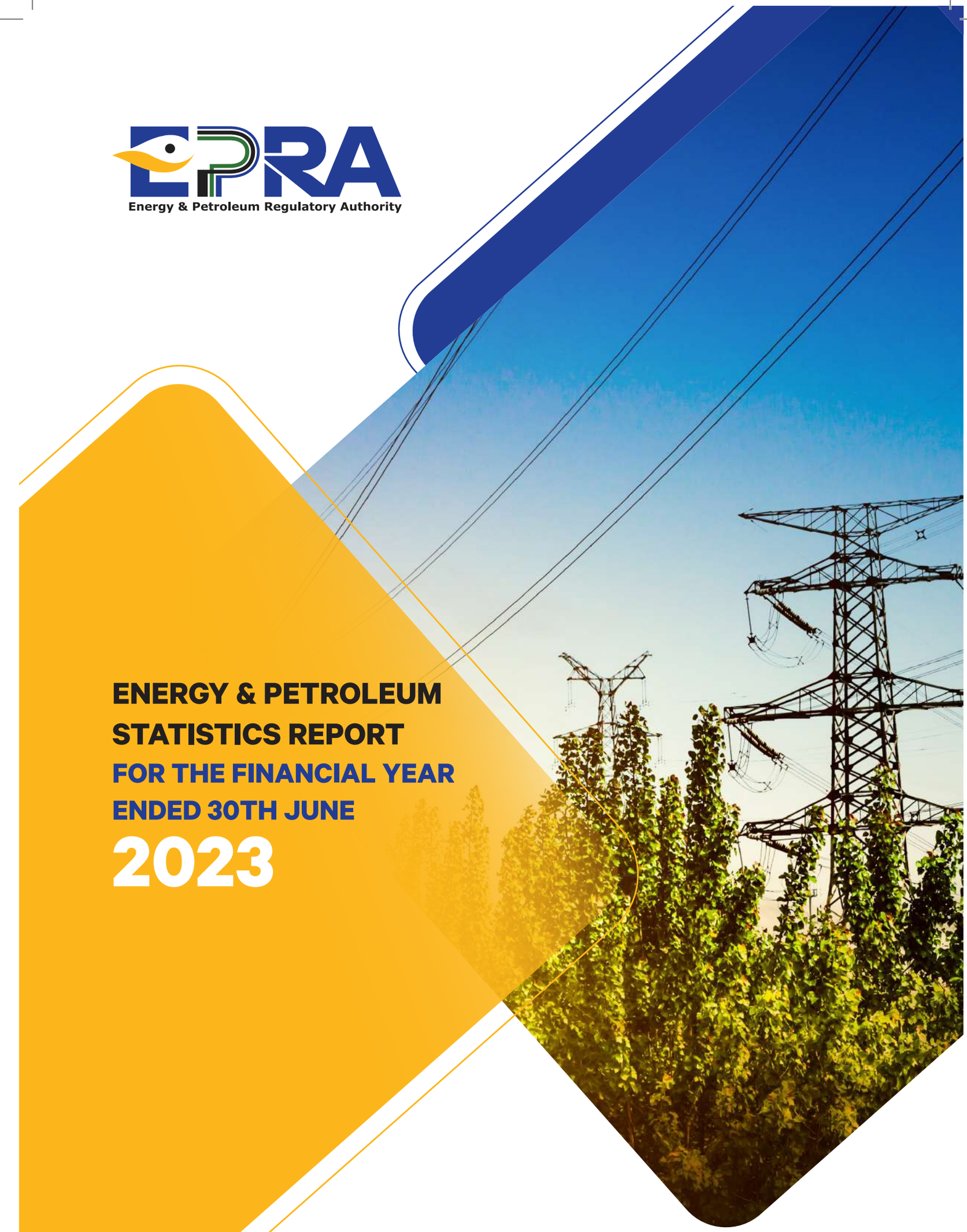
Energy & Petroleum Regulatory Authority



ENERGY & PETROLEUM STATISTICS REPORT

FOR THE FINANCIAL YEAR ENDED 30TH JUNE

2023

About EPRA

The Energy and Petroleum Regulatory Authority (EPRA) is established under the Energy Act, 2019 as the regulatory agency responsible for economic and technical regulation of the electricity, renewable energy, petroleum and coal.

Our Mission

Enhancing lives by ensuring there is sustainable, cost efficient and quality energy and petroleum.

Our Vision

A leading regulator driving sustainable and clean energy and petroleum for all.

Our Rallying Call

Quality Energy, Quality Life.

Our Core Values

- **Professionalism**
- **Integrity**
- **Responsiveness**
- **Mutual Respect**
- **Teamwork**

About this report

This report presents key statistics on the performance of the electricity, petroleum and renewable energy subsectors during the financial year 2022/2023. Statistics on the electricity sector include generation, transmission, distribution, retail and cross border trade. Statistics on the petroleum sector include upstream development, midstream and downstream operations and infrastructural developments. Additionally, the report presents the future outlook of the energy and petroleum sectors.

For further information or to provide feedback, please contact EPRA through info@epra.go.ke.

Contents

Abbreviations and Acronyms

AGO	Automotive Gas Oil
DWT	Dead Weight Tonnage
EEU	Ethiopian Electric Utility
EPRA	Energy and Petroleum Regulatory Authority
EREA	Energy Regulators Association of East Africa
ERI	Electricity Regulatory Index
FEC	Fuel Energy Cost
FERFA	Foreign Exchange Rate Fluctuation Adjustment
FDP	Field Development Plan
GDP	Gross Domestic Product
GoK	Government of Kenya
GVA	Gross Value Added
GWh	Giga-Watt hour
HHI	Herfindahl Hirschman Index
IPP	Independent Power Producer
LMCP	Last Mile Connectivity Program
LPG	Liquefied Petroleum Gas
LTWP	Lake Turkana Wind Power
MVA	Mega-Volt Ampere
MWh	Mega-Watt hour
NDC	Nationally Determined Contributions
NOCK	National Oil Corporation of Kenya
NSC	Network Service Contract
OTS	Open Tender System
OMCs	Oil Marketing Companies
KETRACO	Kenya Electricity Transmission Company
KNBS	Kenya National Bureau of Statistics
KPC	Kenya Pipeline Company
KRA	Kenya Revenue Authority
PMS	Premium Motor Spirit
PPA	Power Purchase Agreement
RGI	Regulatory Governance Index
RSI	Regulatory Substance Index
ROI	Regulatory Outcome Index
WHRC	Waste Heat Recovery Cycle

A Message from the Director General

I am pleased to present the Energy and Petroleum Statistics Report for the financial year 2022/2023. The primary objective of this report, consistently produced by the Authority, is to provide valuable insights for informed decision-making.

The past year has been marked by significant developments, which you will discover as you peruse this report.

Kenya has remained steadfast in its pursuit of renewable energy sources, evident in the remarkable achievements of the year. Geothermal energy production, for instance, surged by 21.84%, while energy generation from interconnected solar PV systems saw a substantial 41.84% increase. Furthermore, wind energy contributed 7.28% more compared to the previous financial year. The trajectory towards renewable energy is expected to persist as more power flows into the grid from geothermal sources.

In April 2023, the government introduced the Government-to-Government (G2G) framework for petroleum product imports, a response to the mounting pressure on our foreign exchange reserves and the rapid depreciation of the Kenyan shilling against the US dollar. Under this framework, direct negotiations were initiated with NOCs; Aramco Trading, Emirates National Oil Company, and Abu Dhabi National Oil Company for the supply of petroleum products over the ensuing nine months. Notably, the negotiated credit terms extended to six months, allowing the government a more flexible timeline to meet its obligations. This arrangement also permitted local OMCs to transact in Kenyan shillings, converting to dollars at the maturity of the Letter of Credit. These extended credit terms are anticipated to alleviate pressure on our reserves and slow the depreciation of the Kenyan shilling.

In December 2022, operations at the Kisumu Oil Jetty (KOJ) commenced, marking a significant milestone. The inaugural export, comprising 1,178 cubic meters, departed from Kisumu port on 27th December 2022, and reached its destination on 29th December 2022, with a voyage duration of approximately 16 hours. The adoption of barges for transporting petroleum products over waterways promises enhanced safety and cost-effectiveness compared to road transport. This shift is poised to invigorate the transit market.

During this period, the Authority successfully gazetted two key petroleum regulations: the Petroleum (Pricing) Regulations, 2022, and the Petroleum (Importation) Regulations, 2023. These regulations were designed to align with the recommendations of the Cost of Service Study in the Supply of Petroleum Products (COSSOP), the Petroleum Act 2019, and to accommodate the aspect of petroleum product importation through Government-to-Government arrangements.

Furthermore, the Authority granted approval for the Retail Electricity Tariff for the fourth Tariff Control Period spanning from 2022/23 to 2025/26, effective from April 1, 2023. Significant revisions were introduced to this tariff, with a focus on better serving customers, particularly those with lower incomes. One noteworthy addition was the introduction of a special e-mobility tariff, aimed at incentivizing the growth of e-mobility as Kenya strives for sustainable transport solutions.

Throughout this review period, in a bid to enhance fuel quality in Kenya, the Authority conducted 21,190 sample tests at 4,445 petroleum outlets across the nation. Encouragingly, a significant 98.76% (4,390) of the stations were found to be fully compliant with established regulations.

I am confident that this report will offer valuable insights into the performance of our nation's energy and petroleum sectors, as well as regional developments. I extend my heartfelt appreciation to the dedicated staff of the Authority whose tireless efforts contribute to the fulfillment of our mission, and I express gratitude to our valued stakeholders, whose collaboration has played an indispensable role in our achievements.

Daniel Kiptoo Bargoria, OGW
Director General

The Year at a Glance

13,289.63

GWh electricity generated

2,149MW

Peak demand

21.84%

increase in geothermal energy generation

41.84%

Increase in energy generated from interconnected solar PV systems

84.65%

Share of renewable energy contribution to the energy mix

The Suswa-Isinya line that had previously been operated at 220kv was energized at 400kV in February 2023.

1. Olkaria 1 power plant, the pioneer geothermal plant built in 1981, was shut down in February 2023 to pave way for rehabilitation and capacity enhancement works. The plant's output is expected to increase from the current 43MW to 63MW.

2. In April 2023, the government introduced the Government-to-Government (G2G) framework for the importation of petroleum products. This move was primarily driven by mounting pressure on the country's foreign exchange reserves and the rapid depreciation of the Kenyan shilling against the US dollar. As a result, a total of 1,945,054.91 cubic meters of petroleum products have been imported under this G2G framework.

3. The Authority granted approval for the Retail Electricity Tariff for the fourth Tariff Control Period spanning from 2022/23 to 2025/26, effective from April 1, 2023.

CHAPTER
1

Introduction

In the year 2022, there was marked economic growth in Kenya with the real Gross Domestic Product (GDP) expanding by 4.8%. This was however a reduction from the 2021 performance of 7.6%. The nominal GDP increased from KSh. 12,027.7 billion in 2021 to KSh. 13,368.3 billion in 2022. This acceleration is attributed to the stabilization of most economic sectors after posting high growths in 2021 driven by recovery from the effects of the Covid-19 pandemic. The economy was characterized by high inflationary pressure that closed at 7.9% in June 2023. Despite the inflationary pressure on the economy, the GDP per capita at current prices increased from KSh. 237,861 in 2021 to KSh. 260,024 in 2022.

For the electricity supply sector, the real Gross Value Added (GVA) grew by 4.9% in 2022 compared to 5.3% in 2021. The growth was mostly attributed to the increase in total electricity generated from 12,126.7 GWh in 2021 to 12,669.4 GWh in 2022. Despite the increased prices in the energy sector and high inflationary pressure, electricity consumption increased from 12,652.74 GWh in the previous review period to 13,289.63 GWh and a peak demand of 2,149MW. Figure 1.0 below illustrates the trend of GDP growth rate and electricity demand.

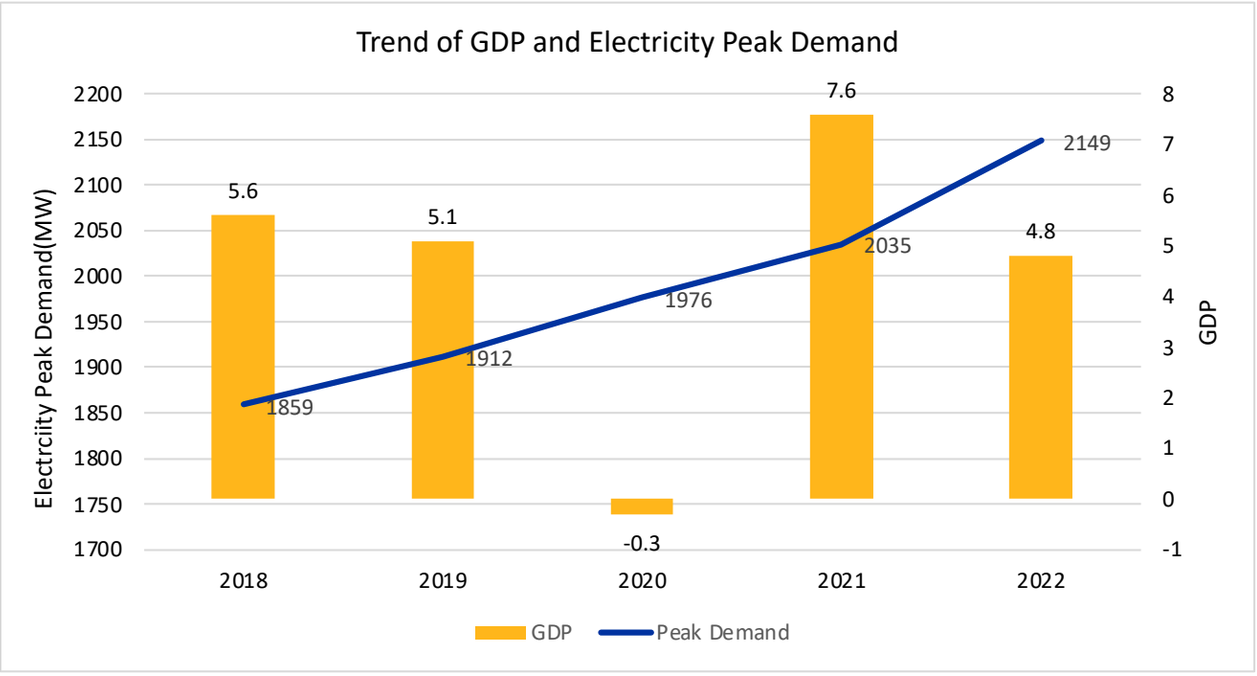


Figure 1.0: Trend of GDP and Electricity Peak Demand from 2018 – 2022

Source: KNBS

In the petroleum Sector, there was a reduction in domestic petroleum consumption by 2.83% to 5,576,147.01 m3 compared to the previous financial year. The reduction in petroleum demand is attributed to the global increase in the prices of petroleum products and the shift towards cleaner fuels.

Kenya, being a signatory to the Paris Agreement, has made several ambitious commitments towards achieving sustainable energy for all. These include Nationally Determined Contributions (NDCs), commitment to achieve universal energy access by 2026, and 100% access to clean cooking by 2028. Kenya is on the cusp of achieving 100% renewable energy electricity generation which currently stands at 77.61% of the installed capacity. In view of transitioning to cleaner fuels, there are efforts to adopt electric mobility in the country. This streams from the government's goal of achieving 5% electric vehicle registration by 2025. To that end, various policy and regulatory initiatives have been implemented to spur the uptake of e-mobility in Kenya. In line with promoting e-mobility the government, as part of the Bottom-Up Economic Transformation Agenda, has also committed to developing charging infrastructure in urban areas, providing fiscal incentives and leveraging financial support.

CHAPTER 2

Electricity

This section provides an overview of the performance across different aspects of the electricity supply chain, encompassing electricity generation, transmission, distribution, and retail. It delves into areas such as electricity supply and demand dynamics, retail tariffs, competition analysis, reliability metrics, and greenhouse gas emissions. Additionally, it offers insights into the performance of the East African Community (EAC) region in these aspects.

2.1 Electricity Supply and Demand

2.1.1 Installed Capacity

Installed capacity refers to the combined maximum power generation capacity of a country's power plants. Table 2.1 shows the country's total installed capacity as at June 2023, which comprises grid connected, captive and off grid generation units.

Technology	Interconnected Capacity (MW)		Captive Capacity (MW)	Total Installed Capacity (MW)	% Total Installed (MW)
	Installed	Effective			
Hydro	838.5	809.6	33.0	871.5	24.80%
Geothermal	940.0	861.1	3.7	943.7	26.86%
Thermal	681.9	645.4	21.3	703.2	20.02%
Wind	436.1	425.5	-	436.1	12.41%
Solar	212.6	212.2	154.9	367.5	10.46%
Bioenergy	2.0	2.0	105.9	107.9	3.07%
Imports	200.0	200.0	-	200.0	
WHRC	-	-	83.5	83.5	2.38%
Total	**3,311.1**	**3,155.8**	**402.3**	**3,713.4**	**100.00%**

Table 2.1: Installed, Effective and Captive Power Capacity as at 30th June 2023

In the financial year ended 30th June 2023, the installed grid connected capacity increased by 275MW to stand at 3,311.1MW representing an increase of 7.46%. This is attributed to the commissioning of the 35MW Sossian Geothermal power plant in Menengai, the 40MW Alten Solar Photovoltaic plant in Kesses and the importation of 200MW from Ethiopia via the Kenya-Ethiopia High Voltage Direct Current (HVDC) transmission line.

Geothermal and hydro accounted for 51.66% of the total installed capacity, while the share of solar and wind generation increased to 22.87%.

At 310MW, Lake Turkana Wind Power (LTWP) plant is the largest single power plant in the country. The 225MW Gitaru hydro-electric plant and the 220MW Olkaria 1AU Geothermal plant are the largest hydro and geothermal plants respectively. Garissa Solar Plant is the largest solar power plant in the country at 50MW.

Captive generation (own use generation) increased to 402.3MW on the backdrop of growing interest in own use generation by commercial and industrial consumers. This accounts for 10.83% of total installed capacity. Solar photovoltaic generation was the most preferred mode of captive generation accounting for 38.5% of the total installed captive capacity. Bioenergy (biomass, bagasse and biogas) and waste heat recovery generation followed representing 26.3% and 20.7% respectively. The 55 MW Devki Steel Mills waste heat recovery plant in Kwale County is the largest captive generation plant.

2.1.2 Electrical Energy Generated

Electrical energy generated refers to energy that was delivered to the national grid by the various power producers in the country.

The total electrical energy generated grew by 5.03% from 12,652.74GWh in the 2021/2022 financial year to 13,289.63GWh in the review period. Geothermal energy generated increased by 21.84 % from 4,953.15 GWh to 6,035.00 GWh. The increase is attributed to additional geothermal capacity from Olkaria 1 Unit 6 and the Sossian Geothermal plants. The decrease in hydro generation was compensated by energy imports from the Ethiopia- Kenya

HVDC link, wind and solar resources. Electricity imports increased by 90.83% while wind and solar generation increased by 7.28% and 41.84 % respectively. The increase in solar generation is attributed to the additional capacity from Alten Solar Plant in Kesses. The generation from thermal plants decreased by 15.31 % following increased energy imports and the lapse of power purchase agreement for Muhoroni Gas Turbine Power Plant. A comparison of energy generated between the financial year 2021/2022 and the financial year 2022/2023 is provided in Table 2.2.

Technology	2021/2022	2022/2023	% Change
Hydro	3,348.71	2,569.18	-23.28%
Thermal	1,647.75	1,395.49	-15.31%
Wind	2,052.26	2,201.72	7.28%
Geothermal	4,953.15	6,035.00	21.84%
Bagasse/Biogas	0.38	0.21	-44.83%
Imports	337.50	644.07	90.83%
Solar	312.99	443.95	41.84%
Total	**12,652.74**	**13,289.63**	**5.03%**

Table 2.2: A comparison of energy generated between the financial year 2021/2022 and 2022/2023

The annual energy generated in Kenya has been increasing by approximately 5% year on year since 2017 with the exception of the 2019/2020 financial year when the energy generated declined by 0.25% due to COVID-19 pandemic. The increase in generation correlates with the growth in Kenya's economy.

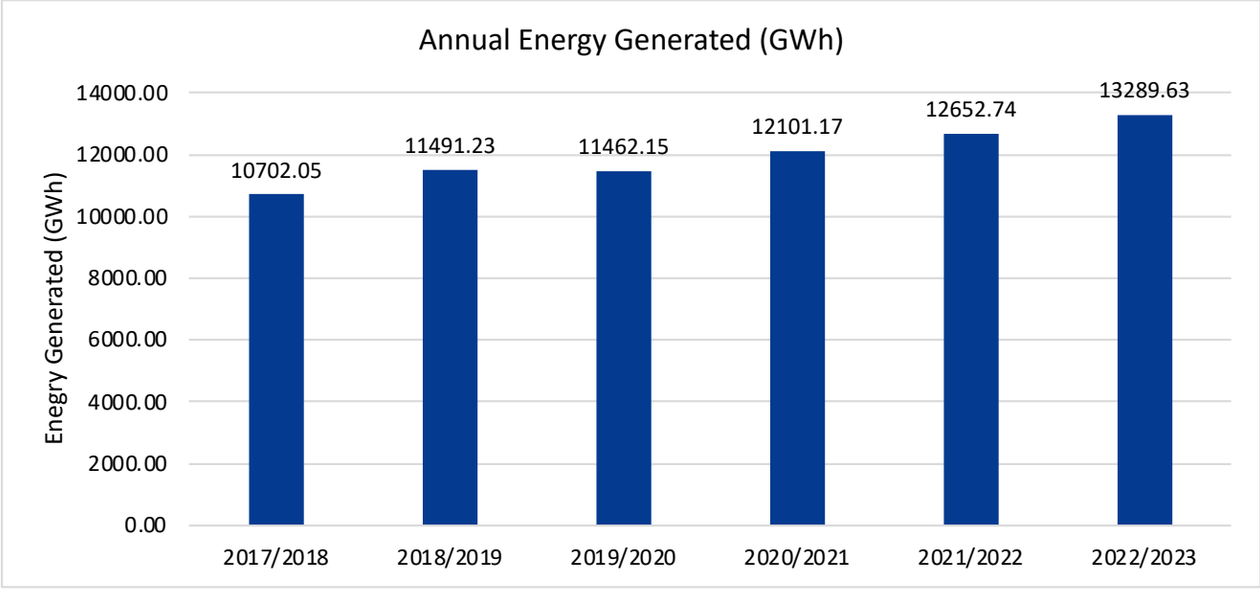


Figure 2.1: A trend of energy generated between the financial year 2017/2018 and 2022/2023

2.1.3 Electricity Monthly Peak Demand

Peak demand is a measure of the highest load demand in the interconnected network for a specified period. It occurs between 2000hrs and 2030hrs in the Coastal region and 1930hrs and 2000hrs for the rest of the country. The peak demand for the year under review was 2,149 MW which was recorded on 14th December 2022. In comparison, the peak demand for the previous financial year was 2,056.67 MW indicating a 4.5%. growth.

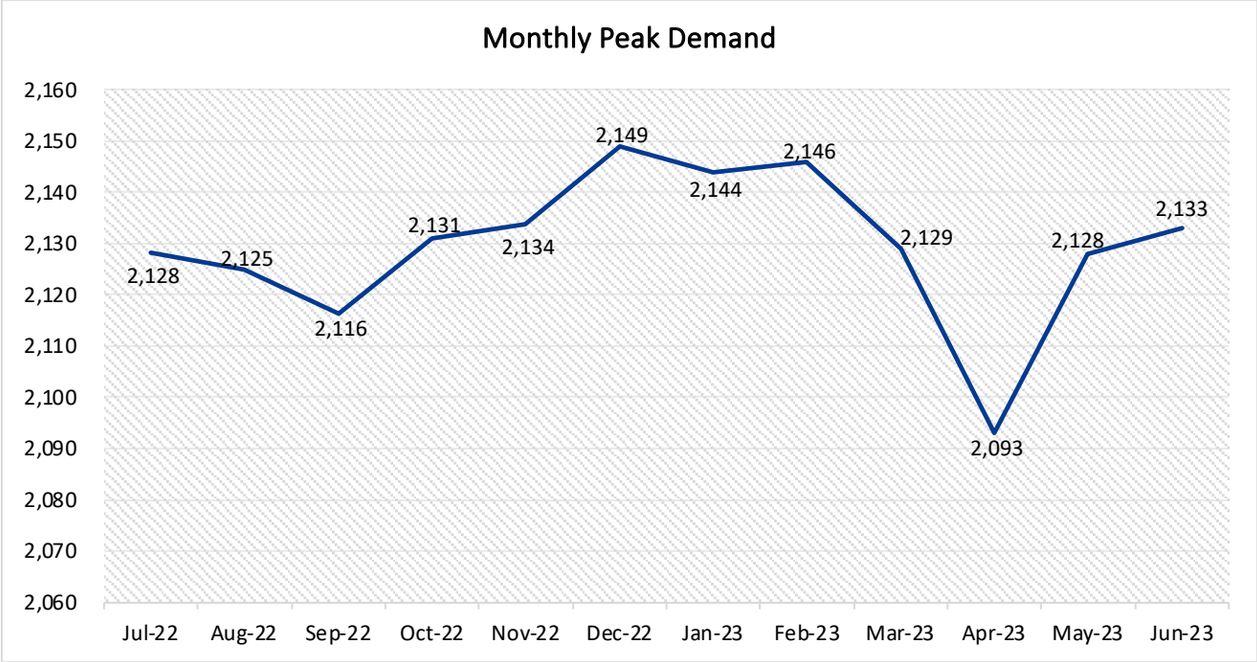


Figure 2.2: Trend in the peak demand between July 2022 and June 2023

The peak demand has registered a consistent year on year growth since 2010. The increase in peak demand has a positive correlation with growth in GDP. Other contributing factors include increased connectivity where previously underserved areas were brought into the national grid. Garissa and Lamu, for instance, were previously served with off-grid thermal generators but were connected to the national grid during this period. Figure 2.3 shows the progression of peak demand since 2010.

