Institutional Architecture for Regional Power System Integration

Government, Utility and Regulator Roles

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Abstract

Establishing appropriate institutional architecture is important to integrate power systems across borders and facilitate electricity trading, as even if the necessary infrastructure is in place, it does not automatically follow that it is being used to exchange power effectively. The co-ordination of all stakeholders – governments, utilities[1] and regulators – is required within jurisdictions, as is the creation of regional entities to support and oversee the integration process.

This report therefore examines stakeholder roles at different stages of cross-border integration to enable multilateral power trade. As energy regulators are our main audience, we focus on their roles and responsibilities after briefly addressing those of governments and utilities.

This document was developed under the Regulatory Energy Transition Accelerator (RETA) initiative, which aims to enhance the capacity of regulators to increase the speed of clean energy transitions. It is part of a series of guidance notes prepared by the IEA, the World Bank's Energy Sector Management Assistance Program (ESMAP) and IRENA to help key stakeholders navigate the challenges associated with regional power system interconnections, by providing analytical outputs and examples of best practices for regulatory frameworks and mechanisms. These notes focus on the soft infrastructure of cross-border power exchange, in accordance with the priority topics identified through a survey of regulators in February-March 2023.

[1] In this paper, a utility is any entity that performs activities related to electricity supply and system operations, in either transmission or distribution. These activities can be carried out by the same entity in the case of vertically integrated utilities or separated in regions where the energy sector is unbundled.

Introduction

Integrating power systems at the regional level offers many benefits

Cross-border integration of power systems has long been recognised as a key strategy to strengthen electricity security, make electricity more affordable and scale up access to – and integration of – renewable energy resources.

Interconnecting power systems makes generation capacity from a wider geographical area available to meet demand and maintain frequency. This decreases dependency on specific generators, and capacity reserves can potentially be shared, boosting the resilience of the broader system.

Integrating power systems also increases system efficiency through economies of scale and price convergence, and by allowing existing generation sources to be used more efficiently. Providing joint access to a wider range of electricity generation resources can reduce total operating costs. In Europe, for example, it is estimated that cross-border electricity trade delivered EUR 34 billion more in welfare benefits in 2021 than if national markets had been isolated.

Finally, larger power systems can integrate greater volumes of weather-dependant variable renewable energy because their wider geographical coverage naturally smooths the variability of the underlying resource. This can also enable supply diversification and, where complementary exists, allow renewable energy sources to be used more efficiently. Additionally, interconnection gives power producers access to a wider range of customers, which can strengthen investment confidence and boost the adoption of renewables. Thus, when coupled with decarbonisation policies, interconnection can accelerate CO_2 emissions reductions.

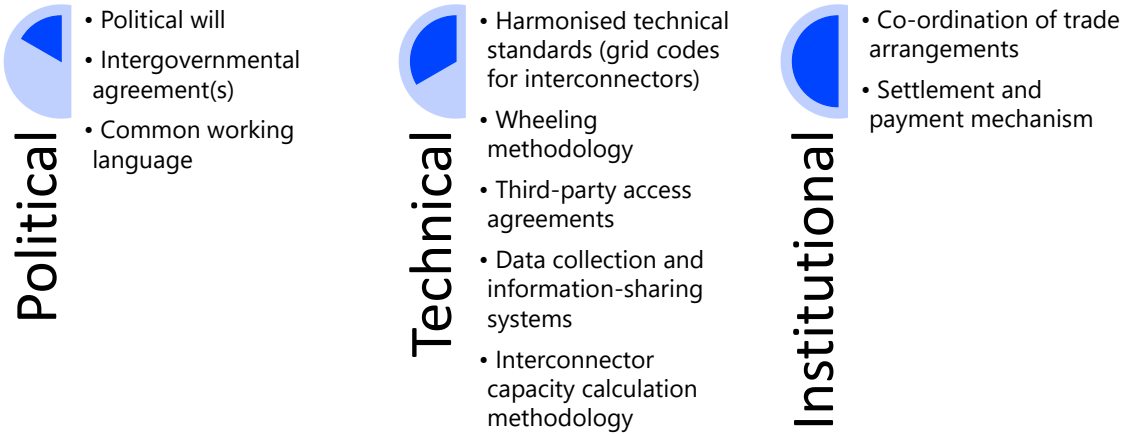
Establishing multilateral power trading requires political, technical and institutional co-ordination

In recognition of these benefits, multiple jurisdictions around the world have been working towards power grid interconnection and multilateral power trading. In this report, jurisdictional borders can be international or domestic, and our assessment of regional integration includes cases in Australia, the United States and Canada.

