

# Reconciling Domestic Energy Security and Regional Geopolitics in Eastern Africa's Electricity Trade and Integration

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## Article

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# Abstract

The growing pressures of climate change, energy (in)security and geopolitical tensions have intensified domestic and regional concerns over electricity supply, while simultaneously renewed interest in regional energy cooperation. This study examines the policies, processes and tensions between meeting domestic energy security and electricity systems integration across the Eastern Africa Power Pool (EAPP). Using an enablers-based framework, the analysis shows that cross-border trade has advanced bilateral interconnectors and supported domestic electricity security, particularly in smaller and import-dependent systems. However, regulatory limitations, political instability and grid bottlenecks, as well as geopolitical tensions, continue to curtail domestic and regional projects, electricity trade and large-scale renewable integration. The paper argues for a differentiated and sequenced approach to regional integration that reflects country-specific electricity systems while strengthening regulatory harmonisation and de-risking mechanisms. Aligning regional electricity trade with domestic priorities and sub-regional geopolitical contexts is crucial for improving energy security and supporting resilient low-carbon energy transitions.

## 1. Introduction

The global energy transition is unfolding amid tensions between advancing sustainable low-carbon pathways, adapting to climate change, and ensuring energy security under conditions of economic and geopolitical volatility. These pressures create a complex policy landscape, particularly in the Global South, where short-term energy security priorities linked to economic development may diverge from longer-term climate and regional integration objectives (Lal et al., 2026; Muttitt & Kartha, 2020).

Across Eastern Africa, climate change and energy security increasingly act as intertwined drivers of domestic policy and regional economic integration in the power sector (Fwd et al., 2009; Rubanda et al., 2022; Shihundu & Nyadera, 2022). At the domestic level, electricity systems are becoming more exposed to climate-related disruptions, ranging from drought-induced power outages in Tanzania throughout the 2010s (Kizito Makoye, 2022) to severe infrastructure damage, such as the Derna dam collapse in Libya in 2023 (Murphy, 2025). These disruptions have heightened policy attention to infrastructure resilience across regional and supranational organisations, such as the African Union, within broader economy-wide strategies aimed at advancing climate action while meeting current energy needs and rapidly growing demand in the region, projected to increase by nearly 130 TWh by 2050 (Khougali & Spataru, 2023). In this context, these pressures shape both the pace and depth of regional electricity integration (Gonçalves et al., 2024), understood as the process of linking electricity systems across jurisdictional boundaries through coordinated planning, grid synchronisation, operational coordination, market integration, and the harmonisation of policies and regulatory frameworks (IEA, 2019).

In parallel, energy security, which is uninterrupted and affordable energy, has become a central driver of economy-wide development policy, closely linked to economic development, industrialisation and social

welfare. Concerns over reliable and affordable energy supply have intensified in response to supply shortages, infrastructure constraints and fuel price volatility in energy markets (Bradshaw, 2009). These pressures have encouraged governments to pursue supply diversification strategies, including the expansion of variable renewable energy (VRE) (Conway et al., 2018) and cross-border electricity trade (Amundsen & Bergman, 2002). Both cross-border integration and increased variable renewable energy (VRE) deployment strengthen energy security by expanding access to interconnected supply and demand centres, while supporting the transition to sustainable energy systems through greater system flexibility and higher shares of renewable energy (Brinkerink et al., 2019; Odeh & Watts, 2019).

Within this context, the Eastern Africa Power Pool (EAPP) has emerged as a critical organisation for coordinating shared energy security concerns across interconnected electricity systems. Established in 2005, the EAPP facilitates coordinated electricity planning for transboundary infrastructure development, and regional trade among thirteen member countries in Eastern Africa with the aim of sustainable energy security across a significant geographical scope to include significant renewable energy potential northwards Egypt and Libya alongside countries in the Horn of Africa, the Nile Basin and the wider eastern African region as shown in Fig. 3 (Eastern African Power Pool, 2020). It aims to link short-term energy security objectives, specifically and here focussed on electricity security provisions, with long-term market integration by promoting interconnections and cross-border electricity exchange. The EAPP aims to develop a unified regional electricity market capable of reducing costs, leveraging economies of scale, and enhancing system stability, particularly for smaller or more vulnerable power systems through access to larger interconnected networks (Degeilh & Singh, 2011; IRENA, 2023).

While the high hydropower and hydrocarbon generation mix in EAPP countries presents opportunities to support and transition towards VRE integration and enhance system flexibility through cross-border interconnections, the extent to which these benefits are realised depends on coordinated transmission investment, regulatory alignment, and sustained political cooperation across member states (Damoun & Poudineh, 2025; Farahmand et al., 2015; Fraunholz et al., 2025; Hoffart et al., 2024).

## **1.1 Reconciling tensions between national policies and regional trade**

Despite the technical and economic benefits of regional electricity integration (Brinkerink et al., 2019), several barriers continue to constrain the development of the EAPP and the integration of VRE in the region. First, integration is limited by deficiencies in transmission infrastructure, including weak cross-border interconnections, insufficient grid capacity, and delays in planned investments. These constraints restrict electricity flows across systems, limiting the ability to balance supply geographically and reducing the reliability benefits of regional trade.

Second, the concentration of generation in large-scale hydropower enables low-carbon exports under favourable conditions but creates systemic exposure to hydrological variability during drought periods, reduced generation limits export availability and disrupts regional exchanges. At the same time, uneven

deployment of VRE constrains diversification and system flexibility, resulting in an asymmetrical system in which some countries act as intermittent exporters while others remain structurally dependent on imports.

Third, integrated electricity systems are inherently geopolitical as electricity transmission lines become a transboundary resource exchanged through agreements between several actors with varying interests (Fischhendler et al., 2016). In this context, the EAPP is both a platform for coordinating cross-border electricity trade and a regional institution shaped by wider geopolitical energy relations. Hydropower development, transmission planning, and electricity trade are closely connected to shared river basins such as the Nile, Lake Victoria, and the Kagera River. In these contexts, domestic energy security priorities may conflict with broader regional coordination objectives (Nile Basin Initiative, 2021). This interdependence creates national and regional geopolitical dynamics that influences states to coordinate the management of shared resources and cross-border electricity markets (Gonçalves et al., 2024).

Hence, the implementation of the EAPP sits within the intersection energy security–climate resilience nexus, and depends on both physical interconnections and sustained multilateral governance. The alignment of domestic policy frameworks with regional objectives remains a central challenge. This analysis argues that domestic policy frameworks across the EAPP remain insufficiently aligned with regional integration objectives. This misalignment constitutes the central contribution of the paper. Greater policy alignment may strengthen regional electricity integration by improving coordination in renewable energy portfolio development, generation flexibility, transmission planning, and cross-border electricity trade.

To this end, strengthening domestic–regional policy alignment would enhance regional electricity integration by improving coordination in renewable energy portfolio development, increasing generation flexibility, optimising transmission planning, and enabling more effective cross-border electricity trade.

## **1.2 Contribution of this paper**

Existing studies have examined the techno-economic benefits of EAPP electricity trade (Remy & Chattopadhyay, 2020), regional electricity market design and institutional governance (Elabbas et al., 2023), and the geopolitical dimensions of energy development and transboundary resources in Eastern Africa (Nasr & Neef, 2016; Shihundu & Nyadera, 2022). Despite growing attention to energy security and electricity systems integration (Adenle et al., 2017; Bradshaw, 2009; Hong et al., 2015), several gaps persist. First, although studies on off-grid solutions and decentralised energy access have enriched the literature (Bhattacharyya & Palit, 2021), comparatively less attention has been given to power pools and interconnected electricity grids. Second, the role of domestic policy, planning and regulatory frameworks in supporting or constraining regional electricity integration is still insufficiently understood, particularly within emerging African power pools. Third, the combined influence of infrastructure constraints, institutional capacity and risks on integration outcomes has not been fully examined. As a result, the effectiveness of institutional mechanisms for coordinating electricity security across diverse national

systems requires further analysis (Elabbas et al., 2023; Fischhendler et al., 2016; Hoffart et al., 2024; Musau et al., 2017; Nasr & Neef, 2016).

To this end, this study addresses the following questions:

- *What national policies and processes drive renewable energy uptake and cross-border trade, and how do regulatory frameworks support investment towards RE and cross-border electricity trade?*
- *Where do policy and regulatory misalignments persist in meeting regional objectives of energy security and energy transitions, and what reforms may be required to achieve more effective outcomes of energy security?*

This paper contributes to the understanding of the energy security–climate nexus in regional electricity system integration and sustainable energy transitions across Eastern Africa. By applying an enablers-based framework to assess the technical, institutional, and policy conditions required for coordinated regional power systems, it identifies policy misalignments between national electricity strategies and regional integration objectives that may limit the EAPP’s ability to deliver secure, reliable, and low-carbon electricity systems, and to reconcile energy security with broader decarbonisation goals. In doing so, we address this gap by dressing how heterogeneous national electricity systems, policy and regulatory frameworks, and geopolitical conditions interact to shape countries’ ability to reconcile domestic energy-security priorities with regional electricity integration across the EAPP.