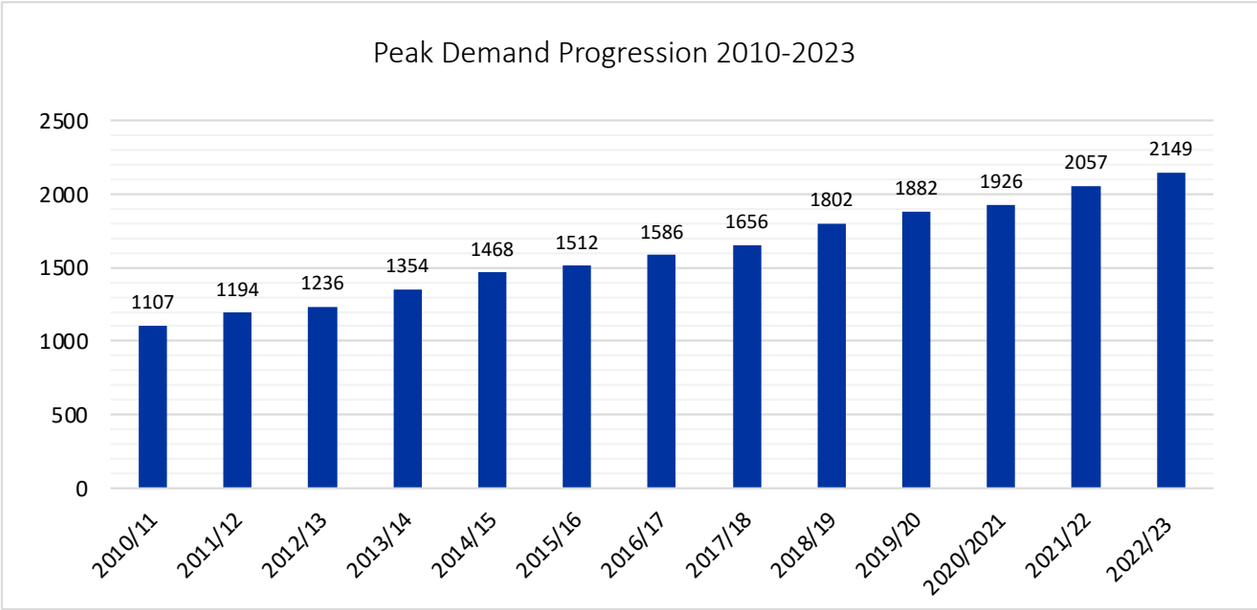


Figure 2.3: Trend in the peak demand between 2010 and 2023

2.1.4 Energy Curtailment

Energy curtailment refers to the reduction of power generation when demand falls below generation. This is done to maintain system frequency and manage voltage profile and line loading. It is done between 0000hrs and 0430hrs when demand is at its lowest. This affects geothermal power plants that are ideally run as base load plants and wind power plants whose output depends on available wind speeds.

Month	Geothermal (MWh)	Wind (MWh)	Total (MWh)
Jul-22	51,252	0	51,252
Aug-22	62,169	1,414	63,583
Sep-22	56,520	0	56,520
Oct-22	56,525	2,030	58,555
Nov-22	336	44,868	45,204
Dec-22	3,715	36,444	40,159
Jan-23	31,911	0	31,911
Feb-23	26,357	0	26,357
Mar-23	25,529	0	25,529
Apr-23	37,967	0	37,967
May-23	30,900	0	30,900
Jun-23	27,500	0	27,500
Total	**410,681**	**84,756**	**495,437**

Table 2.3: A summary of energy curtailment per month

A total of 495.4GWh of electrical energy was curtailed during the year; 82.8% being geothermal energy while 17.8% was wind energy. While geothermal curtailment was done every month, wind energy curtailment occurred mostly in November and December when the wind power plants attained their Deemed Generated Energy (DGE) thresholds.

In the first half of the year 315.3 GWh (63.6%) was curtailed compared to 180.16 GWh (36.4%) in the second half of the year. This reduction was due to the expiry of the 45MW Olkaria 1 power plant in February 2023.

Also contributing to this, was the commencement of operations of the Suswa-Isinya 400kV transmission line and commissioning of the Isinya-Athi River-Embakasi 220kV transmission line in February 2023. This reduced overloading of the Suswa-Nairobi North 220kV line and improved power evacuation from Olkaria complex hence reduced curtailment.

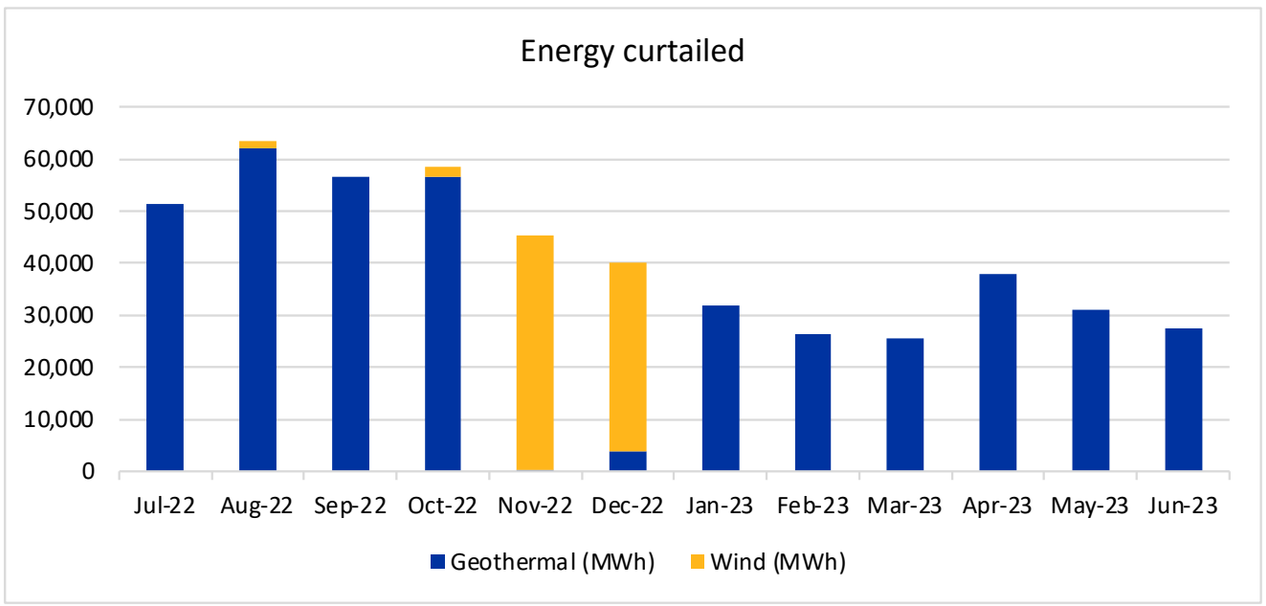


Figure 2.4: Energy curtailment per month

2.1.5 Electricity Reliability Indices

Reliability indices are metrics that measure the reliability of a power system. They give a measure of how often power supply is interrupted and for how long the interruption lasts. These indices comprise:

Customer Average Interruption Duration Index (CAIDI)

This index measures the average outage duration in hours that interrupted customers in a power system experience and is calculated as;

$$CAIDI = \frac{\text{Sum of customer interruption durations per reporting period}}{\text{Total number of customers interrupted per reporting period}}$$

CAIDI describes the average time required to restore service. It only includes customers who actually experienced an interruption in its calculation.

The System Average Interruption Duration Index (SAIDI)

SAIDI is the average outage duration in hours for each customer served. It describes how long, on average, each customer was without power in the reporting period. SAIDI is calculated as;

$$SAIDI = \frac{\text{Sum of all customer interruptions}}{\text{Total number of customers served per reporting period}}$$

The System Average Interruption Frequency Index (SAIFI)

Is the average number of interruptions that any given customer experiences, and is calculated as:

$$SAIFI = \frac{\text{Total number of customers interrupted per reporting period}}{\text{Total number of customers served per reporting period}}$$

	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22	Dec-22
CAIDI (Hrs)	2.29	2.18	2.32	1.96	2.36	2.36
SAIDI (Hrs)	6.9	6.07	6.68	6.76	10.63	8.5
SAIFI	3.05	2.78	2.88	3.45	4.51	3.61
	Jan-23	**Feb-23**	**Mar-23**	**Apr-23**	**May-23**	**Jun-23**
CAIDI (Hrs)	2.14	1.54	2.78	2.26	2.55	2.3
SAIDI (Hrs)	7.65	8.47	12.75	9.97	9.88	6.22
SAIFI	3.58	5.51	4.59	4.41	3.87	2.71

Figure 2.5: Trend in the reliability indices in the period ended 30th June 2023

The Customer Average Interruption Duration Index (CAIDI) for the period under review averaged 2.25hrs per month. The longest outage was 2.7hrs per customer and was recorded in March 2023 while the shortest outages per customer was recorded the preceding month at 1.54hrs. On average customers lacked power for 8.37 hrs per month. This index was highest in November 2022 (10.63hrs) and March 2023 (12.75) due to system disturbances that resulted in national blackouts.

On average, customers experienced an average of 3.75 outages per month during the year under review. Just like SAIDI, SAIFI was highest in the months of November 2022 and March 2023 due to the system-wide blackouts that were experienced in those months.

2.2 Electricity Pricing

Electricity prices are set with the aim of attaining sufficient revenue to meet generation, transmission and distributions requirements. The pricing system is reflective of the cost of power generation, pass through charges, system losses, taxes and levies.

2.2.1 Power Purchase Agreements (PPAs)

Power Purchase Agreements (PPAs) are contractual agreements between electricity producers and the off taker that establish the terms, conditions, and pricing for the sale of electricity.

During the period under review, the Authority approved a PPA between Kenya Power and Ethiopia Electric Power (EEP) for 200 MW.

The Authority also approved the Energy Exchange Agreement between UETCL and KPLC. The energy exchange will enhance grid stability and reliability by allowing surplus electricity from one country to be supplied to the other experiencing high demand or facing generation shortages. This will mitigate blackouts and enhance the overall resilience of the power system.

2.2.2 Base Electricity Tariff

The retail tariffs between July 2022 and March 2023 were based on the 2018 schedule of tariffs with a 15% subsidy on end-user tariffs pursuant to the Presidential Directive of December 2021.

Customer/Code Name	Energy Limit kWh/month	Tariff(15%Reduction)
Domestic	0-100	7.7
	>100	12.6
Small Commercial	0-100	7.7
	>100	12.4
Commercial/Industrial	>15000	8.7
		800
Commercial/Industrial	No Limit	8.1
		520
Commercial/Industrial	No Limit	8
		270
Commercial/Industrial	No Limit	7.8
		220
Commercial/Industrial	No Limit	7.6
		220
Street Lighting	No Limit	5.5

Table 2.4: Electricity Tariffs Applicable between January 2022-March 2023

During the review period, the Authority granted approval for the Retail Electricity Tariff for the fourth Tariff Control Period spanning from 2022/23 to 2025/26, with an effective date of 1st April 2023.

One of the key modifications under the new tariff was the reduction of the Lifeline Band from 100 kWh to 30 kWh. This adjustment was implemented to provide relief to low-income customers, particularly those with low incomes, contituting approximately 71.31% of the total customer count. This customer category is being cross-subsidized by other customer groups, ensuring equitable access to affordable electricity.

Additionally, the tariff restructuring introduced the Domestic Customer Category 2, catering to consumers using between 31 kWh to 100 kWh of electricity. This adjustment was made to encourage electric and clean cooking practices, aligning with Kenya's commitment to climate change mitigation efforts.

To further incentivize the adoption of electric transportation, the Authority introduced a special tariff for E-mobility, providing a cost-effective option for electric vehicle users.

In pursuit of a more flexible and decentralized approach to delivering electricity services, the Authority approved a bulk tariff scheme. This initiative allows large consumers to purchase power in bulk from Kenya Power and distribute it to their customers. This approach promises to revolutionize the electricity service model.

Moreover, the Authority extended the Time of Use tariff to include small commercial customer categories, expanding eligibility beyond commercial industrial customers. This innovative tariff offers eligible customer categories a 50% discount on the energy charge rate, encouraging them to shift their electricity usage away from peak hours. This shift will contribute to a smoother demand curve, promoting stable grid operations and potentially reducing the need for costly peaking power plants, ultimately enhancing overall grid reliability.

A comprehensive overview of customer categories and their respective charges is provided in table 2.5.

Customer category	Voltage at connection	Energy Limit (kWh/month)	Base Tariff (Kshs)	Demand Charge (Kshs)
Domestic	240 Volts/415 Volts	0-30	12.12	0
		30-100	16.30	0
		100-1500	20.97	0
Small Commercial	240 Volts/415 Volts	<30	12.22	0
		30-100	16.40	0
		100-1500	20.18	0
Electric Mobility	240 Volts/415 Volts	<30	16.00	0
Commercial/ Industrial	415 Volts	>15000	14.70	11,000
	11,000 Volts	No Limit	13.24	700
	33,000 Volts	No Limit	12.66	370
	66,000 Volts	No Limit	12.40	300
	132,000 Volts	No Limit	12.12	300
	220,000 Volts	No Limit	10.00	200
	(SEZ)	No Limit	10.00	200
Street Lighting	240 Volts/415 Volts	No Limit	9.22	0

Table 2.5: Approved electricity retail tariff effective April 2023

2.2.3 Pass Through Charges

In addition to the base tariffs outlined in the previous section, the Authority also authorizes monthly pass-through costs that are transferred to consumers by utility providers in response to fluctuations in specific cost components. These pass-through costs account for variations in the Fuel Energy Charge (FEC), Foreign Exchange Rate Fluctuation Adjustments (FERFA), inflation adjustments, and the contributions to the Water Resources Authority (WRA).

The FEC underwent notable changes during the period under review. In July 2022, it stood at 4.63 Ksh/kWh, but by March 2023, it had risen significantly to 8.30 Ksh/kWh, with March marking the peak FEC. Subsequently, in April 2023, the FEC saw a substantial drop to 3.90 Ksh/kWh. The surge in FEC prior to the tariff review was attributed to additional capacity costs incurred by new plants that had come online after the 2018 tariff review. These costs were incorporated into the Fuel Cost Charge to ensure financial sustainability for the utility until the tariff review could address these requirements. This approach was taken to maintain the financial integrity of the utility and sustain the power sector.

FERFA exhibited fluctuations throughout the review period, with June registering the highest value at +2.1629 Ksh/kWh. These fluctuations were primarily linked to changes in the local currency's exchange rate during the period.

The inflation rate saw an upward trajectory, rising from +0.47 Ksh/kWh in July 2022 to +0.85 Ksh/kWh in June 2023. Typically, inflation adjustments are made every six months to account for changes in inflation rates.

The WRMA levy remained relatively stable, oscillating between approximately 0.0067 Ksh/kWh to 0.0174 Ksh/kWh. Figure 2.6 illustrates the trend in pass-through costs over the course of the year.

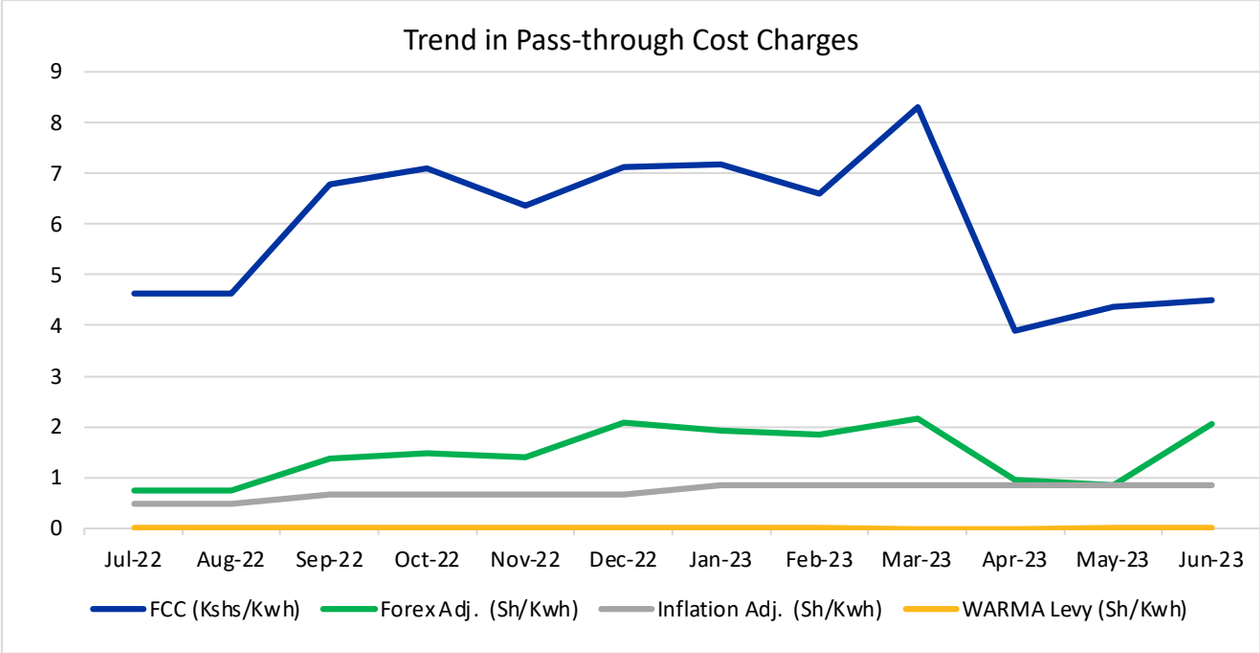


Figure 2.6: Trend in pass-through costs from July 2022 to June 2023

2.2.4 Evolution of the Overall Electricity Tariff

After the implementation of the new tariff structure in April, there was a decrease in the overall tariff for Domestic Lifeline customers, Small Commercial 1 & 2, Commercial Industrial 3 & 4, and street lighting. However, for certain customer categories, there was a slight increase in the overall tariff.

The tariff review also entailed a minor increase in the base tariff to accommodate the rebasing of the 2018/2019 yield. This adjustment was necessary to incorporate the revenue requirements for newly commissioned power plants that had come online since the previous tariff review in 2018. Additionally, the changes in the consumer price index and the base foreign exchange rate assumed in 2018 were taken into account during this review process.

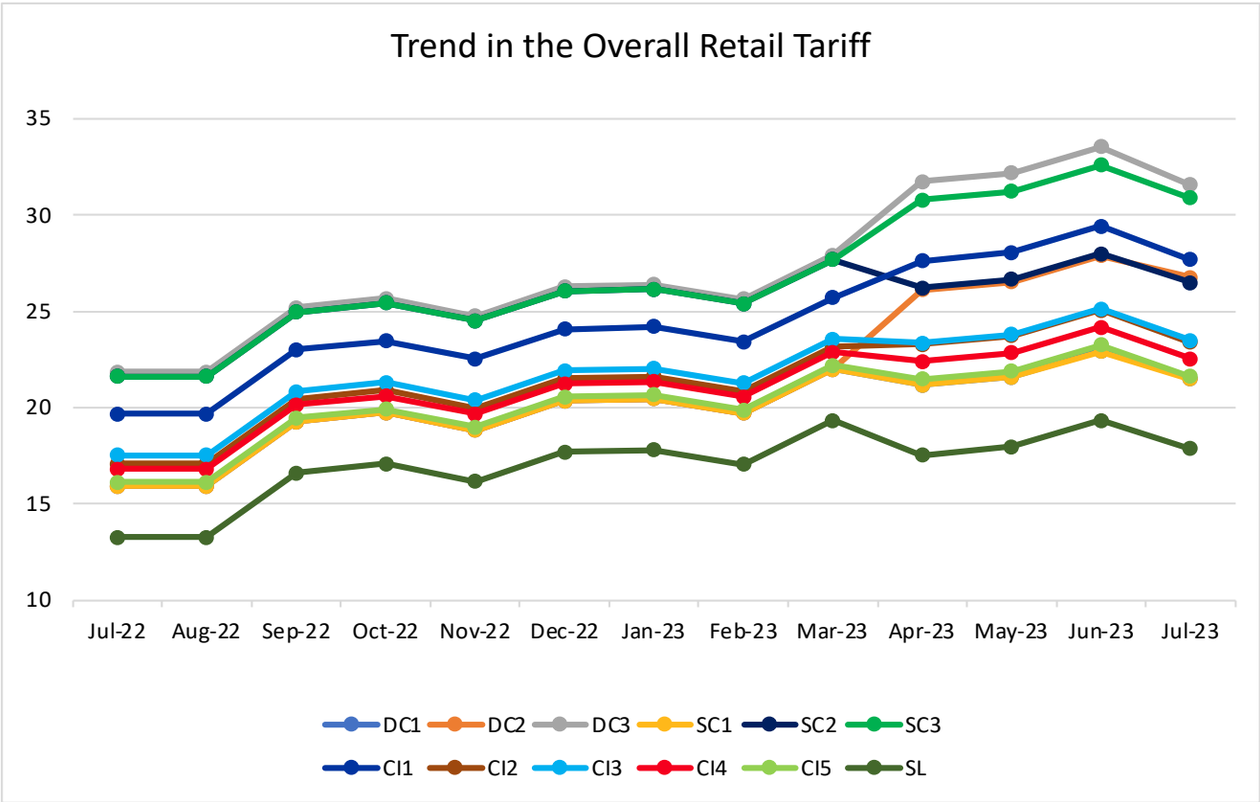


Figure 2.7: Trend in the overall electricity tariff during the year

2.2.5 Time of Use (ToU) Tariff

The ToU tariff targets commercial and industrial consumers with the aim of incentivizing them to consume electricity during the off-peak hours. It provides for a 50% discount on the energy charge rates during the off-peak periods (2200hrs to 0600hrs during weekdays, 1400hrs to 0800hrs on Saturdays and the whole day on Sundays and during Public Holidays) on premises that electricity consumption thresholds are met.

The TOU beneficiaries saved a total of Ksh. 1.2632 billion during the review period. The number of customers and the respective savings are summarized in table 2.6.

Month	No. of Beneficiaries	Electricity demand based on beneficiaries (MW)	Savings by Customers (Kshs Million)
Jul-22	1,423	59.5	113.5
Aug-22	1,190	53.7	97.8
Sep-22	1,205	54.8	94.6
Oct-22	1,865	86.5	167.2
Nov-22	1,489	74.4	121.1
Dec-22	1,466	61.2	120
Jan-23	1,710	76.6	145.5
Feb-23	1,215	45	73.7
Mar-23	1,573	54.6	54.6
Apr-23	777	37.2	105.3
May-23	1,847	52.6	43.6
Jun-23	1,409	43.6	126.3

Table 2.6: A summary of the number of TOU beneficiaries, respective electricity demand and savings

2.3 System Losses

System losses refers to electrical energy lost between the point of generation and the point of consumption. They are calculated as the proportion of energy purchased and not billed. System losses are either technical or commercial. Technical losses are inherent to the power system and are proportional to the efficiency of the transmission and distribution network. Commercial losses include power lost to illegal connections, meter tampering and fraud.

System losses decreased by 1.33% from 24.75% in the previous year to 23.42%. This is higher than the 19.9% benchmark set by the Authority. Technical losses accounted for 12.39% while commercial losses were 11.03%. Figure 2.8 shows monthly system losses for the period under review.

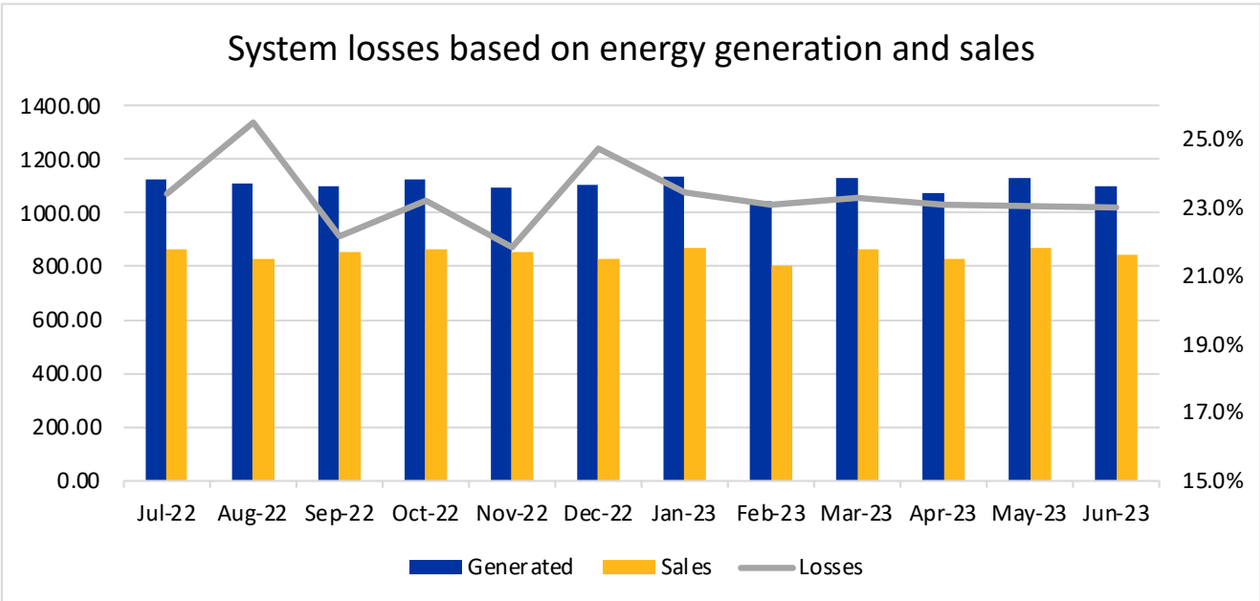


Figure 2.8: System losses on energy generated against sales

2.4 Electricity Access

Between July 2022 and June 2023, a total of 280,624 new customers were successfully connected to the grid. This noteworthy achievement contributed to a 2% increase in the total number of connected customers, which rose from 8,919,584 as of June 2022 to a total of 9,212,581 customers. The expansion of the customer base was primarily attributed to the ongoing densification of the national grid and the effective implementation of the Last Mile Connectivity Program (LMCP).

