KeSEBAE NEWS

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Electricity for Transformation of Kenya

By Yvonne Madahana

Kenya stands at a pivotal moment in its development journey where electricity is no longer a convenience but a critical enabler of transformation. As of now, the country has an installed electricity generation capacity of approximately 3,243 megawatts, with power sourced predominantly from hydropower, geothermal, thermal and wind energy. These sources have underpinned national growth thus far but remain insufficient to meet the country's ambitious socio-economic targets. Despite notable strides in expanding the grid and integrating diverse energy sources, electricity access remains uneven. While national connectivity has reached approximately 84 percent, many rural and marginalized regions still lack reliable and affordable power. The electricity sector is largely managed by three key institutions: Kenya Electricity Generating Company PLC, KenGen, which is responsible for electricity generation, Kenya Electricity Transmission Company Limited, KETRACO, which handles high-voltage transmission, and Kenya Power and Lighting Company, KPLC, which oversees distribution and retail. While these agencies have facilitated growth in power infrastructure, the system still grapples with inefficiencies including frequent outages, technical losses and the limitations of a centralized distribution monopoly. Addressing these challenges is fundamental to unlocking Kenya's full potential. Electricity must be made accessible, affordable and dependable to power industries, modernize agriculture, enhance service delivery and uplift the quality of life for all Kenyans.

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A monthly Newsletter touching on topical issues affecting our environment.

KeSEBAE NEWS is a Newsletter of the Kenya Society of Environmental, Biological and Agricultural Engineers (KeSEBAE)

Inside this Issue!

The transformation we seek as a nation will not be realised without transforming the way we produce, transmit and distribute power.

Why Electricity Matters for Transformation

Electricity is not only a basic necessity but also a cornerstone of economic progress. Across the globe, nations that have achieved sustained growth and improved living standards have done so by expanding access to reliable and affordable power. In Kenya, electricity plays a vital role in supporting key sectors such as manufacturing, agriculture, transport and domestic livelihoods. The pace at which we industrialise and improve social services is directly linked to how rapidly we can expand and stabilise our power supply.

There is a strong correlation between electricity consumption and economic growth. As national income rises, so does demand for energy to fuel productivity, innovation and consumption. In Kenya, increasing electricity use per capita is both a target and a signal of transformation. Vision 2030 aspires to increase per capita electricity consumption from the current 160 kilowatt-hours to over 4,000 kilowatt-hours to align with middle-income benchmarks.

Each economic sector carries distinct energy demands. Industry, including manufacturing and processing, is among the largest consumers of electricity, requiring consistent power for operations, machinery and automation. Agriculture increasingly depends on electricity for irrigation, cold storage and mechanised processing. The transport sector, with emerging electric mobility and electrified rail systems, is set to become a major power user. In the domestic sector, households rely on electricity for lighting, cooking, refrigeration and access to digital services. Meeting the energy needs of each sector is essential for inclusive development.

Global case studies offer useful lessons. China has experienced exponential electricity consumption growth alongside its industrial expansion, enabling it to lift millions out of poverty and become a manufacturing giant. Malaysia, once at Kenya's economic level, has grown its electricity consumption per capita more than tenfold over the past few decades, supporting a modernised economy. South Africa, while facing challenges, remains the continent's largest electricity consumer, with a per capita usage that far surpasses Kenya's, owing to its advanced mining and industrial sectors.

For Kenya, realising a similar trajectory will require deliberate investment, inclusive policies and innovation in power generation and delivery.

Road to 60,000MW: Generation Targets

To become a newly industrialised middle-income economy, Kenya must dramatically scale up its power generation capacity. Vision 2030 projects a leap from the current 3,243 megawatts to over 60,000 megawatts of installed capacity. This target is driven by the need to meet rising per capita electricity demand, support growing sectors, and enable full electrification across the country.

