Integrating Variable Renewable Energy in Kenya

Key challenges and strategic priorities

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Introduction

Kenya operates a power system based on renewable energy, with growing electricity access

Kenya is a leader in expanding electricity access among East African countries, increasing the rate from 37% in 2013 to 79% in 2025. The country is on track to achieve universal access by 2030, and urban electrification has already reached 100%. Kenya has set an ambitious target in its Vision 2030 of becoming a newly industrialising middle-income country with a high quality of life by 2030. A strong emphasis is put on infrastructure development, especially in power grids and electricity generation.

Kenya has made significant progress in utilising its renewable energy resources for power generation, with nearly 90% of its electricity mix derived from renewable energy sources. The country has over 3.5 GW of installed generation capacity, which is dominated by renewable energy sources. In 2025, geothermal accounted for 26% of capacity, followed by hydro (24%), solar (12%) and wind (12%), with thermal generation making up the remaining 26%. The addition of approximately 750 MW of geothermal capacity over the past decade, together with variable renewable sources, has strengthened and complemented the country's large-scale hydropower base.

The rapid development of variable generation and policy changes call for actions to ensure electricity security

Kenya's power sector is undergoing significant transformation, creating new opportunities and challenges for the sector. Historically, progress in renewable generation was guided by a feed-in tariff (FiT) policy programme, which since 2021 has been evolving into an auction scheme under the Renewable Energy Auction Policy to attract investment in larger projects. The introduction of a framework for open access to the transmission and distribution grid and lifting the moratorium on new power purchase agreements (PPAs) will bring new economic opportunities, as well as regulatory and operational challenges that will need to be managed.

Beyond contributing significantly to energy development goals, the increase in variable renewable energy (VRE) capacity has also created challenges relating to system stability, reliability and resilience. This increases the need for energy storage systems and enhanced ancillary services, which can provide grid services and stability.

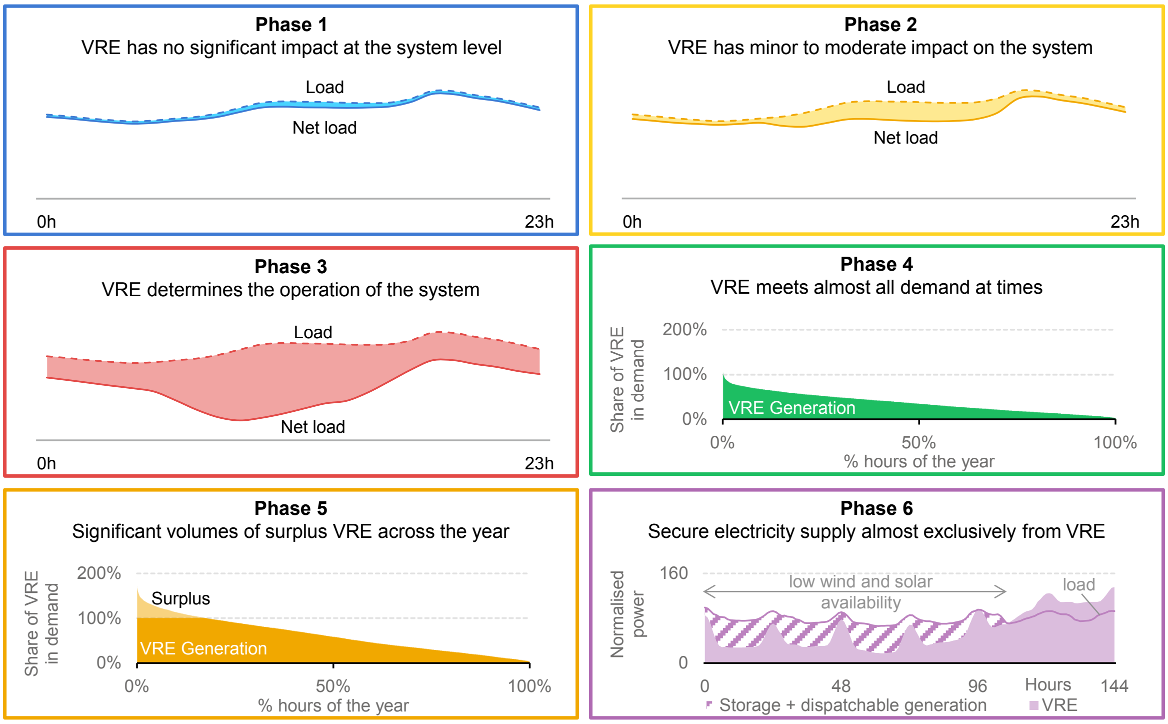
This report explores the key challenges that lie ahead for the Kenyan electricity system and how open access, flexibility and ancillary services can support the development of a reliable, secure and sustainable system.

