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Study on the Roadmap for Multilateral Power Trade in ASEAN

2024

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ASEAN Centre for Energy
6th Floor, JL.H.R. Rasuna Said, Block X-02,
Kav. 07-08, Kuningan, Jakarta 12950

www.aseanenergy.org
Phone: 62-21-527-9332
Fax: 62-21-527-9350

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Acronyms

ACE	ASEAN Centre for Energy
ACMECS	Ayeyawady-Chao Phraya-Mekong Economic Cooperation Strategy
ADB	Asian Development Bank
AERN	ASEAN Energy Regulatory Network
AIMS	ASEAN Interconnection Master Plan
AMS	ASEAN Member States
APAEC	ASEAN Plan of Action for Energy Cooperation
APG	ASEAN Power Grid
APG-AP	ASEAN Power Grid Advancement Programme
APGCC	ASEAN Power Grid Consultative Committee
ASEAN	Association of Southeast Asian Nations
BOT	Build Operate Transfer
CASE	Clean, Affordable and Secure Energy for Southeast Asia
CBET	Cross-Border Energy Trade
DFI	Development Finance Institution
ECA	Export Credit Agency
EDL	*Électricité* du Laos
EE	Energy Efficiency
ESIA	Environmental and Social Impact Assessment
ESCAP	Economic and Social Commission for Asia and the Pacific
ETP	Energy Transition Partnership
EVN	Vietnam Power Group
HAPUA	Heads of ASEAN Power Utilities/Authorities
IEA	International Energy Agency
IFC	International Finance Corporation
IPP	Independent Power Producer
JICA	Japan International Cooperation Agency
LTMS	Lao PDR, Thailand, Malaysia, Singapore
MoU	Memorandum of Understanding
NDA	Non-Disclosure Agreement
NDC	Nationally Determined Contribution
PDP	Power Development Plan
PLN	*Perusahaan Listrik Negara*

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RBMF	Results Based Monitoring Framework
RE	Renewable Energy
RFP	Request for Proposal
SEB	Sarawak Energy Berhad
SESB	Sabah Electricity Sdn. Berhad
TOR	Terms of Reference
UNOPS	United Nations Office for Project Services
USAID	United States Agency for International Development
USD	United States Dollar
USTDA	United States Trade and Development Agency

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Executive Summary

The Study on the Roadmap for Multilateral Power Trade in ASEAN (the Study) recommends a path to implement and expand multilateral power trade (MPT) in ASEAN, including through the use of existing and in-progress transmission infrastructure. The Study focuses on the steps required to implement subregional intermediate-stage MPT markets that would precede more advanced MPT markets across all ASEAN member states (AMS). The remainder of this executive summary is organised as follows: (i) Background; (ii) MPT in ASEAN Today; (iii) A Way Forward for MPT in ASEAN; (iv) and Key Issues for Consideration.

1. Background

The primary objective of the Study on the Roadmap for Multilateral Power Trade in ASEAN is to develop a concrete and monitorable stepwise plan to implement multilateral power markets in ASEAN. The Study recommends a path between the currently existing grid interconnectivity, with nascent power trading activities in the region, and a recommended "end point," or in other words, what the ultimate vision for MPT is for ASEAN.

The focus of the Study is on the nature of, and steps required to implement intermediate-stage markets, with a focus on short- and medium-term actions and priorities. The Study design adheres to guiding principles that were outlined in the International Energy Agency's report, *Establishing Multilateral Power Trade in ASEAN* (2019), and that were separately endorsed by the ASEAN Power Grid Consultative Committee (APGCC).

The guiding principles include that development of MPT should be "stepwise and voluntary"; MPT should focus on international trade of "gaps and excesses" in domestic markets without requiring full participation of all domestic generation in a regional power market; MPT should not require complete regulatory harmonisation amongst the AMS; and expansion of regional cross-border transmission infrastructure as essential for MPT.

Data and information used to prepare the Study were gathered through official data requests, bilateral meetings, and stakeholder consultation workshops. Feedback on interim findings provided during consultation workshops was incorporated into the final Study report.

2. MPT in ASEAN Today

Existing and in-progress grid-to-grid transmission infrastructure provides the physical foundation for MPT development in ASEAN. Cross-border grid-to-grid power trade in ASEAN is primarily bilateral, with several important MPT-related initiatives underway as discussed in this report.

In contrast to other types of cross-border transmission, the need for grid-to-grid transmission to facilitate MPT must be underscored, since some existing and proposed interconnections as depicted in regional MPT market studies are not grid-to-grid.

IPP-to-foreign grid projects may involve cross-border transmission, with transmission being solely for the one-way supply of power from a power plant to the foreign purchasing utility. Similarly, grid-to-isolated foreign load connections do not facilitate the grid-to-grid trade required for MPT.

Grid-to-grid (load switchable) connections represent potentially usable transmission infrastructure in an MPT context, though upgrades and operational matters would need to be addressed for this type of interconnection to allow full-time grid-to-grid linkage.

Currently, the grid-to-grid interconnected regions are in three blocks, as shown in Figure 2-1: Lao PDR, Thailand, West Malaysia (Peninsular Malaysia), and Singapore (the "LTMS" countries);

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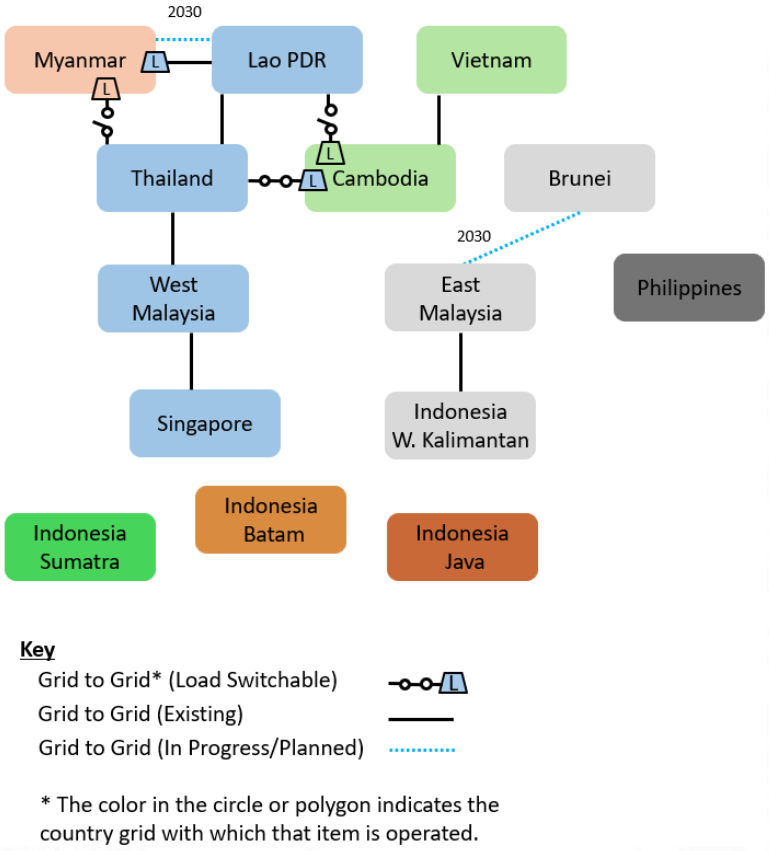
Vietnam and Cambodia; and East Malaysia-Kalimantan (Indonesia), with the Sarawak-Sabah interconnection expected to be completed by end of 2024.

Significant in-progress grid-to-grid projects include an interconnection between Lao PDR and Myanmar, and an interconnection between East Malaysia (Sarawak) and Brunei Darussalam. Given the geographic features, and for other reasons, the Study envisions that MPT will evolve mainly in two separate subregions, with the East Subregion comprised of Brunei, East Malaysia, Kalimantan, and the Philippines, and the West Subregion including all other countries and islands as depicted in the Figure 2-1.

Figure 2--1 Existing and In-progress Grid-to-Grid Interconnections



The Lao PDR-Thailand-Malaysia-Singapore Power Interconnection Project (LTMS-PIP) has yielded important insights for potential successor projects in ASEAN, and more generally, for MPT development in ASEAN. LTMS-PIP is a pilot contract market involving unidirectional flows, with one seller and one buyer. LTMS-PIP officially ended in June 2024, though extension discussions have been held. Amongst the lessons learned are the following:

1. Whilst political and ministerial support for LTMS-PIP has been identified as a key success factor for the project, utilities must perceive individual benefits from trade under a given arrangement, in order for that arrangement to be durable over time. Utilities may question whether other utilities are gaining more, whether each utility has a fair opportunity for the benefits of trade, and whether the necessary investments in trading arrangements, supporting infrastructure and grid management are compensated through existing national regulatory frameworks, if not through the trading arrangements themselves. Utility managers can accommodate pressure to carry forward some relationship-building trading arrangements (referred to in the region as “ASEAN spirit” projects), but over time and as the scale of trade increases, the focus may turn to how the arrangements impact the metrics upon which utility management is judged.

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2. The LTMS-PIP working group/task force structure, involving no external parties such as development partners or regional bodies, has been identified as a success factor for LTMS-PIP itself. However, expanding LTMS-PIP, by adding new countries, multi-directionality, or new products, would involve considerable technical and commercial complexity that could be difficult and expensive for existing members to undertake on their own. The challenge with respect to potential future versions of LTMS-PIP could be addressed through addition of new external working group members, and more generally, by an ASEAN-wide institution dedicated to supporting MPT expansion.

Short-term energy markets complement contract markets: the concept of a Regional Power Market as a short-term energy market that would facilitate opportunity and seasonal trade is recommended for exploration in ASEAN. It is recommended for the region to explore the initiation of subregional or regional short-term energy markets to facilitate gaps and excess traded amongst countries, as energy markets are the core building blocks for initiating MPT markets.

MPT market development in the East Subregion, which has proceeded more slowly than in the West Subregion, gained momentum when the Brunei Darussalam-Indonesia-Malaysia-Philippines Power Integration Project (BIMP-PIP) was formally launched at the 41st ASEAN Ministers on Energy Meeting (AMEM) in August 2023. In a joint statement, the respective energy ministries of the four countries agreed to initiate BIMP-PIP "as a pilot project".

A feasibility study for the project is underway.

Undertaking pilot projects is an appropriate next step to implement MPT in ASEAN. The pathfinding LTMS-PIP project demonstrated the value of learning by doing. That project was a first step toward true MPT in ASEAN. The next steps require similar limits on duration and scope, with multilateral trading projects undertaken on a pilot basis that would allow AMS to design and implement fully functional markets amongst subsets of the AMS, without committing to permanent structures open to more or all AMS.

As will be discussed, two specific types of markets are recommended for potential pilot projects: short-term energy markets and organised contract markets.

Widely held misconceptions impede progress on MPT in ASEAN. Whilst the details of these misconceptions are discussed later in this Executive Summary, and are explored in more detail within the body of the Study report.

Simply stated, the term "market" may be misunderstood to require national power industry restructuring, and the concept of an "ASEAN institution" to involve an entity empowered to force national power industries to restructure or take other actions that may be unwanted. These understandings are incorrect. Existing international MPT markets demonstrate that in ASEAN they can be implemented without national power industry restructuring and without overarching institutions with authority over national power industries.

It must be noted that Southeast Asia as a region faces a number of particular challenges in implementing MPT, although these are resolvable through effective cooperation and planning. Such challenges include wide disparities between countries in economic and power system development, a complex geographic topology that complicates power trade, as yet underdeveloped regulatory frameworks driving MPT, and lack of financing for cross-border infrastructure projects, particularly in the context of pressing domestic needs for power system development. These challenges should inform realistic and achievable priorities and actions for expanding MPT, as set out in this Study.

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3. A Way Forward for MPT In ASEAN

This section initially summarises an analysis of potential MPT market models for ASEAN, then presents proposed next steps toward MPT advancement, and finally depicts how the regional power grid and markets might evolve.

Market Models for ASEAN MPT

The end goal of achieving MPT markets *across* ASEAN should not be interpreted as requiring a single MPT market covering *all of* ASEAN. Rather, achieving subregional markets involving most AMS, with other AMS that are not themselves inside an MPT being able to trade with those subregional markets, is an appropriate goal for ASEAN. Such is the case across Europe and North America. It is not clear that implementing a single regional MPT market in ASEAN – if even politically feasible – would offer net gains over having several subregional MPT markets.

To be clear, whilst there may be little to gain by striving for a single power market across all ASEAN, there would be substantial value in a common regional approach to developing MPT in ASEAN, which could proceed on a subregional basis.

Two intermediate-stage MPT market areas were identified for further analysis and development in ASEAN: the West Subregion Market and the East Subregion Market. In summary, each of these subregional markets is envisioned to ultimately involve both contract markets and short-term energy markets.

The West Subregion Market would begin as a contract market, building on LTMS-PIP lessons learned and structures developed, focusing on delivering renewable energy from the north to the south. Contracting for conventional energy would take place as well, and flows of both renewable and conventional energy would be multidirectional. To be clear, whilst contracts might indicate the type of energy transacted for reference, the organised contract market itself would not distinguish between different types of energy for scheduling and settlement. The contract market would complement, not conflict with, bilateral contract and short-term energy flows in a short-term energy market to be added later.

The East Subregion Market, initially implemented as the BIMP-PIP, is envisioned by this Study to begin as a short-term energy market for opportunity trade amongst this group of AMS. Given its grid topology and other factors, it is expected that contracting can be initially carried out on bilateral basis, with less need for an organised contract market.

A short-term energy market structure that would facilitate opportunity and seasonal trade should be explored in ASEAN and subregionally, and would be applicable in both the West and East subregional market areas.

Proposed Next Steps

The Study recommends a number of next steps. Several of the most urgent or foundational in nature are summarised in the first columns of the three Gannt charts shown in Figures 3-1, 3-2 and 3-3. These charts first present proposed next steps for overall MPT development in ASEAN, then for the two target market areas in the West Subregion and the East Subregion.

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Figure 3--1. Phase-In Actions for Overall ASEAN MPT Development

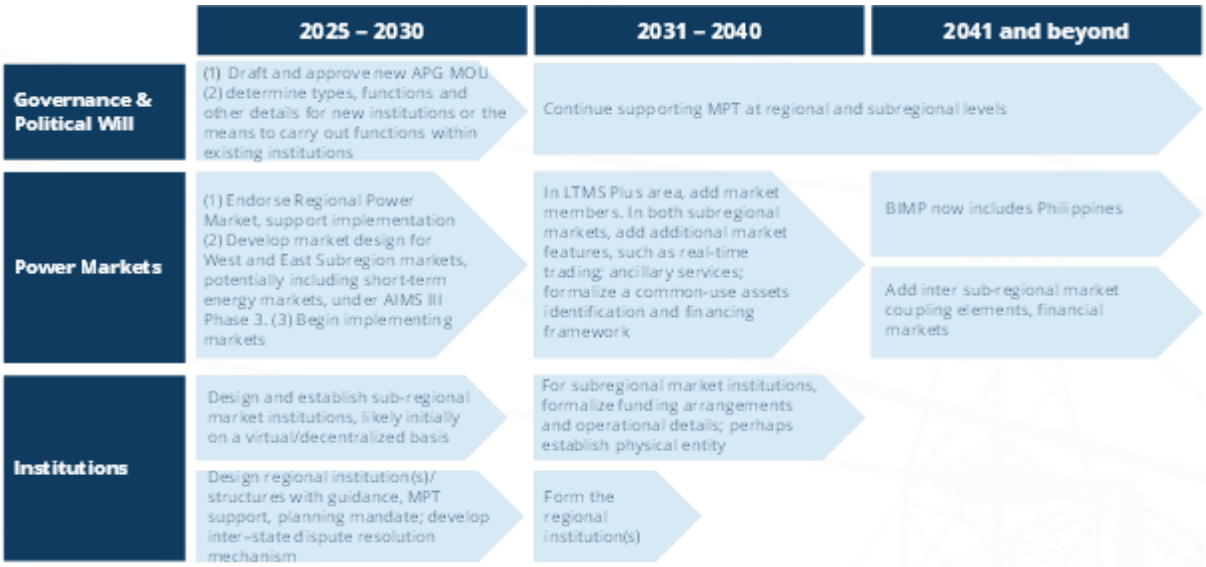
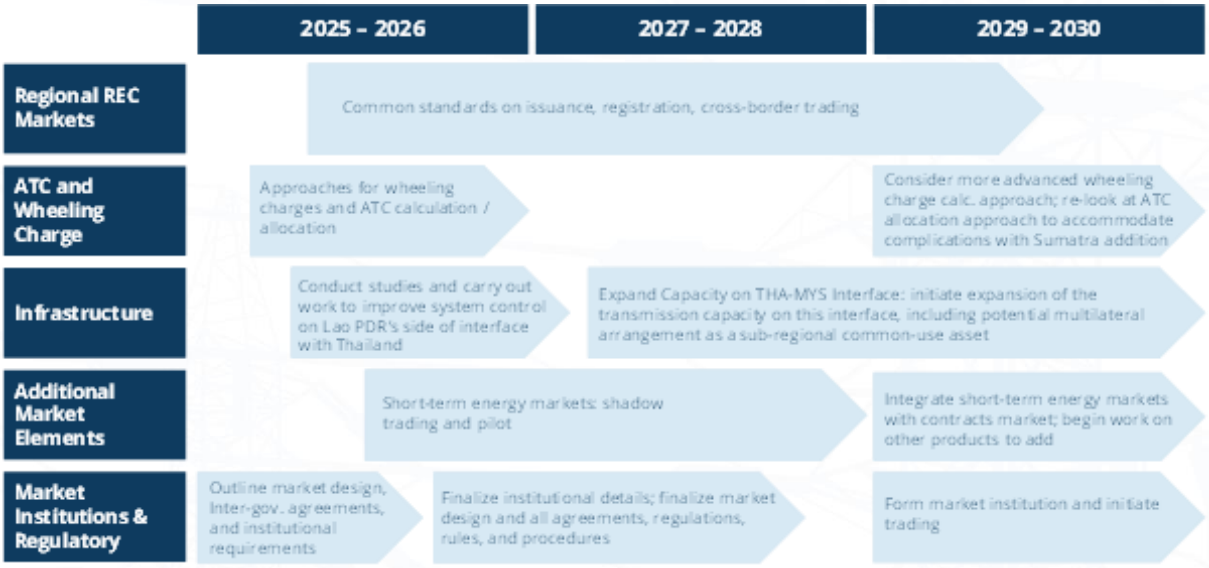


Figure 3-2-. Phase-In Actions for West Subregion



Source: Delphos.

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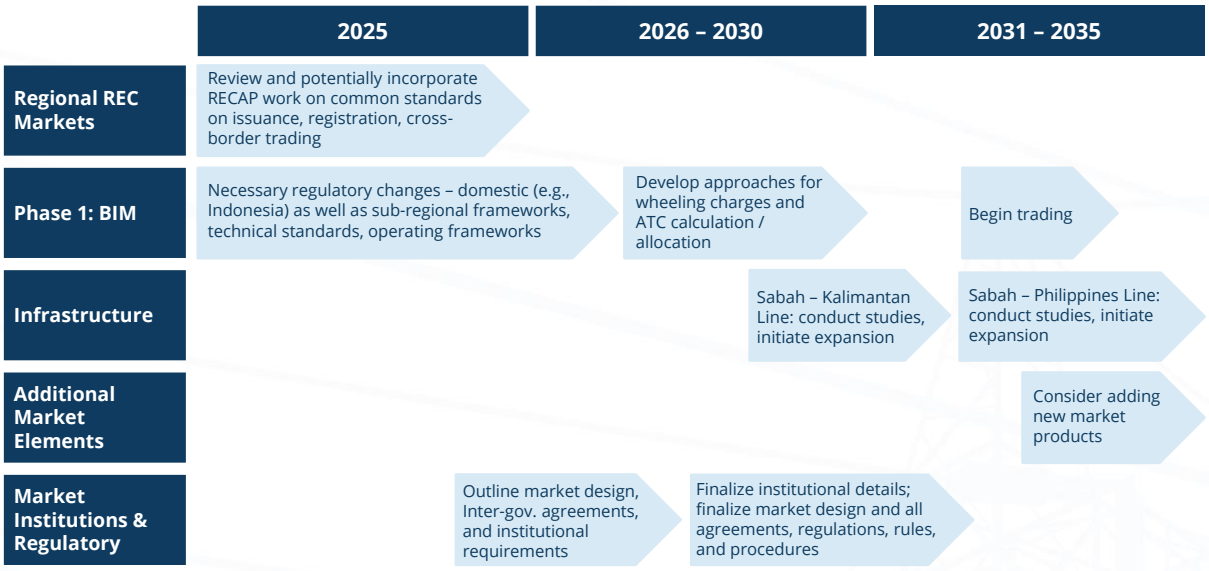
Figure 3--3. Phase-In Actions for East Subregion



Source: Delphos.

ASEAN Power Grid and MPT Market Evolution

There are numerous potential scenarios for expansion of the regional grid. Figure 3-4 shows one version of how interconnections and regional market groupings might evolve. This one version is not intended as a recommendation. Rather, through 2030, it represents the best guess of the Authors as to the earliest completion dates for new grid-to-grid projects, and transfer limits based on various sources. For the post-2040 period, it mainly represents the projected result of interconnection under the AIMS III study.

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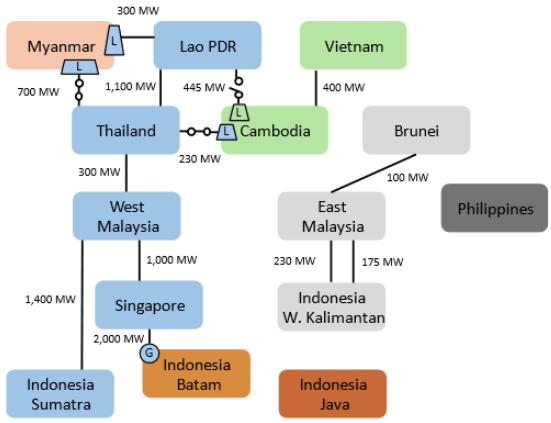
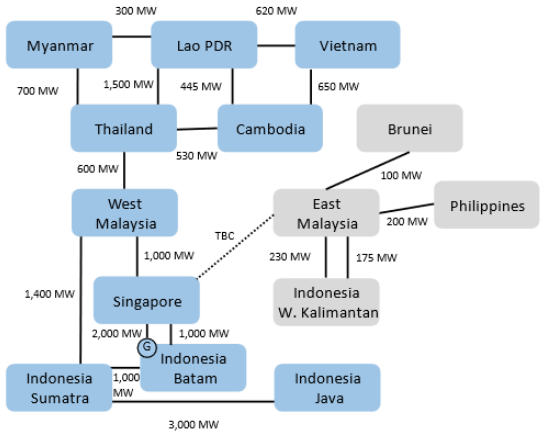
Figure 3--4. Regional Interconnection Evolution: 2030 and Post-2040



2030:

- **Large portions of Myanmar connected to rest of West Subregion**
- **West Malaysia connected to Sumatra**
- **Batam generator-to-foreign-grid projects online**
- **Improved connectivity and nascent market operations in East Subregion (first phase – Philippines still not interconnected)**
- **Key transmission constraints:**
  - **Thailand – Malaysia**
  - **Vietnam - Cambodia**



Post 2040:

- **Philippines link to Sabah is completed**
- **Moderately advanced MPT in both East Subregion and West Subregion, covering all AMS. These two blocks possibly interconnected from Sarawak**
- **Some portions of some AMS will remain outside of the two subregional markets, participating only via generator-to-foreign grid (mainly IPP-to-grid) projects**
- **Key transmission constraints are expected to be resolved**

As with grid connectivity, a projection of the nature and extent of MPT markets in ASEAN over time must be understood as representing just one possible version of how such markets might evolve. Indeed, a core agreed principle is that MPT development in ASEAN should proceed on a stepwise and voluntary basis. Implicit in this principle is that no central authority can impose its vision for MPT on the AMS, meaning that markets will evolve organically, with the guidance and support of regional bodies and development partners.

Figure 3-5 presents one possible evolution of regional markets in terms of the nature of power trade, including how bilateral contracting, different organised contract markets and short-term energy markets in the region could overlap and integrate. The figure assumes that the intermediate stage MPT markets become operational in portions of ASEAN by 2030. It is expected that those markets will evolve to add new market members and features.

Note that the figure includes arrows for “Bilateral Trade Outside MPT Market”, and the graphic for 2030 shows some areas, such as Sumatra, being outside the organised Contract Market area but also trading bilaterally with a country within that market area. Such trade is common on the boundaries of established power markets around the world.

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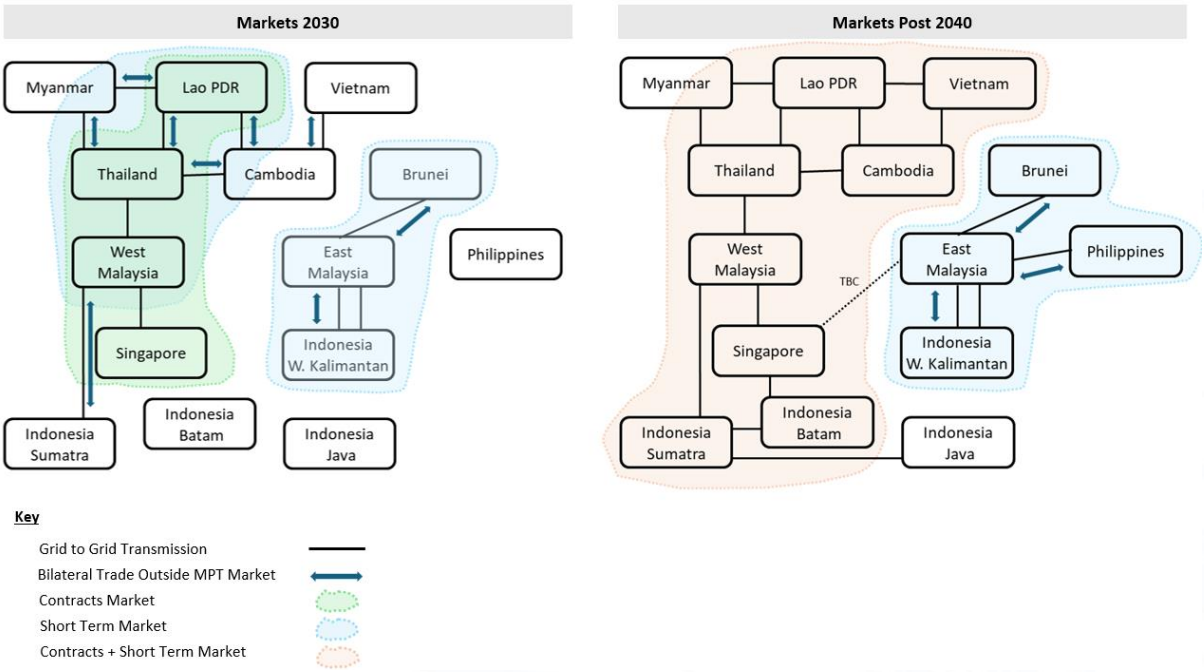
Figure 3--5. Indicative Evolution of Regional Markets by Type: 2030 and Post-2040



4. Key Issues for Consideration

This section summarises several issues that should be considered when developing MPT in ASEAN, or that would benefit from further analysis.

4.1.1. Clarifications To the Stated Minimum Requirements For MPT

Various previous studies regarding development of MPT in ASEAN have identified a set of minimum requirements. The Study finds that adjustments to the wording or interpretation of such minimum requirements are warranted to avoid unjustified and time-consuming efforts, as shown in Figure 4-1, with relevant text underlined and summarised below the figure.

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Figure 4-1. Clarifications to Minimum Requirements for Multilateral Power Trade

Infrastructure: Cross-border grid-to-grid transmission facilities

Economic: Compelling economic justification offering significant value to all market participants

Political:
political will
intergovernmental agreements
common working language

Technical:
harmonised technical standards (grid code)
harmonised wheeling charge methodology
third party access for external resources
data and information sharing
interconnector capacity calculation methodology and allocation methodology

Institutional:
Institutional arrangements
Settlement and payment mechanism
Dispute resolution mechanism

- "Harmonised grid codes are not required for MPT, *per se*. Rather agreed common grid operating standards are required. One approach to harmonisation is to ensure each country's national grid code is aligned in the specific areas required. The second approach is to agree on the set of grid operating standards all countries must meet to participate in the market, and to have countries wishing to participate in the market agree to those standards when they sign market participation agreements.

  The two approaches to achieving the same objective are very different when it comes to implementation. It is difficult to update and enact national grid codes. Doing so often requires a lengthy consultations process and various formal approvals at different bureaucratic levels.

  By contrast, grid operating standards could be contractually agreed by utilities as part of utility participation agreements. In short, drafting a single set of operating standards applicable to all market participants would be considerably more streamlined than attempting to harmonise grid codes of all those participants.

- Third-party access (TPA), as the term is commonly understood, is not necessary for MPT, and may create confusion amongst stakeholders. TPA at the wholesale level is usually understood to refer to requiring the incumbent utility to allow third-party use of its transmission grid and to do so on an equal basis with the utility's use of the grid for its own customers. Providing this type of TPA for MPT in ASEAN would require significant changes to national market designs, which apart from not being necessary, violates the guiding principle that introducing MPT should not require regulatory harmonisation of national markets.

  What is required is for each AMS/AMS utility that is a member of a given MPT market to be able to access the transmission grids of the other member utilities only for specific cross-border power trades, requiring little or no change to national markets. This type of access

can be referred to as "Third Party Access for External Resources" to avoid confusion with TPA as it is commonly understood. This clarification was also made in the International Energy Agency's report, *Establishing multilateral power trade in ASEAN* (2019).

- ATC allocation: The phrase "interconnector calculation methodology" in Figure 4-1 refers to what is commonly known as "Available Transmission Capacity" or ATC. What is required is both an ATC calculation methodology and an ATC allocation methodology. The former item is a technical matter, and the latter is commercial/legal in nature and is an important market design consideration. For instance, in some markets, contracts are prioritised over opportunity trade, and the market may involve firm/non-firm transmission rights.

4.1.2. Institutional Development to Support MPT

A regional or subregional regulatory body facilitating MPT does not require authority over the internal operations of national markets. For instance, in SIEPAC, the regional regulatory authority has no power at all over the structure, behaviour, planning, or operation of national markets. Rather, the authority's powers pertain only to the regional market itself, which exists alongside or parallel to national markets.

The same approach is taken, though even more loosely, in SAPP. Ultimately, MPT markets do require a regulator, but as noted that regulator does not require authority over national markets under all market designs.

All MPT markets, and indeed, all power markets, involve one or more institutions or coordinating/facilitating bodies covering functions ranging from planning to market development support, and always involving market operation and market regulation. In ASEAN, however, there are no permanent electricity market institutions, either at the regional or subregional levels, whose mandate fully covers any of the required functions – noting that HAPUA's mandate includes coordination activities and is generally aligned in MPT development support.

This Study concludes that there are coordination and other support functions that should be carried out at the ASEAN level through a dedicated entity structure, and that market operator and market regulator functions would be best carried out at the subregional level.

4.1.3. Key Misconceptions

It is evident based on discussions with the AMS and stakeholders that several misconceptions about different types of markets are prevalent. These misconceptions, discussed below, combine to yield the belief that short-term energy markets are too difficult, or are somehow inappropriate in the ASEAN context. Nothing could be further from the truth.

- Misconception: a short-term energy market would conflict with the LTMS-PIP contract market structure and potential expansion of contract markets. On the contrary, contract and short-term markets are complementary. They serve different purposes and co-exist by design in all MPT and regional markets.
- Misconception: creating a subregional short-term energy market would require national markets to either already have their own short-term energy markets, or to form them. This is false, as shown by SAPP and SIEPAC markets, which operate short-term energy markets without requiring national short-term energy markets.
- Misconception: short-term energy markets require giving up control of national system operation. This too is shown to be false by the SAPP and SIEPAC examples, which involve trading of gaps and excesses, aligning with one of the guiding principles for MPT development in ASEAN.

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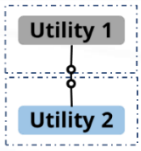
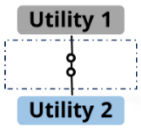
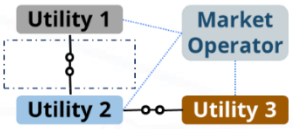
- Misconception: short-term energy markets are too complicated to set up. Whilst they do involve some complexity, there is ample international experience in setting up such markets. In addition, there is considerable complexity in establishing fully functional MPT contract markets, particularly with the "in-line" grid topology found in the West Subregion, which requires addressing thorny ATC allocation issues. See discussion of market topology near the end of the Executive Summary. It is not clear that either type of market is substantially easier to implement than the other.

4.1.4. Challenges to Financing Cross-border Transmission Projects

- National laws and regulations in some AMS make it difficult to achieve regulatory approval for utilities to invest in cross-border grid-to-grid facilities, because standard technical-economic project assessment frameworks require documentation of clear benefit to electricity ratepayers when compared to domestic projects (e.g., new generation and/or transmission), whereas some of the value of the projects themselves may be conditional on the grid operating approach of the utility on the other side of the interface. Thus, harnessing political support for a project, though helpful, may be insufficient for a utility to achieve regulatory investment approval. An assessment of national regulations in this respect is recommended that would identify specific changes to facilitate utility investment in cross-border transmission projects.
- A significant barrier to support for the financing of cross-border transmission projects for many donors, especially multilateral development banks (MDBs), is their restrictive green taxonomies. Such green taxonomies contain stringent criteria that are unfavourable for grid-to-grid transmission projects. Although the *ASEAN Taxonomy for Sustainable Finance*, developed by the ASEAN Taxonomy Board, is a robust and credible alternative green taxonomy that could be more favourable for grid-to-grid projects, the fact is that MDBs and other sources of capital currently use the more restrictive taxonomies, as detailed in Section 4.3 "Green Taxonomy for Transmission Financing". Stakeholders should prioritise working with MDBs to address the critical obstacles to financing.
- Some of the projects that are most obviously supportive of MPT in ASEAN, such as replacement and potential expansion of the HVDC facility connecting Thailand and Malaysia, may be more beneficial, or may be seen to be so, to the other AMS in the LTMS block, than to the two countries sharing the interface. Organised MPT markets often involve a mechanism to finance projects of this sort, generally referred to as "common use" assets, but such a mechanism does not yet exist in ASEAN. In the meantime, the perception that costs and benefits may be unbalanced impedes investment in such projects.

There are potentially feasible financing structures for grid-to-grid cross-border transmission projects. The basic options are outlined in Figure 4-2. Bilateral utility financing is the most common approach internationally. The Bilateral PPP approach involves complex project structuring. The multilateral PPP approach, being the generic approach for a common-use asset, is the most complicated to structure. A common challenge for all the approaches is the use by MDBs of the previously mentioned restrictive green taxonomies.

