Transitioning towards Multilateral Electricity Trade in Asia and the Pacific: A Discussion Paper

Report prepared for the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP)

CONTENTS

1. INTRODUCTION

1.1 Objective of the report

The broad objective of this report is to review the global experience of multilateral electricity trade, with particular emphasis on its rationale, progress, and outcomes. This review is intended to form a 'discussion paper' for the 10^{th} meeting of the UNESCAP Expert Working Group on Energy Connectivity, which will include a discussion on facilitating the transition from bilateral towards multilateral electricity trade across Asia-Pacific.

1.2 Approach and scope

The review in this report is developed based on a case study approach. Regional electricity markets considered in this study are classified into three groups: *mature*, *transition* and *emerging* markets.

Mature markets are those where all countries of the region have become interconnected, and system planning and operation have been undertaken in a regionally-coordinated framework that enables multilateral electricity trade to be the main source of supply. The European Union's internal energy market, included in this report, belongs to this group.

In the *transition markets*, despite significant progress towards multilateral electricity trade, system planning and operation have not yet been fully coordinated at the regional level, and the regional markets remain a supplement to domestic supply. Southern African Power Pool (SAPP), considered in this report, falls into this category.

Emerging markets include regions where some initiatives have been undertaken to trial system-to-system electricity trade between two countries, initially using spare capacity in the dedicated interconnection facilities, and gradually transitioning to use a third country's transmission facilities. A region with such markets, considered in this report, is Southeast Asia.

This market grouping, we believe, provides an adequate coverage – in terms of socio-economic settings, actions undertaken (or contemplated) to deepen power connectivity towards multilateral trade, and the actual outcomes – for developing a panoramic perspective on key issues that Asia-Pacific countries may like to consider while progressing regional power connectivity.

The case studies conducted in this report also consider electricity market reforms in China and India. Given the size and complexity of the electricity systems in these two countries, their efforts aimed at creating nation-wide markets for electricity are somewhat comparable to regional, multilateral power connectivity.

Each case study is organised around four elements of multilateral electricity trade: policy setting, regulatory framework, market arrangement, and trade outcomes. Policy setting refers to the political processes and governance paradigms. Regulatory framework focuses on the prevailing rules for governing the operation (for example, technical standards, procedures for contingency treatment) and planning (such as, long-term supply adequacy) aspects of power connectivity, along with regional institutions responsible for implementing and enforcing these rules. Market arrangement is about the processes and mechanisms for cross-border electricity transactions. Trade outcomes are about the volumes and types of cross-border electricity trade.

1.3 Organisation of the report

This report is organised as follows. Section 2 identifies the purported rationale and key drivers for multilateral electricity trade. Section 3 provides an overview of the salient features of multilateral electricity trade in regions included in the report, complemented by the experience of electricity market reforms in China and India. Section 4 discusses some lessons from the case studies. It also reflects on possible opportunities for expediting the transition towards multilateral electricity trade in Asia-Pacific in the light of these lessons.

2. RATIONALE FOR MULTILATERAL ELECTRICITY TRADE

This section provides an overview of the key threads of the arguments that constitute the purported rationale for multilateral electricity trade.

2.1 Supply security and cost reduction

The pursuit of multilateral electricity trade is often premised on the argument that it would help improve the security and affordability of electricity supply, achieved through the exploitation of scale economies in electricity generation and cross-border sharing of reserve and surplus capacity (ADB, 2012; IEA, 2019a; Krongkaew, 2004; UNESCAP, 2019a; Yang et al., 2022b). In the context of Europe, for example, (MacIver et al., 2021) estimated that increasing Great Britain's interconnection capacity with its neighbouring countries from 5 GW to 8.4 GW would bring down the cost of electricity supply, leading to an annual saving of € 639 million for local consumers. In (Baldursson et al., 2018), the benefits of cross-border reserve markets in Belgium, France, Germany, the Netherlands, Portugal and Spain were quantified in terms of reduced cost of supply: €165 million per year with no transmission constraints, and €135 million per year with transmission constraints. In a recent study by the European Network of Transmission System Operators for Electricity (ENTSO-E), it is proposed to build 64 GW of new cross-border interconnection projects by 2030. This is expected to lower the annual cost of electricity supply by €5 billion and reduce wind and solar curtailment by 17 TWh every year (ENTSO-E, 2022).

A study initiated by the Asian Development Bank estimated the potential savings from power connectivity via six existing or planned transmission interconnections between Afghanistan, Bangladesh, Bhutan, India, Nepal, Pakistan, and Sri Lanka. It shows that the annual savings are in the range of $3,861 million to $4,127 million, far exceeding the annualised costs ($229 million to $243 million) associated with the construction and operation of the interconnections (Wijayatunga et al., 2015). Likewise, regional electricity cooperation is estimated to provide direct savings of $9 billion every year for South Asia (UNESCAP, 2018) and provide large revenue for electricity-exporting countries, such as Bhutan (UNESCAP, 2019b).

The ASEAN Energy Market Integration study found that full energy market integration would decrease total costs of energy supply in Southeast Asia by 3-4% and increase real GDP by 1-3% (ASEAN Studies Center, 2013). Another study on Southeast Asia conducted by the International Energy Agency found that cross-border electricity trade would lead to a reduction in average supply costs of about $1–3 per MWh across the region even without new interconnections, and this cost reduction would help the region save about $1–3 billion per year in total operating costs (IEA, 2019b).

There is a high level of seasonal complementarity of power generation among the Central Asian countries: surplus hydropower in Tajikistan and Kyrgyzstan in the summer wet season, and surplus thermal power in Kazakhstan, Uzbekistan, and Turkmenistan in the winter dry season. This suggests that multilateral electricity trade across the region would help improve the security of electricity supply, as additional supply can be secured from thermal-rich countries to compensate for seasonal variations in hydropower (IEA, 2021). This also suggests that multilateral electricity trade would contribute to lower costs of electricity supply across the region, especially considering that that generation costs in hydro-rich Tajikistan and Kyrgyzstan (less than $10/kWh) are much lower than that in other countries of the region (over $35/kWh) (IEA, 2021).

2.2 Investment attraction

Multilateral electricity trade would incentivise much needed investment in large-scale power projects and associated network infrastructure that would otherwise not be viable at the national levels, especially for smaller, resource-rich countries with relatively small electricity demand (IEA, 2019a; UNESCAP, 2019a; Yang et al., 2022b). To interconnect the power systems across East Asian economies, as part of the Asian Super Grid (ASG) initiative, for example, would incentivise large investment ($295-550 billion) in additional generation capacity and network infrastructure (Shuta et al., 2013; Van de Graaf and Sovacool, 2014). Likewise, building the five corridors of interconnection included in the North-East Asian Energy Interconnection (NAPSI) project would require total investment of $148 billion in HVDC (High Voltage Direct Current) transmission lines (UNESCAP, 2020). In South Asia, regional electricity cooperation and multilateral electricity trade would help unlock its hydro potentials in Bhutan and Nepal, as large hydro projects may not be profitable given the small domestic demand for electricity in these two countries (UNESCAP, 2019b).

2.3 Renewable penetration

More recently, multilateral electricity trade has also been cited for its contribution to greenhouse gas emissions reductions by enabling higher penetration of renewables in the electricity systems. The basic argument is that cross-border balancing and capacity sharing could allow more effective sharing of complementary renewable resources (especially, hydro, wind and solar) that are often distributed unevenly across the region. This could in turn contribute to electricity decarbonisation by enabling higher levels of renewable penetration in the electricity systems while maintaining supply sufficiency and reliability (IRENA, 2021a, 2021b; Yang et al., 2022a).

Take Denmark as an example. It has six interconnections with neighbouring countries, which in total provide around 5.7 GW of import capacity. Significant interconnections with neighbouring countries enable Denmark to integrate about 50% of wind power without significant curtailments (IEA, 2019a). Denmark's interconnection capacity is expected to increase in the coming years to help enable its objective of reaching 100% renewable electricity by 2030 (Danish Ministry of Climate Energy and Utilities, 2019).

A recent modelling study identified interconnections as a key enabler for Europe’s transition towards a clean and reliable electricity system with wind and solar as its backbone. The least-cost pathways considered in the study would see interconnections at least double by 2035 compared to 2020, to enable the cost-efficient expansion of wind and solar capacities by allowing their deployment in countries with the most favourable conditions. Exchange over interconnectors would also play important roles in system balancing when mismatch between supply and demand is geographic (Rosslowe et al., 2022).

