ENERGY
CATALYST

Country Guide: Kenya

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Geography and climate

Kenya is located on the equator in eastern Africa. It has a south-eastern coastline along the Indian Ocean and shares land boundaries with Ethiopia, Somalia, Sudan, Tanzania and Uganda. The climate of Kenya varies from tropical along the coast to arid in the interior. Kenyan weather is generally sunny year-round with the main rainy seasons in March to May and November to December. The terrain consists of low plains rising to the central highlands bisected by Great Rift Valley, and a fertile plateau in the west. It has diverse geographical features ranging from barrier reefs off the Indian Ocean coast to sandy desert, forested uplands, and the perpetually snow-covered Mount Kenya.

Government

Kenya's political governance has evolved over time with a mix of one-party and multi-party systems, with the latter more dominant. Kenya promulgated her new constitution in 2010, ushering in a devolved system of government where 47 semi-autonomous counties were formed. The country is run by the National Government led by a president and 47 county governments led by governors. In October 2017, President Uhuru Kenyatta was re-elected as president for his final five-year term after a repeat election which the main opposition party boycotted after the Supreme Court had invalidated presidential elections held in March 2017. Elections,

Figure 1: Map of Kenya. Source: d-maps

held every five years, sometimes have traces of conflict fuelled by tribal intolerance.

Economy

Kenya is the economic, financial, and transport hub of East Africa. GDP grew by an estimated 5.9% in 2019, driven by household consumption and investment on the demand side and services on the supply side. In alignment with the country's long-term development plan, Vision 2030, the President in December 2017 outlined the "Big Four" development priority areas. These areas are manufacturing, universal healthcare, affordable housing and food security.

Historically, economic freedom in Kenya has been hampered by weak rule of law. Devolution ushered in a new political and economic governance system. It was transformative, and has promoted greater investments at the grassroots. Kenya has met some Millennium Development Goals (MDGs) targets, including reduced child mortality, near universal primary school enrolment, and narrowed gender gaps in education. Agriculture is the biggest contributor to the Kenyan economy, accounting for about half of GDP. Kenya's Vision 2030 programme highlights the country's ambition to become a middle-income country.

The country is a member of the United Nations, the African Union, the East African Community, the Intergovernmental Authority on Development, and COMESA.

In the yearly World Bank survey on "Doing Business", a comparison of business regulation in 190 economies, Kenya is scoring averagely. The 2020 edition of Doing Business ranks Kenya as 129 out of the 190 with a score of 82.7 out of 100 for the ease of starting a business. Figure 2 provides a comparison of Kenya to neighbouring economies for starting a business.

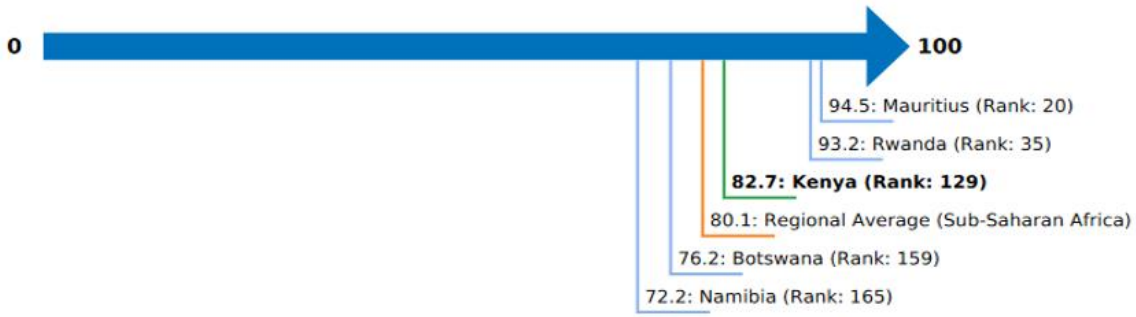

Figure 2: Doing Business 2020 score for starting a business. Data from: World Bank Group, 2020

The energy sector in Kenya

Kenya boasts a continually evolving low-carbon, affordable, and diverse energy mix. Generation capacity stands at a comfortable 2,670 megawatts (MW), with peak demand of 1,841 MW. As of June 2018, renewable energy accounts for 65% of total installed capacity and 78% of total electricity generation (7.9 terawatt-hours). Geothermal represents more than 40% of electricity generated, making Kenya one of the global leaders in the use of this low-cost renewable energy resource.

From 2018–2022, power demand is projected to grow from 1,841 MW in 2018 to between 2,633 MW (reference scenario) and 3,348 MW (Vision 2030 scenario) in 2022. Vision 2030 aspires to achieve universal access to electricity by 2030, but in 2013 the government revised the target year to 2022 to accelerate the achievement of this goal.

