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Fostering a sustainable and secure energy supply for Kenya

The role of grid quality, energy market structure,
and decentralisation

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The recommendations presented in this policy brief were developed in cooperation with Kenyan energy experts during a two-day stakeholder workshop held on 3-4 November 2021 in Nairobi with participants from finance, policy, industry, and research, and an online follow-up workshop on 14 March, 2022. The Kenyan energy system was modelled by the ISIGET research team of the IASS Potsdam using stakeholder-driven Cross Impact Balance Analysis to determine factors preventing or facilitating a sustainable energy future. The subsequent succession analysis, an exercise to assess system dynamics, revealed the factors that need to be addressed in order to trigger changes in the entire system. The recommendations discussed by the Kenyan experts are based on the results of the succession analysis, which suggests that improving the quality of the grid, further liberalising the energy market structure, and promoting decentralisation are the main leverage points for ensuring a secure and sustainable energy future. More details on the method will be available in a forthcoming study.

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Kenya is a climate and renewable energy frontrunner in the sub-Saharan region. The country is committed to decarbonisation and currently aims to reduce greenhouse gas emissions by 32% by 2030, relative to the business-as-usual scenario. Kenya has rapidly increased electrification access over the last decade thanks to a strong on- and off-grid renewable energy sector. Electricity from renewable sources covered 88% of total domestic demand in 2020. The bulk of this is generated using geothermal energy, followed by hydro and wind power. These are complemented by a growing solar PV sector. Despite this laudable progress and the introduction of policies to foster renewables, the energy sector still faces significant challenges, including a lack of universal access, affordability issues and limitations in the transmission and distribution network. These circumstances result in a capacity surplus of generated electricity that cannot be absorbed by demand. Recent discoveries of oil and gas reserves risk derailing efforts to decarbonise the energy sector unless the Kenyan government strengthens its current course.

This policy brief identifies three key areas for action to enhance energy security and continue on a sustainable energy path:

■ **Recommendation 1:**

Improve the quality of the grid

Kenya should bolster its digitalisation efforts, support the adoption of new technologies, invest in research to reduce inefficiencies, foster regional integration to increase connectivity, and implement demand scheduling mechanisms to harness the advantages of different energy sources. These efforts should be flanked by an update of the national grid code.

■ **Recommendation 2:**

Liberalise the electricity market

The procurement process needs to remain competitive and based on least cost criteria. Net metering programmes and renewables auctions should be implemented in order to attract more players and investment. Improved regulations about public-private partnerships and power purchase agreements will be needed to remove bottlenecks for market entry and establish an equal playing field. These measures should be accompanied by open consultations to ensure public participation and improve the investment climate.

■ **Recommendation 3:**

Promote decentralised energy supply options

Decentralised renewable energy generation should be promoted to ensure that off-grid consumers can access affordable, reliable, and secure energy. Kenya should enhance sustainable financing structures and improve tax incentives for technology development and distribution of decentralised energy options. Capacity building efforts should target local communities, domestic companies, and government agencies to facilitate the maintenance and administration of off-grid systems and increase their sustainability.

Context and background

In 2021, renewables accounted for 88% of Kenya's electricity mix, with geothermal energy making up the largest part, contributing 41%, followed by hydro (30%) and wind power (16%).¹ Thermal power plants accounted for 10% of the mix. The solar sector is still quite small (1% of electricity generation) but has grown in recent years and attracts substantial investment.² Kenya is the eighth largest geothermal power producer in the world, with state-owned companies responsible for the bulk of geothermal output. Until the 1990s Kenya relied predominantly on hydropower for electricity generation. However, changes in rainfall patterns due to climate change forced the government to explore other renewable energy alternatives. Hence, Kenya's push for alternative renewable energy sources was driven by the need to meet its energy security and development objectives, and less by a climate mitigation strategy. In contrast to the power sector, the Kenyan industrial and transport sector continue to rely predominantly on fossil fuels.³