The remainder of the paper is structured as follows. Section 2 outlines the methodology and data used in this study. Section 3 presents the results and analysis of the enablers assessment. Section 4 concludes with key findings and policy implications for reconciling energy security and regional electricity systems integration.

## 2. Methods

### 2.1 Enablers framework

The ability to absorb variable renewable energy and participate in regional trade depends on domestic supply portfolios and grid capacity, and cross-border trading capacity and transmission infrastructure. These two enablers, adapted from Bissiri et al. (2024), provide the framework for assessing the EAPP.

This study employs policy content analysis to assess how national electricity policies, planning instruments and regulatory frameworks align with EAPP regional integration. Alignment is assessed by examining national policies, generation plans, grid investments, regulatory instruments and implementation mechanisms against regional objectives for electricity system integration and renewable energy integration.

The selection of the two enablers framework is informed a literature mapping conducted by Bissiri et al. (2024) on the Western Africa Power Pool (WAPP). In this framework presented in Fig. 1, policies and

planning processes are assessed in terms of both their stated commitments and their implementation mechanisms to identify areas of alignment, misalignment and implementation gaps, which may be driven by geopolitical dynamics and climate-related risks.

The analysis draws on national and regional policy, planning, and regulatory documents collected for all thirteen EAPP member states: Burundi, Djibouti, Democratic Republic of the Congo, Egypt, Ethiopia, Kenya, Libya, Rwanda, Somalia, South Sudan, Sudan, Tanzania, and Uganda.

The first enabler is electricity supply generation and expansion and is assessed through each country's generation mix and how national supply choices influence regional integration. This includes the role of domestic energy security priorities, such as the expansion of non-renewable energy, as well as geopolitical considerations related to countries' positions as regional net exporters. The second enabler is regional systems integration through transmissions capacities and governance. This enabler assesses the capacities to trade, and the transmission planning and regulatory frameworks in supporting interconnection development, cross-border electricity trade, and broader regional power pooling challenges including geopolitical dynamics that shape cross-border infrastructure corridors. Although in Bissiri et al. (2024) identify supply-side flexibility as a third enabler, this study embeds flexibility within the two selected enablers, as generation expansion and transmission integration are central to supply-side flexibility.

## 2.2 Data sources

As energy security is closely linked to economic development and regional trade, this study examines economy-wide policies. The documents examined are composed of institutional, legal and regulatory frameworks governing the power sector across all EAPP countries. These documents as shown in Table 1 include national energy policies and strategies, power sector master plans, and regulatory frameworks. Regional planning and regulatory documents produced by the EAPP Secretariat and the Independent Regulatory Board (IRB) were also reviewed to examine regional objectives, market development, and efforts toward regulatory harmonisation. As energy security is an economy-wide agenda, a domestic economy-wide policies were also reviewed as presented in appendix A.

Data on existing and planned interconnections were drawn from EAPP Master Plans to assess cross-border transmission capacity. These data provide information on the financial scale of infrastructure corridors and bilateral interconnectors and agreements.

Documents were sourced from national ministry portals, regional institutional repositories, utility and regulatory authority websites, and publicly accessible databases. Materials were selected based on their relevance to electricity generation planning, renewable energy deployment, transmission development, market regulation, and regional integration. Where official documentation was unavailable or outdated, secondary sources were used to fill gaps and triangulate information across countries, including reports from the International Energy Agency.

The analysis is further supplemented by technical reports, electricity statistics, and datasets from multilateral institutions, including the World Bank, African Development Bank, IRENA, and the International Energy Agency to include the most updated data on power sectors available, which may vary by country. Publications from national regulatory authorities, utilities, and system operators were also reviewed where available.

Table 1

Institutional, legal and regulatory frameworks and actors in the power sector across all EAPP countries.

| <b>Institutional Bodies</b>                                                      | <b>Member Utilities</b> | <b>Legal Frameworks</b>                                                                                  | <b>Regulatory Bodies</b>                                                       | <b>Supporting Mechanisms</b>                                                                                                                                    |
|----------------------------------------------------------------------------------|-------------------------|----------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Burundi Ministry of Energy and Mines                                             | REGIDESO, SINELAC       | Burundi Electricity Act 2015<br><br>Electricity production, import and export of electricity regulations | Authority for Regulation of Water and Energy Sectors (AREEN)                   | L'Agence Burundaise de l'Électrification Rurale (ABER)                                                                                                          |
| Djibouti Ministry Energy and Natural Resources. Ministry of Economy and Finance. | EDD                     | Decree 83–0171/PREDD of 2 February 1983                                                                  | None                                                                           | Social Development Agency (rural electrification). National Energy Commission. Djiboutian Agency for Energy Management                                          |
| DRC Ministry of Energy and Hydraulics                                            | SNEL, SINELAC           | Law No. 14/011 (Electricity Sector)                                                                      | Autorite du Regulation du Secteur de l'Ectricite RDC (ARE)                     | National Electrification Agency (AGENA) and National Electrification Fund (FONEL)                                                                               |
| Ethiopia Ministry of Water and Energy. Ministry of Mines and Petroleum.          | EEP                     | Geothermal Proclamation No. 981 2016. Proclamation No. 810 2013 energy-proclamation                      | Ethiopian Energy Authority. Rural Electrification Agency                       | Electricity Tariff amendment. 5-year Power System Expansion Master Plan of 2016                                                                                 |
| Egypt Ministry of Electricity and Energy                                         | EEHC                    | 87/ 2015 - Electricity Law. Renewable Energy Law No. 203 of 2014                                         | Egyptian Electric Utility and Consumer Protection Regulatory Agency (EgyptERA) | The Egyptian Natural Gaz Holding Company Sustainability Policy                                                                                                  |
| Kenya Ministry of Energy and Petroleum                                           | KenGen, KPLC, KETRACO   | Kenya Electricity Act 2019.<br><br>Energy Act, 2019                                                      | Energy and Petroleum Regulatory Authority                                      | National Distribution Grid Code. Feed-In-Tariff Kenya. Energy Regulatory Commission (ERC). Clean Development Mechanism (CDM). National Master Plan (2013 draft) |
| Libya Ministry of Oil And Gas                                                    | GECOL                   | Law No. 426 establishing (REAOL). Law No: 24 of 1970 (Establishment of National Oil Corporation). decree | Renewable Energy Authority of Libya (REAOL)                                    | Libya Renewable Energy Strategic Plan 2013–2025                                                                                                                 |

| <b>Institutional Bodies</b>                                                  | <b>Member Utilities</b>                    | <b>Legal Frameworks</b>                                                                                                                                                                                                                                           | <b>Regulatory Bodies</b>                                                              | <b>Supporting Mechanisms</b>                                                                                                                                                                          |
|------------------------------------------------------------------------------|--------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                              |                                            | No. 341 for 2012, to approve the organization of the General Authority for the Environment. decree No. 32 for 2012, about the organization of the oil and gas ministry                                                                                            |                                                                                       |                                                                                                                                                                                                       |
| Rwanda Ministry of Infrastructure. Ministry of Finance and Economic Planning | Rwanda Energy Group Limited (REG), SINELAC | Rwanda Electricity Act 2011<br><br>Rwanda Electricity Act Amendments 2018. Ministerial Guidelines for Clean Cooking Technologies. Investment Code (2014). Public Private Partnerships Law (2014). Organic Law on Environment (2005). Law Establishing RURA (2013) | Rwanda Utilities Regulatory Authority. Rwanda Environment Management Authority (REMA) | Feed-In-Tariff. Rwanda Development Board (RDB). Rwanda Standards Board (RSB). Policy Monitoring Action Plan. Approved Ministerial Guidelines on Minimum standards Requirements for Solar Home Systems |
| Sudan Ministry of Energy and Petroleum                                       | SETCO                                      | Sudan Electricity Act ENG 2001                                                                                                                                                                                                                                    | Sudan Electricity Regulatory Authority                                                | Sudan National Quarter-Century Strategy (2007–2031). National Master Plan (2013)                                                                                                                      |
| Tanzania Ministry of Energy                                                  | TANESCO                                    | Tanzania Electricity Act 2016<br><br>Tanzania Electricity Act (Amendments in 2020)                                                                                                                                                                                | Energy and Water Utilities Regulatory Authority (EWURA)                               | Feed-In-Tariff. RURAL ENERGY AGENCY (REA). Energy Efficiency Action Plan. National Master Plan (2012)                                                                                                 |
| Uganda Ministry of Energy and Mineral Development                            | UETCL                                      | Uganda Electricity Act 1999                                                                                                                                                                                                                                       | Electricity Regulatory Authority                                                      | Feed-In-Tariff. National Master Plan (2011)                                                                                                                                                           |
| Somalia Ministry of Energy and Water Resources                               | Private Electricity Utilities              | Somalia National Electricity Act 2023                                                                                                                                                                                                                             | The Department of Energy in the Ministry of Energy and Water Resources                | Power Master Plan                                                                                                                                                                                     |

| <b>Institutional Bodies</b>       | <b>Member Utilities</b> | <b>Legal Frameworks</b>           | <b>Regulatory Bodies</b> | <b>Supporting Mechanisms</b>        |
|-----------------------------------|-------------------------|-----------------------------------|--------------------------|-------------------------------------|
| South Sudan Ministry of Petroleum | SSEC                    | South Sudan Electricity Bill 2015 | None                     | Infrastructure Plan for South Sudan |