Multilateral power trading requires the establishment of harmonised rules and/or agreements among multiple jurisdictions, and international experience has shown that a common set of political, technical and institutional minimum requirements need to be met. Political requirements encompass the creation of political will and

intergovernmental agreements from participating countries, while technical requirements cover rules and regulations to ensure the effective operation of cross-border trade. For instance, grid codes must be harmonised, capacity allocation and calculation methodologies developed, and data collection and information-sharing systems instituted. Institutional requirements refer to multilateral power trade mechanisms such as dispute resolution and settlements.

Minimum requirements for establishing multilateral power trade



Source: IEA (2019), Establishing Multilateral Power Trade in ASEAN.

The integration of trading rules and mechanisms can be divided into three levels: early-stage, shallow and deep harmonisation, depending on:

- the level of interconnectivity with neighbouring countries
- the nature and organisation of power trading arrangements
- the degree of technical harmonisation of grid or market operation rules, grid codes, tariffs and data sharing
- the degree of co-ordination in planning and investment to develop infrastructure
- the amount of institutional architecture in place and its enforcement power.

Identifying the main characteristics of each stage is helpful to understand the changes and minimum requirements needed to transition to higher levels of market integration.

Cross-border power grid and market integration levels

Integration level	Early stage	Shallow	Deep
Interconnection infrastructure	Bilateral power trade starts between two countries, with limited volume.	Interconnected grids link several neighbouring countries. Regional interconnection is fragmented and often underutilised.	Most countries in the region are interconnected and participate in trade. Use of regional infrastructure gradually increases.
Planning & investment co-ordination	Planning happens at a national level, possibly with specific regional agreements to develop priority infrastructure.	National investments are somewhat co-ordinated with an optimised regional investment plan.	Planning is optimised with a regional perspective. Harmonised methodologies may be used for national-level planning.
Technical harmonisation	Simple rules are agreed upon for the operation of the interconnected grids.	Some harmonisation of regulatory practices and technical & market rules exists. (Common data acquisition and supervision protocols are in place.)	Harmonised regulations and technical & market rules, including grid codes, exist. (Interoperable and similar digital technologies and platforms are in place.)
Commercial trading & market design	Long-term bilateral PPAs predominate.	Short-term markets often supplement long-term PPAs. Transmission pricing spreads costs evenly across all users.	Regional markets are fully competitive, cost-reflective and offer various products. Transmission pricing evolves to be more granular.
Institutional architecture	Bilateral agreements are popular, with no strong supranational entity involved.	Regional regulatory bodies and/or steering committees are in place but face enforcement challenges.	Enforceability of regional regulatory bodies and/or steering committees is at an extended level.
Examples	Greater Mekong Subregion LTMS-PIP	SAPP, WAPP, EAPP, MER	EU Internal Market, WEIM

Notes: EAPP = Eastern Africa Power Pool. LTMS-PIP = Lao PDR-Thailand-Malaysia-Singapore Power Integration Project. SAPP = Southern African Power Pool. WAPP = Western African Power Pool. WEIM = Western Energy Imbalance Market (USA).