Although large-scale solar and wind projects have been launched in recent years, current installations reflect just a fraction of Kenya's renewable energy potential. Studies estimate that the total potential for solar energy is 15,000MW⁴, for wind energy 3,000MW and 10GW for geothermal energy.⁵ It is unclear how much of this potential will be developed as the electricity system grapples with demand constraints, with more capacity available than can currently be absorbed. This is due to affordability and grid constraints discussed in more detail below, but also due to errors in demand projections. This overgeneration poses a risk for the financial viability of the sector as most power purchase agreements (PPAs) are "take or pay", meaning that the government (via the majority state-owned KenGen) must pay for energy that is not used.⁶

Kenya aims to achieve a 32% reduction in greenhouse gas emissions by 2030, relative to the business-as-usual scenario. Despite its commitment to decarbonisation, the country has plans in place to further develop its thermal capacity following significant oil and gas discoveries in the last decade.⁷ The ambitious 5000+MW

programme launched by the Kenyan Ministry of Energy and Petroleum in 2013, which aimed to increase capacity to over 5000MW by 2016, also included the significant development of natural gas and coal-fired capacities. The plan has since been scaled back.⁸ In addition, in 2019 the construction of the first coal power plant in the country (the 1,050MW Lamu coal plant) was suspended by the government due to environmental and community concerns.⁹ However, plans to further develop these sources are still in place.¹⁰

The finance gap in the energy sector is estimated to be US\$7 billion for the period 2019–2023 and \$10.3 billion for the period 2024–2030.¹¹ So far, Kenya has been quite successful in attracting international funding for this sector. Two-thirds of the Ministry of Energy's budget is offset by funds from donors, and most of the private companies involved in power generation are investors from Europe or the US.^{12,13} The off-grid energy sector receives substantial multilateral finance and policy support, for example through the World Bank and bilateral development cooperation initiatives from Germany, France, the UK, and the Nordic Development Fund.¹⁴

Although Kenya has dramatically increased electricity access over the last few years, the goal set in the National Electrification Strategy (2018–2022) of achieving universal electricity access by 2022 has not been met. While cities are now fully electrified, only 65% of people in rural areas have electricity access.¹⁵ The low population density of rural areas, especially in the North of the country, makes it costly to connect rural settlements to the grid. Nine counties in Northern Kenya account for over 60% of the land area, but only 12% of the population, for example.¹⁶ In addition, there are affordability issues as Kenya struggles with increasing electricity prices.¹⁷ Many electrified households have very low electricity consumption as they cannot afford higher electricity bills or to purchase new appliances. Connection costs also exceed the budgets of many rural households and act as a brake on uptake even where supply is available, further exacerbating the costs of grid extension.¹⁸

Reliability is another major constraint on the development of the electricity sector. Despite recent upgrades of the transmission and distribution systems, which included the construction of additional lines, substations and transformers, there are frequent power outages and high technical losses in transmission and distribution.^{19,20} The capacity of existing infrastructure to integrate new renewable energy projects is also limited and without proper planning intermittency issues can aggravate grid instability and perpetuate quality problems.²¹

Under these circumstances, decentralised solutions offer a means to improve the energy supply, and the government has acknowledged that they will play an important role in reaching universal electricity access. It is estimated that between 660,000 and 2.1 million rural households could benefit from off-grid energy as the most cost-efficient option, for example through solar home systems or connections to mini-grids.²² Kenya is a pioneer in decentralised renewable energy in Sub-Saharan Africa. Although it accounts for just a fraction of the country's total installed capacity, its growth over the last decade has been impressive.²³



Figure 1:
The transmission network in Kenya, including ongoing and planned extensions (2020).

Source: IASS/Authors, based on KETRACO

Electricity market structure

State-owned enterprises continue to dominate the Kenyan energy system and electricity market despite considerable reforms over the past two decades aimed at introducing competition in the generation, distribution and supply of electricity, creating an enabling environment for Independent Power Producers (IPPs), and attracting more private sector investment.

