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Booklet of Best Practices on Regional Power System Interconnectivity

G20 ETWG Priority Area 3 Outcome 1



AFRICAN DEVELOPMENT BANK GROUP

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Introduction

Countries worldwide face mounting challenges in ensuring reliable, affordable and clean electricity supply while meeting growing demand and ambitious climate targets. Regional power system interconnection has emerged as a critical solution, enabling countries to share resources, enhance energy security and accelerate the clean energy transition through cross-border co-operation.

This booklet draws on extensive research and existing studies to provide policy makers and decision makers with a high-level strategic framework. The outline, selected case studies and structure were refined through virtual consultation sessions with technical experts, African stakeholders and Group of Twenty (G20) member country delegates. It highlights priority areas for action and outlines practical steps to advance integration through strategic investment in infrastructure, co-ordinated power system operations and more effective power exchange. Rather than repeating existing detailed technical analyses, it focuses on the critical decisions and interventions that shape success.

While this guide addresses both interconnection (physical infrastructure) and integration (power system operation, market and regional), its primary focus is on integration. This is structured around five core dimensions: political will, institutional frameworks and governance, harmonisation of technical and operational standards, cross-border electricity market development, and co-ordinated regional planning and investment. Physical interconnection is often the first step, but achieving true integration requires the deeper institutional frameworks and governance structures outlined in these five core dimensions.

The imperative for regional power interconnection

Energy security and reliability

Regional power interconnection helps build resilience against increasing energy demand, fuel supply disruptions, natural disasters and unexpected outages. Access to neighbouring power systems creates a safety net that no single national grid can provide alone without significant cost. When one country faces shortfalls, interconnected neighbours can provide support, enhancing overall system reliability.

Economic benefits

Interconnected power systems create larger regional resource pools that enable more efficient allocation and reduce overall system costs through shared infrastructure. This contributes to affordability while unlocking new opportunities for cross-border energy trade and investment among participating countries.

Clean energy transition

Power system interconnectivity accelerates the transition to clean energy. It enables countries to share variable renewable resources across wider geographic areas, helping to smooth out solar and wind fluctuations as dips in one area can be balanced by generation elsewhere. Interconnections also provide access to diverse flexibility resources that help balance supply and demand. This allows countries to optimise the deployment of low-carbon technologies like hydroelectric, nuclear, and other renewable energy sources at scale.

Global momentum

Recognising these significant benefits, regions around the world are advancing initiatives for deeper regional integration. Achieving high levels of integration typically requires decades of progressive development from simple bilateral trade arrangements to sophisticated multilateral frameworks.

Objectives and target audience

Practical guidance framework

This booklet serves as a comprehensive resource for navigating the complex technical, regulatory and institutional challenges of developing regional power interconnections and cross-border electricity trade. It offers actionable insights based on global best practices and lessons learned from bilateral and multi-country interconnection efforts.

The guide addresses the specific needs of:

- **Policy makers** seeking to develop multilateral power trade frameworks and regional integration strategies.

- **Energy sector regulators** working to harmonise electricity trading rules for cross-border interconnections and establish governance structures.
- **System operators and utilities** planning interconnection infrastructure investments and operational procedures.
- **Regional entities** co-ordinating multi-country energy initiatives through economic co-operation platforms, regulatory harmonisation and utility co-ordination.
- **Financial institutions and development partners** seeking to understand potential investment opportunities in regional power interconnections.
- **African regional institutions and policy makers** working to establish bilateral power trade or deepen integration within power pools.

Strategic alignment and global relevance

This work is undertaken as part of the South African presidency of the G20, reflecting the priority placed on regional energy co-operation and interconnection. The booklet's approach integrates with the priorities of the G20 Energy Transitions Working Group, ensuring that regional interconnection initiatives advance broader international commitments to sustainable energy transitions and climate goals.

While the guidance is relevant to all regions with G20 countries and draws lessons from global experiences, including from European, American, Gulf and Asian markets, issues specific to the African context in deepening the regional integration of power pools and advancing the regional interconnection of power systems are highlighted throughout.

A dedicated section summarises the relevance and specific challenges for African regional integration. This includes considerations for African regional institutions and policy makers working to establish bilateral power trade or deepen integration within power pools such as Southern African Power Pool (SAPP), Western African Power Pool (WAPP) and the Eastern African Power Pool (EAPP), and advance continental interconnection priorities under the African Union's Programme for Infrastructure Development in Africa, the African Single Electricity Market and the Continental Power Systems Masterplan. These efforts are complemented by Africa's Ten-Year Infrastructure Investment Plan for cross-border

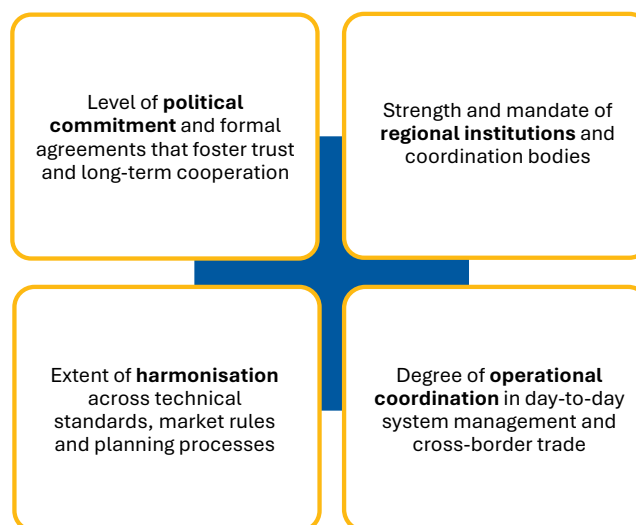
interconnectivity developed as part of the 2025 G20 Energy Transitions Working Group. The section also acknowledges the varied institutional capacities and implementation contexts across the continent.

Understanding integration stages

Regional power system integration exists in various forms worldwide, reflecting diverse starting points, resource endowments and institutional contexts. Current systems range from early-stage frameworks focused on establishing basic interconnection infrastructure to mature integrated markets with decades of operational experience, demonstrating different approaches to cross-border electricity co-operation. Understanding this diversity helps identify realistic pathways and appropriate next steps for deepening integration.

Regional power system integration maturity is determined by the depth of co-operation across four key dimensions: the level of political commitment and formal agreements that foster trust and long-term co-operation; the strength and mandate of regional institutions and co-ordination bodies; the extent of harmonisation across technical standards, market rules and planning processes; and the degree of operational co-ordination in day-to-day system management and cross-border power exchange.

While physical interconnections and power exchange volumes provide useful measures of activity, true integration maturity reflects the underlying institutional, regulatory and operational frameworks that enable sustained co-operation.

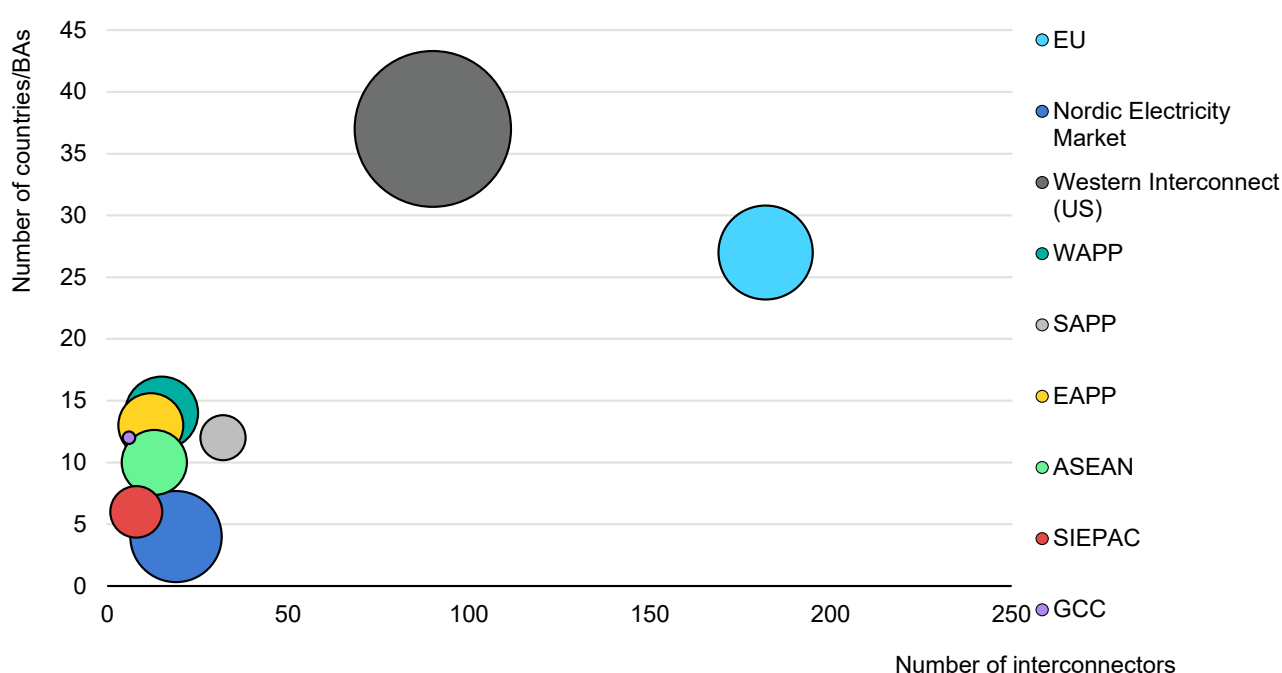


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Scale and scope of regional electricity markets

The scale and scope of regional electricity markets can be visualised through three complementary indicators that together illustrate the size and activity levels of different regional systems: the number of physical interconnections reveals the technical infrastructure foundation that enables cross-border electricity flows; the number of participating countries demonstrates the geographic scope and breadth of regional co-operation; and the share of cross-border electricity exchanges traded volumes relative to the overall demand shows the depth of actual trading activity (whether through competitive markets or bilateral agreements) and utilisation of the interconnected infrastructure.

Number of interconnected countries or Balancing Authorities, interconnections and ratio of exchange volumes over demand in selected regional power systems, 2021-2024



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Notes: The size of the circles indicates the share of exchanged electricity volumes compared to overall demand in a given year. Due to data limitations, the latest data year was used to compute this indicator across the different regions, ranging from 2021 to 2024.

ASEAN = Association of Southeast Asian Nations; SIEPAC = Central American Electrical Interconnection System EAPP = Eastern Africa Power Pool; GCC = Gulf Cooperation Council, WAPP = West African Power Pool; SAPP = Southern African Power Pool; EU = European Union integrated energy market. The Nordic Electricity Market includes Denmark, Norway, Sweden and Finland. BA = Balancing Authorities (for the US Western Interconnection).

Sources: IEA based on data from Hapua, Enerdata, ENTSO-E Statistical Factsheet 2024, Monthly Physical Energy & Power Flows, West African Power Pool, 2021 Annual Report, South Africa Power Pool, 2021 Annual Report, Eastern Africa Power Pool, 2024 Quarterly Bulletins, U.S. Energy Information Administration, WECC, GCCIA, Navigant, CRIE.

Regional electricity markets evolve from limited bilateral power exchange and minimal co-ordination (early stage), through partial interconnection and emerging short-term markets (shallow stage), to full integration with extensive infrastructure, open access, co-ordinated trading and harmonised regulatory oversight (deep stage). When examined together, these metrics create a clear hierarchy of integration levels across global regions. Systems with shallow integration such as GCC, SAPP and the Central American Electrical Interconnection System (SIEPAC) demonstrate initial technical foundations but limited trading volumes relative to their size that remain minimal compared to deeply integrated systems. Others such as WAPP and the Association of Southeast Asian Nations (ASEAN) Power Grid show growing participation but achieve trading volumes that are still only a fraction of those sustained in developed markets.

The most deeply integrated systems reveal the full potential of regional co-operation. In the EU internal energy market and Nordic electricity market covering Denmark, Norway, Sweden and Finland, traded volumes relative to regional consumption are more than 3 to 4 times higher than in emerging systems such as SAPP or SIEPAC, demonstrating how focused regional co-operation can unlock substantial cross-border flows.

For deep integration, infrastructure development, higher number of trading participants and high trading volumes reflect decades of technical, regulatory and institutional development. The EU internal market has developed more than ten times as many interconnectors than other regional markets such as ASEAN, WAPP, SIEPAC or EAPP. However, the GCC regional market example shows that interconnection alone is not sufficient, as traded volumes remain limited despite 12 interconnectors in the region. The Western Interconnection achieves the highest share of traded volumes relative to its size, in part due to its high density of local grids compared to other regional markets.

This global overview demonstrates that integration is clearly a progressive journey, requiring systematic development over time. Most regions today find themselves in the early-to-mid stages of this spectrum, making the step-by-step approach outlined in this booklet directly relevant to their current needs and development trajectories.

Integration development stages

Cross-border electricity exchange develops through distinct stages, each requiring deeper regulatory and market harmonisation.

Stages of regional power system integration and global examples

Stage	Characteristics	Examples
Early	- Limited transmission capacity between countries - Bilateral exchange predominantly through long-term power purchase agreements - National-level planning with minimal regional co-ordination - Ad hoc settlement and data-sharing procedures	Bilateral agreements: India-Bhutan power exchange demonstrates focused bilateral co-operation Central Africa Power Pool: Early-stage regional framework with growing political commitment Eastern Africa Power Pool: Early-stage regional framework with growing political commitment West African Power Pool: Regional co-operation advancing despite infrastructure and institutional challenges South American Southern Electrical System: Emerging cross-border co-operation in South America
Shallow	- Most countries interconnected but transmission capacity underutilised - Introduction of day-ahead short-term markets, either standalone or alongside bilateral agreements - Some regional planning co-ordination established - Partially harmonised electricity exchange rules, grid codes and tariffs	ASEAN Power Grid: Expanding participation across Southeast Asia with growing institutional frameworks Southern African Power Pool: Established multilateral trading with significant potential for deeper integration Gulf Cooperation Council: Resource-rich region developing co-ordinated power exchange mechanisms Central American Electrical Interconnection System: Central American integration with an established transmission backbone
Deep	- Extended infrastructure connecting all participating systems - Open access to regional grid and markets - Co-ordinated day-ahead and intraday markets operating efficiently - Well-developed institutions with enforcement authority - Fully harmonised, adopted and operational market rules, grid codes and regulatory oversight	Nordic electricity market: Mature multi-country integration serving as a global benchmark for deep co-operation EU internal energy market: The world's largest and most sophisticated regional electricity market - North American systems (PJM interconnection, California Independent System Operator, New York Independent System Operator, etc.): Advanced interstate integration within some Eastern Interconnection and Western Interconnection National integration examples: Australia, Canada, the People's Republic of China and Japan showcase different approaches to price zone co-ordination and market coupling within national boundaries, providing insights applicable to regional integration

Notes: ASEAN = Association of Southeast Asian Nations. The Nordic Electricity Market includes Denmark, Norway, Sweden and Finland.

Comprehensive case study coverage

This booklet draws on regional integration experiences from across all major global regions and integration stages. The guidance presented reflects lessons learned, challenges overcome and areas for ongoing development identified across multiple integration experiences, offering practical insights for policy makers at every integration stage. Descriptions of the case studies can be found in the Annex.

Framework for action

This guide provides a comprehensive roadmap for regional power integration, but regions must adapt it to their specific context and current capabilities. The framework is built around a stage-based progression that recognises integration as a journey requiring sustained commitment and incremental development.

Step 1: Assess the current integration stage

Each chapter contains diagnostic tables to evaluate the stage of integration across five critical dimensions:

- **Political will:** Level of political commitment and formal agreements
- **Institutional frameworks and governance:** Strength and mandate of regional co-ordination bodies
- **Harmonisation of technical and operational standards:** Extent of harmonisation across procedures
- **Cross-border electricity market development:** Sophistication of cross-border trading arrangements
- **Co-ordinated regional planning and investment:** Co-ordination of infrastructure development and financing

The “characteristics of systems at this stage” columns provide an indication of a region’s current stage. Regions may be at different stages across the various dimensions, which is both normal and expected.

Step 2: Identify priority actions

Based on the integration stage, focus on the most critical gaps holding back progress. Each chapter's framework tables provide specific guidance through two action columns:

- **Priority actions for systems at this stage:** What to focus on now to consolidate current capabilities
- **Priority actions to progress to the next stage:** What foundational work is needed to advance integration

Rather than attempting all actions simultaneously, practitioners should concentrate on two to three critical actions that will unlock the next level of co-operation. The framework recognises that political capital and implementation capacity are limited resources.

Step 3: Sequence implementation strategically

Regional integration follows a logical sequence, with each stage building the essential capabilities required for the next:

- **Early integration:** Establishes political foundations, basic technical co-ordination and simple bilateral trading arrangements
- **Shallow integration:** Develops regional institutions, harmonised standards and multilateral market mechanisms
- **Deep integration:** Achieves binding regional authority, automatic system co-ordination and sophisticated market integration

Attempting to skip stages or implement all elements simultaneously often leads to delays, cost overruns and stakeholder resistance that can set back integration efforts by years.

This structured approach enables political leaders to focus scarce resources on the most critical priorities at each stage while maintaining clear progression pathways towards more sophisticated co-operation. The framework recognises that successful integration depends not only on technical solutions but also on building trust, institutional capacity and stakeholder

confidence over time. It also recognises that attempting to implement all elements simultaneously can result in political overload and project failure.