Figure 4.1.4-1. Potential Financing Structures for Grid-to-Grid Projects in ASEAN

	Utility Financing (separately)	Bilateral PPP – Private Financing	Multilateral PPP – Private Financing
			
Structure	Each utility finances its line up to the border	Both utilities award concession to a PPP entity	PPP concession for regional common use asset (e.g., Thailand-Malaysia interconnector for Singapore to import hydro from Lao PDR)
Revenue Type	Multiple potential revenue streams (exports, wheeling charges, domestic retail, etc.)	Availability based fixed capacity payments from the utilities	Availability based fixed capacity payments from a market operator or the utilities
Financing Approach	Utility balance sheet financing (corporate bonds, green loans, on-lending from MDBs)	Project-financed debt and equity	Project-financed debt and equity
Capital Raise Challenges	Ability of utilities to raise capital, limited appetite at MDBs	Strength of agreements (inter-governmental, inter-utility, guarantees)	Strength of multilateral and common market agreements
APG Relevance	Doable. Supports grid-to-grid ties and MPT.	Potentially viable in certain interfaces (e.g., Indonesia – Malaysia).	Not viable currently in ASEAN. Need credible multilateral markets and regional institutions.

The high costs and complex nature of cross-border interconnecting infrastructure argues for a coherent regional approach to infrastructure planning and financing. For financing, what is required is a framework to agree on which projects are both required for MPT development and supported by the relevant AMS, and then to identify a financing approach for each project.

Whilst some projects can be undertaken on a bilateral utility-finance basis, evidence suggests that regional utilities do not prioritise such projects, given other pressing domestic investment requirements. The Public-Private Partnership (PPP) structure for some projects could attract significant private financing. Some projects could be for common use assets that are agreed by relevant AMS to be required for MPT expansion and financed on a PPP or other basis. Coordination of investments, development of special investment facilities, and the involvement of development partners and commercial banks will be required.

4.1.5. Renewable Energy Certificates

Whilst increased renewables trade is envisioned to be a driver and justification for MPT in ASEAN, documentation of the renewables content of the trade is inadequate at present. A renewable energy certificate (REC) documents the renewable energy attribute of one megawatt hour (MWh) of electricity from renewable sources separately from the physical electricity.

A core rationale of the ASEAN Power Grid Action Plan (APG-AP) is that advancements in the APG and MPT can help meet the region's growing energy demand, including demand for renewable energy, with optimal renewable energy resources. However, the region lacks a sufficiently robust framework to attribute the RECs associated with renewable energy produced in one country to electricity volumes purchased by another country.

Generator-to-foreign grid projects, for which the energy consumed and energy produced are directly linked, do not involve international renewables attribution challenges. For grid-to-grid connections, however, it is challenging to tie renewable energy attribution to cross-border energy flows.

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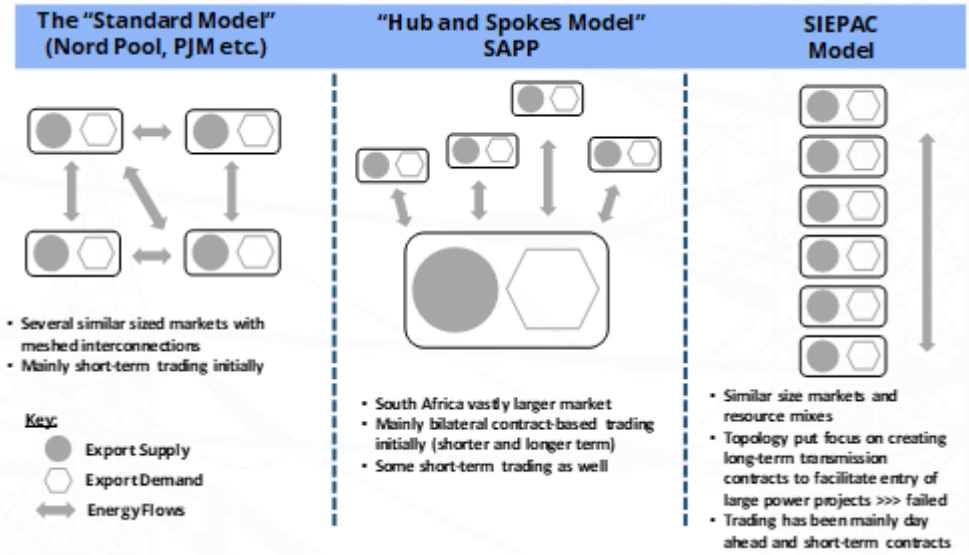
Cross-border REC transactions on grid-to-grid lines are not currently recognised by international reporting frameworks, except for transactions in North America and the European Union. Having internationally recognised frameworks in place for REC attribution and trading on grid-to-grid ties would help MPT development and the transition to renewable energy resources to happen in parallel in ASEAN.

4.1.6. Grid Topology

Grid topology should be reflected in market design. The shape and relationship of national grids (market topology) can play a significant role in the design of MPT markets. Figure 4-3 shows the main MPT market topologies, whilst the text below the figure links market design and market features to the different topologies.

The key findings with respect to potential ASEAN MPT markets are firstly that the West Subregion is of the "in-line" type, like the SIEPAC model. This topology requires extra attention to ATC allocation methodology. Secondly, the East Subregion is akin to the hub and spokes model, in the sense that bilateral connections will exist between most participating AMS, certainly until the Philippines joins. There would appear to be less need in this region for an organised contract market. Therefore, a short-term market is expected to be beneficial.

Figure 4.1.6-1-. Topology and Key Drivers in Other Markets



4.1.7. Updating the *ASEAN Power Grid Priority Projects*

Periodic updates will be required to the 18 Projects list that was produced under the AIMS III project. The list was only indicative of the time in which it was produced, and projects have evolved since then, with facts coming to light about the status of specific projects.

Figure 4-4 shows planned and proposed interconnection projects, together with existing and in-progress projects. The numbers in circles correspond to the 18 Projects that were identified in the AIMS III study as priority interconnection projects. A few items are highlighted in the text after the figure, with details on all items provided in the body of the Study report.

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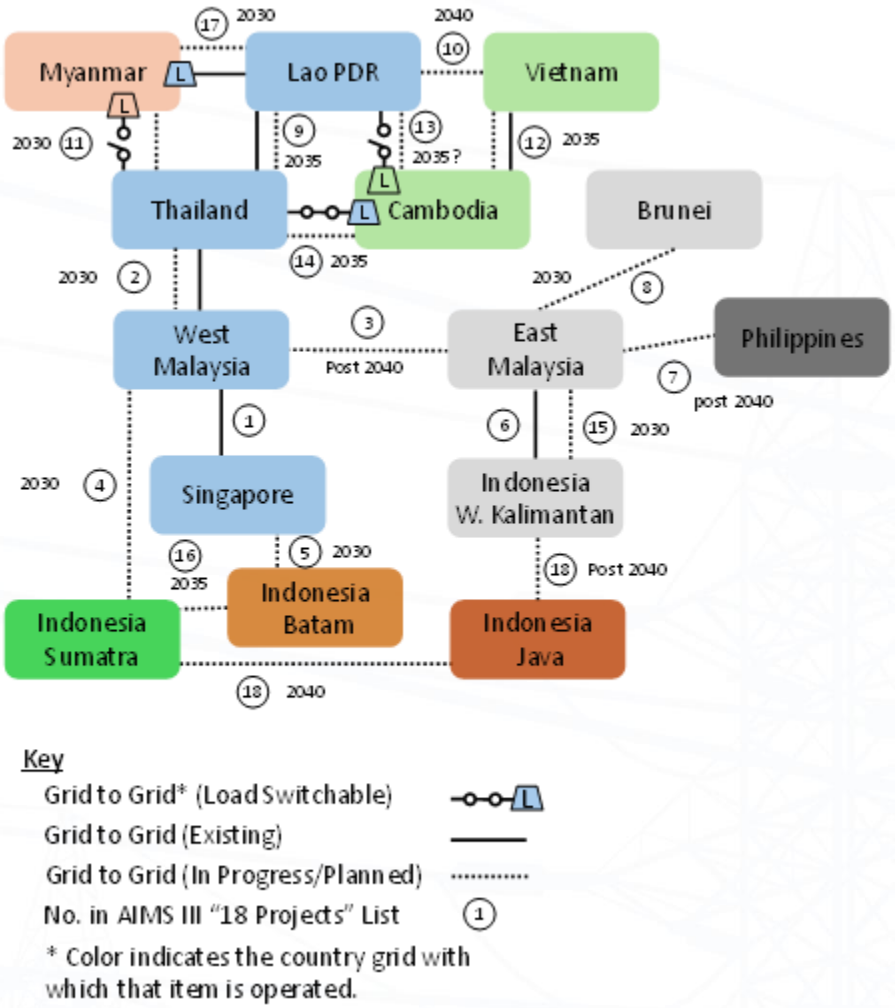
Figure 4.1.7-1. Existing, in Progress, Planned and Proposed Regional Grid



Notes:

1. Projects 1 and 6 have already been completed. Unfinished projects are shown with earliest estimated commercial online dates (CODs).
2. Sarawak and Sabah are shown as a single integrated East Malaysia block, to simplify the depiction of regional interconnections, though they are operated by separate Malaysian utilities. The Sarawak-Sabah transmission line may be completed within 2024.
3. The map does not show the proposed generator-to-foreign grid projects to Singapore from Vietnam, Cambodia, and Sarawak. Project 5 (the Singapore-Batam projects) are shown, even though underlying projects are generator-to-foreign grid, since Project 5 is included on the AIMS III 18 Projects list. A grid-to-grid project linking Sumatra to Singapore via Batam is shown as Project 16, to be completed in 2035.
4. The LTMS region depicted in blue is the most interconnected part of ASEAN. There is ample low-cost hydro and other renewables in Lao PDR, and ample demand, especially for renewable energy, in Singapore. The current transfer constraint is at the Thailand-Malaysia interface, currently limited to 300 MW. The Lao PDR-Thailand and West Malaysia-Singapore interfaces have rated transfer capacity over three times higher.

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Chapter 1: Introduction

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The Study on the Roadmap for Multilateral Power Trade in ASEAN, an output of the ASEAN Power Grid Advancement Programme (APG-AP). This report recommends a path to implement and expand multilateral power trade (MPT) in ASEAN, using existing and in-progress transmission infrastructure. This report focuses on the steps required to implement subregional intermediate-stage MPT markets that would precede more advanced MPT markets across all ASEAN member states (AMS). The APG-AP aims to drive the ASEAN Power Grid (APG) from study stage to implementation. The APG is an initiative to expand cross-border transmission interconnections and power trade amongst the AMS.

The APG was first proposed at the Second ASEAN Informal Summit, held in Kuala Lumpur in December 1997, with five main objectives:

> *(i) promoting more efficient, economic and secure operation of power systems through harmonious development of national electricity networks in ASEAN, by means of region-wide interconnections; (ii) optimised use of energy resources in the region, by sharing benefits, (iii) reduce capital required for generation capacity expansion, (iv) share experiences amongst member countries; and (v) provide close power cooperation in the region.*[1]

The Memorandum of Understanding on APG (APG MOU), adopted in August 2007 at the 25th ASEAN Ministers on Energy Meeting in Singapore, expresses an agreement "to cooperate towards the development of a common ASEAN policy on power interconnection and trade, and ultimately towards the realisation of the ASEAN Power Grid to help ensure greater regional energy security and sustainability on the basis of mutual benefit."

The APG has been a key programme area under the ASEAN Plan of Action for Energy Cooperation (APAEC) since its introduction in APAEC 1999-2004. Other programme areas of APAEC include the Trans-ASEAN Gas Pipeline, Clean Coal Technology, Energy Efficiency and Conservation, Renewable Energy, Regional Energy Policy and Planning, and Civilian Nuclear Energy. APAEC plays a crucial role in providing the strategic direction and policy framework necessary to enhance regional energy cooperation and development, including the APG.

APAEC's focus with respect to the APG has evolved over each five-year cycle. In APAEC 1999-2004, the emphasis was on establishing the policy framework and implementing the electricity networks that form the APG. For APAEC 2004-2009, the focus shifted to the ASEAN Interconnection Master Plan and the creation of a policy framework for the APG's electricity network.

In APAEC 2010-2015, further developments were made in the ASEAN Interconnection Master Plan, including the standardisation of technical and operating procedures and the alignment of regulatory and policy frameworks. APAEC 2016-2020 focused on accelerating the development and completion of APG projects identified in the ASEAN Interconnection Master Plan Study, as well as initiating multilateral electricity trading.

Most recently, APAEC 2021-2025 has concentrated on securing investments and financing, alongside increasing the deployment of renewable energy to achieve the twin goals of energy transition and a sustainable energy future for ASEAN.

As a key initiative within APAEC, the objectives, strategies, and actions of APG have been revised and refined to align with the focus areas of each APAEC cycle. Initially centred on policy frameworks, its focus has evolved to identifying specific projects for multilateral power trade and increasing renewable energy deployment. Thus, the APG covers both the physical cross-border transmission interconnections, as well as the associated agreements, institutional frameworks,

[1] HAPUA. "The Development of the ASEAN Power Grid (APG)." 2nd GMS Energy Transition Task Force Committee Meeting, Siem Reap, Cambodia. December 2023.

market elements, technical requirements, and governance structures necessary for multilateral power trading.

This evolution in the APG focus reflects the need to move APG-related activities from studies to implementation. Actual implementation has similarly taken a phased approach thus far, starting with bilateral and subregional interconnectors and projects, before establishing regional interconnections and multilateral power trading arrangements.

1.1. Study Objectives

The primary objective of the Study on the Roadmap for MPT in ASEAN is to develop a concrete and monitorable stepwise plan to implement the APG using existing and in-progress transmission infrastructure. The Study is intended for use by the AMS and national institutions to plan for domestic projects and activities that facilitate their participation in APG development for the benefit of their respective electric grids and consumers. The Study is also intended as a guide for ACE, ETP, and development partners to inform the next steps, including studies, pilot projects, and other actions, within a coherent vision.

The Study recommends a path between the currently existing grid interconnectivity and nascent power trading activities in the region, as well as a recommended "end point", or in other words what the ultimate vision is for MPT in ASEAN. The focus of the Study is on the nature of and steps to implement intermediate-stage markets, with less attention on the steps between the intermediate stage and the end point vision for MPT in ASEAN.

1.2.Methodology

The approach and methodology of the Authors in developing the Study are based on four pillars: (i) feasibility; (ii) guiding principles; (iii) data and information gathering; and (iv) actionable next steps. An explanation of these pillars follows.

Feasibility: The Study was developed recognising that to be useful, recommendations must be feasible. Feasibility was assessed using data, ASEAN market context, and the power market design experience of the Authors. Assessments included analysis of grid-to-grid connections, the quality of national system grid controls, national market characteristics, the political economy of energy in ASEAN, as well as cultural preferences in the region related to decision making. The strategy focused on defining potential "end point" market models compatible with the specific features of national markets, regional grid topology, and political reality of the priorities of national governments and utilities.

The resulting two end-point market models, SAPP and SIEPAC, contain highly relevant features for ASEAN. To be clear, there is no need to select only a single end point market to use in guiding MPT market development in ASEAN, since different combinations of market structural features from different MPT markets can be appropriate in ASEAN. Indeed, features of other MPT markets examined besides those identified as end point markets, are noted in this Study as meriting additional analysis.

The Study emphasises steps to achieve near-to-medium term objectives to establish intermediate-stage subregional markets initially using existing interconnectors, thereby advancing MPT in ASEAN towards implementation with guidance on long-term pathways to MPT markets across ASEAN.

Guiding Principles: The Study design adheres to guiding principles – with proposed edits – outlined in the International Energy Agency (IEA)'s *MPT in ASEAN Report*, and separately endorsed by the ASEAN Power Grid Consultative Committee (APGCC).

These guiding principles include that development of MPT should be "stepwise and voluntary"; MPT should focus on international trade of "gaps and excesses" in domestic markets, without

requiring full participation of all domestic generating capacity in a regional power market; MPT should not require complete regulatory harmonisation amongst the AMS; and expansion of regional cross-border transmission infrastructure is essential for MPT.

Data and Information Gathering: The data collection process was designed to fulfil the extensive requirements of the Terms of Reference for the Study. A formal "data request" approach was employed, wherein the Authors identified specific data items or types of data needed, and submitted these requests to ACE and to stakeholders via ACE.

The Authors worked with ACE to determine the necessity, appropriateness and availability of the requested data. This process was conducted throughout the study period to reflect new market developments, findings from three consultation sessions with the AMS in workshop format, several bilateral meetings with the AMS and other stakeholder consultations, plus feedback from APG-AP partners.

Review Process: Several drafts of the Study were produced, each carefully reviewed by expert teams from ETP, ACE, CASE, and ESCAP. Consultations with stakeholders to gather information and share preliminary findings and recommendations were held in November 2023, June 2024, and August 2024.

Actionable Next Steps: The approach emphasises developing practical, realistic and implementable next steps tied to the Study's focus on the near-to-medium term, where there is greater clarity on projects and initiatives. Note that all recommendations are anchored in a vision for what MPT markets in ASEAN might look like farther into the future.

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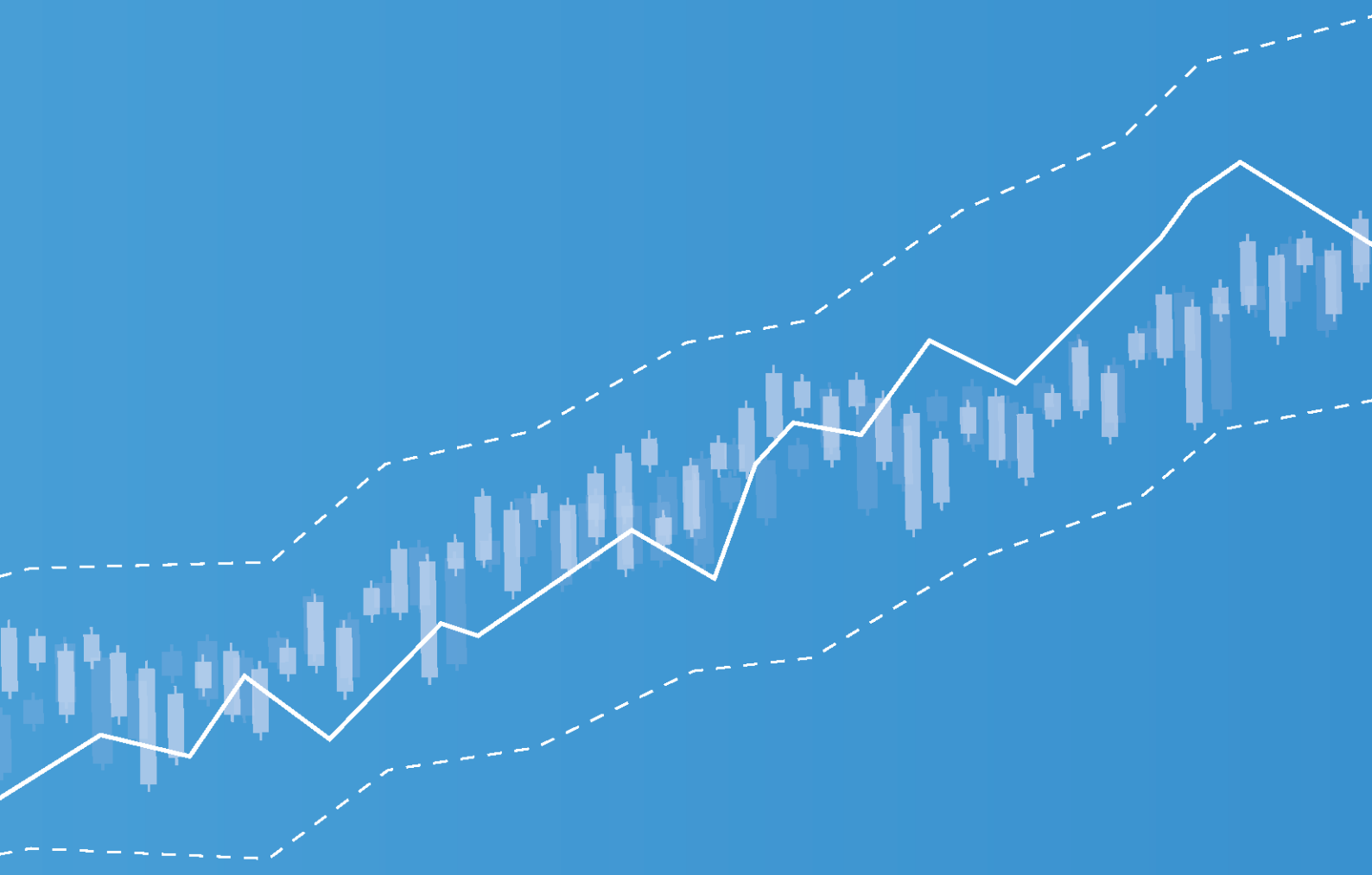
Chapter 2: Status of Existing Markets



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This section of the Study documents the existing regional physical and market context. Subsections cover transmission infrastructure, the major ongoing MPT-related initiatives, and historical regional energy trade.

2.1.Transmission Infrastructure

There are different categories of cross-border transmission facilities and generally only some are directly relevant to MPT markets, namely those involving grid-to-grid connections. The main categories are summarised in Table 2.1-1, whilst Annex A: *Types of Transmission Interconnections and Timelines* provides more detail. There are multiple examples of each category of cross-border transmission in ASEAN.

Table 2.1-1 Categories of Cross-border Transmission

Transmission Category	Characteristics
Internal Grid	Transmission lines connect two parts of an existing domestic transmission system, for instance from one line to another. Such projects can be necessary to enable trade over cross-border interconnections.
Generator to Foreign Grid	A power project, typically an IPP, located in one power system connects directly to the power grid of another system. It is important to understand that, because the importing power system dispatches for the power plant and operates its transmission facilities, these projects are, in almost all relevant operational senses, located within the importing power system, even though the power plant itself is in a foreign country.
Grid to Isolated Load	Like “generator to foreign grid” projects, in this case, a significant load in one system that is isolated (or “islanded”) from the rest of that system is interconnected to a foreign power system. In nearly all operational senses, this load is indistinguishable from other loads on the exporting system’s grid.
Grid to Grid	The transmission line connects two distinct power systems. This type of connection requires a high level of coordination and trust between the two grid operators, since grid instability in one grid can cause problems on the other grid via the interconnection.
Grid to Grid (Load Switchable)	In this arrangement, two grids are physically connected but separated by switching facilities that allow service to a load area to be provided by either of the two grids, but not by both simultaneously, which would require grid synchronisation.

Transmission projects may differ by the technology used. For instance, projects can be either High Voltage Alternating Current (HVAC) or High Voltage Direct Current (HVDC). With respect to interconnection of different grids that are operating asynchronously, HVAC systems can involve significant synchronisation challenges, especially when integrating weaker grids. HVDC can be more suitable in such a situation, though HVDC projects are more expensive upfront than HVAC projects. However, HVDC systems are also more efficient.

Another technological differentiator is whether projects are land-based or subsea. Land transmission projects generally involve lower installation costs, compared to subsea projects. Subsea project costs tend to be higher due to more expensive subsea cables, the need for specialised vessels and equipment, and complex engineering to lay cables on uneven and

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potentially hazardous sea floors. Environmental factors, such as marine currents and corrosion, pose additional risks and challenges.

Recently, there has been a substantial global increase in orders for subsea cables and bookings for cable-laying ships, resulting in extended backlogs for both. There are cost and implementation timeline implications for subsea interconnector projects in ASEAN, which have not advanced sufficiently to lock in orders and bookings.[2]

2.1.1. Existing And In-Progress Interconnection Projects

This section generally characterises existing regional and in-progress physical interconnections. Details on projects are provided in *Annex E: Existing and In-Progress Transmission Projects*.

Since there is a prevalent perception amongst AMS policymakers and development partners that progress towards regional market integration in ASEAN has been slow, it is worth taking stock of the current level of regional integration. In some respects, there already exists substantial regional integration, and there are underlying market features that should impel expanded power trade in ASEAN.

1. There are multiple significant grid-to-isolated load and grid-to-grid (load switchable) connections, including across interfaces that do not have direct grid-to-grid connections. These existing projects can facilitate subsequent direct grid-to-grid linkages and, as with IPP-to-foreign grid projects, can pave the way for more ambitious projects.
2. A central spine of existing grid-to-grid connections links Lao PDR, Thailand, Peninsular Malaysia, and Singapore. Thus, any country adding grid-to-grid links to the central spine would become a member of a five-country regional interconnected zone, which in terms of the number of countries involved – and certainly in terms of electricity demand – would place that interconnected zone amongst the largest internationally. Whilst an interconnected zone is not a power market per se, the LTMS-PIP is an important proof-of-concept basic subregional market involving these four countries. If the LTMS-PIP could be enhanced and extended, then that market would itself qualify as one of the largest multilateral power markets in the world.
3. Recently completed and in-progress grid-to-grid interconnections between Indonesia and Malaysia (West Kalimantan-Sarawak), known as Sarawak and Sabah3, with a planned interconnection linking Brunei Darussalam and Sarawak, set the infrastructural foundation for the BIMP-PIP multilateral power market effort.
4. Market fundamentals suggest considerable trade opportunities based on ample renewable power in some countries/regions, and large power demand with renewable energy at a premium in other countries/regions.
5. Decades of work on the part of regional institutions focused on increasing MPT have created a base of political, regulatory, planning, and institutional frameworks that can be modified, rather than created from scratch.

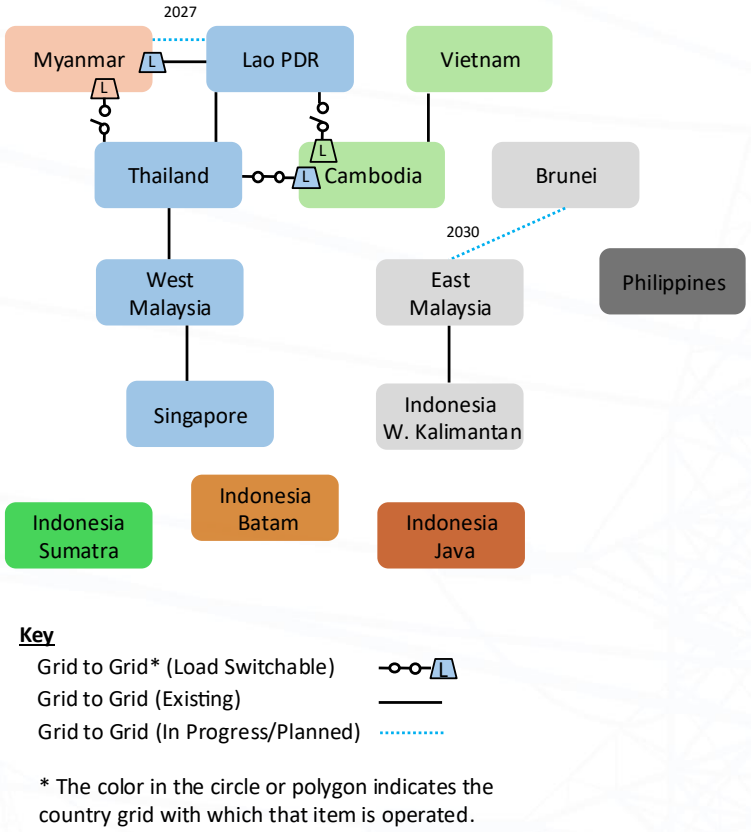
Existing cross-border interconnections in the region involve a mix of grid-to-grid links and other arrangements, as shown in the simplified grid topography map in Figure 2.1-1. The map focuses on cross-border connections of 230 kV and above, with lower voltage exceptions highlighted in the discussion following the map. Note that a single interconnection type between two countries depicted in the map represents one or more such links on the ground. See *Annex E: Existing and*

[2] Whilst there is ample public documentation of high interest in subsea projects globally and its related challenges, with respect to ASEAN information was gathered at the IEA Regional Training Programme on Catalysing Interconnectivity in ASEAN event, held 6-7 June 2024 in Singapore.

[3] Sources including the 2024 ACE APG Map indicate the Sarawak-Sabah line has been completed, but other sources such as the following indicate it was not likely to be completed until perhaps the end of 2024 at the earliest: https://www.sarawakenergy.com/interconnection-power-project-to-sabah-rests-on-completion-of-miri-lawas-transmission-line.

In-Progress Transmission Projects for more detail on individual transmission lines.

Figure 2.1.1-1 Existing and In-progress Regional Grid Topology



Source: Delphos.

Referring to the Figure 2.1-1, grid-to-grid interconnections link the following blocks of countries: (i) Vietnam-Cambodia; (ii) Lao PDR-Thailand-West Malaysia-Singapore; and (iii) Indonesia (West Kalimantan)-East Malaysia (Sarawak and Sabah).[4]

The Lao PDR-Thailand grid-to-grid ties are all at 115 kV, but are included in the map given their high aggregate transfer capacity and operational factors. All grid-to-grid interconnections are HVAC except for the Thailand-Malaysia link, which is HVDC.

Most of Cambodia's high voltage grid is controlled in large part by EVN and synchronised with Vietnam's grid. Similarly, EGAT largely controls Lao PDR's 115 kV grid. Peninsular Malaysia and Singapore are synchronised, as are Indonesia (West Kalimantan) and East Malaysia (Sarawak, with Sabah to be synchronised as well).

Most cross-border interconnections in ASEAN are of the generator-to-foreign-grid type, also known as "export IPPs," of which there are over 15 operating at 230 kV and above. Nearly all of

[4] It is noted that in the AIMS III study, Sarawak and Sabah were depicted and modelled as separate grids. Whilst they are separate grids that are operated by different utilities, the two grids are depicted together in the map for two main reasons: first, when the AIMS III study was conducted, the two grids were not interconnected, but they now are or are about to be; and second, there are fewer challenges in integrating (or further integrating) the systems of two adjacent state-owned utilities in the same country, than in integrating the grids of different countries.

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these projects involve generation in Lao PDR for export. None are shown in the map because they are not directly relevant to MPT markets.[5]

There are numerous grid-to-isolated-load connections, mostly operating at voltages below 230 kV. Amongst the most significant, and shown in the map, is a 115 kV line from Lao PDR to Tachileik, Myanmar[6]. Others include a 110 kV line from Yunnan to Mongla, Myanmar. These others are not shown in the map because they are generally not directly relevant to MPT markets.

Some of the grid-to-grid ties are "load switchable". Significant connections in this category include the 110/220 kV lines from Yunnan to northern Vietnam (not shown in the map), from Yunnan to northern Lao PDR (115 kV not shown in the map), from Yunnan to Mongla, Myanmar (110 kV not shown in the map), a 115 kV line from Thailand to western Cambodia, and a 115 kV line from Lao PDR to Western Cambodia. In the map, the colour of the polygon matches the colour of the country currently providing power to that location. When the circuit is closed, load is served by the foreign country and when it is open, it is served by the local country.

The situation in Western Cambodia is unique in that it receives power from Lao PDR during the rainy season, and then receives power from Thailand during the dry season. The map depicts a dry season arrangement, hence the breaker on the Lao PDR-Cambodia tie is open.

Much of Myanmar is not covered by the national grid, including broad border swaths from the northwest to the southeast. Notably, much of eastern Shan State and all the Tanintharyi region plus the southern half of Mon state above it, are off the national grid. To give a sense of scale, the Tanintharyi Region plus southern Mon state, with a population of over 1.5 million, is larger in area than Denmark and Switzerland, and about the length of Portugal. In the ASEAN context, the region's area is about 30% of the area of Cambodia.

Indonesia and the Philippines are comprised of numerous large heavily populated islands. For Indonesia, the map includes only Sumatra, Java, West Kalimantan, and Batam, each of which is a node on the list of AIMS III transmission projects[7]. The Philippines in the map corresponds to Palawan Island, the 10th largest of the Philippine islands in terms of population.

There are several in-progress HV reinforcements and additions to existing grid-to-grid interconnections in the region, especially between Thailand and Lao PDR. New grid-to-grid interconnection at the 230 kV level or above that are currently in progress include one between Lao PDR and Myanmar, one between Brunei Darussalam and Sarawak, and one between Sarawak and Sabah.

2.1.2. Planned and Proposed Interconnection Projects

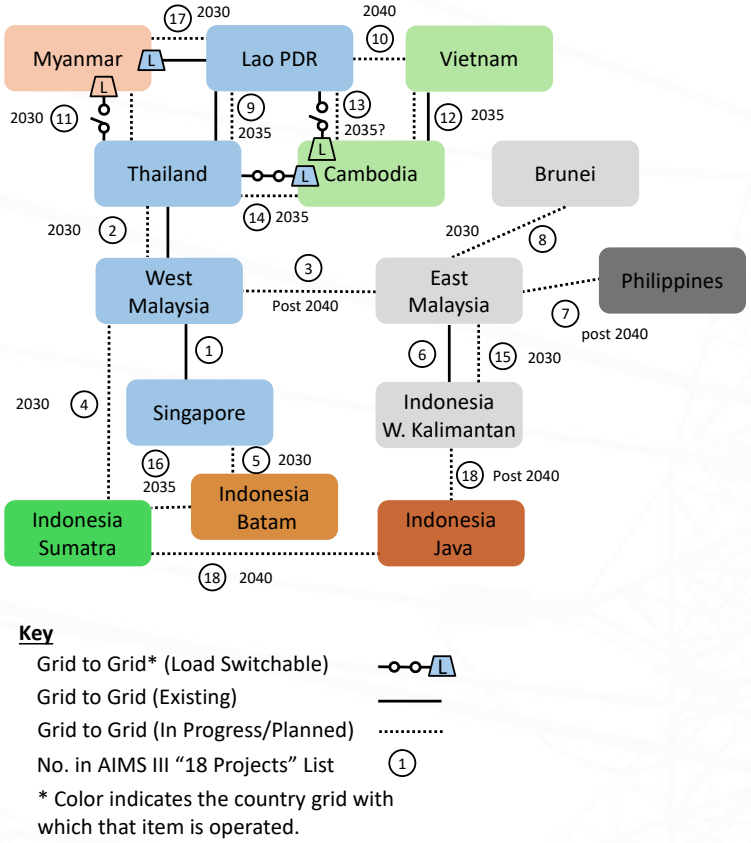
Figure 2.1-2 adds planned and proposed interconnection projects to the existing and in-progress projects in the previous figure. See *Annex F: Planned and Proposed Transmission Projects* for details on individual projects.

[5] There are also two generator-to-foreign grid hydro projects in Myanmar selling into China. These two projects are sometimes falsely depicted as grid-to-grid interconnections. The projects involve specific generating units dedicated to China's grid, with other generating units dedicated to Myanmar's grid, with no ability to transfer power from one grid to the other.

[6] According to the following source, Lao PDR is now exporting 30 MW over a 115 kV line to Tachileik: "The ASEAN Power Grid Meeting Series 2023 HAPUA Lao PDR. Slide Deck. 01 December 2023". EGAT has separately confirmed circuits on that interconnection are open.

[7] The AIMS III Phases 1 and 2 studies involved indicative transmission expansion planning for the APG, leading to recommendation of 18 priority interconnection projects envisioned to establish the physical underpinning of MPT across ASEAN. These projects are referred to in the Roadmap as the "18 Projects".