The uneven distribution of renewable energy resources across the Asia-Pacific means that regional electricity cooperation could allow a smoothing of resource availability and hence contribute to higher levels of renewable penetration (Do and Burke, 2022). For instance, in Southeast Asia, hydro resources are concentrated in Myanmar and several lower Mekong countries, especially Cambodia and Laos. Significant geothermal potential is found along the ‘ring of fire’ regions in Indonesia and the Philippines. Large wind potential lies in the mountainous areas of Laos and Thailand, and coastal areas of Vietnam. Most bioenergy potential is in Indonesia, Malaysia and Thailand, where the size of the agricultural sector is relatively large as compared with other countries in the region. Solar energy appears to be the only exception where its potential is distributed more evenly across the region, due to its tropical environments (UNESCAP, 2019b).

A study conducted by the International Energy Agency found that interconnections could be a main source of system flexibility in the region that helps lower the operational costs (about 15%) for the electricity systems across the region while ensuring supply sufficiency and reliability. It also found that multilateral electricity trade would allow better utilisation of cross-border interconnectors (utilisation rates increase from 60% to 90%) when compared with bilateral trade (IEA, 2019c). A more recent study found that the lack of interconnections could significantly limit the uptake of renewable energy in some areas of Southeast Asia, such as the island of Java, home to roughly 70% of Indonesia’s electricity demand, but possesses only 4% of the solar potential (IRENA, 2022).

3. MULTILATERAL ELECTRICITY TRADE: CASE STUDIES

This section reviews the key elements (policy setting, regulatory framework, market arrangement, and trade outcomes) of multilateral electricity trade in select regional and national markets.

3.1 Mature market: Internal energy market in Europe

Policy setting: In Europe, the process of regional market integration in electricity has been initiated since the mid-1990s, as part of a wider policy to develop an internal market across the region, allowing for the free movement of goods, capital, services, and people (Haas et al., 2006). This process has taken place in four phases, each marked with the passage of a directive for electricity market reform by the European Commission (EC) in 1996, 2003, 2009 and 2019.

The start of the first phase can be identified with the passage of the *Directive for a Common Electricity Market* (96/92/EC) in 1996. This Directive was motivated by the belief that the introduction of market competition in electricity would drive down electricity prices for the whole of Europe. This phase was accordingly aimed at promoting the market reforms of the electricity industries across Europe through restructuring, re-regulation, and privatisation (Haas et al., 2006).

The second phase, marked by the passage of the second Electricity Directive (2003/54/EC) in 2003, focused on further promoting market competition by toughening regulation for access to networks and requiring the establishment of independent regulators (Jamasb and Pollitt, 2005). In 2004, the European Commission began to promote a gradual integration of national electricity markets, through a system of market coupling, whereby national markets would be merged or coordinated (Pollitt, 2019).

Prompted by growing concerns about the slow progress in the creation of a single electricity market, the third Electricity Directive (2009/72/EC) was adopted in 2009, with particular emphasis on promoting cross-border electricity trading (Pollitt, 2019). It also established a pan-European regulatory agency (*i.e.,* the Agency for the Cooperation of Energy Regulators), responsible for fostering cooperation among national regulators and monitoring cross-border competition (Pollitt, 2019).

In more recent years, the rising levels of renewable penetration has led to concerns that the rules laid down in the third Electricity Directive of 2009 could not facilitate changes required for accommodating large outputs from variable renewable energy while ensuring supply reliability and affordability. In response, the European Commission adopted *the Clean Energy for All European Package* in 2019, with specific emphasis on improving the flexibility of the electricity systems to better manage the variability and uncertainty of renewable energy (IEA, 2020a).

Regulatory framework: The electricity industries of European Union (EU) member countries are regulated by their national regulators. The Agency for the Cooperation of Energy Regulators (ACER), created in 2011 by the third Energy Package Legislation (including the Electricity Directive 2009/72/EC), provides a platform for national energy regulators to coordinate their actions with each other. It also has the mandate to coordinate regulatory decisions on cross-border issues that are vital for market integration, and to promote effective implementation of common market rules (IEA, 2020a). Another institution, the Association of European Transmission System Operators (ENTSO-E), was also created by the third Energy Package Legislation, with the mandate to enhance cooperation between Transmission System Operators (TSOs) across Europe, and to provide technical assistance in the development of a pan-European electricity transmission network.

To promote better coordination and information-sharing between TSOs, ENTSO-E has overseen the creation of several regional security coordinators (RSCs), responsible for assisting TSOs in system operation and planning by, for example, undertaking coordinated security analysis to identify risks of operational security and the most efficient measures for risk mitigation, and coordinating short- and medium-term resource adequacy assessments across various TSOs (ENTSO-E, 2021). Some efforts have also been made in more recent years to strengthen regulatory coordination across Europe. In 2020, for example, national energy regulators for 13 EU countries requested ACER to develop common methodologies for coordinating and sharing the costs of electricity re-dispatching and countertrading across 16 TSOs (IEA, 2020a).

In addition, the EU Regulation 2019/943 (as part of the Clean Energy Package of 2019) requires national capacity remuneration mechanisms (CRMs) to be justified based on resource adequacy concern identified and compared against reliability standards and regional and national resource adequacy assessments (ACER, 2020). This regulation also stipulates the development of plans for managing potential outage-contingencies across Europe. These plans use common methods to identify the possible electricity crisis scenarios, at both national and regional levels, and to develop risk preparedness plans with national measures that will be taken to prevent, prepare for and mitigate potential electricity crises (IEA, 2020b).

Facilitating better coordination across Distribution System Operators (DSOs) remains a difficult task in Europe. This difficulty primarily arises from the fact that the region's distribution network is operated by over 2,500 DSOs and these DSOs differ significantly with each other in terms of customer base, ownership structure, and governance framework. This difference makes the design of a region-wide approach for the operation and planning of distribution networks difficult (IEA, 2020b).

Market arrangement: Electricity trade in Europe is organised around three markets, namely, day-ahead, intra-day, and balancing. The day-ahead markets are operational on the day before the actual dispatch. The intra-day markets are operational during the time between the settling of contracts on the day-ahead markets and physical delivery. They are used by market participants to correct unexpected supply-demand imbalances that arise during the day because of load or generation variations. The balancing markets are operated by the system operators to balance supply and demand in real time (Algarvio et al., 2019).

Substantial progress has been made to integrate the day-ahead markets across Europe, leading to the creation of several sub-regional markets (*e.g.*, APX, Belpex, EPEX SPOT, GME, Nord Pool Spot, OMIE, OTE) that cover more than 85% of the region's power system [29]. Several initiatives have also been taken to integrate the intra-day and balancing markets. For instance, the Frequency Containment Reserves Cooperation project was initiated by ten TSOs in 2017 to establish a coordinated market for the procurement and exchange of balancing capacity (IRENA, 2019). In 2018, four power exchanges (EPEX Spot, GME, Nord Pool, and OMIE) together with the TSOs from eleven countries initiated the Cross-Border Intra-Day project, with a view to establish a regional intra-day market that could enable continuous cross-border trading of balancing services (IRENA, 2019).

Despite these initiatives, creating a fully-integrated market for electricity remains a task to be completed in Europe. In the intra-day markets, for example, significant differences are found in gate-closure times, duration of trading interval, allocation of interconnection capacity, and trading arrangements (auction or continuous) across Europe (Algarvio et al., 2019; Behar and Sauvage, 2013). Large differences are also found in the pricing (for example, pay-as-bid, marginal pricing, and regulated price) and bidding (such as, mandatory offers, and precontracted offers) mechanisms of balancing markets across the region (Algarvio et al., 2019).

In addition, some European countries still retain some forms of retail price regulation (such as price caps), especially for small household consumers. Regulated retail prices may distort price signals, and hence, adversely affect the cross-border trade of electricity. The Clean Energy Package of 2019 requires a gradual removal of retail price regulation. But it remains a question whether this requirement could be effectively fulfilled, especially considering that the same legislation also allows the EU member countries to retain price regulation for vulnerable consumers (IEA, 2020b).

Trade outcomes: The volume of cross-border electricity trade has increased steadily, especially after the mid-to-late 1990s, when the creation of an internal market for electricity began (see Figure 1). As shown in Table 1, Germany, France, and Sweden are leading exporters in the region and exported over 36 TWh of electricity in 2020. Some European countries – Estonia, Lithuania, and Luxembourg – are heavily reliant on imports for satisfying their electricity needs, where net imports represent over half of their electricity consumption. Electricity imports also play an important role in satisfying the electricity needs in Denmark, Finland, Hungary, Greece, Latvia, and Malta, with net imports accounting for over 15% of their electricity consumption in 2020. **Error! Reference source not found.**Germany and Italy also import large amounts of electricity (over 40 TWh in 2020) from neighbouring countries.