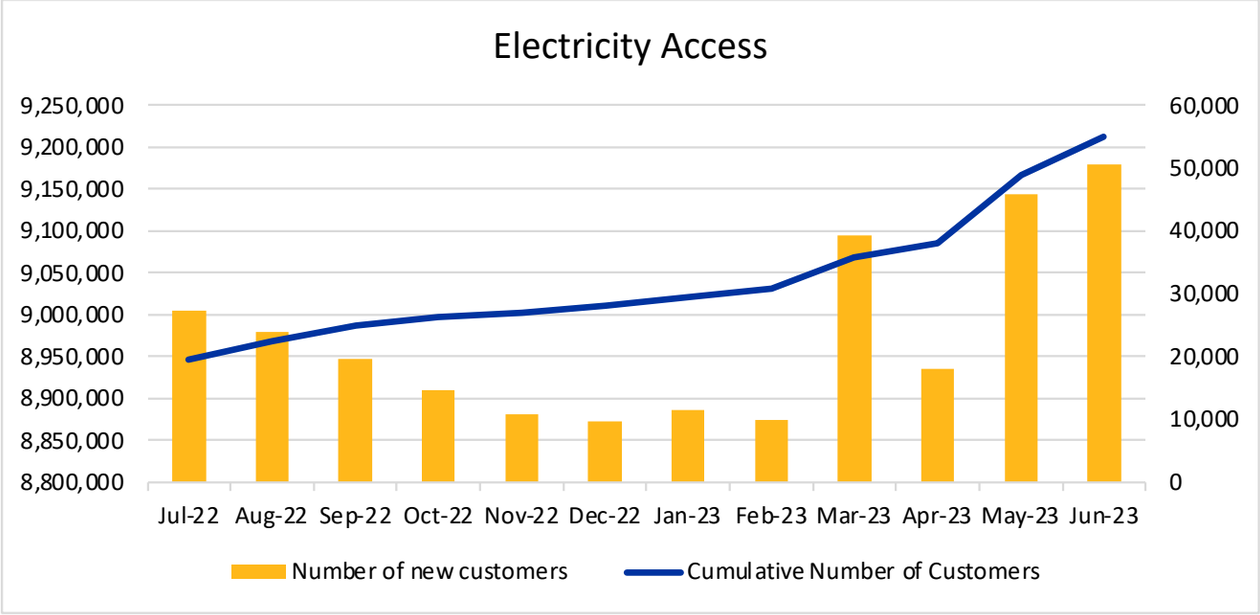


Figure 2.9: Electricity access rate from July 2022 to June 2023

2.5 Competition Analysis

2.5.1 Market Share

The market share within the electricity sector is determined by the proportion of electricity generated by each company. During the period under review, KenGen was a significant contributor, accounting for 60.74% of the total energy generated in the country. Other notable companies with substantial market shares included Lake Turkana Wind (12.70%), Orpower (7.11%), and Imports (4.87%). A comprehensive summary of the market shares within the electricity sector for the financial year 2022/2023 is depicted in Figure 2.10 and table 2.7.

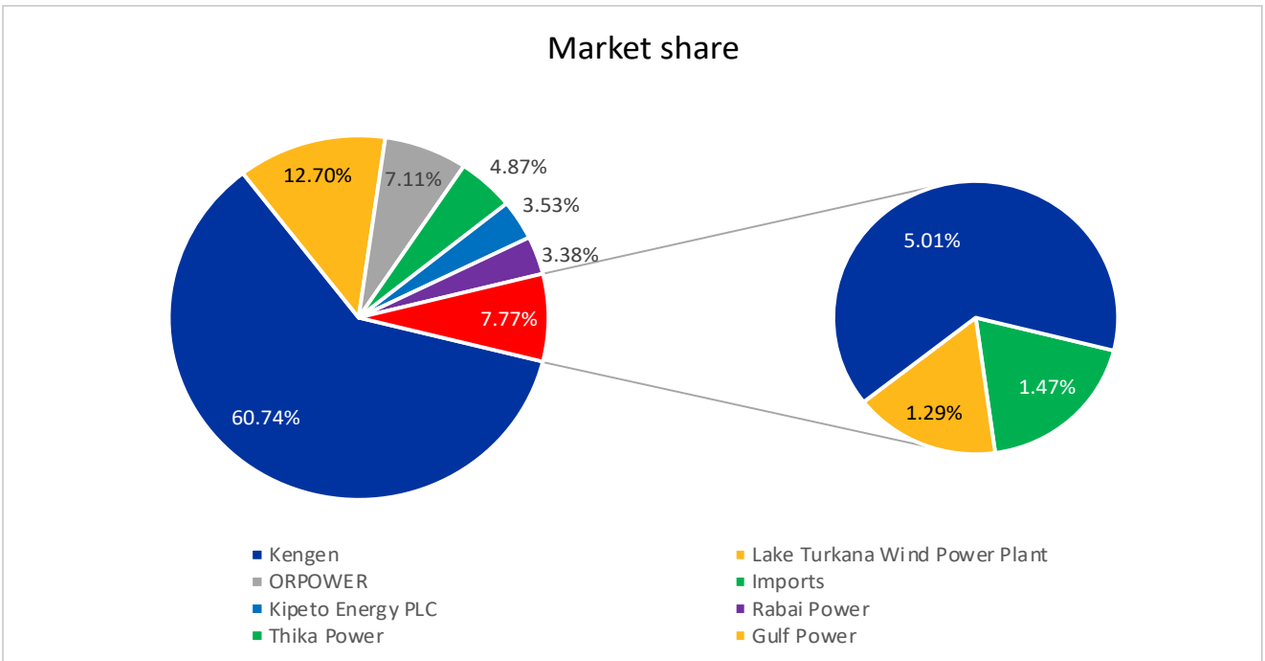


Figure 2.10: Electricity market share during the financial year 2022/2023

Company	Electricity Generated (GWh)	Market share
Kengen	802.86	60.74%
Lake Turkana Wind Power Plant	1678.32	12.70%
ORPOWER	939.23	7.11%
Imports	644.07	4.87%
Kipeto Energy PLC	466.10	3.53%
Rabai Power	446.01	3.38%
Thika Power	194.38	1.47%
Gulf Power	170.42	1.29%
Others	115.52	5.01%

Table 2.7: Electricity Sector Market share during the financial year 2022/2023

2.5.2 The Herfindahl Hirschman Index

The Herfindahl Hirschman Index (HHI) analyzes competition in the electricity sector by measuring the concentration of firms in a market thereby giving insight on the state of competition. It is calculated by squaring the market shares of all firms in the market and summing the squares as follows;

$$HHI = \sum_{i=1}^{K} (MS_i)^2$$

Where MS_i represents the market share of the ith firm and k represents the total number of firms in the market.

A market with an HHI of less than 0.1 is considered a competitive marketplace, an HHI of 0.15 to 0.25 is moderately concentrated, and an HHI of 0.25 or greater is highly concentrated.

The Average HHI index for electricity power generation stood at 0.50 in the 2022/2023 financial year. This is above the Authority's benchmark of 0.1, signifying low competition. Figure 2.11 shows the HHI trend in the period under review.

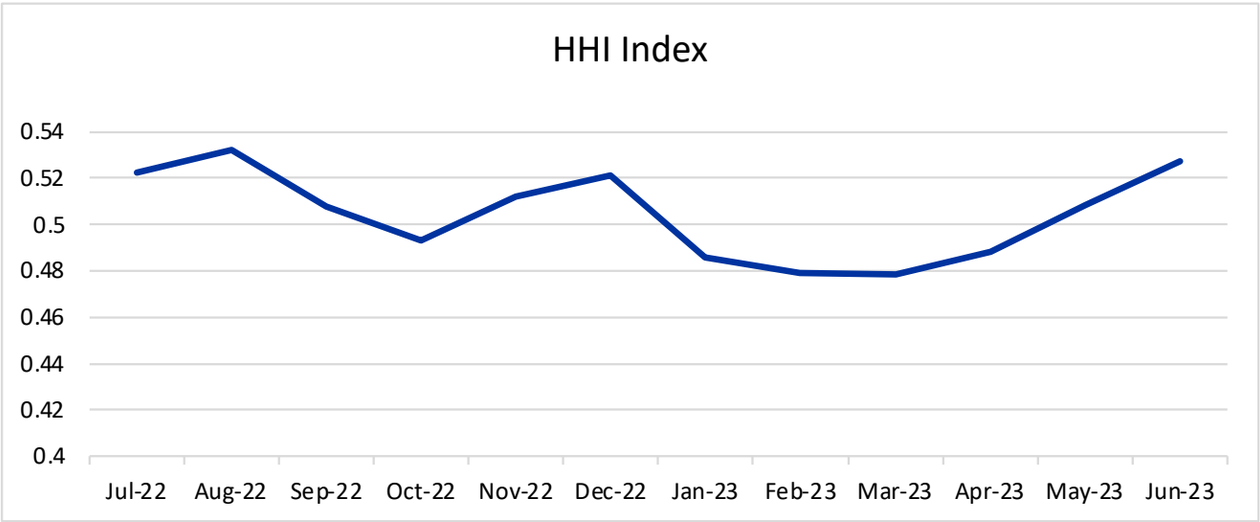


Figure 2.11: Trend in Herfindahl Hirschman Index from July 2022 to June 2023

2.6 Greenhouse Gas Emissions

The estimation of Greenhouse Gas (GHG) emissions within the electricity sub-sector is derived from the electrical energy generated during the period under review and the applicable grid emission factor. In Kenya, the national grid emission factor stands at 0.5tCO2/MWh. Figure 2.12 provides an overview of CO2 emissions resulting from electricity generation spanning from July 2022 to June 2023. Notably, the highest CO2 emissions, totaling 567.92 thousand tonnes, were observed in January, coinciding with a period of heightened electricity generation.

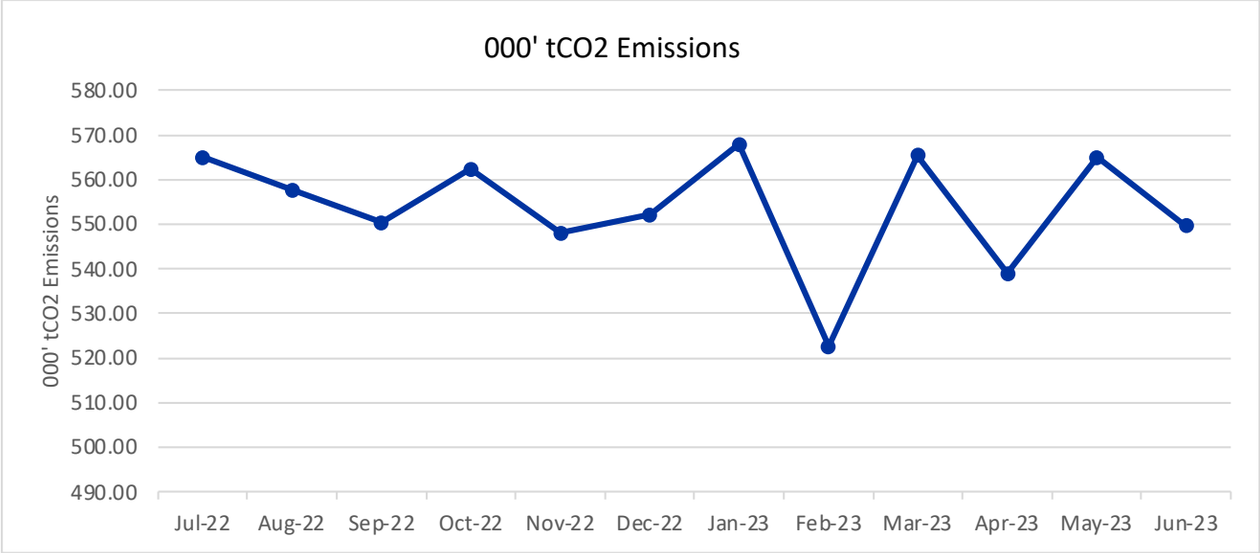


Figure 2.12: A trend of CO2 emission from July 2022 to June 2023

2.7 Electricity Transmission Infrastructure

Transmission refers to the bulk transfer of electrical power/energy from its point of generation to just near its point of use, after which distribution takes over. Due to the often lengthy distances involved, transmission is conducted at high voltages to minimize power losses. Specifically, high voltage is defined as voltages equal to or exceeding 66kV. However, for the scope of this report, we will focus on transmission at voltages exceeding 132kV, as 66kV is primarily utilized for primary distribution within the Nairobi region.

As of June 2023, Kenya's high voltage transmission infrastructure comprised a total of 97 transmission lines, covering an extensive circuit length of 9,177km. While no new transmission lines were commissioned during the review period, significant progress was made in completing the pending work at the Suswa Converter Station, enabling the energization of the 500kV Ethiopia-Kenya HVDC transmission line.

Transmission lines in Kenya are operated at 132kV, 220kV, 400kV and 500kV. These lines are owned by either KETRACO or KPLC. There are five (5) 400kV transmission lines, twenty-two (22) 220kV lines and sixty-nine (69) 132kV lines. KPLC owns 56 of these transmission lines while KETRACO owns 41. Among the five (5) 400kV transmission lines, only the Suswa-Isinya line currently operates at its rated voltage, with the other four operating at 220kV until the completion of works at their terminal substations. Table 2.8 shows the number of lines owned by each utility at each voltage level.

	KETRACO	KPLC	Total
500KV HVDC	1	0	1
400KV	5	0	5
200KV	10	12	22
132KV	25	44	69
	41	56	97

Table 2.8: A breakdown of the number of lines owned by each utility at each voltage level

While KPLC possesses a larger number of transmission lines compared to KETRACO, the latter is responsible for a significant 71% of the total circuit length. This is because KETRACO's transmission lines cover longer distances in contrast to KPLC's lines. The most extended transmission line in KETRACO's portfolio is the Ethiopia-Kenya 500kV bipolar HVDC transmission line, which spans an impressive 641km, resulting in a total circuit length of 1,242km. In contrast, the longest transmission line owned by KPLC is the 440km Kiambere-Rabai 220kV single circuit transmission line.

The longer lengths of KETRACO's transmission lines can also be attributed to the fact that most of their lines are double circuit, as opposed to KPLC's predominantly single circuit lines. Among KPLC's infrastructure, the Tororo-Lessos-Lanet-Juja Rd 132kV transmission line stands as the sole double circuit transmission line. Figure 2.13 illustrates the distribution of transmission line lengths for each utility.

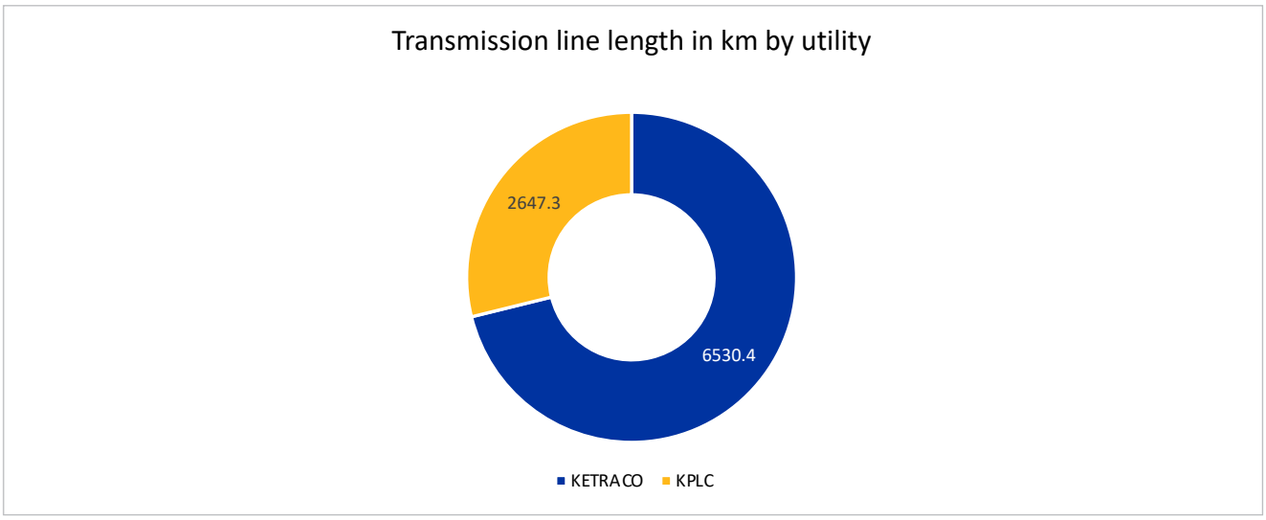


Figure 2.13: The distribution of transmission line lengths for each utility.

All transmission lines rated above 400kV are owned by KETRACO as they were built after 2009 when the mandate for construction of transmission lines was transferred to the company. Figure 2.14 shows the transmission line lengths by voltage levels owned by the two utilities.

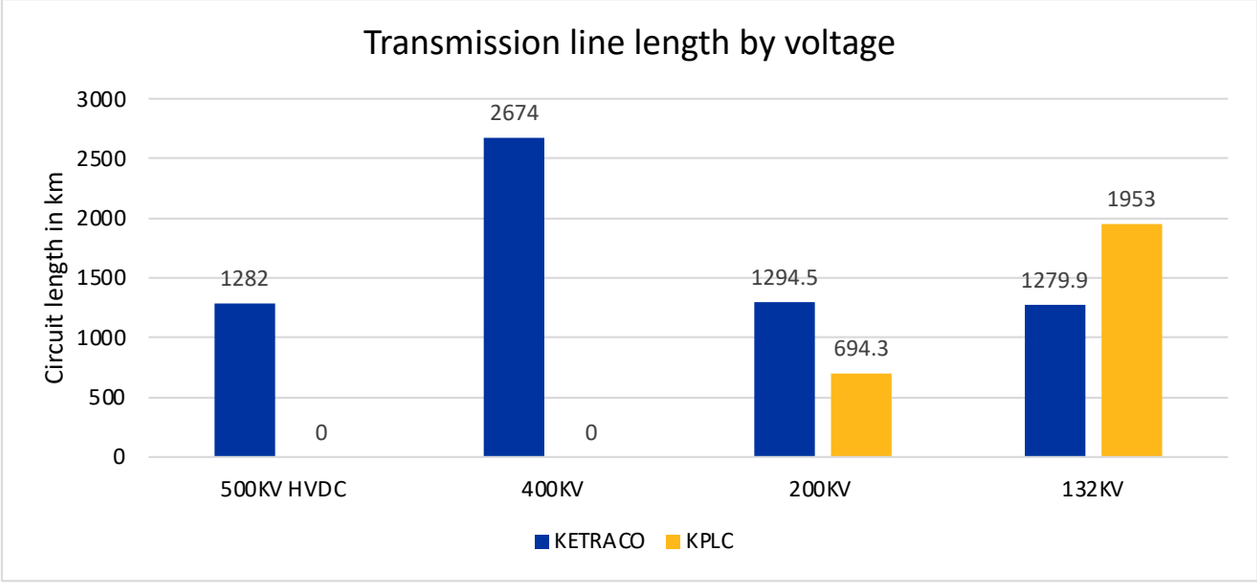


Figure 2.14: Transmission line by voltage level.

2.8 KPLC operated Off-grid sites

KPLC operates offgrid distribution networks in far flung areas of the country that are beyond the reach of the national grid. These networks are found in Marsabit, Turkana, Wajir, Mandera and Garissa Counties. The offgrid networks are powered by diesel generators with some having solar generation integrated and serve customers within a 30km radius of the respective power plants. The total installed off-grid generating capacity as at June 2023 was 27.867MW.

The towns of Wajir, Marsabit and Mandera have the highest off-grid installed capacities at 4.5MW, 2.9MW and 2.1MW respectively. These towns account for 34% of total off-grid installed capacity. Table 2.9 shows installed capacities in various KPLC operated offgrid sites in the country.

Station	Installed Capacity (MW)	Station	Installed Capacity (MW)
Wajir	4.5	North Horr	0.584
Mandera	2.1	Lokori	0.56
Marsabit	2.9	Daadab	0.784
Lodwar	0.46	Faza island	1.508
Merti	0.25	Lokitaung	0.584
Elwak	0.965	Kiunga	0.184
Habaswein	1.88	Banisa	0.184
Baragoi	0.62	Kakuma	1.2
Mfangano	0.65	Kotulo	0.396
Eldas	0.76	Karmorliban	0.184
Takaba	0.78	Khorondile	0.37
Rhamu	0.68	Sololo	0.7
Lokichoggio	1.06	Maikona	0.32
Laisamis	0.64	Lokiriama	0.4
Moyale	1.452	Hulugo	0.212
TOTAL			**27.867**

Table 2.9: Installed capacities in KPLC operated offgrid sites

2.9 Electricity Regulatory Index (ERI) 2022 Performance

The African Development Bank (AfDB) Electricity Regulatory Index (ERI) measures the level of development of electricity sector regulatory frameworks in African countries and the capacity of regulatory authorities to effectively carry out their relevant functions and duties.

The ERI is made up of three pillars or sub-indices: The Regulatory Governance Index (RGI); the Regulatory Substance Index (RSI); and the Regulatory Outcome Index (ROI). The Regulatory Governance Index (RGI) assesses the level of development of the legal and institutional set up of the regulatory framework of a country. The Regulatory Substance Index (RSI) assesses how the regulator has operationalized the mandate bestowed on it by the RGI in developing and implementing key regulatory instruments and frameworks for the sector. The Regulatory Outcome Index assesses the outcomes of regulatory decisions, actions and processes on the sector from the perspective of regulated entities.

The ERI assessment has been undertaken for the last five (5) years from 2018 to 2022. Kenya emerged position 5 in the 2022 edition, which featured 43 out of 45 countries with established regulatory authorities. Kenya has participated in the ERI study for the last five years and has consistently ranked among the top 5 countries. This can be attributed to a robust legal and regulatory framework. Table 2.10 shows a summary of the performance of the top ten (10) countries in 2022.

COUNTRY	RGI	RSI	ERIGS	ROI	ERI	RANK
Uganda	0.944	0.975	0.959	0.747	0.846	1
Egypt	0.804	0.850	0.827	0.745	0.785	2
Senegal	0.714	0.783	0.748	0.674	0.710	3
Ghana	0.738	0.870	0.804	0.625	0.709	4
Kenya	0.920	0.880	0.900	0.537	0.695	5
Zimbabwe	0.733	0.655	0.694	0.678	0.686	6
Tanzania	0.915	0.937	0.926	0.493	0.675	7
Sierra Leone	0.815	0.599	0.707	0.612	0.658	8
Algeria	0.832	0.699	0.765	0.542	0.644	9
Liberia	0.825	0.501	0.663	0.595	0.628	10

Table 2.10: Electricity Regulatory Index 2022 Ranking

Source: AfDB, ERI Report 2022

2.10 Electricity sector performance in the East African Community (EAC)

2.10.1 Installed capacity

As of June 2023, the East African Community (EAC) boasted a total installed capacity of 7,252MW. This marked a significant increase of 503MW, representing a robust 7.3% growth from the 6,794MW recorded in December 2022. Notably, the region's installed capacity had already grown by 6.82% between December 2021 and December 2022, indicating a notable increase in investment within the region's energy sector.

Kenya held the distinction of possessing the highest installed capacity in the region, with a total of 3,311MW, constituting 46% of the entire regional installed capacity. Tanzania and Uganda followed closely, contributing 25.53% and 22.06%, respectively. In the first half of the year ending on June 30, 2023, both Kenya and Uganda demonstrated the most substantial improvements in installed capacity, with Kenya adding 235MW and Uganda contributing 201MW. In the same period, Tanzania and Rwanda increased their installed capacity by 39MW and 20MW, respectively, while Burundi and Zanzibar's installed capacity remained unchanged.

The region's installed capacity is anticipated to experience exponential growth with the completion of flagship generation projects, notably the 2,115MW Julius Nyerere Hydroelectric Power plant in Tanzania and the 600MW Karuma Hydroelectric Power plant in Uganda. These developments are poised to significantly enhance the region's energy generation capabilities.

	Dec 2018 (MW)	Dec 2019 (MW)	Dec 2020 (MW)	Dec 2021 (MW)	Dec 2022 (MW)	Jun 2023 (MW)
Burundi	91	91	99	114	112	112
Kenya	2,351	2,712	2,840	2,984	3,121	3,311
Rwanda	222	226	238	263	311	331
Tanzania	1,518	1,603	1,602	1,609	1,824	1,863
Uganda	984	1,253	1,269	1,365	1,401	1,610
Zanzibar	25	25	25	25	25	25
Total	**5,191**	**5,910**	**6,073**	**6,360**	**6,794**	**7,252**

Table 2.11 Installed electrical capacity in EAC member countries as at June 2023

2.10.2 Peak demand

The region's peak demand at June 2023 was 4,680MW. This is an increase of 173MW from the peak demand recorded in 2022 and a 547MW increase from the peak demand in 2021. The increase in peak demand signifies increase in electricity usage and may be directly related to electricity access or economic activity.

Kenya and Tanzania are the only countries in the region with peak demand exceeding 1,000MW. Kenya leads the region with a peak demand of 2,149MW with Tanzania a distant second at 1,470MW.

	Dec 2018 (MW)	Dec 2019 (MW)	Dec 2020 (MW)	Dec 2021 (MW)	Dec 2022 (MW)	Jun 2023 (MW)
Burundi	65	65	65	65	65	65
Kenya	1,802	1,882	1,926	1,994	2,149	2,149
Rwanda	138	147	155	170	185	200
Tanzania	1,045	1,117	1,152	1,201	1,354	1,470
Uganda	645	724	737	794	843	863
Zanzibar	77	85	81	88	90	112
Total	**3,773**	**4,020**	**4,115**	**4,313**	**4,687**	**4,860**

Table 2.12: Maximum peak demand in EAC countries

2.10.3 Energy mix within the EAC

As of June 30, 2023, the energy mix within the East African Community (EAC) was primarily composed of renewable sources, accounting for 69%. Within this renewable category, hydropower was the dominant source, contributing a substantial 41% to the installed generation capacity. Notably, Uganda, Rwanda, and Burundi primarily relied on hy-

dropower for their electrical energy needs, with Uganda boasting the highest proportion of hydropower at 81.2% of its total installed capacity.

Thermal generation stood as the second most prevalent mode of generation, comprising 31% of the region's energy mix. It played a pivotal role in Tanzania, where it accounted for a significant 68% of the country's total installed capacity and 58.6% of the entire thermal installed capacity in the region. Tanzania's rich deposits of Natural Gas served as a valuable resource for power generation.

Geothermal energy contributed 14% to the total installed capacity, with Kenya being the exclusive source of this resource within the region. Geothermal power was the primary source of energy in Kenya, showcasing its unique position in this regard. Although geothermal exploration has taken place in all EAC countries, Kenya remains the sole nation with a commercially viable geothermal resource in the region.

The adoption of renewable energy technologies such as wind and solar played an essential role in the region, representing 10% of the total installed capacity. Notably, 86% of this capacity was located in Kenya.

Biomass and cogeneration jointly accounted for 3% of the installed capacity within the region. Uganda led in this category with 135MW, followed by Rwanda with 85MW.