Context

Understanding Kenya's level of solar PV and wind integration is essential for identifying the operational challenges the system faces today and the adaptations required over the next decade. The IEA divides the integration of VRE into six phases, reflecting the increasing system impacts of expanding solar PV and wind generation. Each phase is associated with specific challenges and corresponding solutions.

Phases 1 to 3 represent the early stages of VRE integration, when solar PV and wind have limited impact on system operation. Challenges at these stages can typically be addressed through improved use of existing assets or enhanced operational practices. Phases 4 to 6 correspond to higher levels of VRE deployment. These phases are marked by periods of low conventional generation, surplus supply during low-demand periods, and a heightened need for flexibility across all timescales. Addressing these challenges requires a fundamental transformation in how power systems are planned, operated and financed.

Phase assessment framework



Source: IEA (2024), Integrating Solar and Wind.

The phase assessment goes beyond measuring VRE penetration. It also accounts for the generation mix, the alignment between load profiles and renewable generation, and the system's flexibility over different timeframes. The analysis also evaluates the capacity to manage disturbances, especially regarding frequency control and inertia. Other influencing factors include ramping requirements. While solar PV generation is generally more predictable than wind, its midday peak and sharp changes during sunrise and sunset introduce significant ramping and flexibility needs. Wind power tends to vary more gradually and does not typically cause such steep ramps. Consequently, systems with a higher share of solar often face greater operational challenges than those with similar VRE shares dominated by wind.

Variable renewable energies currently shape Kenya's system operation

Kenya's electricity system is currently in Phase 3 of VRE integration, suggesting that VRE is increasingly influencing system operation, particularly during periods of high wind generation. In 2024, VRE accounted for around 19% of total generation, comprising approximately 4% solar PV and 14% wind. At these levels, the system is already experiencing operational challenges, including steeper net load variations and ramping requirements, and increased forecast uncertainty, particularly during periods of elevated wind output.

Flexibility requirements are rising, particularly to manage periods when wind, hydro and geothermal output are not well aligned with demand, which can lead to temporary surpluses, spillage or steam venting. While Kenya's hydropower and geothermal plants remain important sources of operational flexibility, improved co-optimisation across all generation sources is becoming essential to maintain system efficiency and minimise curtailment and steam venting.

As variability from VRE increases, system operators face a growing need for more accurate and higher-resolution forecasts of both wind generation and power demand. This requires shorter update intervals for dispatch and more frequent redispatching to track changing conditions. In parallel, the size, location and availability of operating reserves are becoming increasingly critical in maintaining system balance, underscoring the importance of strengthening Kenya's real-time monitoring, forecasting and reserve management capabilities.

At this stage, Kenya can still largely rely on operational improvements, such as enhanced forecasting, adaptive dispatch procedures and regional co-ordination, to address most challenges, although these needs are becoming increasingly systematic.