Figure 1: Cross-border electricity trade in Europe, 1990-2020

Source: IEA (2022)

Table 1: Cross-border electricity trade in Europe, 2020

	Imports (GWh)	Exports (GWh)	Consumption (GWh)	Net imports (GWh)	Net imports as % of consumption
Austria	24,522	-22,327	63,577	2,196	3%
Belgium	13,722	-14,055	80,748	-333	0%
Bulgaria	3,707	-7,115	29,817	-3,408	-11%
Croatia	10,491	-5,852	15,578	4,639	30%
Cyprus	-	-	4,384	-	0%
Czech Republic	13,368	-23,521	58,498	-10,153	-17%
Denmark	18,594	-11,711	32,804	6,883	21%
Estonia	7,367	-3,723	7,540	3,644	48%
Finland	21,647	-6,671	78,144	14,976	19%
France	19,536	-64,575	420,356	-45,039	-11%
Germany	47,853	-66,882	490,054	-19,029	-4%
Greece	9,831	-967	48,847	8,864	18%
Hungary	19,176	-7,499	41,083	11,677	28%
Ireland	1,761	-1,913	28,784	-152	-1%
Italy	39,790	-7,590	283,815	32,200	11%
Latvia	4,173	-2,548	6,689	1,626	24%
Lithuania	12,013	-4,105	11,155	7,909	71%
Luxembourg	6,543	-1,079	6,120	5,465	89%
Malta	420	-4	2,368	416	18%
Netherlands	19,773	-22,433	113,994	-2,660	-2%
Poland	20,624	-7,357	148,241	13,267	9%
Portugal	7,553	-6,097	47,179	1,456	3%
Romania	8,252	-5,459	48,063	2,792	6%
Slovakia	13,289	-12,970	24,695	319	1%
Slovenia	7,120	-9,123	13,046	-2,003	-15%
Spain	17,928	-14,649	227,172	3,280	1%
Sweden	11,827	-36,824	125,678	-24,997	-20%

Source: Eurostat (2022)

3.2 Transition market: Southern African Power Pool

Policy setting: Cross-border trade of electricity in southern Africa can be traced back to the 1950s and 60s, when several countries reached bilateral agreements with each other, typically on a medium- to long-term basis to exchange electricity with predefined volume, price, and other requirements (*e.g.*, reliability requirements) (Wright and van Coller, 2018). Further efforts were made in the 1990s to promote regional electricity cooperation across the region with the creation of the Southern African Power Pool (SAPP) in 1995, when member countries of the Southern African Development Community (SADC), excluding Mauritius, signed an Intergovernmental Memorandum of Understanding (MoU) for establishing a regional electricity market (Wright and van Coller, 2018).

These efforts were made in the backdrop of severe droughts in the early 1990s that hit hydro-dominated southern African countries, such as Zambia, Malawi, and Zimbabwe. The outcome had been major power shortages, which highlight the need for connecting with the thermal-rich South Africa to allow synergistic sharing of complementary resources, to improve supply reliability and security (Medinilla et al., 2019). The end of the apartheid regime in South Africa also contributed to closer regional cooperation (Medinilla et al., 2019).

The SAPP started to operate in the early 2000s, mainly as a short-term collaborative market for the exchange of surplus generating capacity between national electric utilities of the region (Musaba, 2005). As the region's surplus generating capacity was gradually absorbed by rising electricity demand in the second half of the 2000s, supply security once again became an important policy issue. To address this issue, South Africa sought to promote the expansion of domestic supply capacity, mainly because of the substantial delays in the construction of large hydropower projects in its neighbouring countries and the urgent need to respond to looming power shortages (Mbirimi, 2010). South Africa's national electric utility – Eskom – also re-negotiated its supply contracts with other countries of the region to ensure that it could block electricity export if its own supply came under pressure.

As South Africa looked inwards for maintaining supply security, other countries of the region also sought to secure electricity supply independently from South Africa, mainly through national or bilateral arrangements (Prinsloo, 2019). Botswana, for example, built the Morupule power station as a means of redressing the electricity security challenge. It also secured some short-term supply capacity from independent power producers (IPPs) (Prinsloo, 2019). Namibia procured some supply capacity from Zimbabwe and Angola based on bilateral agreements. It also provided financial support to rehabilitate some aging power stations (*e.g.,* the Hwange Power Station) in Zimbabwe to meet its own electricity needs (Prinsloo, 2019).

To revive the SAPP, its market architecture was restructured with the introduction of a day-ahead market in 2009 and intra-day and forward markets in the following years (Wright and van Coller, 2018). The support of South Africa is widely considered critical for the revival of SAPP. The following excerpts from (Medinilla et al., 2019) should support this viewpoint: 'South Africa was instrumental in the creation of the SAPP…used the SAPP to foster dialogues between stakeholders around the development of the Inga hydropower schemes in the DRC (Democratic Republic of the Congo)…without South Africa's support and commitment to buying off significant quantities to be developed at the Mmamabula project, it is simply not feasible for other countries to invest the initial capacity…due to lack of domestic energy demands'.

Regulatory framework: The electricity industries of each of the Southern African countries are regulated by their national regulators. The SAPP coordinates the planning and operation of the power systems across these countries, mainly through the Coordination Centre created in 2002 (Medinilla et al., 2019). SAPP's Coordination Centre is widely considered to be well-developed and transparent, able to effectively promote the regional energy agenda and cooperation (Vanheukelom and Bertelsmann-Scott, 2016). This stands in stark contrast to many other regional institutions in Africa that have struggled to fulfil their mandates and responsibilities, mainly because of a lack of human and financial resources (Deloitte, 2015; Kessides, 2012), and limited power to enforce their decisions (Eberhard et al., 2011).

To promote regional power connectivity, the SAPP developed a Regional Generation and Transmission Expansion Plan in 2001, which was updated in 2009. It identified 21 generation projects (including Inga 3 in DRC, and several hydropower projects in Mozambique and Zambia) and 12 transmission projects. In 2013, the SADC Energy Ministers approved the identified projects and committed to fast track their execution (World Bank, 2014). Besides project planning, the SAPP is also mandated to promote their execution, as set out by the 2008 SADC Communique. To fulfill this mandate, the

Coordination Centre is responsible for facilitating regional power projects by seeking consensus and authorisation at government level on the individual projects (World Bank, 2014).

The Regional Electricity Regulatory Association (RERA), established in 2002 under the aegis of the SADC secretariat, is responsible for facilitating policy and regulatory harmonisation across southern Africa, promoting coordination between national regulators of the member countries, and providing training and technical support to these national regulators.

Market arrangement: The SAPP coordinates the power systems of twelve SADC countries. It started in 2001 with the Short-Term Energy Market (STEM), a collaborative market where all participating countries trade surplus capacity with each other. The STEM was discontinued and succeeded in 2009 by the Day Ahead Market (DAM). The DAM is a competitive regional energy market that trades hourly contracts for the following day inclusive of existing bilateral contracts (cleared first), transmission capacity constraints and wheeling transmission fees (SAPP, 2021). In 2015, the Intra Day Market (IDM) was created to complement the DAM by enabling market participants to trade with each other until one hour before actual delivery. This allows market participants to correct unexpected supply-demand imbalances which arise during the day because of load or generation variations (SAPP, 2021). The forward physical market was created in 2016, where weekly and monthly contracts are traded for future delivery (SAPP, 2021).

Trade outcomes: The volume of electricity traded in SAPP's competitive market increased significantly over the period from 27 kWh in 2010/11 to over 2,000 kWh in 2018/19 (SAPP, 2019). Consequently, the share of cross-border electricity trade through a competitive electricity market increased from almost negligible in the early 2010s, to more than 30% in 2018/19 (SAPP, 2019). This trend can be explained by the ability of the SAPP to facilitate the trade of flexible contracts that provide a useful solution for Southern African countries to redress short-term variations in supply and demand (UNCTAD, 2017).

Nonetheless, bilateral contracts have continued to dominate cross-border electricity trade in the SAPP. As explained by Rose *et al.,* (2016, p4), 'bilateral contracts are favoured among power purchasers because they provide guaranteed electricity supply during scarcity events…and priority access to the transmission network to sell their power. By contrast, DAM, and IDM trades face high levels of uncertainty as to whether their bids will be matched in the market and, if matched, whether the trades will be technically feasible as a result of transmission constraints…'. Another explanation is that small electricity importers and exporters in the region fear being exposed to the risks of short-term regional market volatility in the IDM. They therefore tend to conduct cross-border electricity trade based on long-term bilateral contracts (Oseni and Pollitt, 2016).

3.3 Emerging markets: ASEAN Power Grid

Policy setting: Southeast Asian countries have engaged in the integration of electricity markets across the region since the early 1990s, through the implementation of a series of plans of action (for example, ASEAN Plan of Action for Energy Cooperation), motivated by its conviction that a greater level of market integration in electricity would contribute to a more reliable and sufficient supply of electricity – essential for the creation of an integrated, competitive and resilient ASEAN Community (ASEAN, 1999). In 1991, for example, the *Programme of Action for Enhancement of Cooperation in Energy* was endorsed by the Tenth Meeting of the ASEAN Economic Ministers on Energy Cooperation, which highlighted the importance of energy market integration in the region. Such importance was further underscored in the *ASEAN Medium Term Programme of Action on Energy Cooperation (1995-1999)* endorsed in 1995, which called for a more focused approach to energy integration in the areas of electricity, coal, oil, gas, renewables, and energy efficiency, through the creation of regional coordinating institutions in each of these areas (ASEAN, 1999).