	Burundi (MW)	Rwanda (MW)	Kenya	Tanzania	Uganda	Zanzibar	Total	
Hydros	50	129	839	575	1,307	-	2,899	41%
Geothermal	-	-	949	-	-	-	949	14%
Thermal (Natural gas, MSD, HFO, Coal)	39	109	646	1,268	101	25	2,163	31%
Wind	-	-	436	2	-	-	439	6%
Solar	8	12	213	7	66	-	305	4%
Biomass and cogeneration	4	85	2	11	135	-	237	3%

Table 2.13: Interconnected grid capacity in the EAC region as at June 2023.

Source: Energy Regulators Association of East Africa (EREA)

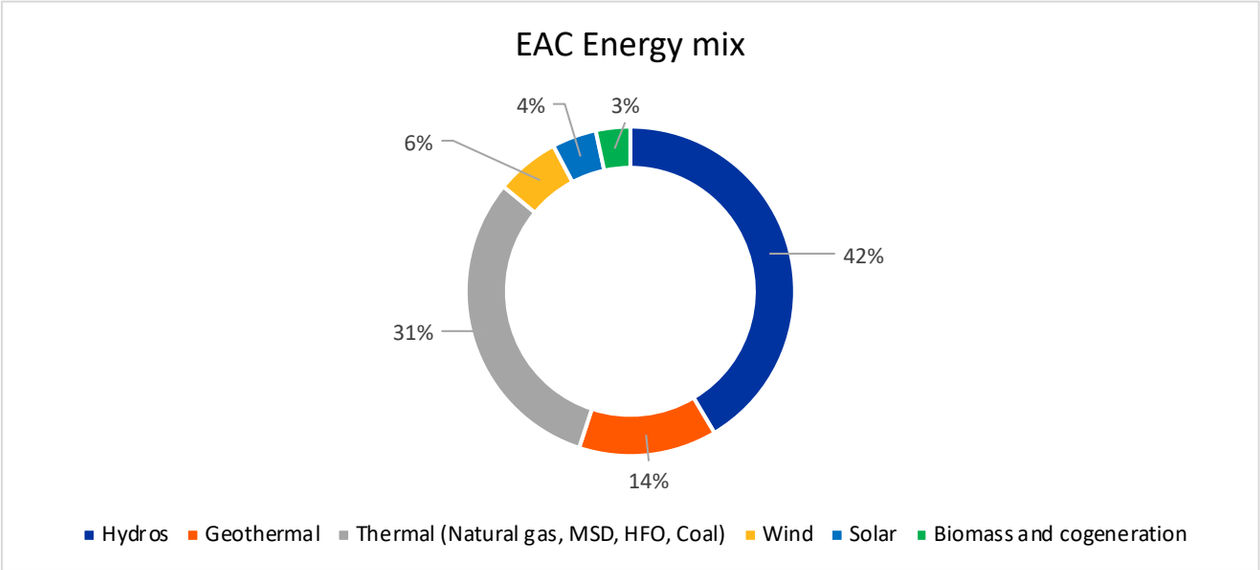


Figure 2.15: The EAC energy mix

CHAPTER
3

Renewable Energy

Kenya is endowed with abundant renewable energy resources including geothermal, hydro, wind and solar resources. The Government of Kenya has prioritized the development of renewable energy projects through various policies including the Least Cost Power Development Plan (LCPDP) and Feed in Tariff (FiT) policy. Further, the cost effectiveness of renewable energy projects has led to the development of captive generation plants by commercial and industrial facilities.

The installed capacity of renewable energy sources as at June 2023 was 2,771.6 MW, which accounts for 77.61 % of Kenya's total installed capacity. This consists of 2,429.2 MW of interconnected renewable energy capacity and 297.4 MW of captive renewable energy capacity. The period under review saw additions in geothermal generation by the 35 MW Sossian Geothermal Power Plant, utility scale solar generation by 40 MW and licenced captive generation by 37.37 MW. The licenced captive generation consisted of 31.37 MW of solar photovoltaic systems and 6 MW of biomass generation. Table 3.1 shows the country's installed renewable energy capacity by technology as at June 2023.

Technology	Interconnected Capacity (MW)		Captive Capacity (MW)	Total RE Capacity (MW)
	Installed	Effective		
Hydro	838.5	809.6	33.0	871.5
Geothermal	940.0	861.1	3.7	943.7
Wind	436.1	425.5	-	436.1
Solar	212.6	212.2	154.9	367.5
Bioenergy	2.0	2.0	105.9	107.9
Total	**2,429.2**	**2,310.4**	**297.4**	**2,726.6**

Table 3.1: Installed renewable energy capacity by technology as at June 2023

During the review period, 84.65% of the energy supplied to Kenya's national grid was obtained from renewable energy sources. Thermal plants accounted for 10.50%, while 4.85% was imported. Among the renewable sources, geothermal energy took the lead with a substantial 45.41%, followed by hydroelectric and wind power at 19.33% and 16.57%, respectively. Solar photovoltaic plants contributed 3.34% to the nation's overall energy generation mix. The renewable energy contribution to the generation mix represented in figure 3.1.

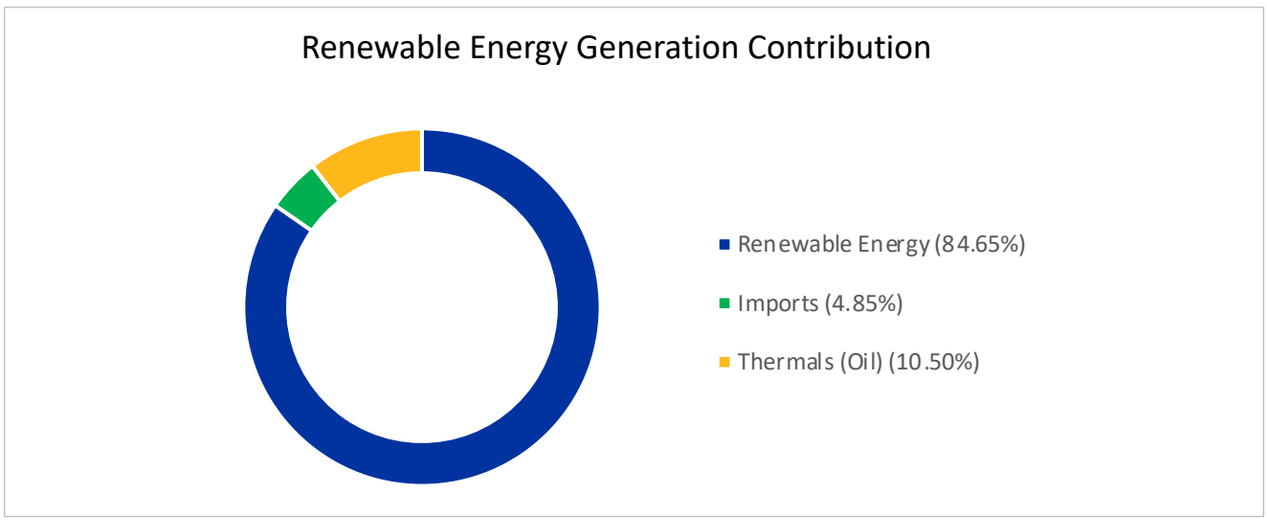


Figure 3.1: Share of renewable energy contribution to Kenya's energy mix

3.1 Geothermal Development

Kenya ranks first in Africa and seventh in the world in geothermal generation with an installed generating capacity of 940MW. In the period under review 6,035 GWh of energy was generated from geothermal energy resources accounting for 45.41% of energy supplied to the interconnected grid. The monthly energy generated between during the review period is illustrated in figure 3.2. The highest geothermal energy in the period under review was generated in December 2022 at 540.80 GWh. This is attributed to lower geothermal curtailment in the months of November and December. The lowest geothermal energy was generated in February 2023 due to reduced energy demand.

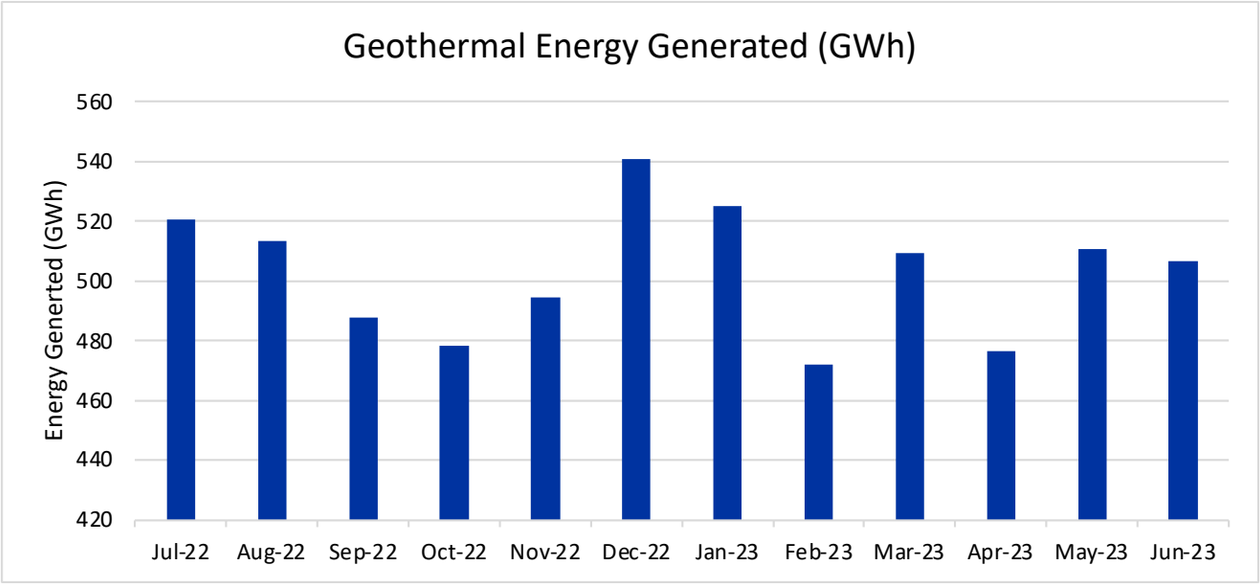


Figure 3.2: Geothermal Energy Generated per month during the financial year 2022/2023

The Geothermal energy generation in the period under review increased by 21.84% from 4,953.15 GWh in the previous review period to a new peak of 6,035.00 GWh in the current review period. This is attributed to an increase in geothermal capacity by additions of Olkaria 1 Unit 6 and Sossian Geothermal plants in the 2022 and 2023 calendar years. The geothermal energy generated between 2017 and 2023 is illustrated in figure 3.3.

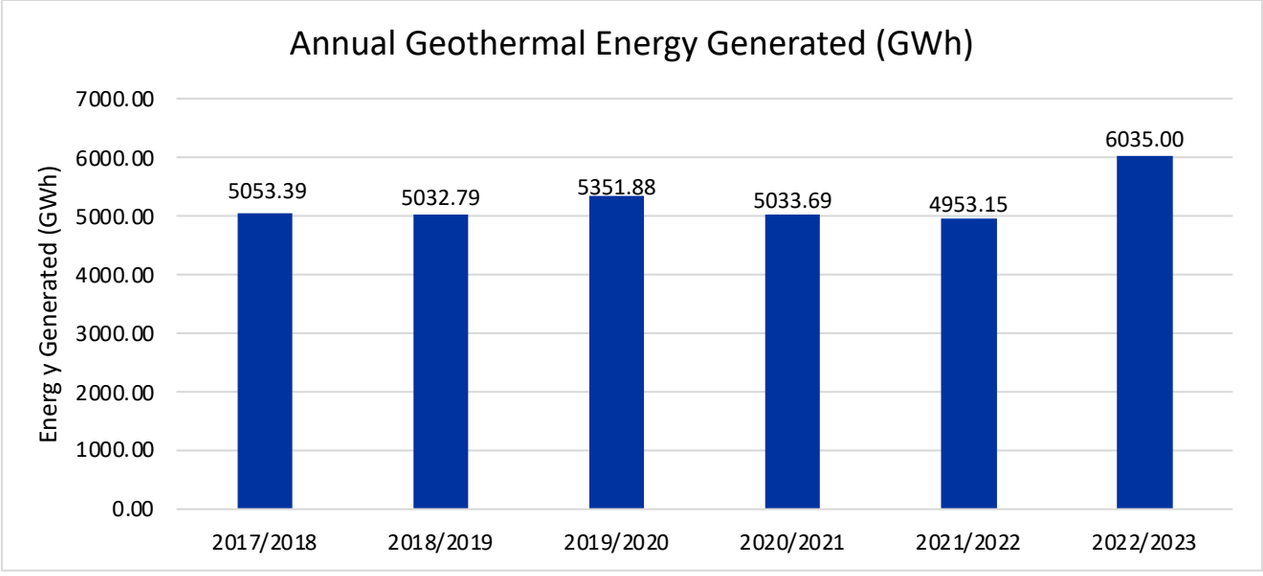


Figure 3.3: A trend of geothermal energy generated from the financial year 2017/2018 to 2022/2023

The contribution of geothermal energy generation is expected to increase as Kenya endeavors to attain 100% renewable energy by 2030.

3.2 Hydro Power

Hydro power is the oldest source of energy in Kenya and contributes significantly to the energy mix. The country's hydro power plants play a key role in integration of variable renewable energy generation by countering their intermittency. As of June 2023, the installed capacity of Kenya's hydro plants reached 871.5MW, comprising 838.5MW of interconnected capacity and 33MW of captive capacity.

During the period under review, interconnected hydropower plants generated 2,569.18GWh, constituting 19.33% of the total energy generated. Figure 3.4 provides a visual representation of the monthly energy generation from hydropower plants throughout the review period. The hydro energy generation closely tracks rainfall patterns, with February 2023 recording the lowest output at 112.91 GWh and June 2023 achieving the highest output at 261.996 GWh.

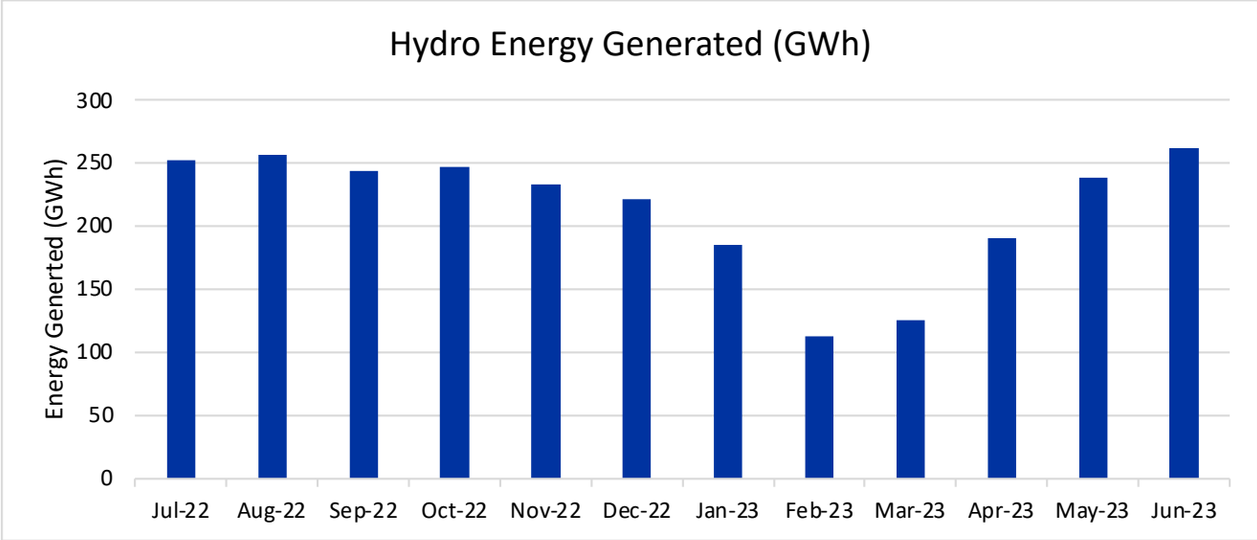


Figure 3.4: Monthly energy generation from hydropower plants

The hydropower generation positively correlates with inflows into Sondu Miriu and dam levels for Turkwel and Masinga. The two dams had the lowest water levels recorded in the past three financial years.

Turkwel had an average dam end month level of 1,136.80 meters above sea level (m.a.s.l) against a Minimum Operation Level (MOL) of 1105 m.a.s.l. and a Full Supply Level (FSL) of 1150 m.a.s.l. The lowest dam levels were recorded in February and June 2023 as illustrated in Figure 3.5. Turkwel dam levels did not decline as fast in previous years due to supplementary power generation from solar resources.

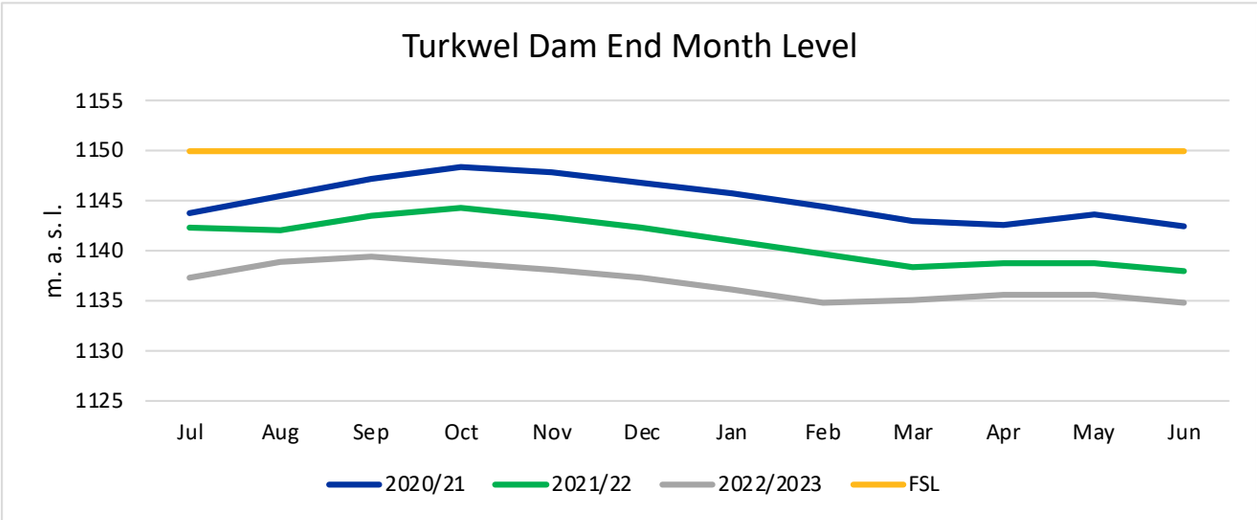


Figure 3.5: Monthly Turkwel dam levels for the financial year 2020/2021 to 2022/2023

Masinga dam had an average dam level of 1,040.21 m.a.s.l. against an FSL of 1,056.5 m.a.s.l. and an MOL of 1035 m.a.s.l. The lowest dam level for the review period was recorded in February 2023 at 1,036.52 m.a.s.l. It should be noted that between October 2022 and March 2023 the dam end month levels were within 4 meters of its minimum operation levels which is attributed to poor hydrology.

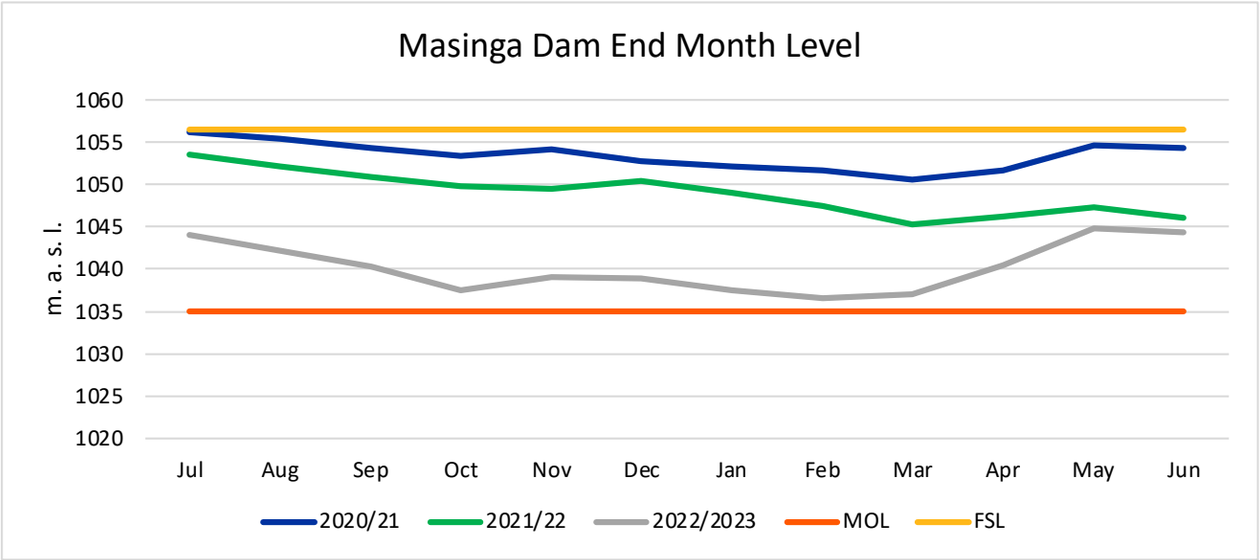


Figure 3.6: Monthly Masinga dam levels for the financial year 2020/2021 to 2022/2023

In the period under review, there was a significant 23.28% decrease in annual hydro energy generation, dropping from 3,348.71 GWh to 2,569.17 GWh. This downward trend in hydro energy generation has been evident since its peak of 4,142.18 GWh recorded in the 2020/2021 financial year. The primary factor contributing to this decline is the unfavorable hydrology conditions.

To offset this deficit, the energy mix has relied on other sources such as geothermal, wind power, and electricity imports. Figure 3.7 illustrates the trajectory of hydro energy generation from 2017 to 2023.

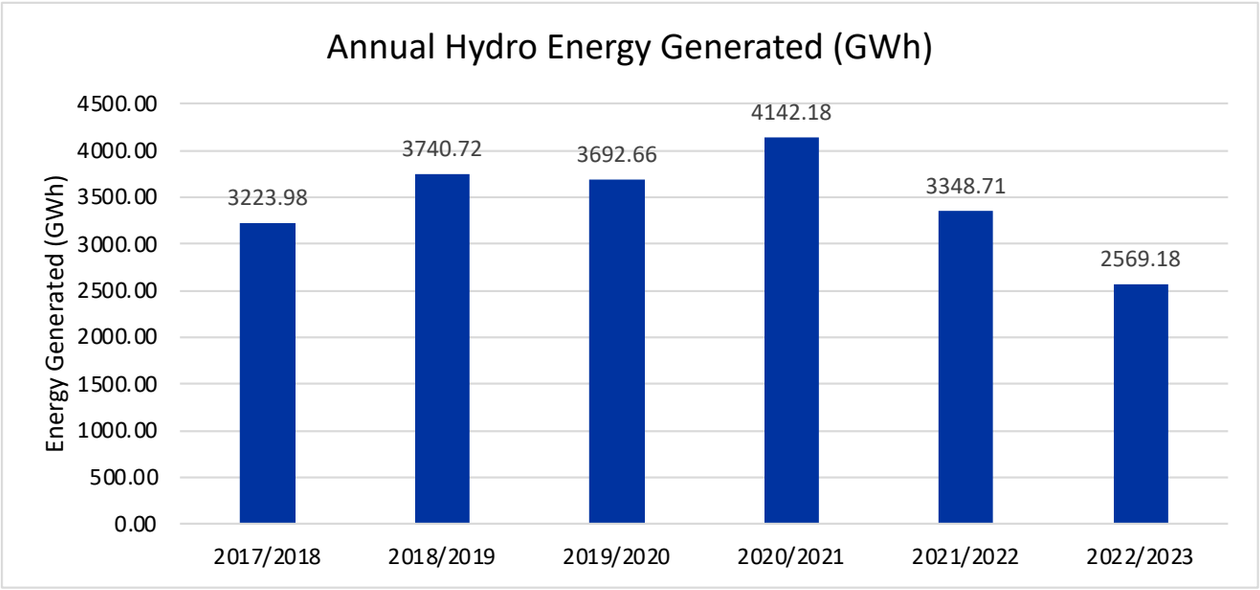


Figure 3.7: A trajectory of hydro energy generation from 2017 to 2023.

Alongside the advancement of grid-interconnected hydropower plants, there has been a growing popularity for the establishment of small-scale run-of-river hydropower facilities, both for captive utilization and integration into the national grid. During the review period, the Authority granted approval for a power purchase agreement for a 1.671MW Hydropower Plant, between Everseasons Limited and the Bureti and Chemalal Tea Factories.

3.3 Wind Energy

Kenya's installed wind capacity as at June 2023 was 436.1 MW. This consist of Lake Turkana Wind Power Plant (310 MW), Ngong Wind (25.5 MW) and Kipeto Wind Plant (100 MW).

Figure 3.8 shows the monthly wind energy generation during the review period. The highest wind energy was generated in October 2022 at 237.493 GWh while the lowest wind energy was generated in December 2022 at 139.351 GWh. The low wind energy generation in December 2022 is attributed to wind curtailment in favor of geothermal generation.