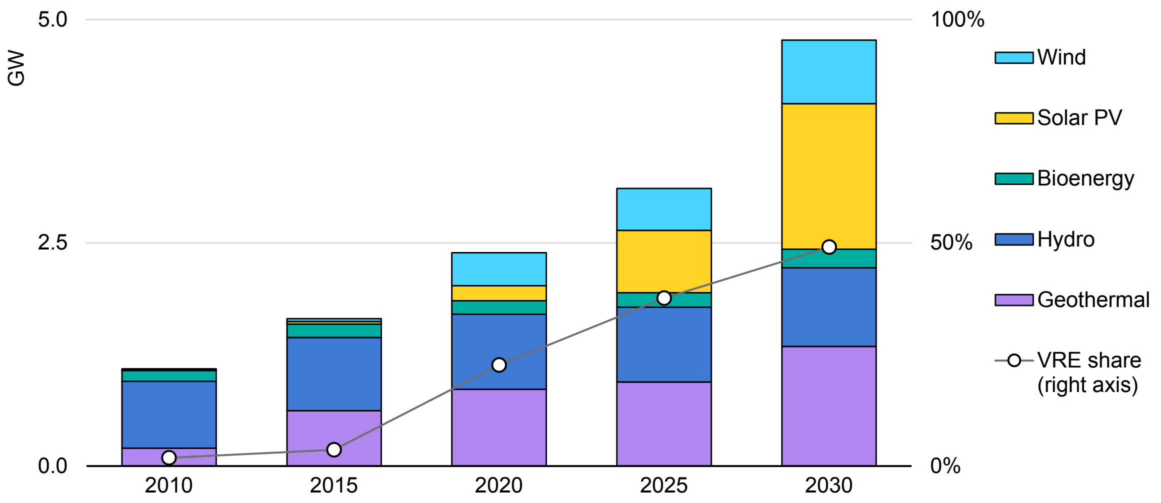
The evolution of the system to 2030 is expected to further change operations while remaining in Phase 3

By 2030, Kenya is expected to remain within Phase 3, but to move deeper into the stage. VRE capacity continues to expand, primarily through additional wind and solar PV capacity. Higher VRE penetration is likely to amplify short-term variability, further increasing short-term flexibility needs, particularly during extended periods of high wind generation coinciding with wet seasons.

The system will need to continue to improve its forecasting accuracy and granularity, with updates integrated more frequently into operational planning. Shorter dispatch and redispatch intervals, coupled with automated balancing and reserve activation, will become key. In parallel, the adequacy, location and responsiveness of reserves and storage assets will become a defining factor for secure operations. Kenya may need to reassess reserve sizing criteria and expand participation from non-conventional resources, including battery storage, demand response, and regional balancing through the Eastern Africa Power Pool.

Strengthening hydro, VRE and geothermal plant co-ordination, improving transmission capacity and adopting real-time operational tools will be critical to manage variability efficiently and avoid unnecessary curtailment. As Kenya moves deeper into Phase 3, operational challenges will become more continuous rather than episodic, reinforcing the need for systematic flexibility management across all timeframes – from forecasting to reserve deployment.

Renewable generation capacity and variable renewable energy share in Kenya, 2010-2030



Note: VRE = variable renewable energy.
Source: IEA (2025), Renewables 2025.

Open access

Open access is an important reform that can expand commercial opportunities for renewable energy and increase competition in Kenya's electricity sector. By enabling generators and large consumers to contract directly and use the transmission and distribution networks on transparent terms, open access can diversify supply, improve investment signals and support more efficient use of the grid. As Kenya transitions from a single-buyer model towards a more open and flexible market structure, clear operational rules and strong regulatory oversight will be essential to ensure that open access contributes to a more competitive and resilient power system.

An open-access electricity market can unlock new pathways for variable renewable energy growth

Open access can accelerate the identification and development of VRE projects and support their integration into the national grid. It allows independent power producers (IPPs) and large power consumers, such as commercial and industrial customers, to contract with one another directly, use the transmission and distribution networks, and participate in competitive electricity trading. By introducing multiple buyers and sellers, the system can foster more transparent pricing, attract new investment and unlock latent demand.

Kenya's current market structure places limits on the degree to which new renewable capacity can be absorbed. Kenya Power and Lighting Company (KPLC) owns and operates the national distribution network, serves as the dominant retail supplier and procures electricity from generators under regulated PPAs. This single-buyer model centralises financial and operational responsibility within one entity.

Introducing transmission- and distribution-level open access would provide alternative commercial routes for renewable energy generators, enabling direct sales to large power consumers, private retailers and regional power markets. This expanded demand base can accelerate VRE project development while reducing reliance on the single buyer and supporting the emergence of a more diversified and robust electricity market.

Despite a complete legal framework, market implementation remains at an early stage

Kenya has taken significant steps to establish the legal foundation for an open-access electricity market. The Energy Act 2019 formalised transmission-level open access, and the subsequent 2024 Energy (Electricity Market Bulk Supply and Open Access) Regulations provide the operational rules for both transmission and distribution networks. The regulatory package defines how bulk supply will function, outlines responsibilities for market participants and sets out the principles for open access across the entire power system. This marks a significant shift from Kenya's single-buyer framework and opens a pathway towards a more competitive market structure.