Table 1: Kenya at a glance

Capital	Nairobi
Total area	580,370 km2
Population	63.81 million (2019)
Official languages	Swahili English
Rural population	73% (2018)
GDP	US $ 109B (2019)
GDP per capita	US $ 2,151 (2019)
Currency	Kenyan Shillings (KES)
Exchange rate 01/03/2020 01/03/2018	 1 GBP = 128.5 KES 1 GBP = 140.0 KES
Access to electricity On-grid electricity Off-grid electricity	75% (2018) 77% 39%

Connectivity has been scaled up tremendously over the past several years, with the access rate more than doubling between 2014 and 2018. As of February 2018, access is estimated at 75% from both grid and off-grid options. In 2014 the government realised that universal access to electricity would not be possible by 2022 without a paradigm shift. In 2015, the Government decided to develop the Kenya National Electrification Strategy (KNES), with the principal objective of defining a strategy to achieve electricity access for all households and businesses in Kenya over the shortest timetable and at acceptable quality of service.

Small hydropower

Small, mini and micro hydroelectric systems (with capacities of less than 10 MW) are estimated to have a potential of 3,000 MW nationwide. In 1997, Kenya's Electric Power Act allowed independent power producers to supply electricity to the grid, but small decentralised schemes, such as micro hydropower, were not fully addressed. Around 55 river sites suitable for rural electrification have been identified as attractive commercial opportunities. Their maximum mean capacities would range from 50 kW to 700 kW.

Table 2: Overview of the main stakeholders in the energy sector in Kenya	
Institution	**Role**
Ministry of Energy and Petroleum (MoEP)	Creating energy policies to the efficient operation and growth of the sector and facilitating the mobilization of resources for energy sector investment.
Energy and Petroleum Authority (EPRA)	Economic and technical regulation of electric power, renewable energy, and downstream petroleum sub-sectors, including tariff setting and review, licensing enforcement, dispute settlement and approval of power purchase and network service contracts.
Kenya Power and Lighting Company (KPLC)	A publicly listed utility which signs purchase power agreements (PPAs) with KenGen and all independent power producers looking to inject electricity into the national grid. It is responsible for distribution and supply of electricity.
Kenya Electricity Generating Company (KenGen)	Kenya's largest power producer, which operates hydro, geothermal, and gas- and diesel-fired power plants.
Kenya Electricity Transmission Company (KETRACO)	Plans, designs, builds, operates and maintains all new transmission lines above 132 kV.
Geothermal Development Company (GDC)	Responsible for the exploration of geothermal fields, exploration and production drilling, development of steam fields and concluding contracts for the off-take of steam by power plant operators.
Rural Electrification and Renewable Energy Corporation (REREC)	Implementing rural electrification projects and spearheading Kenya's renewable energy drive.
Independent Power Producers (IPPs)	Private companies which generate power and sell electricity in bulk to KPLC.

Solar energy

Kenya has high insolation rates, with an average of 5-7 peak sunshine hours and average daily insolation of 4-6 kWh/m^2. The total potential for photovoltaic installations is estimated at 23,046 TWh/year.

Solar power is largely seen as an option for rural electrification and decentralised applications. Photovoltaic stand-alone systems for households and public institutions have been subsidised for some time. The government is aiming to install an additional 500 MW and 300,000 domestic solar systems by 2030. Commercial and industrial applications are also becoming increasingly important: flower and vegetable farms have already pioneered and

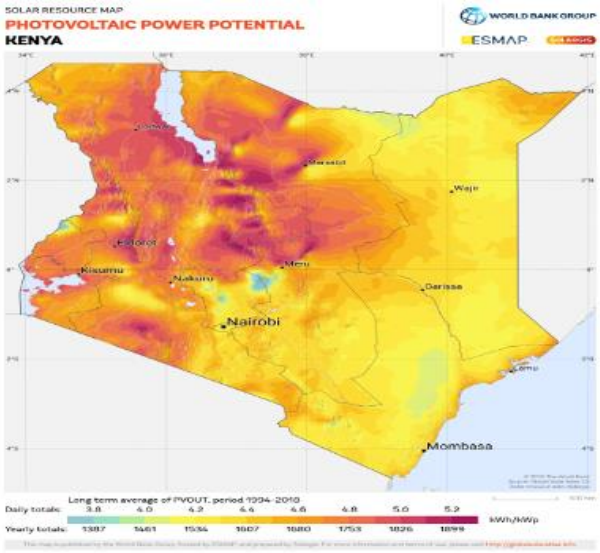

Figure 3: Solar resource Kenya (2019 The World Bank, Source: Global Solar Atlas 2.0, Solar resource data: Solargis)

installed captive renewable energy systems to contribute to the power supplying their premises.