Figure 2.1.2-2. Existing, In Progress, Planned, and Proposed Regional Grid



Source: Delphos

Referring to the previous figure`, note the following:

1. The numbers in circles correspond to the "18 Projects" that were identified in the AIMS III study as priority interconnection projects. Of those projects, Projects 1 and Project 6 have already been completed. Projects still to-be-completed are shown with earliest CODs, as estimated by the Authors.[8]
2. Sarawak and Sabah are shown as a single integrated grid, though they are operated by separate Malaysia utilities. With the completion of the Sarawak-Sabah transmission line, the two grids are shown as a single East Malaysia block to simplify the depiction of regional interconnections, and because the real complexity from a market design and operations perspective is in joining the grids of different countries.
3. The map does not show the proposed generator-to-foreign grid projects to Singapore from Vietnam, Cambodia, and Sarawak.[9] The Singapore-Batam projects are shown; however, those are generator-to-foreign grid projects and they are represented in the AIMS III "18 Projects" list.
4. Project 9 between Thailand and Lao PDR is depicted as being completed in 2025. Based on meetings with EGAT, several reconductoring and other activities have already or will soon increase aggregate transfer capacity. The specific projects are to be confirmed.
5. Project 11 between Thailand and Myanmar is depicted as being completed in 2030, whereas the ASEAN Power Grid Map produced by ACE depicts Project 11 as being

[8] These CODs are later in some cases than the dates provided in an "ASEAN Power Grid Map" produced by ACE in January 2024.

[9] The first two of these correspond to specific projects proposed by developers and with a level of political-regulatory endorsement, whilst the third project appears to have only been mentioned at the political level.

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completed in 2040. The former project would involve linking grids at Myawaddy and Mae Sot, which should be the most straightforward of potential HV grid-to-grid links between these two countries; the latter project is IPP-to-grid and hence is not appropriate to include as a grid-to-grid project.

6. Project 13, connecting Lao PDR to Cambodia, is shown being completed in 2035. The existence and nature of this project should be confirmed. The ASEAN Power Grid map shows a project from Ban Hat to Stung Treng being "expanded up to 200 MW" by 2030. A recent source from Lao PDR shows no planned or in-progress grid-to-grid projects between the two countries. Existing transfer capacity should be confirmed as well.
7. The nature of Project 17 between Lao PDR and Myanmar should be confirmed. The available information indicates that this project would be grid-to-grid HVAC, linking Keng Tung substation in Myanmar, with M. Long substation in Lao PDR. Grid weakness in both countries raises questions about how the link would be operated. One possibility is that the northern Lao PDR grid, including the M. Long substation, would be islanded from the rest of the Lao PDR system following completion of a 500 kV interconnection project with China's Yunnan province. In this case, Myanmar (at least in the area of the Kung Tung substation) would be synchronised with the Northern Lao PDR/Yunnan grids.[10]
8. The LTMS region depicted in blue is the most interconnected part of ASEAN. There is ample low-cost hydro and other renewables in Lao PDR and ample demand for energy, and especially renewable energy in Singapore. The current transfer constraint is at the Thailand-Malaysia interface, and is currently limited to 300 MW. The Lao PDR-Thailand and West Malaysia-Singapore interfaces have rated transfer capacities over three times higher.

2.2. Existing Bilateral and Multilateral Trade in ASEAN

Substantial regional integration already exists in ASEAN. Existing cross-border interconnections involve a mix of grid-to-grid and generator-to-foreign grid (or IPP-to-grid) lines. There are also significant load switchable grid-to-grid connections, allowing flexibility in power supply between countries, based on operational needs. However, it is important to recognise that most cross-border power trade in ASEAN happens on IPP-to-grid interconnections, primarily from Lao PDR to Thailand, and that such interconnections are not directly relevant to MPT, as they do not involve more than two countries, are unidirectional, and are not grid-to-grid.

The following discussion of existing trade in ASEAN is divided into subsections for those types that are not grid-to-grid, and those that are grid-to-grid (of greater relevance to MPT).

The grid-to-grid discussion addresses bilateral trade, plus MPT under the two MPT efforts that have been endorsed by ASEAN bodies, LTMS-PIP and BIMP-PIP, as well as the "Regional Power Market" proposed by the ADB (a short-term energy market concept), which to date has not been formally endorsed.

2.2.1. Not Grid-to-Grid

The two main types of cross-border transmission interconnections that do not involve grid-to-grid linkages are generator-to-foreign grid (sometimes shortened to "generator-to-grid," or as "IPP-to-grid," reflecting the most common version of this approach) and grid-to-isolated load. Examples of these types of interconnections in the ASEAN region are discussed here.

Generator-to-Foreign Grid: Whilst projects in this category constitute actual cross-border trade, they do not by themselves facilitate multilateral power trade. Rather, from the perspective of the importing country's power system, the external generators are not external at all; they are directly connected to that system just like any other generator on the system. There is no need to

[10] This scenario is based on discussions held at an AMS workshop in Siem Riep, Cambodia, in August 2024.

coordinate generation or power flows on the project's dedicated transmission lines, which can only be used to supply power in one direction. Unlike grid-to-grid transmission lines, there is no ability to move power bidirectionally from one system to another and there is no ability to use the line for other purposes without significant investment, when the generator is unavailable or has become temporarily uneconomic.

Notwithstanding the limitations inherent in generator-to-foreign grid transmission projects with respect to the advancement of multilateral power trade, such projects blaze a path for other types of cross-border transmission projects, since a common minimum set of legal, regulatory, and institutional matters need to be addressed for all types of cross-border projects. It is likely, for instance, that the large number of IPP-to-foreign grid projects in Lao PDR selling into Thailand facilitated development of the LTMS-PIP project, and set the stage for eventual advanced MPT in the ASEAN region. Similarly, the proposed IPP-to-foreign grid projects that would sell power from other countries to Singapore over dedicated lines, such as the Indonesia (Batam)-to-Singapore solar projects, will require addressing many of the same legal, regulatory, and institutional details that actual grid-to-grid projects from Indonesia to Singapore would need to address.

Generator-to-foreign grid projects can also lay the physical infrastructure foundation for other types of links. For instance, ownership of transmission facilities for Build, Operate, Transfer (BOT) projects will transfer upon termination to one or more other utilities; and transmission line rights of way may be wide enough to allow addition of new lines.

Grid-to-Isolated Load: As previously discussed in relation to generator-to-foreign grid projects, other types of connections besides grid-to-grid can be supportive of MPT development, and can be much easier to implement. For instance, grid-to-isolated load can make sense economically and operationally when a sizeable load in one country is far from domestic generation resources (or when domestic supply to the area is inadequate) and relatively near to the grid of another country. There are many cases internationally of such arrangements, including portions of the US served by Canada, and portions of Mexico served by the US. Within the ASEAN region, HV examples include Thailand and more recently, Lao PDR, supplying Tachileik, Myanmar and, until several years ago, Thailand supplying Myawaddy, Myanmar.[11] There are dozens of lower voltage examples throughout the region.

Apart from the underlying economic benefits of such projects, there can be other important benefits as well. For instance, isolated or poorly served loads tend to be reliant on inefficient and polluting diesel gensets. Interconnecting such regions to a larger grid displaces those gensets, resulting in reduced emissions. Such projects also smooth the path for more direct market integration between the two countries, by facilitating build out of transmission and distribution infrastructure in the importing region, and establishing the rights of way that could potentially allow for additional lines or uprating of existing lines.

2.2.2. Grid-to-Grid

The ensuing subsections cover grid-to-grid trade and ongoing MPT development efforts, as well as summarizing historical regional power trade data. Section 5.4 " Evolution of Interconnections and Markets" depicts how grid-to-grid interconnections might develop.

Bilateral Grid-to-Grid: There is a long history of bilateral grid-to-grid interconnections and trade amongst the AMS, as summarised here:

1. Thailand-Malaysia: A 25-year contract exists, understood to currently be in its 23rd year, allowing purchase and sale of electricity on the 300 MW HVDC link between the two

[11] The city of Myawaddy was not on Myanmar's national grid until a double circuit 230 kV line was brought up from Mawlamyine in 2019.

countries. The line, at 23 years old, faces high unavailability, and is due to be replaced.[12] A separate 132 kV HVAC line built around the same time also allows energy exchange.

2. Singapore-Malaysia: The original connection between the Plentong Substation (Malaysia) and the Senoko Power Station (Singapore) was double-circuit 275 kV HVAC (capacity of 2 × 250 MVA) and has existed since at least 2012. Use of the interconnection initially was limited to emergency situations, which changed under LTMS-PIP.[13] The interconnection was upgraded recently using new conductors, with a rated capacity of approximately 1,050 MW.
3. Thailand-Lao PDR: Thailand has supplied power to Lao PDR over 115 kV grid-to-grid connections for over 20 years. Higher voltages are used for IPP-to-grid projects.
4. Vietnam-Cambodia: These grids have been connected via a 230 kV line since 2009, with Vietnam providing significant energy exports.
5. Malaysia-Indonesia: Malaysia (Sarawak) exports to Indonesia (Kalimantan) over a 275 kV line completed in 2016.

A sub-category of bilateral grid-to-grid trade is carried out under grid-to-grid (load switchable) facilities, the significant HV examples of which are Yunnan to Vietnam, Yunnan to Lao PDR, Yunnan to Myanmar at Mongla, and Lao PDR to Cambodia, and Thailand to Lao PDR, as described in the introduction to this section.

Other Grid-to-Grid: The other example of grid-to-grid trade in the region is under the LTMS-PIP arrangements, discussed in detail in Section 4.1, whilst the next section provides trade data for that trading structure.

2.2.3.Trade Data

This section discusses the available and compiled trade data for the aggregate cross-border trade in ASEAN. The biggest cross-border interfaces in the region by trade volume are Thailand-Lao PDR, Lao PDR-Cambodia, Vietnam-Cambodia, and Malaysia (Sarawak)-Indonesia (Kalimantan). Table 2.2.3- provides the details. Other important interfaces are the interconnections between China (Yunnan) and each of Myanmar, Lao PDR, and Vietnam; trade over these interfaces is not shown in the table. Even though China is not within ASEAN, trade with China over these interfaces is relevant for regional planning, especially HV grid-to-grid trade (load switchable), such as between China, Lao PDR and Vietnam.

From the effort in compiling the cross-border energy data, there is a significant gap identified which involves the inconsistencies across reporting entities, with few details on what the data includes or how values are measured. This is due to the absence of a data-sharing mechanism in the region for historical trade data, which includes reporting standards amongst regional utilities. Thus, different utilities publish different types of trade data involving differing levels of granularity, for different purposes.

For instance, Thailand's reported electricity exports to Cambodia for 2022, as shown in Table 2.2.3-1 are about 17% higher than Cambodia's reported imports from Thailand (values are not shown)[14]. The discrepancy could be due to a combination of losses between the metering point measuring outgoing energy, and metering points measuring imports, metering errors, or differences in the types of cross-border flows that get measured – whether or not cross-border flows from Thailand on low-voltage lines operated by PEA are counted.

[12] Sources (i) ISEAS. "Accelerating the ASEAN Power Grid 2.0: Lessons from the Lao PDR-Thailand-Malaysia-Singapore Power Integration Project (LTMS-PIP)". (December 2023), ppg 22 & 26 regarding the "LTMS EWA & Supplemental Letter of HVDC system". (ii) Discussion with EGAT, 2 May 2024.

[13] The undated source entitled, "Power Grid Interconnections in the ASEAN Region (by Country)", is an appendix of an unknown ERIA document (apparently "RPR_FY2014_No.30"), reporting on regional interconnection facts on the ground using data from 2012.

[14] Since it was not possible to determine which set of values were correct, it was decided to use Thailand's values.

The reported data on most interfaces are similarly ambiguous on data definition, particularly on whether entities are reporting flows pre- or post-loss.

Table 2.2.3-1 Summary of Cross-border Electricity Trade in APG

		Power Trade (GWh)							
Interface	**Direction**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Thailand (EGAT) - Cambodia (EDC)	EGAT to EDC	147	87	410	1,161	810	284	915	
	EDC to EGAT								
	Total	**147**	**87**	**410**	**1,161**	**810**	**284**	**915**	
Thailand (EGAT/PEA) - Lao PDR (EDL)	EGAT/PEA to EDL					2,013	2,046	2,774	
	EDL to EGAT/PEA					1,395	1,370	902	
	Total					**3,408**	**3,416**	**3,676**	
Thailand (EGAT) - Peninsular Malaysia (TNB)	EGAT to TNB				136	610	33	3	
	TNB to EGAT				118	126	127	89	
	Total	**0**	**0**	**0**	**255**	**736**	**160**	**92**	
Vietnam (EVN) - Cambodia (EDC)	EVN to EDC	1,164	1,077	1,091	1,772	1,247	830	1,303	
	EDC to EVN								
	Total	**1,164**	**1,077**	**1,091**	**1,772**	**1,247**	**830**	**1,303**	
Vietnam (EVN) - Lao PDR (EDL)	EVN to EDL	47	30	29	35	26	45	49	
	EDL to EVN								
	Total	**47**	**30**	**29**	**35**	**26**	**45**	**49**	
Lao PDR (EDL) - Cambodia (EDC)	EDL to EDC			66	129	1,818	2,272	2,735	
	EDC to EDL								
	Total			**66**	**129**	**1,818**	**2,272**	**2,735**	
Sarawak, Malaysia (TNB) - Kalimantan, Indonesia (PLN)	SEB to PLN	684	1,119	1,509	1,697	1,568	973		
	PLN to SEB								
	Total	**684**	**1,119**	**1,509**	**1,697**	**1,568**	**973**	**0**	
LTMS	EDL to Keppel							183	83

Source: compiled by Delphos from EGAT Annual Report, EGAT Power System Planning Department, EVN Annual Report, EDL Annual Report, EDL Statistics Report, EDL System Planning Department, EDC Annual Report, EDC System Planning Department, Suruhanjaya Tenaga Malaysia.

Apart from bilateral cross-border trade, there is also a pilot of multilateral power trade in existence: the Lao PDR-Thailand-Malaysia-Singapore Power Integration Project (LTMS-PIP). This is an important regional market initiative involving grid-to-grid trade amongst Lao PDR, Thailand, Malaysia, and Singapore.

LTMS-PIP has been implemented in three phases. The first phase involved up to 100 MW under the Lao PDR-Thailand-Malaysia (LTM) arrangement. The second phase expanded to 300 MW under LTMS, when Singapore was added. In the third phase, per the September 2024 extension to LTMS-PIP, up to 300 MW is supplied, with sources from both Lao PDR and Malaysia.

The first two phases involved unidirectional flows from Lao PDR, first to Malaysia under LTM, and then to Singapore under LTMS (initially). With the September 2024 extension, there are now two suppliers — Lao PDR and Malaysia — whilst Singapore remains the buyer.

According to available public data, cumulative trade under LTMS up to April 2024, was recorded at 266 GWh. However, there is little detailed information on the actual cross-border trade flows for each country involved.

Reflecting on this, a regional, standardised data-sharing mechanism for historical cross-border power trade is an essential first step to tracking and documenting existing power trade in the region. A verified historical record of cross-border trade would be useful for the region in formulating strategies or key milestones for enhancing MPT. This is an initiative that regional institutions like the ASEAN Centre for Energy (ACE) or the Heads of ASEAN Power Utilities/Authorities (HAPUA) could take forward.

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Chapter 3: Key Considerations for MPT Development in ASEAN

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3.1. MPT Implementation Challenges

Establishing MPT anywhere is a complex and lengthy process. The following summary focuses on key challenges to expanding MPT in the ASEAN region, in comparison to efforts to develop other international power markets. A first step to overcoming these challenges is to recognise them.

1) More than in other MPT regions, ASEAN involves countries with widely ranging levels of economic development and power system controls. Disparities in these areas complicate efforts to plan, finance, and operate interconnections, as well as to establish MPT mechanisms. Unlike US and most EU markets, in the ASEAN region there is no overarching common regulatory structure, nor a long history of grid-to-grid trading arrangements upon which to build organised MPT markets.
2) Operational requirements for grid-to-grid interfaces are lacking. Whilst grid code harmonisation is commonly mentioned as a minimum requirement for MPT development in the region, it is more important for grid operators to have confidence that the operators of other grids they would connect to can be trusted to maintain their grids within agreed operational limits, and to accurately and timely report relevant data. Grid control is notably weak in some AMS and in the Lower Mekong Subregion, and broadly speaking there is significant reluctance to share relevant grid data across all AMS.
3) Financing of cross-border transmission projects faces three key obstacles.
    a) National laws and regulations in some AMS create challenges in obtaining regulatory approval for investments in cross-border grid-to-grid facilities. This is primarily because standard technical-economic project assessment frameworks require clear documentation of benefits to electricity ratepayers in comparison to domestic projects, such as new generation and/or transmission. However, some of the value of these cross-border projects may be speculative and conditional. Consequently, whilst garnering political support for a project is beneficial, it may not be sufficient for a utility to secure the necessary investment approval.
    b) Some of the projects that are most obviously supportive of MPT in ASEAN, such as replacement and potential expansion of the HVDC facility connecting Thailand and Malaysia, may be more beneficial, or perceived to be so, to the other AMS in the LTMS block than to those two countries sharing the interface. Organised MPT markets often involve a mechanism to finance projects of this sort, generally referred to as “common use” assets, but such a mechanism does not yet exist in ASEAN. In the meantime, the perception that costs and benefits may be unbalanced impedes investment in such projects.
    c) A significant barrier to support for the financing of cross-border transmission projects for many donors, especially multilateral development banks (MDBs), is their restrictive green taxonomies. Such green taxonomies contain stringent criteria that do not favour grid-to-grid transmission projects. Although the “ASEAN Taxonomy for Sustainable Finance,” developed by the ASEAN Taxonomy Board, is a robust and credible alternative green taxonomy that could be more favourable for grid-to-grid projects, the fact is that MDBs and other sources of capital currently use the more restrictive taxonomies, as detailed in Section 6.3 “Green Taxonomy for Transmission Financing”.
4) The ASEAN geography is challenging. Several AMS are island nations, with large distances between them and between portions of national grids that also require interconnection. All other major multilateral power markets involve mainly contiguous countries.
5) Whilst increased renewables trade is envisioned to be a driver and justification for MPT in ASEAN, documentation of the renewables content of the trade is inadequate at present. An internationally recognised regional Renewable Energy Certificate (REC) trading framework is required, something that exists presently only in Europe and the US/Canada.

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5. Overly ambitious goals and timelines for regional market integration can lead efforts astray. The GMS experience illustrates this, where visions of complex, multi-directional trade, national unbundling, and centralised dispatch remain unrealistic for decades to come. Whilst long-term goals are valuable, it's important to recognise the time needed to achieve them. Focusing on creating a market that all GMS members could join from day one may have hindered progress on smaller, more practical steps that could have better advanced MPT development. A gradual approach, building simpler markets first, might better support long-term regional integration across ASEAN.

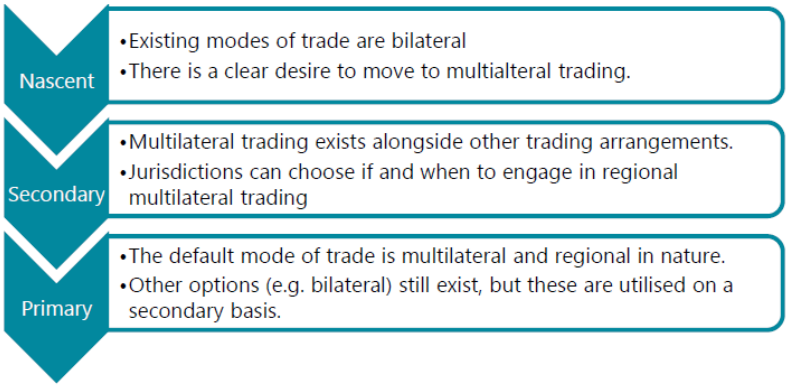
3.2. Defining Key Aspects of MPT Markets

We use here the following definition for MPT: "Multilateral power trade involves three or more countries in a permanent trading structure, offering compelling economic and political benefits to all market participants."

The concept of "trade" in "multilateral power trade" and its definition bear emphasis as well, since some arrangements that involve regional or even multilateral power flows do not themselves constitute *trading* arrangements (buying and selling something), such as ENTSO-E in Europe or the US Western Interconnection. Rather, those arrangements are both frameworks and institutions dedicated to planning and coordination of the operation of regional/multilateral power grids. In addition, ENTSO-E's mandate includes various market developments and facilitation activities, but to be clear, the mandate does not extend to operating any market.[15]

This Study relies on the characterisation of MPT models in the IEA's *MPT in ASEAN Report*, which (i) categorises MPT markets as Nascent, Secondary, or Primary; and (ii) places specific MPT markets into different groups based on their degree of power system integration, as shown in Figures 3.2-1 and 3.2-2.

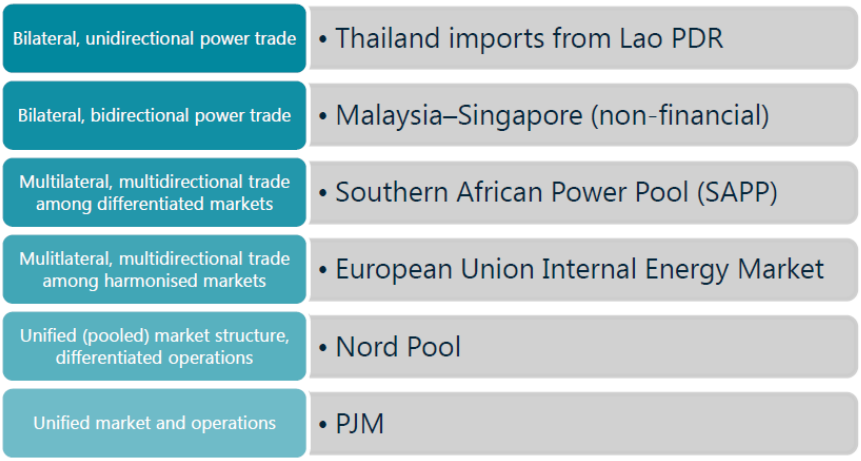
Figure 3.2-1. Categories of MPT



Source: IEA MPT in ASEAN Report

[15] See, for instance: https://www.entsoe.eu/about/market/.

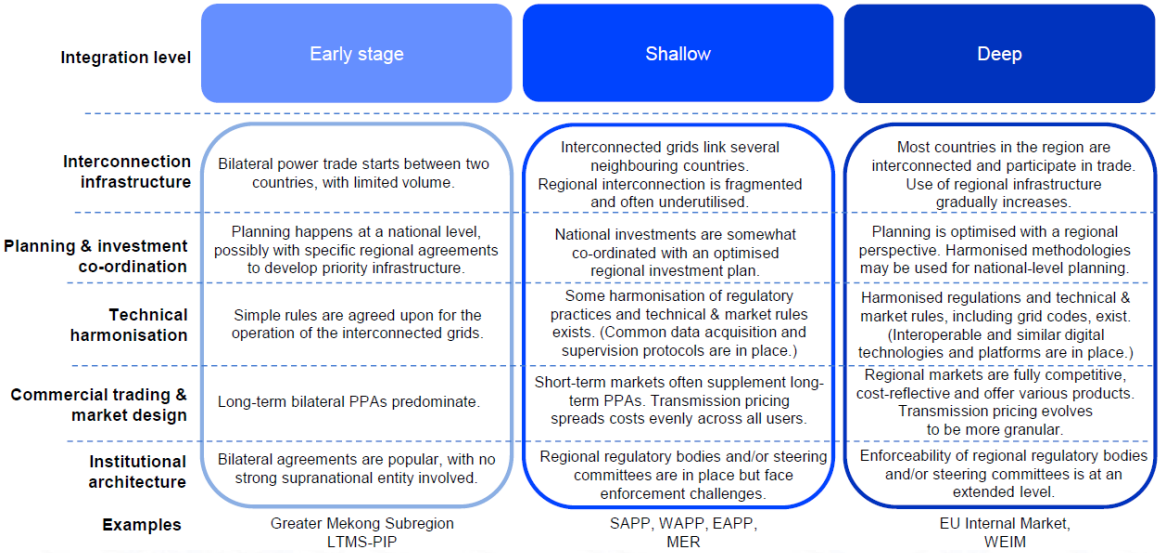
Figure 3.2-2. Degrees of Power System Integration



Source: IEA MPT in ASEAN Report

Another useful IEA MPT categorisation scheme is shown below. This graphic offers a level of granularity that should be understood in a conceptual sense; some specific features of different market types, such as regards transmission cost allocation, may not apply to the listed markets in Figure 3.2-3, or other markets that broadly reflect the overall scheme.

Figure 3.2-2. Stages of MPT: Shallow to Deep



Source: IEA, "Institutional Architecture for Regional Power System Integration for Government, Utility and Regulator Roles". 2023.

3.3. Minimum Requirements for Different MPT Models

This section will first discuss general minimum requirements for MPT, and then the additional requirements necessary to implement specific market models in ASEAN.

Regarding general minimum requirements for MPT, we use the *IEA MPT in ASEAN Report* as the starting point, with several proposed adjustments and points of emphasis, as shown in Figure 3.3- The IEA Report includes subtle but critically important textual guidance for its own graphical summary of minimum requirements. Details are explained here:

- Harmonised grid codes are not required, *per se*. Simply put, harmonised grid codes are not required, but agreed grid operating standards are required. This distinction is

important because: (i) prominent documents related to MPT in ASEAN state that "harmonised grid codes" - without the modifiers and context provided in the IEA report - are a minimum requirement for MPT; (ii) national grid codes address many more topics than just how to operate specific interconnection facilities; and (iii) it can be difficult to update, enact, and enforce national grid codes. As stated in the IEA report, "There is no need to fully harmonise national grid codes across all of the AMS. Rather, it would be sufficient to have a common regional operational agreement that focuses on interconnectors, in order ensure co-ordinated cross-border system operations."[16]

- "Third-party access for external resources". The phrasing used by the IEA is important; there are numerous statements in prominent ASEAN MPT studies and other documents that do not include the modifier, "for external resources". Third Party Access (TPA), as the term is commonly understood, is not necessary for MPT. TPA at the wholesale level is traditionally understood to refer to requiring the incumbent utility to allow third-party use of its transmission grid, such as to facilitate an IPP selling to a large customer, and to do so on an equal basis with the utility's use of the grid for its own customers. TPA is thus related to efforts to add competition in generation and marketing functions within a market. Efforts to develop MPT in ASEAN are not focused on introducing competition within national markets, but rather are focused on achieving gains from trade and increasing renewable energy penetration at the regional level. As noted previously, several important ASEAN MPT-related documents state that TPA is a minimum requirement for MPT, and some of them use TPA in the traditional sense.[17] Introducing "traditional" TPA in ASEAN, i.e. to allow an IPP in Country A to sell to a large customer in Country B, and to require Country B to restructure its market to allow TPA if it did not already do so, would introduce significant complications to market design, regulatory, and dispute resolution areas. What is required for MPT is the sort of TPA defined in the *IEA MPT in ASEAN Report*, that is the TPA at the MPT level could consist merely of allowing each AMS/AMS utility that is a member of a given MPT market to access the transmission grids of the other utilities on an equal basis (*IEA MPT in ASEAN Report*, pp. 76 – 78). This type of access can be referred to as "Third Party Access for External Resources" to avoid confusion with TPA as it is commonly understood.
- "Interconnector calculation methodology". This refers to what is commonly known as "Available Transmission Capacity" or ATC. What is required is both an ATC calculation methodology and an ATC allocation methodology. The former item is a technical matter, and the latter is commercial/legal in nature and is an important market design consideration. For instance, in some markets, contracts are prioritised over opportunity trade, and the market may involve firm/non-firm transmission rights.

[16] International Energy Agency, "Establishing Multilateral Power Trade in ASEAN". (2019). Page 72.

[17] The "ATSO study", for instance, whilst highlighting that SAPP's approach did not require restructuring of national markets and that the market (currently) provides for only a limited type of TPA, nonetheless devotes considerable space to detailing numerous TPA requirements for development of regional MPT markets in ASEAN. The ATSO study is the following: Economic Research Institute for ASEAN and East Asia (ERIA)/Nord Pool Consulting, "Study on the Formation of the ASEAN Power Grid Transmission System Operator Institution". 2018. The study also acknowledges (see p. 49) that implementing these TPA requirements could require significant changes to national markets. Possibly, these seemingly contradictory findings reflect requirements in the Terms of Reference for the ATSO study. Regarding SAPP, there were initially no requirements for TPA and until 2010, there were no IPP participants in SAPP, and as of 2022, there were only two, both in Zambia.

Figure 3.3-1. Minimum Requirements for MPT

Infrastructure: Cross-border grid-to-grid transmission facilities

Economic: Compelling economic justification offering significant value to all market participants

Political:
political will
intergovernmental agreements
common working language

Technical:
harmonised technical standards (grid code)
harmonised wheeling charge methodology
third party access for external resources
data and information sharing
interconnector capacity calculation methodology and allocation methodology

Institutional:
Institutional arrangements
Settlement and payment mechanism
Dispute resolution mechanism

Source: Delphos.

Apart from the general minimum requirements, there are additional minimum requirements specific to different international multilateral power trade models, as summarised in Figure 3.3-2, together with relevant inherent contextual advantages that benefitted each market. Instances of a notable lack of an additional minimum requirement are highlighted as well. These international markets are considered in greater detail at Annex C.1.

Figure 3.4-2. Contextual Advantages and Additional Requirements for Market Models

	Contextual Advantages	Additional Requirements for ASEAN
PJM	Single country. Nearly 7 decades of coordinated market operation of utilities, beginning in 3 US states. FERC Order 888 in 1995 required utility unbundling and transmission open access.	Impossible to implement this style of regional power market in ASEAN.
Nord Pool	Most countries within the EU. Very strong historical Nordic utility and cultural relations. EU advantages: Electricity Directive, dispute resolution (Energy Charter Treaty), common overall legal/regulatory background.	Strong regional regulatory body or law akin to the Electricity Directive. Strong system control. Utility unbundling.
SIEPAC / MER	Cultural, common language, regional institutions. Major concerted market development support and MDB loan package to finance common use market and transmission infrastructure.	Regional regulator with enforcement powers established by treaty. Deep involvement and financing by development banks.
SAPP	Long history of bilateral trade with South Africa, the massively dominant load and supply hub for the region. Hub (South Africa) and spokes transmission topology.	The SAPP's "hub and spokes" topology resulted in a ATC calculation and allocation approach that may not be appropriate for LTMS region.

3.4. Elected End Point and Intermediate Stage MPT Models

This report provides the path between where ASEAN power markets currently are, and a recommended "end point," that is what the ultimate vision is for MPT in ASEAN. The focus is on the nature of, and evolution toward, intermediate-stage markets. The following discussion identifies a recommended market model type as the end point, and then three intermediate-stage MPT markets that could be developed in ASEAN.

Five MPT market models were selected for review: PJM, Nord Pool, SAPP, WAPP, and SIEPAC, which are discussed in considerable detail at Annex C.1. Of these, WAPP was excluded from

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most of the analysis, because trading in that market has not begun. Based on: (i) the comparative market models analysis; (ii) the existing nature of ASEAN national markets; and (iii) minimum requirements and challenges to MPT market development, the Authors conclude that the PJM model is inapplicable, the Nord Pool model has some useful features but overall is not recommended, and that SAPP and SIEPAC markets are the most plausible end-state models for ASEAN, for reasons summarised in Figure 3.4-1.

Figure 3.4-1. Summary Assessment of MPT Market Models for ASEAN

	Features and Requirements		Relevance for MPT in ASEAN
PJM	Is not a MPT model because the market is wholly within the USA. Centralized dispatch, unbundled utilities, strong regional regulator (PJM itself) under a strong national regulator (FERC).		Essentially impossible in a multilateral setting and especially in ASEAN. Would require harmonized industry restructuring across participating AMS, establishing of a strong regional regulator with enforcement powers. Insurmountable political hurdles.
Nord Pool	Unbundled utilities, light market regulations for Nord Pool itself but specific and detailed requirements, regulation, and coordination of pan-regional electricity trade under EU law (EU Electricity Directive), EU regulator (ACER), and regional entities (ENTSO-E).		Extremely difficult to emulate this market model in ASEAN or in any multilateral setting outside Europe. Key obstacles in ASEAN include the requirement for utility unbundling and numerous other national restructuring requirements. Potentially useful features include: (i) "Principles-based" light regulation. For example, one key requirement in the Nord Pool exchange rules is that every market participant at Nord Pool post and maintain collateral to be allowed to trade. (ii) Sophisticated market price/settlement structure and experience implementing/adapting in other markets.
SAPP SIEPAC	Mix of national market types (no need to unbundle utilities). National markets responsible for national system control and dispatch decisions, with the regional short-term market facilitating optimization using excesses. Formal handling of both short-term products markets and contracts markets, while still allowing bilateral contracting outside the market (SAPP). Regulatory approaches differ, with pros and cons to each approach.		Agnostic as to national market structure. TPA in SAPP not required initially and still only at a basic level; TPA in SIEPAC required, but only for the transmission lines built across the 6 countries for the market. Utilities maintain national system control. Formal incorporation of both contracts and products markets, as could be expected in LTMS + Sumatra area. Approach to developing, financing, and owning common use transmission assets in SIEPAC may be useful in ASEAN context.

Source: Delphos.

To clarify, all MPT models have both advantages and disadvantages for ASEAN. The recommendations focus on the fundamental features and broad structural elements of the selected MPT market models. At the same time, there is an openness to considering applicable features from other markets in the ASEAN context.

In essence, the recommended MPT markets are not meant to be viewed as exclusive options. Instead, it is anticipated that elements from both the SAPP and the SIEPAC markets could be relevant for ASEAN. Additionally, some aspects of one or more other markets may warrant further analysis.

For example, whil**st** the SIEPAC market may serve as a useful model in certain respects, it does not imply that an MPT market in ASEAN must establish a regional regulatory authority through a treaty, as SIEPAC does. Conversely, if SAPP is ultimately deemed the most applicable model, it does not follow that a loosely associated regional regulatory authority is the optimal approach for ASEAN. Furthermore, Nord Pool may offer the most efficient organisation and operation model for a day-ahead market in ASEAN. At this stage, it is premature to decide on the specific details of potential MPT markets in ASEAN. A study led by ETP/ACE, known as the AIMS III Phase 3 study, will provide further details in this regard.

Two intermediate-stage MPT market areas have been identified for further analysis and development in ASEAN: the West Subregion Market and the East Subregion Market. In summary, each of these subregional markets is expected to ultimately incorporate both contract markets and short-term energy markets.

The West Subregion Market will initially function as a contract market, drawing on the **lessons learned** and structures of the LTMS-PIP. This market will focus on delivering renewable energy from the north to the south. In addition to renewable energy, contracting for conventional energy will occur, with multidirectional flows of both renewable and conventional energy. Importantly, whil**st** contracts may

indicate the type of energy being transacted for reference, the organised contract market itself will not differentiate between energy types for scheduling and settlement. The contract market will complement, rather than conflict with, bilateral contract energy flows and short-term energy flows in the future short-term energy market.

The East Subregion Market, initially implemented as BIMP-PIP, is envisioned in this Study to commence as a short-term energy market for opportunity trading amongst the AMS in this region. Given its grid topology and other factors, it is anticipated that bilateral contracting can initially take place, with less reliance on an organised contract market.