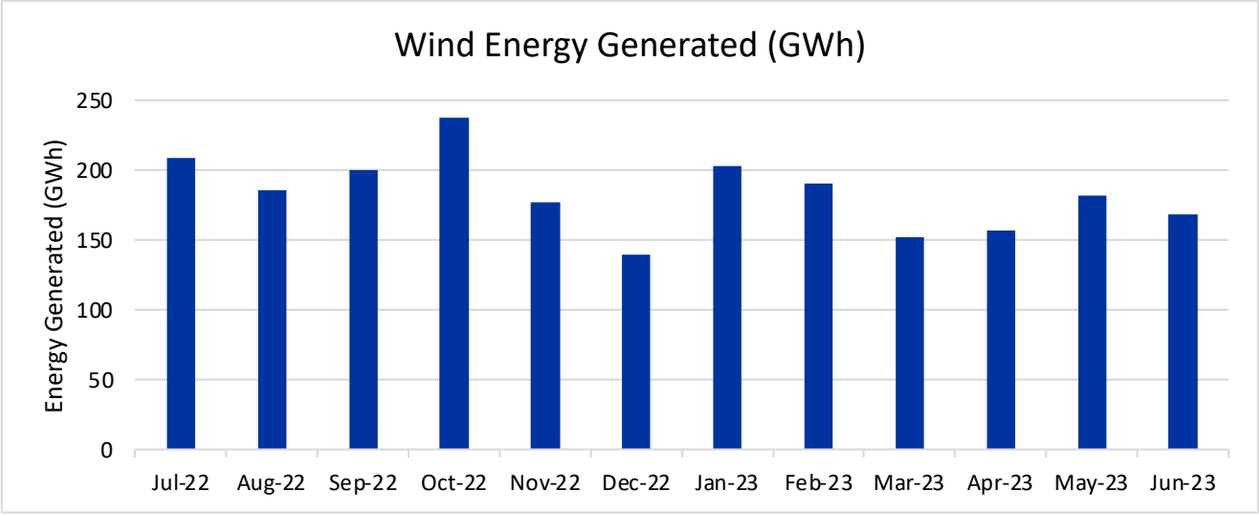


Figure 3.8: Monthly wind energy generation during the financial year 2022/2023

Wind energy contributed 2,201.72 GWh to the interconnected grid during the period under review, constituting 16.57 % of the country's total electricity mix. The wind energy generated increased by 7.28% from 2,052.26 GWh in the previous review period to a new peak of 2,201.72 GWh. The annual wind energy generation trend between 2017 and 2023 is provided in figure 3.9.

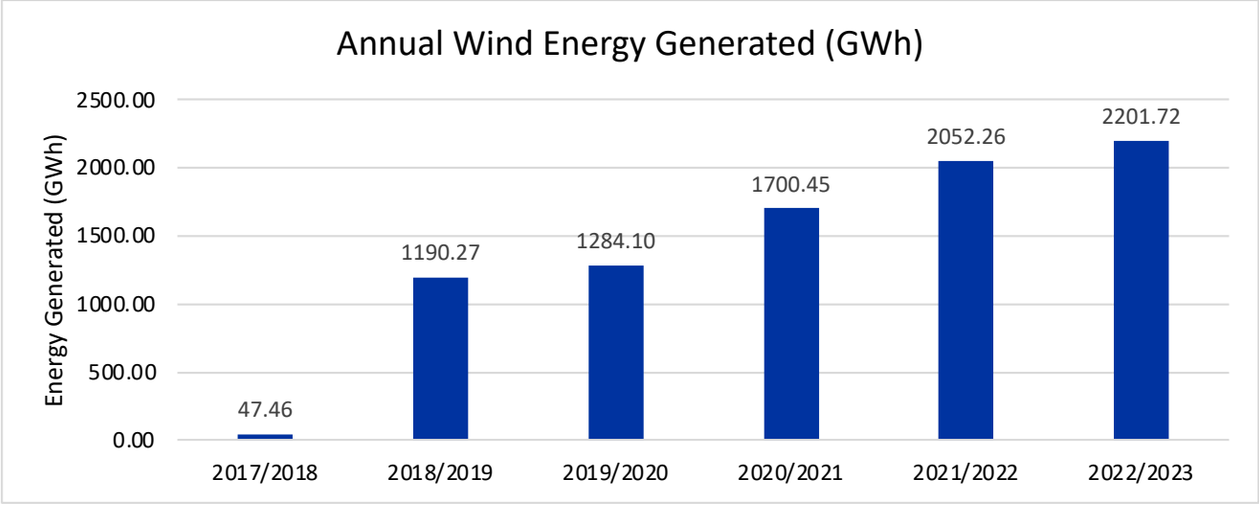


Figure 3.9: The annual wind energy generation trend between 2017 and 2023

3.4 Solar Energy

As of June 2023, Kenya's solar installed capacity stood at 367.5 MW, comprising 212.6 MW of grid-interconnected capacity and 154.9 MW of captive capacity. In the period under review, the utility scale installed capacity increased by 40MW following the commissioning of the Alten Solar Plant in Uasin Gishu County. Additionally, licenced captive capacity from solar photovoltaic systems increased by 31.37 MW.

The monthly energy generation from interconnected solar photovoltaic plants is displayed in Figure 3.10. The highest solar energy generation occurred in January 2023, reaching 46.69 GWh, while the lowest was recorded in August 2022, at 22.53 GWh. These fluctuations in energy generation are attributed to variations in solar insolation levels.

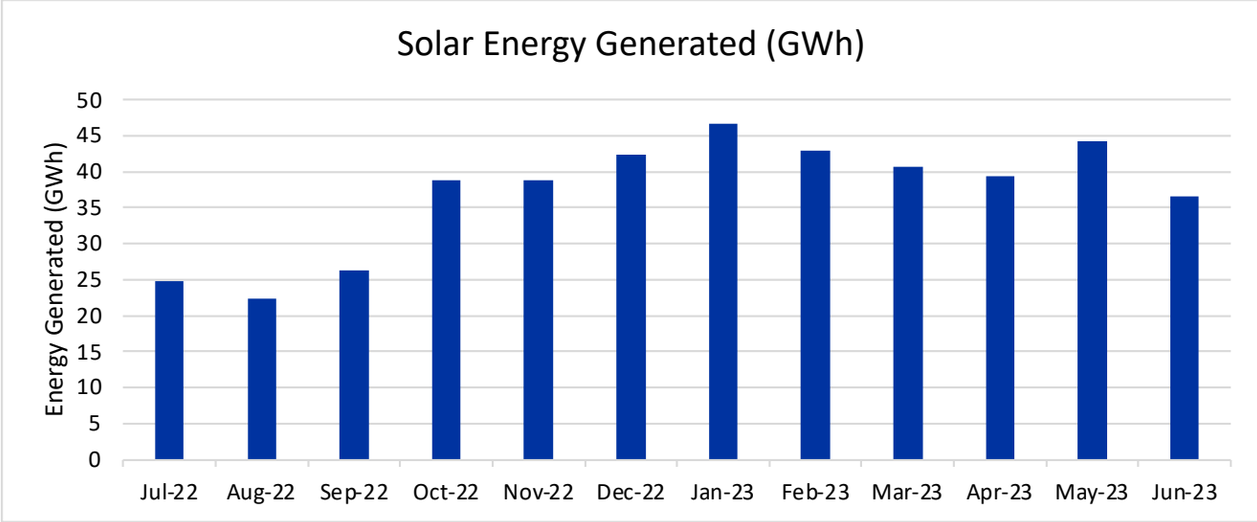


Figure 3.10: Monthly solar energy generation during the financial year 2022/2023

The annual energy generated from interconnected solar PV system increased by 41.84% from 312.99 GWh to a new peak solar generation of 443.94 GWh. This is attributed to the increase in solar installed capacity. A trend in the annual solar energy generation between 2017 and 2023 is provided in figure 3.11.

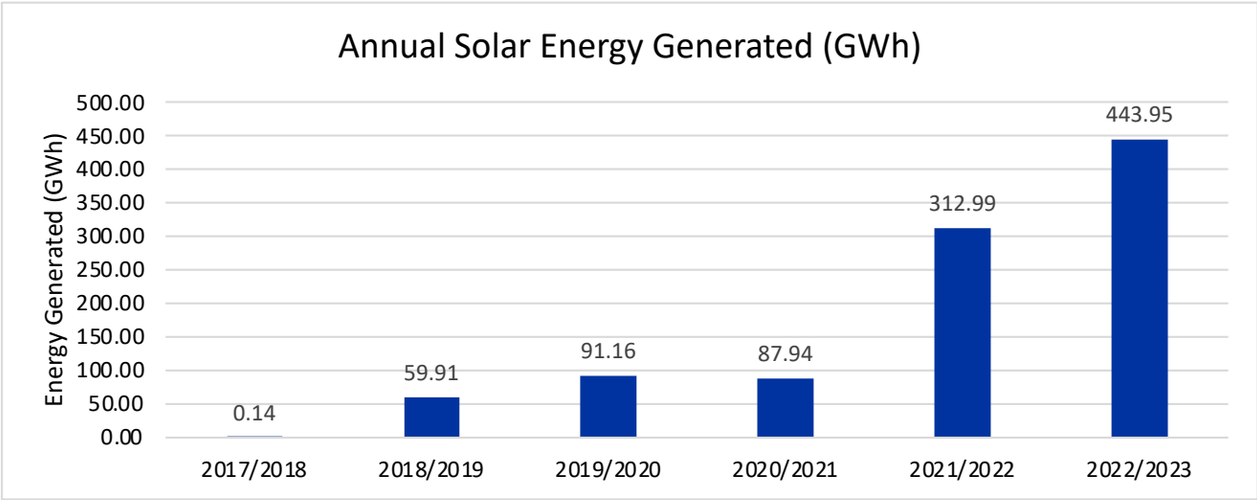


Figure 3.11: A trend in the annual solar energy generation between 2017 and 2023

Solar photovoltaic systems have the highest contribution to the country's captive generation capacity at 154.9 MW which accounts for 38.53 % of the total captive capacity. The preference for this technology can be attributed to several factors, including the ease of setup, advantageous solar insolation levels in many regions of Kenya, cost-effectiveness in terms of energy production, and supportive government policies.

In the period under review, the Authority licenced eleven (11) captive solar plants with a combined capacity of 31.368 MW as outlined in table 3.2.

No	Licensee	Technology	Category	Capacity	Location
1.	DPA Kenya Limited	Solar PV	Generation	100 kW	Lake Bogoria Spa Resort Limited
2.	DPA Kenya Limited	Solar PV	Generation	80 kW	Nanyuki Cottage Hospital
3.	DPA Kenya Limited	Solar PV	Generation	760 kW	Star Plastics Limited
4.	Ecoligo Limited	Solar PV	Generation	80 kW	Keren Roses Ltd. Chepsito Flower Farm
5.	Ecoligo Limited	Solar PV	Generation	80 kW	Keren Roses Ltd. Simotwo Flower Farm
6.	Ecoligo Limited	Solar PV	Generation	100 kW	Keren Roses Ltd. Torongo Flower Farm
7.	Crossboundary Energy Kenya Ltd.	Solar PV	Generation	678.5 kW	Maisha Minerals and Fertilizer Limited
8.	Crossboundary Energy Kenya Ltd.	Solar PV	Generation	490 kW	National Cement Company Limited, Athi River
9.	Tata Chemicals Magadi Limited	Solar PV	Generation	10000 kW	Tata Chemicals Magadi Limited
10.	Momnai Energy Limited	Solar PV	Generation	14000 kW	Bamburi Cement Plant, Mombasa
11.	Momnai Energy Limited	Solar PV	Generation	5000 kW	Bamburi Cement Plant, Athi River

Table 3.2: A summary of the captive Solar PV plants that were licenced during the financial year 2022/2023

3.5 Minigrids

Mini grids refer to integrated systems for local electricity generation, transmission and distribution capable of operating independently from the national electricity grid. They assume a pivotal role in advancing Kenya's objective of achieving universal electricity access. During the review period, the Authority granted tariff approvals for 27 sites owned by Kudura Power East Africa Limited. These mini grid projects are poised to deliver electricity to 6,045 households and businesses, consequently elevating the mini grid capacity by an additional 432 kWp.

3.6 Bioenergy

Bioenergy refers to sustainable energy derived from organic matter and can take various forms such as firewood, biochar, briquettes, bagasse, biogas, syngas, bioethanol, and biodiesel. In Kenya, these diverse forms of bioenergy find applications in open-fire cooking, improved cook stoves, industrial biomass boilers, furnaces, internal combustion engines, lighting lamps, and electricity generation. Notably, bioenergy constitutes the most substantial portion of final energy consumption in Kenya.

As of June 2023, the installed capacity for bioenergy stood at 107.9 MW, comprising 105.9MW of captive capacity and 2MW of grid-interconnected capacity. During the review period, the Authority granted a licence to Busia Sugar Industries Limited for the generation of 6MW of electricity from biomass.

In August 2022, the Authority issued comprehensive biofuels guidelines outlining approval requirements for biofuels businesses in Kenya. These guidelines are designed to promote the safe use of biofuels and encourage adherence to relevant Kenyan Standards in all aspects, including production, transportation, exportation, storage, packaging, and sale of bioethanol. Kenya has experienced a notable increase in the adoption of denatured ethanol as a clean cooking fuel, as demonstrated in Figure 3.12.

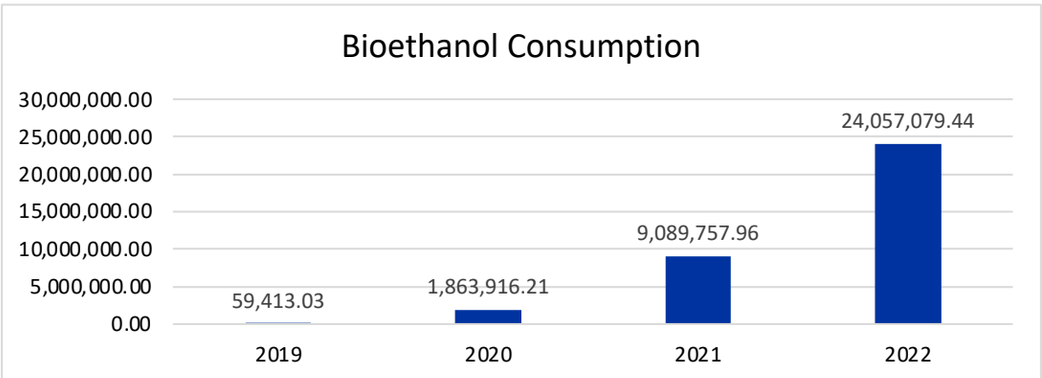


Figure 3.12: A trend in bioethanol consumption from 2019 to 2022

CHAPTER
4

Energy Efficiency

Promoting energy efficiency and conservation is instrumental in reducing both financial and environmental burdens associated with energy consumption. The Authority has instituted two key regulations to foster energy efficiency: the Energy (Energy Management) Regulations, 2012 and the Energy (Appliances' Energy Performance and Labelling) Regulations, 2016.

The Energy (Energy Management) Regulations primarily target commercial and industrial facilities with an energy consumption threshold of at least 180,000 kWh of thermal and electrical energy. These regulations mandate designated facilities to conduct energy audits and implement the recommended measures arising from these audits. In the period under review, a total of 269 facilities underwent energy audits, comprising 27 small, 227 medium, and 14 large energy consumers. These audits projected substantial energy savings amounting to 357.135 GWh from the implementation of recommended energy conservation measures.

During the financial year, the Authority granted Energy Management compliance certificates to five facilities. These certificates serve as recognition for facilities that have diligently adhered to and fully implemented the Energy Management Regulations, resulting in tangible energy savings. Detailed information regarding the awarded facilities are provided in Table 4.1.

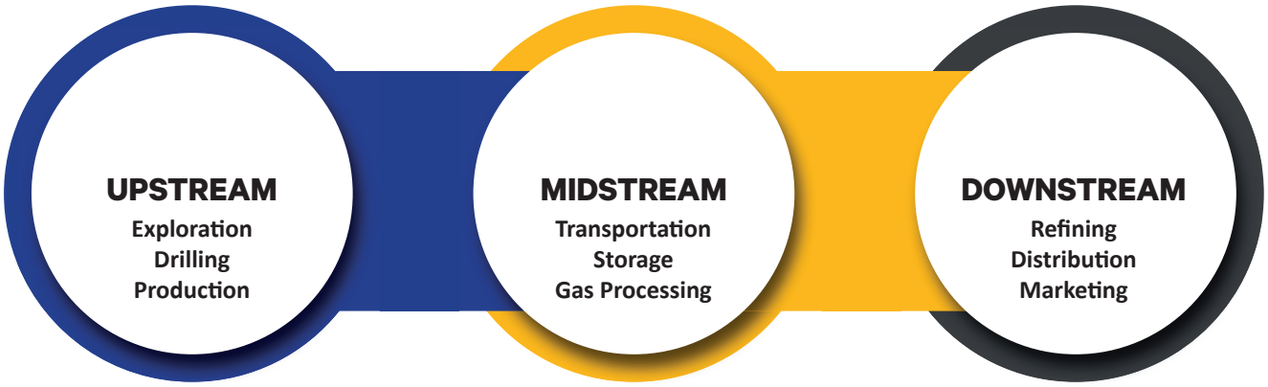
S. No.	Facility	Date of Award
1.	Kenya Breweries Limited	15/06/2023
2.	Iberafrica Power (EA) Limited	01/11/2022
3.	British American Tobacco-Likoni	01/11/2022
4.	British American Tobacco-Thika	01/11/2022
5.	Mombasa Cement- Athi River	01/11/2022

Table 4.1: A list of facilities that were awarded the EPRA Energy Management compliance certificates during the financial year 2022/2023

CHAPTER
5

Petroleum

The petroleum subsector comprises upstream, midstream and downstream petroleum segments.



This section presents a summary of the performance of the various segments entailing supply, domestic consumption, pipeline transport, pricing, and competition.

5.1 Upstream Subsector

The Kenyan government is presently in the process of evaluating the Final Field Development Plan (FDP), which was submitted by the Kenya Joint Venture (KJV) partners in March 2023. This comprehensive FDP outlines a strategic roadmap for the development of resources within the Block 10BB and 13T licenced areas, as well as additional appraisal and exploration activities aimed at optimizing resource extraction within the designated development zone.

The development strategy revolves around a well-structured, phased infrastructure-driven approach, commencing with the most sizable and technically advanced reservoirs. In order to achieve the production of first oil and support the initial production plateau, the Ngamia, Amosing, Twiga, and Ekales fields, collectively referred to as "NEAT," will be developed within the first five years of the production period.

Subsequent to the commencement of first oil production, an Exploration and Appraisal Plan will be implemented with the primary goal of prolonging the plateau period. This will be achieved through the reduction of risks associated with contingent resources and the addition of new discoveries. The development of Agete, Etom, and other fields within the Development Area will follow the successful execution of the Exploration and Appraisal Plan.

During the initial development phase, core infrastructure elements, including field access infrastructure, central processing facilities, gathering systems, and the Lokichar to Lamu Crude Oil Pipeline ("LLCOP"), will be installed. This foundation will not only facilitate future expansion but also leverage existing infrastructure to generate incremental development value from both existing and forthcoming discoveries. The development aims to tap into a discovered Stock-Tank-Oil-Initially-in-Place ("STOIIP") range spanning from 1,620 to 4,573 million barrels and anticipates the recovery of an estimated 240 to 971 million barrels of Contingent resources over the course of the 25-year contract period.

5.2 Midstream and Downstream subsector

5.2.1 Petroleum Import Infrastructure

Petroleum products imported into the country are primarily received through the Kipevu Oil Terminal (KOT) I and Kipevu Oil Terminal (KOT) II jetties. KOT I handles vessel of capacity up to 85,000 DWT while KOT II can handle up to 120,000DWT. The two jetties are connected to primary receiving terminals namely Kipevu Oil Storage Facility (KOSF), Vitol Tank Terminal International Kenya (VTTI) and Kenya Petroleum Refineries Limited (KPRL).

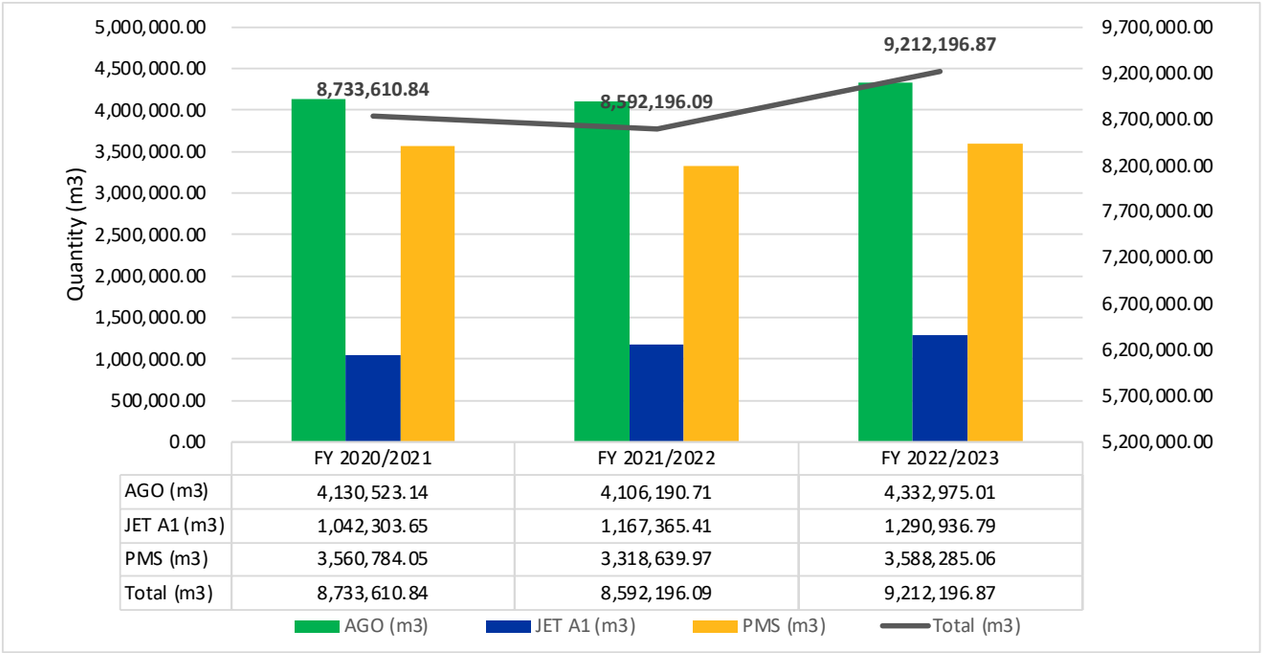
Shimanzi Oil terminal (SOT) receives slightly smaller vessels of capacity up to 18,000 DWT. Table 5.1 shows the capacity of bulk storage facilities within the Mombasa port.

No.	Name of Facility	Capacity (Cubic meters)	Location
1.	Kenya Pipeline Company Limited	326,230	Kipevu
2.	Kenya Petroleum Refineries Limited	252,380	Changamwe
3.	GAPCO Kenya Limited	105,000	Shimanzi
4.	VTTI Kenya Limited	111,000	Kipevu
5.	Vivo Energy Kenya Limited	100,000	Shimanzi
6.	Kenya Petroleum Refineries Limited (Port reitz)	100,000	Kipevu
7.	Total Energies Marketing PLC (MJT)	44,460	Shimanzi
8.	Ola Energy Kenya Limited	42,200	Shimanzi
Total Capacity		**1,081,270**	

Table 5.1: Capacity of bulk storage facilities within Mombasa port

5.2.2 Petroleum Imports

The Ministry of Energy and Petroleum coordinates the importation of petroleum products into the country. During the financial year under review, 9,212,196.87 cubic meters (m3) were imported through both the Open Tender System (OTS) and the government to government (G2G) framework. Figure 5.1 shows the import volumes trends in from 2020 to 2023.



	FY 2020/2021	FY 2021/2022	FY 2022/2023
AGO (m3)	4,130,523.14	4,106,190.71	4,332,975.01
JET A1 (m3)	1,042,303.65	1,167,365.41	1,290,936.79
PMS (m3)	3,560,784.05	3,318,639.97	3,588,285.06
Total (m3)	8,733,610.84	8,592,196.09	9,212,196.87

Figure 5.1: Import volumes trends from 2020 to 2023.

The government to government (G2G) framework was introduced in April 2023 with the objective of easing pressure on the demand for the US dollar thus improving its circulation and subsequently mitigating the depreciation rate of the Kenyan shilling. A total of 1,945,054.91 m3 of petroleum products has been imported between April and June 2023 under the G2G framework.

Overall, the share of volumes designated for domestic market consumption accounted for 58.16% of the total import volume. The monthly trends in imports are shown in figure 5.2.

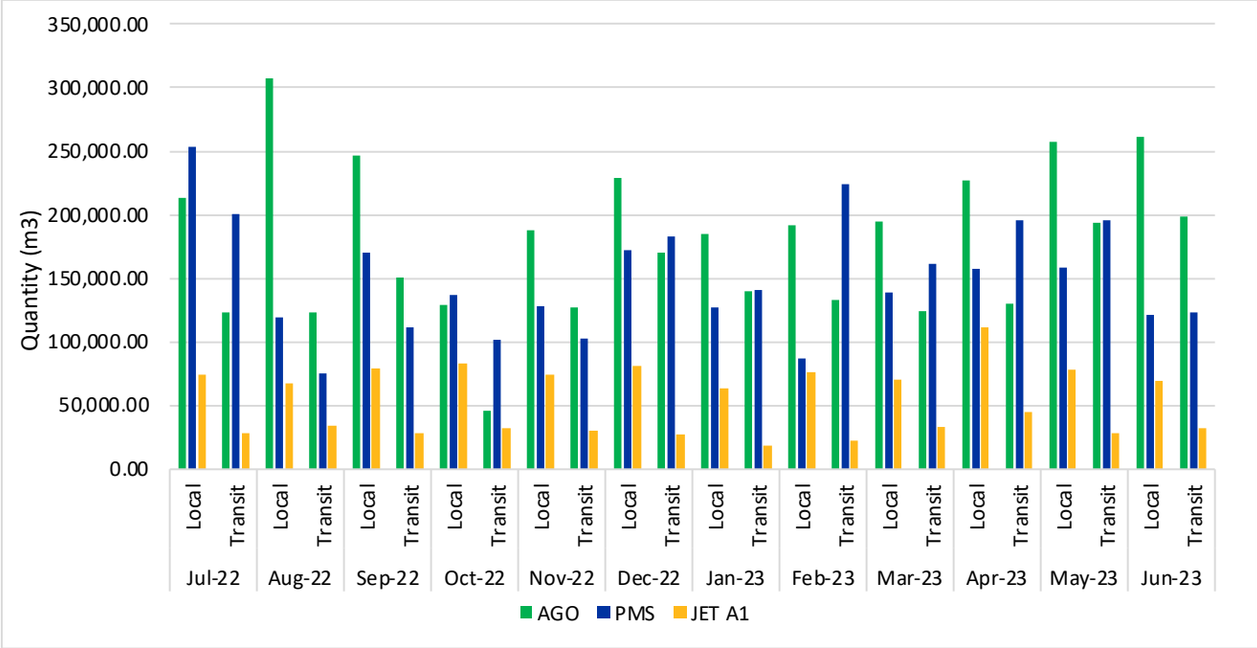


Figure 5.2: Monthly trends in imports during the financial year 2022/2023

5.2.3 Domestic Petroleum Consumption

The total domestic demand for petroleum products decreased by 2.83% to 5,576,147.01 m3 compared to the previous financial year. The decreased consumption could be attributed to suppressed demand occasioned by high fuel prices in the local and international markets. Figure 5.3 shows the trajectory of demand from 2020 to 2023.