## 3. Results and Discussion

### 3.1 Enabler 1: Domestic systems capacity

#### 3.1.1 Hydropower-dominant electricity systems

Hydropower accounts for more than 70% of electricity generation in the DRC, Uganda, Ethiopia and Sudan, and over 90% of generation in Ethiopia and the DRC (IEA, 2026). While all countries' Nationally Determined Contributions (NDCs) and vision policies include plans to develop VRE (UNFCCC, 2026), such as solar and wind energy, as well as geothermal energy from the Great Rift Valley, master plans indicate that hydropower will continue to lead generation expansion. This includes committed generation expansion of 42 GW in the DRC, 14 GW in Ethiopia, and 2.4 GW in Uganda, alongside 3 GW of committed coal capacity in Sudan by 2040 (EAPP, 2014). Across all four countries, several legal and regulatory frameworks have been developed to support generation expansion, meet energy security objectives, and expand the participation of private actors in VRE generation alongside the public sector.

Ethiopia's regulatory framework emerged from the Electricity Proclamation No. 86/1997, which established the statutory basis for electricity regulation and created the Ethiopian Energy Agency. This was strengthened through Energy Proclamation No. 810/2013, which expanded the legal framework for licensing and enabled model power purchase and service agreements for private sector participation. Given Ethiopia's significant geothermal energy potential, as shown in Fig. 3, the Geothermal Resources Development Proclamation No. 981/2016 created a dedicated legal basis for geothermal development, while Public-Private Partnership (PPP) between the public utility and a private company to finance, build, and operate energy infrastructure as part of the PPP Proclamation No. 1076/2018 established a PPP Board and PPP Directorate General under the Ministry of Finance. Together, these instruments allow Independent Power Producers (IPPs) that are privately owned companies that generate electricity for sale, and long-term PPAs, A Power Purchase Agreement (PPA), where the private company buys electricity directly from a generator at an agreed price, particularly for capital-intensive solar, wind and geothermal energy projects. In Ethiopia, a net exporter, Ethiopian Electric Power manages regional electricity exports, major hydropower development and transmission infrastructure, while private sector participation is directed toward commercially viable solar, wind and geothermal energy projects.

Similarly, Uganda's Green Growth Development Strategy 2017/18–2030/31 and National Development Plan (NDPIII) 2020/21–2024/25 are economy-wide planning instruments that include geothermal energy priorities, but do not clarify whether dispatchable capacity procurement will be delivered through public

investment, IPPs or PPPs. However, Uganda, a net importer, has the most operational IPP and PPP framework among the hydropower-dominant systems. The Electricity Act 1999 liberalised and unbundled the sector into generation, transmission and distribution entities, regulated by the Electricity Regulatory Authority. Uganda Electricity Transmission Company Limited is responsible for transmission and managing regional electricity trade.

Sudan's Electricity Strategy 2019–2035 identifies hydropower, solar, wind and nuclear energy expansion, although committed power plants are limited to coal. The Electricity Act 2001 provides the core legal basis for electricity-sector governance and licensing, while the Public Private Partnership Law No. 10 of 2021 creates a formal route for PPPs. However, political and institutional disruptions, among other factors, have constrained electricity-sector reform (Ali, 2021). As a result, Sudan continues to rely on electricity imports from Ethiopia to address domestic supply deficits.

Political and institutional disruptions in the DRC have also limited the implementation of expansion and rehabilitation plans. Law No. 14/011 of 2014 provides the legal basis for electricity-sector reform, while the National Electrification Agency and Investment Code Law No. 0004/2002 provide institutional and investment frameworks that support private participation. These frameworks have supported the Regional and Domestic Power Markets Development Project, which aims to strengthen the DRC's role as a regional net exporter through significant hydropower plant development from the Inga complex and rehabilitation of the domestic grid through IPP and PPP participation (Scherer, 2021). However, limited implementation has contributed to significant stranded generation, or “white elephant” projects particularly in the Inga complex, where the grid cannot fully absorb domestic hydropower generation (Scherer, 2021, p.1).

Ethiopia has pursued an export-oriented strategy through GERD and cross-border electricity trade with Djibouti, Sudan and Kenya, yet domestic electricity access is still low. This mirrors the DRC, which has significant hydropower potential but is still a net importer. Climate risks to hydropower are recognised across national policies and by sub-regional organisations such as the Intergovernmental Authority on Development (IGAD) and the Nile Basin Initiative (NBI). However, these frameworks have not yet addressed the risks of cascading outages across interconnected grids during extreme climate conditions, nor have they developed reserve-sharing mechanisms to mitigate such risks. The NBI has supported cross-border electricity infrastructure despite geopolitical tensions over transboundary resources such as the Nile and Kagera Rivers, which host some of the continent's largest dams, including GERD in Ethiopia and the High Aswan Dam in Egypt. While sub-regional organisations have helped reduce geopolitical tensions and align domestic development with regional electricity trade, gaps persist in addressing cascading system impacts, hydropower path dependency, and dependence on a limited number of corridors and transit states, particularly Sudan. Ethiopia plans to develop an interconnector with South Sudan by 2040, but limited grid development and weak policy support in South Sudan may constrain future electricity trade.

### **3.1.2 Diversified and hydro-natural gas systems**

Kenya, Rwanda and Tanzania represent the most diversified electricity systems in the EAPP, as shown in Fig. 2. Kenya is the strongest case of policy-led renewable energy diversification and private power market development in the EAPP. Its transition has been driven by a long-term shift towards geothermal energy after the oil price shocks of the 1970s (Omenda et al., 2025) and development of regional electricity interconnectors to import electricity, and reinforced through Vision 2030, the National Climate Change Response Strategy, the National Energy Policy 2018, the Energy Act 2019 and successive Least Cost Power Development Plans. Both hydropower and geothermal energy now account for around 90% of electricity generation, with small fractions of solar energy (IEA, 2024).

Kenya's legal and electricity market framework through the Energy Act 2019 has supported this transition by establishing the Energy and Petroleum Regulatory Authority as the regulator for electricity transmission and distribution contracts, licenses, approval and execution. As the generation entity of the power sector is liberalised, public generators and IPPs support electricity generation to Kenya Power through Energy & Petroleum Regulatory Authority (EPRA) approved PPAs, while Kenya Electricity Transmission Company Limited (KETRACO) and Kenya Power. Regionally, Kenya is a major EAPP node through interconnections with Ethiopia, Uganda and Tanzania, and imports from Ethiopia increasingly support supply security. Yet nationwide blackouts since 2020 show that low reserve margins, coupled with significant transmission distribution bottlenecks continue to undermine systems reliability and reserve margins (Waswa et al., 2024). As observed across EAPP countries' policies, processes, and implementation, generation power plants are unable to operate at full capacity from poor maintenance, and aging infrastructure, which increases the risk of cascading outages across interconnected regional systems.

Similarly, Rwanda and Tanzania have diversified away from hydropower, and towards natural gas and imported electricity, and in Rwanda, also towards coal. Given the shocks of both oil prices and hydropower plant shortages from extreme seasons and climate events since 2010, The National Green Growth and Climate Resilience Strategy 2011, Rwanda Energy Policy 2015, Energy Sector Strategic Plan 2013–2018 and National Environment and Climate Change Policy 2019 have supported this transition which led to Oil fell from almost 40% of generation in 2000 to around 7.3% by 2023, while imports accounted for around 8.4% of supply in 2023. Rwanda's electricity sector is governed by Law No. 21/2011, amended by Law No. 52/2018, with Rwanda Utilities Regulatory Authority (RURA) responsible for PPA review, technical standards and dispute resolution. Generation is also open to IPPs for rural off-grid electrification. Rwanda's integration with regional hydropower plant the Ruzizi and Rusumo power plants which has supported Rwanda and other countries including Tanzania, DRC and Burundi meet electricity security through the only transboundary power plant partnership in the EAPP.