3.4. Regional Coordination

Ensuing sections address the development of the three elected intermediate MPT markets and the overall evolution toward more advanced MPT markets in ASEAN. Many of the steps to implement these MPT markets and the overall vision can be pursued subregionally and on an *ad hoc* basis, as needs arise. There are, however, several important issues that are best addressed at the ASEAN level, as discussed here.

- **Regional institutions.** MPT does not emerge without facilitating institutions. Whilst market institutions will certainly be required at a subregional level to develop and operate subregional markets, a regional body is recommended to provide overarching support and coordination for MPT development in ASEAN. Functions of this entity could include planning, tracking, and coordinating efforts to develop MPT; coordinating and carrying out regional infrastructure planning; and providing regulatory guidance and support.
- **Dispute resolution.** Whilst subregional markets likely will require tailored dispute resolution approaches for some types of disputes, an ASEAN-wide dispute resolution mechanism focused on inter-state electricity sector disputes is recommended, as discussed in *Annex C "Dispute Resolution,"* Section C.5.3 .
- **Infrastructure.** The process to implement interconnection projects is lengthy. Such projects need to be included in national and regional planning, studied in sufficient detail, and subsequently financed and constructed. The process is likely to be more challenging for projects to interconnect regions that are not currently interconnected, because there are fewer established frameworks to build on.
- **Finance.** There are obvious advantages to approach support by institutions and development partners at the ASEAN-wide level. Similarly, we would envision development bank finance facilities for cross-border infrastructure to be organised on an ASEAN-wide level, as well as other internationally coordinated infrastructure finance efforts.
- **Regional RECs trading arrangements**. As discussed in *Annex C " Regional REC,"* Section C.4, a regional cross-border unbundled REC trading arrangement would be supportive of renewable energy (RE) trade and RE project development, by allowing RE buyers to verify and document that the RE they are purchasing under contract was actually produced by an RE facility of a given type and location.
- **Development partners and donors**. There is an enormous amount of work and funding required to implement advanced MPT across ASEAN. A concerted deep and extended engagement by development partners and donors will be required, which should be organised at the ASEAN level.

3.5. Governance Arrangements

This section identifies mechanisms for making high-level decisions necessary for the implementation of MPT. Before proceeding with the findings and recommendations in this area, it is essential to address the definitions of key terms.

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In the ASEAN context, the terms “regional” and “subregional” have specific meanings. “Regional” pertains to all ASEAN Member States (AMS) and generally refers to activities or structures carried out under the ASEAN framework. In contrast, “subregional” relates to any subset of AMS.

By contrast, market design studies and documents that do not focus specifically on ASEAN use the term “regional” in a more general sense, referring simply to any group of countries or states within the same geographic area. For instance, Nord Pool operates in the Nordic region, as well as elsewhere across Europe. Additionally, “regional transmission organisations” (RTOs) are the preferred term used to designate the regional (multi-state) power markets in the US and Canada.

To reduce confusion regarding the use of these terms, this section adopts the following approach:

- When referring to “regional” in the ASEAN sense, the phrase “ASEAN-wide” is used. Otherwise, “regional” is used in the generic sense.
- When referring to “subregional” in the ASEAN sense, “subregional” is used.

A major decision in the design of multilateral power trading (MPT) in ASEAN is determining which type of entity — whether a regional authority, regional association, or even a not-for-profit corporation — would be most suitable to act as a regulator for a given market structure in ASEAN. As seen in the case of the Southern African Power Pool (SAPP), a single entity can serve as both the regulator and market operator for certain types of markets.

The advantages and disadvantages of each solution are likely to depend on other aspects of market design and the number of AMS involved in any proposed market. It is fair to say that a "regional authority" would be the most challenging to establish, and would require consensus on its mandate. However, it could also hold the most regulatory power. On the other hand, adopting the SAPP approach would be easier to implement and has proven durable.

Another key decision is whether a regulatory body should be established at the ASEAN-wide level or at a subregional level.

When considering regulatory power, it is important to understand that this power does not necessarily need to extend to overseeing the internal operations of national markets. In fact, the only example of a regional regulatory authority in an operational MPT market — SIEPAC — has no authority over the structure, behaviour, planning, or operation of national markets. Instead, the authority of this entity pertains solely to the regional market, which operates alongside national markets. This distinction is important for those who might be predisposed against the idea of a "regional regulator" in ASEAN, a term that may be misunderstood as implying regulatory authority across the entire ASEAN region.

Market operators are typically corporations, either for-profit or not-for-profit. In some jurisdictions, regional associations and not-for-profit entities may be functionally similar.

There are other types of institutions that play a crucial role in MPT market development. Some experts have identified the presence of regional institutions with "clear and significant executive power" as a key factor in the success of regional interconnection and market development initiatives. The Authors agree with this view, particularly with regard to coordination, planning, and market development support functions, though perhaps less so for regulatory functions related to national market matters, as previously discussed.

The development of North American and European markets greatly benefited from strong coordination, planning, and market development functions. In the US, these functions are provided by entities such as NERC and FERC, which have also actively encouraged market development beyond mere regulation. In the EU, these functions are managed by ACER and ENTSO-E.

In terms of regulation, one central challenge is the regulation of cross-border markets. There are too few true MPT markets, excluding those in the EU and US, to draw firm conclusions, making this an area that warrants further analysis.

Recommendations in relation to governance and institutional matters are summarised as:

1. Although there currently exists strong general political backing for ongoing MPT cooperation, the proximate institutional requirement is to draft and approve a new APG MOU.
2. The types of institutions to create (if any), the entity type, and whether the institutions are ASEAN-wide or subregional, should not be separated from other basic market design decisions, since overall market design and institutional structure are intrinsically linked. Just as important, incorrect views about what could and could not work in ASEAN should not drive decisions as to institutional matters. For instance, it has been shown that a national short-term market is not necessary to create a subregional short-term market; hence, it would be unfortunate if the incorrect opposite view led to crossing off the list of possibilities short-term markets and the types of institutions required to operate them.
3. Decisions on institutional matters should be carefully assessed as an option for ASEAN moving forward, to accelerate MPT and the needs of the more advanced institutional set-up should be evaluated from time to time as the regional cooperation evolves, which process should be facilitated under an agreement or MoU for APG. At the moment, optimising the current platform and established framework on the existing institutions under the APG is necessary.
4. Efforts should be made to ensure that ASEAN-level protocols are not unduly prescriptive as to market design approach. Protocols should focus on recommending principles and the types of outcomes that would be encouraged, rather than state-specific market features that are needed for MPT trade to occur. The objective should be to provide guidance, not to close off options.

3.6. Benefits of Proposed MPT Arrangements

The benefits of MPT for participating countries and utilities have been discussed in depth by several previous studies. These benefits are briefly summarized below to provide context for subsequent discussions on how the proposed MPT market models address these benefits. The benefits of MPT are:

- Increased energy security from resource diversification across multiple countries endowed with different types of resources.
- Reduced costs from more efficient use of supply resources and other infrastructure.
- Improved grid stability and reliability from load balancing or backup power services shared across borders, especially during peak demand periods or outages.
- Environmental benefits of the integration of higher levels of variable renewable energy (VRE) in national power supplies.
- Economic development stimulated by investments into energy infrastructure.
- Political and economic integration through increased levels of cooperation amongst countries.

Both in the EU and the US, there is substantial trade across those regions without there being a single regional power market in either area. If a single MPT market in ASEAN is desired as the ultimate goal of MPT development efforts, then ASEAN policy makers should seek to justify why such a single market would be conceptually or economically more beneficial on a net basis, than linked subregional markets. The Authors believe there is little value in a single common power

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market across all ASEAN, but that there would be very substantial value in a common approach to developing MPT in ASEAN, which could proceed on a subregional basis.

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Chapter 4: A Subregion-Led Approach To Advancing MPT In ASEAN

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In the preceding analysis, two geographic blocks were identified for potential MPT development in ASEAN: the West Subregion and the East Subregion. The West Subregion refers to ASEAN in the mainland, involving Lao PDR, Vietnam, Cambodia, Thailand, Malaysia, Singapore and Indonesia (Sumatra side)[18], whilst the East sub-region, refers to Brunei Darussalam, Indonesia (Kalimantan), Malaysia (Sarawak and Sabah), and the Philippines. Consideration of underlying power sector context and the types of trade that would be most beneficial in each region helps frame the MPT development recommendations in the ensuing subsections.

The West Subregion is vast and diverse in terms of national market structure and grid control. National markets range from vertically integrated and partially unbundled single buyer structures, to advanced restructured markets (Singapore, with Vietnam moving in that direction). Grid control varies from strong to weak.

Trade orientation in the West Subregion is driven by three main factors: topography, resource endowment, and economics. Due to topography, Vietnam has three potential bilateral trading partners: China (Yunnan), Lao PDR, and Cambodia.

Vietnam has secured large amounts of low-cost hydropower for its fast-growing economy from Lao PDR via IPP-to-grid projects, as well as some power in the north from China on grid-to-grid (load switchable) facilities. Vietnam supplies Cambodia with power in the south for historical and political reasons. Overall, Vietnam is import-oriented, with its main suppliers (Lao PDR and China) being neighbours.

Other countries in the West Subregion should perceive strong benefits from MPT markets.

- If MPT existed across the region, Lao PDR could access more buyers for its hydropower and secure supplies for its southern area for dry seasons and dry years.
- Cambodia and Myanmar could access imported supply to augment chronically short domestic supply, whilst also seeing domestic grid reliability benefits.
- Thailand and Malaysia could lock in roles as regional power trading hubs, earning fees for use of its grid, earning profits from exports to neighbours, and reducing the cost of domestic supply through incremental imports.
- Indonesia (Sumatra) could gain access to significant demand for RE, whilst also seeing gains from opportunity trade.
- Singapore could have access to diversified energy supply, including RE, from across the region.

The varied gains from trade from each country's perspective can be distilled for the region to the following objectives: (i) generally move Lao LDR hydropower from the north towards the south, and sometimes move power of different types in different directions; and (ii) capture gains from opportunity trade reflecting different demand profiles and supply costs within domestic markets.

The first motive for trade has been addressed at a basic level in LTMS-PIP, which moved hydropower from Lao PDR to Malaysia in its first phase, and then to Singapore in its second phase, and in its third and current phase, moves hydropower from Lao PDR to Singapore, and power from different sources from Malaysia to Singapore.

LTMS-PIP is a very simple contract market: unidirectional (north to south), one seller (under the first and second phases, now two sellers), one buyer, and time limited. Enhancing LTMS-PIP by creating a fully functional organised multidirectional contract market would serve the first identified objective.

One key topological feature of the West Subregion is that the four LTMS countries are arranged in a line, meaning that Singapore and Malaysia cannot trade with Lao PDR on a bilateral basis,

[18] The West Subregion is what commonly refers to North and South Subsystem in the ASEAN region.

nor can Singapore trade with Thailand on a bilateral basis. An organised contract market solves this problem.

A contract market is not an efficient means to address the second objective of capturing gains from opportunity trade. The fundamental problem is that there is a lack of information in a contract market.

Consider the following scenario: suppose a fully functional multidirectional contract market has been established for the LTMS countries, with live ATC postings and an automated process for ATC allocation. Suppose it is the dry season and Lao PDR is seeking power for the day ahead for its south, for which its marginal cost of supply is $300/MWh. Thailand might have power available at a pre-agreed contract price of $150/MWh, but due to a maintenance outage, those generators that would normally supply the power are not available. Thailand does have flexible generation available for $200/MWh; however. Malaysia has generation available for $160/MWh, but only for Malaysia's off-peak hours. The least-cost solution is for Malaysia to supply Lao PDR during its off-peak hours, and for Thailand to supply the rest of the time using its $200/MWh generators.

The coordination required to identify the least-cost solution a day ahead through a contract market is extremely high even in this simple scenario, and for just three traders. Adding potential trading parties, generation or grid constraints, results in a level of complexity that is nearly impossible to work out in a coordinated day-ahead basis in a contract market. This is why contract markets are not used for opportunity trade anywhere in the world. Opportunity trade is handled through short-term energy markets.

It has been shown that in the West Subregion, there would be great benefit from the establishment of both a contract market and a short-term market.

The East Subregion is much smaller than the West Subregion, both in terms of population and geography. Three of the four countries in the East Subregion are contiguous, with the Philippines' Palawan Island about half the distance from Sabah as some of the subsea projects being considered for the West Subregion, notably Sarawak to Singapore, or Vietnam to Singapore. Grid control is strong for all four countries.

A basic motive for trade in the East Subregion is to connect hydropower in Sarawak and Kalimantan with thermal resources elsewhere in the region. Given the regional topography, most potential trade could be handled through bilateral contracts, at least until the Philippines' Palawan Island is interconnected, which is not expected before 2040. Indonesia can trade with both Sarawak and Sabah, its largest natural trading partners, but not with Brunei. Brunei, for its part can trade with both Sarawak and Sabah. The question is, what would an organised contract market offer that bilateral contracting could not, and is that sufficient justification to form such a contract market?

The answer is that a contract market would allow contract trade between Indonesia and Brunei, which has the smallest ASEAN power sector. It is noted that an organised contract market would also facilitate trade between PLN (Indonesia) and the separate Malaysian utilities operating in Sarawak and Sabah, but it should be possible to carry out such trade on a bilateral basis.

Overall, there appears to be less underlying justification for an organised contract market in the East Subregion, which is not to say formation of such a market would not be helpful.

There is a strong justification for a short-term energy market in the East Subregion, however, which could complement either organised or bilateral contract markets. A short-term market would allow efficient use of regional generation resources.

4.1. West Subregion Market

The West Subregion Market would build on the Lao PDR-Thailand-Malaysia-Singapore Power Integration Project (LTMS PIP), a contract market. Accordingly, this section first provides an

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overview of LTMS PIP, before addressing proposed added features for this contract market. The contract market would complement, not conflict with, bilateral contract and short-term energy flows in a short-term energy market to be added later.

The LTMS PIP, proposed in 2013, has proceeded in phases, as summarised here. Phases are numbered for the convenience of the discussion that follows.[19]

- Phase 1 (LTM-PIP). An Energy Purchase and Wheeling Agreement was signed in September 2017, by utilities in Lao PDR, Thailand and Malaysia. Trading under the agreement took place from January 2018 through December 2019, covering purchases by Malaysia of up to 100 MW from Lao PDR.
- Phase 2 (LTM-PIP). In operation from January 2020 through December 2021, the maximum purchase amount was raised to 300 MW.
- Phase 3 (LTMS-PIP). Singapore was added to the arrangements, taking over the role of buyer of power from Lao PDR, from Malaysia. The initial two-year LTMS-PIP arrangements began in June 2022 and expired in June 2024, covering 30 MW to 100 MW of purchases.
- Phase 4 (LTMS-PIP). In September 2024, arrangements were enhanced and extended for two years. The new arrangements allow Singapore to import up to 100 MW from Lao PDR, as well as up to 100 MW from Malaysia.

The addition of Singapore to the regional trading arrangements was complicated by the fact that Singapore's power market has been restructured. Amongst other issues, this resulted in two separate parties being involved on Singapore's side (compared to the single party involved for each of the other countries in LTMS-PIP), with the Energy Market Authority (EMA) and Keppel, a privately-owned Singapore electricity retailer, as the buyer.

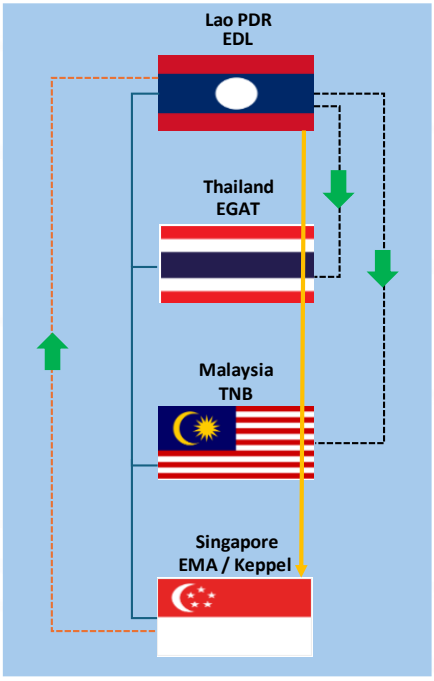
LTMS-PIP arrangements for Phase 3 are summarised in Figure 4.1-1. Arrangements for Phase 4 are understood to be similar in structure. Lao PDR sells power to Keppel, there are wheeling agreements between Électricité du Laos (EDL) and Electricity Generating Authority of Thailand (EGAT) and Malaysia's Tenaga Nasional Berhad (TNB)[20], and coordinating arrangements involving those three utilities and the EMA. Purchases are scheduled day-ahead on an online Communication Platform hosted by EGAT. The platform and associated protocols involve, as initial steps, EGAT and TNB issuing Available Transmission Capacity (ATC)[21] declarations to EDL, which then issues its daily availability declaration to Keppel, which then issues a confirmation of purchase. Subsequent steps involve various confirmations, an offer into the Singapore Wholesale Electricity Market (SWEM), with Keppel recorded as the buyer, and for reconciliations.

[19] Sources for this section on LTMS-PIP include: (i) Mirza, Huda, Sharon Seah, and Qiu Jiahui, *Accelerating Progress on the ASEAN Power Grid 2.0: Lessons from the Laos-Thailand-Malaysia-Singapore Power Integration Project (LTMS-PIP)*. ISEAS - Yusof Ishak Institute. December 2023; (ii) Ms. Titiporn Sangpetch, PhD. *Data Sharing on LTMS Platform: EGAT's perspective*. Electricity Generating Authority of Thailand (EGAT). December 2023; (iii) Meetings and discussions with EGAT and other stakeholders.

[20] Sources differ on whether arrangements are covered under a single tri-partite agreement or separate agreements.

[21] In the protocols, these are termed "Daily Availability Declare" or "DAD" and the concept is applied both to ATC and to available power/energy from EDL.

Figure 4.1-1. LTMS-PIP Arrangements



Arrangements
• Two-year Supply Agreement between EDL and Keppel, for 30 – 100 MW • Wheeling Agreements between EDL – EGAT covering 7 interconnection paths and EDL – TNB, covering one interconnection path • Hourly trades scheduled day-ahead, with weekly indicative nominations • Web-based Communication Platform, hosted by EGAT. Confirmation and coordination protocols

Key:
EDL – Keppel Supply Agreement
Wheeling Agreement
Coordinating Agreements/Protocols
Power Flow Direction
Payment Flow Direction

Source: Delphos International

Although LTMS-PIP in all its phases is an extremely simple arrangement involving one-way trade[22] between only two or three parties at a time – with different buyers under LTM versus LTMS versions, and the possibility of two suppliers under Phase 4 – for a single product (day-ahead supply) for a maximum of two years under each version of the project, it is rightly regarded as a pathfinder project. In several ways, the project has been a significant success. Establishing a trading arrangement of this size and duration involving wheeling across one, and later two countries is extremely rare internationally.[23] There have been challenges as well. Important experience has been gained and lessons learned. Factors contributing to the success of LTMS-PIP are provided as follow:

Success factor 1: the virtue of simplicity. The market is no more complicated than it needs to be. The design of the market matches underlying economic drivers: Lao PDR has excess supply of cheap RE, and there is demand for that RE in Malaysia and Singapore. The recent addition of Malaysia as a supplier again aligns with underlying economic drivers.

Success factor 2: political commitment. LTMS-PIP has been mentioned and endorsed by energy ministers and AGP institutions starting in 2014.

Success factor 3: governance mechanism. During the market design stage, allocating tasks to different countries gave them a sense of ownership. A set of task forces was constituted, operating under an LTMS working group, with each task force managed by a separate country: Malaysia (technical viability), Singapore (legal and regulatory framework), Thailand (commercial

[22] Whilst some sources claim the addition of Malaysia as a supplier amounts to multi-directionality, the claim stretches the meaning of the term, since flows from Malaysia to Singapore are in the same direction as flows from Lao PDR to Singapore. True multi-directionality requires more complicated flows scheduling and can involve much more complicated calculations and allocation of ATC.

[23] The Authors are unaware of any multilateral markets where two "wheels" would currently be feasible, other than in European markets of SIEPAC and SAPP. Within North American markets, true MPT trades wheeled through different countries do not occur. Even within EU markets, it is a matter of debate whether there have been significant trades wheeled across two countries, since the EU constitutes a "country" as the term is used in relation to MPT, given that all EU markets are governed by the Electricity Directive. In SIEPAC, most trades involving wheeling have been relatively short-term (below one year) and involved smaller volumes. Within SAPP, shorter-term trades involving two wheels have occurred.

arrangement) and Lao PDR (tax and tariff structure). While, ultimately, arrangements needed to be agreed by all parties, allocating leadership and responsibility to individual countries helped overcome the pitfalls of developing market design details by consensus.

Success factor 4: learn by doing. The LTM-PIP phases were substantially simpler than the LTMS-PIP version of the project. Later phases built on experience gained during earlier stages. More generally, capacity building by development partners, combined with the experience gained from learning by doing, has improved the policy and technical sophistication of stakeholders in ASEAN, thus benefitting market design and implementation stages.[24]

Several challenges and concerns have arisen as well, as summarised here. All these matters could also be said to be the "learning" part of success factor 4, "learning by doing".

Challenge 1: complexity of the political economy involved in developing MPT. Whilst political and ministerial support is a key success factor, utilities must see how they individually benefit from trade under a given arrangement, for that arrangement to be durable over time. Utility managers can accommodate pressure from above to carry forward some relationship-building trading arrangements – referred to in the region as "ASEAN spirit" – but over time and as the scale of trade increases, the focus may turn to how the arrangements impact the metrics upon which utility management is judged. In all LTMS-PIP phases, the role of EGAT has been limited to wheeling, focusing attention on the cost/benefit of the wheeling charge itself.

Challenge 2: limited transfer capacity and costs related to operation of interconnection facilities. The binding transfer constraint in LTMS-PIP is between Thailand and Malaysia, currently limited to 300 MW. The HVDC facility used for trade across that interface is aging and becoming unreliable. A permanent trading arrangement in this region will require a substantial upgrade of this interface.

Challenge 3: the dimensionality problem. The complexity of developing a MPT market can be conceived as the product of the number of dimensions of that market, with dimensions being the number of countries, products and features involved. For instance, Challenge 1 highlights the importance of ensuring each market participant (especially utilities) perceives gains from trade. Adding a single new market to LTM to create LTMS-PIP uncovered new challenges, for example related to Singapore's market structure. Similarly, the critical role of ATC calculation and allocation methodologies would become evident even if just one more member, such as Indonesia (Sumatra), were added to the market, and even if the market remained primarily unidirectional.

Challenge 4: existing institutional limitations. The LTMS-PIP working group/task force structure, involving no external parties, such as development partners or regional bodies, was identified as a success factor for LTMS-PIP itself. However, expanding LTMS-PIP, for instance by adding new countries, multi-directionality, or new products, would involve considerable technical and commercial complexity that would be difficult and expensive for existing members to undertake on their own. The challenge with respect to potential future versions of LTMS-PIP could be addressed through addition of new external working group members, and more generally, by an ASEAN-wide institution dedicated to MPT expansion.

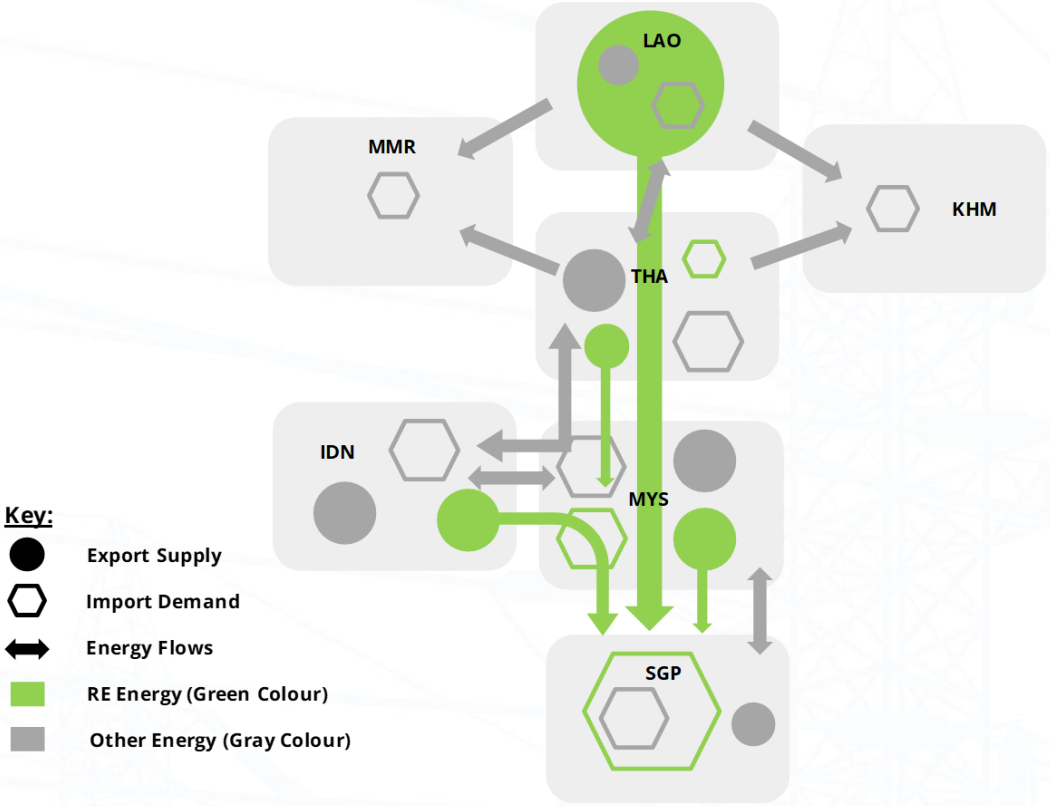
4.1.1 Market Overview

In an expanded form, the foundational market in the West Subregion would be a contract market designed to deliver RE from Lao PDR especially, and from West Malaysia and Sumatra as well, to Singapore. Other suppliers and buyers of RE and conventional energy would transact in the contract market as well. Multidirectional trading would be supported.

[24] Huda, Mirza S., S. Seah and Jiahuil. *Accelerating the ASEAN Power Grid 2.0: Lessons from the Lao PDR-Thailand-Malaysia-Singapore Power Integration Project (LTMS-PIP)*. ISEAS Yusuf Ishak Institute. (December 2023).

The interaction of these different markets and flows in the West Subregion market area is shown in Figure 4.1-2. Since a key economic driver in the contract market is delivering Lao PDR's vast RE export supply towards the south, the figure depicts export supply and import demand for RE in green and undifferentiated or "plain" energy in grey, with the relative size of these items indicated by the size of the icons in the figure. Smaller amounts of RE export supply could be provided from West Malaysia and Indonesia (Sumatra). Trade in the short-term energy market (e.g., the regional power market) would be for "plain" energy, though RECs could be attached to trade in the market for tracking and compliance purposes.

Figure 4.1.1-1. Possible Contract market Trade Flows In West Subregion



Source: Delphos.

As mentioned, the contract market is envisioned to be combined with a short-term market in the same area, though it is possible that different AMS might choose not to participate in one or the other of the different types of markets. For instance, Cambodia may decide against being a founding member of the contract market, as it may be unable to commit contractually to export for a number of years, due to the lack of existing and planned grid-to-grid connectivity. However, it may see benefits from being a founding member of the regional short-term energy market, which could help address the need for energy (not specifically RE) in western Cambodia on a seasonal and as-needed basis.

The two markets — the contract market and the short-term power market—would be agnostic on matters of national electricity market structure.

4.1.1 Recommended Next Steps for West Subregion

The following are the key next steps to develop the West Subregion market. Many of the steps can be carried out in parallel, and most steps would need to be completed before the new markets could be operational, and hence are not presented in rank order of importance. This said, the first two items, pertaining to objectives and political commitment, should be addressed as a priority.

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1) Hold subregional discussions to agree on what each country would expect to gain from the new markets before committing to major next steps. Regional entities and other stakeholders could play an important role at this stage in facilitating discussions and preliminary agreements. A critical issue is to agree on the market design principles that would ensure participating countries see MPT market development efforts as "win-win".
2) Develop intergovernmental agreements on the guiding principles and central features of the contract market, and the short-term energy market. These intergovernmental agreements, which would only be required for the founding market members, and those other AMS that may wish to join in later years, should ideally provide for establishment of a subregional market institution to operate the markets, though market development would be initially carried forward by existing stakeholders. Agreements should outline a governance framework that balances subregional and domestic interests, and allows expansion to other AMS. As an interim approach, it may be possible to pursue work for a period on the contract market under an extension to the existing LTMS-PIP structure, without the immediate need for a wholly new set of intergovernmental agreements.
3) Create a regional RECs market that would allow RE buyers to be confident that the energy they buy in the market is in fact RE. Integrate common standards on issuance, registration, and cross-border trading of RECs into market arrangements. See *Annex C, Section C.4 " Regional RECs,"* for more on this topic
4) Develop an ATC calculation methodology and protocol for the Lao PDR-Thailand, Thailand-West Malaysia, and West Malaysia-Singapore interfaces, and eventually for the Sumatra-West Malaysia interface.
5) Establish a wheeling charges methodology and set initial wheeling charges for Thailand and Malaysia. Initially, negotiated postage stamp wheeling charges, with escalation provisions, would be appropriate. The intergovernmental agreements and market implementation agreements should outline a path to developing more advanced methodologies as needed going forward, though it is noted that the limited number of contract paths, which align with physical flows, may not actually justify more complex approaches in the West Subregion contract market.
6) Identify the critical transmission lines and projects that serve as the physical backbone of the market and prioritise these projects. This list is likely to include capacity expansion on the Thailand-Malaysia interface. The existing 300 MW facility on that interface is insufficient for this market and is aging out of its useful life span. The 600 MW replacement facility that the two countries are discussing also seems undersized, given the expected RE demand from Singapore, and would in any case leave the regional market with a low transfer capacity on its key interface. It is recommended that a substantially larger facility be studied.
7) Investigate financing arrangements to leverage private capital, e.g. PPP concessions or an alternative approach to financing designated common-use assets.
8) A robust dispute resolution structure is required, considering factors such as market topology, with Thailand and Malaysia standing in the middle of subregional trade flows, and especially if common use infrastructure is involved. Issues are discussed in *Annex C, Section C.5.3 "Dispute Resolution"*.
9) A market institution is required. Possibly, as was the case for decades in PJM, the contract market and the short-term energy market as well, could be run by a new department at one or more of the member utilities. However, since the West Subregion market is envisioned as combining both short-term and contract markets , it is recommended to commit at the outset by intergovernmental agreement to creating the institution covering both markets. The market institution, which would be subregional, would perform functions including coordinating contract trade, settling contracts traded in the organised contract market, and operating the short-term energy market if that were established. The market institution would help to develop market rules, but would not itself be a regulator.

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10) A regulatory solution is required. Based on the nature of the market, the regulator and/or regulations would have no authority over the internal workings of national markets, but would pertain only to the West Subregion markets, focused on ensuring these markets operate within the bounds established for them in founding protocols and other agreements, and playing a role in dispute resolution. The SAPP and SIEPAC markets offer two very different approaches to regulation, though in both cases regulation is only with respect to the MPT markets and does not extend to the national markets of member states. SAPP is self-regulated by a stakeholder board, whereas SIEPAC is regulated by a regional authority established by treaty.

4.2 East Subregion Market

4.2.2 Market Overview

The East Subregion Market, initially implemented as the Brunei Darussalam-Indonesia-Malaysia-Philippines Power Integration Project (BIMP-PIP), is envisioned to begin as a short-term energy market for opportunity trade amongst this group of AMS. Given its grid topology and other factors, it is expected that contracting can be initially carried out on a bilateral basis, with less need for an organised contract market.

The BIMP-PIP was formally launched at the 41st ASEAN Ministers on Energy Meeting (AMEM) in August 2023. In a joint statement, the respective energy ministries of the four countries agreed to initiate BIMP-PIP "as a pilot project to study cross-border power trade amongst BIMP countries." The joint statement envisioned that the four countries would set up a BIMP-PIP Working Group to study the project and share their results by 2025. This feasibility study is currently being undertaken with support from USAID SPP.

The interconnection projects that would enable the BIMP-PIP project are:

1. existing HVAC interconnections between Sarawak-West Kalimantan (275 kV, 235 MW) and Sarawak-Sabah (275 kV, 100 MW)[25];
2. new HVAC interconnection between Sarawak-Brunei (275 kV, 100 MW), currently still at the study stage;
3. new HVAC interconnection between Sabah-Kalimantan (275 kV, 200 MW) expected to be completed as early as 2030;
4. new HVDC interconnection between Sabah-Palawan Philippines (275 kV, 200 MW) expected to be completed after 2040; and
5. expanded capacities of the existing lines.

Once the Sarawak-Brunei line is completed, three out of the four BIMP countries (except Philippines) and four out of the five BIMP utilities would be interconnected with 275 kV lines, providing the physical basis for MPT. The experience of LTMS-PIP evolving as an expansion from the initial LTM-PIP phases may serve as a parallel. BIM-PIP phase 1 can commence after the Sarawak-Brunei line, necessary market studies, and agreements are completed. Completion of the Sabah-Kalimantan line may trigger transition to BIM-PIP phase 2, with the fully-fledged BIMP-PIP being implemented when the Sabah-Palawan interconnection is completed. However, this is likely some time away.

BIMP-PIP builds on the vision of a Trans Borneo Power Grid that has been developed under the BIMP East ASEAN Growth Area ("BIMP-EAGA") initiatives. The potential to connect hydropower resources from Sarawak and North Kalimantan with thermal and gas-fired generation in East Kalimantan, Brunei and Sabah form economic and energy security rationale for BIMP-PIP. The subregional interconnections and a multilateral power market would also support the development of renewable generation resources like solar, geothermal, and biomass.

[25] Sources differ as to the status of the Sarawak-Sabah line. See footnote 3.

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Indonesia's proposed shift of its capital to Nusantara, and the need to ensure sufficient power supply for the new capital, is also likely to provide additional political impetus to advance the BIMP-PIP.

The main BIMP-PIP market is envisioned to be a short-term energy market. As discussed in *Section 3.6 " Benefits of Proposed MPT* Arrangements," due to market topology, there would seem to be less benefit to an organised contract market, since most contracting could be carried out on a bilateral basis.

4.2.3 Recommended Next Steps for East Subregion

The next steps for this subregional market will largely be informed by the ongoing feasibility study. However, the following next steps are likely to be important regardless.

1) The BIMP-PIP Working Group should share the results of the feasibility study with regional bodies and development partners. Regional bodies should also share findings with stakeholders from the West Subregion.
2) Transition from a Working Group-based approach to permanent subregional institutions, potentially being initially hosted as new departments in existing utilities, to facilitate more effective market development.
3) Review the conceptual frameworks anticipated to be proposed in the Renewable Energy Certificate System ("RECAP") project – currently in progress as of the date of this report – for potential incorporation within market rules. Lead coordination with West Subregion bodies and regional institutions to advance from conceptual frameworks to firm requirements.
4) Prioritise completion of Sarawak-Brunei interconnection. Without this interconnection, Brunei Darussalam remains islanded and there would only be two countries (Indonesia and Malaysia) in the subregional market until the Philippines join at a later date. A minimum of three countries is considered necessary to qualify for MPT status and as a practical matter, two countries can develop trading relations on a bilateral basis, with less need for organised markets and institutions.
5) Commence multilateral power trading in pilot stages. Draw on lessons learned from LTMS-PIP to inform design and evolution of pilot stages (see Section 4.1).
6) Draw on experience from market development in the West Subregion to refine approaches to calculate wheeling charges and ATC allocations. Some variation between the two markets is reasonable. However, the underlying principles should follow guidelines set by regional institutions.