Actions for promoting regional energy integration culminated in 1997 with the adoption of the *ASEAN Vision 2020*, which called for closer regional cooperation to 'establish interconnecting arrangements for electricity, natural gas and water within ASEAN through the ASEAN Power Grid and a Trans-ASEAN Gas Pipeline, and promote cooperation in energy efficiency and conservation, as well as the development of new and renewable energy resources' (ASEAN, 1999).

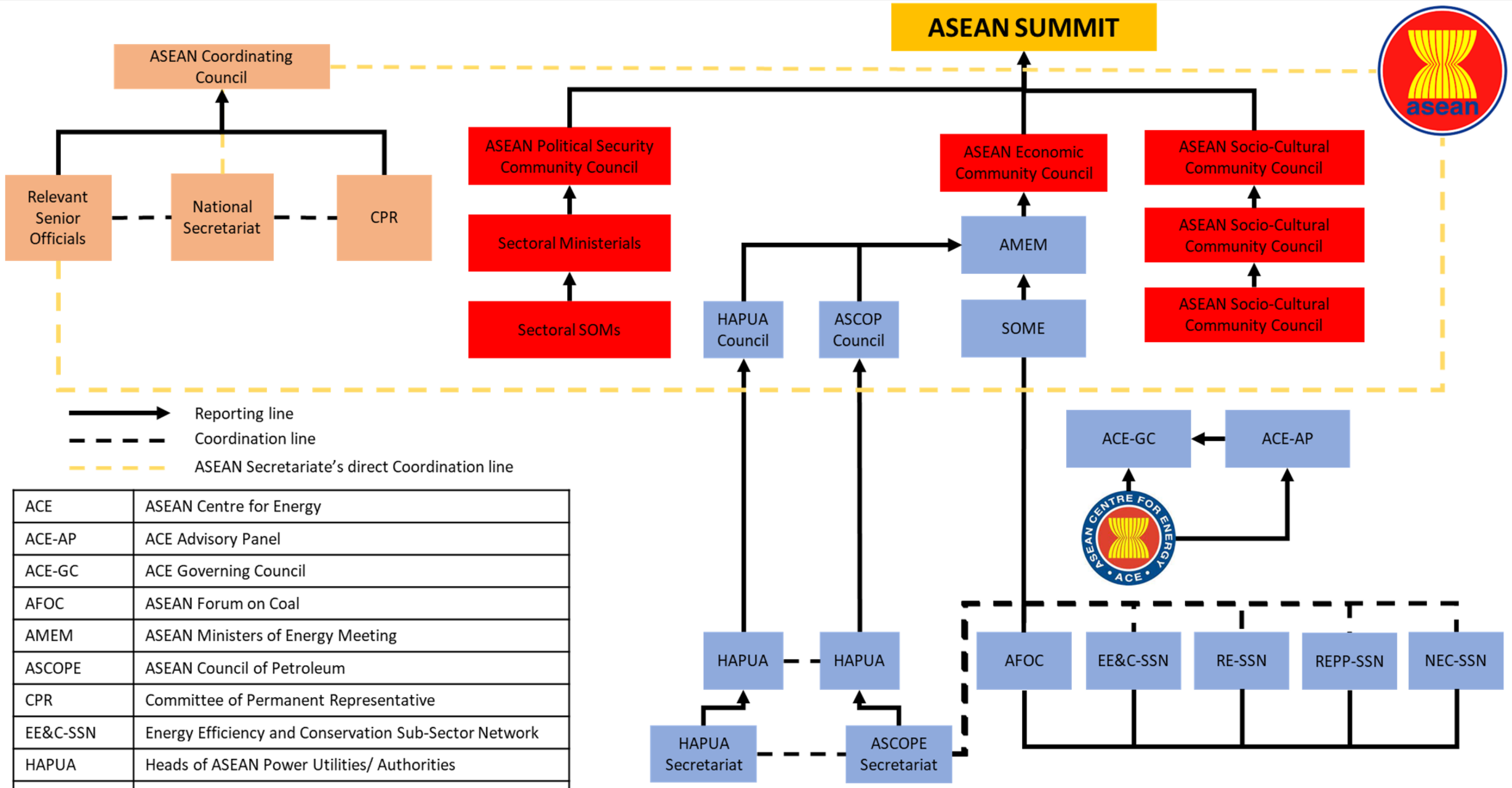
Regulatory framework: The ASEAN Vision 2020 has been translated into the five-year *ASEAN Plans of Action for Energy Cooperation (APAEC)*. Several arrangements – the ASEAN Ministers of Energy Meeting, and the Heads of ASEAN Power

Utilities/Authorities (HAPUA) – have also been made to coordinate their implementation (AEC, 2015). The ASEAN Centre for Energy, created in 1999, is responsible for providing technical support to ASEAN member countries in the pursuit of energy cooperation and integration (AEC, 2015). ASEAN Power Grid Consultative Committee, established in 2007 under the auspices of the HAPUA, is responsible for strengthening and promoting a broad framework or ASEAN member countries to cooperate towards the development of a common ASEAN policy on power interconnection and trade. Its current focus is to prepare the establishment of the ASEAN Electricity Exchange, where multilateral electricity trade takes place between electric utilities across the region. Further details about the regulatory framework in Southeast Asia are provided in Figure 2, where institutions deeply involved in promoting regional energy cooperation are depicted in blue.

Market Arrangement: In the context of electricity, the APAEC envisages the development of an ASEAN Power Grid (APG) that will cover all member countries of ASEAN, divided into three subsystems. The Upper West System, located in the Greater Mekong Subregion (GMS), will cover Cambodia, Laos, Myanmar, Thailand, and Vietnam. The Lower West System will include Peninsular Malaysia, Singapore, Sumatra Indonesia, and Thailand. The East System will encompass Brunei, Malaysia (Sabah and Sarawak), Indonesia (West Kalimantan), and the Philippines (ACE, 2016).

To create the APG, an ASEAN interconnection master plan (AIMS) working group was established in 2000 and released its first plan in 2003. This plan was updated in 2010 with the release of the second master plan. The third master plan is currently under development, and it will update the AIMS II to support renewable uptake and upgrade power connectivity from bilateral to multilateral electricity trade (ACE and HAPUA, 2021). A gradual approach has been adopted in these plans for developing the APG: first creating three separate interconnected subsystems (as noted above) and then integrating them into one single regional power grid (Ahmed et al., 2017).

Figure 2: Regulatory framework in Southeast Asia



ACE	ASEAN Centre for Energy
ACE-AP	ACE Advisory Panel
ACE-GC	ACE Governing Council
AFOC	ASEAN Forum on Coal
AMEM	ASEAN Ministers of Energy Meeting
ASCOPE	ASEAN Council of Petroleum
CPR	Committee of Permanent Representative
EE&C-SSN	Energy Efficiency and Conservation Sub-Sector Network
HAPUA	Heads of ASEAN Power Utilities/ Authorities
NEC-SSN	Nuclear Energy Cooperation Sub-Sector Network
RE-SSN	Renewable Energy Sub-sector Network
REPP-SSN	Regional Energy Sub-Sector Network
SOME	Senior Officials Meeting on Energy

Source: ACE (2022)

Trade outcomes: Southeast Asia has made steady progress towards regional electricity cooperation and integration with the construction of several large hydroelectric and interconnection projects, supported by long-term bilateral agreements. The region has also started a 'pathfinder' trial (*i.e.* LTMS-PIP) on electricity export of up to 100 MW of hydro electricity from Laos to Singapore via Thailand and Malaysia (ASEAN Centre for Energy, 2020).

3.4 Electricity market reforms: Some additional examples

3.4.1 China

Policy setting: The electricity industry was historically considered by the Chinese government as an important tool to serve wider development objectives of promoting rapid economic growth and improving peoples' living standards. The electricity industry was therefore identified as strategically important, and therefore remained in public control (Zweig, 2010). The early 1980s, however, saw rising electricity demand, driven by rapid economic growth. The central government was unable to provide required investments to satisfy this demand. The result was power shortages throughout the country. Between 1984 and 1993, for example, electricity production in China fell short of demand by about 20 per cent (Li and Dorian, 1995).

Chronic power shortages created a bottleneck for economic and social development. In response, in 1985, the central government issued the *Provisional Regulation on Promoting Fund-Raising for Investment in the Power Sector and Implementing Different Power Prices*. This regulation terminated the exclusive rights of the central government to invest in the electricity industry, and allowed other investors (especially, local governments) to invest in the generation sector; this was consistent with the intention of retaining public control of the industry as noted above (Yeoh and Rajaraman, 2004).