Although the Rusumo hydropower plant, developed in partnership with Burundi and Tanzania, has enhanced electricity security, Tanzania's heavy dependence on hydropower continues to expose its generation portfolio to climate-related variability and risks seen in domestic outages since 2010 (Kizito Makoye, 2022). Periodic droughts have repeatedly reduced hydropower output, leading to national blackouts and cascading effects across interconnected countries. These recurrent shortages and

broader supply insecurity have prompted a policy shift toward domestic natural gas resources, notably from Songo Songo and Mnazi Bay, reflected in the National Natural Gas Policy (2013), subsequent petroleum sector reforms, the National Energy Policy (2015), and power system master plans. These frameworks promote investment in gas infrastructure, aim to reduce dependence on hydropower, and encourage participation in regional electricity trading to import electricity. Tanzania's gas reserves, combined with expanding interconnections with Kenya, Uganda, and Zambia, position the country as a potential bridge between the EAPP and SAPP. The Electricity Act (2008) provides the legal basis for electricity regulation, with the Energy and Water Utilities Regulatory Authority (EWURA) responsible for approving power purchase agreements (PPAs). EWURA has also developed standardised small power purchase agreements (SPPAs) for projects ranging from 100 kW to 10 MW, as well as model PPAs. Although these instruments establish a formal framework for independent and small power producers, the sector remains largely state-dominated, with TANESCO continuing to control generation, transmission, distribution, and supply.

### **3.1.3 Fossil-fuel-based systems**

Natural gas accounts for around 70% of electricity supply in Libya and Egypt, while oil contributes approximately 11% in Egypt and 26% in Libya (IEA, 2026). Both countries combined account for around 70% of total electricity consumption in the EAPP, which make Egypt and Libya major demand centres with significant implications for an integrated regional power system. Egypt's renewable procurement has moved from targets to private investment, such as Gulf of Suez wind project (European Investment Bank, 2026), supported through state-backed contracts and land allocation. National strategies, including Vision 2030 and the Climate Change Strategy 2050, aim to meet renewable energy development targets set a 42% renewable electricity target by 2035.

The Egyptian Electricity Holding Company (EETC) and other public entities control planning and implementation, with EgyptERA as a regulator and private participation is enabled through PPAs. Egypt's New National Renewable Energy Strategy 2008 set a target of 20% renewable electricity by 2020, including 12% from wind power, and introduced feed-in tariffs, long-term PPAs, renewable energy funds and land pre-allocation to support VRE uptake. Renewable Energy Law No. 203 of 2014 strengthened this framework by creating legal routes for private renewable generation through competitive bidding and build-own-operate arrangements. Electricity Law No. 87 of 2015 further restructured the sector by strengthening licensing, regulatory oversight and market-opening provisions under EgyptERA. Similar to wider EAPP systems, VRE deployment is constrained by technology lock-in. In Egypt and Libya, gas continues to underpin electricity supply; of Egypt's 20 committed power plants outlined in the EAPP, 12 of the power plants are natural gas projects, indicating that gas will continue to provide the main source of electricity supply until 2040 as shown in Fig. 4.

Similarly, Libya has introduced renewable-energy targets through Law No. 426, which established the Renewable Energy Authority of Libya to support renewable-energy policy, project development, regulatory preparation and private-sector participation. The Renewable Energy Strategic Plan 2013–2025 set targets of 7% renewable electricity by 2020 and 10% by 2025, with planned capacity of 1,000 MW of wind

and 800 MW of solar PV by 2025. The General Electricity Company of Libya, established under Law No. 17 of 1984, controls generation, transmission, distribution and network operation. The electricity sector is state-owned and vertically integrated, with limited independent regulation. Private participation therefore depends largely on project-specific arrangements with state entities rather than a competitive electricity market.

The National Strategy for Renewable Energy and Energy Efficiency 2023–2035 recognises this gap by identifying the need to improve the legislative framework, amend laws to facilitate local and international investment, provide financial incentives and increase renewable-energy deployment. Recent project-specific PPAs, including the 200 MW Ghadames solar PV project and the Al-Sadada solar project, show that private renewable generation can be contracted through negotiated arrangements with General Electricity Company of Libya (GECOL) and Renewable Energy Authority Of Libya (REAOL). However, these projects do not yet demonstrate a systematic IPP procurement framework. Libya's implementation gap is intensified by political instability. Its committed generation pipeline is also dominated by gas, with 15 of 21 committed plants based on natural gas, reinforcing carbon lock-in.

### **3.1.4 Weak-grid and import-dependent systems**

Burundi, Djibouti, Somalia and South Sudan represent the most constrained electricity systems in the EAPP. Somalia and South Sudan rely largely on isolated diesel or small-scale power systems to meet electricity demand, with limited national grid infrastructure. Burundi depends on a small domestic generation base, oil-fired backup and regional hydropower projects. The 80 MW Rusumo Falls project allocates around 27 MW to Burundi, while the planned Ruzizi III project could further expand supply through the Great Lakes hydropower corridor (IRENA, 2015, 2024, 2025b, 2025a). Djibouti is the most import-dependent country, relying heavily on electricity imports from Ethiopia. These imports have reduced dependence on oil-fired generation, but they also concentrate supply security around a single supplier and transmission corridor.

Burundi has introduced several policies to address generation shortages, grid rehabilitation and rural access, including the National Adaptation Programme of Action, Vision Burundi 2025, the Energy Strategy and Action Plan 2011, the Growth and Poverty Reduction Strategy Framework II, and the Decentralised Rural Electrification Strategy 2015–2017. These instruments prioritise small hydropower, national and regional hydropower projects, transmission and distribution rehabilitation. Burundi's legal framework provides formal entry routes for private generation with Law No. 1/014 of 2000 introduced liberalisation in public water and electricity services, while the Electricity Law of April 2015 opened generation to private participation and granted the state utility, Régie de Distribution d'Eau (REGIDESO), a 25-year monopoly over transmission, distribution and supply. Burundi participates in Rusumo and Ruzizi, but limited transmission and distribution lines constrain the conversion of regional hydropower into wider access.

Djibouti has a state-utility model combined with high import dependence and emerging project-specific IPPs. Electricité de Djibouti (EdD), governed by Decree No. 83 – 071/PWEDD of 1983, controls

generation, transmission and distribution. Third-party generation is legally possible, but private power must operate through EdD as the central buyer, network operator and tariff interface. Vision Djibouti 2035, the National Energy Commission and the Djibouti Office for Geothermal Energy Development provide a state-led framework for renewable energy, especially geothermal, by identifying resources, preparing projects and creating institutional channels for investment. The emergence of solar IPPs is reflected in the 25 MW Grand Bara solar PV project with battery storage, developed under a 25-year BOOT PPA with EdD. However, this project emerged as a negotiated, project-specific model rather than a standardised competitive procurement framework. Hence, policy priorities include strengthening EdD's financial and operational transparency, standardising IPP procurement, de-risking geothermal development, aligning solar-plus-storage projects with grid planning and diversifying import routes.

Electricity in Somalia is supplied mainly by private Electricity Service Providers operating isolated, diesel-based mini-grids. National planning documents emphasise insufficient generation capacity and the absence of a national grid, hence while policies promote renewable energy and future regional interconnection, particularly through planned Ethiopia–Somalia links and wider EAPP integration, the immediate priority is the formalisation and regulation of the existing electricity sector. This aim is addressed in the Electricity Act 2023, which establishes the basis for a National Electricity Authority. Similarly, South Sudan's electricity sector is largely off-grid and lacks a national transmission backbone. The South Sudan Electricity Corporation Act 2011 establishes the state utility with the National Electricity Policy and draft Electricity Bill seek to expand the regulatory framework to include private investment and PPPs. However, these measures have not yet produced a national electricity market and electricity supply is concentrated in isolated, diesel-based systems in urban centres such as Juba, Wau and Malakal (Thiak & Hira, 2024).

## **3.2 Enabler 2: Cross-border trade and corridors**

### **3.2.1 EAPP Planning**

The EAPP coordinates regional electricity planning by integrating national master plans into a unified regional optimisation model. The first EAPP Master Plan was completed in 2011 and updated in 2014 to include additional members, including Libya, South Sudan and DRC. The 2014 Master Plan aimed to identify least-cost generation and transmission investments through coordinated planning of power generation and interconnection infrastructure. The Master Plan identifies three strategic transmission corridors: the North-Central Corridor, linking Egypt, Sudan, South Sudan, Ethiopia and Libya; the Central Corridor, connecting Uganda, Kenya, Rwanda, Burundi and eastern DRC; and the Western Corridor, intended to trade electricity through large-scale hydropower from the DRC to load centres in East Africa and eventually Southern Africa, as shown in Fig. 5. Derived from BALMOREL least-cost modelling, these corridors are projected to reduce system costs, increase resilience through reserve sharing and diversify renewable integration pathways. However, these corridors are also shaped by geopolitical bottlenecks and dynamics, including civil conflict in Sudan, disruptions from internal conflict in Ethiopia, tensions

over the Nile water basins, and political and geopolitical instability in key transit and generation countries.

The Master Plan recommends six new cross-border transmission projects with a combined transfer capacity of approximately 3,400 MW by 2020, representing cumulative transmission investments of around USD 795 million. By 2025, cumulative recommended interconnector capacity rises to approximately 6,100 MW, with an estimated cumulative investment requirement of about USD 1.58 billion. Long-term modelling suggests cumulative interconnector capacity of approximately 8,600 MW by 2030, 10,100 MW by 2035 and 11,800 MW by 2040, corresponding to indicative cumulative investment requirements of roughly USD 2.17 billion, USD 2.53 billion and USD 2.96 billion, respectively, according to the EAPP Master Plan.