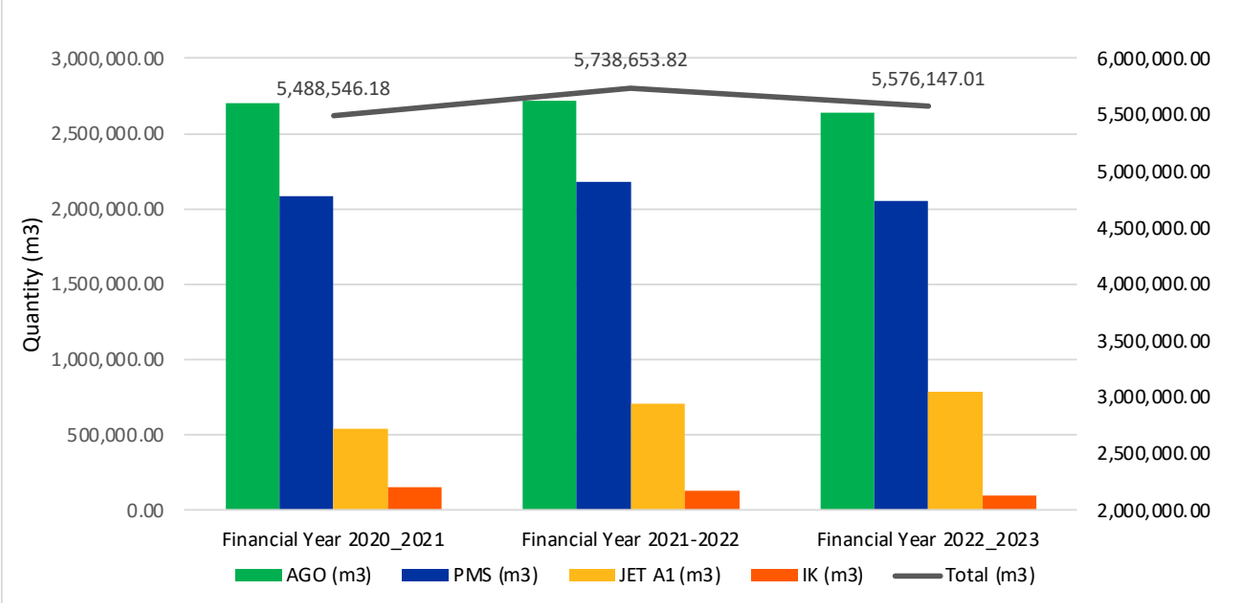


Figure 5.3: The trajectory of demand from 2020 to 2023

The demand for petroleum products remained consistent throughout the review period, with the peak consumption occurring in March 2023. Notable, March also recorded the highest demand for Automotive Gas Oil (AGO).

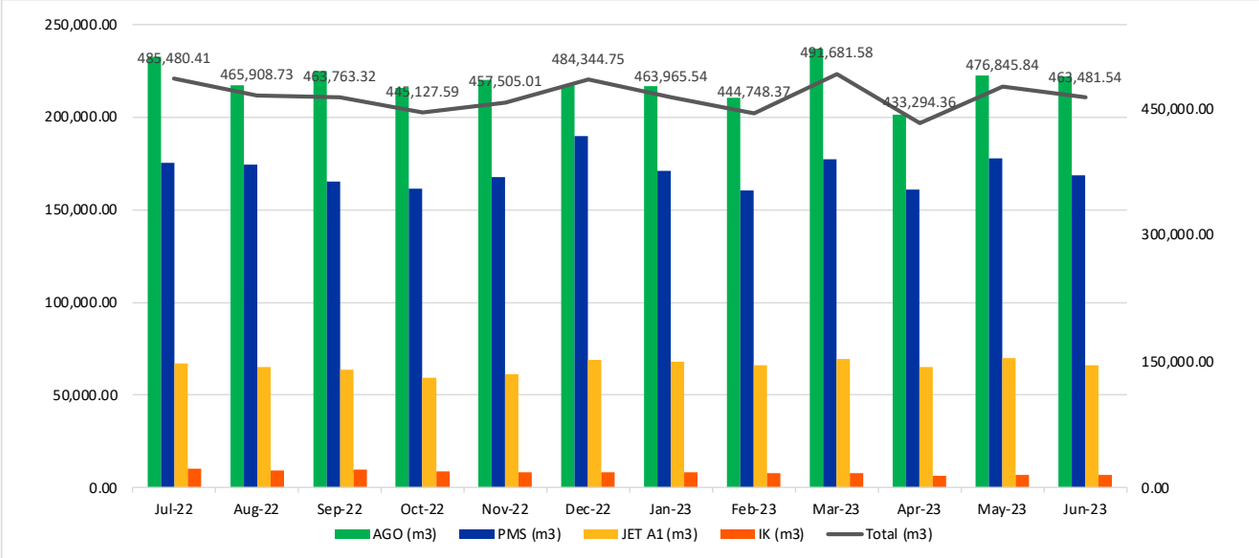


Figure 5.4: Trend in the consumption of petroleum products

5.2.4 Pipeline Throughput

The Kenya Pipeline Company (KPC) primarily handles petroleum products imported through the OTS. Capacity enhancements have been made to enhance throughput of the Mombasa - Nairobi pipeline (Line V). The line is now capable of evacuating petroleum products at approximately 1,300 m3/hr up from 950 m3/hr. Table 5.2 shows the pipeline infrastructure and design flow rates.

Pipeline	Pipeline Diameter (Inches)	Pipeline length (km)	Flow rate (m3/hr)
Nairobi – Sinendent – Eldoret pipeline (Line 2)	8/6	325	220
Sinendet – Kisumu pipeline (Line 3)	6	121	140
Nairobi – Eldoret pipeline (Line 4)	14	325	311
Mombasa – Nairobi pipeline (Line 5)	20	450	1,300
Sinendet – Kisumu pipeline (Line 6)	10	121	280

Table 5.2: Pipeline infrastructure and design flow rates

The overall pipeline throughput statistics for the period under review are indicated in Figure 5.5.

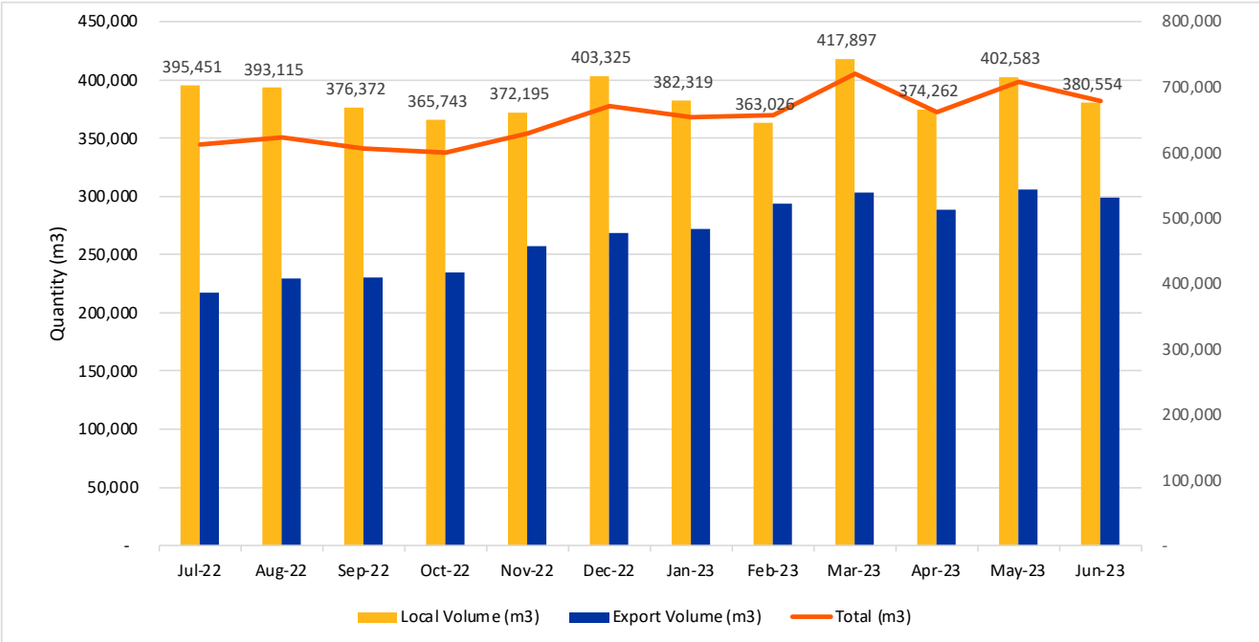


Figure 5.5: Pipeline throughput from July 2022 to June 2023

Figure 5.6 shows an overall increase in pipeline throughput as compared to the previous financial year. This increase primarily stems from higher volumes directed toward the transit market. Nevertheless, there was a decrease in throughput to the local market, indicating a clear sign of reduced demand.

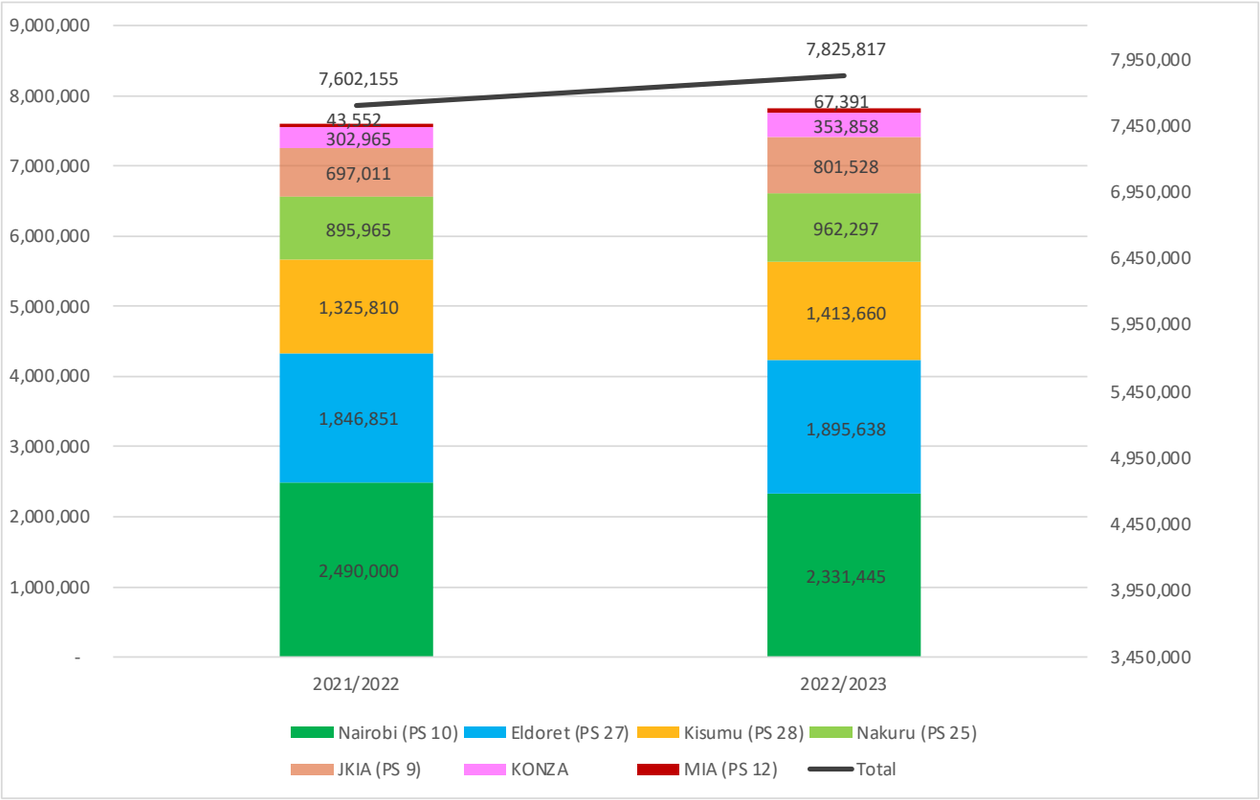


Figure 5.6: A comparison of pipeline throughput between the financial year 2021/2022 and 2022/2023

5.2.5 Sector Consumption of Petroleum Products

The total net domestic sales of petroleum fuels experienced a slight decline of 1.1% for the period ending in December 2022, amounting to 5.1 million tonnes. In 2022, there were notable increases in net domestic sales of petroleum products in the Agriculture, Aviation, Power Generation, and Government consumption sectors, while all other sectors witnessed declines. Specifically, fuel sales to the Power Generation sector surged by 28.8%, reaching 189,900 tonnes in 2022.

Likewise, fuel sales to the Aviation sector exhibited growth, rising from 499,400 tonnes in 2021 to 570,300 tonnes in 2022, while fuel sales to Government consumption saw a modest increase of 4.4% during the same period. On the flip side, net domestic sales to the Tourism sector experienced a notable drop of 18.3% in 2022, totaling 4,900 tonnes. The consumption of petroleum by sector is shown in table 5.3.

CONSUMPTION BY SECTORS (Thousand Tonnes)	2018	2019	2020	2021	2022
Agriculture	59.7	25.7	24.8	26.6	29.0
Retail pump Outlets and road transport	3,743	3,752	3,650.5	3,937.8	3,849.3
Air transport (exc. Government)	671.4	710.8	392.7	499.4	570.3
Power Generation	34.2	29.1	75.8	147.5	189.9
Industrial and Commercial sectors	635.1	635.5	494.4	530.5	446.3
Government	18.7	15.6	21.5	22.8	23.8
Tourism	9.5	13.9	6.5	6	4.9
Marine (exc. Naval forces)	5.1	5.6	1.1	2.1	1.5
Rail transport	12.3	19	11.4	19.4	19.0

Table 5.3: Consumption of Petroleum products by sector from 2018 to 2022

Source: KNBS, Economic Survey 2023

5.2.6 LPG Import and bulk storage infrastructure

There are two primary routes for importing LPG into the country: Namanga and the Mombasa port. The Mombasa port serves as the primary import route for LPG. Figure 5.7 shows a representation of the distribution of imports by route.

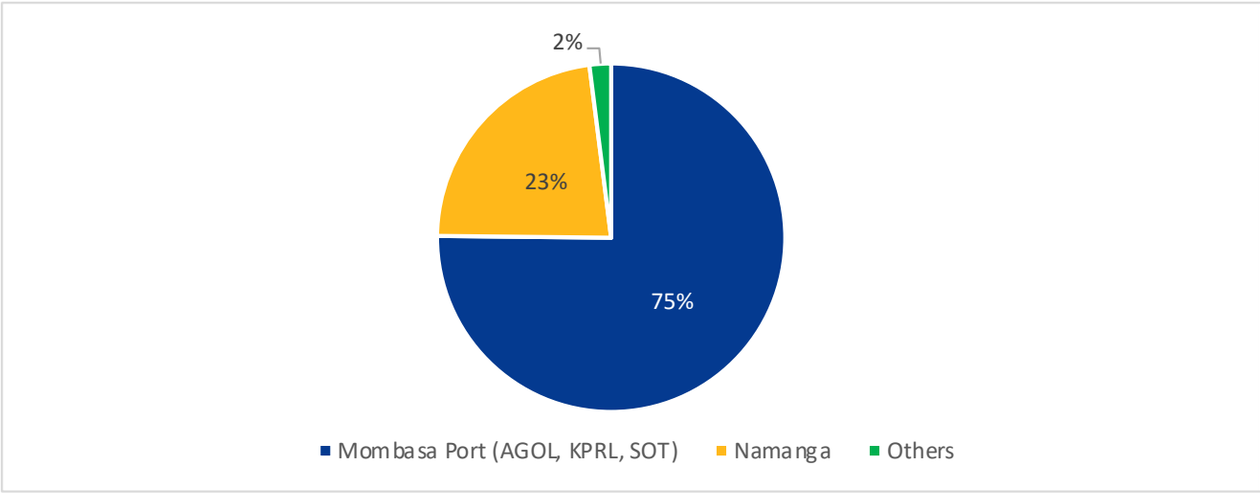


Figure 5.7: LPG imports distribution by route

There are two (2) jetties, Shimanzi Oil Terminal (SOT) and the African Gas and Oil Company Limited (AGOL) import facility, which are used to receive LPG into bulk storage facilities within Mombasa. AGOL has the largest bulk storage capacity of 25,000Mt. SOT connects to 5 LPG bulk storage facilities as indicated in table 5.4 below.

No.	Facility	Capacity (metric tons)	Location
1.	Kenya Petroleum Refineries Limited	1,195	Changamwe
2.	Vivo Energy Kenya Limited	445	Shimanzi
3.	Hashi Energy Limited	400	Changamwe
4.	Total Energies Marketing Kenya PLC	300	Changamwe
5.	OLA Energy Kenya Limited	415	Shimanzi
Total Capacity		**2,755**	

Table 5.4: Bulk LPG storage facilities connected to SOT

The total LPG import receiving infrastructure capacity within Mombasa currently stands at approximately 27,755 Mt. There are 117 LPG bulk storage and filling plants distributed in various parts of the hinterland as indicated in Table 5.5.

No.	Region	No. of Facilities	Combined Capacity (metric tons)
1.	Nairobi	42	3,194
2.	Central	26	978
3.	Rift valley	24	949
4.	Nyanza	7	388
5.	Eastern	6	295
6.	Coast	4	179
7.	Western	3	96
8.	North Eastern	5	86
Total		**117**	**6,164**

Table 5.5: Bulk LPG storage and filling facilities in the hinterland

5.3 Consumption of LPG

Demand for Liquefied Petroleum Gas (LPG) recorded a slight decrease in 2022 to 333,830 metric tonnes from 373,865 metric tonnes in 2021. There is still sustained use of LPG following continued government policy to promote use of clean energy. The trend in the consumption of LPG is illustrated in the figure 5.8.

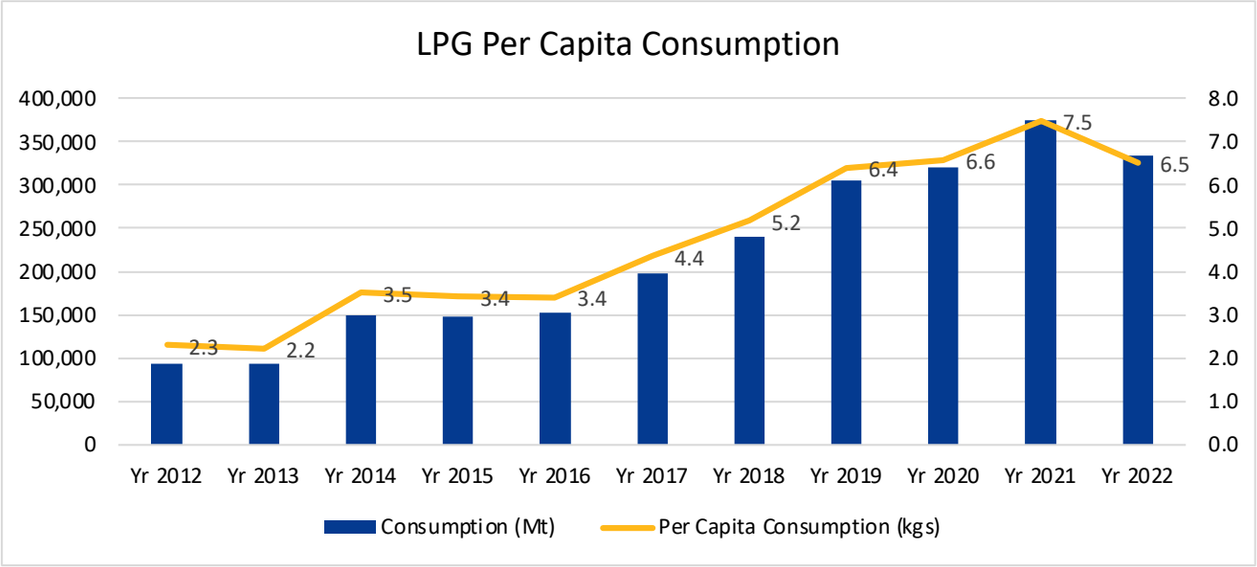


Figure 5.8: Consumption of LPG (Metric Tonnes) and Per Capita Consumption of LPG (Kgs)

It was noted that LPG consumption spiked in the second half of 2022, which is likely due to the reduced taxes on the commodity. Figure 5.9 shows the monthly trend in LPG consumption

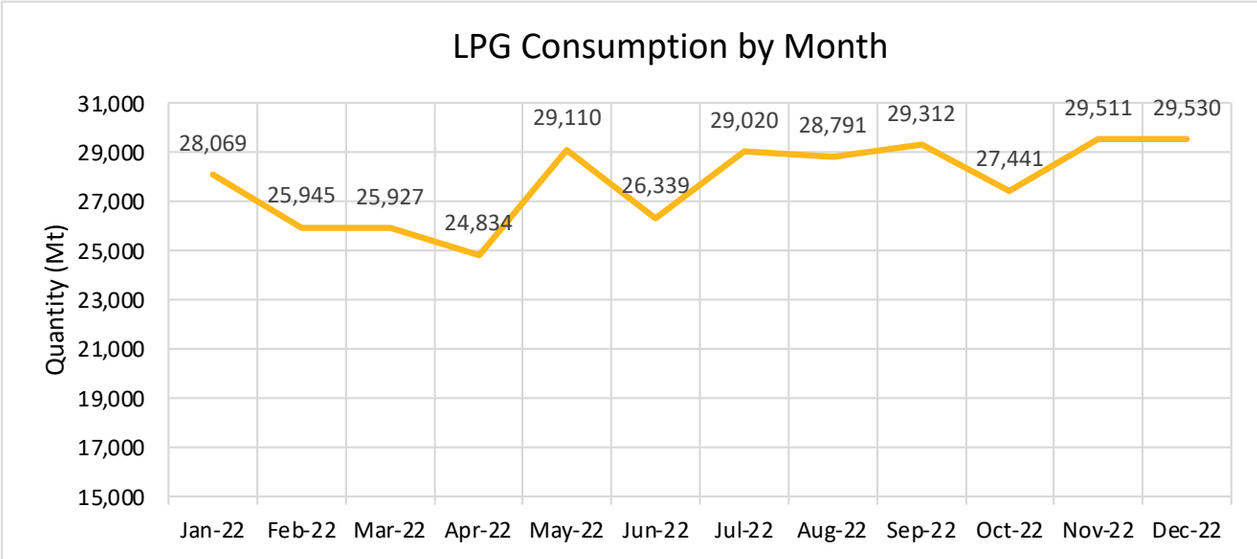


Figure 5.9: Consumption of LPG (Metric tonnes) by month

5.4 Petroleum Prices

5.4.1 Evolution of International Crude Oil prices

Murban Crude Oil recorded a peak price of 117.53 $/Bbl in September 2022 and a minimum price of 79.55$/Bbl in June 2023. There was an overall downward progression in international crude oil prices across the financial year. The decrease in crude prices was occasioned by the easing of the Russia - Ukraine conflict coupled with global decrease in oil demand.

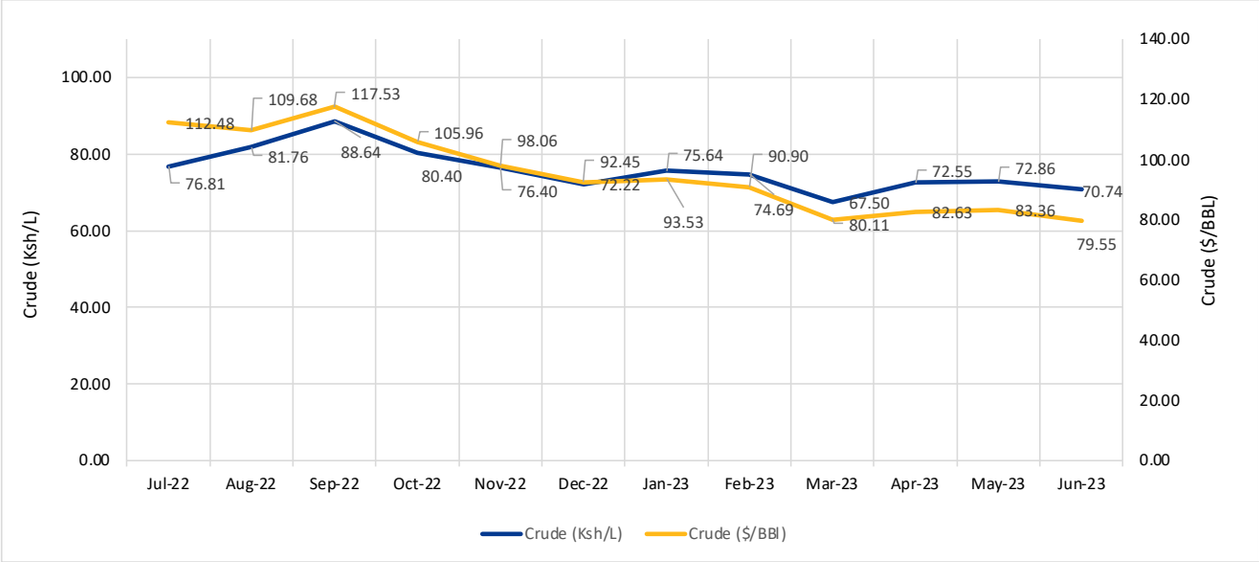


Figure 5.10: Trend in Murban Crude oil prices during the financial year 2022-2023

5.4.2 Local Retail Petroleum Prices

Fuel prices in Kenya are determined by factors such as landed costs, distribution costs, taxes and levies, demurrage costs and margins accrued by Oil Marketing Companies (OMCs). The Authority computes these costs and publishes monthly prices for super petrol (PMS), Diesel (AGO) and Illuminating Kerosene (IK) on the 14th day of every month. Figure 5.11 shows the trend of the Nairobi pump prices for the period July 2022 to June 2023.