Kenya has one of the most active commercial PV system markets in the developing world, with an installed PV capacity in the range of 4 MW. An estimated 200,000 rural households in Kenya have solar home systems and annual PV sales in Kenya are between 25,000-30,000 PV modules. This success has been largely due to private sector activity. The high level of uptake has been through the sale of products that best fit the purchasing power of rural households, and by making these products available within the mobility range of potential customers, typically less than 40km from customers' homes.

In mature market areas, such as central and western Kenya, 20-40% of households have solar home systems. Most units are in the power range of 10-20 kWp, with prices as low as US $50. These are offered in cash or on a pay-as-you-go basis. Notable companies are M-Kopa, D-Light and Biolite.

Biomass energy

As of 2018, biomass accounted for about 69% of total national primary energy production. Charcoal, firewood, paraffin, and LPG continue to be the main sources of cooking fuel. At the national level, 64.7% of the households use firewood as the main cooking fuel. Almost 93.2 % of the rural population is dependent on firewood for cooking and heating, whilst in urban areas approximately 10% of the population use firewood. Charcoal, on the other hand, is mainly an urban fuel: 82% of urban households depend on it as part of their energy mix, compared to 34% of households in rural areas. About 58% of households in Kenya in 2019 (compared to 76% in 1999) use the Three Stone Open Fire. Over the last two decades (1999-2018), the number of households using LPG has increased about six times from approximately 0.6 million to 3.7 million (54% urban and 18% rural households now use LPG).

Kenya has the potential for generation of electricity from biomass sources generated from agricultural wastes from the sugar cane (bagasse), sisal, timber (sawdust) and meat industries. The development of a bioenergy industry could improve energy access. The 2014 National Energy Policy Draft sets out biogas expansion targets of 10,000 small and medium-sized digesters by 2030. By 2018, 17,900 biogas systems had been installed at household level.

A study conducted in Kenya by MOEP, CCAK and SNV shows that 93.2% of the rural populations still rely on solid fuels as their primary fuel source. Using clean cooking solutions will support the move by the Government to restore Kenya's forest cover to 10% up from the current 7% and reduce the country's annual disease burden attributable to HAP from 49% (21,560) to 20%.

Kenya has an ambitious target of achieving universal access to modern cooking solutions by 2030. These solutions include LPG, electricity, biogas, bioethanol and improved solid fuel cook stoves. The country

commits to shift to clean cooking through the development of efficient cooking solutions, projecting an abatement potential of 7.3 Mt $C0_2e$ by 2030 to help mitigate climate change.

Geothermal

Kenya is the largest geothermal producer in Africa. It has a potential to produce 10,000 MW of geothermal-powered electricity, according to the Geothermal Development Company.

As of 2019, Kenya had over 690 MW of installed geothermal capacity (more than 20% of total electricity generation in the country) and by 2030, it plans to increase this to over 5,000 MW. Kenya has recently pushed its geothermal capabilities hard, with a significant increase of the geothermal electricity generation capacity from 45 MW in 1985 to 690 MW in 2019, with nearly 400 MW being connected in 2014.

Geothermal fields in Kenya include Olkaria, Menengai and Eburru. The Kenya Electricity Generating Company (KENGEN), has built several power stations to exploit the Olkaria geothermal resource: Olkaria I (185MW), Olkaria II (105MW), Olkaria IV (140MW), and Olkaria V (158MW).

In addition, there is a 4 MW binary power plant owned by Oserian Flower Farm, which draws steam from Olkaria Central Sector and a 139.3 MW power station (Olkaria III), which is a privately owned plant.

Wind

Kenya has some excellent wind regime areas. The northwest of the country (Marsabit and Turkana districts) and the edges of the Rift Valley are the two windiest areas, with average wind speeds of over 9m/s at 50 metres. The coast has lower but still promising wind speeds (about 5-7m/s at 50m). As of 2018, the Ngong Hills area close to Nairobi had installed 5.1 MW. An average of 80-100 small wind turbines (400 W) had been installed as part of a hybrid PV-wind system with battery storage.

Kenya is home to the Lake Turkana Wind Power, the largest wind project in Africa. This 310 MW project is part of the country's ambitious plan of reaching 100% green energy by 2020.

Mini grid sector development

By 2018, about 30 private companies were engaged in the development of off-grid energy solutions in Kenya and serving more than 700,000 people through mini grids and standalone renewable energy

systems. Kenya has made tremendous progress in improving energy access to off-grid areas in the past decade. In 2019, Bloomberg NEF's annual Climatescope report ranked Kenya as one of the top five countries globally for substantial investment in non-large renewables.