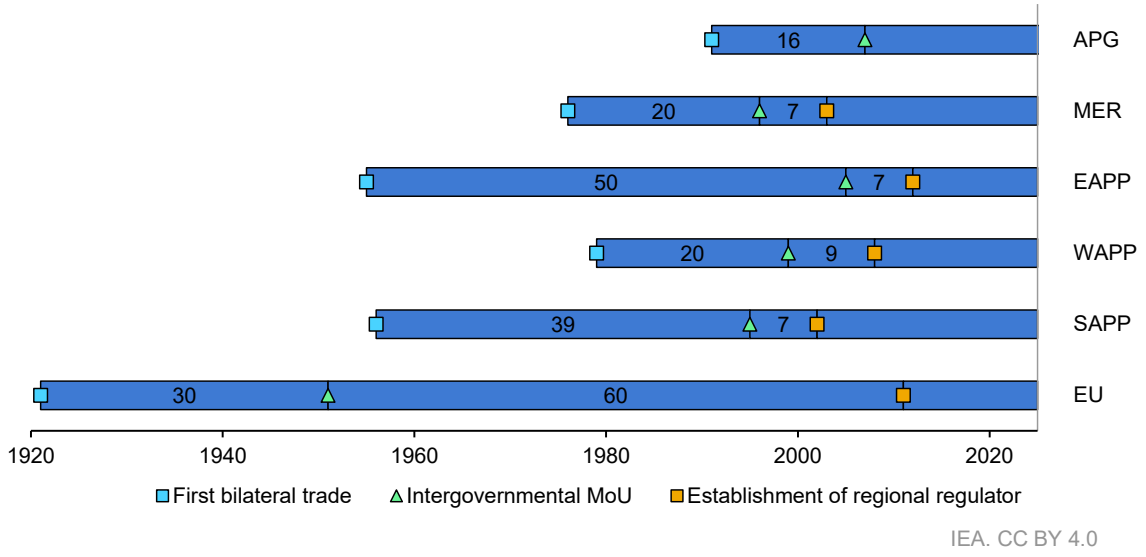
Source: Adapted from World Bank (forthcoming), Beyond Borders: Power Grid Interconnections & Regional Electricity Markets for the Sustainable Energy Transition (working paper).

Key milestones mark the lengthy regional power system integration process

It can take a long time for a fully integrated regional electricity market to materialise, usually decades, as exemplified by the EU integrated regional electricity market. The process typically starts with a bilateral cross-border electricity trade arrangement before an explicit expression of interest from governments and utilities in multilateral power trading, usually in the form of a memorandum of understanding (MoU), kicks off a regional market initiative. In some cases, the MoU already specifies the creation of institutions such as a regional system operator and a regional regulator and defines their respective roles.

Establishment of a regional regulator – or sometimes co-operation among national regulators – can incite substantial progress by creating consensus on the operational aspects of cross-border trade. Beyond this point, institutional and organisational co-ordination are crucial for successful integration and operation, with regional structures being granted greater power. This often leads to the harmonisation of market rules and regulations at the regional level.

Historical milestones of selected regional power system integration initiatives



Notes: APG = ASEAN Power Grid. MER = Mercado Eléctrico Regional. EAPP = Eastern Africa Power Pool. WAPP = West African Power Pool. SAPP = Southern African Power Pool. EU = EU Internal Electricity Market.

Achieving these milestones and meeting the requirements described above calls for the active participation of multiple stakeholders – governments, utilities and regulators – across jurisdictional boundaries because, in addition to physical interconnectors, consensus is needed on system operations and the related

regulations. Therefore, reaching a deeper level of integration is often an iterative process in which stakeholder consensus on changes and their implementation is gradually achieved.

Regional institutions tasked with improving and strengthening the system at the regional level may thus be the best placed to instigate the successive waves of change in this evolution.

Role of governments

Governments provide the political impulse for cross-border power system integration

National (or supranational) governments provide the legal and political foundation for interconnection projects, with their political will and leadership supporting the early stages of the process. Intergovernmental agreements such as MoUs and joint statements, which sometimes encompass the creation of regional institutions, typically initiate the actions needed to fulfil political requirements. Like any other cross-border activity, interconnectors cannot be constructed or operated without the consensus of all participating countries.

In the ASEAN region, member states signed an intergovernmental MoU in 2007 to establish regional power trade, followed by subregional agreements for specific interconnection projects (e.g. the LTMS-PIP and the BIMP-PIP). ASEAN Member States are currently in the process of extending this initial MoU until 2025. Similarly, the Central American Electricity Market Framework Treaty, signed by the region's six national governments in 1996, provided the political impetus to formally create a regional competitive power market (MER), turning decade-long feasibility studies and local power trading into a co-ordinated regional power integration process.