Figure 5 illustrates the scale of existing, committed and planned capacity exchanges, including 2,000 MW from Ethiopia to Kenya and 1,300 MW to Tanzania, reflecting incremental regional integration through capacity and transmission expansion. However, implementation has been delayed by technical constraints, political instability and fragmented progress, particularly in the Central Corridor involving the DRC and South Sudan. Ethiopia is connected to Djibouti and was previously connected to Sudan before the conflict, while the Uganda–Kenya–Rwanda triangle only recently achieved functional synchronisation after prolonged delays linked to grid instability in Uganda. These delays are also linked to wider geopolitical bottlenecks, as presented in Table 2, including Kenya’s reliance on Ethiopia’s supply, border tensions and shifting bilateral relations, limited institutional capacity, slow regulatory harmonisation, and divergence between regional power pool members.

Despite these ambitions, EAPP master plans function primarily as strategic coordination documents rather than binding investment programmes. The EAPP identifies regional priorities but provides limited binding mechanisms requiring member states to implement regional priorities. Transmission expansion therefore continues to depend on national investment decisions and bilateral agreements, hence, the pace of integration is determined by the financing capacity and political priorities of individual member states and bilateral agreements.

## 3.2.2 Country-level policies

All EAPP interconnectors are currently developed through bilateral agreements rather than a fully integrated regional market. While all 13 EAPP countries are modelling, only Burundi, DRC, Ethiopia, Kenya, Rwanda, Somalia and Tanzania have specifically outlined regional integration as part of their policies. Two policy approaches to regional electricity integration emerge; the first policy group aims to be net exporters through the EAPP and other sub-regional, and trans-regional groups, as part of macro-economic ambitions to become regional electricity exporters, namely Ethiopia, the DRC and Tanzania. Ethiopia’s Pathway to Prosperity 2021–2030 positions renewable energy, particularly hydropower through GERD, as both a national asset for welfare and a regional export commodity. Through projects such as GERD, Ethiopia pursues an export-oriented electricity strategy supported by transmission projects supplying Djibouti, Sudan and Kenya. Similarly, the DRC’s Regional and Domestic Power Markets

Development Project aims to meet both domestic electricity demand and regional demand in the EAPP and SAPP through the Inga complex, alongside policies to rehabilitate existing generation, transmission and distribution assets. Tanzania's National Natural Gas Policy 2013 similarly expands its natural gas reserves as a resource for national economic development and regional trade as a member of both the EAPP and SAPP, to supply electricity through gas-to-power projects like the East African Crude Oil Pipeline corridor that strengthens Tanzania's geopolitical position in the region.

The second approach reflects the interests of importing countries, whereby regional integration is critical for energy security, namely in Burundi, Somalia, Rwanda and Kenya. Burundi's Energy Strategy and Action Plan 2011 prioritise improving domestic electricity access through participation in regional hydropower projects, including the regional power plants Rusumo and Ruzizi. While Tanzania is also part of the Rusumo hydropower project, its National Energy Policy 2003, NSGRP II 2010/11–2014/15 and Five Year Development Plan 2016/17–2020/21 also emphasise cooperation with regional institutions such as the EAC, SADC and RERA to support other regional electricity systems. Similarly, Kenya's role in the Ethiopia–Kenya HVDC line, the Kenya–Tanzania interconnector and geothermal expansion supports regional electricity trade. More recent members such as Somalia that may be interconnected by 2040 according to EAPP plans have developed policies such as Somalia's Ninth National Development Plan 2020–2024 to interconnect with Djibouti, Kenya and Ethiopia as part of its long-term electricity strategy.

### **3.2.3 Institutional and regulatory frameworks**

The EAPP was established under the African Union regional integration agenda to deliver a continental African electricity market through several power pools including the EAPP, which is formed by 15 utilities. The EAPP governance structure includes a Council of Ministers as the main decision-making body, a Steering Committee composed of utilities, a Permanent Secretariat and technical committees covering planning, operations and market development. This gives national governments and utilities a central role in regional electricity cooperation. However, the EAPP does not allow IPPs to participate at the regional level. This differs from the SAPP, where the Project Advisory Unit (PAU) provides a bankability and coordination interface between IPPs, utilities and the power pool.

While the SAPP is closely aligned with Southern African Development Community (SADC), an intergovernmental organization, the EAPP operates across multiple sub-regional institutions rather than anchored in a single regional economic organisation. Member states participate in overlapping institutions, including the Common Market for Eastern and Southern Africa (COMESA), Eastern Africa Community (EAC), IGAD and NBI. Hence, the responsibilities for electricity trade, transmission planning, water resource management and wider economic integration across several sectors including agriculture and water services that intersect transboundary resources such as Kagera and Nile Rivers, and Great Rift Valley lands are therefore dispersed across several institutions with competing agendas with limited regulatory harmonisation.

The absence of a mechanism similar to the PAU may limit the EAPP's ability to align countries with different levels of investment readiness. Kenya, with stronger IPP participation, more developed

regulatory and institutional systems, tariffs closer to cost-reflective levels and a larger electricity market, is better positioned to attract private investment. In contrast, countries such as Burundi and South Sudan are at earlier stages of sector development and require time and finance to strengthen institutions, governance, market structures and wider economy-wide policies that support power-sector reform. Projects such as the Bujagali Hydropower Project in Uganda, geothermal projects in Kenya and methane development in Rwanda show how IPP-led investments can mobilise large-scale finance, attract international lenders and development finance institutions, and support stronger risk-sharing and project governance. Lower-income and fragile states may therefore need both greater capital investment in backbone infrastructure and stronger governance and capacity frameworks to participate effectively in regional electricity trade. Shared learning mechanisms or a PAU-type structure could help address these asymmetries.

In response to the need for regulatory harmonisation, and to satisfy member states, the EAPP established the Independent Regulatory Board (IRB) as its regional regulatory entity to support the development of cross-border electricity trade and a regional electricity market. The IRB reports to the EAPP Council of Ministers and is composed of heads of national regulatory authorities or, where no regulator exists, representatives from ministries responsible for energy. Its mandate includes regulatory harmonisation, market oversight, support for regional power-trade rules and recommendations for aligning national electricity legislation with regional market requirements. However, the IRB is still developing the institutional capacity and legal instruments required to function as an effective regional regulator. Regulatory responsibilities across the region are yet to be harmonised across national regulators and overlapping regional bodies, including the East African Community's regional electricity regulation structures and RAERESA. Independent of the EAPP, the Energy Regulators Association of East Africa (EREA) was founded, however this does not include all 13 EAPP members.

Table 2  
Geopolitical bottlenecks and proposed solutions for EAPP corridors.

| <b>Cross-border transmission line</b> | <b>Geopolitical bottlenecks and dynamics</b>                                                                                                                                                                                                                                                                                                                 | <b>Proposed solutions</b>                                                                                                                                                                                                                                                                                                           |
|---------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Ethiopia – Sudan                      | <p>Civil conflict in Sudan since April 2023.</p> <p>The corridor sits within wider Nile Basin geopolitics, where hydropower development, water security and downstream concerns in Sudan and Egypt intersect.</p>                                                                                                                                            | <p>Phased trade agreements. Bilateral PPAs with flexible supply provisions.</p> <p>Redirecting electricity to Djibouti and Kenya. Embedding power trade within wider Nile Basin confidence-building, including data-sharing on dam operations and coordinated drought planning.</p>                                                 |
| Ethiopia – Kenya                      | <p>Long-term contracts reduce investment risk but can also lock countries into politically sensitive supply obligations. The corridor strengthens Ethiopia's role as a regional electricity exporter, potentially shifting power relations and Nile hegemony within the EAPP.</p>                                                                            | <p>Long-term PPAs. Institutional coordination via EAPP. Contract flexibility to manage drought, domestic shortages and system stress. Strengthening balancing, reserve-sharing and transparent dispatch rules to reduce dependence on ad hoc bilateral decisions.</p>                                                               |
| Egypt – Sudan                         | <p>Tensions over the Nile Basin and GERD. Sudan's conflict.</p>                                                                                                                                                                                                                                                                                              | <p>Gradual and phased capacity expansion. Coordinated GERD filling and operation arrangements. Subregional cooperation alongside diplomatic negotiations. Separating technical electricity cooperation from unresolved water-sharing disputes where possible, while maintaining data-sharing and dispute-resolution mechanisms.</p> |
| Kenya – Tanzania                      | <p>Differing domestic electricity market structures. Competing national priorities as regional exporters for Kenya in the EAPP, for Tanzania in the EAPP and SAPP.</p>                                                                                                                                                                                       | <p>Gradual regulatory harmonisation.</p>                                                                                                                                                                                                                                                                                            |
| Uganda – Rwanda                       | <p>Border tensions and shifting bilateral relations. Limited institutional and utility capacity,</p>                                                                                                                                                                                                                                                         | <p>Joint grid synchronisation initiatives. Standardised operating procedures.</p>                                                                                                                                                                                                                                                   |
| Tanzania – Zambia / EAPP–SAPP link    | <p>Divergence between regional power pool mechanisms between EAPP and SAPP. Competing regional priorities may affect investment sequencing and utilisation. The corridor has strategic importance because it could determine whether EAPP integration develops as a self-contained regional market or as part of a wider continental electricity market.</p> | <p>Harmonisation of market rules. Sequenced market coupling between EAPP and SAPP and congestion management.</p>                                                                                                                                                                                                                    |