The proposed generation mix under Vision 2030 includes both renewable and non-renewable sources, carefully balanced to ensure sustainability, reliability and energy security. Kenya's strength lies in its abundant renewable energy potential, which already contributes over 80 percent of the current electricity supply. Going forward, renewables will continue to form the backbone of expansion, complemented by strategic investments in conventional energy sources.

Geothermal energy is expected to play the largest role in the generation mix, projected to contribute around 26 percent of total capacity. Kenya has vast untapped geothermal reserves, particularly in the Rift Valley, and is already a continental leader in this sector. Wind and solar power will also increase their contributions, supported by major projects such as the Lake Turkana Wind Farm and growing private sector investment in solar mini-grids and utility-scale installations.

***Table 1**: Consumption Per Capita (kilowatt-hours, kWh)*

	Consumption Per Capita (kilowatt-hours, kWh)							
	Coal	**Oil**	**Gas**	**Nuclear power**	**Hydropower**	**Wind**	**Solar**	**Other renewables**
China	18,036.30	6,315.73	3,060.56	774.76	2,327.21	1,713.36	1,441.84	459.06
Malaysia	8,455.88	14,058.86	12,983.89	0.00	2,358.74	0.00	241.52	129.67
South Africa	15,251.93	4,186.91	745.39	297.22	41.92	422.97	251.50	22.96

Despite the focus on renewables, non-renewable sources such as coal, liquefied natural gas (LNG) and nuclear energy are expected to contribute significantly to meet baseload demand. Nuclear energy is anticipated to provide up to 19 percent of total capacity, with the first plant projected by 2030. LNG will account for

about 11 percent, offering a flexible and cleaner option compared to traditional thermal sources. Coal remains part of the mix at 13 percent, although its development must be guided by stringent environmental safeguards and clean technologies. Kenya's energy future must strike a balance between economic imperatives and environmental responsibilities. As the country moves toward its 60,000-megawatt target, the emphasis should remain on affordability, diversification and climate resilience

Transmission and Distribution

Expanding electricity generation is only part of the challenge; effective delivery to homes and businesses requires a strong transmission and distribution network. Kenya's transmission infrastructure is managed by KETRACO. As of early 2025, the high-voltage transmission network spans approximately 9,100 kilometres, with KETRACO owning and operating about 5,638 kilometres. These lines include voltage levels of 132 kV, 220 kV, 400 kV and 500 kV.

Major expansion efforts are underway. KETRACO's Transmission Master Plan (2023–2042) aims to add around 9,600 kilometres of new high-voltage lines and increase transformer capacity by nearly 15,900 MVA to meet future demand and evacuate power from large-scale renewable energy projects.

On the distribution front, KPLC manages the medium- and low-voltage networks and is responsible for connecting most consumers to the grid. KPLC operates an extensive system of over 310,000 kilometres, although most high-voltage transmission is under KETRACO's mandate. The Rural Electrification and Renewable Energy Corporation (REREC) plays a complementary role, focusing on connecting underserved and off-grid communities through grid extensions and decentralised solutions.

One of the major constraints in the sector has been the monopoly over distribution. However, reforms are now opening the space for other licensed distributors to use the existing infrastructure through regulated wheeling arrangements. The Energy and Petroleum Regulatory Authority (EPRA) is preparing and implementing the necessary regulatory frameworks to support this shift, signalling the government's commitment to liberalise the electricity market. This transition is expected to enhance competition, expand access and improve service quality, particularly in regions that have historically been underserved.

Looking ahead, modernising Kenya's grid requires investment in smart technologies, flexible systems and inclusive governance.

Legislation, Policy and Reform

Kenya's electricity sector has been shaped by a series of legislative and policy developments aimed at expanding access and encouraging investment in renewable energy. One of the key milestones was the enactment of the Energy Act of 2006. This law provided a framework for regulating the generation, transmission and distribution of electricity, while also addressing petroleum and other energy resources. However, as the sector evolved and the need for a more integrated approach became clear, the Energy Bill of 2015 was introduced. This eventually led to the Energy Act of 2019 which now governs the sector.