In some areas, dedicated platforms for governments facilitate diplomatic efforts to formulate consensus among countries involved in regional interconnections. In Africa, the Regional Economic Communities provide institutional support for market integration and accelerate the creation of international consensus. In 2006, the Economic Community of West African States (ECOWAS) took the lead in creating the West African Power Pool (WAPP). Two years later, the ECOWAS Regional Electricity Regulatory Authority (ERERA) was created within the framework of the ECOWAS Energy Protocol and the WAPP to regulate cross-border electricity connections and trade, acting as a central regulatory entity with the authority to make legally binding decisions. In the case of Central America's MER, the Central American Integration System (SICA) was created in 1993 as a regional and political organisation.

However, the role of governments is not only to forge intergovernmental agreements. They also endorse regional-level regulations on cross-border trade,

standards and market design (if a market is in place). For instance, both EU member states and the EU Parliament will discuss and amend the current European Commission proposal for EU electricity market reform to reach a consensus.

Furthermore, when regulations are adopted, governments bear the ultimate responsibility for ensuring that regional agreements are transposed into national regulations. For example, France's government was obligated to revise its national Energy Code to clarify the role of local regulatory authorities in line with relevant European directives.

Apart from laying the legal and institutional foundation for cross-border interconnectors, governments can support integration projects by promoting and simplifying transmission investments. For instance, every two years the European Commission endorses a list of Projects of Common Interest to simplify planning and streamline permit-granting to facilitate the commissioning of cross-border integration projects.

Role of utilities

Electricity utilities and power system operators are the driving force behind regional-level technical harmonisation

As utilities bear primary responsibility for constructing and operating power systems to ensure the delivery of secure supplies, collaboration among them is crucial to develop cross-border interconnections. Utilities develop interconnections and assess their impacts, share their knowledge of the system for regional power system planning, and adjust their technical standards to harmonise with other utilities in the region. These actions and roles satisfy the technical requirements for cross-border power trading.

Effective co-ordination is necessary to assess the energy security impacts of interconnection in regional power system integration. Typically, utilities assess impacts on frequency stability, violation of thermal limits, voltage profiles and short-circuit strengths, although the methods and criteria adopted vary by utility. Assessment findings determine the techno-economic feasibility of an interconnection project and technology selection, but may also incite modifications to national power system plans or operating procedures (procurement of reserves and determination of thermal limits, grid codes, communication protocols, etc).

As a second step, utilities may also assess dispatch and market-clearing impacts, as the injection or offtake of power at the interconnector may affect domestic dynamics. The results of these various studies often shape the design of cross-border trade agreements and rules on how interconnection capacity is allocated and used.

Utilities can also be involved in regional power system planning, considering their tools and knowledge of the system. This work must be performed jointly with planning authorities to ensure that energy infrastructure meets both cross-sector (electricity, gas, transport, heating, climate, etc.) and regional co-ordination objectives.

Depending on final regional arrangements, utilities may need to adjust their own grid codes, operational procedures, database structures, communication protocols and grid modelling methodologies. To harmonise arrangements among different utilities, working groups and task forces made up of representatives of each utility (and ideally of the regulator) should be convened.

A regional association of utilities, system operators and planning co-ordinators, or an independent system operator, may eventually be needed to ensure all work streams are harmonised and guided by a single strategic outlook. Establishing such a regional institution makes it easier to aggregate local power system development plans into a regional project.

In Europe, the European Network of Transmission System Operators for Electricity (ENTSO-E) is responsible for drafting Europe-wide development plans, a process that involves all relevant local transmission system operators (TSOs). Meanwhile, the United States currently has seven regional and state independent system operators (ISOs) and regional transmission organisations (RTOs)[2] to oversee regional planning, pricing and wholesale power markets. Local utilities are part of these RTOs and ISOs.

Similarly, the Association of Power Utilities of Africa (APUA) unites African power utilities and was important in establishing the Central Africa Power Pool in 2003 and the Eastern Africa Power Pool in 2005. The Heads of ASEAN Power Utilities/Authorities (HAPUA) in Southeast Asia and the Association of Mediterranean Transmission System Operators (Med-TSO) in the Mediterranean region play similar roles.

Role of regulators

Regulator mandates differ regionally and locally and can evolve

Along with governments and utilities, regulators are also key stakeholders in cross-border power market integration. They can be independent or part of the central government, for instance within a department of the ministry in charge of

[2] The California Independent System Operator (CAISO), Midcontinent Independent System Operator (MISO), Independent System Operator New England (ISO-NE), New York Independent System Operator (NYISO), PJM Interconnection, Southwest Power Pool (SPP) and the Electric Reliability Council of Texas (ERCOT).

energy. We discuss the role of regulators independently of governments because regulatory bodies have distinctive roles.