| Cross-border transmission line           | Geopolitical bottlenecks and dynamics                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Proposed solutions                                                                                                                                                                                                                                                                                |
|------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| DRC – Regional corridors / Inga projects | Political instability, governance challenges and security risks constrain project bankability and corridor implementation. Large-scale hydropower exports raise questions over who benefits from regional electricity trade, particularly where domestic access remains low. Inga-related corridors are geopolitical because they could reorder regional power flows, create dependency on a single mega-resource, and link electricity trade to mineral, industrial and infrastructure strategies. | Public–private partnerships. Multilateral financing frameworks. Stronger domestic benefit-sharing and access provisions. Transparent regional off-take agreements, risk guarantees and phased development to avoid stranded assets.                                                               |
| Ethiopia – Egypt / indirect via Sudan    | High geopolitical tension over GERD. Water politics over Nile resources and basin governance between Egypt as downstream Ethiopia as upstream country.                                                                                                                                                                                                                                                                                                                                              | Diplomatic mediation. Decoupling energy trade from water disputes where possible. Joint technical platforms on hydropower operations, drought risk and electricity exchange. Using electricity trade as a confidence-building mechanism rather than treating it only as a commercial transaction. |

## 4. Conclusion and policy implications

Regional electricity integration presents significant opportunities for improving energy security and accelerating sustainable energy transitions through economies of scale and VRE integration. Realising these benefits requires reconciling domestic policy frameworks that account for the contextual diversity and governance complexity across a significant geographical scale. The following policy implications and proposals highlight key priorities for enabling sustainable regional power system integration across the EAPP for energy security.

### 4.1 Differentiated and sequenced phasing of integration recognising national and sub-regional contexts

Given the substantial geographical coverage of the EAPP and typology of generation portfolios, a standardised approach to regional electricity integration risks imposing obligations that are misaligned with domestic, economy-wide priorities, and may potentially lead to reduced state participation and inefficient investment decisions. Instead, integration should be conceptualised as a differentiated and sequenced process that accommodates structural and institutional diversity across countries, while maintaining a shared regional objective of domestic and regional energy security. A differentiated and sequenced approach would support the EAPP in three key ways: facilitating sustainable transitions away

from path-dependent systems, strengthening the management of transboundary regional resources, and enhancing the efficiency of investment allocation.

Countries such as Egypt, Libya and Tanzania have electricity systems that rely on existing fossil-fuel infrastructure and long term commitments to natural gas, coal and oil to meet energy security. Addressing this carbon lock-in through a sequenced approach would allow these systems to first grid readiness and flexibility mechanisms for renewable integration while gradually reducing dependence on gas, oil or coal. Similarly, hydropower-dominated systems such as Uganda and Ethiopia are increasingly exposed to climate variability that may impact other importing countries, as well as worsen geopolitical tensions related to transboundary water governance. The staged filling of the GERD for example shows how phased implementation can help manage downstream vulnerabilities, and create space for negotiation between riparian states, even where geopolitical tensions persist.

Second, a phased approach supports more efficient investment allocation by aligning infrastructure development with domestic VRE potential and regional integration readiness. While regional integration can unlock economies of scale, expanding generation without parallel investments in transmission and distribution risks misallocation, particularly across the EAPP, where power systems are at different stages of development. For example, in Sudan, political instability and conflict has shifted priorities towards grid rehabilitation, while in countries such as Burundi and Somalia, electricity access is mostly driven by off-grid systems, hence in such contexts, large-scale cross-border trade transmission lines may be ineffective without stronger domestic grids and institutional capacity, and can lead to underutilised or stranded assets, as seen in large-scale projects such as the Inga complex. A differentiated sequencing of investments would prioritise system stability and regulatory capacity before deeper integration within the EAPP.

Strengthening grid readiness for both integration and VRE deployment requires a system-wide approach to asset assessment and investment planning aligned with climate-resilient development objectives. Such assessments can identify infrastructure requiring urgent rehabilitation, assets approaching retirement, and the investments needed to maintain reliability under changing demand and climate conditions. This is particularly relevant for ageing hydropower assets in countries such as Sudan, Uganda, and the DRC, where rehabilitation can improve efficiency and output before new capacity is added. Similarly, projects such as the Rusumo Falls hydropower plant demonstrate that regional generation only delivers value where domestic grids are sufficiently developed to absorb and distribute electricity. Asset lifecycle management should therefore extend beyond maintenance to include monitoring, refurbishment, repurposing, and, where necessary, the retirement and decommissioning of ageing or carbon-intensive infrastructure. Infrastructure planning must also incorporate stranded asset risk. Long-term uncertainty in global decarbonisation is particularly relevant for fossil fuel investments in emerging natural gas, coal and oil expansion in Tanzania, Libya, and Egypt. Embedding stranded asset assessments within national and regional planning processes can improve investment efficiency and reduce long-term transition costs.

This phased approach would also support incorporating targeted risk-mitigation mechanisms, such as geothermal energy de-risking mechanisms as seen in Kenya, and foster cross-country learning to diffuse innovative financing models like the GERD financial model that succeeded despite geopolitical tensions, and thereby unlock investment in capital-intensive VRE. Institutional alignment within sub-regional organisations can enable incremental integration through shared governance frameworks, and trust-building among neighbouring states. The NBI for example can support by addressing geopolitical and legal tensions over potential vulnerabilities across interconnected systems, and ensure that integration reduces rather than transmits systemic risks. By embedding differentiation and developing from existing sub-regional frameworks, the EAPP can enable more adaptive and resilient integration, ensuring that interconnected systems evolve in a way that strengthens both national energy security and collective regional stability.

Third, a differentiation approach strengthens regional resource management by enabling strategic coordination of transboundary electricity resources across the EAPP. This is particularly important as regional power plants and projects increasingly depend on shared generation assets, river basins and resource corridors, including the Ruzizi hydropower scheme on the Rwanda–DRC–Burundi border, the Rusumo Falls project in the Kagera Basin, and geothermal development along the Great Rift Valley, as well as transboundary electricity systems that include associated infrastructure on shared water and land resources. Climate change further intensifies these interdependencies by altering rainfall patterns and exposure to risks as seen in power plants across the Nile and Kagera rivers, which implicates water geopolitical dynamics where frameworks are not agreed upon the development of electricity systems.

Finally, grid investment should be closely aligned with climate-resilient development and finance mobilisation through dynamic and flexible governance frameworks. Integrated electricity systems support climate mitigation, by enabling VRE integration, and climate adaptation, by improving system resilience to climate shocks and rising demand. These challenges are particularly pronounced in hydropower-dependent regions such as the Nile and Lake Victoria basins, where rainfall variability affects generation, and in conflict-affected areas where infrastructure faces heightened operational risks. Aligning domestic and regional priorities can help mobilise concessional finance, blended finance, and risk-reduction instruments to support VRE and electricity systems integration.

## **4.2 Proposed further research**

Further research could extend this analysis in several directions. First, engagement with policymakers, utilities, regulators, ministries, financiers and regional institutions could provide deeper insight into how political priorities and geopolitical tensions shape the development and implementation of EAPP projects. This would also help identify the conditions under which regional power pooling can support equitable outcomes for both exporting and import-dependent countries. Second, future research should examine how climate change affects the water–energy–land nexus in regional electricity integration, particularly in shared basins such as the Nile, Kagera and Lake Victoria, where hydropower generation, irrigation, water security, land use and electricity trade are increasingly interconnected. Third, comparative analysis across African power pools, could identify governance and financing models that

are most effective in supporting equitable, climate-resilient and geopolitically stable electricity trade. Such analysis would support evidence-based regional energy planning by addressing further the challenges in developing a reliable, sustainable and equitable electricity network in Eastern Africa, while providing insights for policymakers, and other energy-sector stakeholders.

## Declarations

## Author Contribution

Galila Khougali conceptualized the study, developed the methodology, curated the data, conducted the formal analysis, prepared the figures and tables, and wrote the original draft of the manuscript. Steve Pye contributed to the methodology and interpretation of the findings, provided supervision and validation, and reviewed and edited the manuscript. Paul Dodds contributed to the interpretation of the findings, provided supervision and validation, and reviewed and edited the manuscript. All authors reviewed and approved the final manuscript.