Each subsequent chapter provides detailed guidance on a specific dimension of integration, supported by practical examples, case studies and tailored recommendations for different stages of development. While the success factors apply universally, different stakeholders should prioritise specific aspects of the framework according to their roles and responsibilities. These are outlined as “key recommendations for practitioners” in the relevant chapters, providing a practical roadmap to navigate the complex but rewarding journey of regional power integration.

Political will: The starting point for regional power integration

Regional electricity integration succeeds only when political leaders believe co-operation will deliver tangible national benefits without undermining domestic priorities. Despite the compelling technical and economic rationale for regional exchange, integration ultimately hinges on political trust and leadership. Politicians must answer to voters, manage energy security risks and address legitimate concerns about sovereignty and costs. While integration can reduce overall system costs, it may require upfront investment or expose countries to external dependencies, raising concerns about reliability, control and fairness. Political champions are often fundamental to maintaining momentum and breaking deadlocks. [The Kenya–Tanzania interconnection](#) illustrates this clearly. In the early 2000s, energy ministers from both countries directly championed the project, aligned national objectives and personally intervened when disagreements arose over cost-sharing and technical standards. Their credibility and engagement were essential in translating a memorandum of understanding (MoU) into a built, functioning interconnection.

Sustained political commitment transforms regional visions into durable co-operation.

Technical solutions and regulatory design alone cannot substitute for political leadership. Regional integration advances only when heads of state and ministers are willing to make public commitments, align national priorities and resolve difficult power imbalances. The Nordic electricity market experience demonstrates this evolution: what began as an economic unbundling exercise transformed into a strong political project at the EU level. Despite intense opposition during the recent energy crisis, it emerged stronger, with reforms outlined in the Electricity Market Design package, including the Electricity Regulation that entered into force in July 2024.

Early-stage political agreements play a critical role in building trust and signalling intent.

Political declarations, joint communiqués and MoUs establish goodwill, define shared objectives and give technical experts a mandate to begin co-ordination. These can be flexible arrangements that allow governments to explore integration without overcommitting, helping

manage domestic sensitivities. The ASEAN MoU on the [ASEAN Power Grid](#) is a non-binding but formal agreement among ASEAN member states to co-operate on regional electricity interconnection and integration. It serves as the foundational political instrument guiding the development of a regional power grid in Southeast Asia.

Aligning regional integration with national and global priorities increases political durability. Political support is stronger and more resilient when countries see integration as a vehicle to achieve domestic development goals, climate targets or energy security objectives. Embedding regional co-operation in national development plans helps ensure continuity across administrations and budget cycles. [The Central American Electrical Interconnection System \(SIEPAC\)](#) demonstrates how regional integration becomes more politically durable when it aligns with both national interests and broader development agendas. Backed by the Inter-American Development Bank and framed within the Central American Integration System, SIEPAC connected six countries through a regional transmission line and market. It addressed domestic challenges such as supply reliability and cost reduction while advancing regional power integration. This alignment helped sustain political support across successive governments and diverse national contexts.

Inclusive stakeholder engagement strengthens legitimacy and reduces political risk. Agreements developed exclusively among political elites or external advisors often face implementation problems. Including ministries, regulators, system operators and utilities in the negotiation process enhances technical feasibility and national ownership. Transparent processes build trust among stakeholders and reduce the risk of opposition. This was critical in the case of the Economic Community of West African States (ECOWAS), where engagement with national institutions underpinned the successful launch of WAPP and the ECOWAS Regional Electricity Regulatory Authority (ERERA). Broad participation helps governments anticipate and address implementation challenges early, making agreements more robust and politically defensible.

Political leadership must plan for continuity and embed co-operation in durable mechanisms. Regional electricity integration is a decades-long process, and political support must outlast individual leaders and electoral cycles. Political champions are essential for launching co-operation initiatives, but institutionalised mechanisms are needed to sustain

progress. High-level declarations should be paired with ongoing co-ordination platforms, such as joint ministerial councils or regional energy summits, that reinforce commitments and adapt to changing circumstances. [The Southern African Power Pool \(SAPP\)](#), for example, originated from a 1995 Southern African Development Community summit with strong political endorsement. This catalysed the creation of SAPP's governance structure, enabled utility co-operation and signalled political ownership that endured beyond the initial agreement. Under the SAPP model, governments ultimately retained national regulatory authority while forming a regional co-ordination mechanism without executive power. In contrast, ECOWAS built WAPP and empowered the regional regulator, the ECOWAS Regional Electricity Regulatory Authority (ERERA), with actual regulatory authority through successive political decisions taken at the level of heads of state.

Premature attempts to formalise integration without sufficient political trust and national alignment often fail. While political will is essential for regional co-operation, it operates within contextual limits that vary across countries and political systems. [The Inga 3 project](#) in the Democratic Republic of Congo, despite its immense technical potential to deliver over 40 GW of hydropower across the region, has been hampered by political fragmentation, unclear institutional roles and insufficient stakeholder engagement. More fundamentally, such mega-projects reveal the limits of trust between governments, particularly the reluctance to rely on other countries for critical security of supply. However, recognising these boundaries enables more realistic and achievable integration approaches that work within political constraints rather than against them. Successful integration requires matching ambitions to political context, building trust incrementally and designing arrangements that enhance, rather than threaten, energy security. Political will must be actively nurtured throughout the integration process while understanding that effective co-operation works with, not against, fundamental political dynamics.

To help navigate these challenges and build lasting political support, it is essential to tailor action items to each phase of regional integration. While many of these actions are discussed throughout the text, the following table organises them by integration stage, highlighting which political efforts should be prioritised early on and which must be sustained or adapted as co-operation deepens.

Integration stages, characteristics and priority actions

Early Integration

What is in place

- Public statements of intent; Regional, subregional or bilateral MoUs
- Identification of senior political champion(s)
- Ad hoc ministerial engagement; no formal agreed scheduling
- Inclusion of regional interconnection in national (high-level) strategies
- Implementation co-operation limited to specific projects

Priority actions for systems at this stage

- Keep MoUs current; publish simple progress notes quarterly
- Maintain scheduled political check-ins (e.g. semi-annual) to avoid drift
- Fund low-risk pilots or feasibility studies that deliver quick wins
- Run study tours or peer exchanges to sustain interest and capability
- Use neutral progress dashboards to keep the agenda visible domestically

Priority actions to progress to the next stage

- Convert intent into time-bound political commitments (e.g. joint communiqués with milestones)
- Appoint country focal points with authority to co-ordinate across ministries and utilities
- Establish a regular ministerial forum (e.g. quarterly or biannual) with action logs
- Mandate whole-of-government alignment (energy, finance, foreign affairs)

Shallow Integration

What is in place

- Recurring ministerial meetings with agendas and decisions
- Regional priorities reflected in national plans
- Leaders endorse draft governance concepts (e.g. secretariat, committees)
- Crisis-by-crisis co-ordination

Priority actions for systems at this stage

- Focus leadership on implementing already agreed decisions (no new scope)
- Keep the secretariat resourced and mandate compliance reporting
- Hold after-action reviews of co-ordination failures; fix processes
- Maintain transparent agendas and minutes to preserve legitimacy
- Refresh portfolio risk registers and contingency plans annually

Priority actions to progress to the next stage

- Ratify a framework agreement that formalises roles and decision rules
- Create a political oversight body (e.g. council of ministers or heads of state) with defined roles and responsibilities
- Require joint announcements on key approvals to lock in alignment
- Direct ministries to prepare enabling legislation and cross-border investment decisions

Deep Integration

What is in place

- Treaty-level commitment in force; delegated authorities agreed
- Regular heads-of-state or ministerial review of performance dashboards
- Budgeted, multi-year contributions to regional bodies
- Clear escalation and dispute-settlement pathways used when needed

Priority Actions to Advance Integration

- Refresh long-term political compacts (5–10 year visions) tied to transition goals
- Commission periodic mandate reviews to adapt institutions (e.g. new markets or services)
- Expand regional constituency-building (parliamentary, private sector, civil society)
- Maintain scenario-based leader dialogues for crisis management and investment pacing

Key recommendations for practitioners

For policy makers

- Secure high-level political commitment through dedicated heads-of-state engagement, including ministers of energy and finance, with formal endorsement processes and regular leadership summits.
- Issue a cross-party, time-bound regional vision and maintain visibility through public addresses, joint communiqués and championing integration in regional and global forums.
- Set a fixed convening schedule (e.g. quarterly senior officials' review) with published actions and owners, including intervention authority to resolve inter-ministerial disputes.
- Appoint empowered national focal points to co-ordinate across ministries and other public entities.
- Mandate and protect multi-year budgetary allocations for regional institutions and projects to signal continuity of intent.

For national energy sector regulators

- Provide independent, plain-language briefs on consumer benefits and risks to underpin the political narrative.
- Align consultation calendars with political review cycles so leaders see timely, evidence-based options.
- Publish short progress notes on cross-border readiness (what is feasible now; what needs policy decisions).
- Advise on safeguard clauses and phased commitments that reduce political exposure.

For system operators

- Deliver joint reliability and adequacy snapshots that leaders can cite, presented in a concise, decision-ready format.
- Run periodic cross-border tabletop drills and share lessons with ministers.

- Flag low-regret operational pilots that demonstrate early value without major commitments.
- Maintain a secure data brief (maps, bottlenecks, outage scenarios) for leadership use.

For utilities

- Present concise business-case notes for pilots (cost, benefit, timelines) to support leadership decisions.
- Provide customer-facing case studies that illustrate reliability and affordability gains.
- Participate visibly in joint announcements and follow through on delivery commitments.
- Raise implementation risks early with policy makers and transmission system operators (TSOs), along with practical mitigation options.

For financial institutions and development partners

- Align support behind a single, government-led political roadmap; avoid parallel platforms.
- Fund convenings, neutral secretariat capacity and public scorecards that sustain scheduling and accountability.
- Back peer exchanges and leadership study tours to enhance collaboration.
- Provide flexible instruments for “political insurance” (e.g. support windows for smaller or late-starter countries).

Key implementation considerations

Political resilience

Political commitment should be insulated from electoral cycles and cabinet changes. Build longevity by tying regional objectives to long-term national strategies and cross-party compacts, so momentum survives leadership transitions and shifting priorities.

Strategic narrative, visible leadership and coalition building

Leaders should articulate a clear, consistent public case for integration and reinforce it through regular, visible engagement. A disciplined narrative anchors expectations at home and across the region. Broaden support by engaging parliaments, utilities, regulators, major users and civil society early. Structure benefits and sequencing so smaller or late-starter countries see tangible gains, strengthening coalition durability.

Binding commitments, time-bound milestones and scheduled convening

Translate intent into time-bound joint decisions and measurable deliverables. Simple, shared milestones reduce delays, make progress trackable and keep stakeholders focused on concrete outcomes rather than open-ended aspirations. Set a predictable calendar for head-of-state or ministerial meetings with clear agendas, decisions and action logs. Regular senior engagement sustains momentum and provides an authoritative forum to resolve issues.

Whole-of-government coherence

Align energy, finance, foreign affairs, planning and justice portfolios behind one political roadmap. Clear internal co-ordination prevents cross-ministry vetoes and ensures national positions are coherent in regional forums.

Multi-year budget anchors

Create visible, multi-year budget lines, even if modest, for regional workstreams and institutions. Budgetary signals demonstrate seriousness, protect activities from stop-start funding and enable medium-term planning.

Partner and donor alignment

Orchestrate external support around a single political roadmap led by governments. Avoid parallel platforms or fragmented initiatives that dilute legitimacy and complicate national co-ordination.

Risk-sharing, political insurance and safeguards

Use reciprocal commitments, phased deliverables and safeguard clauses to manage asymmetries and election-timing risks. Political insurance mechanisms make collaboration more resilient to domestic shocks. Adopt ethics rules, conflict-of-interest norms and transparent appointment processes around cross-border decisions. Credible safeguards protect legitimacy and reduce the risk of politicisation or undue influence. Define who decides what, and how unresolved issues escalate through technical, ministerial and leader levels. Clear decision routes prevent stalemate and reduce the risk of sensitive matters becoming politicised by default.

Institutional frameworks and governance: Building the structures that make regional integration work

Translating political commitment into operational reality requires robust institutional frameworks that can co-ordinate diverse stakeholders, implement agreements and sustain regional co-operation over decades. Effective institutional design must balance the need for regional co-ordination with respect for national sovereignty, creating governance structures that are both legitimate and capable of delivering tangible benefits to participating countries.

Governance models must fit the region's political, legal and institutional context. Whether centralised or decentralised, institutional frameworks only work if they align with existing national systems and political dynamics. Successful governance depends on the trustworthiness and human capacity of institutions but also requires consideration of key structural factors: who wields the power to impose binding rules, and whether there is a regional regulator with executive power and technical capability. The European Union has supranational authority through the European Commission, which can impose binding rules such as market participation and unbundling requirements but lacks a fully empowered regional energy regulator. West Africa's WAPP operates without regional government authority but has ERERA as a regional regulator with actual executive power, enabling Africa's most advanced regional power market. Central America's SIEPAC similarly established the Regional Commission for Electrical Interconnection (CRIE) with supranational regulatory authority despite lacking overarching regional government authority. In contrast, SAPP operates through voluntary utility co-operation, with neither regional government authority nor an empowered regional regulator. These varied pathways demonstrate that while institutional trustworthiness and capacity remain fundamental, the structural arrangements of power and regulatory authority significantly influence what each governance model can achieve within its regional context.

Clear institutional roles are essential for effective and accountable regional electricity integration. Cross-border co-operation requires clarity on who plans, builds, finances, regulates and operates regional infrastructure. When roles are well defined, actions can be coordinated more smoothly, and delays or conflicts reduced. In West Africa, the ECOWAS Authority of Heads of State and Government provides strategic direction for WAPP, with national utilities and regulators aligning implementation. The regional regulator ERERA focuses specifically on cross-border regulation, complementing rather than duplicating national mandates. This separation of responsibilities ensures coherence across layers of governance and strengthens regional ownership.

Regulatory co-operation ensures reliable and seamless cross-border electricity exchange. When regulators engage regularly and share information, they can address interoperability issues, harmonise standards and resolve cross-border disputes. In the European Union, the [Agency for the Cooperation of Energy Regulators \(ACER\)](#) has a clear mandate to intervene when national regulators cannot reach agreement on cross-border issues. It issues binding decisions and provides oversight of regional co-ordination platforms, such as the European Network of Transmission System Operators for Electricity (ENTSO-E). In West Africa, ERERA plays a [similar but more limited role](#), regulating cross-border electricity tariffs and facilitating dialogue among national regulators. These examples highlight that regulatory co-operation, whether formal or informal, is essential to maintain trust and reduce friction in regional markets.

Institutionalising collaboration helps preserve momentum and accountability through political cycles. Integration processes can span decades and outlast governments, so institutional memory must be protected. Permanent bodies such as secretariats, standing committees and legally embedded regulators ensure continuity of planning, implementation and reform. CRIE in Central America operates under a treaty framework that grants it independence, legal authority and financial stability, enabling consistent regulation across six countries. In Europe, ACER, as a formal EU agency established in 2010, has maintained consistent regulatory oversight across multiple European political cycles and national government changes. ENTSO-E, operating since 2008 as a permanent association of TSOs, has provided technical continuity even as energy ministers and national policies have shifted across more than 40 member countries. WAPP's [Engineering and Operations Committee](#) plays

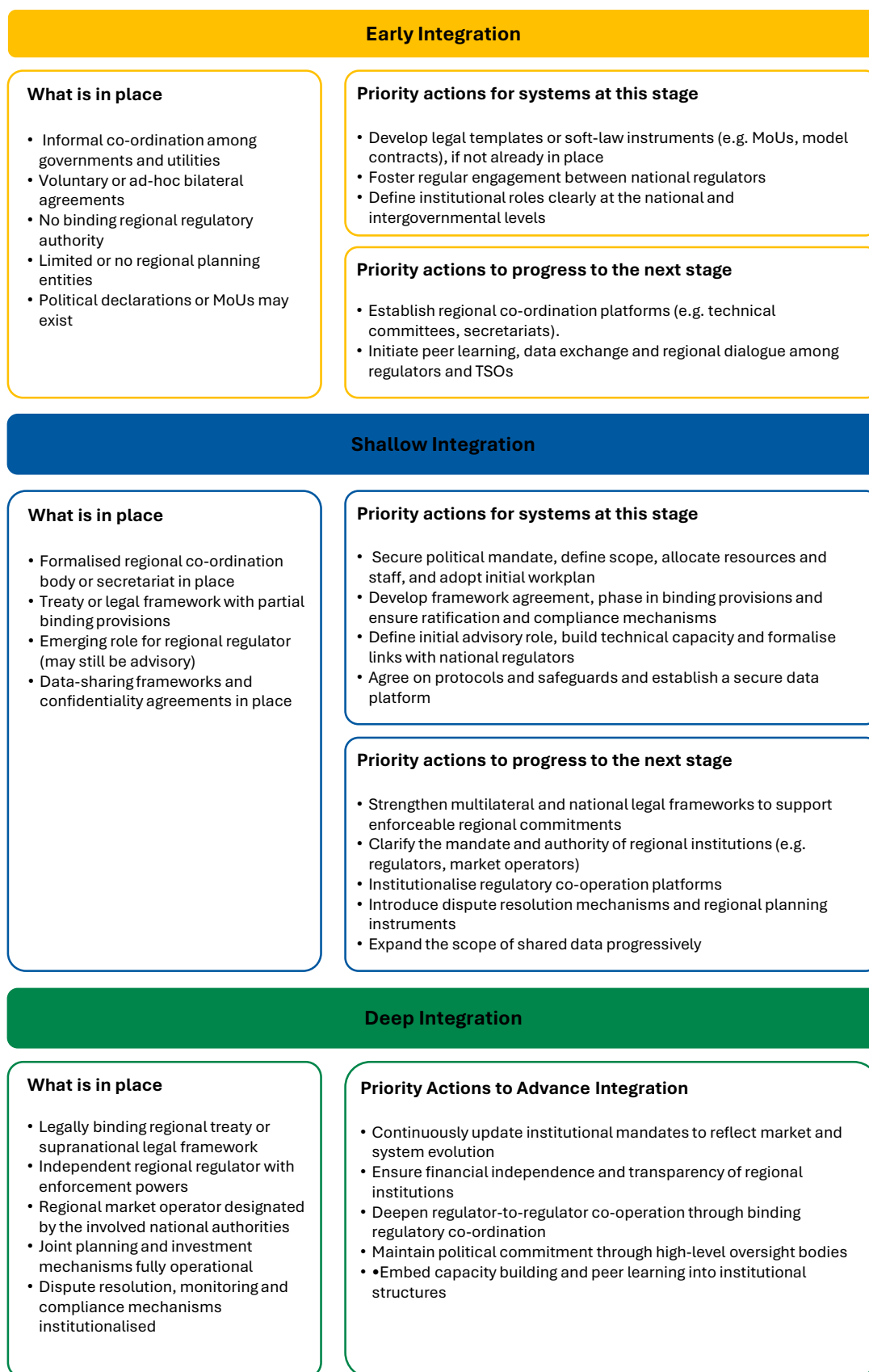
a similar role in West Africa, aligning national investment plans with regional priorities and facilitating operational co-ordination across borders.