Although there is no single ideal configuration, a number of theoretical and empirical arguments support the creation of independent regulators to benefit energy consumers. Many deficiencies can be attributed to a lack of regulatory independence, which is a power sector challenge almost all developing countries face according to the Global Electricity Regulatory Index. However, as establishing an independent institution requires time and resources, it is sometimes not the most effective solution when quick action is needed.

Global experience has shown that successful regional market integration involves adopting a regulatory framework to enable co-ordination among national regulators, market operators and system operators. Where a regional regulatory entity has been designated, it is a key institution for cross-border power exchanges because it facilitates fulfilment of the technical and institutional requirements, with its functions generally covering:

- Regulatory oversight of regional electricity infrastructure development and power grid planning, by reviewing (through technical or planning process reviews) and approving plans advanced by the regional planning entity.
- Harmonisation of investment recovery methodologies (e.g. for transmission cost allocation, transmission pricing and wheeling charges) among interconnected jurisdictions.
- Definition and regulation of the regional market framework (e.g. trading mechanisms and settlements, market rules).
- Monitoring of electricity markets and market participants to ensure transparency, compliance with market regulations and fair competition, and the designation of dispute resolution methods (potentially also including an arbitration role for regulators).

A regulator's role varies depending on whether power system integration efforts occur within the regulator's own jurisdiction or involve multiple regulated jurisdictions. When an overarching regulatory entity (national or supranational) coexists with local regulators (subnational or national), the latter are often tasked with supporting the regional interconnection initiative by:

- Ensuring the harmonisation of local rules with regional regulations by identifying points of conflict, making amendments when required and evaluating the impact of such amendments.
- Verifying that cost-benefit analyses and plans of regional regulators and utilities are sound, and approving the outcome of these plans.
- Establishing and maintaining dialogue with the other local regulators to ensure alignment and the sharing of best practices.

- Creating a dedicated department or team and developing staff expertise to handle interconnection matters.

Regional power system integration initiatives around the world demonstrate that there is more than one way to develop regulatory institutions. What matters is whether the different governments involved have given the regional regulator explicit mandates and support, recognising its key role in advancing the regional integration initiative.

Moreover, it is important that the regulator's mandate be clearly defined and well understood by all regional market stakeholders. Roles and responsibilities can be split among different institutions and evolve over time. At the local scale, the regulatory entity's function could be first identified as part of the ministry in charge of energy, before being spun off as an independent institution. As cross-border projects become more complex and require specific expertise, a dedicated team within the local authority can be designated (e.g. around ten full-time employees work on these issues at Energy Regulatory Commission in France and Ofgem in the United Kingdom).

In this regard, it is also important to design a flexible regulatory framework that can be adapted to market evolution and new policy objectives such as decarbonisation targets.

Evolution of the role of energy regulatory institutions during clean energy transitions

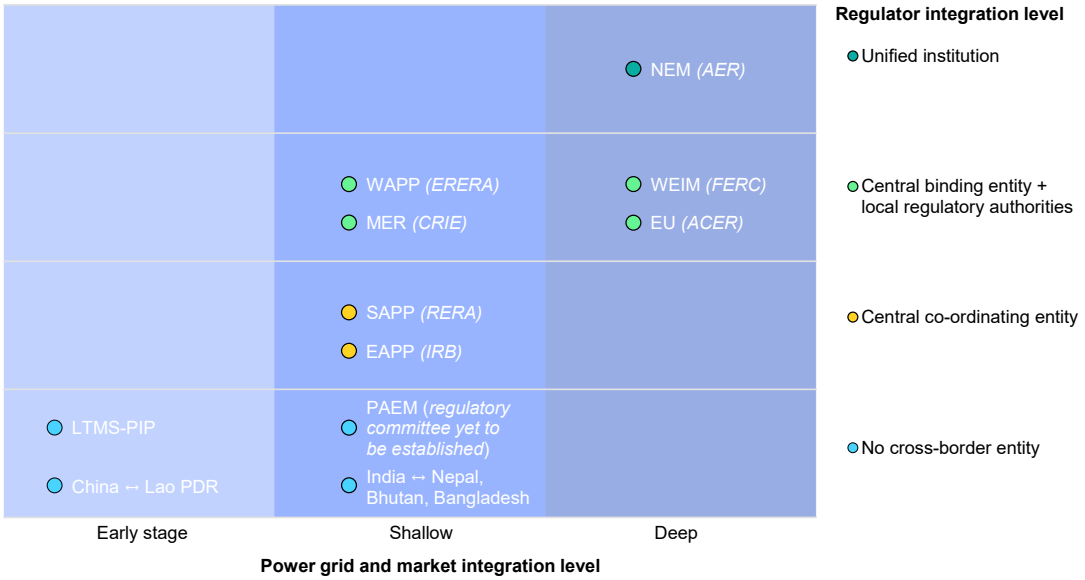
Energy regulators around the world are actively discussing how their mandates should evolve to act on decarbonisation:

- In line with the European Clean Energy Laws of 2019, the first article of the regulation for the Agency for the Cooperation of Energy Regulators (ACER) now specifies that ACER should contribute to the "consistent, efficient and effective application of Union law in order to achieve the Union's climate and energy goals".
- The UK government recently granted the regulator Ofgem a "statutory net zero duty". An amendment to the energy bill specifies Ofgem's mandate to support the government's net zero by 2050 obligation while fulfilling its objective of protecting consumer interests.
- The Canada Energy Regulator (CER) is guided by mandates from the Ministry of Energy and Natural Resources of Canada (NRCAN), which expects to put forward a new set of scenarios to model a path to net zero emissions. This reinforces Canada's commitment to achieve net zero emissions by 2050.

Different regulatory frameworks are possible at different levels of regional integration

Based on the Introduction's definition of power grids and market integration, we recognise four levels of integration for regulators of cross-border interconnectors. Classification is based on whether a supra-jurisdictional regulatory entity is in place, whether this entity has binding powers, and whether regulatory entities at local levels exist in parallel with the central regulatory entity. The regulatory entity's level of integration is not necessarily related to regional power grid and market integration levels, as this depends on the regulatory design agreed upon by participating jurisdictions. However, empirical evidence shows that the most integrated power markets today have all established a regional regulatory institution, albeit with structural variability.

Regulator integration levels, corresponding to regional power grids and market integration



Notes: LTMS-PIP = Lao PDR-Thailand-Malaysia-Singapore Power Integration Project. WAPP = West African Power Pool. ERERA = ECOWAS Regional Electricity Regulatory Authority. MER = Mercado Electrico Regional. CRIE = Comisión Regional de Interconexión Eléctrica. SAPP = Southern Africa Power Pool. RERA = Regional Energy Regulators Association. EAPP = Eastern Africa Power Pool. IRB = Independent Regulatory Board. PAEM = Pan-Arab Electricity Market. NEM = National Electricity Market of Australia. AER = Australian Energy Regulator. WEIM = Western Energy Imbalance Market. ACER = Agency for the Cooperation of Energy Regulators. FERC = Federal Energy Regulatory Commission.

When existent, the name of the regional regulatory body follows that of the regional interconnection initiative. Although ACER was put in this classification for reference, it is not an actual regulator as explained below.

Unified institution

The most comprehensive regulatory integration is realised when a single, unified institution is responsible for regulating regional interconnection. The leading example is the Australian Energy Regulator (AER), which regulates the National

Energy Market interconnecting five jurisdictions in eastern and southern Australia: Queensland, New South Wales (including the Australian Capital Territory), South Australia, Victoria and Tasmania. Created in 2005 as a national independent body, AER assumed the responsibilities of the previous regulating bodies across jurisdictions to reduce complexity and cut compliance costs for the industry sector. AER's current mandate includes the regulation of wholesale and retail markets as well as the operation of electricity and gas networks.