Regulatory preparations are ongoing. The Energy and Petroleum Regulatory Authority (EPRA) continues to issue power undertaking licences for generation and supply under an existing regulatory framework that supports participation by multiple market actors. In parallel, discussions are underway to expand private sector involvement in transmission and distribution infrastructure, including potential public–private partnerships for new 400 kV and 200 kV lines.

However, several regulatory instruments are still pending. The Energy (Electric Power Undertaking Licensing) Regulations remain under public consultation and, once approved, will replace the 2012 licensing framework. Finalising these instruments will be essential to ensure regulatory clarity for the operationalisation of open access across the sector.

The next steps needed to operationalise open access are clear

A critical priority is to implement the open-access regulations through detailed tariff methodologies and market rules. EPRA will need to finalise cost-reflective wheeling and network tariffs, settlement arrangements and procedures for market registration and supplier switching. As these measures move towards implementation, a central task for the regulator will be designing tariffs that recover system costs while remaining affordable for consumers and sufficiently attractive for investment, which many emerging power markets have struggled to achieve. Tariffs set too low can undermine utility viability and grid investment, whereas those set too high can dampen demand and deter market entry. A transparent and predictable charging framework will be central to attracting new retailers and large customers into the market.

Clarifying market roles and governance is equally important. Following the Energy Act of 2019, the Kenya Electricity Transmission Company (KETRACO) has been designated as the national transmission system operator, responsible for operating and planning the high-voltage grid and regional interconnectors. KPLC, by contrast, owns and operates most of the distribution network, is the dominant retail supplier and has historically acted as the single buyer of electricity from generators. Once open access is implemented, KPLC's role will need to evolve from sole offtaker to a network service provider and one of several competing retailers. This transition requires robust and clear rules to manage potential conflicts of interest between KPLC's network and supply activities, and to ensure non-discriminatory access for other market participants.

Finally, open access needs to be closely linked to VRE integration and system planning. Grid expansion, congestion management and siting of new VRE projects should be co-ordinated with the new commercial routes to market to avoid creating new bottlenecks or zones of curtailment.

International practices on open-access regimes can inform Kenya on key priorities

Countries that have introduced open-access frameworks provide useful insights for Kenya. Examples from India and Zambia show how legal reforms can create new commercial pathways for renewable energy generators and large power consumers, while also helping address operational challenges that arise during implementation.

India's Green Open Access Rules provide one of the most advanced examples of operationalising open access for renewable energy. India clearly defines eligibility thresholds for consumers (100 kW and above), establishes rules for banking surplus renewable energy and sets out methodologies for network losses and cross-subsidy surcharges. These measures illustrate how operational rules can be structured to support predictable network use, transparent pricing and accelerated VRE deployment. While Kenya's market structure differs, introducing similar operational clarity could provide greater predictability for market participants as its open-access framework evolves.

Zambia offers lessons on access rights and capacity management. Its 2024 Open Access Regulations define short-, medium- and long-term access categories, each with clear procedures for application, queuing and capacity allocation. These provisions help manage network constraints and provide certainty for market participants. Developing comparable time-differentiated access rights and capacity reservation procedures in Kenya could support the orderly growth of bilateral transactions and help manage emerging congestion risks as VRE deployment accelerates.

Overall, the experiences of India and Zambia suggest that detailed, transparent and predictable operational rules are central to enabling effective open access and realising its potential benefits for renewable energy integration, while recognising that approaches must be adapted to each country's institutional and power system context.

Flexibility and storage needs

Flexibility and storage are increasingly important features of electricity systems, and their need is growing in Kenya. Flexibility refers to the system's ability to respond smoothly to changes in supply and demand, while storage allows excess energy to be held and released when needed. Together, they help stabilise the grid, increase reliability and manage assets in a cost-effective way.