The Energy Act of 2019 introduced a number of important reforms. It established several key institutions including the Nuclear Power and Energy Agency, NuPEA and the Rural Electrification and Renewable Energy Corporation. It also clarified the roles of players across the energy value chain and promoted the development of renewable energy technologies and energy efficiency measures.

To encourage investment in clean energy, the government introduced a Feed-in Tariff policy in 2008. This was later revised in 2010 and 2012. The policy offers guaranteed prices for electricity generated from renewable sources such as wind, solar, small hydro and biomass. In addition, the government has provided incentives such as VAT exemptions on renewable energy equipment and zero-rated import duty on items like wind turbines and solar panels. There are also dedicated credit facilities available to support green energy projects.

Despite these efforts, several gaps remain in the current policy framework. One of the major challenges is integrating renewable energy into the national grid. This is complicated by a lack of storage infrastructure and smart grid systems.

There is also slow progress in the development of regulations for net metering and wheeling which are important for encouraging distributed generation. Tariff structures remain a concern as there is a need to balance affordability for consumers with the financial sustainability of power utilities. Coordination of off-grid electrification efforts, especially across counties, has also been inconsistent.

In response to these issues the government has proposed several reforms. These include a shift from feed-in tariffs to a competitive auction model for procuring large-scale renewable energy projects. There is also an effort to improve planning through the use of digital platforms and energy data. Enhancing the independence and capacity of the Energy and Petroleum Regulatory Authority is another key objective.

Several institutions play a central role in implementing these reforms.

i. The EPRA is responsible for regulating the energy sector including setting tariffs and licensing.
ii. The NuPEA promotes research and development in nuclear energy and supports national planning.
iii. The REREC is tasked with implementing rural electrification and renewable energy projects.
iv. The KETRACO and KenGen manage transmission and public power generation infrastructure respectively.
v. At the policy level the Ministry of Energy and Petroleum provides overall leadership and coordination.

Sustainability and Environmental Considerations

Kenya's electricity sector is strongly anchored in sustainability. Over 90 percent of grid electricity is from renewable sources including geothermal, hydro, wind and solar. The country is also promoting cleaner off-grid options like solar home systems, biogas, briquettes and improved cookstoves to reduce reliance on wood fuel and kerosene.

Major green energy technologies renewable projects have greatly lowered emissions:

i. Olkaria Geothermal Fields in Naivasha generate over 950 MW, using reinjection technology to reduce land and water impact.

***Figure 1**: Olkaria Geothermal Fields*

ii. Lake Turkana Wind Power (310 MW) contributes 17 percent of national demand and monitors bird migration to reduce ecological harm.
iii. Garissa Solar Plant (54.6 MW) powers thousands of homes while avoiding over 43,000 tonnes of carbon emissions annually.

At the community level:

iv. Biogas systems are widely used in rural households, especially in Central and Rift Valley regions, converting animal waste into clean cooking fuel.
v. Charcoal briquettes, made from agricultural waste, offer a low-cost and cleaner alternative to traditional charcoal in urban settlements.

All large energy projects must undergo Environmental and Social Impact Assessments (ESIAs), overseen by the National Environment Management Authority (NEMA). Common mitigation actions include tree planting and land rehabilitation, creation of wildlife corridors around wind farms, Safe disposal of solar batteries and e-waste and dust and noise control during construction. In geothermal areas, KenGen monitors air quality, reuses geothermal fluid and conserves nearby forests to minimise impact.

Energy projects often require land, so community engagement is mandatory. Developers must hold public consultations and provide fair compensation, either in cash or through relocation, infrastructure or shared benefits. Example is at Olkaria IV and V, displaced Maasai families were resettled with new homes, roads, schools and healthcare under a World Bank-funded plan.

Even small-scale projects are becoming more inclusive. NGOs and county governments promote biogas and solar lighting in schools, health facilities and public markets, often with community co-funding or training schemes.