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## Figures

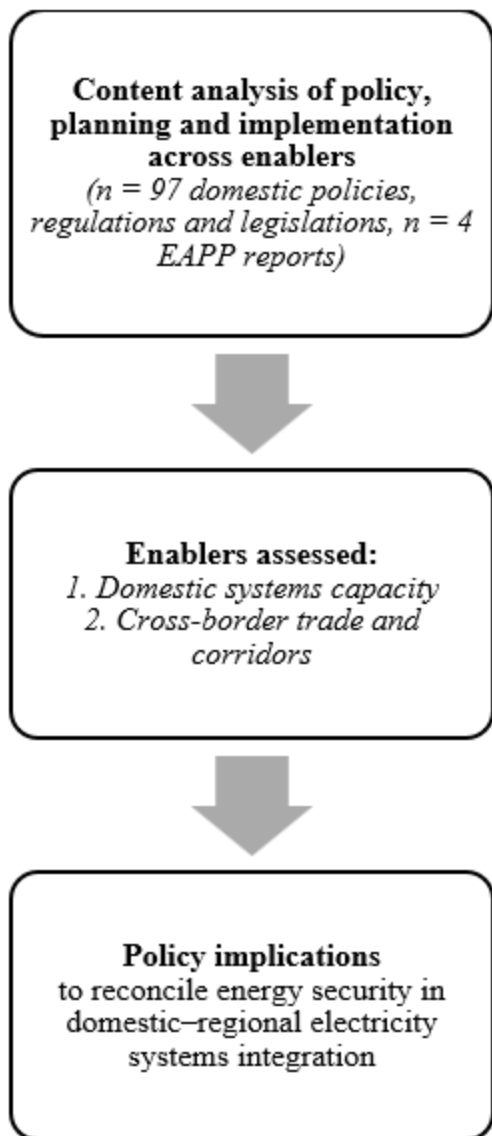


**Figure 1**

Methodological framework of the study and enablers as adapted from Bissiri et al. (2024).

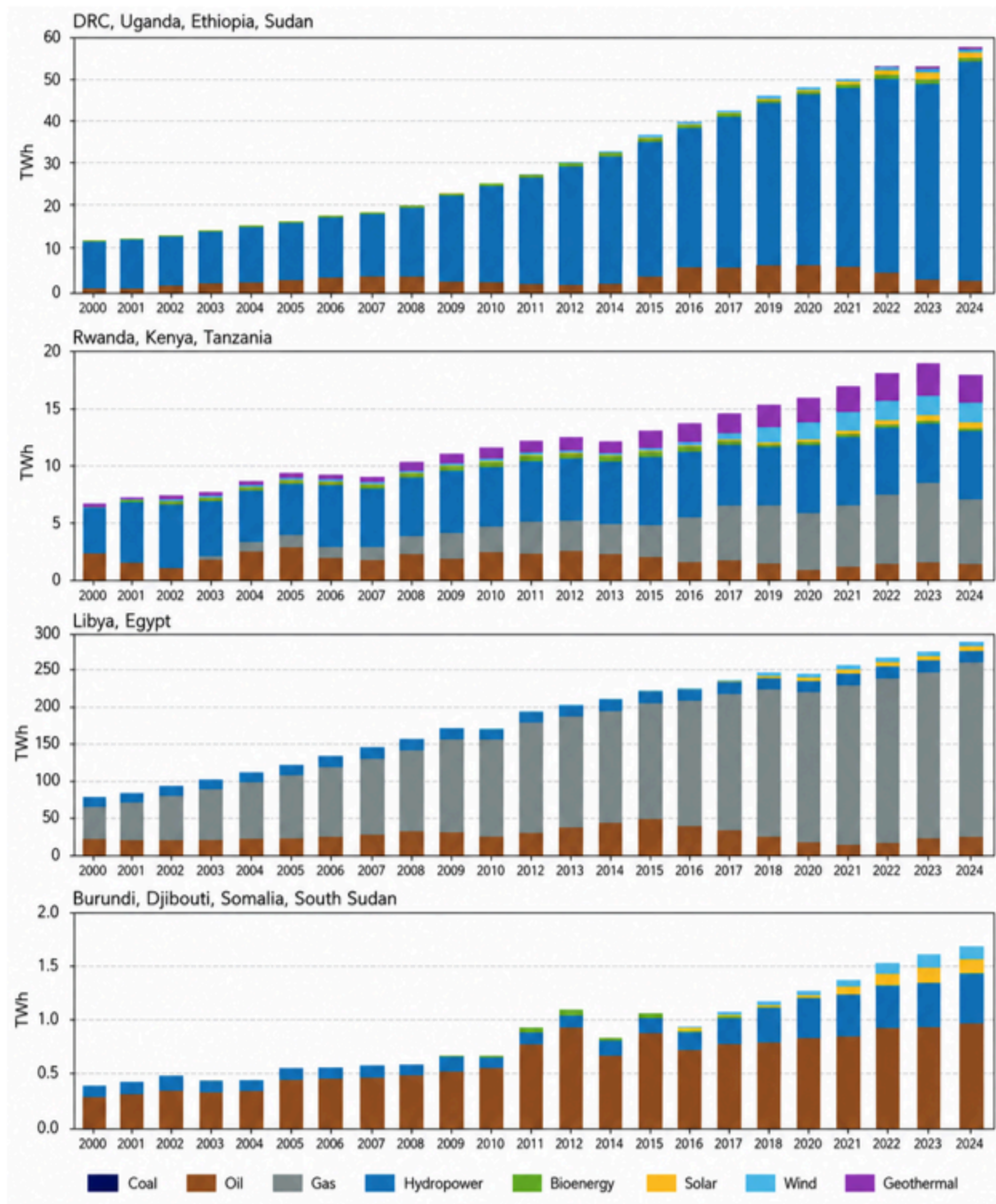


Figure 2

Electricity generation mix by source across EAPP country groups, 2000–2024 (IEA, 2026).

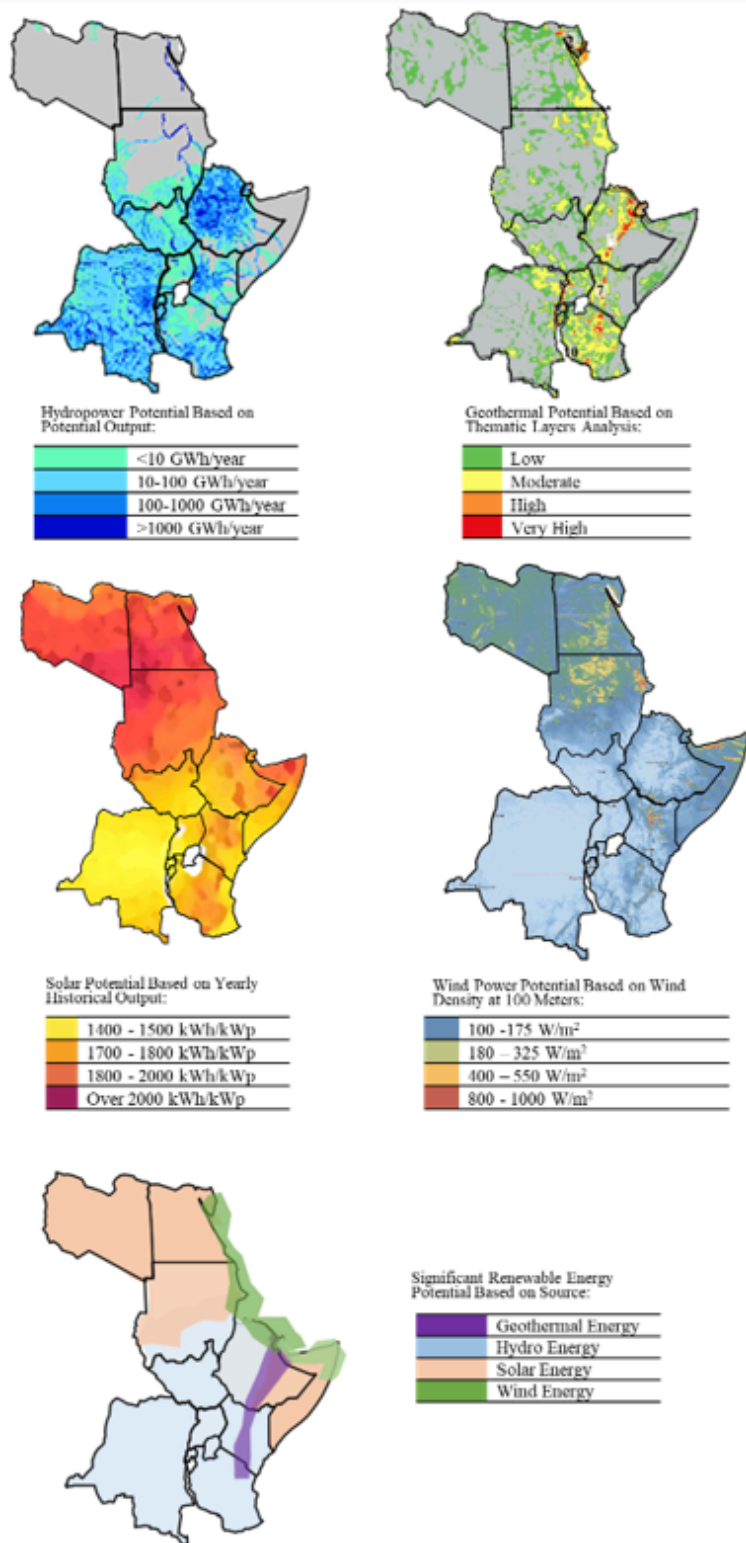


**Figure 3**

Renewable energy potential across the EAPP region. Authors' elaboration from (Elbarbary et al., 2022; ESRI, 2026.; Hoes et al., 2017; Solargis, 2026).