4.3 Establishing Short-term Energy Markets

The analysis in this report calls for the establishment over time of short-term energy markets in both the West and East Subregions, in which generation gaps and excesses can be traded on a short-term basis. This would include taking advantage of existing grid-to-grid transmission spanning Lao PDR, Thailand, Malaysia, and Singapore, as well as the LTMS-PIP market development efforts.

Short-term energy markets have been the first type of product market developed in all MPT markets internationally, as well as all regional markets, e.g. markets in the US, Canada, and elsewhere that do not involve three or more countries. Short-term energy markets are the most basic and most important MPT product market. Whilst there appears to be some interest at the ASEAN-body level in this market concept, it is noted that ASEAN bodies have not formally endorsed exploring this concept further, unlike the BIMP-PIP and LTMS-PIP markets.

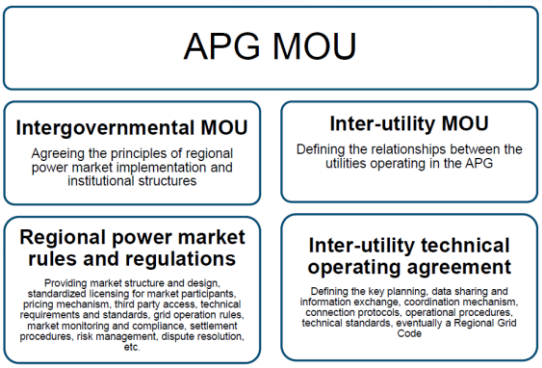
The core concept is to develop a short-term trading market amongst already interconnected countries, on a voluntary basis. The market could be expanded geographically and in terms of

features over time. This "opt in" and gradual approach respecting ground realities marks a departure from previous regional market development efforts, which can be characterised as consensus-driven and inclusive from the beginning.

Short-term energy markets would act as a day-ahead market to enable short-term system optimisation that would complement long-term bilateral agreements, e.g. under PPAs and power supply for border areas, and multilateral trades such as under the subregional contract market. Market operations would be decentralised, with each national entity participating in the market being responsible for managing its own grid and determining its own dispatch under its own national rules. However, the market operator would incorporate and share relevant price and quantity information at interfaces, including any pre-scheduled contract flows, identify and execute cost saving trades, and post settlements, allowing participants to see the financial outcome of the trading.

In other words, interconnected countries could decide whether to join the short-term energy market. Once a member, these countries could decide on any given day whether to offer generation or demand into the market.[26] Figure 4.3-1 shows the key requirements to implement such a market.

Figure 4.2-1. Key Enablers for Regional Power Market Development



Source: ADB, "Accelerating Multilateral Power Trade through Regional Power Market and Interconnection Development 2nd GMS Energy Transition Task Force Committee Meeting". Hyunjung Lee. December 20

Although third-party access is a topic to be addressed in the establishment of such a market, clarifications are required. Structurally, the market does not require third party access as it is commonly understood, to be provided by participating countries within those same countries. In other words, countries with vertically integrated utilities (most AMS) that do not offer internal market third-party access could participate in the market on an equal footing with restructured power markets, such as Singapore, that do provide internal market third-party access. Potentially, countries without internal third-party access could offer access for IPPs, or even large consumers, mediated by and with trades backed by the national vertically integrated utility.

Since Singapore's demand represents an obvious potential driver of trade in potential ASEAN regional markets, a key issue would be how to allow Singapore's buying entities – its privately owned retailers – access to the market. Singapore's retailers are fundamentally different than nationally-owned, vertically integrated entities.

For instance, whilst national authorities can stand behind their own trades and disputes, they could potentially be managed through regional government-to-government structures. The same would not be true for private parties operating in the market. This conception of short-term markets appears most like SAPP and SIEPAC markets, at least with regard to the following

[26] It is expected that at least some level of binding commitment would be required of country members of the market to maintain grid access for other countries.

features: opt-in for participation, decentralised operation, and third-party access in which there is no requirement for third-party access at the national market level. A stepwise approach appears pragmatic and potentially achievable.

Questions and issues for further investigation are presented here:

1) Which countries might realistically participate in a short-term market over the near to medium term? The LTMS countries, already interconnected grid-to-grid, constitute the expected core countries at the initial operational stage. This may be expanded to include Indonesia (Sumatra), once the proposed interconnection between Sumatra and Peninsular Malaysia is operational. Portions of Cambodia's and Myanmar's power systems could potentially participate, though they would need to be fully islanded from the rest of those systems initially, to preserve system control. Other controls and infrastructure investments would likely be required as well. A separate short-term market may be implemented in the East Subregion, since Brunei, Indonesia (Kalimantan), and Malaysia (Sabah and Sarawak) are all expected to soon be interconnected with grid-to-grid connections. Similarly, Lao PDR, Cambodia and Vietnam could also form a separate subregional market, given existing and planned interconnections. Over time, these separate markets could be combined or linked together though market coupling approaches.
2) Are stakeholders interested in pursuing development of short-term energy markets in ASEAN? It is not clear that there is currently strong interest. The Authors of this report believe that lack of strong interest may be due to several fundamental misconceptions that may exist amongst stakeholders.
    a) Misconception: a short-term energy market would conflict with the LTMS-PIP contract market structure and potential expansion of contract markets. On the contrary, contracts and short-term markets are complementary. They serve different purposes and co-exist by design in all MPT markets and regional markets.
    b) Misconception: creating a subregional short-term market would require national markets to already have their own short-term markets. This is false, as shown by SAPP and SIEPAC markets, which operate short-term markets without requiring national short-term markets.
    c) Misconception: short-term markets require giving up control of national system operation. This too is shown to be false by the SAPP and SIEPAC examples.
    d) Misconception: short-term markets are too complicated to set up. Whilst such markets do involve some complexity, there is ample international experience in setting up such markets. In addition, there is also considerable complexity in establishing fully functional MPT contract markets, particularly with the "in-line" grid topology found in the East Subregion, which requires addressing thorny ATC allocation issues. It is not clear that either type of market is substantially easier to set up than the other.

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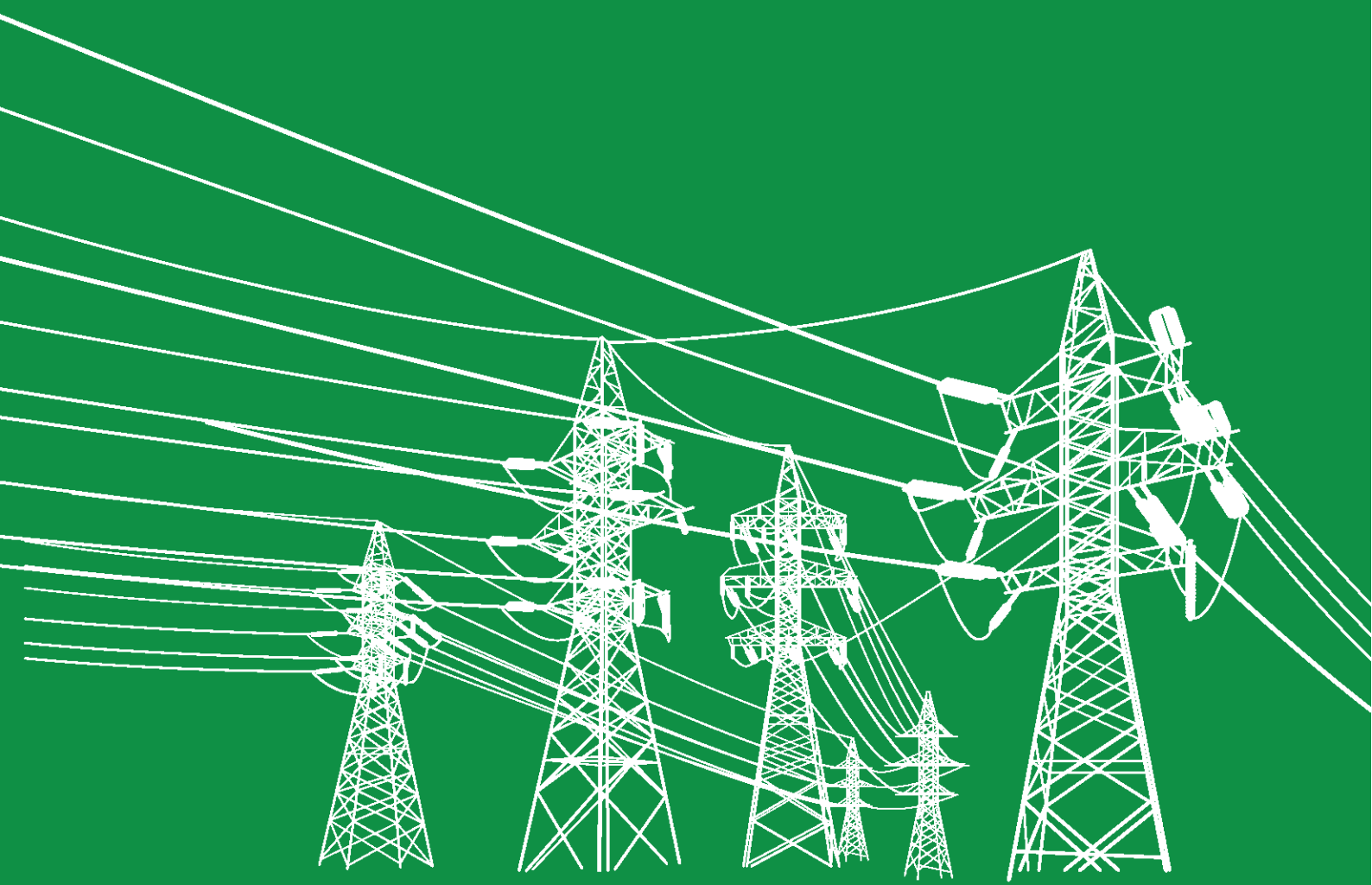
Chapter 5: Next Steps for MPT Development In ASEAN – An Indicative Roadmap



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The Roadmap detailed here, based on the foregoing analysis, focuses on identifying the main steps to advance MPT in ASEAN in the short to medium term, with less longer-term detail offered. Upcoming initiatives, such as AIMS III Phase 3, will elaborate on short-to-medium term MPT development details, including implementation of pilot MPT markets at a subregional level in ASEAN, which may include the markets proposed in the present Roadmap.

The preceding sections described the intermediate-stage MPT markets identified for further analysis and development in ASEAN: West Subregion Market, East Subregion Market, and potential short-term energy markets within these. West Subregion Market and East Subregion Market are geographically defined subregional markets that are not expected to physically overlap in the near to medium terms. The third market is of a type that could be implemented in either or both subregional markets.

The Study adapts the set of MPT development principles agreed upon in April 2017, by the ASEAN Power Grid Consultative Committee (APGCC). The principles agreed to by the APGCC were reaffirmed at a follow-on workshop held in September 2018. The *IEA MPT in ASEAN Report* adopted the same principles as the foundation for its recommendations. The specific principles guiding this Study are listed in Figure 5-1, aligning with those of the APGCC and the *IEA MPT in ASEAN Report*.

Figure 5-1 Principles for MPT Development

1. Efforts to establish multilateral power trading should be stepwise and voluntary

- *Start simple, building features and adding new AMS over time*
- *Coordination, MPT development support, and indicative planning required at regional level*

2. Power trade should focus on gaps and excesses and not require the full participation of all domestic generation in a regional power market

- *MPT should not interfere with operation of national power systems*

3. National regulations should be complemented by regional coordination

- *Some regulatory alignment to support trade but complete regulatory harmonization not required*

4. Multilateral power trading should be supported by expansion of regional cross-border power system infrastructure

- *Develop indicative master regional infrastructure plan tied to MPT development areas of focus*

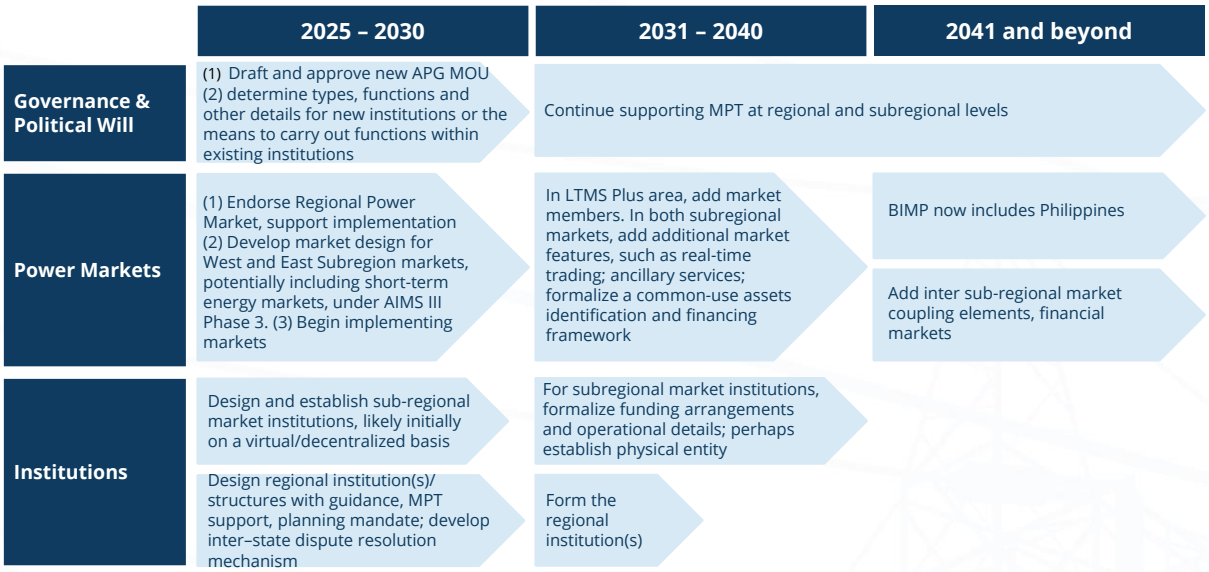
Source: Delphos

Several actions that must be taken to advance each of the subregional markets are either common to both those markets, or would benefit from regional guidance on core principles. Therefore, the following sub-sections begin with detailed next steps at the regional level, followed by steps for the two subregional markets.

5.1 A Roadmap for Long-term MPT Development in ASEAN: Regional Actions

Notwithstanding that the recommended markets themselves would be subregional, there are still numerous actions that must be taken at the ASEAN-wide regional level even in the short and medium term. Figure 5.1-1 provides a high-level overview of how next steps for the two subregional markets and the short-term energy market would be aligned with institutional development at the regional level.

Figure 5.1-1. Phasing of Actions for Overall ASEAN MPT Development



Source: Delphos.

Table 5.1-2 provides further details on next steps at the regional level. They are grouped into four broad Work Areas that do not map directly on the summary of the previous chart, reflecting the additional detail offered in the table. The four groupings are:

(1) Multilateral Market Development, encompassing several underlying requirements to enable and implement MPT models.

(2) Regional Standards and Guidelines, which lists specific technical and contractual matters for which regional guidelines and standards adapted for subregional markets would facilitate regional harmonisation in the long term.

(3) Regional Institutions, describing additional studies to determine the organisation and role of various functions within existing regional bodies, or under new institutions.

(4) Financing Frameworks, which broadly covers region-wide issues that impact how the necessary transmission infrastructure can be financed.

Table 5.1-2 Summary of Next Steps: Regional-Level

Work Area	Sub-Task:
Multilateral Market Development	Political Will and Governance: (1) Finalise and approve new APG MOU; (2) Review existing work on potential regional bodies (potentially decentralised) to carry out specific MPT development, coordination, and planning functions in ASEAN.
	Market Design: Develop detailed MPT market frameworks for selected market models, covering political requirements, institutional set up, commercial frameworks, dispute resolution, regulatory bodies, governance arrangements. Provide capacity building for ASEAN stakeholders on market design and market operation topics.
	Data Requirements and Sharing: (1) Develop an approach to update and share historical cross-border power trade data, define a minimum set of non-sensitive data, data requirements, and periodicity of data sharing; (2) Integrate approach within operating agreements and standards on subregional markets.

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Work Area	Sub-Task:
	Regional RECs: (1) Increase awareness of RECs as a tool to facilitate cross-border RE trading through acknowledging the findings of reference study on RECs (ACE RECAP Study); (2) Consider the recommendation of the study to establish a regional RECs framework; (3) Identify bilateral or subregional markets with highest potential for grid-to-grid RECs trade; (4) Define next steps for regulatory harmonisation specifically on issues relevant to RECs standards, issuance, accounting, governance, and trading; (5) Engage with donors and international reporting bodies to conduct a pilot for cross-border RECs trade on grid-to-grid ties to assess suitability for international recognition. Reiterate until gaps are addressed; (6) Engage with other stakeholders to adopt common standards and practices to expand markets where cross-border grid-to-grid RECs trade is recognised by international best practices.
Regional Standards and Guidelines	(1) Develop standard principles and best practices for calculating available transmission capacity; (2) Develop standard principles and best practices for allocating available transmission capacity under different MPT models.
	Develop guidelines and economic principles for setting wheeling charges.
	Develop standard practices for dispute resolution mechanisms and guidelines for integrating them into agreements and national legal frameworks. Potentially develop a regional MPT dispute resolution framework focused on inter-state disputes.
	Develop guidelines on Transmission Access, with recommendations on how to adapt for subregional markets.
	Develop detailed methodology and guidelines on conducting national and ASEAN-wide Integrated Resource and Resilience Planning (IRRP).
	Develop common regional standards and frameworks for RECs, especially for cross-border grid-to-grid trades.
Regional Institutions	Regional Entities: (1) Develop regional market entity (decentralised or centralised) with coordination, MPT development support, and regional indicative transmission system planning/IRRP mandate; (2) Potentially include a dispute resolution function with the aforementioned entity, or create a new entity or mechanism to handle such disputes.
Financing Frameworks	Innovative financing models: (1) Conduct a study on potential innovative financing models for cross-border transmission infrastructure in ASEAN; (2) Recommend approaches to address the green taxonomy challenge (see following as well); (3) Evaluate feasibility of identified models, and any national-level regulatory or institutional barriers; (4) Develop a strategy on addressing those barriers and coordinate with donors on carrying out demonstration pilots.
	Regional Common-Use Transmission Assets: (1) Conduct detailed investigation on the need for establishing regional common-use assets; (2) Evaluate potential transmission projects or corridors for common-use assets; (3) Initiate feasibility studies on designating and implementing identified projects as common-use regional assets.
	Green Taxonomy: Engage with MDBs to update international standards for green taxonomy for sustainable finance regarding transmission projects, especially cross-border transmission projects.

5.2 A Roadmap for MPT Development in West Subregion

Next steps in the short and medium terms are expected to focus on the West Subregion. This subregion has significant cross-border interconnections and benefits from experience gained

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from the LTMS-PIP pilot. The high-level summary of actions in Figure 5.2-1 focuses on five critical aspects, which may become barriers if not addressed in a timely and systematic manner:

(1) Regional RECs Markets are necessary to ensure that the demand for RE supply in the region can be harnessed to advance MPT and grid-to-grid cross-border power trade;

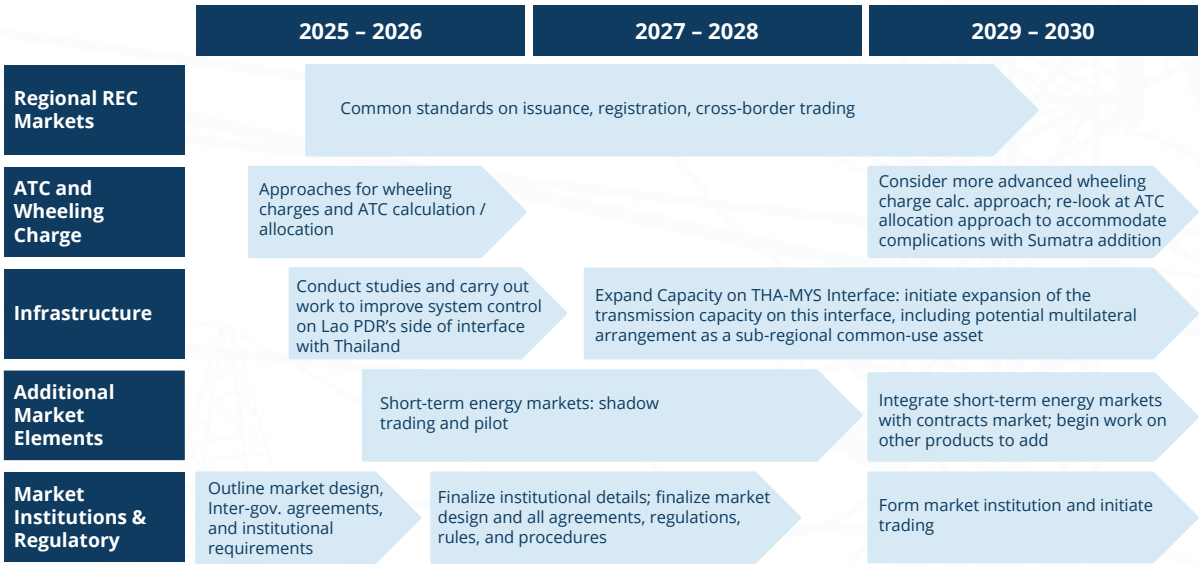
(2) the approaches for wheeling charges, and for calculating and allocating ATC, must be developed and refined to ensure transparency and win-win outcomes;

(3) existing capacity on the Thailand-Malaysia interface is an emerging bottleneck for MPT in this subregion;

(4) integrating the Regional Power Market would deepen MPT, by creating a multi-product market featuring both an organised contract market and a short-term trading market; and

(5) institutions that support and perform various market operations, coordination, and oversight functions are key for durable long-term development of MPT.

Figure 5.2-1 Phasing of Actions for West Subregion



Source: Delphos.

Additional details on the next steps for West Subregion are provided in Table 5.2-2. The first category deals with the steps needed to define, establish, and implement the recommended MPT market models. The issue of regional RECs framework is discussed separately, since a separate and extensive process may be necessary to enable internationally recognised RECs traded on cross-border grid-to-grid ties. Thereafter, the activities are organised by the major interfaces in this sub-region, where new projects are planned, or issues have been identified on existing lines.

Table 5.2-2 Summary of Next Steps: West Subregion Market

Work Area	Sub-Tasks
Multilateral Market Development	Market Consultations and Design: (1) Hold consultations with stakeholders to establish each AMS and utility stakeholders' expectations from this market; (2) Demonstrate benefits of proposed market design concepts with stakeholders' requirements, refine as necessary; (3) Establish plan for phased expansion of trading area, including opt-in approaches for integration of other bilateral trade, integration of short-term energy trade, and addition of other countries to the market; (4) Finalise market model and necessary agreements and structures needed to implement selected market model.

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Work Area	Sub-Tasks
	Intergovernmental Agreements: (1) Draft MOUs on the guiding principles and central features of the market, required for founding members of the market and optional for potential future additions; (2) Develop required intergovernmental and inter-utility agreements with integrated dispute resolution framework; (3) Develop market charters or membership agreements for participating utilities to sign.
	Market Design: Develop agreements, regulations, guidelines, rules, methodologies, structures, and procedures for the market, including for ATC calculation and allocation, wheeling charges, data sharing, dispute resolution, settlement, security postings, and so on.
	Donor Support: It would be costly and difficult for the AMS to develop the envisioned market on their own, without substantial support from donors and other development partners and regional entities. Ensure that these parties are actively engaged in assisting development and implementation of the market.
Regional RECs	(1) Initiate bilateral discussions on common RECs framework between Malaysia and Singapore; (2) Initiate options for internationally recognized cross-border RECs trading between Peninsular Malaysia and Singapore; (3) Initiate discussions on integrating other subregional countries in a common RECs framework.
Thailand-Peninsular Malaysia Interface	(1) As a priority, engage with Thailand and Malaysia to gain an understanding on the scopes and findings of any studies performed. If it has not already been done, seek to add no regrets/limited regrets steps to the design of the 300 MW HVDC replacement of the existing facility to potentially facilitate adding another circuit later. Carry out additional studies, if necessary, for significantly larger projects allowing 600 MW to 1,000 MW of transfer; (2) Incorporate findings from IRRP modelling under AIMS III Phase 3 for potential sizing for the interconnector; (3) Develop a cost-benefit matrix for each scenario across different interconnector capacity and stakeholders; (4) Propose preliminary approaches to sharing costs and benefits based on the matrix; (5) Conduct stakeholder consultations to gather feedback; (6) Identify financing needs and options for different scenarios of interconnector capacity and usage models; (7) Propose financing mechanisms and revenue models under different usage models; (8) Determine necessary political agreements to enable different revenue and financing models; (9) Determine regulatory gaps and updates necessary to enable selected models.
Indonesia-Peninsular Malaysia Interface	(1) Review findings of USTDA-funded feasibility study of Sumatra-Peninsular Malaysia HVDC sub-sea cable project; (2) Engage technical assistance support to resolve identified technical barriers (HVDC lines, sub-sea cable operations); (3) Develop solutions to potential Indonesian regulatory issues and criteria restricting conditions for cross-border trade and establish strategy for necessary regulatory reform; (4) Develop intergovernmental and inter-utility agreements, other technical and commercial agreements per regional guidelines, identified business models, and market models; (5) Engage donors regarding potential support to finance the line.
Indonesia-Singapore Interface	(1) Review updated plans from PLN regarding Batam-Singapore and Sumatra-Batam connectors; (2) Conduct feasibility study to assess techno-economic viability and identify any other issues, including follow-on technical assistance; (3) Align development of lines to maximize benefits. (4) Develop intergovernmental, inter-utility agreements, other technical and commercial agreements per regional guidelines, identified business models, and subregional market models.
Thailand-Lao PDR Interface	(1) Expand capacity on grid-to-grid ties between Thailand and Lao PDR to minimise curtailment of hydropower during rainy season; (2) Conduct study evaluating equipment upgrades required at existing and planned interconnecting substations for more stable grid operation with Lao PDR.

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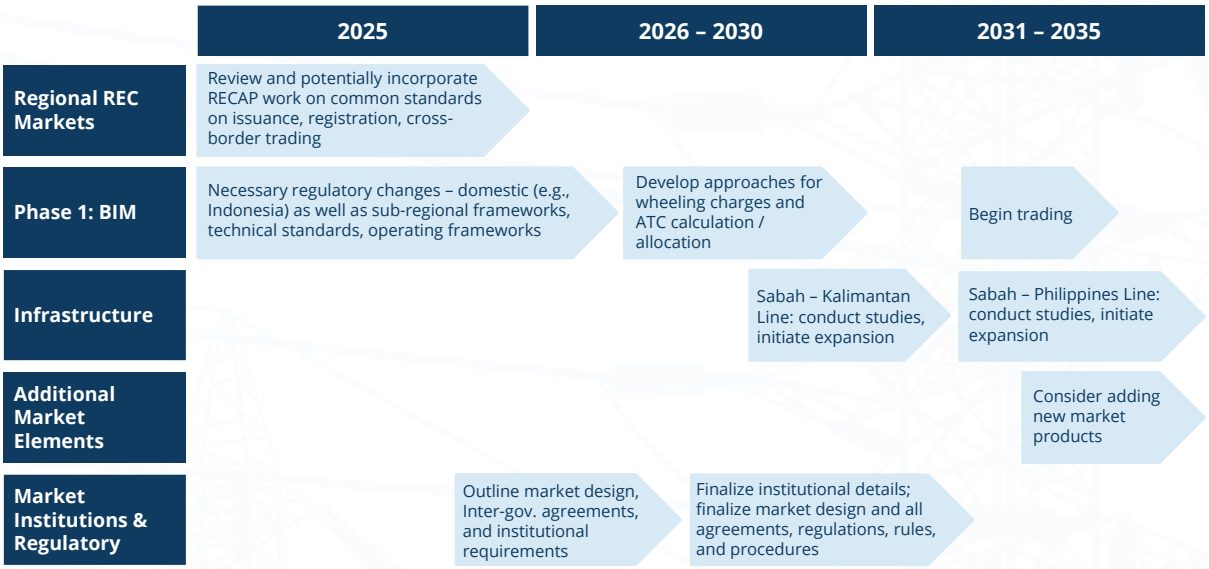
Work Area	Sub-Tasks
Thailand-Cambodia Interface	(1) Conduct techno-economic assessment on benefits to both sides from higher capacity and higher voltage lines; (2) Evaluate benefits from combined contracted and short-term markets in the subregion, with respect to interconnector size and options.

5.3 A Roadmap for MPT Development in East Subregion

Next steps for the East Subregion are expected to be relatively high-level in the short and medium terms, except for detailed support to advance several planned interconnector projects. The feasibility study of the BIMP-PIP market is ongoing. Two cross-border interconnectors in this subregion are also in study stage: Sabah-Kalimantan and Sarawak-Brunei. Findings from these studies would help clarify next steps suggested in the high-level summary of actions shown in Figure 5.3-1.

Figure 5.3-1 Phasing of Actions for East Subregion



Source: Delphos.

Additional details are provided Table 5.3-1 on some key issues and important topics for the ongoing studies. Initial findings indicate that domestic regulatory changes may be necessary in some countries (e.g. Indonesia) to enable bidirectional cross-border power trading under different market models. It is important to identify such barriers to MPT market models as early as possible, so that appropriate solutions can be developed.

Table 5.3-2 Summary of Next Steps: East Subregion Market

Work Area	Sub-Tasks
Multilateral Market Development	Market Consultations and Design: (1) Review results of ongoing feasibility study and refine proposed market design concepts; (2) Establish plan for phased expansion of the market based on when interconnectors are expected to be completed; (3) Finalise market model in line with anticipated phased expansion, and the necessary agreements and structures needed to implement the selected market model.
	Market Design: (1) Decide whether the initial product market to focus on is a contract market or a short-term energy market – it could be both but likely the latter; (2) Develop all relevant market agreements, regulations, guidelines, rules, procedures, etc.

Work Area	Sub-Tasks
	Intergovernmental Agreements: (1) Draft MOUs on the guiding principles and central features of the market; (2) Develop required intergovernmental and inter-utility agreements with integrated dispute resolution framework; (3) Develop market agreements and charters for participating AMS and utilities.
	Donor Support: It would be costly and difficult for the AMS to develop the envisioned market on their own, without substantial support from donors, other development partners and regional entities. Ensure that these parties are actively engaged in assisting development and implementation of the market.
Regional RECs	(1) Initiate bilateral discussions on common RECs framework between Malaysia (Sarawak) and Indonesia (Kalimantan); (2) Initiate options for internationally recognized cross-border RECs trading between Sarawak and Kalimantan.
Sarawak-Kalimantan Interface	(1) Evaluate potential sizing for an expanded interconnector based on different scenarios from results of updated capacity expansion and grid modelling analyses; (2) Review historical flows and operations on the existing line to evaluate options for optimisation; (3) Review intergovernmental, inter-utility, and commercial agreements pertaining to this line to draw recommendations for other planned lines; (4) Evaluate whether updated agreements are necessary for new market or trade models, or for consistency with current regulations or anticipated regulatory changes.
Sabah-Kalimantan Interface	(1) Review findings of USTDA-funded feasibility study of Sabah-Kalimantan HVAC interconnector; (2) Engage technical assistance support to resolve identified technical barriers, e.g. grid stability issues in remote Kalimantan grid; (3) Conduct a study to assess potential Indonesian regulatory issues and criteria restricting conditions for cross-border trade, and establish a strategy for necessary regulatory reform; (4) Develop intergovernmental and inter-utility agreements, other technical and commercial agreements per regional guidelines, identified business models, and BIMP market models; (5) Engage donor support to finance the line.
Sarawak-Brunei Interface	Confirm status of this project and seek means to advance and finalise the project.

5.4 Evolution of Interconnections and Markets

This section will begin by illustrating how high-voltage (HV) grid-to-grid interconnections in ASEAN could evolve and map onto subregional MPT markets, then moves to more detail on how subregional markets themselves might evolve, reflecting grid infrastructure expansions.

5.4.1 Potential Expansion of Interconnections

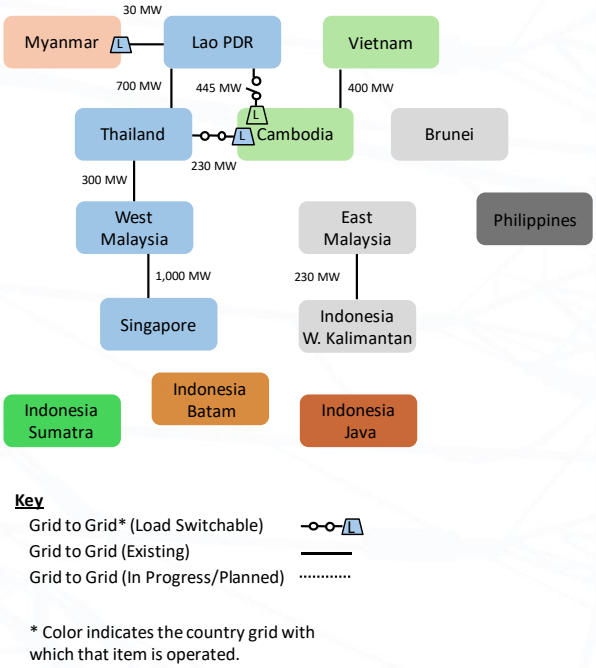
Figure 5 depicts the current HV grid-to-grid interconnections and Figure 5 shows how grids could evolve. Each stylised map provides indicative transfer capacities for each interface. These values should all be verified.[27]

[27] Values were developed from various sources, including the ASEAN APG Power Grid Map, meetings with stakeholders and utilities, and other research. In several cases, values in primary sources were unclear, contradictory, or seem implausible. For instance, for existing transfer capacities, values shown seem too high between Cambodia and Thailand, and Cambodia and Lao PDR, based on features of HV lines: it is thought some of the HV transfer capacity claimed in various sources reflects in fact the summation of MW transfer capacity for HV/MV/LV, inclusive of grid-to-isolated load. For grid expansions, some of the earliest CODs seem optimistic.

The key transmission constraint is on the Thailand-Malaysia interface, which restricts transfers to 300 MW, well under half the current transfer limit on the Lao PDR-Thailand and Malaysia-Singapore interfaces, and far below expected unconstrained flows. Moreover, the HVDC facility on the Thailand-Malaysia interface is aging and, according to stakeholders, subject to frequent unavailability and other issues. The two countries have executed an MOU to investigate a replacement facility with double the transfer capacity[28]; even so, the same interface seems likely to remain the key binding constraint in the West Subregion, and in general, for ASEAN MPT, for the foreseeable future. It is recommended that the option for a larger facility should be seriously investigated.

There are numerous potential scenarios for expansion of the regional grid. What is presented in this section is one version of how interconnections and regional market groupings might evolve. This one version is not intended as a recommendation. Rather, through 2030, it represents the Authors' best guess as to the earliest completion dates for new grid-to-grid projects and transfer limits based on various sources. For periods after 2030, it represents mainly ACE's "ASEAN APG Grid Map"[29], which in turn reflects project details from previous AIMS III studies.