Institutional success depends on clearly defined mandates, appropriate authority and independence. Regional institutions must avoid overlapping with national authorities and be given sufficient authority to fulfil their responsibilities. EREDA, for example, focuses only on cross-border issues, while domestic regulation remains under national jurisdiction. CRIE's enforcement powers are aligned with its oversight function for the regional electricity market. ACER's ability to issue binding decisions is restricted to transnational issues, preserving the balance between EU-wide consistency and national sovereignty. Institutions also require operational independence, protected mandates, secure funding and transparent governance to maintain credibility and effectiveness.

Different institutional models can work if grounded in trust, performance and legal clarity. The evolution of [Nord Pool](#) illustrates how institutional roles can expand over time through demonstrated competence. Initially a voluntary arrangement between Norway and Sweden, it became one of several [designated market operators \(NEMOs\)](#) in the integrated European electricity market. Nord Pool, like EPEX Spot, OMIE and others, operates under EU rules and is designated by national regulators to manage day-ahead and intraday trading. Meanwhile, the [European Energy Exchange](#) plays a complementary role by providing central clearing services for long-term and short-term contracts via the [European Energy Clearing](#). These functions, though distributed across private and public actors, succeed because they are underpinned by legal clarity and regulatory oversight.

As these institutional models show, countries must actively support the development of trusted institutions, align domestic policies with regional frameworks and ensure that legal mandates are backed by operational capacity for successful integration. At each stage of integration, from early co-ordination to full market coupling, governments have distinct roles to play in building trust, enabling co-operation and maintaining momentum. The following table outlines the key political actions that should be prioritised at each phase to help countries navigate the integration process effectively.

Integration stages, characteristics and priority actions



Key recommendations for practitioners

For policy makers

- Legally anchor regional co-operation through treaties or binding agreements to ensure institutional continuity.
- Clearly define mandates for national and regional institutions to avoid overlaps or confusion.
- Ensure national commitments align with regional governance structures and planning processes.
- Provide long-term political support for regional institutions.
- Create high-level oversight bodies to monitor progress and resolve political bottlenecks.

For national energy sector regulators

- Clarify regulatory jurisdiction between national mandates and regional responsibilities, particularly regarding cross-border exchange.
- Actively participate in regional regulatory platforms to harmonise standards, tariffs and dispute procedures.
- Build internal capacity to address regional issues and collaborate with peers to align approaches.
- Promote regulatory transparency and predictability to build stakeholder trust across borders.

For system operators

- Engage in regional operational co-ordination through formal platforms.
- Contribute technical expertise to regional institutions for planning studies and grid code harmonisation.
- Share relevant system and planning data under agreed confidentiality protocols.
- Support the implementation of regional operational procedures and market mechanisms as they evolve.

For utilities

- Align internal planning and commercial practices with regional rules and institutional decisions.
- Participate in consultations on regional market design and cross-border regulatory frameworks.
- Flag implementation challenges to regulators and TSOs early to support responsive institutional design.
- Build capacity to engage with evolving institutional processes and comply with regional protocols.

For financial institutions and development partners

- Support long-term institutional development, not just infrastructure or market reforms.
- Invest in regional capacity building, peer learning and institutional diagnostics.
- Co-ordinate support with regional priorities and avoid duplicating institutional efforts.
- Provide catalytic funding for regional institutions while encouraging sustainable resourcing models.
- Facilitate structured dialogue among policy makers, regulators and operators to build alignment.

Key implementation considerations

Designing institutions for political resilience

Institutional structures should be insulated from short-term political changes. Even in the early stages, stakeholders should anticipate how institutions will endure leadership transitions, shifts in political priorities and changes in government structure. This requires embedding regional commitments into long-term visions rather than treating them as short-term projects.

Regional legitimacy through transparency and confidentiality protocols

Regional institutions must be trusted by national actors. Regardless of their authority level, they should operate transparently, sharing decisions, methodologies and outcomes to build legitimacy. This is especially critical for regional regulators and co-ordination bodies, whose credibility relies on perceived fairness and neutrality. Integration also requires sharing sensitive data on grid operations, planning and markets. Regional institutions must develop robust protocols that protect confidentiality while enabling transparency and trust-based co-operation between entities.

Establishing and maintaining institutional memory

As regional power integration unfolds over years or decades, institutional memory must be preserved. Rotation of personnel, political turnover or inconsistent funding can erode momentum. Documenting processes, decisions and institutional knowledge ensures continuity even as actors change.

Tailoring communication across stakeholder types

Technical institutions must engage diverse audiences: policy makers, regulators, TSOs, utilities, financiers and the public. Clear, audience-specific communication strategies that avoid unnecessary technical jargon can support understanding, buy-in and compliance across stakeholder groups.

Embedding adaptive governance principles

Institutional mandates should not be static. As systems evolve with the growth of renewables, decentralisation and market liberalisation, regional institutions must have the procedural flexibility to adapt rules, expand roles and modify governance structures through pre-defined mechanisms.

Balancing regional leadership with country ownership

Institutions must lead integration without being perceived as detached or imposed. Successful governance strikes a balance between driving regional coherence and respecting national

circumstances. This requires inclusive processes and regular bottom-up input from national actors, including those from less dominant markets.

Ensuring alignment with broader regional integration frameworks

Power sector institutions should be harmonised with wider economic and regional co-operation frameworks (e.g. regional economic communities or exchange agreements). Misalignment can create institutional friction or duplication. Energy-specific initiatives must co-ordinate with overarching regional governance structures.

Running smoothly: Operating the grid across borders

Harmonisation of technical and operational standards, particularly grid codes, ensures the secure and reliable operation of interconnected power systems. This involves aligning rules and procedures related to interconnection requirements, system security, frequency and voltage control, data exchange and emergency protocols. While full harmonisation may be a long-term goal, establishing minimum harmonised regional grid codes focusing on cross-border interconnectors is a critical first step. A co-ordinated approach among the different jurisdictions is vital for the successful operation of an interconnected grid.

It is important to understand which standards must be perfectly aligned to begin trading versus those that can be harmonised gradually as integration deepens. A set of physical and operational characteristics must be aligned for power systems to safely interconnect and begin trading electricity: equipment settings that ensure technical compatibility, day-to-day operational procedures that enable co-ordinated system management and standards that establish the governing rules and methodologies. Sequencing harmonisation efforts over time allows countries to implement what is feasible now, while creating a clear pathway for progressively adopting more advanced technical and operational standards. SAPP's evolution from bilateral trading (1995) to competitive markets, including day-ahead markets (2009), demonstrates progressive standards development that builds institutional capacity over time.

The challenge in developing these standards lies in balancing the benefits of co-ordination with the reality that power systems involve massive, long-term infrastructure investments that cannot be easily replaced. Interconnection projects succeed when they adopt a pragmatic, step-by-step approach that delivers immediate benefits while enabling deeper integration over time. This evolutionary approach builds trust and capabilities through successful basic co-ordination before moving on to more sophisticated integration. Clear metrics for progress, such as interconnection capacity targets and co-ordination milestones, help maintain focus on eventual deeper integration.

Critical technical alignments for system security provide an essential foundation for safe interconnection. Not all technical standards must be fully aligned from the outset. A core set of minimum requirements must be harmonised early to ensure the physical stability of interconnected grids. Japan's experience connecting 50 Hz and 60 Hz systems through frequency converter stations demonstrates that fundamental incompatibilities can be managed when safety standards are prioritised.

The ability to share grid data in compatible formats is a key foundation for co-ordinating electricity systems across borders. Reliable real-time co-ordination requires direct communication links between control centres and agreement on how system operators exchange information. Many regions have adopted common protocols¹ that enable real-time data exchange on grid status, contingency information and power flows while maintaining the autonomy of each national operator. SIEPAC's implementation of these standardised communication protocols demonstrates how technical co-ordination can advance without compromising individual country control over their domestic systems.

Co-ordinated operational procedures across borders enhance system reliability and efficiency. Joint operational planning, outage co-ordination and shared contingency responses help ensure safe and efficient system operations. The Central American Regional Operating Entity manages day-ahead regional dispatch based on offers from national systems, co-ordinating generation across multiple countries while respecting national market structures.

Flexible governance mechanisms let countries adopt harmonised standards at their own pace. This flexibility allows for different speeds of implementation while maintaining a minimum baseline to safeguard system stability. Europe's approach shows how regional standards can develop incrementally through co-operative governance structures that enhance co-ordination without undermining national authority.

¹ Many regional systems adopt the IEC/IEC 60870-6 communication protocol as the standard for inter-control centre data exchange and operational coordination.

Stages, characteristics and priority actions

Early Integration

What is in place

- Same operating standards for voltage and frequency at interconnector ends
- Co-ordinated interconnector protection to quickly isolate faults while preventing unnecessary disconnections from external faults
- Basic emergency communication protocols

Priority actions for systems at this stage

- Establish direct communication links
- Set up real-time monitoring of power flow and voltage at each end of interconnector
- Agree operating procedures for normal operation and emergency disconnection

Priority actions to progress to the next stage

- Begin standardising data exchange protocols
- Develop common contingency analysis approaches
- Set out steps for requesting, activating and monitoring reserve support from neighbouring systems

Shallow Integration

What is in place

- Direct communication links and real-time monitoring capabilities established
- Co-ordinated maintenance scheduling and generation dispatch
- Agreed operating procedures for normal operation and emergency disconnection

Priority actions for systems at this stage

- Implement standardised data exchange protocols (ICCP/IEC 60870-6) for sharing operational data
- Establish common contingency analysis (N-1 security assessments)
- Set joint emergency response and system restoration procedures

Priority actions to progress to the next stage

- Establish comprehensive reserve-sharing agreements
- Develop advanced co-ordination mechanisms
- Build integrated monitoring systems

Deep Integration

What is in place

- Automatic system response to changes
- Joint emergency response and system restoration procedures treating interconnected systems as a unified entity
- Comprehensive reserve-sharing agreements

Priority Actions to Advance Integration

- implement reserve-sharing agreements (emergency, load following, frequency control)
- Configure automatic generation co-ordination for frequency events
- Co-ordinate reactive power and voltage regulation
- Enhance co-ordination algorithms
- Continuously improve technical standards
- Work with existing capabilities while establishing frameworks for future development

Key recommendations for practitioners

For system operators

- Prioritise safety-first sequencing: Establish voltage/frequency and emergency protocols before pursuing operational efficiencies such as co-ordinated dispatch.
- Develop cross-border capabilities progressively: Build direct communication links and real-time monitoring in parallel with physical interconnection development.
- Secure long-term institutional support: Given the decades development timelines, establish formal agreements and dedicated funding streams that can survive political transitions.

For energy sector regulators

- Use inclusive standards development: Create working groups comprising technical experts from all participating countries rather than relying solely on standards from dominant markets.
- Implement flexible harmonisation frameworks: Allow countries to adopt standards at different paces while maintaining minimum safety baselines. Balance co-ordination benefits with existing infrastructure constraints and large-scale, long-term investments.
- Build specialised regional oversight capacity: Establish dedicated technical committees with the authority and resources necessary to monitor harmonisation progress.

For utilities

- Invest in operator training early: Begin cross-border co-ordination training before interconnections go live, using simulation exercises and exchanges with experienced regions.
- Engage actively in standards development: Assign senior technical staff to regional working groups rather than treating participation as a secondary priority.
- Upgrade systems proactively: Plan communication systems and protection equipment upgrades as part of interconnection investments.

- Conduct joint operator training, tabletop exercises and simulation drills to strengthen readiness and co-ordination.

For financial institutions and development partners

- Fund hard infrastructure for co-ordination: Support control room upgrades, communication systems and protection equipment necessary for technical co-ordination.
- Support institutional capacity building: Finance training programmes, technical working groups and regulatory development for harmonisation processes.
- Facilitate regional knowledge exchange: Finance study tours, technical exchanges and secondments between regions at different stages of integration.

Key implementation considerations

Technical compatibility and safety

Safe power transfer between interconnected systems requires compatible equipment settings. At the fundamental level, both ends of an interconnector must operate to the same standards for voltage and frequency, with protection systems that can isolate faults without triggering wider failures. Emergency communication protocols should be established to define minimum communication standards between control centres for co-ordination during system emergencies and to maintain operational safety. As integration ambitions grow beyond simple bilateral trading to deeper integration, co-ordination requirements will broaden to cover aspects of how systems respond automatically to changes and manage the supply-demand balance across the interconnection. To achieve this level of co-ordination, countries must develop and enforce harmonised regional grid codes with compliance monitoring frameworks.

Operational co-ordination and data exchange

Day-to-day operational procedures enable co-ordinated management of interconnected systems. Direct communication links between control centres and real-time monitoring capabilities give operators visibility into power flows and system conditions across the interconnection. Building on these essential capabilities, standardised data exchange protocols allow operators to share real-time operational data, forecasts and system status in

structured formats. The establishment and enforcement of cybersecurity and data integrity standards for operational and market data exchange can ensure the reliability and security of these exchanges. Co-ordination also covers maintenance scheduling and generation dispatch to optimise resource utilisation and system reliability, as well as the sharing of reserves among neighbouring systems. Advanced procedures also include protocols for requesting, activating and monitoring reserve support. However, operational co-ordination capabilities must develop alongside physical infrastructure integration to realise the economic benefits, requiring time, training and trust as system operators adapt to working collaboratively across organisational boundaries.

Governance framework and emergency response

Standards, rules and methodologies provide the governance framework for interconnected operations. This framework establishes agreed operating procedures for normal operation and emergency disconnection, along with standardised voltage and frequency deviation limits that ensure predictable system behaviour. More sophisticated standards include common contingency analysis approaches, such as N-1 security assessments, joint emergency response and system restoration procedures that include integrated approaches to load shedding, system restoration and mutual assistance, treating interconnected systems as a unified entity in times of crisis. Reserve-sharing agreements can also cover emergency support, load following and frequency control. The challenge is to balance the benefits of co-ordination with the reality that power systems involve massive, long-term infrastructure investments that cannot be easily replaced. Effective approaches must therefore work with existing capabilities while establishing frameworks for future development.

Making regional power exchange work: Cross-border electricity market development and commercial arrangements

Cross-border electricity exchange can deliver significant economic and operational benefits, but commercial arrangements should match the stage of regional integration and institutional capacity. Commercial arrangements are needed both for the exchange of electricity across borders and for the allocation of available interconnection capacity. Access to least-cost generation resources across borders allows countries with abundant resources to export surplus electricity, while importing countries can reduce reliance on more expensive generation. This promotes lower system costs, improved reliability and enhanced energy security. However, the economic value of physical interconnections cannot be fully realised without clearly defined trading rules, pricing mechanisms and settlement systems. In the absence of such arrangements, interconnected networks remain confined to emergency exchanges, falling short of delivering sustained efficiency gains.

Successful cross-border market development requires a sequenced approach that evolves alongside institutional maturity and regional trust. Early-stage bilateral arrangements are essential for demonstrating commercial viability, building operational experience and generating the political momentum necessary for deeper co-operation. These foundational mechanisms, often focused on surplus exchanges or predefined bilateral contracts, help establish standard procedures, cultivate trader confidence and identify areas for improvement. Over time, these arrangements can be expanded into more co-ordinated market structures with transparent dispatch and broader participation. Regional experience shows that multilateral power markets often take 15-20 years to develop and deliver substantial returns when supported by sustained political commitment and progressive institutional strengthening.