The range of reforms includes the introduction of international competitive tendering for IPP projects in power generation, the reduction of subsidies and imposition of cost-reflective pricing, the design of investment frameworks for public-private partnerships (PPPs) and separation of power generation and transmission to reduce conflicts of interest in procurement.²⁴ While IPPs now account for around one-third of effective generation capacity, they are mostly active in the thermal and geothermal energy sectors and their share in other renewables is limited.²⁵ The development of a Feed-in-Tariff (FiT) in 2008 has failed to bring change, as the relatively low tariffs available under the FiT scheme made many wind and solar projects financially unviable.^{26,27} Other options such as auctions and net metering have been developed, but await implementation.

Despite restructuring efforts and the successful introduction of IPPs, state-owned entities (with significant private shareholding) KenGen and KPLC remain the dominant players in the Kenyan electricity market. KenGen is responsible for electricity generation and KPLC for the distribution of electricity to retail customers. This state of affairs invites political interference (for example, with respect to retail tariffs, project procurement, and demand forecasting), which leads to market distortions and suboptimal outcomes. As consumers cannot choose their provider, there is no incentive to provide customer satisfaction.

The Least Cost Power Development Plans (LCPDPs), which are drafted by the Least Cost Power Development Planning Committee, provide an overview of current demand and supply, forecast national energy demand, and specify future generation sources. However, criteria that would ensure the fair assignment of projects between the public and private sectors are lacking in the LCPDPs, which disadvantages the private sector.²⁸ Experience so far shows that the private sector is called to participate in electricity generation only when KenGen has been unable to finance new investments. In addition, there have been recent cases, for example the Lake Turkana Wind Project (LTWP), where unsolicited bids were accepted, which were not subject to the LCPDP. As a consequence, there was no prior analysis of the technical and financial compatibility of these projects with least-cost planning standards.²⁹ This reduces transparency and has a negative impact on the performance and financial sustainability of projects.

Finally, while steps have been taken to liberalise electricity generation, transmission remains in the government's hands and there is only marginal private involvement in distribution. The Energy Act of 2019 envisions private sector participation in the transmission sector. However, what is lacking is the political will for this to be actually implemented.

1. Improve the quality of the grid

Kenya's grid infrastructure presents significant challenges, not least of all due to its limited geographical coverage but also with respect to its reliability and the losses that occur in transmission and distribution. Improving the quality of grid infrastructure and extending regional integration will be paramount to achieving energy security, ensuring the successful uptake of more renewables and reaching the last mile of end users.

The digitalisation of grid infrastructure would facilitate the development of a smart grid and deliver significant efficiency gains. Smart grids enable operators to monitor and forecast power demand more accurately and to detect faults in real time, ensuring continuity of supply, improving reliability, and reducing costs. Dedicated investment and capacity building programmes will be needed to ensure that digitalisation efforts do not stall. These activities will need to be flanked by the development of adequate data protection policies to safeguard the integrity of energy infrastructure and communication systems.³⁰

Further improvements in the quality of infrastructure could be achieved by updating the national grid code at the transmission and distribution levels. The current code was introduced in 2008 and specifies the technical requirements for accessing the electricity grid. An update would improve reliability and enable more actors to enter the market (e.g. by making the grid compatible with small-scale generation and net metering).³¹

Kenya will also need to undertake demand scheduling of different energy sources to reduce the need to rely on different storage facilities, which account for the largest share of costs around renewables integration. Currently, overgeneration in Kenya is partly a result of needing to rely on thermal plants as a backup when using intermittent sources. This could be reduced by a better demand-side management. Advanced digitalisation, as previously discussed, allows for a better provision and analysis of data to help electricity users to adapt their consumption more flexibly to the availability of renewable energy, which can reduce

the need for thermal power plants to provide backup electricity.³²

Targeted policies for technology adoption are required to foster solutions that help manage overload peak times and storage capacities. Integrating renewables into the grid requires access to technologies that help manage intermittency and reduce transmission losses to remote areas. This includes some very expensive technologies such as reactive power compensation devices. Kenya will need technology transfer and capacity building assistance to support their adoption. The government also will need to incentivise technology uptake by putting policies in place that reduce costs and encourage investment.