Figure 5.4.1-1 Map of Current Regional Interconnections with Transfer Capacity



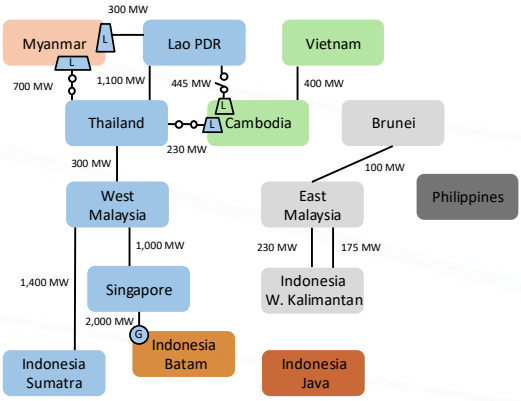
Source: Delphos International

The most fundamental requirement for MPT is grid-to-grid HV interconnections of the power systems of multiple countries. Generally, these interconnections would be expected to be operational "full time," as opposed to seasonally, or on an as-required basis such as is the case with several of the grid-to-grid (load switchable) interconnections in the ASEAN region.

[28] Source: meeting with EGAT planning team, 2 May 2024.

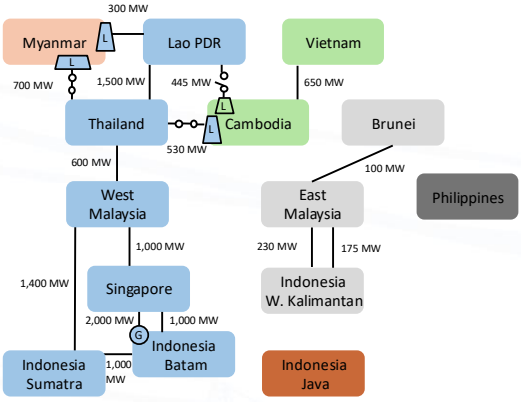
[29] Some project details in maps from 2035 on were adjusted. For instance, the completion dates in the ASEAN APG Power Grid Map for connections between Singapore and Sumatra, Sumatra and Java, and East Malaysia and Philippines, were pushed back, and links between West Malaysia and East Malaysia, and between Java and Kalimantan, are assumed to not be completed based on findings in the AIMS III report and other factors.

Figure 5.4.1-2 Regional Interconnections Evolution



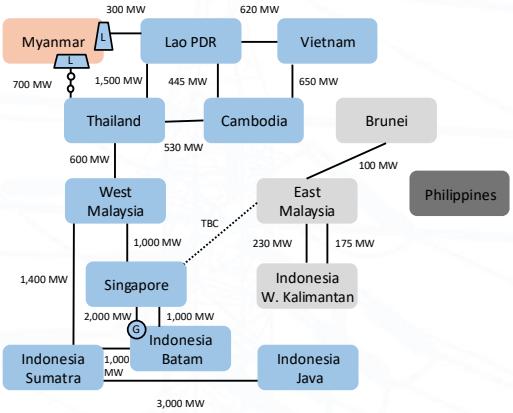
2030:

- Large portions of Myanmar connected to rest of West Subregion
- West Malaysia connected to Sumatra
- Batam generator-to-foreign-grid projects online
- Improved connectivity in East Subregion but Philippines still not interconnected
- Key transmission constraints:
  - Thailand – Malaysia
  - Vietnam - Cambodia



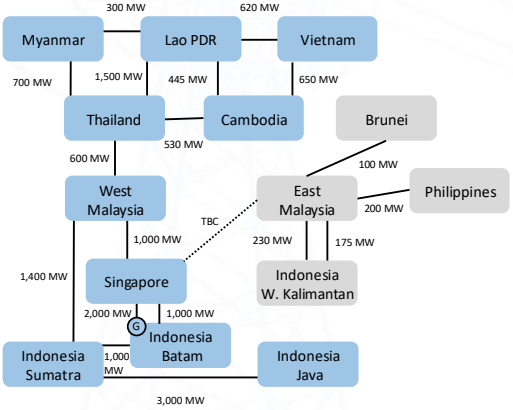
2035:

- Large portion of Cambodia connected to regional markets
- Singapore-Batam-Sumatra grid-to-grid link completed
- East Subregion: Philippines still not interconnected
- Key transmission constraints:
  - Thailand – Malaysia, even after expansion
  - Vietnam – Cambodia
  - Brunei – East Malaysia
  - East Malaysia - Kalimantan



2040:

- Interconnected block from Vietnam through Java. The bulk of Myanmar's grid still isolated.
- East Subregion: Philippines still not interconnected, market advancing but limited market development due to lack of scale from transmission constraints
- Possible grid-to-grid linkage of East Malaysia (Sarawak) - Singapore (or Sarawak -West Malaysia)
- Key transmission constraints:
  - Thailand - Malaysia
  - Vietnam – Cambodia
  - Vietnam – Lao PDR
  - Brunei – East Malaysia
  - East Malaysia - Kalimantan



Post 2040:

- Philippines link to Sabah is completed.
- Moderately advanced MPT in East and West Subregions, covering all AMS. Two blocks possibly interconnected from Sarawak.
- Some portions of AMS will remain outside of the two markets, participating only via generator -to-foreign grid (mainly IPP -to-grid) projects.
- Key transmission constraints are expected to be resolved.

Source: Delphos.

There are nuances. What is not required for active bilateral trade, if not for trade within a specific MPT market, is that the entire national HV grid of a country be interconnected with the national grids of other countries. Rather, portions of a country's HV grid could be interconnected with the HV grids of other countries, allowing interchange with that country's generation and/or load.

The CAMX subregion of the Western Electricity Coordinating Council (WECC) is a good example. The WECC coordinates operation of the "Western Interconnection" covering most of Western US and Canada, plus northern Baja California (which is part of Mexico). Within the US state of California, the California Independent System Operator (CAISO) manages most of the California grid and operates the power market. The CAMX subregion comprises the entire State of California and the abovementioned portion of Baja California (part of Mexico). Mexico's portion of the CAMX subregion, which is not connected to Mexico's main HV grid, contains a population of over 5 million people, with significant electricity demand and generation resources. There is cross-border power trade (mainly for balancing) between Mexico's portion of the CAMX subregion and other parts of WECC, including with the CAISO, even though Mexican entities are not formally members of the CAISO.

Another example of a regional or multilateral market operating within only part of a country is when Nord Pool initially expanded to Denmark in 1999, it was only to Western Denmark.

This example is highly relevant to the situation in the Lower Mekong Subregion, where there are significant HV grid-to-grid (load switchable) connections from Thailand to Cambodia, from Lao PDR to Cambodia, and from Thailand to Myanmar (at Myawaddy). There are also significant HV grid-to-isolated load connections from Lao PDR to Myanmar at Tachileik. There are plans to connect Lao PDR grid-to-grid with Myanmar at the Keng Tung substation.

There are significant loads located in Myanmar's Myawaddy province as well, that have been investigated for service via cross-border projects. It is possible that the easiest way to significantly expand HV cross-border grid-to-grid trade with Myanmar and Cambodia would be to expand existing cross-border facilities of the type discussed and create new ones, such that the expanded/new areas would cover larger geographic areas with more load served. The maps from 2030 on depict such a scenario.

Similarly, it could make sense for certain islands to be served by neighbouring countries, rather than remaining standalone systems. One obvious example is Batam island (and other islands in the Riau Island group), which could be easily interconnected with Singapore's system, thereby joining the large, interconnected, block in Western ASEAN.

5.4.2 Potential Evolution of Market Structures

As with grid connectivity though physical infrastructure, a projection of the nature and extent of MPT markets mechanisms or structures in ASEAN over time must be understood as representing just one possible version of how such markets might evolve. Indeed, a core agreed principle is that MPT development in ASEAN should proceed on a stepwise and voluntary basis. Implicit in this principle is that no central authority will impose its vision for MPT on ASEAN, meaning that cross-border markets will evolve organically, with the guidance and support of regional bodies and development partners.

Figure 5 presents one possible evolution of regional markets, including how bilateral contracting, contract markets and short-term energy markets in the region could overlap and integrate. The figure assumes that the intermediate stage MPT markets become operational in portions of ASEAN by 2030. It is expected that those markets will evolve to add new market members and features. The discussion of this evolution follows in the text after the figure.

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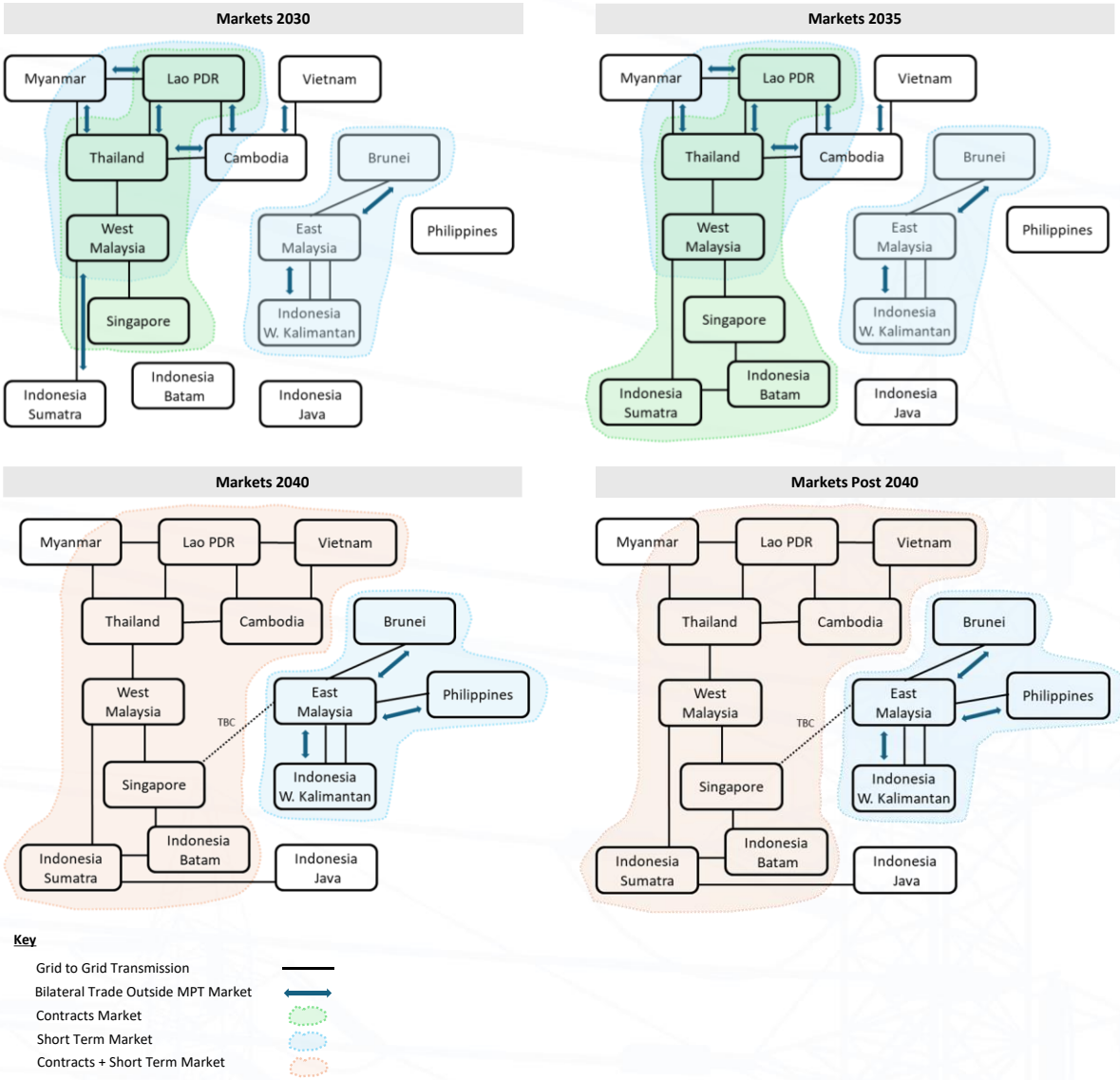
Figure 5.4.2-1 Indicative Evolution of Regional Markets by Type



Key market developments over time are summarised as:

1) By 2030
   a) A contract market is functioning in the LTMS countries. By comparison to the current LTMS-PIP market, the new market would be permanent, ideally operated by a market institution. It should include technically robust ATC calculation and allocation methodologies linked to a binding dispute resolution mechanism; and involve higher interconnection capacity and contract flows.
   b) There are two short-term energy markets, one covering the LTMS countries and parts of Myanmar and Cambodia, and the other covering the BIM countries. There would be bilateral contract trade across both the East Subregion (not yet including the Philippines) and the West Subregion. Within the West Subregion, bilateral contract trade would not be expected across the TMS country interfaces, which would likely be dedicated to the subregional contract market. To be clear, countries within the market could bilaterally trade by contract, but those trades would need to be scheduled with the market operator.
   c) Key requirements for such a scenario include:
      i) Form an ASEAN-wide coordination/planning/support institution. Whilst this is not strictly required in order to advance subregional markets, as a practical matter, it will

be difficult to organise subregional power markets without support from development partners and other entities, and those MPT activities are mainly organised on an ASEAN-wide basis.

ii) Proceed with short-term shadow trading to gain experience necessary for subsequent pilot short-term trading, and eventual implementation of a short-term trading market. It is noted that participating in the shadow-trading activity would be a "no regrets" action, as it involves very low or no costs to AMS utilities, and would not lock in participation for the pilot stage, which also would not lock in participation in a permanent short-term market.

iii) Address technical and infrastructure requirements within Lao PDR to facilitate bidirectional trade over the Thailand-Lao PDR interface. It is expected that development partners would be required to fund the studies and potentially to arrange funding for the necessary investments.

iv) Form a subregional market institution. This entity could initially be virtual or decentralised, though it would need an operating budget. The operating budget would be funded by fees of different types from market members, such as an annual membership fee for active members, a lower fee for observer members, plus transaction-based fees tied to trade volume. In order to ensure stable operating revenues, it could be necessary for initial active members to agree to supplemental annual fees if transaction-based fees fall short. Examine existing national-level laws and regulations to accommodate participation in regional markets.

v) Develop methodologies and market rules. The most challenging methodologies to develop are for setting wheeling charges, calculating ATC, and allocating ATC. Data sharing would be required as well.

vi) Consideration should be given to developing a financing mechanism for common-use assets.

6. A dispute resolution mechanism would likely be required.

2) By 2035

a) The West Subregion contract market expands to include Sumatra. Batam remains connected to Singapore by generator-to-foreign grid interconnections and does not participate directly in regional markets.

b) The short-term energy market in the West Subregion expands to include a larger portion of Cambodia, as interconnections with Thailand are expanded. As depicted, this market does not yet include Sumatra or Singapore, though it should be possible for either or both to have joined by that point.

c) In the East Subregion, it is expected that the short-term market is the main organised market, since bilateral contract trade – perhaps facilitated by market structures – would be the simplest approach to meeting subregional contracting needs.

d) There are no notable additional requirements for the market itself, though having Sumatra join will complicate market topology. It is envisioned that the design at the market formation stage of the ATC allocation methodology would cater to Sumatra's eventual joining. However, there are known regulatory changes within Indonesia that would be required to allow bidirectional trading from Sumatra.

3) By 2040

a) A grid-to-grid transmission link between Sumatra and Singapore is completed, via Batam.

b) Cambodia and Vietnam join the short-term West Subregion market.

c) The Philippines are interconnected with the rest of the BIMP group.

d) A transmission link between Sumatra and Java is completed. Bilateral trade is not depicted on this link, because both regions are controlled by the same utility.

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e) A grid-to-grid link between Sarawak and Singapore is depicted as potentially having been completed. If this were the case, then the East Subregion and West Subregion market blocks could be merged, or they could remain as separate markets with trade between them, which is the approach for markets across Europe and North America.
f) Key requirements include addressing the technical and operational challenges of connecting Vietnam and the bulk of Cambodia's system with other countries, since the rest had already been participating in the market. It likely would also be necessary to address legal-regulatory changes in the Philippines to enable participation in an external market. Since the East Subregion would only interconnect with Palawan Island of the Philippines rather than larger portions of that market, possibly Palawan Island could be exempted from relevant features of Philippine power market laws and regulations, rather than attempting a broadly applicable market harmonisation.

4) Post 2040
   a) The entire West Subregion is covered by an advanced regional market combining contract markets, short-term energy markets and other market features. The bulk of Myanmar is depicted as still being outside this formal market, but it is likely it could be fully incorporated by then. There are various configuration scenarios involving portions of different countries participating in the market.
   b) In the East Subregion, given grid topology, a contract market is not envisioned for this block, since contract trade can be handled adequately on a bilateral basis. However, there is interest in and a need for such a market, it could be added.

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Chapter 6: Financing Plan

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The financing requirements to support implementation of the actions identified to progress MPT in ASEAN are extensive and varied. The types of financing needs can be broadly grouped into the following types of financing: (i) technical assistance grants to support the initial activities on planning and technical studies; (ii) capital needs for construction of infrastructure, including equity, debt, grants, and various forms of guarantees; and (iii) a combination of the two to establish new institutions or fund new market functions within existing institutions. Table 6-1 summarises the types of financing needs, timing and activities covered by type of financing.

Table 6-1 Financing Requirements by Category of Need and Activity

Type	Stage	Typical Funding Needed (000s USD)	Types of Activities
High-level concept studies (Technical Assistance)	Early stage	50 to 250	Assess viable market type, potential commercial structures, single or multi-country beneficiaries
Planning and technical studies (Technical Assistance)	Early stage	Pre-feasibility: 300 to 750 Feasibility: 750 to 2,500	In-depth feasibility studies; capacity expansion planning and modelling grid studies; environmental impact assessments; market and institutional design; operating manuals; single or multi-country
Enabling environment support (Technical Assistance)	Mid-stage, ongoing (multi-year)	500 to 5,000	Policy and regulatory gap analysis, recommendations; drafting new regulations, policies; investment climate; PPP laws
Institutional development (Technical Assistance and Infrastructure Finance)	Mid-stage, ongoing	200 to 2,000	Institutional design/structure and business plans; governing and operating manuals; software licences; upfront capital requirements (offices, hardware)
Capacity building (Technical Assistance)	Ongoing	20 to 100	Tailored for utilities, regulators, and other planning bodies; get stakeholder buy-in
Infrastructure EPC (Infrastructure Finance)	Late stage	50,000 to >2,500,000	Procuring materials and equipment; labour costs; financing and soft costs i) Low: e.g. uprating conductor capacity on existing lines ii) High: e.g. greenfield subsea interconnector

Source: Delphos International (funding estimates based on our market experience).

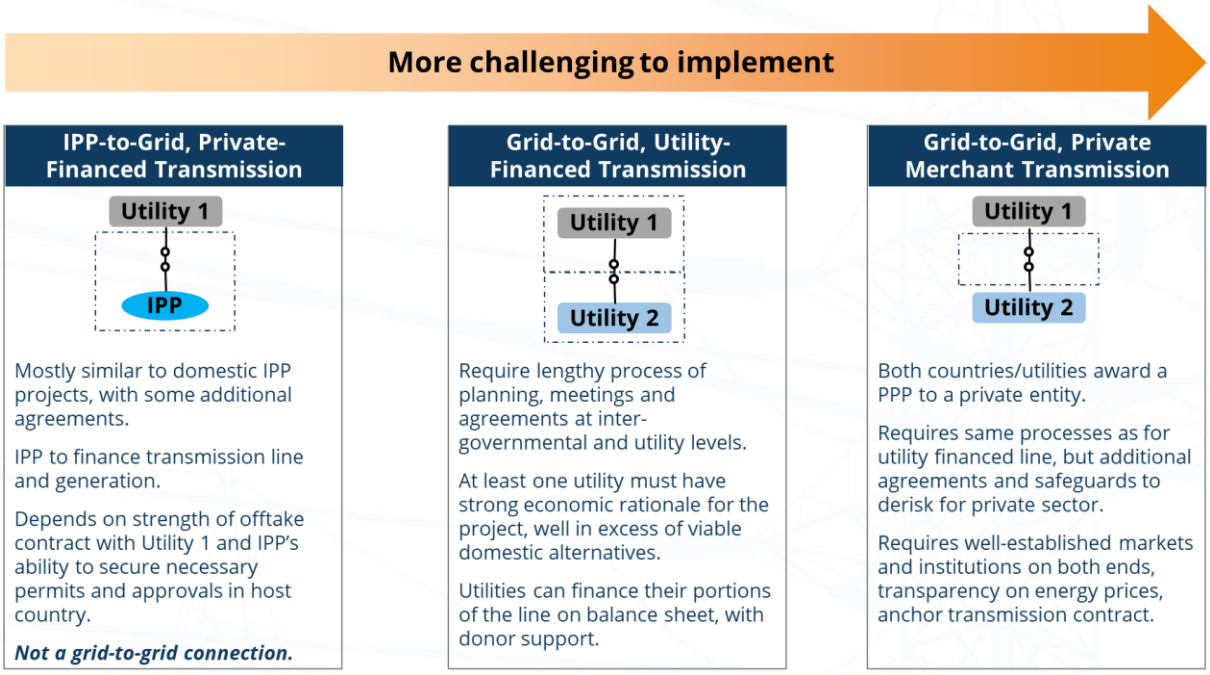
6.1 Transmission Infrastructure Financing Options

The biggest category of costs pertains to the capital needs to implement large cross-border transmission infrastructure projects. Even smaller projects of this type tend to have high capital costs. Therefore, it is important to pursue efficient financing structures to ensure that the available capital can be maximised. Given the magnitude of capital needs, donors and AMS are keen to leverage private sector financing, where possible. Cross-border transmission projects

are more complex to finance than infrastructure projects located wholly within a single country. The addition of one or more countries to a financing structure involves more counterparties to negotiate with, evaluation of regulatory issues in different jurisdictions, and usually joint and several liability, given that any country involved in the project may, through action or inaction, cause the entire project to fail.

There are different types of cross-border transmission project financing structures, some of which are shown in Figure 6.1-1. It is important to note that these structures do not represent the universe of potential structures, but rather denote an indicative range of the most used financing approaches. These structures may also have many variations.

Figure 6.1-1 Financing Structures for Cross-Border Projects Range in Complexity



Source: Delphos.

An IPP-to-grid project, on the left of the preceding figure, is the simplest type of cross-border project to implement and mobilises private sector financing. Several such examples already exist in ASEAN. However, these are not grid-to-grid connections and do not enable multilateral market development on their own.

Utility-financed grid-to-grid projects require lengthy processes, but the approach to financing is relatively simple. However, it may be challenging for utilities to raise the necessary capital on their balance sheets. Donors have also shown reluctance to providing support for pure utility-financed projects. In any case, it is unlikely donors have the resources to support even a substantial fraction of the APG priority transmission projects, without mobilising private capital.

In addition, a significant barrier for many donors, especially multilateral development banks (MDBs), are their restrictive green taxonomies covering investments in transmission projects. A green taxonomy is a set of rules or criteria used to classify the activities or investments that deliver on climate or environmental objectives. Green taxonomies are useful to help prioritise capital deployment toward priority climate-friendly and sustainable projects. Many MDBs and similar donors have their own green taxonomies, but they are largely shaped by international best practices and requirements of their major shareholders. Currently, most MDBs' green taxonomies have very stringent criteria that restrict which investments would qualify as green. These criteria are particularly challenging for many transmission projects to meet. Hence, many MDBs and other likely donors find it very challenging to get shareholder approvals for financing

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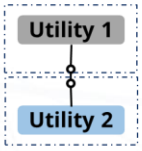
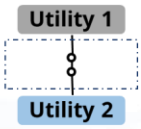
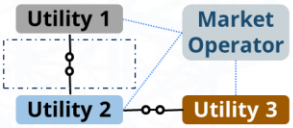
most transmission projects for their green attributes, even if they would promote greater penetration of RE resources. This topic is further elaborated in *Section 6.3 "Green Taxonomy for Transmission Financing"*.

Privately financed cross-border merchant transmission projects are extremely challenging, and rare. A merchant project generates a significant portion of its revenues directly from wholesale power markets, and not just from long-term contracts, or having its costs recovered through rate-basing. These projects generally do involve some revenue streams tied to anchor transmission contracts, such as between marketers on either end of the line, plus either anticipated additional transmission fee revenues from other users, or monetisation by the transmission line owner of energy price differences in markets at either end of the line. This approach is only viable with credible multilateral power markets and regional institutions with a track record, making it infeasible for many years in ASEAN.

6.2 Non-Merchant Private Transmission Financing

Private financing structures tend to be inherently more complex relative to a utility-financed structure, even for non-merchant projects. Figure 6.2-1 shows two types of non-merchant private finance structures and outlines the challenges with each, together with a utility-financed structure for comparison. A discussion of these options is provided after the figure.

Figure 6.2-1 Potential Financing Structures for Grid-to-Grid Projects in ASEAN

	Utility Financing (separately)	Bilateral PPP – Private Financing	Multilateral PPP – Private Financing
			
Structure	Each utility finances its line up to the border	Both utilities award concession to a PPP entity	PPP concession for regional common use asset (e.g., Thailand-Malaysia interconnector for Singapore to import hydro from Lao PDR)
Revenue Type	Multiple potential revenue streams (exports, wheeling charges, domestic retail, etc.)	Availability based fixed capacity payments from the utilities	Availability based fixed capacity payments from a market operator or the utilities
Financing Approach	Utility balance sheet financing (corporate bonds, green loans, on-lending from MDBs)	Project-financed debt and equity	Project-financed debt and equity
Capital Raise Challenges	Ability of utilities to raise capital, limited appetite at MDBs	Strength of agreements (inter-governmental, inter-utility, guarantees)	Strength of multilateral and common market agreements
APG Relevance	Doable. Supports grid-to-grid ties and MPT.	Potentially viable in certain interfaces (e.g., Indonesia – Malaysia).	Not viable currently in ASEAN. Need credible multilateral markets and regional institutions.

Source: Delphos.

The utility-financed approach may involve private sector participation in specific circumstances, if the utility is able to issue corporate bonds or secure green infrastructure loans. Donors, particularly MDBs, may be able to facilitate such approaches by providing guarantees. Otherwise, this approach would entail on-lending for the project by major development banks, such as the World Bank or Asian Development Bank, to state-owned utilities via their governments.

A bilateral PPP approach would allow the project to be implemented through project-financed debt and equity, provided the necessary agreements and commercial arrangements are robust and bankable. This approach might also entail participation by bilateral or multilateral DFIs in the

financing arrangements, in the form of a concessional debt tranche and potential guarantee instruments, but the financing would be raised by a private entity. This approach may be viable on interfaces with financially healthy utilities and governments on both ends, e.g. between Indonesia and Malaysia, or Thailand and Malaysia.

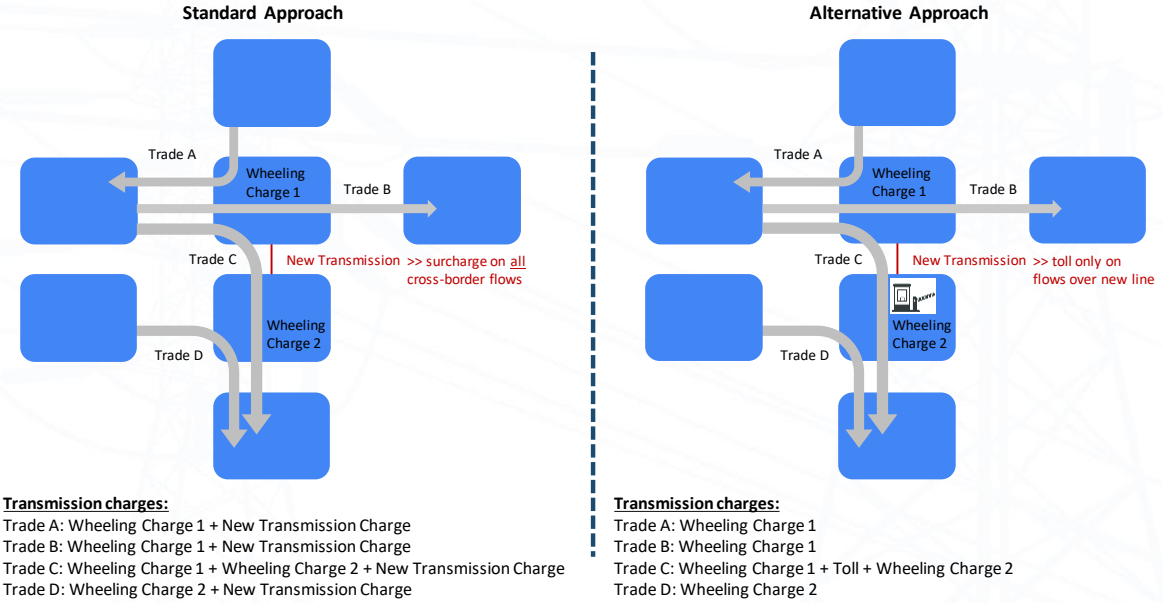
Regional common-use asset designation can be given to projects whose benefits are shared relatively equally by all members of the MPT market. Common-use transmission assets are a feature of regional power markets spanning multiple utility service areas and jurisdictions. Typically, the costs for such projects are allocated to all market participants based on common cost allocation methodologies, often as a non-circumventable surcharge on market transactions. A "common use" asset designation and financing approach could be developed for ASEAN, *after* several other MPT elements and governance agreements have been established.

Therefore, a subregional market featuring integrated transmission planning and a cost recovery structure for common use assets is not likely to be implemented in ASEAN in the near to medium terms.

One of the high-priority projects that may require some sort of common use financing approach is for the replacement and expansion of the interconnector between Thailand and Malaysia. The financing for this project is expected to be required before the regional MPT market structure is fully established. In addition, this project is unlike most common use assets in that the assets are expected to primarily benefit only a subset of market participants.

A potential alternative cost recovery approach for this project shown in Figure 6.2-2. On the left in the figure, the "Standard Approach," shows how the surcharge for a new common use transmission asset, denoted by the red line, might typically be passed on to all market participants. As can be seen, even transactions that do not use the line would still have to pay the surcharge. However, under the "Alternative Approach" on the right, only those transactions that use the new assets would pay increased transmission fees, via a toll on that interface.

Figure 6.2-2 Potential Approach for Financing Regional Common-Use Assets



Transmission charges:
Trade A: Wheeling Charge 1 + New Transmission Charge
Trade B: Wheeling Charge 1 + New Transmission Charge
Trade C: Wheeling Charge 1 + Wheeling Charge 2 + New Transmission Charge
Trade D: Wheeling Charge 2 + New Transmission Charge

Transmission charges:
Trade A: Wheeling Charge 1
Trade B: Wheeling Charge 1
Trade C: Wheeling Charge 1 + Toll + Wheeling Charge 2
Trade D: Wheeling Charge 2

Source: Delphos.

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6.3 Green Taxonomy for Transmission Financing

Green taxonomy, sometimes referred to as "sustainable" taxonomy, is a classification system for defining the concept of environmental sustainability, including with respect to financing infrastructure. Different development finance institutions may have their own taxonomies, or may follow the taxonomies defined by the authoritative body in their region. In ASEAN, the ASEAN Taxonomy for Sustainable Finance, developed by the ASEAN Taxonomy Board (ATB), fosters adoption of sustainable finance practices by the AMS, and caters to the needs of different ASEAN economies and financial systems. The taxonomy developed by the ATB appears robust and appropriate for economic activity carried out and financed by ASEAN entities.

However, MDBs and DFIs are restricted from following the ATB's taxonomy, even for financing critical projects in ASEAN, due to formal or informal practices, as has been noted by others. In fact, the appendix on stakeholder consultations in the ATB's own taxonomy document notes, "international investors also expressed a wish to see alignment of the ASEAN Taxonomy with international standards to make green investment easier in ASEAN."[30]

The "international standards" referenced is the EU Taxonomy Regulation, which is regarded as the global gold standard for sustainable finance taxonomy, and influences the financing policies of the major DFIs able to finance cross-border transmission infrastructure. For instance, the World Bank Group aligns its financing policies with global best practices in sustainable finance, which includes elements of the EU's green taxonomy. World Bank and ADB representatives have stated during events attended by the Authors and in direct discussions, that the green taxonomies followed by their respective organisations make it challenging for them to support financing for cross-border transmission in ASEAN.

The EU Taxonomy Regulation is particularly restrictive as a *global* guideline for transmission infrastructure in general, particularly cross-border grid-to-grid projects. It is part of the EU's strategy to reorient capital flows toward sustainable investments. According to the EU Green Classification System, an investment would have to make a substantial positive contribution to at least one of six objectives: (i) climate change mitigation; (ii) climate change adaptation; (iii) sustainable use and protection of water and marine resources; (iv) transition to a circular economy; (v) pollution prevention and control; and/or (vi) protection and restoration of biodiversity and ecosystems.[31] Furthermore, any economic activity must also not do significant harm to any of the other five objectives.

These criteria, whilst well-intentioned, are extremely challenging to clearly meet, due to the nature of electric grid operations and markets.

The World Bank itself argues that upgrades, expansions and modernisation projects should be considered "green," as they are essential components of decarbonisation plans, especially in the developing world where transmission networks tend to be owned by financially weak state-owned entities.[32] The World Bank's policy research working paper states:

> *"To assess if grid investments 'should' or 'to what extent' be attributable to Climate Finance (concessional type as such GCF, IDA PSW etc.), several criteria have been put forward in practice. These include the EU Taxonomy* developed *by the European Commission and the Common Principles approach developed by MDBs and DFIs. The EU considers transmission and network to be green only if two-thirds of the newly connected generation capacity has CO2 emissions intensity below 100g CO2e/kwh or if the average grid emissions factor is below 100g CO2e/kwh over a rolling five-year average period (Pye, 2021). This is a somewhat restrictive, narrow and myopic view and if a more forward-*

[30] ASEAN Taxonomy Board, "ASEAN Taxonomy for Sustainable Finance. Version 2." Updated February 2024.
[31] S&P Global, "A Short Guide to the EU's Taxonomy Regulation." May 2021.
[32] The World Bank Group, "Green Transmission: Context, Rational, and Planning Methodology." July 2023.

looking view on transmission and critical scale-efficient transmission projects cannot be inculcated, energy transition will almost inevitably get stuck mid-way. Common Principles on the other hand uses a non-binary forward looking approach where it gives partial climate credit to grid investment based on the share of the very low carbon electricity in the grid over a time horizon such as 10 years (Pye, 2021) unless the grid lines are solely dedicated for evacuating very low carbon electricity generation in which case the total investment is fully attributable to climate finance. Nonetheless based on a recent analysis presented in CoP26, it is estimated that less than 40% of the grid investments needed in EMDEs by 2030 would be climate finance attributable under the current eligibility criteria in use."[33]

Despite the position of the World Bank's energy sector technical teams, there are clearly constraints on the World Bank's ability to support transmission projects through concessional pools of capital designated for sustainable infrastructure, due to the restrictive nature of their green taxonomy.