Multilateral trading platforms and real-time markets are only viable once institutional frameworks are in place to support them. Advanced market arrangements require harmonised regulatory oversight, shared monitoring systems and robust governance structures. Attempting to impose complex multilateral systems before countries have gained experience through simpler mechanisms can undermine confidence and delay integration. SAPP exemplifies this staged approach, starting with standardised bilateral contracts that established early trust in cross-border transactions. Over time, SAPP introduced a day-ahead and intraday market with transparent pricing and automated settlement, progressively enhancing market complexity and reliability. Similarly, [Med-TSO's phased approach](#) in the Middle East and North Africa region shows how integration can progress from fixed bilateral prices to daily auctions, and eventually to open markets with neutral operators.

Avoiding common pitfalls is as important as following best practices when developing cross-border electricity markets. Regions often falter by overreaching, implementing complex mechanisms without first building basic commercial trust or overlooking the foundational elements of settlement, pricing and transparency. Recurring challenges include launching sophisticated trading platforms before establishing trust, neglecting robust payment and dispute mechanisms and applying tariff structures or pricing rules that distort trade signals. These missteps can erode market confidence and stall regional integration. The priority actions that follow are grounded in practical experience and structured to help regions advance while avoiding these risks.

Flexible market integration models can enable regional power exchange while respecting national sovereignty. For example, SIEPAC's overlay market allowed Central American countries to engage in regional electricity exchange without requiring full harmonisation of their national commercial frameworks, preserving each country's control over its internal systems. This approach demonstrates that regional exchange can thrive even when participating countries have varying levels of market development and political constraints, as long as mechanisms are adapted to fit the institutional landscape.

Tailored financial mechanisms are essential to manage payment and currency risks in developing regions. In West Africa, [WAPP's Letter of Credit-based settlement system](#), the Liquidity Enhancement Revolving Fund, directly tackled persistent challenges like payment

delays and currency volatility. By establishing monthly settlement cycles, clear credit requirements and regionally co-ordinated financial safeguards, it created more certainty and reliability in transactions. This shows that even relatively simple financial innovations, when designed to reflect local constraints, can significantly reduce commercial risk and unlock greater regional exchange.

Robust central clearing infrastructure supports large-scale, low-risk electricity trading across jurisdictions. The European Energy Exchange, through its central counterparty European Energy Clearing, demonstrates how advanced financial architecture underpins efficient cross-border electricity markets. With standardised credit requirements, daily mark-to-market processes, and guaranteed settlement, the system minimises counterparty risk while enabling over 1 000 TWh of transactions annually. This case highlights the importance of strong institutional capacity and clearing mechanisms for mature regional markets.

Transparent, layered price formation mechanisms can reconcile regional optimisation with local realities.² The Nordic electricity market covering Denmark, Norway, Sweden and Finland introduced a two-tier pricing structure: a theoretical “system price” used for financial reference and long-term planning, and “area prices” that reflect local conditions and transmission constraints. This approach enables efficient regional co-ordination while preserving local price signals, serving as a model for price formation in integrated electricity markets that require both investment-grade signals and operational flexibility. In addition, long-term [physical bilateral contracts to trade across borders can hinder efficient price formation](#) across interconnected markets, replaced by financial contracts in many advanced regional power markets.

² Price formation is the economic process through which market prices are determined based on fundamental factors, such as the supply-demand balance, fuel costs and transmission constraints. This is distinct from pricing mechanisms, which refer to the specific computational methods and rules used to calculate prices (e.g. uniform pricing and locational marginal pricing).

Integration stages, characteristics and priority actions

Early Integration

What is in place

- Bilateral exchange arrangements dominate
- Limited co-ordination between systems
- Ad hoc settlement and data sharing
- National-level ancillary services only

Priority actions for systems at this stage

- Use simple bilateral contracts with clear terms
- Avoid tariff pancaking on cross-border flows
- Publish basic operational and pricing data

Priority actions to progress to the next stage

- Establish minimal harmonisation of settlement and scheduling
- Begin sharing market data regionally
- Develop standard contract templates

Shallow Integration

What is in place

- Partly harmonised exchange rules and grid codes
- Limited multilateral co-ordination of capacity
- Some regional co-ordination of ancillary services

Priority actions for systems at this stage

- Harmonise core exchange and market rules
- Pre-agree congestion rent allocation mechanisms
- Set up partial multilateral capacity assessment and ancillary service markets

Priority actions to progress to the next stage

- Introduce multilateral co-ordination platforms
- Expand scope of harmonised market functions
- Build capacity for real-time operations

Deep Integration

What is in place

- Regional wholesale markets in operation
- Co-ordinated capacity and ancillary services
- Binding regional rules and dispute resolution mechanisms in place

Priority Actions to Advance Integration

- Operate regional day-ahead and intraday markets
- Co-optimize ancillary services regionally
- Establish real-time data sharing and comprehensive market monitoring
- Implement a central counterparty/clearinghouse
- Continuously improve market monitoring
- Align with global best practices for transparency and governance

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Key recommendations for practitioners

For policy makers

- Start with simple bilateral arrangements before attempting more sophisticated markets.
- Ensure that political foundations are solid before pursuing technical complexity.
- Plan for 15-20 year development timelines for deeper regional power market integration, with intermediate milestones.

For national energy sector regulators

- Develop regional co-ordination capabilities progressively.
- Balance market efficiency with operational reliability.
- Invest in market monitoring and oversight capabilities.
- Ensure the timely, transparent publication of operational data (e.g. available capacity) and market data to build confidence among stakeholders and the public.
- Ensure open and transparent access to the power exchange, allowing traders to book, trade, and utilise available transmission capacity under fair and non-discriminatory conditions.

For utilities

- Build commercial capabilities alongside technical interconnection.
- Develop risk management expertise for cross-border trading.
- Participate actively in regional market development processes.

For financial institutions and development partners

- Support capacity building and power exchange development and expansion.
- Provide credit enhancement and risk mitigation mechanisms.
- Facilitate knowledge transfer between regions and cost-effective collaborative initiatives.

Key implementation considerations

Market operations and price formation

Regional markets should prioritise least-cost dispatch and price formation mechanisms that reflect true system value and drive investment efficiency. Market-based economic dispatch ensures that the lowest-cost electricity generation resources are used first across the entire interconnected region, rather than optimising only within individual countries. Regional dispatch requires co-ordinated operational procedures among system operators, including standardised methodologies for determining available transmission capacity and scheduling procedures that account for cross-border implications. To address price volatility risks that can affect contract values, regions should implement price caps and floors during early market development, gradually introducing more sophisticated risk management tools as markets mature.

Market rules and transparency

Non-discriminatory rules covering scheduling, accounting, metering and settlement support predictability and trust among participants and establish transparent and standardised market rules. Market access rules must clearly define participation eligibility and conditions, covering utilities, independent power producers, traders and large consumers. Standardised operational procedures provide reliable cross-border power exchange foundations, with scheduling procedures specifying how transactions are planned and co-ordinated, accounting systems tracking cross-border flows accurately and consistent metering standards ensuring the accurate quantification of electricity flows.

Capacity allocation mechanisms

Cross-border electricity trading requires co-ordination of two distinct mechanisms: electricity market operations and transmission capacity allocation. Regions typically choose between explicit allocation, where transmission capacity and electricity are traded separately, or implicit allocation, where capacity allocation is embedded within electricity market clearing. Explicit allocation provides direct control over transmission access but requires participants to manage both capacity and electricity trading separately. Implicit allocation simplifies

participation and improves efficiency through automated optimisation but requires more sophisticated market systems and regulatory co-ordination.

Transmission pricing and cost recovery

Effective transmission pricing must balance cost recovery, economic efficiency, fairness and predictability while avoiding multiple layers of charges that can make cross-border power exchange unnecessarily expensive. When cross-border transactions are subjected to overlapping transmission fees, economically beneficial exchanges can become unviable as costs no longer reflect actual network usage. Initial frameworks should prioritise cost allocation at the country level rather than to individual market participants, using straightforward mechanisms such as equal sharing between countries, capacity-based allocation or usage-based charging methods like “average participation”. The “beneficiaries pay” principle provides fundamental guidance for proportional cost distribution among countries deriving benefits from regional transmission infrastructure. As markets mature and institutional capacity develops, more sophisticated mechanisms, such as congestion-based pricing, become viable, delivering efficient locational signals for operational decisions and long-term investment planning while maintaining stable cost recovery for transmission operators.

Settlement and financial risk management

Establishing clear transaction and payment procedures, often through a central counterparty or clearinghouse, can reduce financial risk and ensure timely settlements when implementing secure financial settlement systems. Cross-border exchange exposes participants to electricity price volatility, transmission constraints and counterparty defaults. Effective settlement systems require appropriate credit guarantees, such as cash deposits, prepayment of electricity, letters of credit or government guarantees, calibrated to protect counterparties without creating excessive barriers. Payment procedures must accommodate cross-border realities, including currency considerations, banking arrangements and multi-jurisdictional regulatory requirements.

Classification, monitoring and reporting

Comprehensive governance, including monitoring and reporting systems enable regulatory oversight, market analysis and continuous improvement of cross-border trading arrangements. Exchange classification systems should distinguish between transaction types, such as emergency assistance, surplus energy sales, scheduled exchanges under long-term contracts or market-based transactions, to enable appropriate regulatory treatment and analysis. Consistent classification and reporting allow transparency, regulatory compliance and accurate statistical tracking, with transactions categorised based on their economic nature, such as the physical delivery of electricity, use of transmission infrastructure or trading of financial instruments.

Looking ahead: Co-ordinated regional planning and investment

Regional planning can deliver transformational infrastructure benefits, but only when planning approaches match the level of integration maturity. Regional planning facilitates the efficient buildout of generation and transmission infrastructure and enables deeper market integration between power systems. Long-term plans, looking 10 years or more ahead, build investor confidence and make financing new infrastructure easier. However, the right approach requires alignment with existing institutional capabilities and regional co-ordination mechanisms. Overly ambitious planning frameworks imposed on immature markets typically collapse under their own complexity, causing setbacks that can delay effective regional integration for years. While extensive regional planning frameworks involving joint planning exercises and new regional institutions are well suited to highly integrated regions, bilateral planning co-ordination may be more appropriate in early stages of market integration, where trading is carried out bilaterally between countries. Investment approaches can be matched to the level of regional integration, focusing initially on essential bilateral links and system reinforcement, and later advancing to more complex, region-wide infrastructure co-ordination supported by common funds, decision-making frameworks and cost allocation methodologies.

Regional plans require joint processes and methodologies, as well as harmonised data across countries. [The African Continental Power Systems Masterplan](#) illustrates how this can be done. It unites all five African power pools under one governance structure, the African Union Development Agency-NEPAD, and uses standardised modelling frameworks, such as the International Renewable Energy Agency's [System Planning Test models](#), to create harmonised platform conditions for co-ordinated infrastructure planning. Joint system studies are essential for planning regional systems to identify and prioritise economically and technically viable interconnection projects. Without harmonisation, system planning entities may have diverging approaches to planning horizons and study periods, technical criteria, modelling assumptions, analytical methodologies, and planning objectives and priorities. This can lead to poor alignment between national and regional plans, with national planning

authorities often developing studies independently and disregarding regional co-ordination efforts. In the United States, [FERC Order 1000](#) requires regional planning authorities to exchange data annually and engage in joint efforts to harmonise assumptions, models and cost-benefit assessments. Most regional planners have complied and amended their frameworks accordingly.

Implementing regional plans requires common, fair and transparent cost-benefit assessment methodologies to facilitate project prioritisation and the allocation of costs following the “beneficiary pays” principle. Transparent, regionally agreed criteria, focused on security of supply, economic efficiency and affordability, can help ensure that resources flow to the most impactful projects. Costs should be allocated according to the “beneficiary pays” principle, meaning parties bear costs in proportion to the benefits they receive. This approach helps to avoid overinvestment and secure acceptance for new interconnector investments. Although it can be challenging to measure all benefits precisely, robust methodologies make it easier to reach consensus among multiple parties. This principle is applied in the cost allocation methodologies used in the European Union ([EU integrated market through the common cost allocation methodology](#)), and well as in US markets, with [FERC Order 1000 setting common principles for cost allocation](#).

Financing regional infrastructure also needs strategies that match the integration stage and degree of market readiness. These projects often face long lead times, revenue uncertainty and regulatory complexities, making private investment challenging and ultimately raising costs. Governments or state-owned utilities are typically responsible for transmission infrastructure financing, but many in emerging market and developing economies are not sufficiently creditworthy. Early-stage integration efforts may require concessional funding or sovereign guarantees, while mature markets can leverage blended finance, private investment through [independent transmission projects](#) or more sophisticated financing instruments. Deploying instruments like guarantees, cost-sharing arrangements and clear regulatory and revenue frameworks can further mitigate investment risk and attract capital.

Investment risk mitigation frameworks can catalyse financing for cross-border infrastructure. The [United Kingdom’s cap and floor](#) regulatory regime reduces investor uncertainty by guaranteeing minimum revenue levels while capping excess profits, thereby

aligning public and private interests. This model has proven effective in attracting private capital to merchant interconnector projects, offering a pragmatic solution to the problem of revenue volatility in infrastructure with high up-front costs. This underscores how regulatory certainty and risk-sharing can accelerate the development of enabling infrastructure for regional exchange.

Independent transmission projects, where the [rights and obligations](#) associated with a single transmission line, or a package of a few lines, are often awarded through the competitive tenders, allow for the [separation of cash flows and risks](#) associated with a particular transmission investment from the cash flows and risks that are related to other investment in the whole network. Private capital has been successfully mobilised for single transmission line or a group of transmission line projects following this model [in many countries](#), including in Australia, India, North America and South America. In Brazil alone, 60 000 km of transmission lines have been built using this approach. The model is also currently being developed in South Africa, with the launch of the [Independent Transmission Programme](#) in 2025.

Stages, characteristics and priority actions

Early Integration

What is in place

- Planning is conducted at the national level
- Specific bilateral or regional agreements are in place to develop priority infrastructure

Priority actions for systems at this stage

- Co-ordinate national plans bilaterally
- Implement concessional funding and sovereign guarantees for interconnection projects

Priority actions to progress to the next stage

- Integrate generation and transmission planning
- Harmonise planning data and methodologies

Shallow Integration

What is in place

- National investments are somewhat co-ordinated
- Optimised regional investment planning is initiated but limited

Priority actions for systems at this stage

- Develop joint planning tools based on harmonised data and methodologies
- Combine bottom-up and top-down planning approaches
- Allocate costs following the “beneficiary pays” principle

Priority actions to progress to the next stage

- Develop joint decision-making governance with enforcement powers
- Leverage blended finance, private investment or more sophisticated financing instruments

Deep Integration

What is in place

- Optimised planning with a regional perspective
- Harmonised methodologies may be used for national-level planning

Priority Actions to Advance Integration

- Harmonise national planning methodologies
- Develop regional cost allocation methodologies based on cost-benefit assessments
- Set up centralised regional planning entities with some enforcement powers, balancing regional interests with national sovereignty

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Key recommendations for practitioners

For policy makers

- Mandate national regulators to oversee national planning processes, and co-ordinate with other regional regulators to develop regional planning processes.
- Where the institutional framework allows, use enforcement powers to incentivise the implementation of regional plans, or delegate enforcement to a regional entity.
- Use regional plans to inform national energy policy planning.
- Agree with participating countries on cost allocation methodologies based on the “beneficiary pays” principle to develop interconnection infrastructure.
- Provide sovereign guarantees for interconnector projects to develop interconnection in early-stage integration regions.
- Set up regional funding mechanisms to support common infrastructure development.

For national energy sector regulators

- Engage with other national energy regulators through regional forums to align planning of regulatory frameworks.
- Develop regional planning methodologies and data co-ordination capabilities progressively.
- Monitor the consistency of regional and national plans.
- Review and validate regional plans in co-ordination with other national regulators, if no central entity has such a mandate.

For planning entities

- Embed national system plans into regional plans, and vice versa.
- Ensure plans are implementable in practice by considering and incorporating constraints, such as economic viability or local limitations.
- Consider both generation and transmission planning together.

- Engage a broad range of stakeholders, including private developers, private market traders/operators and civil society, to validate assumptions and support cost allocation and interconnection priorities.

For financial institutions and development partners

- Support capacity building and technical capabilities for concerned entities to develop regional system plans and collaborate effectively with a common understanding of planning processes and methodologies.
- Facilitate knowledge transfer between regions, particularly regarding methodologies for regional planning.
- Provide opportunities for concessional funding to develop regional interconnection in priority areas.

Key implementation considerations

Interactions between regional and national plans

Regional planning works best when it combines top-down and bottom-up approaches. Bottom-up planning brings in national priorities, while top-down planning identifies regional projects that benefit the overall system. Using both ensures that local needs and regional goals are balanced by embedding local plans into regional plans and vice versa. For example, [SAPP's regional planning methodology](#) compares three planning approaches: an aggregation of national plans, a top-down full integration plan and a blended “realistic” integration plan that considers additional constraints, such as minimum security and reliability criteria for each country and minimum capacity factors for gas and coal plants. Governance can also reflect both bottom-up and top-down perspectives, as seen in Europe, where the planning entity [ENTSO-E brings together national TSOs](#) to serve both national and regional interests.