Kenya has ambitious plans to reach universal electricity access by 2022. The 2018 National Electrification Strategy estimates that to reach universal access, an additional 121 mini grids are needed to serve about 35,000 households located too far from the national grid, or where the grid will not be available for at least 10 years (from 2018). In addition, existing mini grids could be densified further to reach an additional 100,000 households. This will require an investment of up to $1.2 billion for grid densification (including existing mini grids), and $333 million for development of new mini grids.

To achieve these targets, the government recognises the need to improve conditions around policy to encourage more investment in the off-grid space. Kenya has traditionally implemented a uniform tariff structure for both on-grid and off-grid projects, an issue that has made investments in off-grid remote locations less attractive to private companies. The government has not yet put in place a framework to subsidise the cost of installation and operation for off-grid projects. In addition, Kenya plans to develop a framework for private developers to build and operate mini grid systems rather than fully owning and operating them.

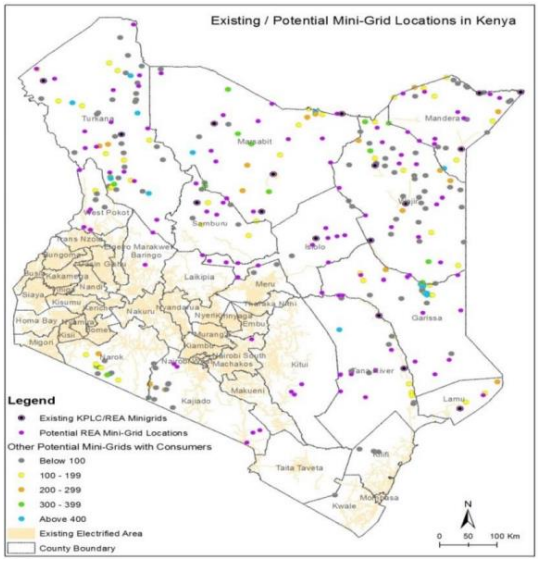

Figure 4: Mini grids in Kenya. Source: Kenya Electrification Strategy Project, 2017

Some mini grid companies operating in Kenya include:

> Africa Solar Designs
> DREAM Kenya
> PowerGen
> Powerhive
> Renewable World
> Renewvia
> RVE.Sol
> Skynotch Energy Africa
> Talek Power

Mini grid and off grid programmes currently active in Kenya are outlined in Table 3.

Table 3: Active support programmes in Kenya	
Programme	**Main activities**
Kenya Off-grid Solar Access Project for Underserved Counties (KOSAP)	The main objective is to increase access to modern electricity and clean cooking solutions in 14 underserved counties in the country. Activities include access to electricity through mini grids or standalone solar systems, facilitating transition from low-efficiency stoves to cleaner and more efficient ones, promoting electrification of community facilities, access to finance, and consumer education.
Transforming Energy Access (TEA)	A four-year programme funded by DFID providing incubating support to a series of off-grid energy projects, ranging from businesses to academia. The project is divided into five main components: stimulating technology innovation, accelerating enterprise-led innovation in technology and business models, clean energy partnerships, developing local skills and expertise, and bioenergy for sustainable local energy services.
Project Jua	The project aims to install solar systems in private schools and health facilities in underserved counties in the northern and coastal parts of Kenya.
The Green Mini Grid Help Desk	Funded by the Africa Development Bank as part of the Green Mini Grid Market Development Programme (GMG MDP). Mini grid developers receive technical assistance, from support on demand assessments to technical sizing, capital raising, procurement and installation support, commissioning, and optimisation of operations.
Green Mini Grid Facility Kenya	Funded by the European Union's Africa Infrastructure Trust Fund. Provides grants and technical assistance to mini grid developers in Kenya.

Industry associations

Kenya Renewable Energy Association
Formed in August 2002, KEREA is an independent non-profit association dedicated towards facilitating the growth and development of renewable energy businesses in Kenya. It has the following membership categories: full membership, associate membership and honorary membership. KEREA has 116 corporate members and 54 associate members.

Africa Mini Grid Developers Association
AMDA works collaboratively with policy makers, government authorities, regulators, national utilities, professionals, donors and other stakeholders to build an optimal energy network based on innovation and adoptive clean technology that will meet the needs of African economies.

References and further reading

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https://www.doingbusiness.org/content/dam/doingBusiness/country/k/kenya/KEN.pdf

Market Information about Kenya
https://www.get-invest.eu/market-information/kenya/renewable-energy-potential/

Official UK Government travel advice for Kenya
https://www.gov.uk/foreign-travel-advice/kenya

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