It is noted that the green taxonomy constraint is highly likely to apply not just for support of MDBs for projects through grants, loans, and other means, but also to investment instruments like Infrastructure Investment Trusts or Sustainable Bonds that are being adopted across different types of infrastructure. This is because approval processes for these instruments are likely to require meeting the same green taxonomy requirements that MDBs face.

Thus, engaging with MDBs to adopt a broader definition of green transmission as "green investments" is critical to allow MDBs and others to finance transmission infrastructure leveraging concessional climate finance pools of capital.

[33] Ibid.

Annex

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Annex A: Types of Transmission Interconnections and Timelines

This Annex explains the main categories of transmission interconnections in terms of how the interconnections function in one grid with respect to another grid. For instance, grid-to-grid interconnections are distinguished from grid-to-isolated load projects and IPP-to-grid projects. Indicative timelines to develop and construct interconnections are also discussed.

A.1 Types of Transmission Connections

Regional power market integration depends, in the first instance, on the physical interconnection of different national power systems. There are multiple types of transmission interconnection projects that are relevant in this context, as depicted in Figure A.1-1, and summarised below. In the figure, dashed lines indicate the project in question and colour indicates dispatch control. "G" represents generators and "L" represents loads.[34]

- **Internal Grid:** A transmission line connects two parts of an existing transmission system, for instance from one line to another. Such lines may be relevant to regional integration if, for instance, the internal grid project would be required to support cross-border transmission projects.
- **Grid-to-Grid:** A transmission line connects two distinct power systems. This type of connection requires a high level of coordination and trust between the two grid operators, since instability in one grid can cause problems on the other grid via the interconnection.
- **Generator-to-Foreign Grid:** A power project, typically an IPP, located in one power system connects directly to the power grid of another system. There are numerous examples of this type of power-plus-transmission project in ASEAN, especially IPPs in Lao PDR selling into Thailand, Vietnam, and Cambodia. It is important to understand that, because the importing power system dispatches the power plant and operates its transmission facilities, these projects are, in almost all relevant operational senses, located within the importing power system, even though the power plant itself is in a foreign country. Note that some "generator to foreign grid" projects are also interconnected with the domestic grid (that is, the exporting grid); nonetheless, there is no grid-to-grid connection. Rather, specific generating units at the power plant (under foreign dispatch control) will be dedicated to and physically connected to the export transmission line, while other generating units (under domestic dispatch control) will be dedicated to and physically connected to the domestic grid.
- **Grid-to-Isolated Load:** Like "generator-to-foreign grid" projects, in this case, a significant load in one system that is isolated (or "islanded") from the rest of that system is interconnected to a foreign power system. In nearly all operational senses, this load is indistinguishable from other loads on the exporting system's grid. There are numerous sub-transmission/distribution projects of this nature throughout ASEAN (mainly in the GMS), and several higher voltage (transmission) projects as well.
- **Grid-to-Grid (Load Switchable):** In this arrangement, two grids are physically connected, but separated by switching facilities that allow service to a load area to be provided by either of the two grids, though not by both simultaneously, which would require grid synchronisation.

[34] Substations that might allow interconnection of other projects are assumed at G and L locations, as appropriate.

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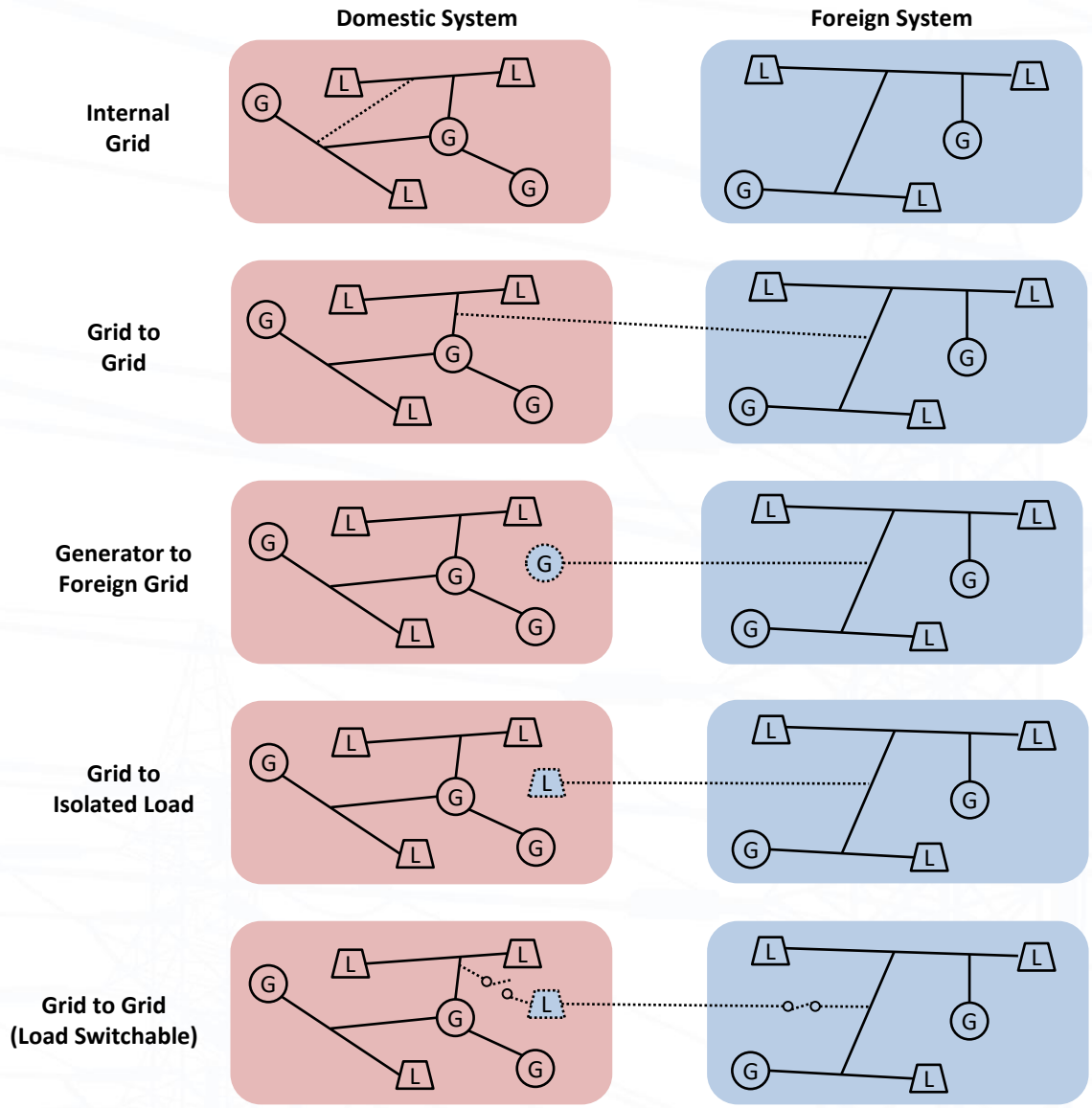
There are variations on the project types summarised here, including "domestic generator-to-internal isolated load" and more commonly the "domestic generator plus transmission-to-domestic grid", where the transmission tie-in is *via* a purpose-built transmission line that is not usable by other loads or generators on the system.

Figure A.1-1. Main Types of Interconnections



Source: Delphos

Transmission projects also differ by the technology used. For instance, projects can be either High Voltage Alternating Current (HVAC) or High Voltage Direct Current (HVDC). With respect to interconnection of different grids that are operating asynchronously, HVAC systems can involve significant synchronisation challenges, especially when integrating weaker grids. Disturbances can easily propagate, leading to grid instability. In contrast, HVDC systems operate independently of AC frequency, allowing for stable asynchronous interconnections. This advantage can make HVDC more suitable for linking grids of varying strengths.

HVDC projects are more expensive upfront than HVAC projects, primarily due to the cost of converter stations. However, HVDC has lower energy losses, and the efficiency advantage can outweigh the higher initial investment at distances as low as 500 kilometres, depending on

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factors such as terrain, power capacity, and the value of energy carried by the transmission project.

Another technological differentiator is whether projects are on land or subsea (crossing bodies of water). Land transmission projects generally involve lower installation costs and simpler maintenance compared to subsea projects. Projects on land are easier to access for repairs and upgrades, and the terrain can be more predictable.

Subsea transmission projects, whilst essential for connecting distant regions separated by water, face significant challenges. These include higher installation costs due to more expensive subsea cables, the need for specialised vessels and equipment, complex engineering to lay cables on uneven and potentially hazardous sea floors, and difficulties in performing maintenance and repairs. Environmental factors, such as marine currents and corrosion, also pose additional risks and challenges.

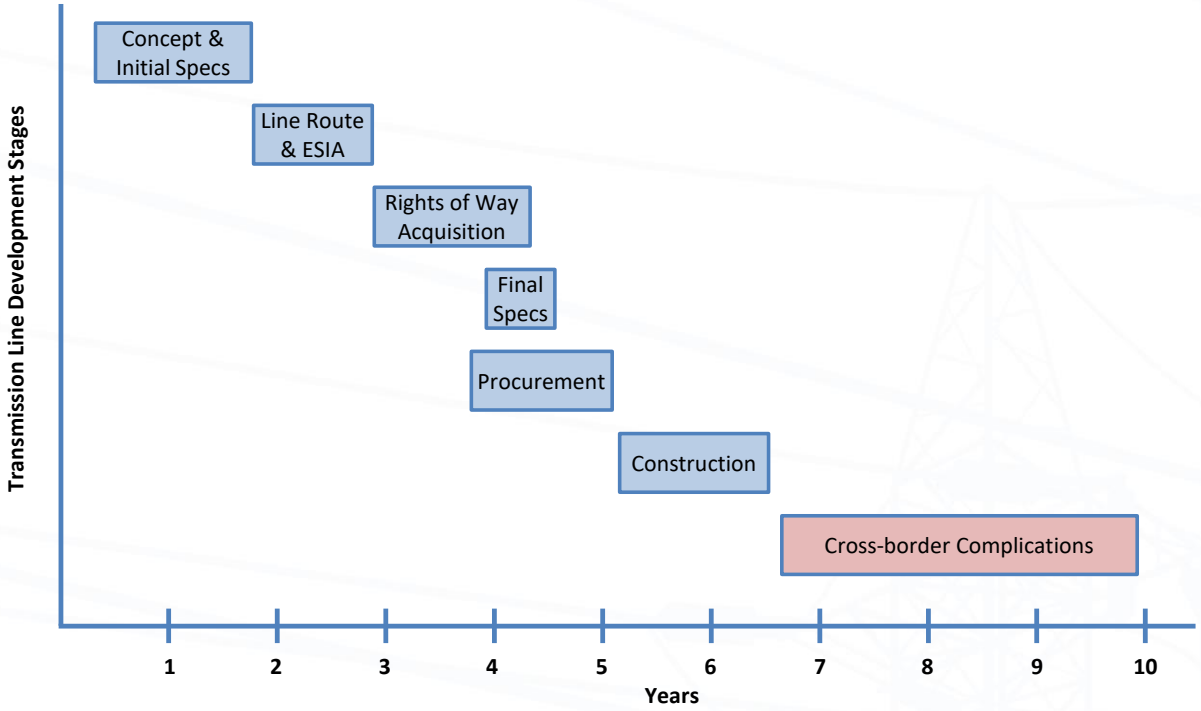
Recently, there has been a substantial increase in orders for subsea cables and bookings for cable-laying ships, resulting in long backlogs for both. There are cost and implementation timeline implications for subsea interconnector projects in ASEAN, which have not yet advanced sufficiently to lock in orders and bookings.[35]

A.2 Transmission Project Timelines

The process of getting from a transmission expansion plan to a significant completed transmission line on the ground is lengthy, particularly when the project crosses national borders, as outlined in Figure A-A.2-1. In this stylised example, the transmission plan would include the project's concept and basic specifications, which would need to be approved for funding by some entity (e.g. a utility, perhaps with donor support). Additional studies would then need to be performed, including a line routing study and an associated environmental and social impact assessment (ESIA). ESIAs for major transmission line projects, especially those receiving donor support, require six months to a year to produce. Approval processes by environmental authorities can add another several months to a year. Once the project has been fully approved at the technical/economic and ESIA levels, the process of acquiring rights of way for the project can begin. Depending on the country's laws regarding eminent domain, it can take months to years to acquire rights of way. Development of final specifications and procurement can proceed in parallel to later stages of the rights of way acquisition. Construction could take six months to a year or two. All told, significant national-level transmission projects are unlikely to be built sooner than 4 years to 7 years after conception. Significant cross-border projects face additional complications, such as having to approve the project at all stages under two separate regulatory regimes, addressing grid integration issues if the project is grid-to-grid, then having to coordinate rights of way acquisition, financing, procurement, and construction across frontiers.

[35] Whilst there is ample public documentation of high interest in subsea projects and related challenges globally, with respect to ASEAN, information was gathered at the "Singapore – IEA Regional Training Programme on Catalysing Interconnectivity in ASEAN" event held 6 – 7 June 2024.

Figure A.2-1. Indicative Transmission Line Development Timelines



Source: Delphos International

In the preceding figure, the indicative timeline for a significant cross-border transmission project stretches to ten years. Subsea projects should be expected to take somewhat longer than other types of cross-border transmission projects, perhaps 7 years to 15 years, due to the sorts of complications mentioned in the previous subsection. There are several scenarios that could involve shorter timelines (perhaps as few as 4 years to 7 years):

- Generator-to-Grid projects, particularly once there are pre-existing models for how this would be done across the two countries. The numerous IPP-to-grid projects in Lao PDR selling into Vietnam, Cambodia and Thailand demonstrate that having a blazed trail to follow can dramatically reduce development timelines.
- Lower voltage projects over relatively short distances. A 115 kV or 230 kV project of under 50 km, connecting existing substations and using primarily existing rights of way is a fundamentally different project than a 500 kV project running several hundred kilometres that would require a major rights of way acquisition.
- Projects on existing transmission paths that expand existing links, such as over the Thailand-Malaysia interface, can proceed significantly faster than greenfield projects between countries that do not have existing grid-to-grid interconnections.

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Annex B: Market Background

This Annex provides the current MPT context to document the starting point for future MPT development in the region, as described here.

Section B.1 "Market Overviews for the AMS" summarises the national markets of the AMS at the physical and regulatory levels, and depicts the types of interconnections found in the region.

Section B.2 "AMS Policy Objectives and Utility PDPs" describes the orientation of the AMS in terms of key focus areas for government and market institutions as expressed in policy and power development plans (PDPs) both for internal purposes (e.g. diversification of fuel sources, focus on increasing supply), and with respect to MPT (e.g. focus on exports, importance of imports for RE energy needs).

Section B.3 "Existing and Proposed Power Trade in ASEAN" handles the topics named in its title in three subsections. The first briefly addresses those cross-border interconnections that are not grid-to-grid. The second subsection provides details on grid-to-grid interconnections, both in terms of the physical infrastructure and in terms of the markets that have been developed or proposed. The third subsection summarises historical cross-border trade in the region.

B.1 Market Overviews for the AMS

The domestic power markets in the AMS vary greatly in size, resource mix, and dependence on cross-border power trade. Brunei Darussalam is the smallest market, with no cross-border power trade and relies almost completely on fossil fuels for generation. However, the next smallest domestic market – Lao PDR – has significant excess hydro generation capacity and exports about four times its domestic electricity demand. Other AMS besides Singapore have significant hydroelectric capacity, with the potential to add even more hydro generation. However, solar PV and wind generation capacities lag well behind; only Vietnam has significant levels of both solar and wind capacity.

The three largest markets – Vietnam, Indonesia and Thailand – all have fossil fuel-based generation systems. Due to location, power exports/imports are a significant part of Thailand's power market, but comprise relatively limited components for Vietnam and Indonesia.

Table B.1-1 Snapshot of AMS Power Markets

Country	Demand	Supply (MW)
Brunei Darussalam	Peak: 629 MW (2021) Energy: 5,699 GWh (2021)	Solar PV: 1.2 MW Natural Gas: 877 MW Oil/Diesel: 12 MW **Total: 890 MW (2019)**
Cambodia	Peak: 2,026 MW (2021) Energy: 16,751 GWh (2023)	Solar PV: 437 MW Biomass/Waste: 49 MW Hydro: 1,791 MW Coal: 1,300 MW Oil/Diesel: 400 MW Imports: 672 MW **Total: 4,649 MW (2023)**
Indonesia	Peak: 41,801 MW (2022) Energy Demand (2022)	Solar PV: 291 MW Wind: 154 MW

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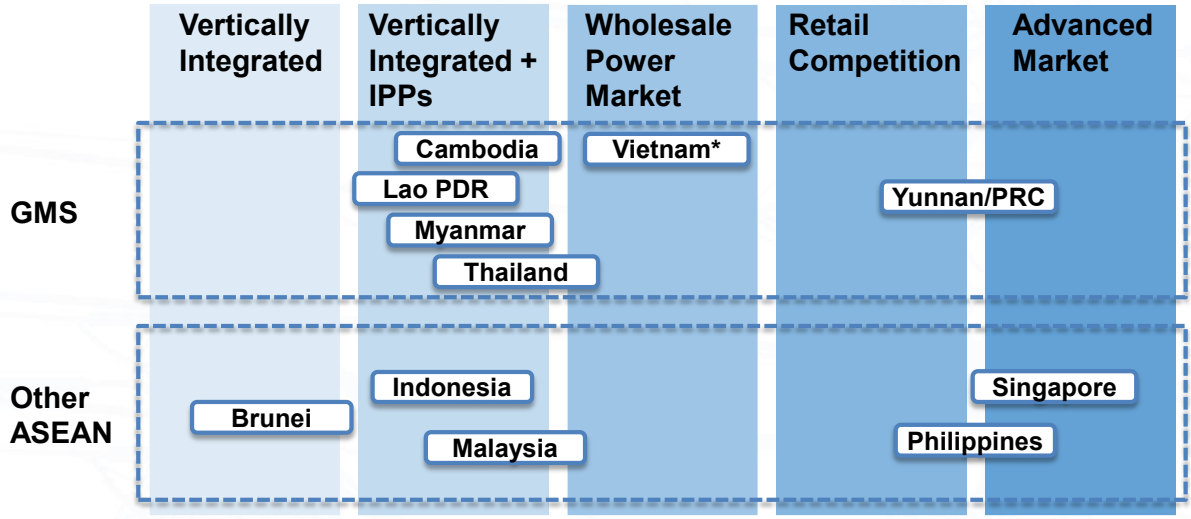
Country	Demand	Supply (MW)
	Domestic: 312,423 GWh Generation: 337,160 GWh Imports: 973 GWh Exports: 0 GWh	Biomass/Waste: 3,005 MW Geothermal: 2,343 MW Hydro: 6,689 MW Fossil Fuels: 57,225 MW **Total: 69,706 MW (2022)**
Lao PDR	Peak: 1,203 MW (2021) Energy Demand (2022) Domestic: 8,829 GWh Generation: 45,954 GWh Imports: 1,365 GWh Exports: 35,113 GWh	Solar PV: 34 MW Biomass/Waste: 105 MW Hydro: 9,483 MW Coal: 2,600 MW **Total: 12,222 MW (2022)**
Malaysia	Peak: 19,866 MW (2023) Energy Demand (2022) Domestic: 181,005 GWh Generation: 194,290 GWh Imports: 38 GWh Exports: 1,062 GWh	Solar PV: 1,933 MW Biomass/Waste: 900 MW Hydro: 6,211 MW Fossil Fuels: 27,257 **Total: 36,301 MW (2022)**
Myanmar	Peak: 3,997 MW (2021) Energy Demand (2022) Domestic: 15,473 GWh Generation: 20,381 GWh Imports: - Exports: 1,317 GWh	Solar PV: 103 MW Biomass/Waste: 59 MW Hydro: 3,304 MW Fossil Fuels: 3,527 MW **Total: 6,993 MW (2022)**
Philippines	Peak (2023) Luzon: 12,221 MW Visayas: 2,380 MW Mindanao: 2,363 MW Energy: 102,834 GWh (2022)	Solar PV: 1,625 MW Wind: 443 MW Biomass/Waste: 55 MW Hydro: 3,037 MW Fossil Fuels: 19,713 MW **Total: 27,542 MW (2022)**
Singapore	Peak: 7,740 MW (2023) Energy: 57,029 GWh (2022)	Solar PV: 572 MW Biomass/Waste: 275 MW Fossil Fuels: 11,692 MW **Total: 12,568 MW (2022)**
Thailand	Peak: 32,288 MW (2022) Energy Demand (2022) Domestic: 199,672 GWh Generation: 181,934 GWh Imports: 34,223 GWh	Solar PV: 3,065 MW Wind: 1,545 MW Biomass/Waste: 4,476 MW Hydro: 3,110 MW Fossil Fuels: 44,459 MW

Country	Demand	Supply (MW)
	Exports: 2,020 GWh	**Total: 57,216 MW (2022)**
Vietnam	Peak: 45,434 MW (2022) Energy Demand (2022) Domestic: 251,549 GWh Generation: 267,746 GWh Imports: 1,515 GWh Exports: 629 GWh	Solar PV: 18,475 MW Wind: 4,628 MW Biomass/Waste: 367 MW Hydro: 21,857 MW Fossil Fuels: 39,713 MW **Total: 85,040 MW (2022)**

Sources: Brunei – IEA, IRENA, Accenture; Cambodia – EAC; Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand, Vietnam – EIA;

Most markets in the area of interest are at a comparatively early stage of restructuring, as shown in Figure B.1-1, which arrays markets on a continuum from the traditional vertically integrated utility structure to advanced markets featuring independent regulators and system operators, wholesale power markets/exchanges where multiple products are transacted on different time horizons, and also involving competition across the entire sectoral value chain.[36]

Figure B.1-1. Market Types in Region



Source: Delphos International

** Vietnam is in the process of implementing a significant market restructuring.*

The different stages of AMS power market structures and limited market restructuring in the region are regularly cited as reasons why progress on APG has been slow thus far. Whilst MPT is likely to be facilitated more easily between countries with more advanced markets involving unbundled utilities and markets for different products, it is not necessary for all types of MPT. Most existing cross-border power trade in ASEAN occurs between countries with vertically integrated utility structures, with some IPP participation. The priority interconnections identified by AIMS III also largely interconnect similarly organised power systems.

[36] The figure is intended to help orient the reader as to the relative level of market development; it is not intended to represent a complete taxonomy of regional markets. There are numerous variations on market structure within each of the columns, and there are entire market structural types (such as "single buyer" structures) that could fit between the existing columns and might apply to some of the markets. With respect to "vertical integration", the focus is on the vertical integration by government-controlled entities (even if partially unbundled, such as by corporatisation and sale of a minority stake to private investors) across the three main sectoral functions: generation, transmission, and distribution.

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Table B.1-2 highlights the national-level market status and market features that have the most bearing on potential new regional trade through the medium term.

Table B.1-2 Summary of Regional Grid-to-Grid Trade Orientation Factors

Country	Peak Demand (MW)	Supply Mix	VRE, % of Capacity / Energy	Supply/ Demand Balance	Grid Control	Sync Status	Stance on Power Trade
Brunei Darussalam	629	Gas-fired	0.0% / 0.4%	Adequate	Strong	Isolated	TBC
Cambodia	2,026	Hydro dominated	0.5% / 1.5%	Tight, increasing import reliance	Weak	with Vietnam	Import
Indonesia	41,801	Coal + Gas-fired	0.2% / 0.6%	Adequate	Strong	West Kalimantan grid with Malaysia (Sarawak, Sabah)	Export RE to Singapore, import power into West Kalimantan
Lao PDR	1,203	Hydro dominated	0.1% / 0.3%	Excess supply	Weak	with Thailand at 115 kV; high voltage levels to be confirmed	Export hydro, wind
Malaysia	19,866	Coal + Gas-fired	1.1% / 5.3%	Excess supply	Strong	Peninsular grid with Singapore; Sarawak and Sabah grids with Indonesia (West Kalimantan); TBC nature of HVAC 115 kV interconnect with Thailand	Export RE
Myanmar	3,997	Hydro + Gas-fired	0.5% / 1.5%	Tight	Weak	Stand-alone system	Import
Philippines	16,694	Coal-fired	2.5% / 7.5%	Adequate	Strong	Stand-alone systems	Energy security
Singapore	7,740	Gas-fired	2.1% / 4.6%	Adequate	Strong	with Peninsular Malaysia grid	RE imports, energy security
Thailand	32,288	Gas-fired	4.4% / 8.1%	Excess supply*	Strong	with Lao	Import hydro, export excess gas generation
Vietnam	45,434	Coal-fired + Hydro	12.6% / 27.2%	Tightening	Strong	with Cambodia	Import cheaper supply

Source: Delphos International

Several aspects of the individual power markets of the AMS create rationales for increased cross-border interconnections and MPT.

1. Supply Adequacy: Cambodia and Myanmar (and Vietnam to a lesser extent) need to

import power to meet domestic demand. Their neighbouring markets in Lao PDR and Thailand have excess supply. Therefore, Lao PDR, Thailand, Cambodia, and Vietnam already have the most cross-border interconnections in the region. Expected load growth in these countries is further likely to strengthen this driver. Likewise, energy demand in Kalimantan would increase sharply when Indonesia shifts its capital city to Nusantara, creating a driver for imports from Brunei and Malaysia (Sarawak and Sabah).

2. Economic Asset Utilisation and Balancing Services: Thailand, Peninsular Malaysia, and Singapore, which are amongst the strongest grids in the region, are connected by an HVDC link between Thailand and Peninsular Malaysia, and by an HVAC link between Peninsular Malaysia and Singapore. The interconnections can help the utilities to improve economically efficient use of supply resources and strengthen grid reliability through balancing services. Expanding the interconnections on these interfaces will be increasingly important with higher penetration of VRE generation and more cross-border connections with the weaker neighbouring grids. Stronger interconnections also provide a potential framework for MPT in the BIMP-PIP, given the recently established grid-to-grid connections between Brunei, Indonesia (West Kalimantan), and Malaysia (Sarawak and Sabah).
3. RE Demand: There is growing demand for RE generation in the region, driven by national policy objectives (e.g. Singapore) as well as economics (e.g. cheaper hydro from Lao). It is the commercial rationale underpinning the LTMS-PIP. Singapore's appetite for RE imports and willingness to pay a premium for RE generation means that expanded connections with Malaysia, as well as new interconnections with Indonesia (Batam, Sumatra), Vietnam, and Cambodia are more likely to be viable. Similarly, the ability to import RE generation from Peninsular Malaysia – facilitated by ENEGEM – could facilitate expanded cross-border or multilateral power trade between Malaysia and Thailand, Indonesia, and Singapore.
4. Energy Security: This is a key priority for the AMS. Although energy security can have different meanings depending on the context, diversifying the power supply mix undoubtedly strengthens energy security by making power systems more resistant to market shocks, generation outages, climate change, and natural disasters.

B.2 AMS Policy Objectives and Utility PDPs

The AMS governments and utilities have expressed ambitious visions for RE generation and cross-border projects, reflecting their climate policy commitments and national development priorities. These announcements may alter the trade orientation factors for some countries, summarised in Table B.2-**Error! Reference source not found.**, or not being consistent supply/demand factors. Some ambitious projects have also been announced that may not be realistic. The vision of the AMS governments and utilities are summarised in Table B.2-1. A discussion follows on the implications for trade orientation for some countries and prioritisation of planned projects.

Table B.2-1. Summary of Relevant Energy Policies and Announced Plans from AMS

Plan/Policy Document	Key Energy- and RE-related Policies and Cross-border Initiatives
Indonesia	
Electricity Procurement Business Plan 2021-2030 (RUPTL 2021-2030). The new RUPTL is expected to be released by Q4 2024.	• According to the plan, Indonesia is planning to have an additional 40.6 GW of power generation capacity. Out of this number, 51.6% of the energy source is RE. • Indonesia RE composition by 2030 is 10.3 GW of wind power, 4.7 GW of solar power, 3.3 GW of geothermal, and 2.5 GW of other RE.

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Plan/Policy Document	Key Energy- and RE-related Policies and Cross-border Initiatives
	• Encourages multilateral power trading beyond LTMS by supporting BIMP-PIP • Two interconnection projects under feasibility studies: 1) Sumatra-Peninsular Malaysia; and 2) Sabah-North Kalimantan. • Ongoing bilateral initiative between Indonesia and Singapore for establishing a Green Corridor. It is a collaboration between Government of Indonesia (GoI) and Government of Singapore (GoS) to develop green energy industry in Riau Islands.
Philippines	
Power Development Plan 2020-2040	• DOE is targeting RE power generation mix target of 35% by 2030, and 50% by 2040. In 2040, the Philippines' total capacity should increase to 114,601 MW. • Focus on strengthening of the transmission network/reliability and from 2021-2035, the Philippines are planning to build 7 more inter-island interconnections between major grid and sub-grid with total additional capacity of 4,890 MW. • Adoption of new market operator performance standards to improve WESM design and rules, and enhancement and expansion of existing Wholesale Electricity Spot Market (WESM). • MPT is not yet on the horizon; prioritising energy security and reliability
Cambodia	
Cambodia Power Development Master Plan 2022-2040	• Cambodia to increase solar power role within their energy mix from 4% to 14% between 2030 and 2040. • Remote area electrification will become Government of Cambodia's focus. Therefore mini-grid construction with solar power and BESS or provision of Solar Home Systems would be the priority. • To develop and enhance the capacity of existing sub-transmission and distribution infrastructure to supply the final consumption of electricity according to projected demand growth • Planned/proposed interconnections with neighbouring countries Thailand, Lao PDR and Vietnam. Plans to export RE power to Singapore via subsea cable
Lao PDR	
National Power Development Strategy Energy Policy 2021-2030	• Develop potential power sources in the country with power generation mix for domestic use and export. Power generation mix for domestic use comes from Hydro accounts for 75%, Coal-based 14% and RE 11% • Promote power generation for export and power exchange amongst neighbouring countries • Promote electricity exportation across GMS countries to achieve under MOU that was signed and the ASEAN Power

Plan/Policy Document	Key Energy- and RE-related Policies and Cross-border Initiatives
	Grid especially Lao PDR-Thai-Malaysia-Singapore (LTMS - PIP) project • Electricity exports target to reach over 10,500 MW to Thailand, 5,000 MW to Vietnam, 6,000 MW to Cambodia, 600 MW to Myanmar and 300 MW to Malaysia and Singapore via (LTMS-PIP)
Malaysia	
National Energy Transition Roadmap (NETR) APGCC Malaysia Presentation at APG Meeting Series	• Installed power system capacity to reach 97 GW with 58% from PV, 11% from hydro, 29% from gas, and 1% by bioenergy by 2050. • Increase share of RE to 31% by 2025 and 40% in 2035 • Set up RE exchange hub to enable cross-border RE trading through the establishment of market aggregator, develop regulations for implementing cross-border RE trading, establish new interconnection or upgrade existing interconnection, monetise excess power through bi- or multi-lateral power trading agreement • Support engagement for power trading – bilateral/multilateral and continue to explore on new/enhanced existing interconnection with neighbouring countries • Interconnections with neighbouring countries under feasibility studies: 1) Sumatra-Peninsular Malaysia, 2) Sabah-North Kalimantan and 3) Sarawak-Brunei • Malaysia is part of both LTMS-PIP and BIMP-PIP
Vietnam	
Vietnam's Decree on PDP8 Approval and Updates Supplementary Presentation on Vietnam's PDP8	• Prioritising the development of RES • Connecting the power grid with Laos using 500kV and 220kV transmission lines to import electricity from power plants in Lao PDR. Plans to export RE power to Singapore via subsea cable • The proportion of RE in the total mix will be 15%-20% by 2030, with an orientation of about 80%-85% by 2050.
Thailand	
National Energy Plan Power Development Plan 2018 Revision 1 (2018–2037)	• Focus on clean-energy transition to achieve carbon neutrality by 2050 and Increase share of new renewable power plants to more than 50% • To develop the interconnection infrastructure to connect with neighbouring countries, meanwhile ensuring grid security and stability for seamless power flow • To accelerate Multilateral Power Trade alongside the ongoing LTMS-PIP initiative, there are efforts to expand electricity trading in a multi-directional manner involving multiple sellers and buyers • Thailand is planning to have feasibility studies for new transmission lines with Cambodia, Lao PDR, and Myanmar.

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Plan/Policy Document	Key Energy- and RE-related Policies and Cross-border Initiatives
	• Thailand is also planning to upgrade existing transmission line with Malaysia and Lao PDR • Prefers to ensure optimal utilisation of existing assets before further investment in cross-border interconnections
Singapore	
Green Plan 2030 EMA's media announcements	• 1.5 GWp of solar energy deployment in 2025, and 2 GWp in 2030 • Import up to 4 GWp low-carbon electricity by 2035 which make up around 30% of Singapore's electricity supply through regional power grid • Ongoing bilateral initiative between Indonesia and Singapore to establish Green Corridor. It is a collaboration between Governments of Indonesia and Singapore to develop green energy industry in Riau Islands. • Initiatives to become major RE importer of the region by proposed imports: 1) 1 GW of RE from Cambodia via 1,000km subsea cable; 2) 2 GW of RE from Indonesia (part of Green Corridor initiative); and 3) 1.2 GW of RE from Vietnam via 1,000 km subsea cable.
Myanmar	
National Energy Policy 2014	• MOU extension is in progress for 230kV interconnection between Lao PDR and Myanmar
Brunei	
Brunei Vision 2035	• Brunei adopted a strategic plan to achieve 10% share of renewables in the national energy mix by 2035. • In the process of establishing the Brunei-Sarawak Working Group committee for planned Sarawak-Brunei interconnection

Annex C: MPT Implementation Issues

This Annex covers a wide range of topics related to MPT implementation in general, and in the ASEAN context, in the sections listed here:

C.1 International Experience and References for MPT Development

C.2 Minimum Requirements for Different Models for MPT

C.3 Status of Regional Market Initiatives

C.4 Regional RECs

C.5 Potential Pathways to MPT Models in ASEAN

C.6 Legal Steps

C.7 Donor Coordination

C.1 International Experience and References for MPT Development

Key MPT markets were examined for this report. Using the overlapping approaches to categorisation from the preceding figures, these MPT markets are introduced here, together with ASEAN market development efforts.

- ASEAN, or "APG" markets are nascent, in the form of the pathfinding basic MPT approach under LTMS-PIP.
- PJM is a primary market type, with unified market, operations and deep integration.
- Nord Pool is a primary market type, with a unified market, but differentiated operations. It reflects deep integration in some respects, but not in the areas of technical harmonisation (since operations are not centralised) or planning. Also, the institutional architecture reflects a "light regulation" approach to the market's rules, though those regulations and key structural features reflect guidance under the EU Electricity Directive and other guidelines.
- SAPP is a secondary market type, with multilateral, multidirectional trade amongst differentiated markets. Market integration is shallow.
- SIEPAC / MER[37] can be categorised the same as SAPP, but technical harmonisation is more extensive and approaching "deep" integration status, and market operations are more centralised than in SAPP.
- The West African Power Pool (WAPP) can also be categorised the same as SAPP. Since trading in this market is almost entirely under bilateral contracts at this point, with short-term trading not yet begun, WAPP is mentioned throughout this Study for reference, but is not examined in detail.