Timely addition of storage and flexible resources is key to enhance grid stability and variable renewable energy integration

The Kenyan power grid is subject to grid stability issues and network losses. In 2023, network losses amounted to around 23% and the system experienced many outages, over 40 for an average consumer. While these losses can occur for many reasons and are not necessarily linked to grid stability issues or the integration of VRE, they highlight operational constrains that may result in higher investment needs. The country is already investing in its grid infrastructure to increase network reliability, with over USD 2 billion to be invested by 2030. In this context, flexibility and especially storage can play an important role by absorbing excess generation and providing voltage and frequency regulation, thereby reducing the need for additional investment in generation and transmission assets without compromising reliability.

The growth in VRE capacity increases the impacts of time and weather on the system. Solar and wind already account for 18% of Kenya's power generation and their installed capacity is expected to double before 2030. VRE generation is hard to forecast precisely and can lead to rapid change in the demand addressed to dispatchable assets. Storage assets are therefore key to balancing supply and demand, as they can respond to system needs by both generating and absorbing power.

Flexibility and storage additions could deliver substantial benefits to the power system. Beyond increasing grid reliability and easing the challenges of VRE integration, more flexible operation of the system can deliver economic benefits and help lower overall costs. Storage assets can avoid the use of costly peak plants in instances of high demand and conversely avoid steam venting in geothermal plants during times of lower demand. By shifting the peaks and valleys of the demand addressed to dispatchable generation, storage assets can deliver benefits to consumers while supporting secure operation of the system.

Kenya's National Energy Policy already identifies energy storage systems as critical to future grid stability and prioritises battery energy storage systems (BESS) and pumped-storage hydro as a result of a recent technical assessment, offering a concrete basis for early pilot procurement.

Battery energy storage systems can play a key role in providing intraday flexibility to the Kenyan system

BESS are becoming a cornerstone of short-duration flexibility in modern power systems. Thanks to a very fast ramping rate, they can respond almost instantaneously to the system's needs and therefore enhance reliability, adapt to VRE output and mitigate demand peaks. In recent years, the cost of BESS has fallen significantly, reducing the upfront investment needed and making BESS a more cost-effective source of storage and flexibility. As a low-carbon and network-friendly technology, BESS offer a flexible resource that investors can deploy where market conditions and remuneration frameworks appropriately reflect their system value.

BESS have the potential to strengthen intraday system balancing in Kenya's power system. Batteries are a highly modular technology that can easily adapt to the local constraints close to generation assets or at strategic nodes on the grid. This can enable the development of hybrid projects, as highlighted in the Least Cost Power Development Plan 2024-2043, to increase VRE capacity while ensuring secure and flexible operation. Kenya is expected to develop over 400 MW of stand-alone BESS before 2035 and over 500 MW of hybrid VRE-BESS projects.

As Kenya integrates higher shares of VRE, ensuring system flexibility across multiple time horizons will require more than BESS alone. While BESS is well suited to providing fast response and intraday balancing, it cannot economically address weekly and seasonal flexibility needs. Pumped-storage hydro, already present in Kenya's resource mix, can provide large-scale, long-duration energy shifting that supports longer-term variability and enhances system reliability. Managing prolonged and structural variability will also depend on a broader set of resources, including existing dispatchable thermal generation and effective use of transmission networks and regional interconnectors. A diversified portfolio of technologies combining short-duration BESS, longer-duration storage, dispatchable generation, interconnection, and demand-side flexibility will therefore support a resilient power system.

The integration of storage into the power system requires a review of the current framework

Integrating storage into a power system requires a reliable revenue stream that rewards the entirety of the service provided. Kenya's current tariff structure does not yet define how storage should be compensated for its contribution to system stability, congestion management or short-term balancing. Stand-alone storage is not eligible for feed-in tariffs (FiTs), and the absence of a dedicated remuneration mechanism limits the ability of developers to recover their costs. Establishing clear and predictable tariff principles would help ensure that storage assets can operate while contributing effectively to security of supply. In that respect, the design of the remuneration is of the utmost importance as it is the key driver of the operation of the asset. A flat FiT might not reward a behaviour in line with system needs; time-of-use pricing, capacity-based payments and performance-linked contracts should therefore be considered.

Regulatory and legal frameworks might not always be up to date to allow storage to deliver its full value. Kenya's grid codes do not yet define the operational requirements of, or connection rules applicable to, storage assets, which undermines private investment incentives. Reforming the regulation would enable BESS and other storage technologies to be integrated in a technology-neutral manner and allow them to deliver benefits to the system.