Further efforts were made to deepen market reform in 2002, with the release of a policy document known as the 'Document No.5'. The State Power Corporation (SPC) was unbundled and its generation assets were assigned into five generation companies – the 'big five' – and its transmission and distribution assets were allocated into two grid companies, namely, the State Grid company, and South China Grid company (Xu and Chen, 2006).

But these efforts were stifled in 2003 when severe power shortages afflicted the country. In 2004, 25 of China's 31 provinces and major municipalities sustained significant power losses. The power deficit was estimated to be 10 per cent of installed capacity. Industry experienced forced closures and consequential economic losses; and households felt the impact of a significant reduction in basic comfort levels. The Chinese government felt that their main priority for the electricity industry – sufficient power supply to support economic growth and living standards – was threatened. They immediately put market reforms on halt and shifted to encouraging investments in new power projects (Wang and Chen, 2012).

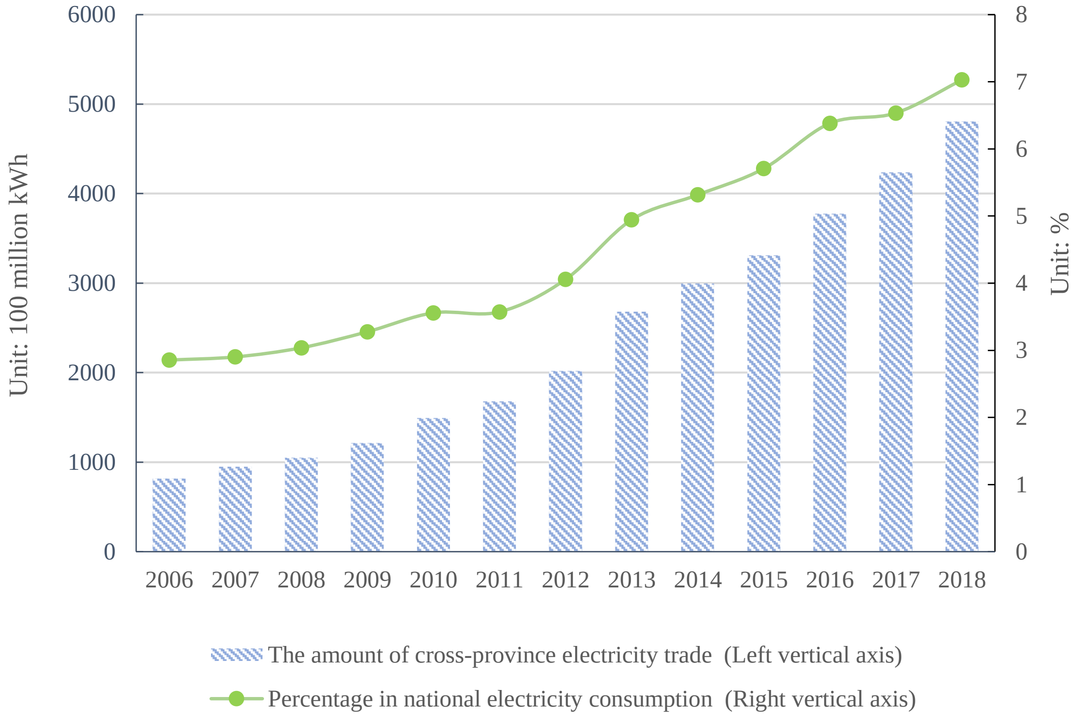
In 2015, the Central Committee of the Communist Party of China and the State Council jointly issued the Several Opinions on Further Deepening Power Sector Reform, aimed at improving the efficiency of electricity supply, mainly through the establishment of a 'fair, normative, efficient, competitive, open-access, and non-discriminative' market for electricity trading (Guo et al., 2020). In 2022, the National Development and Reform Commission (NDRC) and the National Energy Administration (NEA) issued the Guiding Opinions on Accelerating the Establishment of a Unified National Electricity Market Reform, with particular emphasis on accelerating the marketisation process in the electricity industry. The creation of a nation-wide electricity market is expected to have positive impact on interregional and interprovincial electricity trade that could help facilitate the transport of electricity produced in the resource-rich western provinces (for example, wind and solar in Inner Mongolia and Qinghai, and hydro in southwest provinces) to the eastern coastal city-clusters, and improve the utilisation of renewable energy (Guo et al., 2020; Li et al., 2021).

Regulatory framework: Two central agencies are responsible for determining the direction of China's electricity policy at the national level, namely, the National Development and Reform Commission (NDRC) and the National Energy Administration (NEA). Local authorities also play an important role in the governance of the electricity sectors within their own jurisdictions, especially for system planning and operation, and project approval (IEA, 2018). There, however, appears to be limited coordination between local authorities, making interregional and interprovincial electricity trade difficult. Most interregional and interprovincial electricity trade has, therefore, been conducted based on long-term plans or deals made directly between provincial governments. One issue associated with this arrangement is system inflexibility, as local system operators often take the yearly interregional and interprovincial trading plans proposed by the State Grid Company as mandatory, though it is supposed to be an indicative guideline. In 2022, when hydro-rich province Sichuan was hit by a major supply shortfall because of less-than-expected rainfall, it still exported some electricity to north China, to fulfill the interregional trading plans.

Market arrangement: There are currently two national power exchange centres – Beijing and Guangzhou Power Exchange Centres – and 32 provincial power exchange centres that cover all provinces of mainland China (Guo et al., 2020). Besides planned trade, interregional and interprovincial electricity trade is also facilitated through the national power exchange centres, where policy-based electricity transactions (*e.g.*, West-East Electricity Transmission Project), direct power purchasing (DPP) between generators and large consumers or retailers, and trade of forward contract are conducted (Guo et al., 2020).

Trade outcomes: Cross-province trade in electricity has increased substantially in China over the period 2006-2018, from less than 100 TWh in 2006, to over 480 TWh in 2018 (see Figure 3). This is comparable to the world's tenth largest electricity consumer – France. In 2021, interregional and interprovincial electricity trade in the Beijing Power Exchange Centre registered a 7.3% year-on-year increase, reaching 1,240 TWh. The same year also witnessed record growth of interregional and interprovincial electricity trade in the Guangzhou Power Exchange Centre, which rose to 67 TWh, a more than 90% increase from the previous year (Sun et al., 2022). Despite this growth, substantial difference in the market arrangements across provincial electricity exchange centres, lack of cross-province coordination in system operation, and insufficient network infrastructure are still restricting further progress toward interregional and interprovincial electricity trade in China.

Figure 3: Cross-province electricity trade in China, 2006-2018



Source: Li *et al.*, (2021)

3.4.2 India

Policy setting: The 1980s saw a considerable increase in the Indian government's fiscal deficit. It reached more than 10 percent of the GDP in the late 1980s (Ganguly and Mukherji, 2011). The balance-of-payment crisis broke out in 1991, as the Indian government could not guarantee its debt repayments, and consequently the international banks lost their confidence in the country. This crisis was further exacerbated by the collapse of India's important trade partner (the Soviet Union) in 1990, and rising oil bills in the early 1990s caused by the Iraq War (Tenhunen and Saavala, 2012). India turned to the International Monetary Fund (IMF) for financial assistance to avoid defaults on loans. As part of the conditions for receiving such assistance, the Indian government agreed to implement market reforms that led to several legislative changes made in the 1990s and 2000s, with specific emphasis on reducing the role of the government in the electricity industry.

In 2003, the central government sought to deepen electricity market reforms through the enactment of the Electricity Act of 2003. This Act emphasised private ownership, market mechanisms for electricity trading, elimination of subsidies and price control, and identified a sector-specific regulator for overseeing the operation of power systems

(Sen and Jamasb, 2013). These reforms have however only been partially implemented. In some areas (such as, encouragement of private investment), reforms have been implemented with relative ease, while in others (particularly, removal of price subsidies) there has been strong resistance. Most of the resistance comes from agricultural interests that fear market-based pricing would reduce the amount of subsidies they receive on their electricity consumption (Sen and Jamasb, 2013).

The partial reform has indeed encouraged large private investments in electricity generation, resulting in a more than fivefold increase in generation capacity over the period 1992-2022, from 78 GW in 1992, to 408 GW in 2022 (MoP, 2022). With this remarkable capacity expansion, total electricity shortages fell from 10.1% in 2009-10, to less than 1% in 2021-22. The same time period also saw a significant reduction in peak shortages from 12.7% to 1.2% (MoP, 2022). Despite this improvement, however, the electric utilities (State Electricity Boards, SEBs) have continued to register large financial losses and hence accumulated large debts. These debts amounted to around $6.25 billion in 2015-16 (Ghosh et al., 2021). As a result, most SEBs could not pay generators on time and are reported to have nearly $5.7 billion outstanding in dues to power generators in 2019 (R. K. Singh, 2019).