By contrast, power system regulation in Canada has historically been done entirely at the subnational level, with each province retaining its own energy regulator. Creation of the Canada Energy Regulator (CER) in 2019 – with a mandate that includes overseeing interprovincial and international power lines – aimed to modernise Canada's regulatory framework for energy projects under federal jurisdiction, but it has not led to a unified national regulatory approach (nor was it the policy intent behind the creation of CER). As provinces have jurisdiction over energy and natural resources and gain revenues from them, granting the federal government greater power in these areas is often perceived as a threat to provincial independence. Also for sovereignty reasons, it is difficult to imagine a unified cross-border institution operating without national regulators, and in fact this situation has not yet been observed.

Central binding entity with local regulatory authorities

A common configuration for regulating regional power markets that span several jurisdictions is a regional regulatory authority coexisting with local regulatory authorities (LRAs) responsible for their own jurisdictions. For integrated markets, the overarching regional institution is often granted binding authority to enforce regional market rules.

Comparing the European Union and United States is instructive, as both have highly integrated forms of power markets, albeit with major differences in their regulatory frameworks and the responsibility balance between local and central regulators.

In the European Union, ACER is responsible for the completion of internal electricity and gas markets and co-ordinates the work of members states' energy regulators on cross-border interconnection issues. As its name suggests, ACER (the Agency for the Cooperation of Energy Regulators) is not an actual EU regulator and the balance between regional and local regulation favours local. LRAs retain responsibility over their national transmission and distribution systems and wholesale and retail power markets, while ACER plays a crucial role in supporting co-operation among LRAs and can step in to make decisions when countries cannot agree.

A different framework applies in the United States, where the Federal Energy Regulatory Commission (FERC) acts as the single federal regulator and has regulation authority over the interstate transmission system and interstate wholesale electricity transactions, while LRAs at the state level are responsible for distribution systems and retail markets. However, FERC does not regulate the vertically integrated utilities that own and operate transmission, distribution and generation infrastructure in some states.

Division of regulatory authority in the United States and the European Union

	United States	European Union
Role of the central regulatory authority	**FERC** • regulates the transmission system • regulates the wholesale market • encourages regional collaboration	**ACER** • drafts framework guidelines for network codes • imposes cost-sharing arrangements for cross-border transmission lines in limited cases • resolves cross-border regulatory issues
Role of the local regulatory authority	**State regulators** • regulate the distribution system • regulate the retail market	**National regulatory authorities** • regulate transmission and distribution systems • regulate wholesale and retail markets (in compliance with EU legislation)

Source: IEA (2019), Integrating Power Systems Across Borders.

Central America's MER (Mercado Eléctrico Regional) with its interconnector project, the SIEPAC line, is another interesting example of a power system integration effort supported by designated regional institutions. The Regional Commission on Electrical Interconnection (CRIE) co-ordinates the national regulators of the six interconnected MER countries (Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua and Panama). It regulates MER to ensure fair competition, being responsible for regulating commercial relations and for setting transmission system tariffs, and it can also approve extensions to the regional transmission network and intervene to some extent in the market to prevent abuses. Furthermore, it is in charge of overseeing system exchanges and verifying that each country has enough reserves to comply with regional performance indices.

However, CRIE's lack of a sound regulatory framework and enforcement rights have led to mistrust among the interconnected countries of MER. This was one of the reasons for Guatemala's decision to pull out of the regional market in 2021, a decision that could take years to materialise.

On the African continent, the regional Western African Power Pool (WAPP) market has adopted a similar governance structure, having designated ERERA as the regional regulator. ERERA regulates cross-border trade, transmission tariffs and bilateral contracts in the region, intervenes in disputes between market participants and has the authority to issue binding regulations for market operation. However, despite having a clear regulatory mandate, WAPP has been very slow to develop a unified regional market, mainly due to a lack of political consensus among participating countries. For instance, ERERA has elaborated a sophisticated regional grid code, but it is still pending approval at the country level.

Central co-ordinating entity

Regional interconnected power systems can also exist without any entity being granted the traditional mandate of a regional regulator. In this case, a regional institution generally assumes a co-ordinating role among local regulators rather than exercising binding regulatory authority in the regional market. The Southern African Power Market (SAPP) applies this type of governance framework and is often considered a self-regulated market, as the regional association RERA has no power to establish or enforce regulations. Participating countries must therefore agree with one another on market and transmission rules, and RERA's mandate is limited to furthering the development of SAPP while encouraging regulatory harmonisation and capacity building in its member countries.