Capturing interactions between generation and transmission planning

Comprehensive regional planning typically integrates generation and grid investment plans, as well as resource adequacy assessments. Carrying out these exercises at the same time

ensures that transmission expansion plans reflect the expected generation development and vice versa. Many regional initiatives, including the European Union, the Western Power Pool, WAPP, SAPP and SIEPAC, already integrate these processes. The crucial factor is consistency in the use of data, assumptions and scenarios across planning exercises. For instance, in the [EU internal electricity market planning process](#), transmission plans and adequacy studies are aligned by harmonising the scenarios and data used, ensuring coherence and credibility. Regular updates of these plans are essential to keep them relevant as demand, technology and policies evolve.

Financing framework for regional infrastructure

Regional funding mechanisms are effective tools for supporting the financing of regional infrastructure. For example, the [Regional Transmission Infrastructure Financing Facility](#) was set up in SAPP as an innovative blended finance fund to mitigate the inherent high risk and substantial capital requirements of transmission infrastructure projects. In Europe, interconnection projects designated as Projects of Common Interest are eligible for EU public funding. The European Union has allocated a budget of EUR 5.84 billion for energy infrastructure projects, including interconnectors, for the 2021-2027 period.

Building cross-border power markets in Africa: Region-specific challenges and mitigation strategies

Regional power interconnection across Africa holds immense promise for transforming the continent's energy landscape and is fundamental to achieving the ambitious [Mission 300 goal](#) of connecting 300 million people in Africa to electricity by 2030. From the West African Power Pool (WAPP) to the Southern African Power Pool (SAPP), African regional economic communities have prioritised electricity integration as a pathway to lower costs, enhance reliability, deploy renewable energy and strengthen regional co-operation. Given the scale and urgency of Mission 300's objectives, collective action through these regional power pools becomes even more critical, enabling countries to leverage shared resources, optimise cross-border renewable energy potential and accelerate grid connections that would be impossible for individual nations to achieve alone within the Mission 300 timeframe.

Looking further ahead, ambitious long-term visions for African integration, including Agenda 2063, the Continental Power Systems Masterplan, the Ten-Year Infrastructure Investment Plan and the African Single Electricity Market, envisage a single continental system operator and control centre to enhance co-ordination among regional power pools and maximise the continent's energy resource potential, leveraging the strong foundation of existing regional power pools.

However, African governments, utilities and regional power pools face distinctive challenges, such as diverging national priorities, regulatory fragmentation across diverse legal systems, institutional capacity constraints in resource-limited environments and infrastructure financing hurdles in frontier markets. This chapter examines these Africa-specific challenges and presents proven mitigation strategies drawn from successful African experiences and global best practices adapted for the continent's unique context.

Africa-specific manifestations of common power system integration challenges

Experiences across African interconnection efforts reveal how common integration challenges take on distinct characteristics in African contexts, requiring specialised approaches that account for the continent's unique institutional and political realities.

Political and institutional pitfalls

- Attempting to leap into binding treaties without first investing in political trust and stakeholder confidence.
- Excluding key technical actors (e.g. regulators, system operators or utilities) from political negotiations, making agreements difficult to implement given Africa's mixed public-private utility sectors and varying regulatory maturity.
- Failing to align regional goals with domestic economic development priorities, leaving integration vulnerable to political turnover.
- Opaque negotiation processes that undermine public trust and raise legitimate concerns about sovereignty and domestic impacts.
- Domestic political decisions that impact regional commitments, underscoring the need to balance national sovereignty and the stability of regional frameworks.

Technical and operational pitfalls

- Failing to adopt proper regulatory design, creating barriers to investment.
- Rushing physical interconnections without adequate harmonisation of technical standards, risking system instability.
- Neglecting essential communication links and data exchange protocols needed for safe operational co-ordination.
- Underestimating the time and training required to build cross-border operational capabilities.
- Outdated information technology systems limiting market data sharing and access to updated information for market participants.

Market and commercial pitfalls

- Launching regional markets without clear settlement procedures or dispute resolution mechanisms.
- Applying tariff structures or pricing rules that distort trade signals or create unfair cost allocation among participants.
- Implementing sophisticated trading platforms before establishing transparent, standardised market rules suited to Africa's institutional maturity levels.
- Failing to address payment and currency risks that undermine commercial confidence.

Planning and investment pitfalls

- Starting infrastructure development without adequate feasibility studies, particularly environmental and social assessments critical in the African context.
- Proceeding with poorly defined risk allocation between parties, increasing financing costs in already capital-scarce environments.
- Initiating infrastructure development of projects in a regionally adopted plan without updated mandates or newly issued approval letters from the ministries of finance or highest government authorities of the concerned countries.
- Attempting to finance complex projects without access to financial instruments suited to African risk profiles mechanisms suited to African risk profiles, or without adequate regulatory arrangements for allocating and recovering costs.

Deep dive 1: Regulatory fragmentation in the African context

Regulatory fragmentation is one of the most serious and persistent obstacles to developing regional power interconnections. In Africa, this fragmentation reflects deeper historical and institutional realities. Unlike regions with shared legal traditions, African countries operate under diverse legal systems – common law, civil law, Islamic law and customary law – often overlapping within single jurisdictions.

Although regional economic communities, such as the Economic Community of West African States (ECOWAS), Southern African Development Community, East African Community and Common Market for Eastern and Southern Africa, have prioritised electricity exchange in their development agendas, the legal, technical and commercial frameworks that govern national electricity systems remain largely independent and, in some cases, incompatible. This creates unique challenges for regulatory harmonisation.

Key dimensions of regulatory fragmentation

Technical standards divergence

Many African grids operate with incompatible technical standards. Frequency and voltage tolerances, fault-clearing times and reserve margins often differ across countries. This stems from uncoordinated development over decades, influenced by a range of donors and equipment suppliers.

The 2017 WAPP blackout was triggered by a protection failure that cascaded through the region due to inconsistent protection settings. The incident underscored how minor technical inconsistencies can escalate into regional crises, causing costly outages and undermining trust in the system. WAPP responded by accelerating grid code harmonisation through intensive stakeholder consultations, conducting comprehensive operator training programmes to address skills gaps and introducing technical compliance reviews adapted to varying institutional capacities. These measures now serve as a model for preventing similar incidents in the future.

Market structure complexity

African electricity markets span unprecedented diversity, ranging from South Africa's competitive wholesale market to West African state monopolies that subsidise more than 90% of electricity tariffs. This complexity goes beyond typical emerging market challenges, requiring nuanced approaches to cross-border pricing and revenue sharing.

SAPP's experience with wheeling charge disputes illustrates these challenges. Despite being Africa's most advanced power pool, differing tariff methodologies among member states have hindered market growth, demonstrating the need for patient, consensus-building approaches.

Burdensome licensing and permitting

Developers of cross-border infrastructure projects must often navigate complex, duplicative and uncoordinated licensing and permitting processes across participating countries. These processes are typically opaque, politically influenced and time-consuming. It is critical for project preparation and development to have clear and expedited permit regulations.

Jurisdictional ambiguities

A lack of clarity over which laws and jurisdictions govern cross-border infrastructure can create disputes around accountability, enforcement and adjudication. In Africa, regional regulators, such as the ECOWAS Regional Electricity Regulatory Authority (ERERA), often lack the binding authority needed to resolve these disputes effectively, resulting in gaps in oversight that erode the confidence of investors and utilities.

In addition, regional regulators, as well as power pools such as WAPP, have limited influence over high-level political decisions made by ECOWAS heads of state. This was evident when bilateral electricity exchange with coup-affected countries such as Burkina Faso, Mali, and Niger was suspended following sanctions imposed by member states of the Community. This illustrates how political interventions can override regulatory authority, agreements and affect regional electricity market operations and cross-border exchange.

Improved regulatory and legal certainty will enhance project implementation and power trade execution, mitigating risks and reducing costs. This will require regional dialogue to integrate the different legal systems and regulatory frameworks.

Strategies for mitigating regulatory fragmentation

Build trust-based regulatory dialogue

Addressing regulatory fragmentation begins with regular dialogue among national regulatory authorities and stakeholders, facilitated by regional power pools. Solutions should be introduced gradually into existing legal and regulatory structures.

At the same time, technical issues should be addressed through joint regular grid operation planning studies and regional grid codes to align frequency, voltage, protection settings and

reserve requirements. Regional bodies can facilitate training, audits and compliance reviews, as WAPP did after the 2017 blackout, to ensure consistent technical operation and prevent cascading failures.

Develop transitional market frameworks

Market structures should converge step by step, beginning with agreement on common principles for tariffs and revenue-sharing mechanisms. Regional regulators and power pools should lead consultations to develop transitional frameworks that accommodate national differences while promoting fair and transparent cross-border pricing mechanisms.

Licensing and permitting transmission assets are often the most difficult areas, involving multiple jurisdictions and sensitivities over sovereignty. Upon agreement, countries should work towards establishing one-stop regional permitting frameworks to reduce duplication and improve transparency. Regional institutions should also act as focal points to negotiate mutual recognition of licenses and standardise procedures.

Mitigate political risks to regional electricity exchange

To mitigate the impact of political interventions on regional electricity exchange, the authority of regional regulators (ERERA) and power pools (WAPP) should be strengthened through binding mandates and clear operational roles. Trade agreements should include contingency clauses and risk-sharing mechanisms to preserve essential flows during political crises. Independent arbitration and escalation procedures can help resolve disputes while maintaining system stability. Additionally, standardised cross-border operational protocols and regular dialogue among political leaders and technical operators can enhance co-ordination and resilience, ensuring that regional integration is less vulnerable to political disruptions.

Deep dive 2: Institutional capacity in resource-constrained environments

Building institutional capacity represents a critical challenge for African regional integration, where many countries face resource constraints, skills shortages and competing development priorities. Even supportive policies cannot overcome weak institutional foundations.

Key dimensions of institutional capacity constraints

Fragmented mandates and weak governance

Many African countries lack clear institutional mandates for regional interconnection. Responsibilities are dispersed across ministries, regulators and utilities with limited co-ordination capacity, a particular challenge in resource-constrained governments managing multiple development priorities.

Kenya's experience with the Kenya-Ethiopia interconnector illustrates these challenges. Fragmented responsibilities among the Ministry of Energy, the Energy and Petroleum Regulatory Authority, the Kenya Electricity Transmission Company, and the Kenya Power and Lighting Company created co-ordination gaps, overlaps and implementation delays.

Lack of skilled personnel and experience

Utilities, ministries and regulators often lack staff with experience in regional projects, power trading or interconnected grid management. Those who gain expertise may leave for higher-paying opportunities, resulting in institutional knowledge gaps that hinder progress.

Smaller systems struggle the most, as limited resources make it difficult to attract or retain the engineers, planners and negotiators needed for regional engagement. This constrains their ability to participate effectively in regional negotiations or operate interconnections safely and reliably.

Limited data and analytical capabilities

Many African utilities lack adequate monitoring systems, modelling tools and data-sharing protocols necessary for interconnected operations. The absence of harmonised data standards complicates cross-border co-ordination and increases operational risks.

The SAPP competitive market – the only regional market in Africa not relying on bilateral trade agreements – suffers from the lack of a comprehensive online information system for offering market data to participants and allowing them to make efficient power allocation decisions in the short term (day-ahead).

Strategies for mitigating institutional capacity constraints

Designate national focal points

Each country should designate and empower a national focal point for regional interconnection issues. This can help to avoid co-ordination gaps, such as those seen with the Kenya-Ethiopia interconnector. Some regions, like the Southern African Power Pool (SAPP), have worked to encourage member states to designate clear national focal points for cross-border electricity matters.

Build regional structures

Stronger regional alignment and structures are necessary to properly address cross-border issues and effectively manage regional institutions. A bottom-up approach may include the following:

- **Regular stakeholder consultations** to explain the purpose and benefits of regional integration, with communication targeted to different audiences to build broad support.
- **Interministerial committees** to align national stakeholders and maintain continuity. Meetings should be held regularly, with monitoring of the implementation of decisions taken.
- **Delegated authority to regional institutional secretariats**, with supranational enforcement power and accountability. SAPP has empowered its regional secretariat through a robust governance system.

Invest in capacity development

Regional integration cannot succeed without adequate capacity building at both the regional and national levels. Stakeholders need training in negotiations, regional market operations and grid management. Mentorship and exchange programmes with more experienced regional operators in Africa and beyond are an important and underused resource. Equally important

are staff retention plans that enhance job attractiveness through clear career progression pathways, continuous training opportunities, and competitive compensation to prevent brain drain of skilled personnel.

Develop data infrastructure

Data platforms and standardised reporting protocols should be developed to facilitate regular information sharing between regional bodies and market participants (countries, utilities and traders). SAPP is addressing the previously identified systems gaps through improvements to its IT systems and updated online information.

Deep dive 3: Financing hurdles in African markets

Regional interconnections require significant upfront investment, involve long payback periods and carry high perceived risks. Weak preparation, poor creditworthiness due to utilities' weak financial standing and political uncertainty make financing difficult and expensive. Without innovative financial solutions and strong preparation, many promising projects remain stalled. Additionally, regional interconnections often create a mismatch where the countries required to build and operate the infrastructure are not necessarily the primary beneficiaries of the resulting electricity exchange, further complicating investment decisions and cost-sharing arrangements.

Key dimensions of infrastructure financing challenges

Utility financial weakness and unequal benefits

A major financing challenge is the weak financial standing of many African utilities, which often operate at significant losses and depend on government subsidies. This undermines their ability to secure financing, even for projects with strong economic justification.

Regional interconnections can also create unequal benefits. The countries financing and operating infrastructure may not be the primary beneficiaries of the increased exchange. For example, transit countries bear infrastructure costs, while destination markets capture most of the economic benefits, complicating cost recovery and investment justification.

Complex transmission asset ownership

Transmission ownership varies across Africa, from state-owned entities like South Africa's Eskom to mixed public-private arrangements. Each approach brings different challenges:

- **State-owned transmission** can improve creditworthiness through government backing but may limit commercial flexibility and efficiency.
- **Private transmission companies** may bring commercial expertise but require clear regulatory frameworks and revenue certainty for cross-border investments.
- **Mixed models** require careful stakeholder co-ordination between public policy objectives and private commercial interests.

Successful regional projects must engage all relevant transmission companies, whether state-owned or private, as critical stakeholders throughout project development, not just as technical implementers.

Weak project preparation} Timing and prioritisation challenges

Many projects in Africa launch without thorough feasibility studies or clear risk allocation frameworks. [The Tanzania-Zambia Interconnector](#) illustrates these challenges. Initial studies began in the early 2000s, but slow procurement, institutional turnover and limited national utility capacity delayed financial close until 2025. Without careful prioritisation and timely progression from studies to construction, projects face the dual risk of outdated technical assessments and loss of investor confidence.

Poorly drafted contracts that fail to clearly allocate risks between parties exacerbate the problem, as investors tend to price in higher risk premiums or abandon projects altogether. Stronger project preparation can thus help to mitigate the perceived risks and improve access to capital.

Limited access to financing

National budgets face competing development priorities, utilities lack creditworthiness and clear revenue frameworks, and private investors are wary of political instability and currency risks – all of which severely constrain available capital. Currency mismatches, where debt must

be paid in a foreign currency while revenue is earned in the local currency, expose utilities to significant financial risk, compounded by limited access to foreign currency and exchange rate volatility.

Even when financing is secured, it is often short-term, expensive and mismatched with the long lifespans of interconnection assets. This undermines the financial feasibility of projects and can discourage future regional co-operation. New financial instruments to attract private capital are needed to close the financing gap.

Strategies for mitigating financing challenges

Improve project preparation and prioritisation

Strong project preparation is essential for securing financing and successfully implementing regional power projects. While thorough preparation requires upfront investment from governments and utilities, it delivers better long-term value by reducing project risks and implementation costs. In Africa, effective project preparation requires structured approaches and proper monitoring of progress to ensure studies remain current and focus limited resources.

Projects should meet minimum preparation standards. These should include comprehensive feasibility studies covering technical, economic, environmental and social assessments that remain current within 3-5 years of financial close. These studies must also incorporate clear benefit-sharing frameworks that address how gains will be distributed among participating countries, particularly important given that infrastructure costs and economic benefits are often unequally spread across borders. Projects also require detailed risk assessments that specify how risks will be allocated between public and private stakeholders, including transmission companies. Robust financial modelling should account for utility creditworthiness and government guarantee structures. Throughout this process, comprehensive stakeholder mapping and engagement plans must involve all relevant parties, including transmission companies, regulators and civil society.

Strengthening preparation processes involves developing prioritisation frameworks using consistent criteria, such as economic-benefit analysis, strategic value-add, technical feasibility and financial assessment. This approach helps focus limited preparation resources

more effectively. Projects should follow phased development approaches that progress from pre-feasibility to detailed studies only for priority initiatives. This avoids wasting resources on initiatives unlikely to proceed while ensuring that viable projects receive the thorough preparation needed for successful implementation.

Strengthen utility financial health and benefit sharing

Addressing utility creditworthiness requires multiple co-ordinated approaches. Government guarantees and letters of credit can provide safety nets for utility payment obligations, while blended finance structures reduce risks for private lenders by mixing public and private funding. Regional guarantee mechanisms offer additional support by pooling risks across multiple utilities, creating stronger collective creditworthiness than individual utilities can achieve alone. Over time, targeted capacity-building programmes can strengthen financial management within utilities, addressing underlying weaknesses.