Regulatory framework: India's electricity sector is jointly governed by the central and state governments. In the central government, the Ministry of Power is the lead agency responsible for determining the direction of India's electricity policy. The Central Electricity Authority (CEA) advises the Ministry of Power on all technical and techno-economic matters associated with the electricity sector. The Central Electricity Regulatory Commission (CERC), established under the *Electricity Regulatory Commissions Act of 1998,* is responsible for regulating electricity prices for generation companies owned by the central government and for those that supply electricity to more than one state. It also regulates the inter-state transmission of electricity. The CERC issues licenses for inter-state transmission and trading and promotes the development of the electricity market. Besides these central agencies, all Indian states have also constituted State Electricity Regulatory Commissions (SERC) for carrying out functions like the CERC within their own jurisdictions.

Market arrangement: Electricity trade in India is dominated by long-term supply contracts between generators and SEBs. To satisfy the demand for electricity in their systems, the SEBs 'self-dispatch' generation from the portfolio of generators with whom they hold long-term supply contracts. The SEBs sometimes also trade electricity in power exchange markets or with utilities in other Indian states based on bilateral agreements, in order to adjust their contract obligations to the current demand by purchasing the shortfall in electricity or selling the surplus (CERC, 2018). There are two power trading platforms in India: Indian Energy Exchange (IEX) and Power Exchange India Limited (PXIL). Both platforms offer electricity products for day-ahead and term-ahead trading. The third trading platform, Hindustan Power Exchange (HPX), is currently under development and will come online upon approval from the CERC.

Trade outcomes: Cross-state electricity trade has been quite limited across India, and net imports of electricity accounted for less than 2% of the electricity consumed in 2019-20 (see Table 2). One of the main causes is the self-dispatching mechanism through which the SEBs schedule generation on a day-ahead basis from amongst their portfolio of contracted generators. This mechanism presents the SEBs from sharing the generation resources across the country, as they often do not have the right to schedule cheaper generators from other states with whom they do not have a contract (CERC, 2018). The Ministry of Power has recently proposed to create a nation-wide market arrangement for electricity trading, where the SEBs could choose cheaper generators from outside their portfolio (K. Singh, 2019).

Table 2: Electricity imports, exports, and consumption in India, 2019-20

	Exports (GWh)	Imports (GWh)	Net imports (GWh)	Consumption (GWh)	Net imports as % of consumption
Northern	2,517	4,229	1,713	312,608	0.5%
Western	6,036	1,628	-4,408	312,199	n.a.
Southern	1,397	1,148	-249	299,444	n.a.
Eastern	333	2,209	1,876	116,583	1.6%
North-Eastern	101	135	34	11,512	0.3%

Notes:
1. *Northern region* includes Chandigarh, Delhi, Haryana, Himachal Pradesh, Jammu & Kashmir & Ladakh, Punjab, Rajasthan, Uttar Pradesh, and Uttarakhand; *Western region* includes Chhattisgarh, Gujarat, Madhya Pradesh, Maharashtra, Daman & Diu, Dadar & Nagar Haveli, Goa; *Southern region* includes Andhra Pradesh, Telangana, Karnataka, Kerala, Tamil Nadu, Puducherry, and Lakshadweep; *Eastern region* includes Bihar, Jharkhand, West Bengal, Odisha, Sikkim; and *North-Eastern region* includes Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, and Tripura.
2. n.a. means not available as the region is a net exporter.

Source: (CEA, 2021)

3.5 Summary

Key features of multilateral electricity trade in the electricity markets discussed above are summarised in Table 3. Some observations, based on a review of the table, are as follows.

Policy setting

- In Europe, progress towards multilateral electricity trade has primarily been driven by EU legislation (*e.g.,* directives, and regulations) introduced as part of the economy-wide reform program to create a European single market, in which the free movement of goods, capital, services, and people is assured.
- In Southern Africa and Southeast Asia, multilateral electricity trade has been pursued through the signing of a series of intergovernmental agreements under the auspices of regional institutions (*e.g.,* SADC, ASEAN). These agreements, though not legally binding, express the commitment of the governments to promote regional cooperation.
- Prompted by concerns about power shortages in the 1980s and its crippling impact on socio-economic progress, China initiated electricity market reform in the early 1990s, with specific emphasis on encouraging investments for capacity expansion, predominantly from public sources (non-central government). In the early 2000s, some further attempts were made to introduce market competition in generation, mainly through industry restructuring and the creation of wholesale electricity markets. In more recent years, efforts have been made to accelerate the process of electricity marketisation with a view to create a national unified electricity market.
- In India, electricity market reform initially focused on encouraging investments in generation in the form of IPPs, with the aim of alleviating severe power shortages. In the early 2000s, the central government sought to consolidate electricity reforms undertaken at the state level by enacting the Electricity Act of 2003 that emphasised private ownership, market mechanisms for electricity trading, elimination of subsidies and price control, and identified a sector-specific regulator for overseeing the operation of power systems.

Table 3: Multilateral electricity trade: Key features

	Europe: IEM	Southern Africa: SAAP	Southeast Asia: APG	China	India
Policy setting	- Regional electricity cooperation as part of the wider economic reform to create a single internal market of the European Union (EU) - Facilitated through EU legislations	- Regional electricity cooperation facilitated through intergovernmental agreements - Strong support from South Africa, the largest economy in the region	- Regional electricity cooperation is high on the regional policy agenda - Facilitated through intergovernmental agreements (*e.g.*, ASEAN Vision 2020)	- Initial focus: capacity expansion - Shift towards marketisation in more recent years - Call for the creation of a unified national energy market in 2022, as part of the efforts to rebuild the power system around renewable energy	- Focus on investment attraction in the 1990s - Further reform after the enactment of the Electricity Act 2003 that emphasises private ownership, market competition, elimination of price subsidies, and independent regulation
Regulatory framework	- Formal institutions (*e.g.*, AER, ENTSO-E) created to coordinate national regulators and grid operators	- Coordination in system planning and operation facilitated by SAPP's Coordination Centre - RERA for coordinating national regulators	- APAEC for progressing regional energy cooperation - HAPUA responsible for coordinating APAEC's implementation	- Significant local autonomy in system operation and planning - Some coordination provided by central authorities and national grid companies	- Significant state autonomy in system operation and planning - CERC mainly responsible for regulating power assets owned by the central government and interconnections
Market arrangement	- Harmonised sub-regional markets, especially for day-ahead trading - Significant differences remain in the intra-day and balancing markets	- Regional market that offers day-ahead, intra-day and forward products - Differentiated national market supplemented by regional market	- Bilateral trade based on long-term PPAs - Trial on multilateral trade from Laos to Singapore via Thailand and Malaysia	- Interprovincial trade predominantly based on long-term plans or deals between provincial authorities - Two national power exchange centres for cross-province trade	- Limited scope of cross-state trade, mainly caused by state utilities' *self-dispatch* mechanism - Two trading platforms for cross-state electricity transactions

Continues the next page

	IEM	SAAP	APG	China	India
Trade outcomes	- Steady increase in cross-border electricity trade	- Dominated by bilateral trading - Steady increase in short-term trading	- Dominated by bilateral trading - Starting to trial cross-border trade via third countries' networks	- Substantial increase in cross-province trade	- Limited cross-state trade

Notes: IEM: Internal Energy Market in Europe; SAAP: Southern African Power Pool; APG: ASEAN Power Grid; APAEC: ASEAN Plans of Action for Energy Cooperation; HAPUA: Heads of ASEAN Power Utilities/Authorities; PPAs: Power Purchase Agreements; and CERC: Central Electricity Regulatory Commission.

Source: developed by the authors based on discussion presented in Section 3.

Regulatory framework

- In Europe, legal entities (*e.g.*, ACER) have been created to coordinate national regulators and network operators across the region.
- The Southern African Power Pool (SAPP), established in 1995 by an intergovernmental Memorandum of Understanding to form a regional electricity market, is entrusted with the responsibility of coordinating the planning and operation of the power systems across the region. A regional regulatory association (*i.e.*, RERA) has also been created under the aegis of the Southern African Development Community Secretariat to provide a platform for national regulators to cooperate with each other.
- There is no regional electricity regulator or system planning coordinator in Southeast Asia. Instead, some arrangements have been made to coordinate the implementation of the regional action plans for energy cooperation (*i.e.*, APAEC) that envisions the creation of a region-wide electricity grid, called the ASEAN Power Grid. These arrangements include: the ASEAN Ministers of Energy Meeting, and the Heads of ASEAN Power Utilities/Authorities, the ASEAN Centre for Energy, and the ASEAN Power Grid Consultative Committee.
- In China, local authorities have significant autonomy in the governance of the electricity sectors within their own justifications with limited coordination. In such settings, interregional and interprovincial electricity trade has been largely undertaken based on inflexible long-term plans developed by central authorities or national grid companies, or deals made directly between provincial governments.
- In India, the Central Electricity Regulatory Commission (CERC) is entrusted with the responsibility of regulating interconnections and electricity prices for generation companies that supply more than one state. All Indian states have also constituted their own state electricity regulators (*i.e.*, SERCs).