To unlock the necessary investment, forward visibility of the system's condition and regulation is of the utmost importance. Investors face both currency-related financing constraints and uncertainty around the long-term framework for storage deployment. Clear signals on future procurement needs, transparent planning assumptions and a coherent trajectory for market and regulatory reforms would help reduce risk premiums and support access to competitive financing. Providing consistent long-term guidance on how storage will be valued and co-ordinated within Kenya's power system would strengthen confidence among investors and accelerate the deployment of the storage capacity required to meet the country's growing flexibility needs.

International examples highlight pathways to effectively enable storage and flexibility investment

South Africa stands as a leader in Africa for its extensive programmes for BESS investment. Several procurement programmes have been implemented to unblock investment in batteries, with associated tariff structures. The BESS IPP procurement programme attracted private investors through long-term PPAs, such as the Oasis project. This allowed the development of projects delivering a wide variety of services, from load shifting to ancillary services procurement. Other mechanisms show that flexibility can be incentivised through technology-neutral schemes. For instance, the South African Risk Mitigation IPP Procurement Programme simply aimed to provide more flexibility to the system through dispatchable generation units, and yet resulted in several projects including hybrid VRE storage capacity totalling over 1 GW.

Effective storage integration often depends on well-designed policy and financial support mechanisms that recognise the system value of storage and enable early investment. The Indian electricity system, for instance, increased its installed VRE capacity, leading to a greater need for flexibility. In response, the government set storage targets to ensure secure operations, supported by several programmes. The Viability Gap Fund was introduced to ease investment in standalone batteries by financing a high share of capital expenditure and a smaller share of operational costs for a limited time thereafter. It successfully supported the introduction of over 43 GWh of BESS in the system. Although Kenya's market structure differs from the wholesale market implemented in India, India's experience illustrates the importance of targeted support during the early phases of market development to ensure both the necessary investment and operations.

Flexibility can also be achieved through other mechanisms. Egypt, for instance, focused on long-term storage with pumped hydro, mainly funded from private sources via tenders held by the authorities. These projects are larger than BESS projects, but provide the needed long-term flexibility to the system. Once the investment is made, ensuring that the asset is used efficiently becomes critical. The People's Republic of China, for instance, implemented differentiated tariffs to adequately remunerate different services that pumped-storage hydro gives to the system. This is designed to improve asset performance and deliver greater system benefits.

Ancillary services

Ancillary services are essential to maintaining the stability and reliability of an electricity system, particularly as the share of VRE grows. These services support core system functions such as frequency control, voltage regulation, operating reserves and system restoration, ensuring that electricity supply remains secure even as conditions change rapidly. In Kenya, rising variability and evolving power flows are increasing the importance of well-defined and well-procured ancillary services to complement the country’s strong renewable energy base and safeguard system performance.

The evolving power system is driving the need for essential ancillary services in Kenya

As already highlighted, Kenya is experiencing growing operational pressures driven by increasing variability and rising flexibility needs. It is becoming clear that expanding generation capacity alone cannot resolve these emerging challenges, underscoring the need to strengthen the real-time operational frameworks required to maintain system stability. A systematic approach to defining, procuring and compensating ancillary services is essential, including frequency response, operating reserves, reactive power support and system recovery services.

In practice, Kenya’s system operator already faces episodes of significant frequency excursions and localised voltage instability, particularly during evening peaks and periods of high wind output. While Kenya benefits from substantial synchronous inertia from its hydro and geothermal fleet, the effectiveness of this support can vary, as geothermal units often have limited governor response and operate under conditions that restrict their ability to absorb disturbances. Local areas of low system strength, constrained transmission corridors and limited deployment of modern voltage regulation equipment mean that disturbances can propagate more widely than expected. These conditions reinforce the need for fast-acting ancillary services, such as fast frequency response, primary reserves and voltage support, as core tools for maintaining dynamic stability.