As SAPP is currently one of the most advanced regional power markets in Africa, this case shows that market development is not proportional to the amount of power granted to the regional institution. However, RERA's lack of authority has greatly limited SAPP's harmonisation process, notably in transmission planning and operating reserves. Discussions are currently under way on expanding RERA's mandate to include more of the responsibilities expected from a regional regulator.

Regional platforms for energy regulators

Initiatives and platforms also exist to co-ordinate the work of national energy regulators involved in interconnections, in the absence of (or in parallel with) supra-jurisdictional regulatory structures. In Europe, the Council of European Energy Regulators (CEER) facilitates information exchange and assistance for LRAs and works closely with ACER.

In the ASEAN region, although its mandate could evolve with renewal of the ASEAN Power Grid (APG) MoU, AERN (the ASEAN Energy Regulatory Network) acts as a platform for sharing best practices on regulatory issues and networking among ASEAN countries. In South Asia, regulator forums such as the South Asia Forum for Infrastructure Regulation (SAFIR) and the Council of Experts of Energy

Regulators (CEERE) enable discussion on issues such as grid codes and cross-border trade operations within their corresponding regional economic communities. However, the success of AERN, SAFIR and CEERE in harmonising rules and regulations for power trading across their respective interconnected countries has proven very limited so far.

Conclusion

It is only through the participation and co-ordination of all stakeholders, at both the national and regional levels, that the full benefits of cross-border power trading can be achieved. Several enabling factors form the preconditions for successful regional interconnection initiatives:

- **Strong political will to co-operate**: Intergovernmental agreements and co-ordinated political leadership are necessary to facilitate strong regional integration, for instance through regional economic communities.
- **Sound cross-border trading rules and transmission regulation**: Utilities have a crucial role in ensuring that the technical aspects of these rules do not compromise the delivery of secure, reliable and affordable electricity to consumers. Harmonising these rules can take several iterations to progressively reach higher levels of integration.
- **Regional institutions with clear and significant executive power**: Often, regional institutional design takes longer to formulate than the technical aspects of interconnection (e.g. hard infrastructure, grid codes), as it can be political. Designing regional institutions from the beginning of a project enables faster implementation of co-ordinated action.

The format, roles and responsibilities of regional institutions, as well as regulatory design, can vary from one region to another, depending on the political and physical context – number and size of members, interconnection capacity, and policy decisions regarding the desired level of competition and openness to foreign participants.

The regional regulatory entity is particularly important in harmonising rules and operations at the regional level, which international experience demonstrates as a necessary step towards higher levels of market integration.

Finally, it is crucial for regulators to understand the desired level of regional integration, considering political and cultural alignment as well as the time required to achieve it. Studying global examples can give regulators insight into the efforts necessary and help them choose the most suitable path to establish regional institutions.

Abbreviations and acronyms

ACER	Agency for the Cooperation of Energy Regulators
AER	Australian Energy Regulator
AERN	ASEAN Energy Regulatory Network
APG	ASEAN Power Grid
APUA	Association of Power Utilities of Africa
BIMP-PIP	Brunei Darussalam, Indonesia, Malaysia and the Philippines Power Integration Project
CEER	Council of European Energy Regulators
CEERE	Council of Experts of Energy Regulators
CER	Canada Energy Regulator
CRE	Commission de régulation de l'énergie (Energy Regulatory Commission)
CRIE	Comisión Regional de Interconexión Eléctrica
EAPP	Eastern Africa Power Pool
ECOWAS	Economic Community of West African States
ERERA	ECOWAS Regional Electricity Regulatory Authority
ESMAP	Energy Sector Management Assistance Program
FERC	Federal Energy Regulatory Commission
HAPUA	Heads of ASEAN Power Utilities/Authorities
ISO	Independent system operators
LRA	Local regulatory authorities
LTMS-PIP	Lao PDR-Thailand-Malaysia-Singapore Power Integration Project
MER	Mercado Eléctrico Regional
MoU	Memorandum of understanding
NEM	National Electricity Market of Australia
NRCAN	Natural Resources of Canada
RETA	Regulatory Energy Transition Accelerator
RTO	Regional transmission organisations
SAFIR	South Asia Forum for Infrastructure Regulation
SAPP	Southern African Power
TSO	Transmission system operators
WAPP	West African Power Pool

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