Market arrangement

- In Europe, multilateral electricity trade has been facilitated through several sub-regional markets. Substantial progress has been made, over the years, in harmonising the operation of these markets, especially for day-ahead trading. Nonetheless, significant differences remain in the intra-day and balancing markets.
- The market arrangements for conducting multilateral electricity trade in Southern Africa

have been built around day-ahead and intra-day trading. Forward markets, where weekly and monthly contracts could be traded, were also introduced in 2016.

- Southeast Asia has recently initiated a trial (LTMS-PIP) on electricity export from Laos to Singapore via Thailand and Malaysia using existing interconnections. It serves as a pathfinder towards multilateral electricity trade.
- In China, two national power exchange centres have been established in Beijing and Guangzhou to provide platforms for conducting cross-provincial electricity trade. Similarly, there are two power trading platforms in India – Indian Energy Exchange (IEX) and Power Exchange India Limited (PXIL) – that offer electricity products for day-ahead and term-ahead trading.

Trade outcomes

- In Europe, substantial progress towards sub-regional electricity market harmonisation, also known as market coupling, has led to a steady increase in the volume of cross-border electricity trade.
- Multilateral electricity trade in Southern Africa remains a supplement to domestic supply, despite a significant rise in its volume over the past decade. Furthermore, long-term bilateral contracts have continued to dominate cross-border electricity trade in the region, mainly due to concerns about volatility and uncertainty in the short-term regional markets.
- Southeast Asia has made steady progress towards regional electricity cooperation and started to trial electricity export from Laos to Singapore through Thailand and Malaysia.
- Despite a steady increase in the volume of cross-provincial electricity exchange in China since the mid-2000s, much of this exchange has taken place based on either long-term planning, or deals made directly between provincial authorities.
- Cross-state electricity trade in India has been almost negligible, mainly caused by the self-dispatching mechanism that prevents state utilities (*i.e.*, SEBs) from sharing supply capacity across the country, as they often do not have the right to schedule cheaper generators from other states with whom they do not have a contract.

4. SOME LESSONS AND POINTS FOR REFLECTION

Based on the case studies discussed in the previous section, this section presents some lessons that policymakers and energy planners in Asia-Pacific may like to consider for further strengthening the architecture of their regional electricity cooperation programs (Section 4.1). This section also provides a reflection on possible opportunities for accelerating the progress towards multilateral electricity trade across Asia-Pacific regions (Section 4.2).

4.1 Lessons from the case studies

Multilateral electricity trade is a key contributor to an affordable, reliable, and clean electricity future. A transition from bilateral to multilateral electricity trade could unlock considerable opportunity for capacity sharing over larger geographical areas with a diverse resource base. This could, in turn, help lower the costs of electricity supply through the exploitation of scale economies in electricity generation and supply; and enable higher levels of renewable penetration while maintaining supply reliability by taking advantage of the complementarity between different clean energy resources.

These benefits associated with multilateral electricity trade become even more attractive if one takes notice of the urgency of addressing the climate change challenge. Europe is a good example. There, multilateral electricity trade over interconnectors helps maintain supply reliability by enabling system balancing across the region when mismatch between supply and demand is geographic. A least-cost path for the European grid, as shown in (Rosslowe et al., 2022), also includes a significant expansion of interconnection capacity (at least double by 2035 compared to 2020), to enable the cost-efficient uptake of wind and solar capacities by allowing their deployment in countries with the most favourable conditions.

It is possible to attain some forms of multilateral electricity trade, even in diverse regions with a history of conflicts. The benefits (*e.g.*, cost-saving, more reliable supply, higher levels of renewable penetration) associated with multilateral electricity trade provides some potential grounds for possible regional cooperation. Almost all studies on regional electricity cooperation agree that realising these benefits requires a strong political will for all participating countries to implement necessary reforms in their national electricity markets [see, for example, 5,20,78,79]. The case studies considered in this report suggest the possibility of securing political will to attain some forms of multilateral electricity trade, even in diverse regions with troubled history.

Take Southeast Asia as an example. If there is one observation that is always made about this region, it is about its diversity. Whether it is measured in terms of living standards, economic structure, governance regimes or cultural beliefs, there is much that distinguishes one Southeast Asian country from another. Yet, despite all this diversity, the region has made steady progress towards multilateral electricity trade since the early 2000s when the APG program was initiated. This progress involves, for example, significant improvement in cross-border network infrastructure with the delivery of several major interconnection projects as set out in the regional interconnection master plan (AIMS), the initiation of trial program on multilateral electricity trade (LTMS-PIP), and a shift in the focus of the regional coordinator for electricity cooperation (*i.e.*, HAPUA) towards building institutions (*e.g.*, ASEAN Electricity Exchange) for facilitating multilateral electricity trade (see further details in Section 3.3).

Southern Africa, considered in this report, where significant progress towards multilateral electricity trade has been made (see Section 3.2 for details), is also known for its diversity. Not only does the region contain many ethnic African religions and different forms of governance, but it is also distinguished by massive disparities in wealth distribution. Even if the region's troubled history (*e.g.*, South Africa's isolation during apartheid) is put to one side for a moment, and one concentrates solely on the indicators of per capita GDP, it is clear that there are very significant differences in the underlying economic circumstances of Southern African countries.

Even in Europe, where multilateral electricity trade is widely considered as advanced as compared with most other regions, substantial diversity can be observed, especially in the socio-cultural domain. The European Union has 24 official languages and a number of other minority languages (*e.g.*, Sorbian in Germany) among its 27 member countries – a sign of significant cultural diversity. This diversity has become more pronounced in recent years, as the inflow of immigration has brought many foreign languages and cultures into Europe (Schneider and Heath, 2020). The region also has a long list of historical conflicts, where major European powers engaged in violent struggles that devastated the region.

Pursuing multilateral electricity trade as part of a broader regional cooperation is key for its progress. This could help address some of the key impediments to power connectivity, including concerns about national sovereignty, and security challenges imposed by import dependency. This transition entails the creation of regional rules (*e.g.*, grid codes and technical standards) and institutions to govern cross-border electricity transactions. However, this suggests that the governance of some electricity issues (*e.g.*, electricity pricing, congestion management, and supply sufficiency) is taken out of the scope of national policymaking, which may be at odds with some region's fundamental norms of protecting and enhancing national sovereignty. By implication, this also suggests that deeper regional cooperation on electricity is incompatible with national sovereignty.

This view, we contend, is deficient, especially if one realises that national sovereignty is in practice relative, not absolute. Indeed, in many cases, countries have shared or pooled part of their sovereignty in the pursuit of national interests, such as addressing common problems (*e.g.*, pressures from globalisation, and security threats) that cannot be easily solved in a national context (Draper, 2010; Gamble and Payne, 1996). Here, the key question is how to progress regional electricity cooperation through inter-state bargaining and strategic hedging. One possible solution is to implement it as an integral aspect of a broader regional cooperation program. This could potentially increase the scope of bargaining, and hence, create more opportunities for participating countries to discover common grounds.

Energy security concerns are another key impediment to regional electricity cooperation (Do and Burke, 2022; Huda and McDonald, 2016). Some may argue that multilateral electricity trade is a mutually dependent relationship, in which the exporting country, keen to reap the benefits of electricity trade (*e.g.*, revenues from electricity sales), would be incentivised to ensure supply security (Oseni and Pollitt, 2016). The strength of this argument, however, is weakened if one notes that any supply failure represents only missed opportunities for the exporting country but immediate economic costs (*e.g.*, power shortages, production curtailments, and job losses) for the importing country. Facilitating the transition towards multilateral electricity trade as part of a broader regional cooperation program would be an attractive strategy to address the concern about energy security. It could help create a complex regional web of interdependent relationships, spanning across various economic sectors. This could, in turn, incentivise the exporting countries to fulfill their supply commitments, to maintain their relationships with other countries of the region.

The three regional case studies – as presented in Sections 3.1 to 3.3 of this report – should lend some support to the above-noted viewpoint, *i.e.*, pursuing multilateral electricity trade as part of a broader regional cooperation is key for its progress. Indeed, the transition towards multilateral electricity trade in all the three regions has been pursued as part of a region-wide cooperation program.