Policy ambition is high, but system services frameworks remain incomplete

Kenya’s electricity market remains organised around a single-buyer model, with KPLC responsible for wholesale procurement and retail supply. Within this structure, ancillary services are not procured through a dedicated transparent mechanism, but are instead implicitly provided through generation and dispatching arrangements, primarily by KenGen. Kenya does not yet operate a dedicated ancillary services market, and current regulations provide limited guidance on service definitions, procurement processes and pricing.

Both the IEA Kenya Energy Policy Review (2024) and the National Energy Policy 2025-2034 highlight gaps: the absence of formal system service products, a lack of methodologies for sizing and compensating services, limited institutional analytical capacity, and early-stage implementation of broader market reforms under the Energy Act 2019 and the draft Open Access Regulations 2024. As mentioned previously, the value of energy storage such as BESS in increasing network strength is clearly highlighted in the National Energy Policy and activity in this area is starting. Kenya's ancillary services framework therefore remains at an early stage of development, consistent with the current structure of its electricity market.

International experiences can inform Kenya's system services transition

Countries that have undergone similar transitions provide useful guidance for Kenya's next steps. South Africa's framework – anchored in its Grid Code and Ancillary Services Technical Requirements – demonstrates that a single-buyer model can still support a structured approach to system services, provided that technical standards and procurement processes are clearly defined. Formal service definitions for frequency control, reserves, reactive power management and system restoration have enabled secure operation amid rising variability and network stress.

The Philippines illustrates the value of a gradual, staged transition. Its Ancillary Services Procurement Plan created a transparent contracting framework for essential services, which later evolved into the development of a reserve market within the wholesale electricity spot market. This approach allowed operational capabilities, digital systems and institutional capacity to mature progressively.

India provides an example of deeper integration of ancillary services with real-time power markets. By linking reserve products to real-time price formation and building on existing deviation settlement mechanisms, India strengthened operational incentives and broadened participation to include storage, renewables and demand-side resources. Its phased evolution shows how incremental reform can expand the sophistication of system services markets over time.

Across these examples, several principles consistently emerge: clear and enforceable service definitions, predictable procurement structures, phased implementation, and alignment with broader market and digital infrastructure development. These lessons offer practical direction as Kenya designs its own framework.

Key strategic priorities for developing ancillary services in Kenya can be identified

Clarify system service needs and operational responsibilities

A modern ancillary services framework begins with clear definitions of the required services, their technical characteristics and indicative volumes. It is essential to define system service products – including fast frequency response, primary and secondary reserves, reactive power support, voltage control, congestion management and black-start capability – to enable accurate assessment of the system's needs and the development of effective procurement frameworks. Clear and consistent definitions will also support the system operator in quantifying requirements, designing procurement methods and monitoring performance. Finally, enhancing the operational flexibility of existing hydropower and geothermal plants together with targeted investments in voltage support technologies (such as static synchronous compensators [STATCOMs] and static VAR compensators [SVCs], and, where justified by system strength needs, synchronous condensers) will further strengthen grid stability and system resilience.

Clarifying operational responsibilities is equally important. Over time, generators, retailers and large consumers will need to assume increasing responsibility for managing their own imbalances as market reforms progress, while the system operator – whose role is expected to evolve as reforms advance – should hold the mandate to address residual imbalances through least-cost balancing and ancillary service procurement. This delineation of roles is foundational for transparent and efficient system operation.

Strengthen regulatory foundations and institutional capacity

Advancing the development of system services will depend on establishing a coherent regulatory and institutional architecture. The division of roles between EPRA, the Ministry of Energy and Petroleum, KETRACO, KPLC and KenGen must be clearly defined, covering planning, system operation, oversight and market facilitation. The strategic direction outlined in the National Energy Policy 2025-2034 should be translated into concrete regulatory instruments, including updates to the Grid Code and the creation of a dedicated Ancillary Services Code.

In the early stages, EPRA may rely on cost-based remuneration for essential services to ensure transparency and predictability. Over time, as system modelling capabilities, digital tools and institutional capacity mature, these arrangements can gradually transition towards more competitive and performance-based mechanisms.