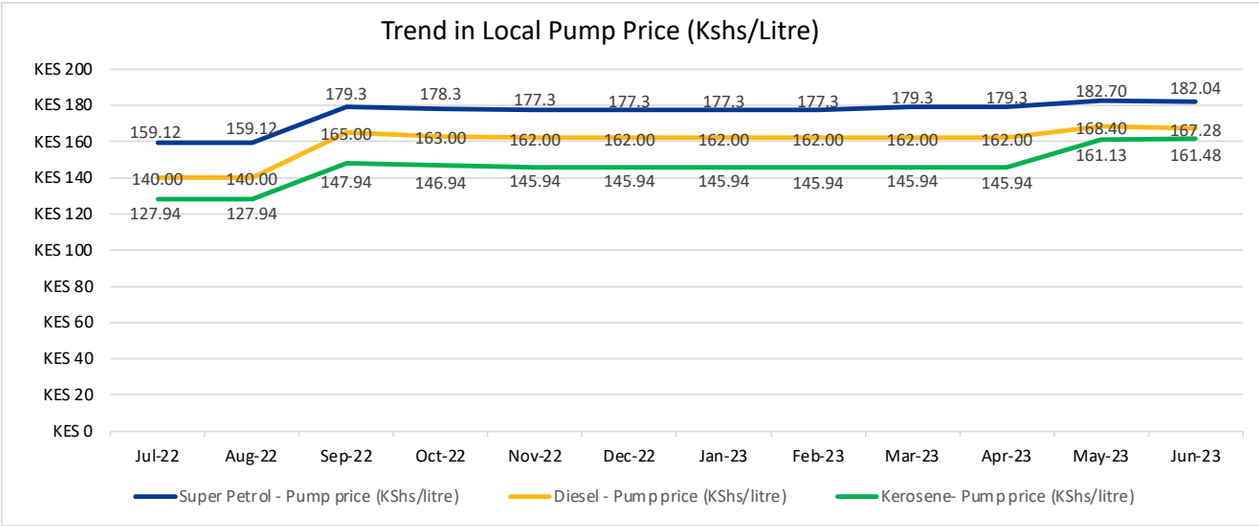


Figure 5.11: Trend in the local petroleum pump prices with Nairobi used as an example

5.5 Competition in the Petroleum Sector

5.5.1 Market Share

There were 137 registered Oil-Marketing Companies (OMCs) as at June 2023. These companies market petroleum products; diesel, kerosene, petrol, lubricants, and LPG. Table 5.6 presents the market shares of the OMCs during the review period.

OMC	Local sales volume for OTS imported products (m3)	% Share
Vivo Energy Kenya Limited	1,234,018.97	22.10%
TotalEnergies Marketing Kenya Plc	867,653.48	15.54%
Rubis Energy Kenya Plc	694,044.02	12.43%
Ola Energy Kenya Limited	419,581.00	7.51%
Oryx Energies Kenya Limited	260,209.56	4.66%
Be Energy Limited	211,594.43	3.79%
Stabex International Ltd	185,646.12	3.32%
Galana Oil Kenya Limited	148,186.61	2.65%
Lake Oil Limited	123,876.80	2.22%
Petro Oil Kenya Limited	112,730.00	2.02%
Hass Petroleum Kenya Limited	106,434.00	1.91%
Tosha Petroleum (Kenya) Limited	102,708.72	1.84%
Gapco Kenya Limited	93,964.70	1.68%
Gulf Energy Holdings Limited	81,161.05	1.45%
Texas Energy Ltd	74,655.96	1.34%
Fossil Supplies Limited	69,932.00	1.25%
Lexo Energy Kenya Limited	53,220.56	0.95%
Dalbit Petroleum Limited	42,004.17	0.75%
One Petroleum Limited	41,325.00	0.74%
Riva Petroleum Dealers Limited	39,670.72	0.71%
Others	621,778.26	11.13%

Table 5.6: Market share of Oil-Marketing Companies

5.5.2 Herfindahl–Hirschman Index (HHI)

In the financial year 2022/2023, the Herfindahl–Hirschman Index (HHI) for the downstream petroleum subsector stood at 0.1037. This marked a decrease from the previous financial year's figure of 0.1099, signifying an enhancement in competition within the sector, primarily attributed to the entry of new Oil Marketing Companies (OMCs) into the market.

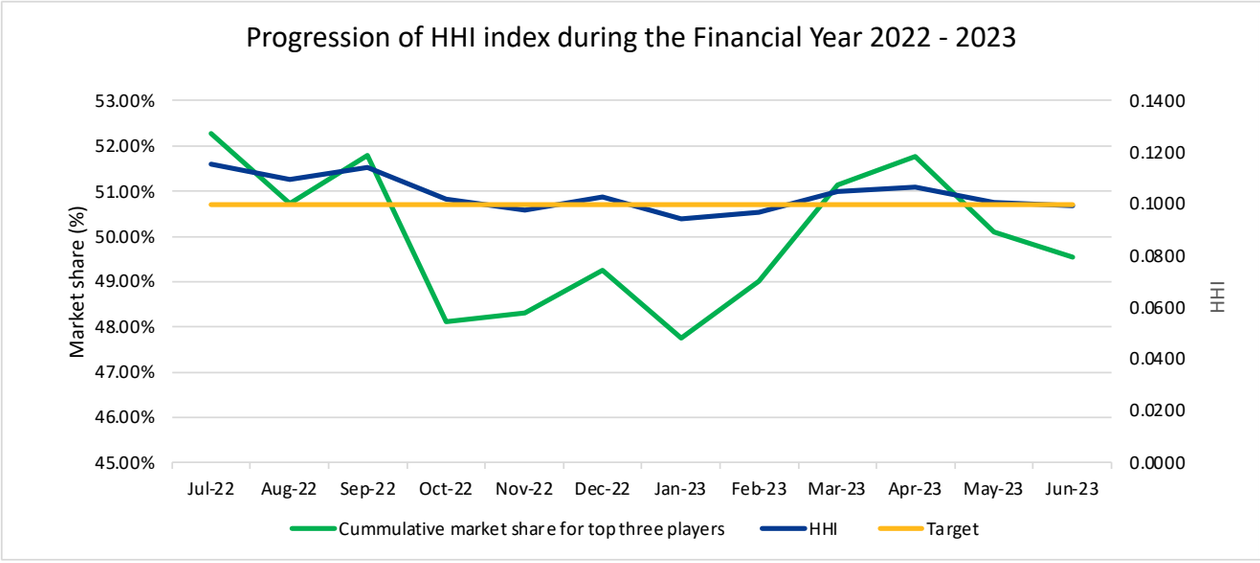


Figure 5.12: HHI index for downstream petroleum

5.6 Regional Statistics

Table 5.7 below shows an analysis of volumes of petroleum imported for domestic consumption for selected EAC countries during the financial year 2021/2022.

COUNTRY	VOLUME OF LOCAL IMPORTED PRODUCTS			
	Kenya	Rwanda	Tanzania	Zanzibar
PMS (m3)	2,053,765.79	147,703.17	1,418,177.35	95,968.66
AGO (m3)	2,624,784.78	235,250.46	2,131,178.65	54,569.91
IK* (m3)	861,333.81	4,151.32	169,585.43	5,734.03
JET–A1(m3)		45,382.59		18,383.22
LPG (Mt)	351,794.55	28,202.41	254,104.00	6,798.75

Table 5.7: An analysis of petroleum imported for domestic consumption

Source: EREA

*Dual Purpose Kerosene (DPK) import volume comprises Jet A-1 and Illuminating Kerosene.

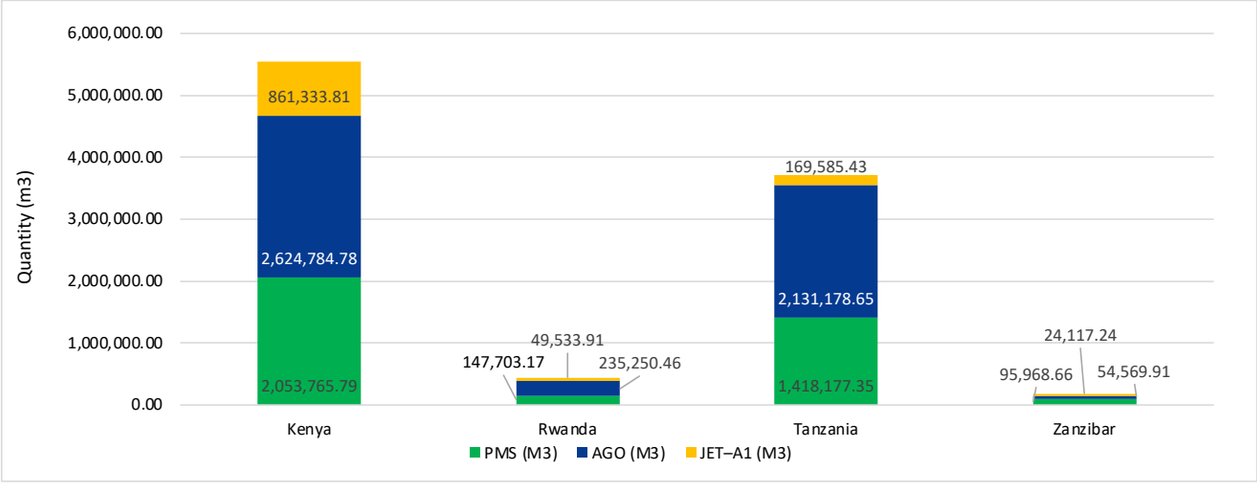


Figure 5.13: Trend in imports of petroleum products for domestic consumption

Kenya is also the largest importer of LPG in the EAC. Kenya imported 351,795 Mt of LPG for domestic consumption during the year.

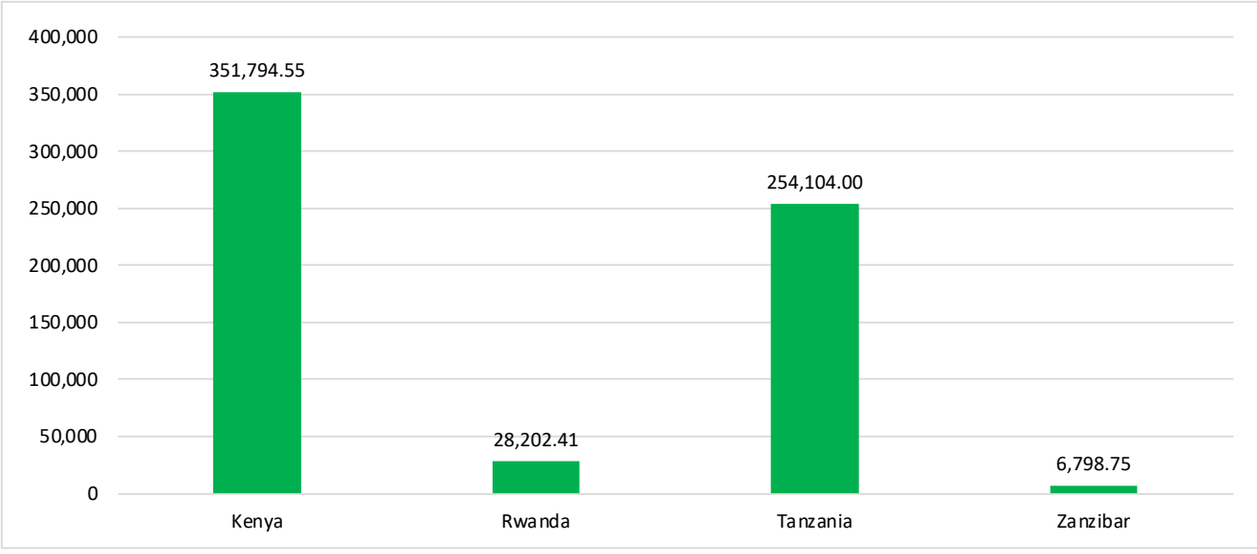


Figure 5.14: Trend in imports of LPG (Metric tonnes) for domestic consumption

CHAPTER
6

Other Energy Sources

6.1 Nuclear Power

Nuclear power has been proposed as a key component of Kenya's future energy mix. According to Kenya's Least Cost Power Development Plan (LCPDP) 2022-2041, it is projected that a 291 MWe nuclear power plant will be commissioned by 2038. Nuclear power's attractive attributes such as high capacity factor, low greenhouse gas emissions, and relatively small footprint further reinforces the need and urgency for its deployment.

The Nuclear Power and Energy Agency (NuPEA) is coordinating the implementation of the nuclear power programme. The Agency is guided by the International Atomic Energy Agency (IAEA) milestones framework in developing the requisite infrastructure to facilitate a successful nuclear power programme and in assessing the progress made in the development process. The Figure below depicts a schematic representation of the phases and milestones in the development of the infrastructure for a national nuclear power programme. At present, Kenya is in Phase 2 at which the country is implementing activities to ensure readiness to invite bids and negotiate a contract for the first Nuclear Power Plant.

To achieve this, preparatory activities for nuclear power plant construction are ongoing such as site selection, reactor technology assessment, funding and financing, and strategic environmental assessment being at advanced stages. Other activities being implemented include; the development of a nuclear regulatory framework, human resource capacity building, industrial assessment and stakeholder engagement.

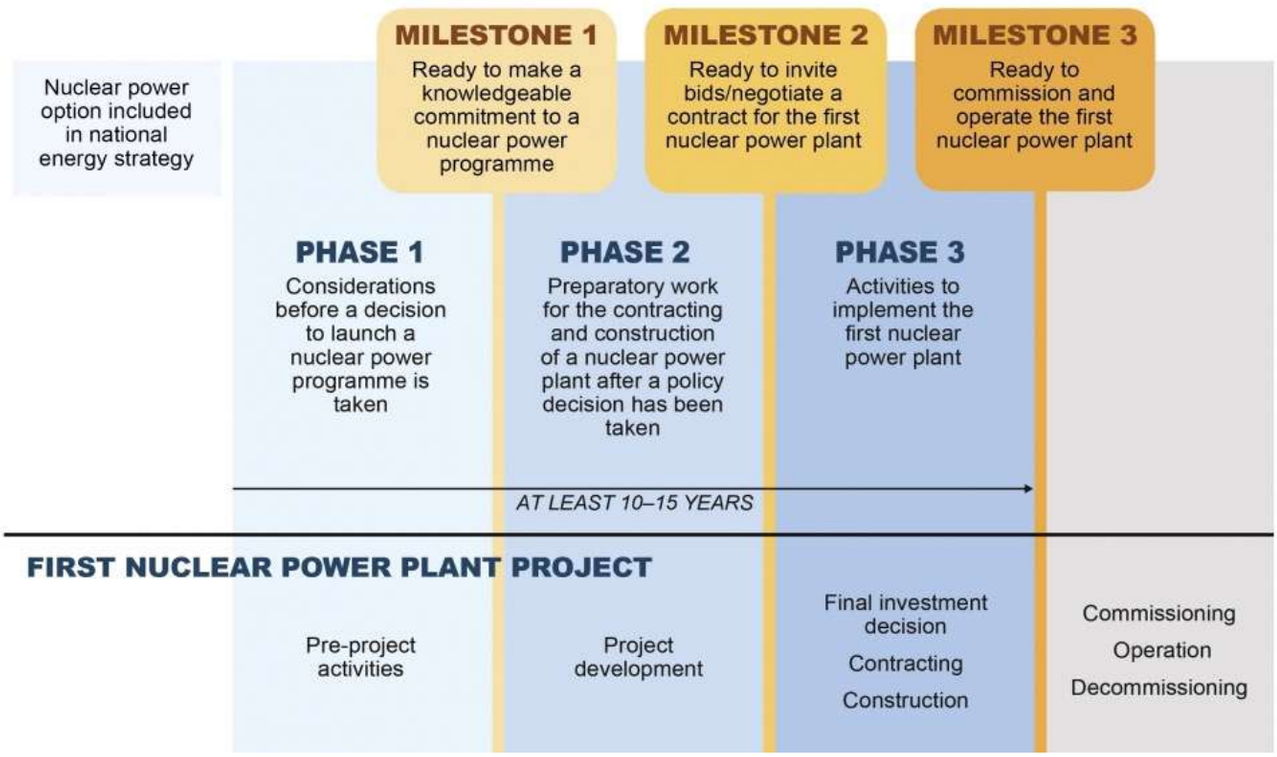


Figure 6.1: Nuclear Power Infrastructure Development

Source: NuPEA

CHAPTER 7

Kenya's Energy Balance

7.1 Structure of the Energy Balance for Kenya

An Energy balance is a method used to track the flow of energy within a geographical area in a given period. It shows, inter alia, the production, transformation and final consumption of all forms of energy with quantities expressed in terms of a single accounting unit for purposes of comparison and aggregation.

The structure of the energy balance in Kenya provides an overview of how energy is produced, transformed, distributed, and consumed within the country. It outlines the quantities of electricity generated, biomass produced, petroleum products and coal imported, energy lost and consumption by different sectors.

7.2 Total primary energy production

The country's total primary energy production was 18,117.75ktoe in 2022 an increase from 17,995.65 ktoe in 2021. This was derived mainly from biomass and renewable energy sources. Biomass was the dominant primary energy source contributing 95% to the total primary energy supply in the country. Renewable energy sources contribute the remaining 5%. Figure 7.1 shows the contribution of each of the primary sources of energy.

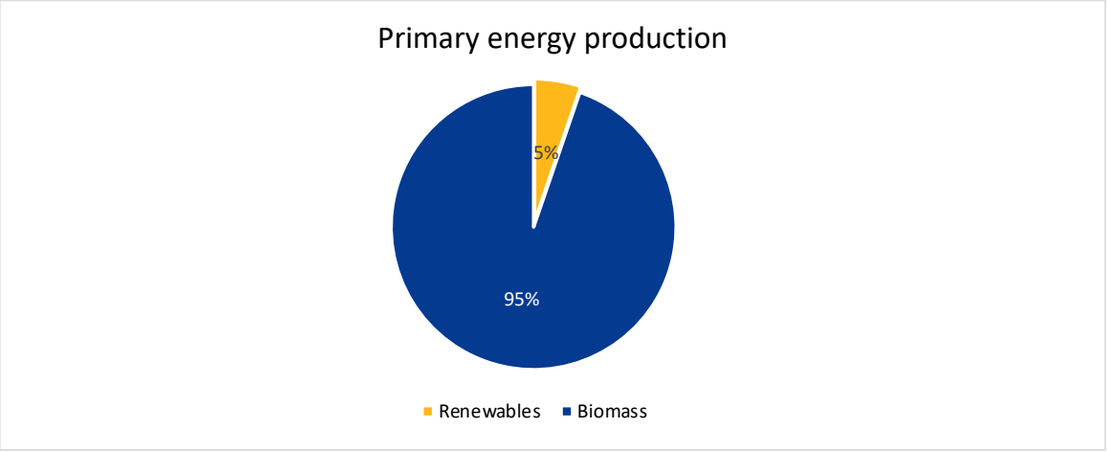


Figure 7.1: Total primary energy production in Kenya

7.3 Total Energy Supply

The total energy supply in the country comprises of both primary supply and imports which stood at 24,107.70 ktoe in 2022, a slight decline by 1.5% from 24,472.52ktoe in 2021. Of the total energy supply, 71% was from biomass and waste, 20% from petroleum products, 5% from coal and coke and 4% from renewable electricity sources. Figure 7.2 show the contribution of each energy source to the total energy supply in the country.

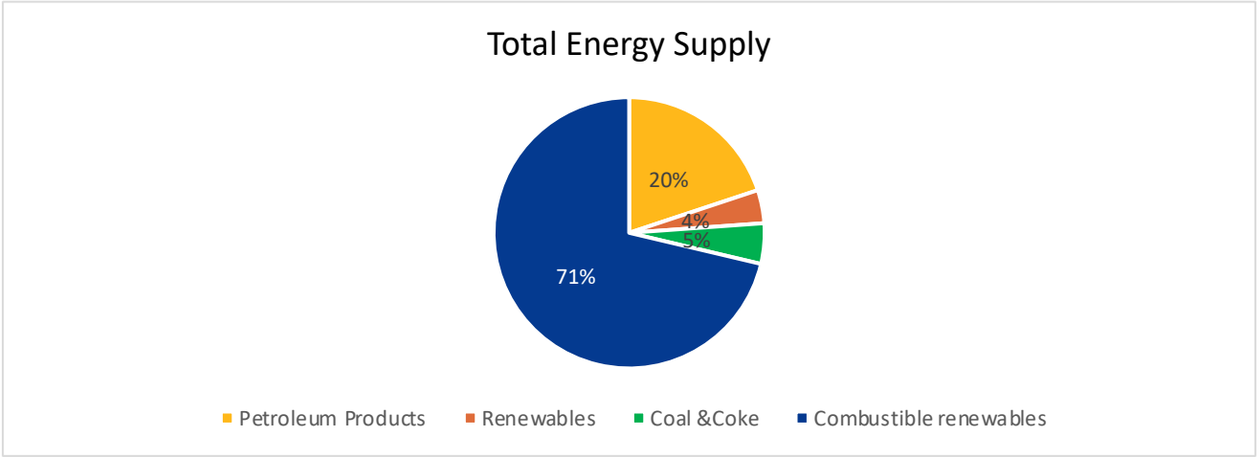


Figure 7.2: Contribution of each energy source to the total energy supply in 2022.

7.4. Total final consumption by sectors

The total final energy consumption in the country saw a modest increase of 0.16%, rising from 17,453.07 ktoe in 2021 to 17,480.52 ktoe in 2022. Notably, the residential sector accounted for a significant portion, representing 65% of the energy consumed within the country. The transport and industrial sectors followed with 27% and 10% consumption, respectively, while the commercial sector contributed to the remaining 1%.

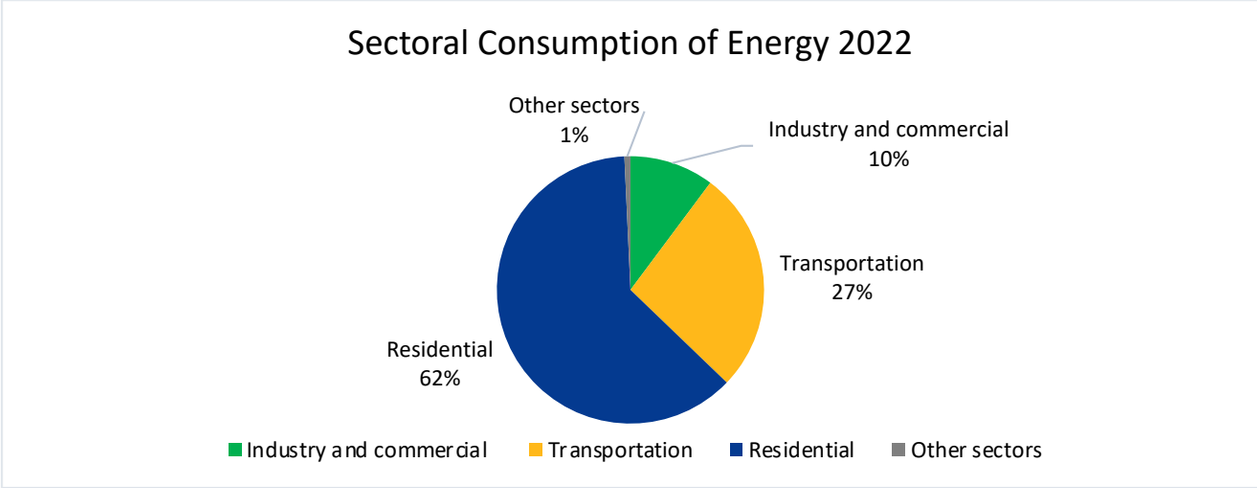


Figure 7.3: Total sectoral energy consumption in the country

An analysis of the energy balance shows that the total indigenous production, primary energy supply, and total final energy consumption have generally been increasing with the exception of the year 2020 which recorded a decline due to the impact of the COVID-19 pandemic. This overall increase can be attributed to both population growth and the expansion of the economy. Figure 7.4 shows the trend of the total indigenous production, total energy supply, and total energy consumption in the country from 2009 and 2022.

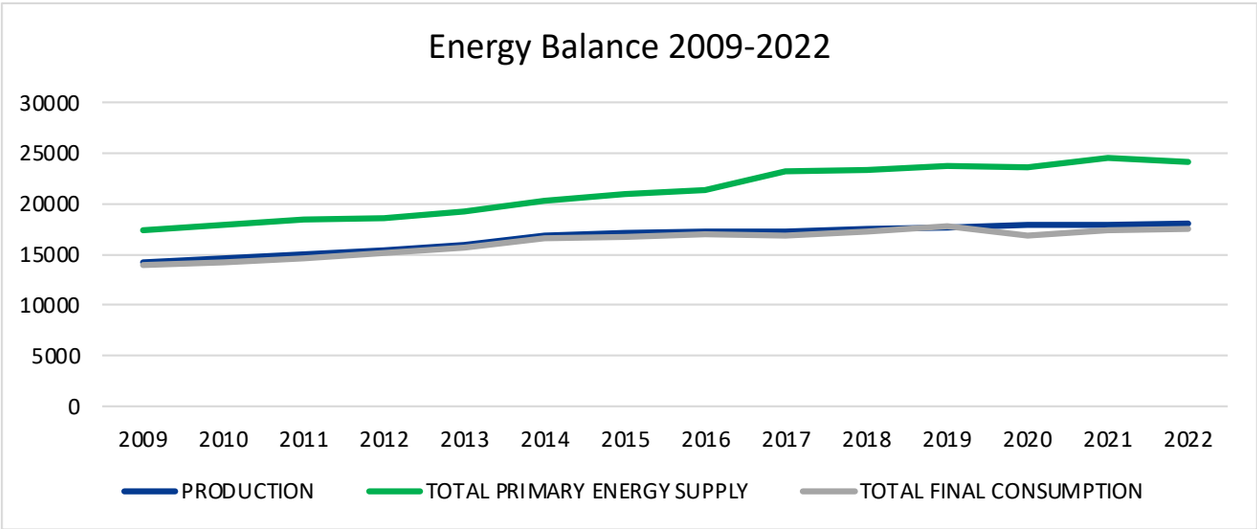


Figure 7.4: Trend in energy balances from 2009 to 2022

CHAPTER 8

Consumer Protection

8.1 Introduction

Consumer rights in Kenya are enshrined and protected by the Constitution of Kenya, 2010. These rights encompass various entitlements, including access to goods and services that meet reasonable quality standards, access to pertinent information for optimizing the benefits derived from such goods and services, safeguarding their health, safety, and economic interests, and receiving compensation for any losses or injuries resulting from defects in goods or services.

The Authority plays a vital role in safeguarding consumer interests within the energy and petroleum sector. This role is fulfilled through a range of activities, including licensing, economic regulation, monitoring the quality of energy and petroleum products, handling complaints and disputes, and investigating accidents and incidents. This section specifically covers aspects related to licensing, fuel quality, and LPG compliance.