Benefit-sharing mechanisms must evolve to ensure the equitable distribution of regional integration gains across all participating countries. Fair distribution requires upfront agreement on how investment costs will be shared among participating countries based on their expected benefits from the interconnection. Each country can then recover its agreed portion through its own domestic regulatory framework and tariff structures. Regional solidarity funds can provide additional mechanisms to redistribute economic gains from electricity exchange to countries that invest heavily in transmission infrastructure. Joint ownership structures help align incentives across participating countries, supported by revenue-sharing agreements that distribute returns based on the actual economic benefits rather than simply where the infrastructure is located. While transit fees and wheeling charges may seem like obvious solutions, they should be used sparingly. These charges are primarily justified for transit countries that host transmission infrastructure but gain no access to cheaper electricity from neighbouring countries. However, widespread use of transit fees risks creating “tariff pancaking”, where multiple fees accumulate across borders and discourage the very electricity exchange that regional integration seeks to promote.

Leverage African development finance institutions

African development finance institutions provide the essential foundation for regional power financing. For example, the NEPAD Infrastructure Project Preparation Facility, established in

2002 and hosted by the African Development Bank, was created to support African countries, regional economic communities, specialised agencies and related institutions with grants for the preparation of high-quality infrastructure projects that will attract financing from public and private sources. As a testament to its success, between 2004 and 2022, the facility approved 106 grants totalling USD 115 million, bringing in investment financing of USD 11.4 billion.

More recently, the [Alliance for Green Infrastructure in Africa](#) launched two complementary facilities: a USD 100 million Project Preparation Facility to support upstream project preparation activities through grants, and a USD 400 million Project Development Fund that uses blended finance for project development. The Project Development Fund achieved its first close at USD 118 million in August 2025, with the African Development Bank contributing USD 40 million, comprising USD 20 million in grants, USD 10 million in commercial equity and USD 10 million in junior equity from the Sustainable Energy Fund for Africa. Both facilities focus on power infrastructure and renewable energy projects as part of the broader initiative to mobilise USD 10 billion in transformative infrastructure investments across Africa.

Develop regional financing mechanisms

Regional financing mechanisms can be tailored to the characteristics of specific power pools to address challenges. [SAPP's announced Regional Infrastructure Financing Facility](#) exemplifies this approach as the first regional power pool to partner with fund managers for project development. The facility focuses exclusively on regional interconnection projects while maintaining African institutional control through SAPP's participation, demonstrating how regional bodies can create specialised financing vehicles that attract private capital while serving continental development objectives. These regional mechanisms should adapt to the specific characteristics of each power pool. For instance, WAPP's fragmented market structure requires different approaches than SAPP's more integrated trading arrangements.

The European Union's [Connecting Europe Facility](#) demonstrates how effective regional financing mechanisms operate in practice. Since its establishment in 2014, the facility has supported cross-border Projects of Common Interest through grants, guarantees and blended finance, and crucially gone beyond capital provision by funding project preparation studies, standardising cost-benefit analyses and streamlining cross-border permitting processes. Its success with interconnection between the Baltic states and Nordic grids, where public

investment reduced risk and attracted private capital, illustrates the catalytic potential that African regional mechanisms like SAPP's Regional Transmission Independent Facility could achieve. This European precedent shows how regional bodies can create specialised financing vehicles that address the unique coordination challenges of cross-border infrastructure while maintaining institutional control and adapting to specific regional characteristics.

Build local capital market participation

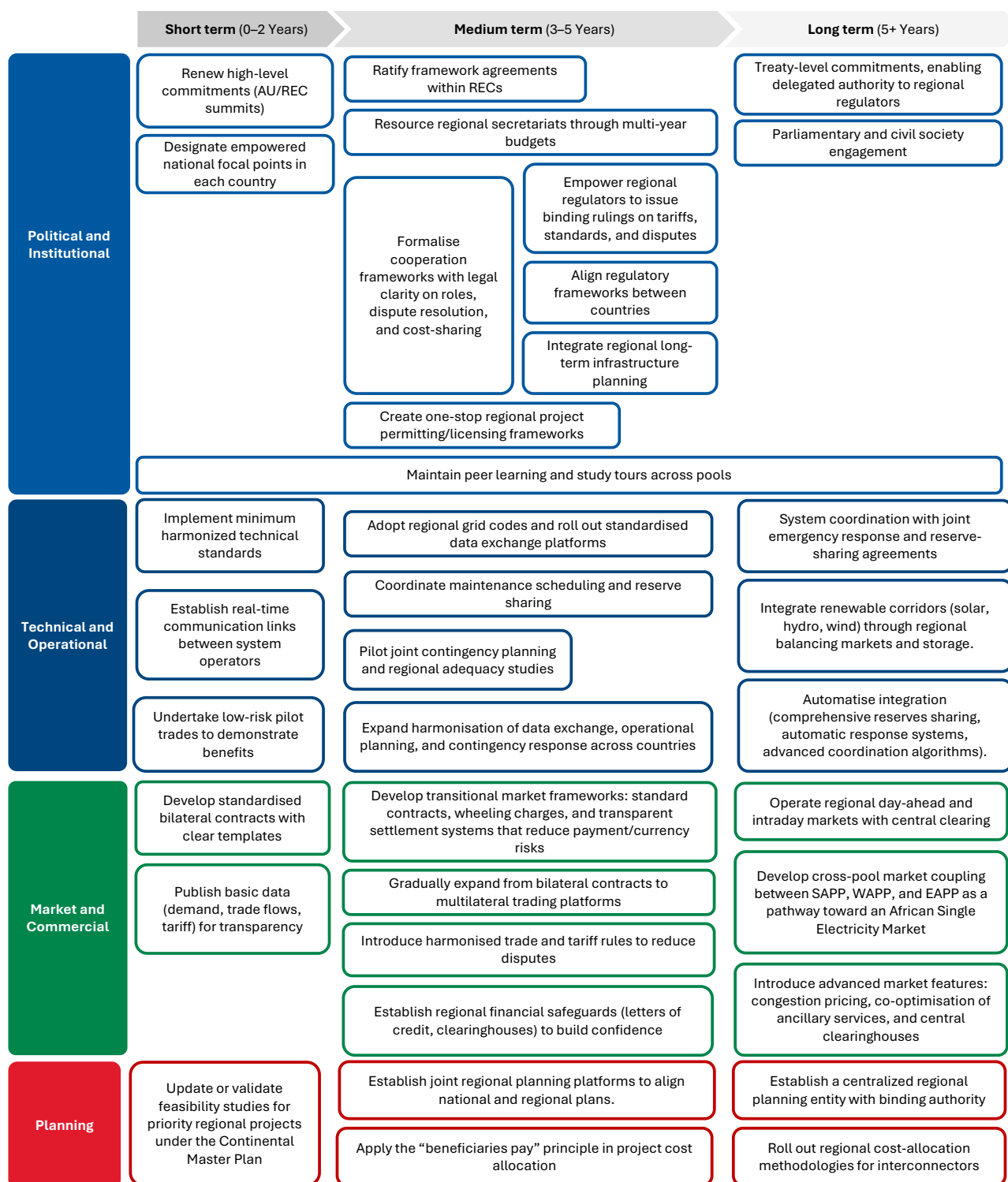
Local capital market participation facilitates long-term financing capacity and mitigate currency risks. [Nigeria's InfraCredit](#) illustrates the potential for mobilising domestic institutional investors towards infrastructure financing, although it is not exclusively focused on interconnectivity. Despite challenging economic conditions, it has successfully attracted 18 pension funds to finance 22 infrastructure projects since 2017 through financial guarantees. The model combines financial support from the Nigerian Sovereign Investment Authority with development partner support to enhance project creditworthiness while deploying local currency long term financing. Expanding such approaches across Africa requires regulatory adjustments and risk mitigation strategies to make infrastructure investments attractive to domestic pension funds, insurance companies, financial investors and other institutional investors.

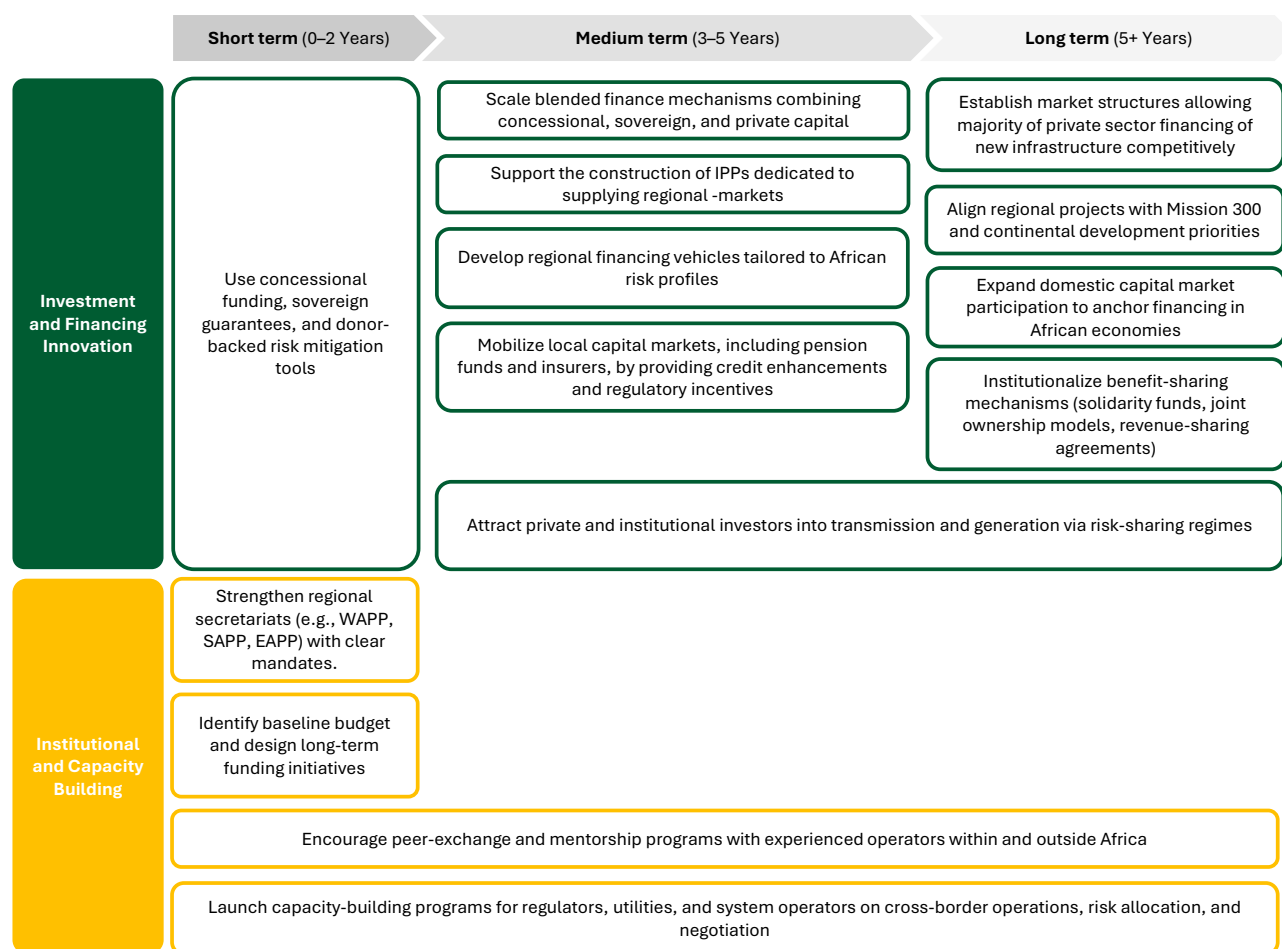
Staged implementation for the African context

Africa's regional power integration journey is characterised by high ambition, immense opportunities and persistent structural challenges. While political will exists – reflected in the African Union's Agenda 2063, the Programme for Infrastructure Development in Africa and regional pool initiatives such as SAPP, WAPP, EAPP and CAPP – countries remain at different starting points with varying institutional capacities and integration depth. A pragmatic phased roadmap is essential to ensure steady progress.

This section outlines roadmaps for staged implementation pathways in Africa, linked to immediate (0-2 years), medium-term (3-5 years) and long-term (5+ years) actions. It adapts the general framework of early, shallow and deep integration to Africa's realities: fragmented regulations, weak utility finances, financing constraints and political sensitivities.

Proposed roadmap for the staged development of regional market integration in Africa





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For Africa, the pathway to regional power integration is not linear but must be sequenced. Immediate actions should focus on political trust, technical safety and pilots. Medium-term reforms strengthen institutions, harmonise standards and deepen markets. Long-term ambitions aim to deliver treaty-based, fully coupled regional power markets. By following this staged approach, Africa can progressively unlock the economic, reliability and clean-energy benefits of regional power exchange while ensuring ownership, inclusivity and resilience.

Conclusion

Africa's regional interconnection ambitions face serious regulatory, institutional and financial challenges. Yet, experience shows that these barriers can be overcome through deliberate, sustained reforms and political will.

Regional and national actors must commit to structured dialogue, co-ordinated planning and targeted capacity building to translate political vision into functional, resilient systems. Equally

essential is securing financing and implementing alternative financial structures that are not fully reliant on sovereign guarantees. This hinges on better project preparation, innovative financial instruments and mechanisms to manage risk. Existing tools and frameworks such as [PPIAF's Power Transmission Risk Allocation Tool](#) can provide guidance on risks typically found in a power transmission transaction and how they can be allocated between involved parties. Above all, progress depends on strong governance with clear mandates and empowered and efficient regional bodies.

Regional scorecards, such as the African Development Bank's [Electricity Regulatory Index](#) and the World Bank's [Regulatory Indicators for Sustainable Energy](#), offer structured diagnostic tools and benchmarking to assess regulatory readiness, policy effectiveness and institutional maturity across electricity markets. These benchmarks help identify gaps and guide reforms, offering policy makers and investors data-driven insights into how to prioritise reforms, overcome barriers and achieve least-cost regional power exchange that supports Africa's development goals.

Encouragingly, several initiatives are gaining momentum across the continent. [The African Continental Master Plan \(CMP\)](#) provides a strategic framework for infrastructure development, whilst programmes like the [Africa Single Electricity Market \(AfSEM\)](#) through CEPA are building the technical and regulatory foundations for integration. These efforts demonstrate growing commitment and provide practical pathways forward.

The convergence of political will, proven diagnostic tools, innovative financing mechanisms, and emerging continental initiatives creates an unprecedented opportunity for Africa's power sector transformation. Success will require sustained co-ordination between regional bodies, national governments, and development partners, but the potential rewards such as enhanced energy security, economic growth, and improved quality of life for millions, justify the effort required to turn this vision into reality.

Recommendations and the way forward

Regional power interconnection delivers transformational benefits when implemented strategically with sustained political leadership, robust institutions and progressive market development. Success requires implementing a pragmatic, phased approach that builds trust and capabilities over time, rather than attempting complex integration all at once.

The following success factors synthesise lessons learned from the regional integration experiences examined throughout this booklet. They distil common patterns and critical requirements that appear consistently across different governance models, technical approaches and implementation challenges. Based on international experience, successful regional interconnection requires simultaneous attention to these essential elements.

Seven critical success factors for regional integration

1. **Champion political leadership:** Secure sustained commitment from heads of state and ministers who can overcome political inertia, build trust among countries and maintain momentum through electoral cycles and economic challenges.
2. **Build institutional capacity:** Establish clear institutional roles and co-ordination mechanisms that evolve from informal co-operation to binding regional authority as integration deepens and stakeholder confidence grows.
3. **Prioritise essential technical foundations:** Start with critical safety standards and interoperable data exchange, then gradually harmonise operational procedures as systems gain experience with cross-border co-ordination.
4. **Develop markets incrementally:** Begin with simple bilateral contracts to prove commercial viability before advancing to transparent multilateral platforms with sophisticated price formation and settlement mechanisms.

5. **Match financing to integration maturity:** Deploy concessional financing and guarantees for early-stage projects, transitioning to blended finance and private investment as markets mature and regulatory frameworks strengthen.
6. **Align planning frameworks:** Harmonise technical standards, planning tools and assessment methodologies to enable joint system studies and co-ordinated regional infrastructure project preparation and development.
7. **Prioritise sound regulatory content:** Ground all regulatory frameworks in proven international practices, recognising that strong institutions and harmonised procedures cannot compensate for poor regulatory design that discourages private investment and cross-border exchange.

These success factors are interdependent. Political leadership enables institutional development, which facilitates technical harmonisation, which supports market evolution, which attracts appropriate financing. Regions that attempt to skip foundational steps or implement all elements simultaneously often face delays, cost overruns and stakeholder resistance that can set back integration efforts by years.

Stakeholder-specific guidance

While the five success factors apply universally, different stakeholders should prioritise specific aspects of the framework based on their roles and responsibilities:

Policy makers play the essential role of creating and sustaining momentum for regional integration. The chapter on political will provides guidance on building sustained commitment and managing stakeholder engagement, while the implementation framework tables throughout the booklet illustrate what effective political leadership looks like at each integration stage. Case studies demonstrate how political champions have successfully driven integration despite inevitable challenges.

Energy sector regulators must navigate the complex task of harmonising frameworks while preserving national sovereignty. The chapter on institutional frameworks presents proven governance models and regulatory co-operation mechanisms, while the chapter on technical standards provides practical approaches to harmonisation that balance co-ordination benefits

with existing infrastructure realities. The chapter on Africa-specific challenges proposes strategies for overcoming regulatory fragmentation drawn from the regional context.