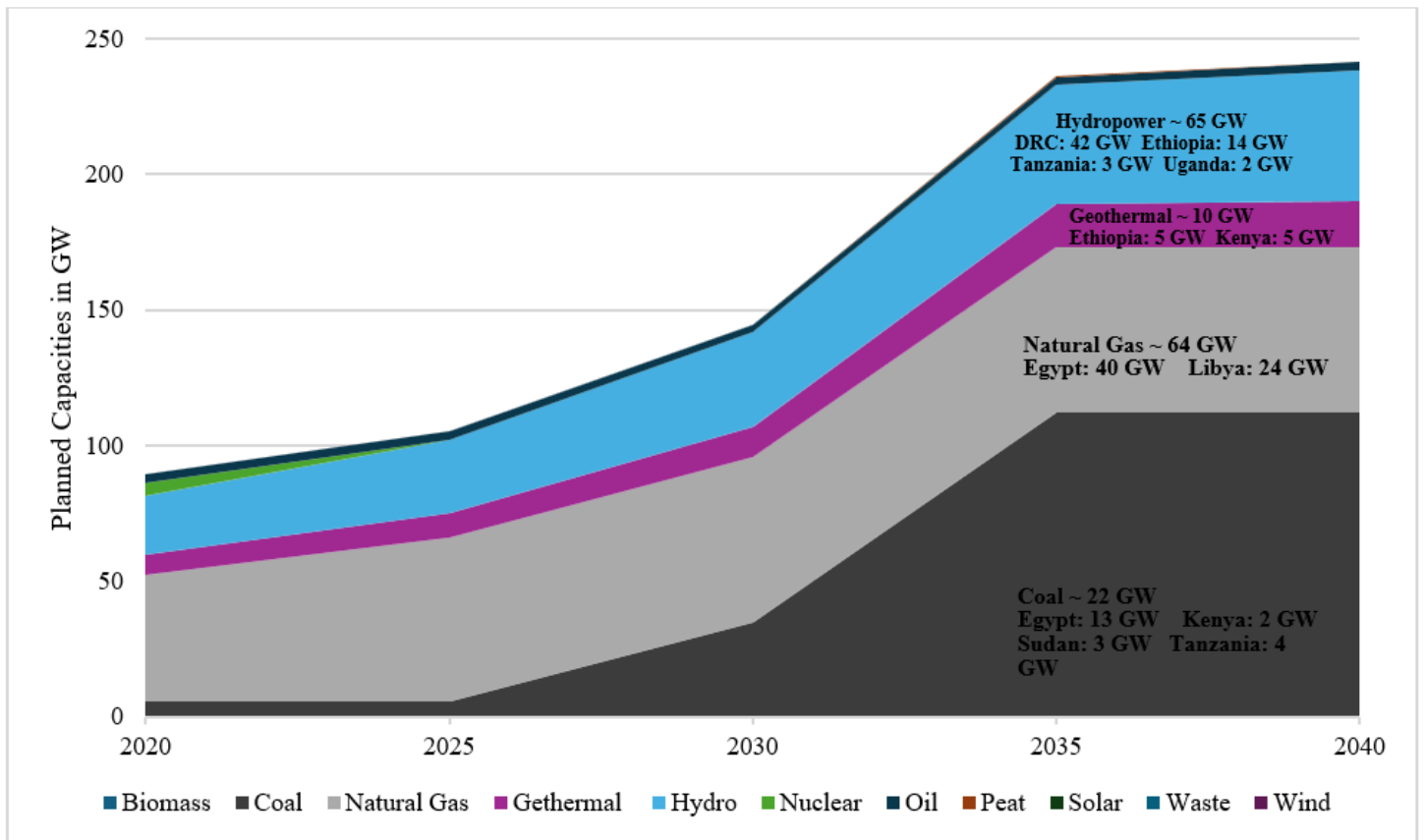


**Figure 4**

EAPP technology priorities based on master plans and planned electricity supply generation expansion based on non-harmonised master plans from 2020–2040 from EAPP Master Plan (EAPP, 2014).

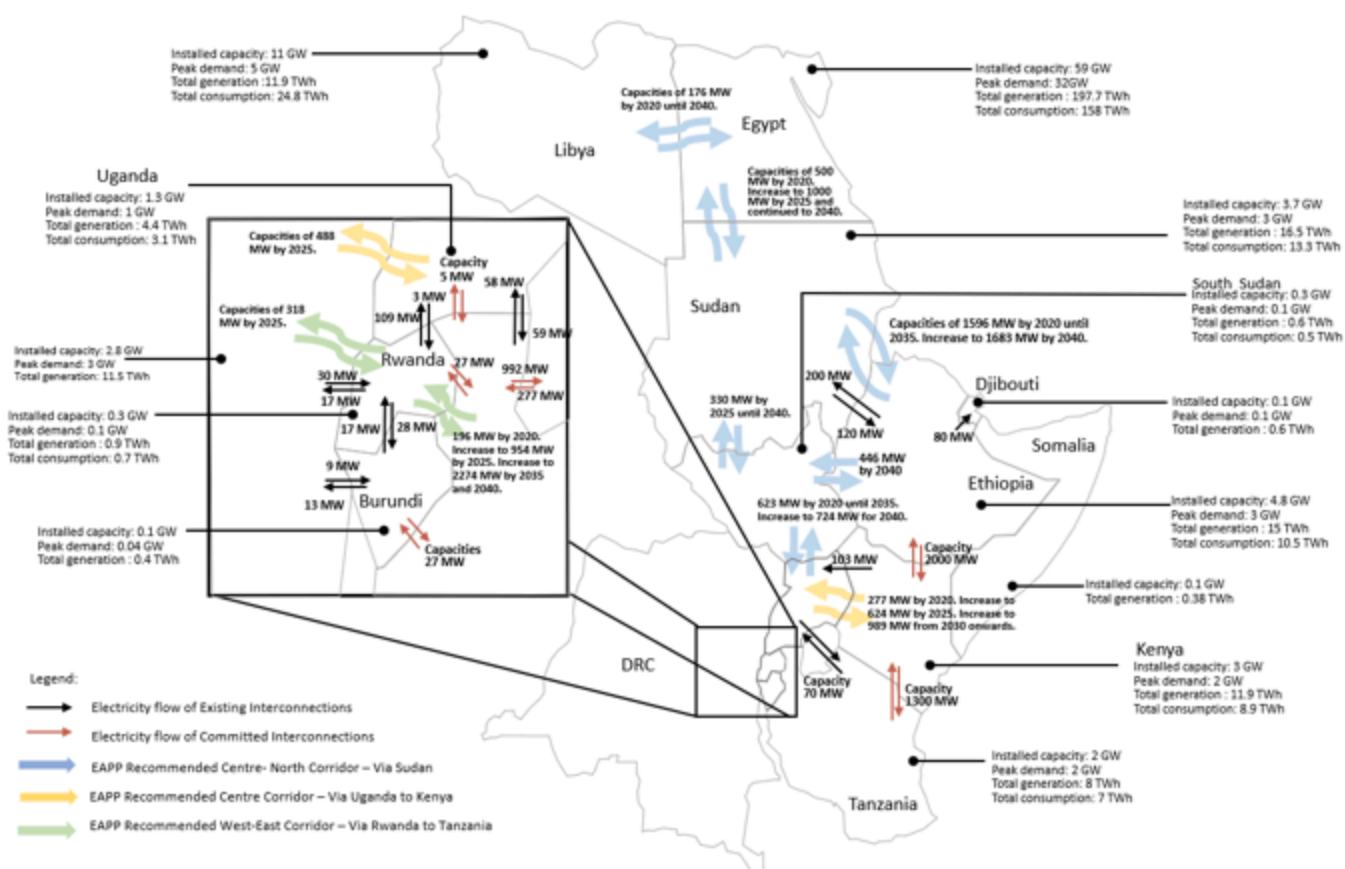


**Figure 5**

EAPP interconnections, and electricity capacity, demand, generation and consumption of EAPP. Authors’ elaboration from (EAPP, 2014c; IRENA, 2021; IEA, 2021).

## Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [AppendixA.docx](#)