More research is needed to identify infrastructure deficits and technical options to improve grid quality. Research funding provided by the Kenyan government should be channelled towards this aim, instead of the exploration of coal or nuclear options.³³ Furthermore, enhanced international cooperation in capacity building and knowledge sharing is needed. This requires an establishment and institutionalisation of networks and sharing platforms, where the public and private sector should cooperate. An example is the RES4Africa Foundation, which offers training programmes with a number of partners like the Italian national utility ENEL, the Kenyan Strathmore University, and private companies.³⁴

Regional integration will be key to increasing connectivity and managing the intermittency of renewable energy sources. Strengthening and expanding existing interconnections with neighbouring countries, and more broadly through the Eastern African Power Pool, would reduce energy storage costs, ensure better demand-side management, and improve grid stability. Greater regional integration also harbours potential economic benefits and could support further growth in clean energy generation. This will require the development of a regulatory framework and incentives at the regional level in order to balance the technical requirements and commercial interests of different actors.³⁵

2. Liberalise the electricity market

Despite efforts over the past two decades to liberalise the electricity market, state-owned entities continue to dominate the power generation, transmission, and distribution sectors. Significant progress has been made with respect to improving the investment climate, policy and regulatory clarity, power sector reform, least-cost independent power planning, competitive procurement, and the development of risk mitigation tools. Maintaining and expanding this progress will be crucial to ensure success going forward.³⁶

Officially, power generation procurement processes are competitive and comply with the least cost criteria of the LCPDP. This open bidding process is intended to provide a level playing field and encourage market participation. However, instances of direct allocation have occurred in recent years and this must be avoided going forward. In addition, there is a need for new and transparent (least cost) allocation criteria to regulate state and private investment in power generation.³⁷

Planning needs to be improved to ensure that electricity demand and supply are matched. Power planning should be underpinned by independent techno-economic analyses that also consider the dimension of sustainability.^{38,39} Resulting improvements in forecasting would enable investors to anticipate and adequately respond to capacity requirements. Better coordination would also reduce government spending.

Open consultation with possible independent renewable energy producers could help to mitigate knowledge gaps that have hampered prior policies aimed at liberalising the renewable energy sector. A lack of project development experience has been cited as one of the reasons behind the slow progress of the FIT policy.⁴⁰ Improvements in regulatory transparency and investor outreach are needed to support actors interested in entering the market.

Net metering programmes and renewables auctions should be implemented to attract more players and competitive investment in the renewable electricity market. The 2019 Energy Act includes provisions that aim at attracting private sector finance through auctions and net metering. However, further regulatory fine-tuning is needed to improve these measures, which are not yet operational.^{41,42}

Similarly, public-private partnerships (PPPs) and PPAs help increase private sector participation in power generation. In 2021 the government issued a PPP Act to boost investor confidence in Kenya by harmonising and making the process clearer.⁴³ This is a step in the right direction. However, PPP and PPA regulations will need to be further improved to remove bottlenecks such as high entry fees and transaction costs.⁴⁴ Amendments are also needed to improve accessibility and ensure that regulations and processes are transparent for both private actors and authorities. Disaster and climate risks as well as social inclusion also need to be better addressed through binding legal rules for disaster and climate risk management and social inclusion goals of PPPs.⁴⁵

Market reforms will only bear fruit if they are supported by measures to improve the investment climate, reduce risks, and attract private investments. While instruments such as escrow accounts and letters of credit have been used successfully in the past to reduce the financial risks faced by IPPs, they lack versatility and the scope for their application is limited. Credit enhancement instruments and guarantees should be developed and made available to unlock financing by de-risking projects. Other instruments or policy measures should be developed to alleviate the risk of payment defaults, termination risks, and political and regulatory risks. These should dovetail with partial risk guarantee programmes provided by development finance institutions.