Regional institutions as the strategic entry-point to garner support for multilateral electricity trade. Regional cooperation, including multilateral electricity trade, is influenced by the pursuit of interests that involve a diverse range of actors (Hooghe and Marks, 2001; Moravcsik, 1998; Taylor, 1991). They interact with each other in a myriad of ways and over different timescales, and their interests are informed by a host of ever-changing domestic (security, stability, development) and international (geo-strategy) exigencies (Borzel and van Hullen, 2015; Caballero-Anthony, 2008; Neumann, 2003). In such settings, regional institutions, responsible for promoting regional electricity cooperation, provide a platform (*i.e.*, strategic entry-point) for all relevant stakeholders, such as national regulators, utility companies, energy planners, and business groups, to interact with each other. More frequent interactions could cultivate the habit of working together and help build trust across the region. They could also help find the balance between regional cooperation and the competing sets of national interests and facilitate the identification of opportunities for deepening power connectivity based on mutual understanding, accommodations, and tacit agreements. A review of the experience with multilateral electricity trade in Europe, Southern Africa, and Southeast Asia – as presented in Sections 3.1 to 3.3 of this report – also highlights the importance of regional institutions; this review clearly shows that regional institutions have actively been involved in driving the process of regional electricity cooperation in these regions.

Multilateral electricity trade as a supplement to domestic supply may be a better fit for developing countries. Multilateral electricity trade, as demonstrated by the case studies included in this report, can take different forms. In its most basic form, two countries can trade with each other based on long-term PPAs, supported by a variant of wheeling transmission charges for the use of the third countries' networks. An example is the LTM-PIP project in Southeast Asia, where Laos exports hydropower to Singapore through Thailand and Malaysia (see Section 3.3). A more complex form of multilateral electricity trade, as seen in the SAPP, involves multidirectional trade among differentiated national markets via long-term PPAs and short-term regional markets. Here, multilateral trade takes place between national utilities of the region for the exchange of surplus capacity and strategic reserve, mainly as a supplement to local supply. Interprovincial electricity trade in China, and cross-state electricity exchange in India, as discussed in Section 3.4, also bear some resemblance to this form of multilateral electricity trade. Multilateral electricity trade becomes even more complex if market arrangements and regulatory frameworks are harmonised across the region, such as in Europe's internal energy market for day-ahead trading, as discussed in Section 3.1.

As multilateral electricity trade deepens, the complexity involved increases. This complexity arises from the need to reform national electricity markets, which may sometime incur substantial costs, especially when reforms encroach into politically sensitive policy areas and pose a major threat to entrenched interests. One example is fuel subsidies. In some resource-rich countries, fuel suppliers are providing fossil fuels to power generators at subsidised prices, as part of the efforts to ensure electricity affordability, especially for the most vulnerable. This may, however, distort the market prices and hence affect the functioning of the regional market (KAPSARC, 2020, 2018). The removal of fuel subsidies could be difficult, especially considering that it may put upwards pressure on retail electricity prices. The moribund electricity market reforms in many developing countries should lend some further credence to this viewpoint, *i.e.*, the need to implement painful reform in national electricity markets could make the transition towards multilateral electricity trade difficult.

It is therefore plausible to argue that multilateral electricity trade as a supplement to local supply may be a better fit for developing countries. This form of multilateral electricity trade involves fewer requirements for technical and regulatory harmonisation that often entails painful reforms in national electricity markets. It also fits with the existing electricity market structure in many developing countries, where national utilities act as the single buyer in the market and deliver electricity to end users. It is also easier to secure industry support, as the regional market is mainly used by national utilities to exchange surplus and reserve capacities with each other. This could be a win-win situation for both sides: additional revenues for electric utilities providing surplus and reserve capacities, and cost-savings for electric utilities procuring these services, as they do not need to build expensive local capacity.

In a fully-integrated regional market, in contrast, there must be price differentials for trade to happen. When low-price countries export to high-price countries, their domestic spot prices rise because of the trade. It is often difficult for national utilities in some developing countries with regulated retail prices to pass on the costs incurred by rising spot prices to end-users. The outcomes would be an additional financial burden on the national utilities. Meanwhile, electric utilities in the importing countries may also oppose multilateral trade because this can erode their profits.

Gaining the support of the people to sustain the momentum for multilateral electricity trade. The transition from bilateral to multilateral trade is a long process. In the case of Southeast Asia, as discussed in Section 3.3, trial on bilateral electricity trade via third countries' networks has only been initiated recently after almost 30 years of efforts. Likewise, it took Southern Africa over 20 years to move from a collaborative market (*i.e.,* STEM) for the exchange of surplus capacity, to the current market structure with platforms for day-ahead, intra-day and forward trading (see Section 3.2 for details). In Europe, after over 20 years since the endorsement of the European Commission Directive for electricity market reform in 1996, the creation of a harmonised regional market for electricity remains a work in progress, with substantial differences in the intra-day and balancing markets across the region.

The timeframe required for the move to multilateral electricity trade is far beyond the electoral cycles in many developing countries. If programs towards multilateral electricity trade are going to survive and succeed over the long term, the support of the people is critical. This support would help sustain the momentum for multilateral electricity trade while the vicissitudes of changes in national governments take place over time, because people of the region would demand their respective national governments to deepen multilateral electricity trade. One way to gain support of the people is education that highlights the critical role of multilateral electricity trade in promoting a sustainable and clean energy future in the region.

4.2 Points for reflection

Some points for reflection are provided below regarding how to accelerate the progress towards multilateral electricity trade across Asia-Pacific.

- As the transition towards a clean and sustainable electricity future is gaining momentum across Asia-Pacific, the need for closer regional electricity cooperation also increases, given its contribution to the provision of adequate amounts of clean, reliable, and affordable electricity.[1]
- Existing infrastructure and resource complementarity provide the foundation for deepening electricity cooperation.[2] Yet, lack of trust, concerns about a loss of national sovereignty, challenges imposed by import dependence, and domestic politics could undermine the political will to promote regional electricity cooperation, making the transition towards multilateral electricity trade difficult.
- This difficulty gets compounded by the recent turbulence in the international energy market, with energy security and supply independence once again occupying a central place in many countries' policy agenda. To mitigate the impact of international market volatility, actions have been taken by various countries to boost their domestic energy supply (*e.g.*, renewable energy in

[1] Multilateral electricity trade can sometimes lead to increased use of coal-fired power plants due to their low operating costs in some resource-rich countries. This means that the introduction of some forms of carbon pricing would be needed to internalise the costs of carbon emissions into the regional electricity market and hence ensure multilateral electricity trade deliver its promised environmental benefits. It is also worth noting that the Carbon Border Adjustment Mechanisms (CBAM) introduced by the European Union may not necessarily deliver its expected outcomes if no additional support is provided to developing countries to help them create carbon reduction measures.

[2] In Central Asia, wet seasons in Tajikistan and Kyrgyzstan, which have abundant hydropower resources, often coincide with summer peak demand in Kazakhstan, Uzbekistan, and Turkmenistan, creating export opportunities for Tajikistan and Kyrgyzstan. Likewise, the creation of a national electricity market in China could help unlock the country's huge potentials for renewable generation in resource-rich western provinces to satisfy the fast-growing demand for electricity in the eastern coastal city-clusters. Singapore's recent trial on electricity import from Laos through Thailand and Malaysia. Singapore – a land stressed city-state with limited potential for clean power – has recently initiated several large regional projects (e.g., Sun Cable project with Australia, and LTMS-PIP), to reduce its reliance on expensive fossil fuel imports for electricity generation by tapping its neighbours' renewable energy.

Europe), to shelter consumers from price hikes by introducing a variant of subsidies, and to restructure national electricity markets[3].

- The rising energy nationalism raises the question: how to generate sufficient political will for regional cooperation? Clearly, insights into this question are central to devising ways to deepen electricity cooperation towards multilateral trade. These insights become even more valuable if one realises that many impeding factors (*e.g.*, ensuring supply security over long-duration extreme weather conditions, high cost of financing infrastructure projects due to small domestic market) for energy transition cannot be easily resolved in a national context, highlighting the necessity of collective actions.
- An effective means to develop such insights, we contend, is to revisit the experience of multilateral electricity trade, namely, its rationale, processes, and outcomes. This can then be juxtaposed against the geo-strategic and socio-economic contexts of various regions to develop deeper insights into the dynamics of electricity cooperation.
- Such a revisit and juxtaposition will inevitably involve a reflection on several issues, some of which were noted in Section 4.1 of this report. Others include, for example:
    - What explains the variation in multilateral electricity trade across regions? To what extent is this variation attributable to electricity-specific factors, such as network infrastructure, energy endowment, national market arrangements and regulatory framework. Are there any extraneous (*e.g.*, geo-strategic shifts, domestic politics) influences at work?
    - How to better integrate electricity into the broader regional cooperation program?
    - How to define the boundaries and interfaces between regional and national markets?

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[3] In the United Kingdom, a proposal is made to create a Green Power Pool that could enable direct access to cheap clean power for consumers and hence insulate them from rising wholesale electricity prices fuelled by gas scarcity.

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