8.2 Licensing

8.2.1 Licencing of Petroleum and LPG operations

The Authority grants licenses, permits or certificates to persons intending to undertake the importation, exportation, bulk storage or transportation of petroleum products. Table 8.1 summarizes the licenses issued in the financial year under review.

Type of licence	No. of licences issued
Driver Certification	8,916
Export and Wholesale of Petroleum Products(Except LPG)	1,160
Retail of LPG in Cylinders	1,024
Transport of petroleum products(Except LPG) by Road	947
Storage & Wholesale of LPG in cylinders	208
Transport of LPG in Cylinders	207
Import, Export and Wholesale of Petroleum Products (Except LPG)	137
Transport of LPG in bulk by Road	121
Storage & Filling of LPG in Cylinders	114
Import, Export and Wholesale of LPG in bulk	63
Transport of Jet-A1	50
Export and Wholesale of LPG in bulk	47
Export & wholesale of Jet-A1	46
Storage of petroleum products(Except LPG)	41
Import, Export and Wholesale of Bitumen	21
Import, Export and Wholesale of Fuel Oil	18
Bunkering of Petroleum Products (Except LPG)	9
Import of Lubricants	6
Storage & Filling of LPG in Bulk	11
Storage of LPG in Bulk	5
Storage of Crude Oil	1
Reticulation of LPG	1
Total	**13,153**

Table 8.1: Summary of Petroleum and LPG licences issued in the financial year 2022/2023

The permits issued during the period under review for the construction of petroleum facilities are detailed in Table 8.2.

Permit Category	Permits issued
Petroleum Retail Dispensing Station	54
LPG Storage And Filling Facility	12
LPG Storage depot	4
Pipeline	3
Fuel Consumer Site	2
Autogas Dispensing Station	2
Fuel storage Depot	1
Total	**78**

Table 8.2: No of petroleum and gas permits issued

8.2 Licencing of Electrical and Solar Photovoltaic Workers and Contractors

The Authority is responsible for licencing individuals and contractors engaged in electrical and solar photovoltaic system projects. The licencing process serves the critical purpose of ensuring that those involved in these activities possess the necessary competence, thus enhancing the functionality and safety of installations. Moreover, it guarantees that products and services conform to the required standards.

During the year under review, 469 electrical workers and 446 electrical contractors were licenced. Consequently, the total number of licenced electrical workers rose from 6,337 to 6,806, while the number of licenced electrical contractors increased from 2,660 to 3,106. It is worth noting that there was a balanced distribution between the issuance of electrical contractor and electrical worker licenses, a notable departure from previous years when a higher number of electrical worker licenses were issued compared to electrical contractor licenses. This shift can be attributed to the increased awareness and emphasis on licencing of contractors. Table 8.3 shows a comparisons in the number of licences issued between the financial year 2021/2022 and 2022/2023 in each category of contractors and electrical worker licences.

Licence Class	Electrical Worker Certificates		Electrical Contractor Licences	
	FY2022/23	FY2021/22	FY2022/23	FY2021/22
C2	205	325	195	107
C1	171	202	152	124
B	36	79	41	43
A1	52	52	52	46
A2	5	9	6	4
Total	**469**	**667**	**446**	**324**

Table 8.3: Electrical Worker and Contractor Licences issued during the financial year 2022

Additionally, licences were granted to 145 solar PV technicians, 245 solar PV companies, and 7 energy audit firms to carry out work on solar photovoltaic systems and energy efficiency projects.

Category	Class	Number of Issued
Solar PV Contractor/ Vendor/ Manufacturer	C1	71
	V1	67
	V2	107
Solar PV Technicians	T3	111
	T2	34
Energy Audit Firm	A	7

Table 8.4: Number of solar PV and energy efficiency licences issued during the financial year 2022/2023

8.3 Electrical appliances certification

The 2016 Energy (Appliances' Energy Performance and Labelling) Regulations have a primary focus on improving the energy efficiency of electrical appliances. These regulations mandate that both imported and locally manufactured refrigerators, non-ducted air conditioners, fluorescent lamps, and motors undergo testing to verify compliance with the relevant Kenya Standard.

Importers or manufacturers of these regulated appliances are eligible to receive a registration certificate upon demonstrating their compliance with these regulations. It's important to note that a registration certificate for a specific appliance model remains valid until the relevant standard is revised.

In the financial year 2022/2023, a total of 177 refrigerator models, 54 air conditioner models, and 1 fluorescent lamp model received certification. Figure 8.1 provides a representation of the growth in the number of certified appliances from 2017 to 2022.

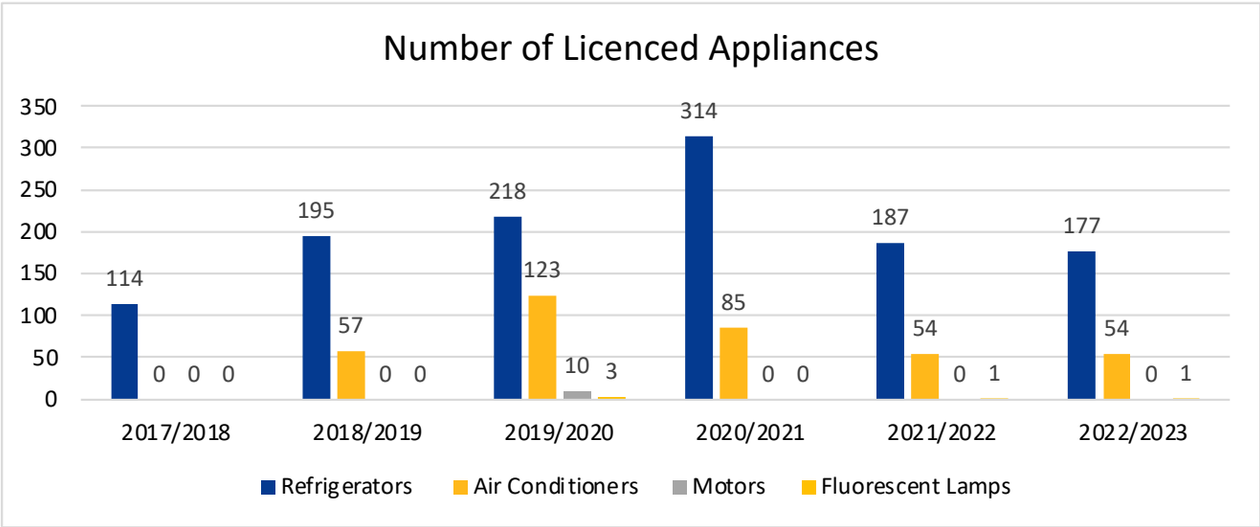


Figure 8.1: Growth in the number of certified appliances from 2017 to 2022.

As depicted in Figure 8.1, there was a notable increase in the certification of refrigerator models during the financial year 2020/2021. This surge was prompted by a modification in the Standard KS 2464:2020, necessitating the recertification of these specific models. However, it's important to note that the number of licenced air conditioners and refrigerators has been gradually decreasing, primarily because a significant portion of the available models in the market have already obtained their licenses. A comprehensive overview of the cumulative appliances licenced over the past six financial years is provided in figure 8.2.

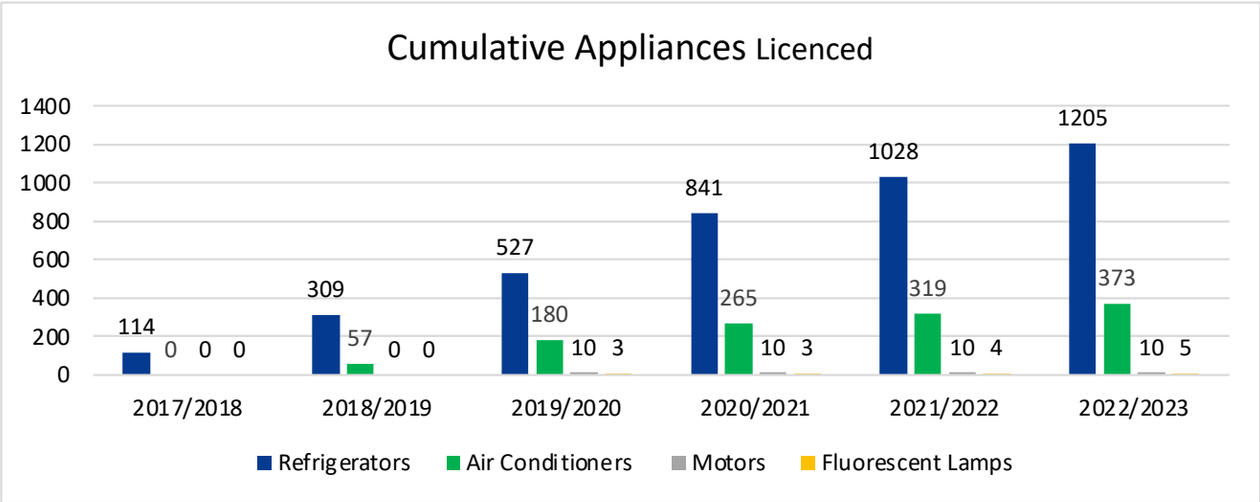


Figure 8.2: A comprehensive overview of the cumulative appliances licenced from 2017 to 2023

8.4 Fuel Quality Monitoring

The Authority monitors the quality of fuel both for local consumption and export bound through a process known as Fuel Marking. The process entails adding small amounts of a distinct identifier (referred to as the marker), commonly a bio-chemical liquid, to fuel products in order to identify the presence of fuel adulterants or fuels intended for export.

During the review period, the Authority marked 3,137,068,078 Litres of export/duty free motor fuels and 94,723,615 Litres of domestic kerosene.

When compared to the fiscal year 2021-22, there was a notable 8.32% increase in the volumes marked for export, while there was a significant 22.05% decrease in volumes marked for local kerosene. This decline in local kerosene products marked can be attributed to reduced demand for industrial and domestic use, as more consumers are transitioning to alternative fuels.

In the case of export products marked, there was a remarkable increase in the volumes marked. This increase can be attributed to Oil Marketing Companies (OMCs) choosing to transport products intended for the East African Market through the Northern Corridor.

Throughout the review period, the Authority conducted 21,190 sample tests at 4,445 petroleum outlets across the country. When selecting sample sites, the Authority takes into account various factors, including the need for nation-wide coverage, intelligence gathered through surveillance efforts, and feedback from the public. Out of the tests carried out, a substantial 98.76% (4,390) of the stations were found to be compliant with regulations. However, a total of fifty-five (1.24%) sites were identified as non-compliant, and appropriate penalties were imposed in accordance with relevant legislation.

8.5 LPG Monitoring

The Authority performs routine compliance inspections on LPG facilities to assess their adherence to regulatory requirements, operational safety standards, maintenance of plant and equipment, emergency preparedness, and risk management practices.

During the period under review, the Authority undertook 1,680 inspections on wholesale and retail sites which scored a compliance level of 53.54%, 108 bulk LPG road tankers with a compliance level of 79.35% and 36 LPG storage and filling plants with a compliance level of 65.15%.

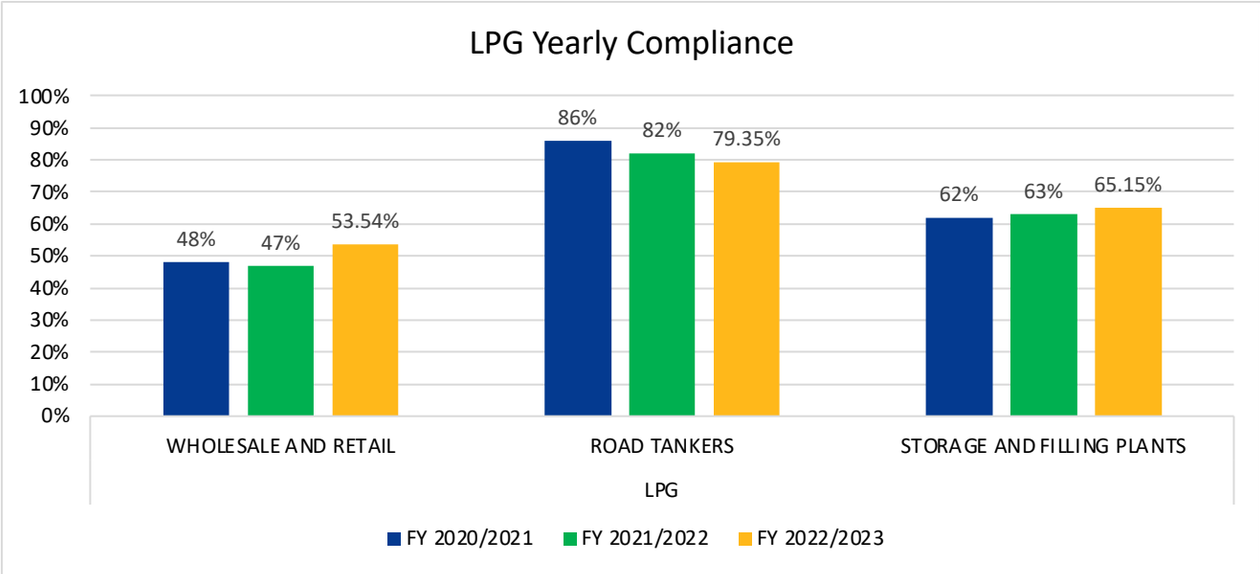


Figure 8.3: LPG compliance levels from 2021 to 2023

CHAPTER 9

Future Outlook

The country's installed capacity is expected to witness growth, primarily driven by developments in the Menengai geothermal field. A total of 105MW has been contracted to three developers, namely Sosian Energy, Globeleq, and Quantum Energy.

Moreover, there is an anticipated increase in electricity imports, with an additional 200MW expected from Ethiopia over the next three years, boosting the import capacity from Ethiopia to 400MW.

The EAC region is poised for an uptick in power trading, thanks to the impending commissioning of the Kenya-Tanzania 400kV interconnector. This infrastructure will enable the region to harness the abundant hydro resources in Tanzania and Ethiopia, as well as Kenya's geothermal resources, promoting economic prosperity across the region.

The share of renewables in the energy mix is expected to rise following the expiration of the Power Purchase Agreement (PPA) for the Kipevu Diesel Plant I in Mombasa, which had an installed capacity of 60MW and had been operational since 2003. Additionally, the Geothermal Development Company (GDC) is developing steam fields in the Baringo-Silali geothermal fields with an expected output of 300MW in the first phase.

Renewable energy capacity is set to increase further to meet the demand generated by proposed green hydrogen projects. Green hydrogen is viewed as an alternative for decarbonizing the transport, agricultural, and energy sectors. The Authority has received proposals for the development of renewable energy generation projects, specifically utilizing geothermal, wind, and solar technologies for green hydrogen production. This green hydrogen will find use in fertilizer production, serve as a transport fuel, contribute to energy storage, and even support export initiatives.

The push to decarbonize the transport sector has spurred an increased interest in electric mobility (e-mobility) in Kenya. The country's energy mix is well-suited to support e-mobility, with nearly 85% of energy generation coming from renewable sources. The uptake of e-mobility is expected to raise the country's energy demand, especially during off-peak periods when demand has historically been low. As of June 2023, there were 2,079 electric vehicles in the country, a figure that is aimed to reach 5% of the total registered vehicles by 2025. This is projected to increase the country's annual electricity consumption by 5.155 GWh.

Vehicle Type	Fleet size	Average Annual distance - km	kWh consumption/100 km	Projected annual electricity consumption (GWh)
Saloon	9	25,213	14.19	0.032
S. Wagon	181	44,314	14.19	1.138
Van	5	25,213	14.19	0.018
Lorry/Truck	3	48,383	124.6	0.181
Bus/Coach	20	43,815	124.6	1.092
Special Purpose	3	13,108	124.6	0.049
Trailer	20	48,383	124.6	1.206
Roller/Grader/Crane/Combine	4			
Wheel/Tractor	1			
Motor Cycle	1,500	17,807	4	1.068
Three Wheeler	176	17,807	6.1	0.191
Prime Mover	1			
Fork Lift	149			
Van/Pickup	3	44,314	124.6	0.166
Coupe	1	25,213	14.19	0.004
Double Cab	3	25,213	14.19	0.011
Total	**2079**			**5.155**

Table 9.1: Projected e-mobility electricity demand

Source: The Africa E-Mobility Alliance (AfEMA)

Captive generation is anticipated to play a significant role in future capacity additions as commercial and industrial consumers seek competitive alternatives to utility supply.

The future of the petroleum industry in Kenya holds promise, with several key decisions and infrastructure projects in the pipeline:

a) KPC's acquisition of KPRL is nearing completion, potentially revitalizing the entity by taking over tankage assets at Port Reitz and the refinery facility in Changamwe, alongside other useful assets.

b) The restructuring of NOCK into three segments: NOC Upstream Limited, NOC Downstream Limited, and NOC Trading Limited, is expected to improve accountability and enhance effectiveness in their respective sectors.

c) The government is keen on increasing the per capita consumption of LPG. To realize this, there is need to build infrastructure to enhance competition and provide for economies of scale allowing for less costly imports of LPG. H.E. Dr. William Samoei Ruto in February 2023, broke ground for the construction of a bulk LPG receiving terminal in Dongo Kundu SEZ. The facility which is owned by Taifa Gas is expected to have a storage capacity of 30,000 Mt.

d) Further, KPC is in the process of finalizing the Front End Engineering Design (FEED) for the proposed 30,000 Mt bulk LPG receipt terminal which will be constructed in Changamwe. Lake Gas Limited is also constructing a 10,000Mt facility in Kilifi. Additionally, there are a number of investors who have expressed interest in setting up bulk terminals in Kipevu. On the supply side, the government has issued a directive on implementation of reticulated systems for LPG in schools in Kenya. These developments will build towards growing the demand for LPG and ensuring that the commodity is available at a cost-effective price

e) Capacity improvements in KPC, including a new pipeline line between Mombasa and Nairobi, will enhance efficiency in the overall pipeline network.

f) Policy directives, such as the removal of the 8% VAT on LPG in the New Finance Act 2023, are expected to reduce LPG prices and boost demand.

These developments collectively suggest a positive outlook for the future of both the energy and petroleum sectors in Kenya.

Annexes

Annex 1: Electricity Transmission Infrastructure in Kenya

400KV Transmission lines

No.	Transmission line	Voltage	No. of circuits	Route length	Circuit Length	Owner
1	Isinya-Rabai	400kV	2	472	944	KETRACO
2	Loiyangalani-Suswa	400kV	2	436	872	KETRACO
3	Olkaria-Lessos	400kV	2	230	460	KETRACO
4	Suswa-Isinya	400kV	2	103	206	KETRACO
5	Kenya-Tanzania interconnector (Kenya side)	400kV	2	96	192	KETRACO
		1,337	**2,674**			

220KV Transmission lines

No.	Transmission line	Rated Voltage	No. of circuits	Route length (km)	Circuit Length (km)	Owner
1.	Kiambere-Rabai	220kV	1	440	440	KPLC
2.	Turkwel-Lessos	220kV	1	222	222	KPLC
3.	Kiambere-Embakasi	220kV	1	152	152	KPLC
4.	Rabai-Kakuyuni (Malindi)	220kV	1	122.3	122.3	KETRACO
5.	Kamburu-Dandora 2	220kV	1	109.5	109.5	KPLC
6.	Kamburu-Dandora 1	220kV	1	109	109	KPLC
7.	Kakuyuni (Malindi)-Garsen	220kV	1	105.8	105.8	KETRACO
8.	Garsen-Lamu	220kV	1	96.4	96.4	KETRACO
9.	Lessos-Kibos	220kV	2	70.5	141	KETRACO
10.	Isinya-Athi River	220kV	2	48.4	96.8	KETRACO
11.	Nairobi North- Thika Rd- Dandora	220kV	2	46.5	93	KPLC
12.	Suswa-Nairobi North	220kV	2	41	82	KPLC
13.	Kamburu-Kiambere	220kV	1	35	35	KPLC
14.	Olkaria I AU- Suswa	220kV	2	25.2	50.4	KETRACO
15.	Dandora-Embakasi	220kV	1	21	21	KPLC
16.	Olkaria IV- Suswa	220kV	2	18.3	36.6	KETRACO
17.	Athi-River- Embakasi + 6.5Km Cable I	220kV	2	18	36	KETRACO
18.	Kipeto-Isinya	220kV	1	17	17	KPLC
19.	Gitaru-Kamburu	220kV	1	7	7	KPLC
20.	OrPower-Olkaria II	220kV	1	7	7	KPLC
21.	Olkaria II-Olkaria 1AU	220kV	2	3	6	KETRACO
22.	Olkaria IV- Olkaria V	220kV	2	1.5	3	KETRACO
				1,716.4	**1,988.8**	

132KV Transmission lines

No.	Transmission line	Voltage	No. of circuits	Route length (km)	Circuit Length (km)	
1.	Mwingi- Garissa	132KV	1	204.3	204.3	KETRACO
2.	Kamburu-Ishiara-Meru	132KV	1	135.2	135.2	KETRACO
3.	Lessos-Lanet	132KV	2	126	252	KPLC
4.	Kindaruma-Mang'u	132KV	1	107	107	KPLC
5.	Maungu-Rabai	132KV	1	107	107	KPLC
6.	Mtito A'ndei-Voi	132KV	1	90	90	KPLC
7.	Kiboko-Mtito A'ndei	132KV	1	86	86	KPLC
8.	Naivasha-Juja Rd	132KV	2	76.2	152.4	KPLC
9.	Chemosit- Sotik- Kegati	132KV	1	72.1	72.1	KETRACO
10.	Tororo-Musaga	132KV	2	70.5	141	KETRACO
11.	Lanet-Naivasha	132KV	2	67	134	KPLC
12.	Musaga-Lessos	132KV	2	66	132	KPLC
13.	Olkaria-Narok	132KV	1	68	68	KETRACO
14.	Eldoret-Kitale	132KV	1	65.1	65.1	KETRACO
15.	Masinga-Kutus	132KV	1	64.8	64.8	KPLC
16.	Juja Rd-Konza	132KV	1	63	63	KPLC
17.	Konza- Sultan Hamud	132KV	1	62	62	KPLC
18.	Mangu-Githambo	132KV	1	58	58	KETRACO
19.	Lessos-Muhoroni	132KV	1	56.7	56.7	KPLC
20.	Kutus-Kiganjo	132KV	1	52.5	52.5	KPLC
21.	Sondu-Kisumu	132KV	1	52.2	52.2	KETRACO
22.	Kiganjo-Nanyuki	132KV	1	51.5	51.5	KPLC
23.	Muhoroni-Kisumu	132KV	1	48.5	48.5	KPLC
24.	Rabai-Galu	132KV	1	48	48	KETRACO
25.	Mwingi – Kitui	132KV	1	46	46	KETRACO
26.	Mangu-Juja Rd	132KV	1	46	46	KPLC
27.	Kegati-Awendo	132KV	1	44.00	44	KETRACO
28.	Sultan Hamud-Kiboko	132KV	1	43	43	KPLC
29.	New Bamburi-Mombasa Cement	132KV	1	41.6	41.6	KPLC
30.	Sultan-Wote	132KV	1	41	41	KETRACO
31.	Awendo-Ndhiwa	132KV	1	35	35	KETRACO
32.	Mumias-Rangala	132KV	1	34	34	KETRACO
33.	Lessos-Eldoret	132KV	1	32.1	32.1	KPLC
34.	Muhoroni-Chemosit	132KV	1	30.7	30.7	KPLC
35.	Kindaruma-Mwingi	132KV	1	29.32	29.32	KETRACO
36.	Mangu-Gatundu	132KV	1	29	29	KETRACO
37.	Voi-Maungu	132KV	1	28	28	KPLC
38.	Ishiara-Kieni	132KV	1	27	27	KETRACO
39.	Sotik-Bomet	132KV	1	26.47	26.47	KETRACO

No.	Transmission line	Voltage	No. of circuits	Route length (km)	Circuit Length (km)	
40.	Meru-Isiolo	132KV	1	26	26	KETRACO
41.	Olkaria1AU-Naivasha	132KV	1	23.1	23.1	KPLC
42.	Rabai-New Bamburi	132KV	1	22.5	22.5	KPLC
43.	Mumias- Musaga	132KV	1	22	22	KPLC
44.	Kindaruma-Kamburu	132KV	1	18.4	18.4	KPLC
45.	Masinga-Kamburu	132KV	1	18.4	18.4	KPLC
46.	Musaga-Webuye	132KV	2	18	36	KETRACO
47.	Kipevu III- Rabai	132KV	2	18	36	KPLC
48.	Mombasa Cement-Kilifi	132KV	1	17.6	17.6	KPLC
49.	Kipevu II- Rabai	132KV	1	17	17	KPLC
50.	Total KPC Tee-offs from Juja-Rabai line	132KV	1	15.1	15.1	KPLC
51.	Galu-Tiomin	132KV	1	14	14	KPLC
52.	Menengai-Soilo	132KV	2	13	26	KETRACO
53.	Jomvu-Rabai	132KV	1	12	12	KPLC
54.	Konza-Katoloni	132KV	1	11.4	11.4	KETRACO
55.	Jomvu Tee-Off- New Bamburi tee-off	132KV	1	9.8	9.8	KPLC
56.	Kibos- Kisumu (Mamboleo)	132KV	2	9.1	18.2	KETRACO
57.	Kipevu 1-Jomvu	132KV	1	8.7	8.7	KPLC
58.	Gitaru-Kamburu	132KV	2	7.7	15.4	KPLC
59.	Sangoro-Sondu	132KV	1	6	6	KETRACO
60.	Olkaria1AU-Olkaria II	132KV	1	4	4	KPLC
61.	Simba Cement Tee-off	132KV	1	3.1	3.1	KPLC
62.	Mariakani LILO	132KV	1	3	3	KPLC
63	Roysambu Tee-Off 1	132KV	1	3	3	KPLC
64	Dandora-Juja Rd	132KV	1	2	2	KPLC
65	Dandora-Juja Rd	132KV	1	2	2	KPLC
66	Olkaria 1-Olkaria 1AU	132KV	1	2	2	KPLC
67	Roysambu Tee-Off 2	132KV	1	2	2	KPLC
69	Rai MDF Tee-Off	132KV	1	1.1	1.1	KPLC
				2,692.79	**3,164.29**	

Quality Management

The Authority is committed to providing quality regulatory services for the energy and petroleum sectors in Kenya in compliance to international standards, legal requirements, statutory requirements, policy requirements, the needs and expectations of its stakeholders. The commitments are achieved through tools such as the Quality Management System (QMS) set out in the ISO 9001:2015.

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