Steps should also be taken to advance private sector engagement in electricity transmission, as envisaged in the 2019 Energy Act. To achieve this, private sector investment could be allowed through the introduction of an Independent Power Transmission (IPT) model. First-mover investors should be supported by a provision of sovereign guarantees by the National Treasury to introduce PPP schemes for electricity transmission infrastructure.⁴⁶ Regulatory frameworks should be adapted to support IPTs and competition should be introduced in the sector by open tenders for IPTs.⁴⁷

Despite this emphasis on further liberalisation, government should continue to play an important role in the power sector. Robust policymaking and governance will be required to implement necessary reforms, support universal energy access, and expand Kenya’s renewable energy industry. In particular, government involvement is necessary to promote renewables, support investment in infrastructure in challenging market conditions (cf. the development of the geothermal sector, for example) and safeguard the investment climate. And while further liberalisation is likely to increase affordability by lowering power production costs, the state should at the same time ensure that electricity remains affordable for low-income households through state interventions such as lifeline tariffs, cross-subsidisation, and connection subsidies.

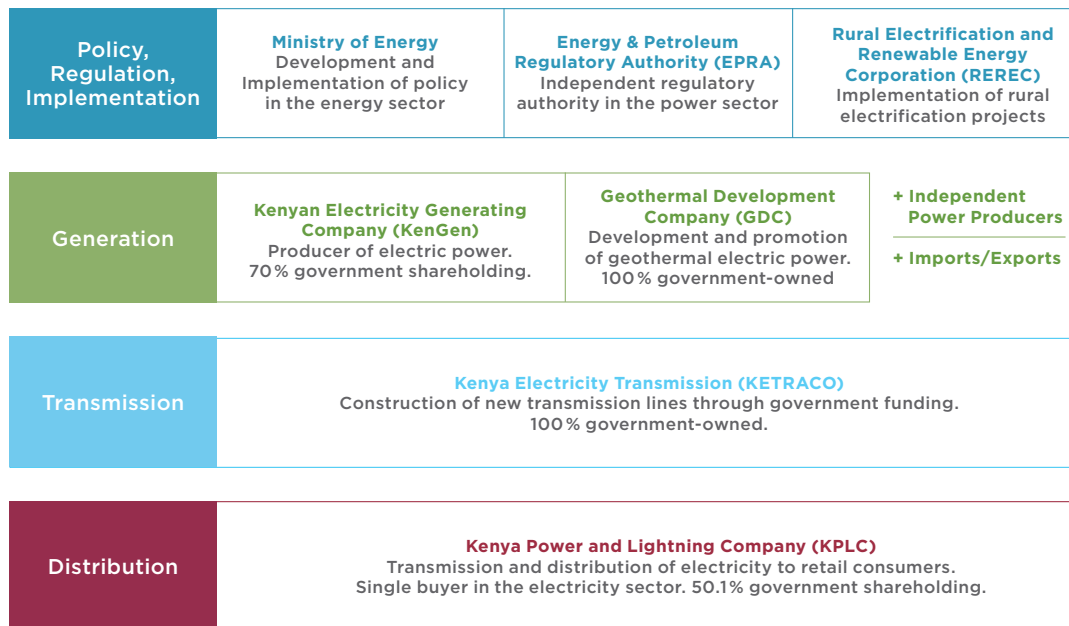


Figure 2: Key institutions in the Kenyan energy sector.
Source: IASS/Authors

3. Promote decentralised energy supply options

While grid expansion and reinforcement efforts will help address energy security, decentralised renewable energy solutions will be the most effective means of delivering energy access to more isolated communities. Although the decentralised energy sector has seen steady growth, fluctuations in power demand in rural Kenya make it difficult for suppliers to reliably recover costs in the near term and this has stifled competition. To help the off-grid sector reach scale, the provision of supply-side subsidies should be considered. Results-based financing schemes could attract investment by offering a supply-side incentive (for example, per-connection-grants) and at the same time allow the Kenyan government to control the direction of the off-grid market's development.⁴⁸ The allocation of any subsidies must be transparent, and clear selection criteria need to be stated in order to avoid over-subsidisation. In addition, demand-side subsidies for off-grid energy projects operated by private actors and international organisations should be introduced. These would foster uptake while helping to close gaps in affordability by subsidising low-income households that would otherwise struggle to afford electricity at regular prices. Value added tax (VAT) and import duty exemptions for RE products (e.g. PV cells and windmills) should be maintained until market conditions improve to the extent that the operation of electricity infrastructure is economically viable and companies are incentivised to expand without further support.

Measures such as subsidies, results-based financing and VAT exemptions are necessary and can lend momentum to the much-needed expansion of the Kenyan off-grid sector. Nevertheless, particular prudence must be exercised in their application, which should serve the long-term goal of spurring growth and putting the sector on a solid footing. Care must be taken to facilitate the uptake of other forms of financing, including debt and equity instruments.⁴⁹ Sustainable financing structures such as equity financing oppor-