Define a procurement pathway to support gradual market development

Given Kenya's current level of market maturity, a phased procurement strategy offers the most pragmatic pathway for implementation. In the short term, structured agreements with KenGen, IPPs and major hydropower and geothermal plants will remain essential to securing stability-related services that are currently provided implicitly. Hydropower supplies a large share of Kenya's inertia, spinning reserves and reactive power support, yet these contributions are largely uncompensated and increasingly difficult to sustain as many plants operate near minimum load during certain periods. Formalising these services through transparent contractual or tariff-based mechanisms would ensure cost recovery and provide clear operational signals as renewable variability grows.

At the same time, uncertainty around remuneration mechanisms for BESS – reflecting the absence of defined tariff structures or cost recovery frameworks – creates a barrier to early investment and limits the optimisation of hybrid geothermal or wind-plus-storage configurations. Pilot long-term contracts for battery storage, advanced power electronics devices and demand-side response can therefore help to de-risk emerging technologies by providing revenue visibility and supporting the development of operational experience.

Over the longer term, as institutional capability improves, Kenya can move towards co-optimised balancing and ancillary service arrangements that incorporate marginal pricing, performance-based remuneration and expanded participation from distributed and flexible resources. Harmonising domestic procurement rules with those of the Eastern Africa Power Pool will facilitate regional reserve sharing and enhance system security.

Conclusion

Kenya has achieved remarkable progress in expanding renewable energy-based electricity and improving electricity access, positioning itself as one of Africa's leaders in clean energy. As wind, solar, geothermal and hydropower continue to shape the country's electricity supply mix, Kenya now faces a new phase in which operational flexibility and system stability become central to maintaining secure and reliable electricity. The analysis in this report highlights that Kenya is moving deeper into Phase 3 of VRE integration, where variability increasingly influences system-wide operations and requires more sophisticated tools and operational practices. Enhanced market frameworks can support this transition by improving resource efficiency, guiding cost-effective investment and enabling more structured procurement of flexibility and ancillary services, thereby delivering both economic and security benefits to the system.

Ensuring that the next stage of Kenya's clean energy transition remains secure and affordable will depend on three mutually reinforcing pillars. First, open access can unlock new commercial pathways for renewable developers, diversify supply and progressively address structural constraints inherent in the single-buyer model. To be effective, however, this framework must be supported by transparent network tariffs, clear market roles and predictable procedures that safeguard non-discriminatory access. These elements will be essential to ensuring that open access strengthens investment signals, supports developer confidence and contributes to a more resilient and competitive electricity market.

Second, flexibility and storage will become essential complements to Kenya's growing renewable energy fleet. Building on the existing flexibility of hydropower plants, BESS can help manage variability, reduce curtailment, support frequency stability and relieve network constraints. Addressing the existing issues can also generate important economic benefits by enabling productive use of excess energy during low-demand periods and helping avoid the need to dispatch high-cost thermal units during periods of tight supply or high demand. Realising this potential will require a supportive regulatory framework, defined remuneration principles and improved forecasting, data and operational visibility.

Third, ancillary services will play an increasingly important role in strengthening system stability as the grid becomes more dynamic and increasingly influenced by VRE. Establishing clear service definitions, procurement arrangements and performance requirements will help ensure that generators providing essential system services are remunerated for the value they deliver, and create stronger investment incentives for new flexibility resources, including BESS. International experience shows that a phased approach, starting with structured agreements and evolving towards more competitive and co-optimised arrangements, can effectively build operational maturity and deliver economic benefits over time.

Across these areas, the underlying message is clear: increasing generation capacity alone cannot resolve Kenya's emerging power system pressures. Next steps must therefore focus on building a system that is flexible, well-coordinated, data-driven and supported by clear regulatory and operational arrangements. Achieving this will require a transparent and predictable framework that attracts sustained private sector investment while maintaining cost-effectiveness for consumers, ensuring that the benefits of Kenya's clean energy transition are delivered in a reliable and affordable manner.

Abbreviations and acronyms

BESS	battery energy storage systems
EPRA	Energy and Petroleum Regulatory Authority
FiT	feed-in tariff
IEA	International Energy Agency
IPP	independent power producer
KETRACO	Kenya Electricity Transmission Company
KPLC	Kenya Power and Lighting Company
PPA	power purchase agreement
PV	photovoltaic
STATCOM	static synchronous compensator
SVC	static VAR compensator
VRE	variable renewable energy

See the IEA glossary for a further explanation of many of the terms used in this report.

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