Challenges Ahead

Kenya's energy sector has made impressive progress, but several constraints remain:

i. Infrastructure gaps: Reliable electricity access remains limited in remote and marginalised counties. Grid extension is expensive and time-consuming, and many mini-grids face maintenance and scaling issues.
ii. Financing limitations: Large energy projects often depend on external loans or grants.

iii. Private investors face risks from currency fluctuations, delays in approvals and challenges securing long-term power purchase agreements.
iv. Policy and regulatory bottlenecks: Implementation of updated tariff models is slow. The renewable energy auction framework is yet to be finalised, and there is no clear policy on net metering. Coordination between national and county governments, particularly for off-grid electrification, is often inconsistent.

Opportunities for Innovation and Entrepreneurship

i. Smart energy technologies: Innovations like prepaid meters, solar-powered cold storage units and mobile-based energy management tools offer scalable solutions for both urban and rural areas.
ii. Local manufacturing: There is potential for growth in the local production of solar components, improved cookstoves and charcoal briquettes to meet rising demand and reduce imports.
iii. Training and capacity building: Expanding technical training for solar installers, mini-grid operators and energy auditors will improve service delivery and create jobs.
iv. Productive use of electricity: Electricity can power agro-processing, irrigation, water pumping and ICT services, especially in rural areas, boosting income and local development.
v. Green industrial investment: Kenya's strong renewable base positions it well to attract sustainable manufacturing, carbon credit schemes and climate finance.

Energising Kenya Together

Transforming Kenya's energy future requires collective effort. The government must continue investing in infrastructure, improving policy clarity and ensuring transparency in procurement and regulation. County governments should strengthen support for last-mile access and localised energy planning. The private sector has a critical role in bringing capital, technology and business models that reach underserved areas. Public-private partnerships can fast-track mini-grids, energy-efficient housing and clean cooking solutions. Academia and research institutions should expand their role in training, innovation and evidence-based policymaking. Energy curricula must reflect real-world needs, and universities can be centres for piloting clean energy solutions. Citizens also play a role. By choosing cleaner technologies, paying energy bills on time and participating in public consultations, communities can help shape a just and inclusive energy transition.

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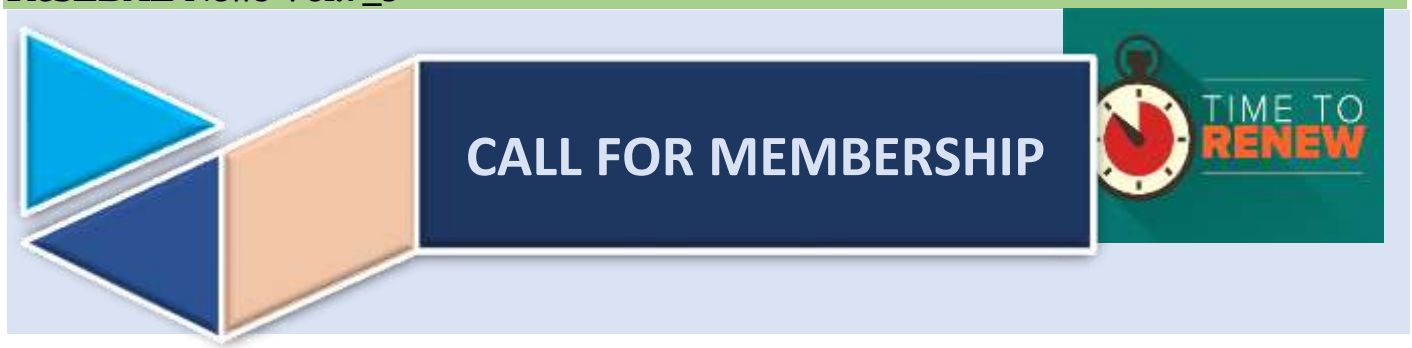

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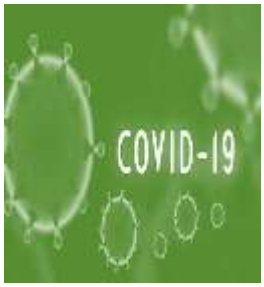

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