tunities should be promoted to achieve this. These could be incentivised by reducing tax liabilities for off-grid renewable energy companies.⁵⁰

Local businesses have reported problems obtaining loans because local banks are unfamiliar with the off-grid sector and classify it as a high-risk investment area.⁵¹ Here too, partial risk guarantees provided by development finance institutions could help to de-risk off-grid energy investment. The importance of this instrument in development finance has been growing in recent years and has proved successful so far.⁵² Going forward, more additional ways by which the costs of finance can be lowered need to be explored.

The uptake of off-grid solutions could additionally be strengthened by building awareness in rural populations and local authorities of the available options and their benefits as well as the various payment models. Capacity building measures are also needed to build knowledge networks within communities to support the development and operation of off-grid systems.⁵³ Additional measures are needed to support domestic companies, which often lack the expertise necessary to raise capital, fulfil administrative requirements, or manage off-grid projects.⁵⁴ County and state governments would benefit from technical assistance in the administration of off-grid renewable energy markets, the development of enabling conditions for profitable business models, and the efficient administration of subsidy schemes and other relevant measures.⁵⁵

Finally, training programmes are needed that adequately prepare technicians for the challenges they will face in the field. Many of the university programmes and training courses currently available are highly theoretical. Joint programmes delivered by training institutions in cooperation with companies could enable trainees to gain relevant experience during their qualification.⁵⁶

Conclusion and outlook

Despite the progress made over the last decade, ensuring access to affordable, reliable, and secure energy remains a challenge for Kenya. In order to address energy security concerns and strengthen its clean energy sector, Kenya must focus its efforts on improving grid quality, promoting off-grid energy solutions and liberalising the electricity market. These efforts can build on previous reforms and existing strategies and programmes to promote (clean) energy access. Delays in the implementation of reforms and policy innovations create uncertainty for investors and slow progress on a broad front. Follow-up measures will be needed to safeguard the implementation and success of future policies.

The three proposed areas of action are interrelated and often affected by the same policies. Action across

the three proposed areas promises to deliver mutually reinforcing outcomes. Successful metering frameworks, PPPs, PPAs and auctions will promote both liberalisation and decentralisation and improve the grid quality. A liberalised market structure will improve affordability and enable companies to generate gains that can be reinvested in improved infrastructure. The expansion and improvement of grid infrastructure will facilitate the entry of more players in energy production, including the decentralised space. While these outcomes are interrelated, it is important that one is not promoted at the expense of the other. Opportunities to develop off-grid renewable energy solutions should not be traded off against improvements to the quality of the grid and vice versa. Promoting decentralisation and improving the quality of the grid should go hand in hand. ■

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