System operators and utilities are responsible for the day-to-day reality of cross-border co-ordination. The chapter on technical standards details operational co-ordination and data exchange requirements essential for safe interconnected operations, while the market development chapter explains how commercial arrangements should evolve alongside technical capabilities. The implementation framework tables specify the technical requirements at each integration stage.

Planning authorities and infrastructure developers must co-ordinate investments across multiple jurisdictions while managing complex financing challenges. The chapter on planning and investment provides tools for co-ordinated regional planning and appropriate financing strategies, while the Challenges chapter addresses institutional capacity constraints and innovative financing mechanisms. Case studies illustrate successful approaches to infrastructure financing and risk mitigation.

Development partners and donors can maximise their impact by aligning support with integration maturity levels. The financing approach columns in implementation framework tables specify stage-appropriate instruments and risk mitigation strategies, while the chapter on Africa-specific challenges details innovative mechanisms for addressing financing hurdles. Regional adaptation considerations guide context-specific support approaches for different types of regions.

Implementation framework

The following table presents a structured implementation framework for regional integration, recognising that most regions today are operating in the early-to-mid stages and may require 15-20 years to achieve deep integration. Each phase builds on previous achievements while introducing new capabilities and co-ordination mechanisms to support continuing progress.

Implementation framework

Integration stage	Political focus	Institutional priorities	Technical requirements	Market development	Financing approach	Success metrics
Early	- High-level political endorsements - International forum support - Stakeholder engagement - Identification of political champions	- Regional co-ordination platforms - National focal points - Technical committees - Data-sharing protocols	- Communication links between control centres - Basic emergency protocols - Compatible protection settings - Real-time monitoring	- Bilateral contracts with clear terms - Standard contract templates - Transparent pricing data - Simple settlement procedures	- Concessional funding - Sovereign guarantees - Project preparation facilities - Grant-based capacity building	- Political declarations signed - Co-ordination bodies operational - Basic data exchange functioning - First bilateral exchanges completed - Project preparation facility established
Shallow	- Binding treaties and protocols - Regular ministerial summits - Embedded co-operation mechanisms - Crisis resilience frameworks	- Regional regulatory authority - Dispute resolution mechanisms - Joint planning entities - Enforcement capabilities	- Harmonised grid codes - Standardised data exchange - Co-ordinated maintenance - Common contingency analysis	- Shallow market integration - Transparent capacity allocation - Regional tariff methodology - Multilateral co-ordination	- Blended finance mechanisms - Regional infrastructure funds - Risk-sharing instruments - Credit enhancement	- Regional regulator established - Harmonised grid codes adopted - Day-ahead markets operating - Infrastructure plans being implemented - Regional infrastructure fund operational
Deep	- Supranational elements - Advanced co-ordination - Adaptive legal mechanisms - Long-term sustainability planning	- Binding decision-making powers - Independent financing - Performance monitoring - Continuous improvement of institutional mandates to reflect market and system evolution	- Comprehensive reserve sharing - Automatic response systems - Advanced co-ordination algorithms - Integrated monitoring	- Deep market integration - Real-time optimisation - Central counterparty clearing - Sophisticated risk management	- Private investment leadership - Market-based financing - Advanced financial instruments - Competitive infrastructure development	- Binding regional authority functioning - Automatic emergency response operational - Private investment financing the majority of new infrastructure - Quantifiable economic benefits delivered - Regional market fully integrated

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Regional power interconnection represents one of the most impactful investments countries can make in their energy future, but success requires treating it as a long-term institutional and political process rather than a purely technical challenge. The benefits of enhanced energy security, reduced costs, accelerated clean energy deployment and strengthened regional co-operation should be commonly understood and compelling enough to justify the sustained effort required.

Regions that invest systematically in political foundations, institutional capacity, technical harmonisation, market development and appropriate financing can achieve transformational results. The European Union's internal energy market's EUR 34 billion in [annual consumer benefits](#) (2022 figures), USD 258 million (2023 figures) reported savings by the [Gulf Electrical Interconnection](#), the Nordic energy market's integration of renewable energy at scale, Africa's growing cross-border exchange through SAPP and North America's Western Energy Imbalance Market with [over USD 7 billion in benefits from just day-ahead market integration](#) demonstrate what sustained commitment can accomplish.

Regional co-operation has evolved from being beneficial to becoming essential for achieving national energy objectives efficiently and cost-effectively. By following the principles and practices outlined in this booklet, regions can harness the transformational power of interconnection while building institutional foundations that will outlast their creators and provide stable co-operation frameworks for decades to come.

Annexes

Annex A. Regional institutional development timeline

Regional institutional development timeline

Region	Phase 1: Basic co-ordination	Phase 2: Formal institutions	Phase 3: Mature governance
EU internal electricity market	1951: Coal and Steel Community co-ordination	From 1990s: EU electricity directives to 2003: Regional regulatory frameworks	2009: ACER established to 2015: ENTSO-E network codes
Nordic Electricity Market	1991: Norway-Sweden TSO co-operation	From 1996: Nord Pool market operator to 2000s: Regulatory co-ordination	2009: NordREG formal co-operation to 2015: Integrated governance
SAPP	1995: Utility co-ordination committee	From 2001: SAPP Coordination Centre to Day-ahead market operation	From 2015: Forward market development to Ongoing: Regional Energy Regulators Association of Southern Africa mandate evolution
ECOWAS	1999: WAPP Secretariat established	From 2006: ECOWAS Energy Protocol to 2008: ERECA with binding powers	2017: WAPP mandate expansion > Ongoing: Institutional strengthening

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EU = European Union integrated energy market. The Nordic Electricity Market includes Denmark, Norway, Sweden and Finland.

Annex B. Regional power integration governance models: Case studies

Model 1: Voluntary co-ordination

The Southern African Power Pool (SAPP) exemplifies how co-ordination models can function effectively even without binding regulatory authority. It applies a governance framework often considered self-regulated, as the Regional Energy Regulators Association of Southern Africa

(RERA) has no power to establish or enforce regulations. Participating countries must agree with one another on market and transmission rules, and RERA's mandate is limited to furthering SAPP's development while encouraging regulatory harmonisation and capacity building in member countries.

As one of the most advanced regional power markets in Africa, SAPP demonstrates that market development is not proportional to the amount of power granted to regional institutions. It facilitates cross-border electricity trading, manages a competitive day-ahead market (the only functioning one in Africa) and oversees infrastructure projects through voluntary co-operation and consensus-building among members. The organisation has evolved through co-ordinated voluntary participation and agreed functional expansion.

However, RERA's advisory-only mandate has limited SAPP's ability to enforce harmonisation or resolve disputes authoritatively. Discussions are ongoing about expanding RERA's authority, illustrating the natural evolution from co-ordination towards more binding arrangements as institutional trust and the benefits of integration become more evident.

Model 2: Evolution from advisory to binding authority – regulated co-ordination

The Central American Electrical Interconnection System (SIEPAC) provides a clear example of how regional integration can evolve into a framework with binding regulatory authority. Initiated in the 1990s, SIEPAC aimed to connect the power systems of six Central American countries – Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua and Panama – through a shared transmission network and a regional electricity market. In its early phase, the initiative relied on intergovernmental co-ordination and bilateral agreements, with limited formal oversight of cross-border electricity exchanges.

A decisive institutional shift occurred with the signing of the Framework Treaty for the Central American Electricity Market, which created the Regional Electricity Market and established the Regional Commission for Electrical Interconnection (CRIE). Unlike advisory bodies, CRIE was granted supranational authority to regulate the regional market, approve legally binding rules, resolve disputes and oversee cross-border tariff frameworks. Today, CRIE operates as an

independent regulator with enforcement powers across all six countries, ensuring transparent market operation and regulatory consistency.

This progression from loosely co-ordinated interconnection to a rules-based, binding regional governance structure illustrates how sustained political will and legal instruments can transform regional power co-operation into a fully integrated institutional system. Governments can strengthen institutional arrangements progressively, moving from informal co-operation towards semi-formal structures that lay the groundwork for deeper market integration and future regulatory harmonisation.

Model 3: Sophisticated multi-tier systems – supranational integration

Europe's institutional development demonstrates how sophisticated regulatory frameworks can evolve over decades through sustained political commitment and adaptive governance. The Agency for the Cooperation of Energy Regulators (ACER) and the European Network of Transmission System Operators for Electricity (ENTSO-E) form a two-tier regulatory system that balances EU-wide oversight with technical execution.

ACER serves as the primary EU-level regulator overseeing ENTSO-E, ensuring compliance with European electricity market rules. It monitors ENTSO-E's operations and development plans, resolving disputes between ENTSO-E's countries and reviewing transparency and market reports to prevent anti-competitive practices. ENTSO-E develops and enforces common grid codes and technical standards, co-ordinates system operation and security, facilitates cross-border electricity exchange, supports market integration and plans future transmission infrastructure through the European Union's Ten-Year Network Development Plan.

This sophisticated structure promotes a secure, competitive and sustainable electricity market, though evolving energy transitions demand continuous regulatory adaptation. The European experience demonstrates that comprehensive harmonisation requires sustained political commitment, strong institutional frameworks and the ability to adapt approaches as integration deepens, while maintaining flexibility for diverse national circumstances. These components of the institutional framework may not be developed in earlier stages of regional market integration.

Annex C. Regional power integration governance models – comparative analysis

Comparative analysis of regional power integration governance models

Governance element	SAPP model	ECOWAS model	SIEPAC model	Nordic model	EU model	Key success factor
Stakeholder representation	Utilities lead, regulators co-ordinate, governments oversee	Governments lead, regulators implement, utilities participate	Mixed governance with private sector participation	Market-based with regulatory oversight	Multi-tier: national regulators and EU institutions	Clear role definition prevents institutional conflict
Decision-making process	Consensus for policy, majority for operations	Political consensus for major decisions, technical delegation for implementation	Weighted voting based on participation levels	Voluntary co-operation with regulatory backup	Legal framework with qualified majority and consensus rules	Match the decision process to decision type
Accountability mechanism	Peer pressure and voluntary compliance	Political oversight through ECOWAS structures	Independent monitoring and reporting	Market discipline and regulatory oversight	Multi-level accountability to national and EU authorities	Balance independence with accountability
Conflict resolution	Escalating procedures: negotiation → mediation → arbitration	Dual track: technical arbitration (ERERA) and political mediation (ECOWAS)	Binding decisions by the regional regulator with appeal procedures	Market-based solutions with regulatory arbitration	Binding decisions by ACER with Court of Justice appeals	Appropriate expertise for the conflict type

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The SAPP experience demonstrates how utility-led governance can work effectively when supported by clear voluntary agreements and peer pressure mechanisms. SAPP's Executive Committee operates through consensus for major policy decisions but uses majority voting for routine operational matters, preventing individual members from blocking day-to-day market functioning while ensuring no utility is forced to accept fundamental changes it cannot support.

The Nordic model across Denmark, Norway, Sweden and Finland illustrates how market-based co-ordination can evolve into effective regional governance without requiring supranational institutions. Nord Pool's governance relies on voluntary co-operation among national TSOs and market participants, supported by compatible national regulatory frameworks. When conflicts arise, national regulators can intervene, but the system generally operates through market discipline and technical co-operation rather than binding regional authority.

The European Union represents the most advanced example of multi-stakeholder governance, combining national regulatory authorities (through ACER), TSOs (through ENTSO-E) and EU-level political institutions. This multi-tier structure ensures representation for different stakeholder groups while maintaining clear decision-making authority. ACER provides regulatory co-ordination, ENTSO-E handles technical co-ordination and the European Commission ensures political oversight, with each institution having clearly defined roles that prevent institutional conflicts.

The ECOWAS model shows how political leadership can drive regional integration while delegating implementation authority to technical institutions. Major institutional decisions like establishing WAPP and ERERA required political consensus at the level of heads of state, but day-to-day implementation is delegated to specialised institutions with appropriate technical expertise.

SIEPAC's governance structure includes weighted voting mechanisms where countries' influence reflects their participation in regional infrastructure and markets, combined with different decision-making procedures depending on the type of decision being made.

Annex D. Comparative overview of technical and operational standards harmonisation

Harmonisation progress across regional power markets

Harmonisation element	EU internal energy market	SAPP	SIEPAC
Equipment settings			
Voltage	Standardised 400 kV/220 kV levels with advanced reactive power optimisation	Multiple levels (765 kV, 533 kV, 400 kV, 330 kV, 220 kV) with basic reactive power	Standardised 230 kV alternating current (AC) backbone with co-ordinated reactive power compensation
Frequency	50 Hz synchronous operation (AC + selective high-voltage direct current) with co-ordinated automatic generation control (AGC) and shared reserves across 27 countries	50 Hz regional operation (AC + high-voltage direct current where needed) with manual frequency control, developing AGC across 12 countries	60 Hz synchronous operation (AC backbone), developing co-ordination for AGC across six countries
Protection	Co-ordinated wide-area protection with IEC 61850 standards	Developing co-ordination with mixed legacy and modern systems	Co-ordinated protection with standardised digital relays
Day-to-day operation procedures			
Communication	Direct links with standardised Inter-Control Center Communications Protocol (ICCP)/Common Information Model protocols via regional security co-ordination centres	Basic links via the SAPP Coordination Centre, developing ICCP	Direct links with standardised ICCP protocols via independent system operator (Regional Operating Entity)
Monitoring and data sharing	Real-time grid monitoring with Phase Measurement Units and Wide Area Monitoring Systems	Basic SCADA systems, limited PMU deployment	Real-time Supervisory Control and Data Acquisition monitoring systems
Operational co-ordination	Market coupling, automated balancing platforms and reserve-sharing agreements	Manual procedures, developing reserve-sharing agreements and automation	Co-ordinated scheduling, dispatch and regional-reserve sharing agreements

Harmonisation element	EU internal energy market	SAPP	SIEPAC
Standards, rules and methodologies			
Normal operation	Harmonised operating procedures and deviation standards	SAPP Grid Code established, country variations remain	Regional operating procedures and co-ordinated standards
Contingency	Co-ordinated N-1 security assessments across all systems	Basic N-1 analysis, limited cross-border co-ordination	Regional N-1 and N-2 security assessments
Emergency	Joint emergency procedures, system restoration and reserve-sharing agreements	Basic emergency procedures, developing reserve agreements	Joint emergency response with 30-minute restoration target
Overall	Advanced harmonisation – common grid codes, synchronised standards across 27 countries, unified technical requirements	Developing harmonisation – SAPP Grid Code established, working towards common standards, but still country-specific variations	Good harmonisation – regional technical standards, co-ordinated procedures across six countries, standardised 230 kV system

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Annex E. Comparison of regional planning frameworks

Regional planning frameworks across regional power markets

	South African Power Pool (SAPP)	West African Power Pool (WAPP)	Central America (SIEPAC)	EU internal energy market	Western Power Pool
Planning entity	Decentralised (national TSOs)	Centralised (ECOWAS)	Centralised (Regional Operating Entity - EPR)	Centralised (ENTSO-E)	Centralised (Western Power Pool)
Regional entity powers	Informative	Binding powers but no enforcement power	Central entity in charge of implementation (EPR)	Some binding powers (EU law, ACER)	Informative
Scope	Generation and transmission	Generation and transmission	Generation and transmission	Generation and transmission	Generation and transmission
Planning methodologies	Not harmonised	Not harmonised	Not harmonised	Harmonised	Not harmonised
Infrastructure decisions	National level	Regional entity implementation	Regional entity implementation	National level	National level
Cost allocation	Common tariff methodology	Common tariff methodology, bilateral agreements	Common tariff methodology	Standardised methodology	Common principles
Source of funding	Regulated tariffs, development banks, regional funding	Regulated tariffs, development banks	Regulated tariffs, development banks	Merchant, regulated tariffs, regional public funding	Merchant, regulated tariffs, regional public funding

Annex F. Public and concessional financing instruments

Regional interconnections require significant upfront investment, long payback periods, and face high perceived risks. Without financial solutions and strong preparation, many promising projects remain unimplemented. A summary of alternative concessional financing options for preparation and construction is set out below.

Public and Concessional Financing Instruments

Instrument	Purpose	Example Use Case
Guarantees	De-risk private capital by covering political, regulatory, or payment risk	Partial Risk Guarantee to backstop utility off-take in fragile markets
Blended Finance	Combine public/concessional funds with private investment to improve bankability	Using donor grants to subsidise interest rates or absorb first-loss tranches
Sovereign Guarantees	Backstop payments or obligations by national governments	National government guarantees for state-owned utility loan repayment
National Funding Envelopes	Allocate country-level funding windows from regional or multilateral programmes	EU-style national envelopes for energy integration or digital infrastructure
Results-Based Financing	Link disbursement to verified outputs or milestones	Disbursement of funds only after commissioning a new cross-border substation
Climate Finance	Tap into global funds to address mitigation/adaptation goals	Green Climate Fund co-financing a renewable energy corridor
Project Preparation Facilities	Cover early-stage costs (feasibility, E&S studies, legal structuring)	NEPAD-IPPF or EU CEF funding for bankable project documentation

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Case studies

European internal energy market: A deep integration example

Political will and leadership

Europe's integration demonstrates how embedding co-operation in binding treaties creates political durability across electoral cycles. When oil crises hit in the 1970s, Europe used crisis momentum to deepen rather than fragment integration. The Ireland-Northern Ireland market surviving Brexit intact shows how sustained political commitment can overcome complex challenges when co-operation delivers clear benefits to stakeholders.

Institutional frameworks and governance

Europe also has the challenge of creating effective cross-border authority without countries losing control over their domestic energy systems. ACER can issue binding decisions on cross-border disputes, but only when national regulators disagree and only on cross-border issues. This gives regional authority actual power while preserving national control over domestic policy. ENTSO-E co-ordinates transmission across 27 countries despite having no enforcement powers, succeeding through technical competence and legal backing. The Single Electricity Market Committee demonstrates how joint regulatory oversight can work across different jurisdictions within the EU framework. Europe avoided institutional conflicts by clearly separating EU cross-border authority from national domestic control.

Technical standards and operations

ENTSO-E develops common grid codes, co-ordinates investment planning and supports market coupling across 27 countries. Common contingency analysis (N-1 security assessments) treats interconnected systems as a unified entity during emergencies, enabling automatic system response across borders. Progressive harmonisation allowed countries to adopt practices at different paces while maintaining minimum baselines, showing how flexible governance enables gradual standards adoption while safeguarding system stability.

Market development and commercial arrangements

Market-coupling mechanisms automatically optimise electricity flows across borders while respecting transmission constraints – the key innovation enabling European integration. Day-ahead and intraday markets with transparent price formation operate across the region. Central clearing through the European Energy Exchange and the European Energy Clearing demonstrates how advanced financial architecture underpins efficient cross-border markets, minimising counterparty risk while enabling over 1 000 TWh of annual trading. Congestion management with efficient price signals allows the system to handle surplus renewable energy in one country flowing to meet demand in another. Multiple market operators operate under common regulatory framework while flexible arrangements like the Single Electricity Market maintain European integration despite geographic isolation and unique characteristics.

Planning and investment

The Projects of Common Interest process transforms infrastructure from national planning into regional optimisation. Binding interconnection targets drive measurable progress – 14 countries exceeded their 2030 targets by early 2025. The Connecting Europe Facility provides EUR 5.84 billion in dedicated funding using blended public-private financing. The “beneficiary pays” principle ensures fair cost allocation, essential for avoiding overinvestment and gaining acceptance for new interconnector investments. The European Investment Bank provides long-term capital that enables private investment without market distortion. The United Kingdom’s cap and floor regulatory regime demonstrates effective investment risk mitigation by guaranteeing minimum revenue levels while capping excess profits, proving effective in attracting private capital to critical interconnector projects by addressing revenue volatility concerns.

Key lessons

Europe demonstrates that regional integration requires institutional innovation sustained over decades, clear role separation to address sovereignty concerns, technical solutions adapted to local realities and financial mechanisms that align regional benefits with fair cost allocation. Crisis can accelerate integration when channelled through robust institutions. Supranational bodies can have enforcement authority while respecting national sovereignty through clearly defined competency divisions.

Nordic electricity market: The first international market template

Political will and leadership

Norway's 1990 Energy Act provided the foundational legal framework that enabled the world's first international electricity market. What began as economic co-operation through power sector unbundling evolved into a broader political integration project. The Nordic market demonstrated crisis resilience during the energy crisis, emerging stronger with market design reforms. This experience shows how economic foundations can enable broader political integration when countries build trust through successful commercial co-operation.

Institutional frameworks and governance

Nord Pool operates as a designated market operator under EU rules, demonstrating how voluntary arrangements can evolve into sophisticated institutional frameworks. The Nordic regulatory co-operation model influenced broader European regulatory frameworks and became a template for the EU Internal Energy Market Target Model. Clear role separation between competitive generation/sales and regulated grid operations created the institutional foundation, with independent state-owned transmission system operators providing neutral market facilitation.

Technical standards and operations

The Nordic approach prioritised maximum standardisation and harmonisation across the region, enabling advanced integration. Transparent market operations with publicly available information on outages and capacity limits built stakeholder confidence. The region minimised national exemptions that could reduce integration efficiency, demonstrating that technical harmonisation works best when countries commit to common standards rather than maintaining special arrangements.

Market development and commercial arrangements

Nord Pool achieves the highest trading volumes globally, at 96-98% of consumption, demonstrating two critical success factors: open market incentives that enable optimal price discovery, and a highly unbundled power sector without mandatory trading obligations. The innovative two-tier pricing system uses a "system price" for financial reference and "area prices"

reflecting local conditions and transmission constraints. This voluntary high participation proves market efficiency can be achieved through proper incentives rather than regulatory mandates.

Planning and investment

Cross-border electricity sales made generation projects bankable by providing access to larger markets beyond domestic demand. Nordic regulatory co-operation supported co-ordinated investment frameworks, while regional resource optimisation reduced the need for new local infrastructure development. This approach demonstrates how market mechanisms can drive efficient investment when supported by appropriate regulatory frameworks and cross-border access.

Key lessons

The Nordic market shows that starting with strong domestic liberalisation and unbundling creates the foundation for regional integration. Maximum harmonisation of rules and standards, combined with transparent operations and open market incentives, can achieve exceptionally high voluntary trading participation that exceeds what regulatory mandates typically accomplish.

Southern African power pool: Africa's most advanced regional market

Political will and leadership

The Southern African Power Pool (SAPP) originated from a 1995 Southern African Development Community summit where political leaders endorsed regional power co-operation. This high-level support catalysed SAPP's governance structure, enabled utility co-operation and signalled political ownership that endured beyond the initial agreement. Political commitment varies across member states, affecting implementation pace.

Institutional frameworks and governance

SAPP operates under a self-regulated, consensus-based governance model that has enabled Africa's most advanced regional power market despite its informal nature. The Regional Electricity Regulators Association provides regional oversight with a limited but functional mandate. The Project Acceleration Unit was created to advance priority regional projects, reducing reliance on utilities alone.

Technical standards and operations

SAPP demonstrates progressive standards development, evolving systematically from bilateral trading in 1995 to competitive day-ahead markets by 2009 and forward physical markets by 2015. The organisation is governed by four comprehensive agreements that establish specific rules of operation, pricing and operating guidelines, creating a regulatory framework developed through member consensus. Standardised bilateral contracts established early trust in cross-border transactions. However, not all SAPP members are connected to the regional network despite the market running for two decades.

Market development and commercial arrangements

SAPP evolved from bilateral trading to competitive day-ahead and intraday markets with transparent pricing and automated settlement, representing Africa's only regional market not relying solely on bilateral agreements. The market suffers from limited comprehensive online information systems affecting efficiency.

Planning and investment

SAPP's regional planning methodology exemplifies a comprehensive approach by comparing three distinct planning approaches: an aggregation of national plans, a top-down full integration plan and a "realistic" integration plan that considers additional constraints, such as minimum security and reliability criteria for each country and minimum capacity factors for gas and coal plants. The Regional Transmission Infrastructure Financing Facility represents innovative blended finance to mitigate high-risk transmission infrastructure projects. SAPP initially relied on individual countries and private investors, which slowed progress. This integration of national plans into a regional framework demonstrates a methodology that combines bottom-up and top-down approaches.

Key lessons

SAPP proves that informal, consensus-based institutions can enable sophisticated markets. Progressive development over time builds institutional capacity, but infrastructure requires coordinated regional mechanisms rather than country-by-country approaches.

West African power pool: Crisis learning and institutional development

Political will and leadership

The institutional development of the West African Power Pool (WAPP) has followed a clear progression. In 1999, the WAPP Secretariat was established, followed by the 2006 ECOWAS Energy Protocol, then the crucial 2008 establishment of the ECOWAS Regional Electricity Regulatory Authority (ERERA) with binding powers and the 2017 expansion of WAPP's mandate, demonstrating ongoing institutional strengthening. ERERA was established through a ECOWAS decision that made the crucial choice to grant ERERA binding regulatory authority rather than advisory status, distinguishing successful political commitments from symbolic engagements.

Institutional frameworks and governance

ERERA serves as the regional regulator supporting harmonisation. Clear institutional roles separate responsibilities: WAPP co-ordinates planning and operations, while ERERA handles regulation, focusing specifically on cross-border issues, and domestic regulation remains under national jurisdiction. WAPP plays a more active role in infrastructure planning and implementation than other pools, backed by multilateral institutional support from the World Bank, the African Development Bank and European donors.

Technical standards and operations

The 2017 WAPP blackout was triggered by a protection failure that cascaded through the region due to inconsistent protection settings, demonstrating how minor technical inconsistencies can escalate into regional crises. In response, WAPP accelerated efforts to harmonise grid codes, provided training to operators and established technical compliance reviews. This crisis response demonstrates institutional learning and adaptation capability.

Market development and commercial arrangements

WAPP's Letter of Credit-based settlement system, the Liquidity Enhancement Revolving Fund, directly tackles persistent challenges like payment delays and currency volatility. The system establishes monthly settlement cycles, clear credit requirements and regionally co-ordinated

financial safeguards, creating more certainty and reliability in transactions. This shows how tailored financial mechanisms can address developing region constraints.

Planning and investment

WAPP has achieved major infrastructure progress with the Côte d'Ivoire-Liberia-Sierra Leone-Guinea line and the North Core project, with over 10 000 km of transmission lines either completed or under construction. WAPP's Planning and Operation Committee aligns national investment plans with regional priorities and facilitates operational co-ordination across borders. The inclusive regional planning process uses legal instruments mandating co-operation, with transparent, regionally agreed criteria considering security of supply, economic efficiency and affordability to ensure resources flow to the most impactful projects. However, institutional gaps at the national level can slow implementation despite strong regional frameworks, highlighting the need for capacity building at both the regional and national levels.

Eastern Africa power pool: Early-stage regulatory co-ordination

Political will and leadership

The Eastern Africa Power Pool (EAPP) operates as an early-stage regional framework with growing political commitment, backed by the East African Community, which provides a legal framework for integration. Integration occurs within the broader East African Community and Common Market for Eastern and Southern Africa frameworks, demonstrating how regional power integration can be embedded within existing political integration structures. The Kenya-Uganda interconnection illustrates how political champions can be decisive in maintaining momentum. Energy ministers from both countries directly championed the project in the early 2000s, aligned national objectives and personally intervened when technical teams encountered delays or disagreements over cost-sharing, transmission cost-sharing and synchronisation protocols. Their sustained engagement and political capital were essential in translating an MoU into actual construction and eventual grid integration, demonstrating how political champions can overcome technical inertia when implementation challenges arise.

Institutional frameworks and governance

The Independent Regulatory Board, composed of national regulators, facilitates rule-making and provides a platform for harmonising tariff structures, grid codes and trading arrangements. Working groups focused on planning and operations enable technical co-ordination, showing how regional co-ordination can occur without supranational enforcement powers through peer co-operation and technical collaboration.

Technical standards and operations

The EAPP focuses on harmonising technical standards across diverse national systems through Independent Regulatory Board working groups. Key interconnectors include Ethiopia-Kenya and Kenya-Uganda, which are operational, with Rwanda-Democratic Republic of Congo under development. However, mixed progress shows some projects face financing or co-ordination delays.

Market development and commercial arrangements

A 2021 EAPP study noted that deeper alignment of market rules and dispute resolution frameworks is needed before launching a fully functional regional market. Prerequisites identified include harmonised regulations and cost-reflective tariffs as essential for trading confidence. The financial health of national utilities must also be addressed to build trading confidence among regional partners.

Planning and investment

The EAPP's experience demonstrates that infrastructure alone is insufficient – regulatory coherence and institutional trust are equally vital for market integration success. Mixed infrastructure progress, with some interconnectors completed while others face delays, shows the importance of co-ordinated regional planning alongside physical development.

Key lessons

The EAPP illustrates that early-stage integration requires building regulatory coherence alongside infrastructure development. Regional co-ordination can occur through peer co-operation platforms like the Independent Regulatory Board, but sustainable market integration requires addressing both institutional frameworks and the financial health of utilities simultaneously.

Central American Electrical interconnection system: An overlay market model

Political will and leadership

The Central American Electrical Interconnection System (SIEPAC) demonstrates how regional integration becomes more politically durable when aligned with both national interests and broader development agendas. Backed by the Inter-American Development Bank and framed within the Central American Integration System, SIEPAC connected six countries through a regional transmission line and market while addressing domestic challenges such as supply reliability and cost reduction. This alignment helped sustain political support across successive governments and diverse national contexts.

Institutional frameworks and governance

The Regional Commission for Electrical Interconnection operates as a supranational regulator, with binding authority under a treaty framework that grants it independence, legal authority and financial stability. This enables consistent regulation across six countries and demonstrates how supranational regulators can have enforcement powers in smaller regional contexts while focusing specifically on regional electricity markets.

Technical standards and operations

SIEPAC uses standardised ICCP/IEC 60870-6 protocols that enable real-time data exchange for grid status, contingency information and flow data while maintaining national operator autonomy. The regional transmission line connects all six countries, with the Central American Regional Operating Entity developing day-ahead regional dispatch based on offers from national systems, co-ordinating generation across multiple countries while respecting national market structures.

Market development and commercial arrangements

SIEPAC's innovative "secondary market" approach operates as an overlay system alongside domestic markets, enabling the Regional Operating Entity to develop day-ahead regional dispatch based on offers from national systems while co-ordinating generation scheduling and economic dispatch across six countries. The system uses a nodal pricing mechanism with auctioned capacity rights, allowing regional optimisation while maintaining national market

structures. This approach demonstrates that regional exchange can thrive even when participating countries have varying levels of market development and political constraints, showing how overlay institutions can enhance rather than replace national capabilities, enabling regional benefits while preserving local control.

Planning and investment

SIEPAC provides co-ordinated planning across the six countries with multilateral development bank support reducing financing risks. The regional transmission backbone provides the foundation for trade, resulting in a functional regional market despite varying national market development levels.

Key lessons

SIEPAC shows how overlay market models can enable regional exchange while respecting national sovereignty. Treaty-based systems with supranational regulators can work in smaller regional contexts when supported by multilateral development institutions and aligned with broader political integration frameworks.

ASEAN power grid: A flexible, non-binding approach

Political will and leadership

The Association of Southeast Asian Nations (ASEAN) MoU on the ASEAN Power Grid is a non-binding but formal agreement that serves as the foundational political instrument guiding regional electricity interconnection. This flexible approach allows countries to explore integration without overcommitting, helping manage domestic sensitivities while establishing a political foundation for co-operation. Subregional initiatives build confidence in broader integration through gradual expansion that respects diverse national circumstances.

Institutional frameworks and governance

The ASEAN Power Grid operates through flexible governance mechanisms that allow countries to adopt practices at different paces while maintaining minimum baselines to accommodate diversity. Growing institutional frameworks provide structure without constraints, demonstrating how non-binding but formal frameworks can provide co-ordination mechanisms while respecting varying national readiness levels for deeper integration.

Technical standards and operations

The focus remains on essential technical compatibility for safe interconnection, with progressive development of common standards through subregional pilots that test approaches before broader application. This allows the region to build basic operational co-ordination capabilities while learning what works across diverse technical and institutional contexts.

Market development and commercial arrangements

Early-stage development relies primarily on bilateral arrangements with limited multilateral co-ordination. Subregional power exchange initiatives serve as stepping stones towards broader regional integration, focusing on proving commercial viability through simple mechanisms before attempting more sophisticated trading systems.

Planning and investment

Co-ordinated planning is emerging through ASEAN institutional frameworks, with focus on identifying priority interconnection projects and building capacity for regional co-operation. The diverse economic development levels across member countries require tailored approaches that accommodate varying financial and technical capabilities.

Key lessons

The ASEAN Power Grid demonstrates how non-binding frameworks can provide meaningful co-ordination while respecting sovereignty concerns. Subregional initiatives can serve as stepping stones for broader integration, allowing regions to test approaches and build confidence before expanding scope.

Gulf Cooperation Council: Resource-rich co-ordination

Political will and leadership

Gulf Cooperation Council (GCC) power sector co-operation builds on the existing GCC political integration framework, with resource abundance providing an economic foundation for co-operation. Shared energy security and diversification objectives drive regional co-ordination, supported by political stability and shared governance models that facilitate co-operation among member states.

Institutional frameworks and governance

The GCC develops co-ordinated power exchange mechanisms by building on established institutional frameworks, demonstrating how existing regional integration structures can be leveraged for power sector co-operation. Evolving institutional capacity focuses on deeper power sector integration while maintaining the consensus-based approach typical of GCC co-operation.

Technical standards and operations

Technical co-ordination focuses on co-ordinating power exchange among resource-rich economies and managing seasonal demand variations across the region. The abundant conventional generation base requires co-ordination for optimisation rather than scarcity management, creating different technical requirements compared to resource-constrained regions.

Market development and commercial arrangements

The GCC approach emphasises resource optimisation rather than competitive markets, with focus on the co-ordination of generation resources across borders. This unique context of resource abundance creates different market dynamics than in scarcity-driven regions, allowing for co-operative resource-sharing arrangements.

Planning and investment

Strong financial capacity for infrastructure development enables regional co-ordination of generation and transmission planning. Resource wealth supports long-term investment in

regional interconnection, with strategic focus on economic diversification through regional energy co-operation.

Key lessons

The GCC demonstrates how resource-rich regions can pursue co-ordination for optimisation rather than competitive market development. Existing political integration frameworks can provide effective foundations for power sector co-operation when supported by shared economic interests and strong financial capacity.

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