Developing MPT markets takes decades, as illustrated in Figure C.1-1. Note the following:

- It can be seen that: (i) a minimum of several decades has elapsed between the first bilateral trading in a market area and the first MPT trades; (ii) those markets with a longer history of bilateral trading reached the MPT trading milestone earlier; and (iii), the gap between those two milestones is shorter for the two more recent MPT markets in the chart – SIEPAC and SAPP – compared to Nord Pool and PJM, likely reflecting international market development, sharing lessons learned and best practices.
- The period between key regulatory developments and the start of MPT trading can be relatively short – approximately five to ten years.

[37] Formally, the market is known as the *Mercado Eléctrico Regional* or "MER", but is frequently referred to as SIEPAC, from the Spanish acronym for the regional grid that was built across six countries for the market.

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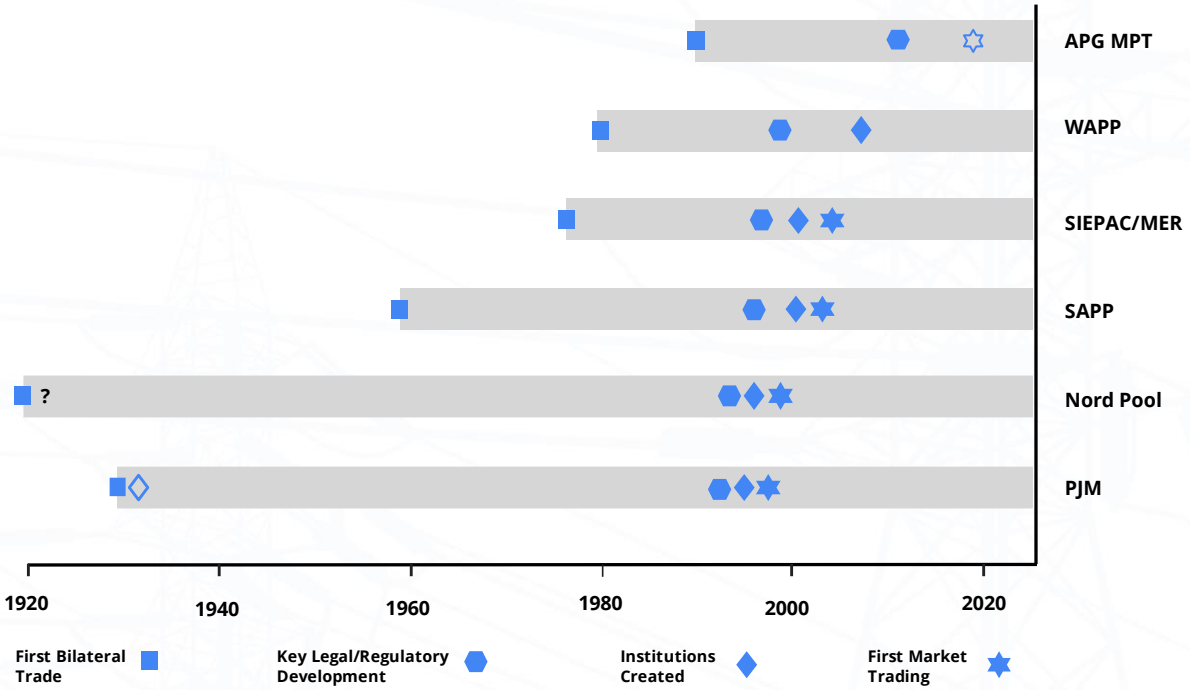
- No market in the figure, and no existing MPT market anywhere, has reached full MPT status without a dedicated institution. In fact, most MPT markets involve multiple institutions of different types, including functions ranging from regulatory issues to planning to market operations.
- Several observations can be made about specific markets:
- APG. The key regulatory development in this case is the 2007 APG MOU. First multilateral trading in the region is depicted with a star in outline, rather than the solid stars used for other markets, to reflect that the trading under LTM-PIP beginning in 2018 does not fully meet requirements for MPT, in that the trading framework was time limited, with no permanent framework. There is no regional institution in ASEAN permanently dedicated to supporting MPT development and implementation.
- WAPP. Trading in this market has not begun.
- Nord Pool. Whilst different sources provide different dates for the start of bilateral trading, it is certainly fair to say that grid integration had been ongoing for decades before formation of Nord Pool.[38]
- PJM. The PJM "institution" was originally operated as a department within one of the original three member utilities, as depicted in the figure by an outline diamond. An independent institution was created in 1997.

Figure C.1-1 Timelines to MPT, Selected Markets



Source: Delphos. Concept from IEA, "Institutional Architecture for Regional Power System Integration Government, Utility and Regulator Roles". 2023.

MPT market development timelines are depicted differently in Figure C.1-2, starting with the first MPT market trading.

- All markets began with a single short-term product market (e.g. spot/day-ahead, intra-day). Other product markets were added later. However, all markets also involved trade under

[38] Sources: (i) Vattenall History: https://history.vattenfall.com/stories/power-to-the-people/a-national-grid, and (ii) Norwegian Water Resources and Energy Directorate (NVE), *"Overview of Norway's Electricity History; Information from NVE and Norad"*, 2016. Also, the icons for key regulatory development, institutions created, and first market trading, are clustered close together. There are different ways to represent the timing of these key developments, but the first true MPT under Nord Pool (involving three or more countries) occurred in 1998 when Finland joined.

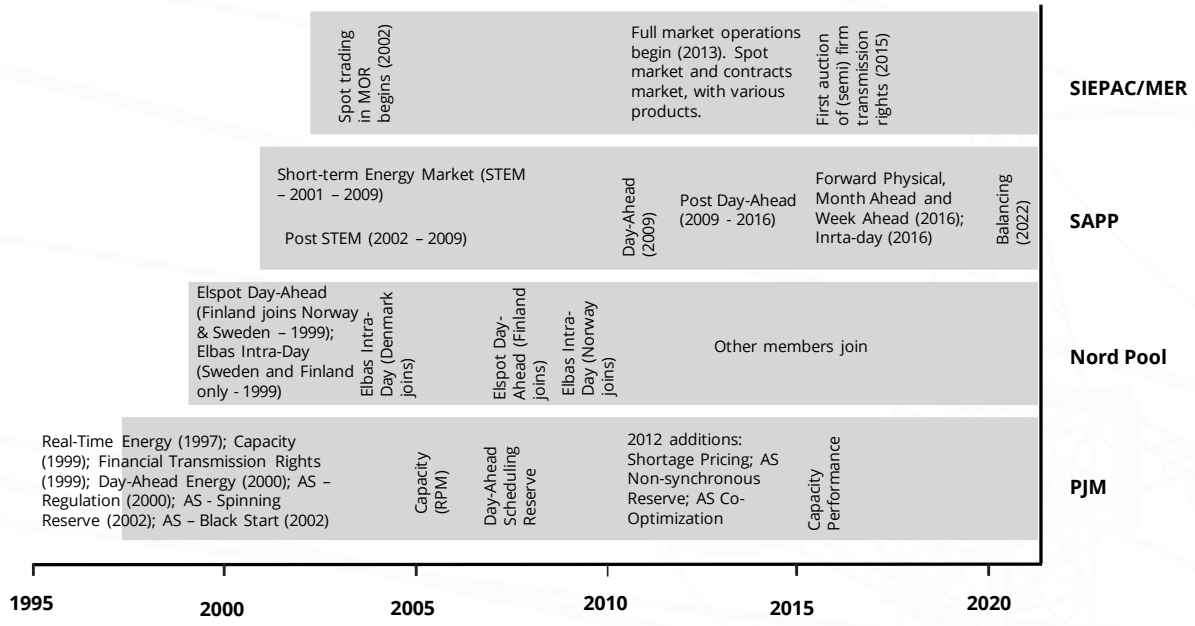
pre-existing bilateral contracts (financial only and/or physical) that continued through the start of the markets.

- PJM added half a dozen product markets within the first few years after the first MPT trading, with a slower pace thereafter.
- In Nord Pool, MPT activity began with the Elspot Day-Ahead market, when Finland joined Norway and Sweden in 1999. Denmark followed in 2000. The Elbas Intra-day market began in 1999 between Sweden and Finland. By 2004, Eastern Denmark had joined, followed by Germany in 2006, Western Denmark in 2007, and Norway in 2009. Thus, Norway, whilst a member of Nord Pool from the beginning, did not join the Elbas Intra-day market until 2009. Several lessons learned relevant to MPT development may be embedded in these facts.
- It is important to understand that, whilst Nord Pool (the company) operates other power markets besides the Nordic market, such as in the UK, those markets are distinct from the Nordic market, with different rules and regulations.[39] Trading across these markets is technically and commercially possible, and some of Nord Pool's separate markets are relatively closely integrated, but it is inaccurate to characterise the separate markets as being a single "Nord Pool" market. The same analysis applies for US and Canadian markets, where substantial trade occurs between, say, PJM and NYISO, or between ISO-NE and Quebec and the Canadian Maritime Provinces, but these markets are all distinct.
- Norway was the only member of the original Nord Pool members that was not part of the EU. The development of EU electricity markets was greatly aided by the 1995 EU Electricity Directive, which required amongst other things the unbundling of vertically integrated utilities, and for countries to take steps to integrate their national power market. There are other EU-level laws, regulations, and institutions as well that pertain to power markets. Stated generally, countries in the EU can be considered much more like US states or the states/provinces of a single country, when it comes to power markets. In other words, the EU might be regarded as a single country for discussion of power markets.
- For the first five years of Nord Pool's MPT existence, the "true MPT" market involved only four members trading in one Nord Pool market: Elspot. The Elbas market did not gain its third member until 2004, and did not gain a single non-EU member (Norway) until 10 years after Elspot trading began.
- For the above reasons and others, it may be misleading to regard Nord Pool currently as a single MPT market involving many different countries. Instead, it may be more accurate to characterise Nord Pool as a regional power market. Why does this matter? It matters because developing MPT markets, involving three or more fully independent countries such as those of ASEAN, is exceptionally complex; it can be done, but assessment of the types of markets that might be realistically feasible should involve a close look at the full context involving formation of those markets.
- SAPP has involved an evolution of different product markets. The STEM and Post-STEM were essentially "day-ahead" and "day-ahead plus extra hours" markets. The bulk of energy trading initially and through the start of the Forward Physicals markets, was on a bilateral basis, which was coordinated through but not settled by SAPP. The most recent addition is the Balancing Market. It appears the market has been thinly traded and its status is unclear.
- SIEPAC involved trading for 11 years under interim market rules, and before the six-country 230 kV dedicated transmission project was complete. The complete package of final market rules was highly detailed, including as to various types of firm transmission rights. Such firm transmission rights were regarded as the key for the market to achieve one of its original

[39] Questions have been raised about arrangements for use of the cross-border between Norway and the UK as well: https://www.eftasurv.int/newsroom/updates/esa-investigates-possible-breach-norway-eea-competition-rules-over-exclusive.

objectives of facilitating financing of large cross-border power projects that could benefit from economies of scale (the national markets were too small individually for such projects).

Figure C.1-2 Product Market Timelines, Selected Markets



Source: Delphos.

Minimum Requirement in Different MPT Contexts

PJM: Strictly speaking, this is not an MPT market since it does not involve multiple countries. However, PJM is regarded as one of the largest and most successful regional power markets, and as such is a useful reference point for APG MPT development efforts. Several features of the market, including fully unbundled utilities, centralised dispatch, and centralised planning linked to a common use infrastructure development and finance mechanism that imposes costs on all market participants, would seem virtually impossible to accomplish without a common legal and regulatory authority. The political requirements of PJM's market are extremely high if attempted in a multilateral setting, as this would require giving up essentially all national control over national HV power systems and ceding legal/regulatory authority over the national power industry structure.

Nord Pool: In its early version years, Nord Pool involved only four countries, three of which were within the EU (Sweden, Finland, and Denmark) and one was outside the EU (Norway). The market did not arise on its own: the EU Electricity Directive the same year (1995) as Nord Pool was founded between Norway and Sweden, and there was ample visibility that the Directive was likely to be issued for several years before. Other contextual advantages include inter-utility connections and bilateral trade on a grid linking all four initial Nordic countries for over a decade before all those countries joined Nord Pool (and for many decades fore that on a grid linking some Nordic countries); all advanced economies with tight power system control, the Energy Charter Treaty establishing an inter-state dispute resolution framework, and historically tight Nordic relations. The key additional requirement of the Nord Pool market is that it requires unbundling of national utilities. This requirement is not stated here simply as a function of the fact that the utilities of all national markets participating in Nord Pool are unbundled, which after all could reflect merely the need to comply with the EU Electricity Directive. Instead, this requirement for utility unbundling derives from the practical impossibility of establishing competitive product markets and exchanges around which Nord Pool is designed. These product markets all require high levels of liquidity, which would be much lower with only vertically integrated utilities, and

trading transparency, including as to prices. Additionally, there are anticompetitive market surveillance under Nord Pool, and enforcement mechanisms at the national and EU level. As a practical matter, vertically integrated utilities in ASEAN may be expected to be uncomfortable with many of these aspects of Nord Pool.

SAPP: This market's development benefitted from a long history of bilateral trade between South Africa, the massively dominant load and supply hub for the region, and other countries in the region. Prior to the formation of SAPP, and in some cases to this day, South Africa's utility, Eskom, actually operated the HV grids of several of its trading partners. The formation of SAPP initially was focused on complementing existing bilateral trading through introduction of a short-term energy market that could yield system operating cost savings across the region. Since none of the national markets involved had been restructured, market designers took a "light regulation" approach that would not impinge on national sovereignty of each country's domestic market.

SAPP features a "hub and spokes" transmission topology, with South Africa serving as the hub for both load and supply, and with transmission lines directly linked to all initial operating members.[40] Initially, therefore, the hub and spoke topology meant that the market participants did not have to worry much about ATC calculation and allocation methodology, which are generally very difficult methodologies to develop.

SIEPAC: Since this market was found to be highly relevant to MPT in ASEAN, additional details beyond those provided to this point in the text and following are presented in Annex C, Section 0, "***Relevant Features of SIEPAC Market***". An important feature of this market is that it is agnostic as to national market structure. There is thus no requirement for national market restructuring and indeed, the six Central American countries in the market exhibit a broad range of market designs, with the markets of three countries (Guatemala, El Salvador and Panama) being fully restructured, the market in Nicaragua being partially restructured, and markets in Honduras and Costa Rica remaining as traditional single-buyer models. A related and very important feature is that the regional market, which as noted earlier, involves short-term and contract markets amongst other products, neither interferes with the operation of the organised national markets, nor even requires that there be organised national markets. Rather, the SIEPAC market exists as a so-called "seventh market" sitting alongside the other markets. Thus, for instance, trading areas within SIEPAC exist for each of the six countries, and market clearing prices are developed and publicly reported hourly for each of those areas, meaning that that there are separate hourly prices developed in both national markets and SIEPAC itself for the four countries that also have organised short-term markets, and there are also hourly prices developed for the countries that do not themselves have organised national markets.[41] Similarly, SIEPAC's contract markets allow for both buyers and sellers to be located in any of the six national markets. Finally, whilst there is a regional market operator, that operator does not operate national markets (as noted) or national systems. The regional market operator, apart from developing market prices and settling trades at the regional level, also coordinates a regional dispatch that allows cost savings with respect to national pre-dispatch and tracks all underlying contracts. Each national system, however, retains operational control of its own system.

SIEPAC's contextual advantages include that all markets are Spanish speaking, roughly similar in size, and with roughly similar levels of economic development, with strong grid control. Market development also benefitted enormously from the major role of donors in putting the market structure together and financing the market's operational systems and common use infrastructure. A structural feature of this market, and potentially a requirement for any similar market, is its regional regulatory institution, with (weak) enforcement powers, established by treaty. Given there may be a consensus emerging amongst the AMS that a regional regulator is

[40] See Annex C, Section C.2.1 *"Role of Topology in Market Design"* for more on this topic.

[41] The Authors have several times heard the misconception in the ASEAN region that creation of a short-term MPT market requires that national short-term markets exist as well.

not preferred, it is important to re-iterate SIEPAC's regional regulator only has jurisdiction over "the seventh market" (that is, over SIEPAC itself) and not over the structures of or activities within national markets. It is also noted that part of the requirement for a regional regulatory body relates to the large investment required in common-use transmission assets to create the physical infrastructural foundations for this market. Further analysis is required on whether such a body would be required if the need for common use assets did not feature so prominently at design stage.

Relevant Features of SIEPAC Market

Several features of the SIEPAC – MER market appear highly relevant to ASEAN, and especially to the West Subregion. These features, some of which have been mentioned elsewhere in this Study, are discussed below. The intention is to consolidate the discussion of this market for ease of reference.

SIEPAC is one of few "true", fully functional, MPT markets. To be an MPT market requires that trade occurs within the market across three or more countries. Technically, various European markets meet this test, but all such markets except for Nord Pool operate wholly within the European Union, which involves a quasi-federal electric power market structure operating under EU Law (especially, the EU Electricity Directive) and EU institutions. With respect to the power sector, these markets cannot be said to truly operate across different national markets, certainly not in the same way that SIEPAC and SAPP do.

Nord Pool, for its part, operates multiple power markets, but none of them individually involve more than a single country that is outside of the EU, which means that on this basis, Nord Pool markets are also not "true" MPT markets. Whilst this may all seem mere definitional quibbling, it is not: it is much more difficult to form MPT markets where they do not exist with federal or quasi-federal regulatory structures. Moreover, it approaches the impossible to implement some of the types of markets found within the EU and North America elsewhere around the world.

SIEPAC is agnostic on market design. There is thus no requirement for national market restructuring and indeed, the six Central American countries in the market exhibit a broad range of market designs. The markets of three countries – Guatemala, El Salvador and Panama – are fully restructured, the market in Nicaragua is partially restructured, and markets in Honduras and Costa Rica remain as traditional single-buyer models.

There is no need for national short-term markets in order to have a regional short-term market. This market involves short-term and contract markets amongst other products, none of which interfere with the operation of the organised national markets, nor even requires that there be organised national markets. Rather, the SIEPAC market exists as a so-called "seventh market" sitting alongside the other six national markets. Thus, for instance, trading areas within SIEPAC exist for each of the six countries, and market clearing prices are developed and publicly reported hourly for each of those areas, meaning that *there are separate hourly prices developed in both national markets and SIEPAC itself for the four countries that also have organised short-term markets, and there are separate hourly prices developed for the countries that do not themselves have organised national markets*. Similarly, SIEPAC's contract markets allow for both buyers and sellers to be located in any of the six national markets. Finally, whilst there is a regional market operator, that operator does not operate national markets (as noted) or national systems. The regional market operator, apart from developing market prices and settling trades at the regional level, also coordinates a regional dispatch that allows cost savings with respect to national pre-dispatch and tracks all underlying contracts. Each national system, however, retains operational control of its own system.

SIEPAC involved a common-use infrastructure financing solution from Day 1. SIEPAC-MER involved design, construction, and ownership by a new market entity for a 230 kV circuit transmission line linking all six Central American countries in the market, plus a regional market

and control centre. A consortium of development banks was heavily involved in financing market design and the physical assets.

Lessons learned from the approach to common use assets in other regions can provide valuable insights for ASEAN. A key challenge for the West Subregion market is the lack of transmission capacity at the Thailand-Malaysia interface. Addressing this issue upfront, potentially through a common use asset financing model, is recommended if Thailand and Malaysia are unable to finance the investment themselves.

The method of dispatch coordination in these systems offers trade benefits without requiring national markets to relinquish control over their own systems. To understand how the final approach to dispatch coordination was adopted in SIEPAC, it is useful to consider the regional context.

All six Central American countries in SIEPAC-MER can be characterised as "hydro-dominated," similar to many Latin American power markets. Hydropower plays such a significant role in these systems that market design and system operations are tailored to accommodate its unique characteristics. One of these features is that hydropower is an "energy-constrained" generation technology, meaning the amount of energy that can be generated over time is limited by water availability.

Although the cost of generating hydropower is almost zero, its value is determined by the cost of the thermal generation it displaces. In hydro-dominated markets, especially those with substantial storage capacity, system planning depends heavily on optimising the use of stored water. During the market design phase for SIEPAC, it became clear that regional least-cost optimisation could lead to using stored water in Country A to lower the average system cost across the region, while increasing the system cost in Country A itself. This was seen as politically unacceptable.

To address this, a multi-step process was developed. National markets perform their own pre-dispatch, with excess thermal generation offered to the regional market operator. The regional operator then creates a new regional pre-dispatch, which is sent back to the national operators. Each national market then dispatches its system according to this schedule. This process ensures that national markets always benefit from trade, while also providing political cover against claims that the regional market is exporting low-cost hydro to the disadvantage of local ratepayers.

Although the role of hydro in the LTMS + Sumatra region involves less storage hydro than in SIEPAC-MER, this dispatch approach seems applicable in the ASEAN context. The approach to dispatch in the Southern African Power Pool (SAPP) is similar, though it was not driven by the same hydropower considerations. The approach envisioned for the ASEAN Regional Power Market appears to align with this method as well.

The sequence of steps leading to the final pre-dispatch at the national level is illustrated in Figure C.1-3.

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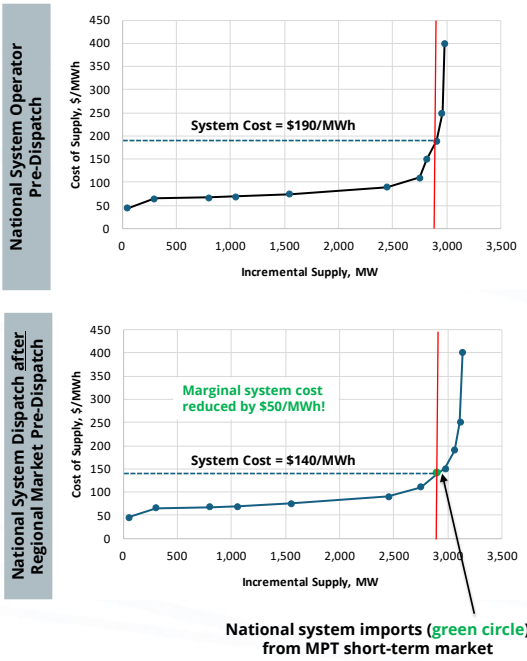
Figure C.1-3 National and Regional Market System Dispatch Coordination in SIEPAC



- On the day ahead of national system dispatch, national system operator (NSO) conducts national system pre-dispatch using only domestic resources and sends pre-dispatch details to regional market operator (RMO)
- RMO collects national pre-dispatch details of all NSOs and conducts regional pre-dispatch, with regional market injection offers* from generating units that were not scheduled in national pre-dispatch
- RMO sends final pre-dispatch to all NSOs, reflecting any cleared injection offers
- NSOs dispatch their own systems based on the RMO's final pre-dispatch
- Summary
  - National systems not obligated to participate. But they all do, because it offers value
  - Outcomes can only improve for a national system for each day it participates. Either its own cost of supply will be reduced through cheaper imports or it will earn money through exports

* Withdrawal offers are also allowed. Discussion focuses on injection offers only for simplicity.

Source: Delphos.

SIEPAC's market employs an ATC allocation approach that could be applicable to ASEAN. One of the core objectives of the SIEPAC market was to facilitate the financing of larger power projects, which would be too large for any single small national market to handle on its own. By pooling resources, the market aimed to capture the economies of scale in generation. The idea was that new, large hydropower projects or combined-cycle gas turbine (CCGT) power plants using imported LNG could replace medium-speed diesel units operating on heavy fuel oil (HFO).

To finance such large projects, power purchase agreements (PPAs) with off-takers in multiple countries would be required. For these projects to be bankable, long-term firm transmission access over the relevant cross-border interfaces would also be essential. A complicating factor was the grid topology in SIEPAC, which involves six countries arranged in a linear fashion. This meant that contracts and energy trade across the region were highly dependent on ATC calculation and allocation. In a more meshed grid topology, a lack of ATC on a particular interface might limit trade between two countries. However, in SIEPAC-MER, it could entirely split the market, making ATC a critical issue.

As a result, significant attention was given to ensuring long-term firm transmission access and developing ATC calculation and allocation methodologies. Even though it eventually became evident that large projects involving multiple SIEPAC countries would face bankability challenges beyond the availability of firm transmission rights during the financing period, the ATC allocation system that was developed has proved effective in a more limited context.

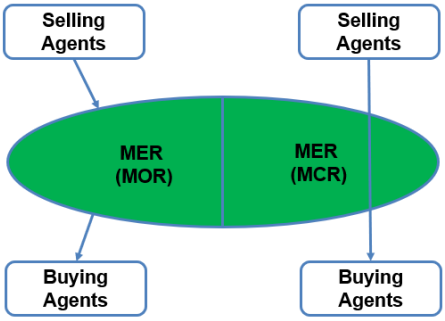
This approach could be well-suited for ASEAN, particularly for the West Subregion contract market that is being envisioned, as it faces a similar topological challenge.

SIEPAC involved creation of both an organised contract market and a short-term market from Day 1.

By contrast, all other MPT markets focused initially on short-term markets that could supplement existing bilateral contracts trade and eventual organised multilateral contract trade. In the West Subregion, it seems clear that there is a need to develop both a contract market focused on

delivering RE from Lao PDR and perhaps Indonesia to other AMS in that market[42] and a short-term market such as the Regional Power Market, that could help address short-term needs for power in areas bordering Thailand, and to facilitate opportunity trade amongst all members of that market.

Figure C.1-4 Relationship of Short-term and Contract Markets in SIEPAC-MER



Source: Delphos.

Figure C.4-1 illustrates the relationship between the short-term and contract markets in SIEPAC-MER. The short-term market, referred to as the "MOR" (the Spanish acronym for the Regional Spot Market), involves offers to buy and sell electricity from both Buying Agents (such as national vertically integrated utilities, unbundled distribution companies, marketers, and large customers) and Selling Agents (national vertically integrated utilities, independent power producers, and marketers).

Flexible Offers — whether to buy or sell — are linked to Non-Firm Flexible Contracts, whilst Injection Offers are tied to Firm Contracts. The contract market, known as the "MCR" (the Spanish acronym for the Regional Contract Market), includes three types of contracts: Financial Contracts, Non-Firm Physical Flexible Contracts, and Firm Contracts.

Firm Contracts are pre-scheduled across cross-border interfaces and must be backed by Firm Transmission Rights. In contrast, Non-Firm Physical Contracts do not require Firm Transmission Rights. They are scheduled if Available Transfer Capacity (ATC) exists, and the associated Flexible Offers are accepted in the MOR. Financial Contracts, also known as "contracts for differences," are used to settle specific amounts of energy based on price differences between various market pricing nodes.

Governance Arrangements in Different MPT Contexts

Table C.1-1 shows governance arrangements for various international power markets in terms of which types of entities perform different functions for those markets. In reviewing the table, bear in mind that outside of Europe, there are few MPT markets: most North American markets are wholly contained within a single country, with only one market (MISO) operating across even two countries. European MPT markets also operate under a quasi-federal system with a unified power sector legal/regulatory structure, rendering such markets not clearly “MPT” per the definition established for this Study, under which MPT requires trading to occur across three or more countries.

Table C.1-1 Functions and Types of Institutions

Entity	Function	Entity Type	Applicable Entity Type in ASEAN

[42] The statement is not intended to suggest that other sources for renewables exports, or non-renewable energy, would not be traded in the market.

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FERC	Regulator	Federal Agency	Not Applicable
ACER	Regulator	EU Agency (Quasi-federal)	Not Applicable
ENTSO-E	Planning & coordination	Regional Association	ASEAN-wide or Subregional Association
NERC	Reliability Assessment & Coordination	Not-for-profit Corporation	Not-for-profit Corporation
Nord Pool	Market Operator	For-profit Corporation	For-profit Corporation
EPEX Spot	Market Operator	For-profit Corporation	For-profit Corporation
OMIE	Market Operator	Not-for-profit Corporation	Not-for-profit Corporation
PJM	Market Operator	For-profit Corporation	For-profit Corporation
All Other N. Amer. RTOs	Market Operator	Not-for-profit Corporation	Not-for-profit Corporation
SAPP-RERA	Regulatory Coordinator[43]	Regional Association	ASEAN-wide or Subregional Association
SAPP	Market Operator/ Regulator	Not-for-profit Corporation	Not-for-profit Corporation
SIEPAC-CRIE	Regulator	Regional Authority	ASEAN-wide or Subregional Authority
SIEPAC-EOR	Market Operator	Not-for-profit Corporation	Not-for-profit Corporation
WAPP-ERERA	Regulator	Regional Authority	ASEAN-wide or Subregional Authority
WAPP	Market Operator	Specialised Regional Entity	ASEAN-wide or Subregional Specialised Regional Entity

As shown in the table, the US and EU regulators are federal or quasi-federal entities. This type of entity is not applicable for ASEAN. SIEPAC is the only regional regulatory authority in those RTOs and MPT markets that are currently in operation. The WAPP, which is under development, features the same type of regulatory entity. The only MPT market whose regulator is a regional association is SAPP. Regional authorities require establishment by regional treaty/protocol.

Regional vs. Subregional Approaches in Different MPT Contexts

It is important to address concepts at the heart of the effort to develop an ASEAN Power Grid and to develop an MPT across ASEAN. The question is, what do stakeholders regard as "success" when it comes to developing MPT in ASEAN? The Authors found that some stakeholders may regard anything short of a single interconnected market across all ASEAN countries to be a suboptimal ultimate goal. The Authors submit that having a single interconnected market across all of ASEAN would be exceptionally difficult on technical, commercial, and regulatory grounds – essentially impossible to implement – without delivering substantial benefit over less integrated structures.

[43] RERA does not have regulatory powers. Its mandate is for regulatory capacity building and regional regulatory cooperation. SAPP is self-regulated by a stakeholder board approach within the SAPP organisation.

To understand why larger MPT markets are not always preferable to smaller ones, it is useful to examine the situation in the EU and the US. In the EU, there are several MPT markets, all functioning under a shared EU regulatory framework. Some of these markets are shown in Figure C.1-5. Whilst various issues are treated differently across these markets, it has been possible for many years to buy power in one market and deliver it to another across the region.

The "price coupling of regions" initiative, which might appear to enable trading between markets, actually focuses on something else. It optimises security-constrained regional dispatch to improve the efficiency of cross-market trading, which is already feasible. This highlights that whilst larger markets might seem beneficial, smaller, well-coordinated markets with efficient cross-border trading mechanisms can be just as effective.

Figure C.1-5 Multiple MPT Markets Across Europe

Source: "Chapter 10 - Benefits of Market Coupling in Terms of Social Welfare". Regulation and Investments in Energy Markets; Solutions for the Mediterranean. (2016). Note that market boundaries have evolved since 2016, but the graphic nicely depicts the different regional markets in Europe.

In North America, the situation is similar to that in Europe, as illustrated in Figure C.1-6. There are several regional power markets, including the Midcontinent Independent System Operator (MISO), which spans parts of both the US and Canada. Notably, the US regulator, the Federal Energy Regulatory Commission (FERC), which promoted the creation of "regional transmission organisations" (the term used for regional power markets in the US), has never aimed to establish a single power market for the entire country, nor even for any of the three major interconnections in the US.

In fact, FERC views the existence of multiple markets as beneficial for encouraging innovation across different markets. As a result, a diverse patchwork of regional and single-state markets has emerged, evolved, merged, and adapted over the years. Furthermore, it is technically possible to trade power between markets, such as from MISO to ISO-New England, and even onward to Canada's eastern provinces. Cross-market trade over shorter distances, between various US and Canadian markets, is a common occurrence.

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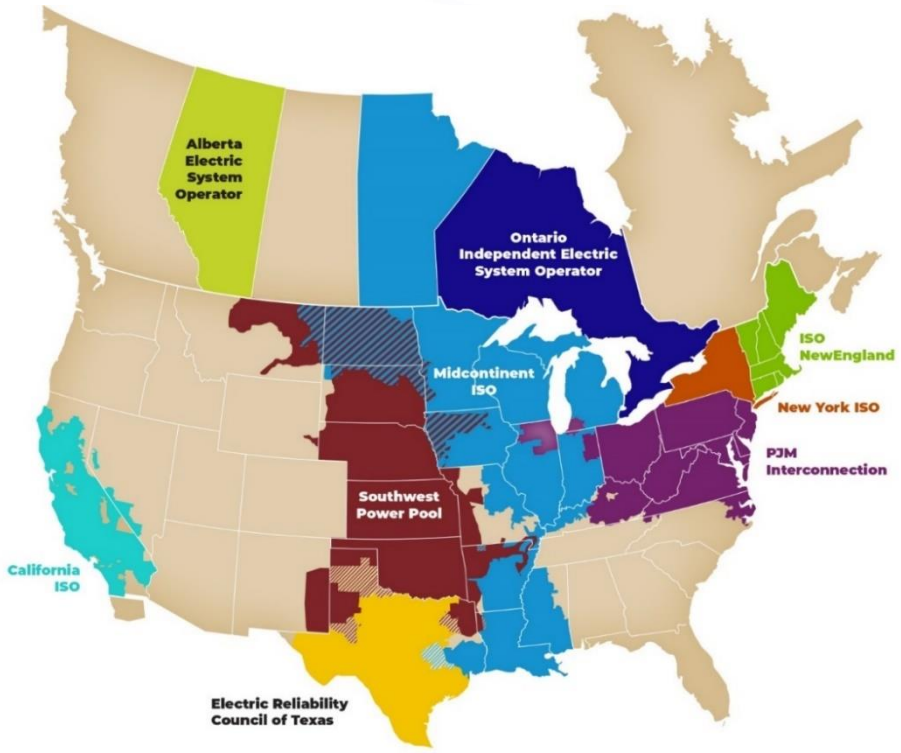
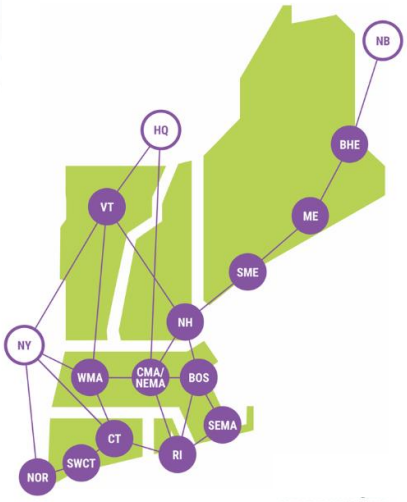
Figure C.1-6 Multiple MPT Markets Across North America



Source: ISO RTO Council

Consider potential trades from the perspective of ISO-New England (ISO-NE), as shown in Figure C.1-7. In the figure, pricing zones within ISO-NE are shown in solid circles, whilst external pricing zones are shown in open circles. ISO-NE is connected to one competitive, restructured, US market (NYISO) and two unrestructured Canadian markets: Quebec (whose utility, Hydro Quebec or HQ, is shown in the open circle) and New Brunswick. ISO-NE itself is interesting and potentially relevant to MPT in ASEAN, since this market involves six US States, each with its own state electricity laws and structure. Of these US states, all except for Vermont have restructured to allow retail access. NYISO, for its part, trades with ISO-NE, Hydro Quebec, Ontario ISO (a Canadian power market), and PJM (a US regional power market).

Figure C.1-7 Internal and External Trading Zones for ISO-New England

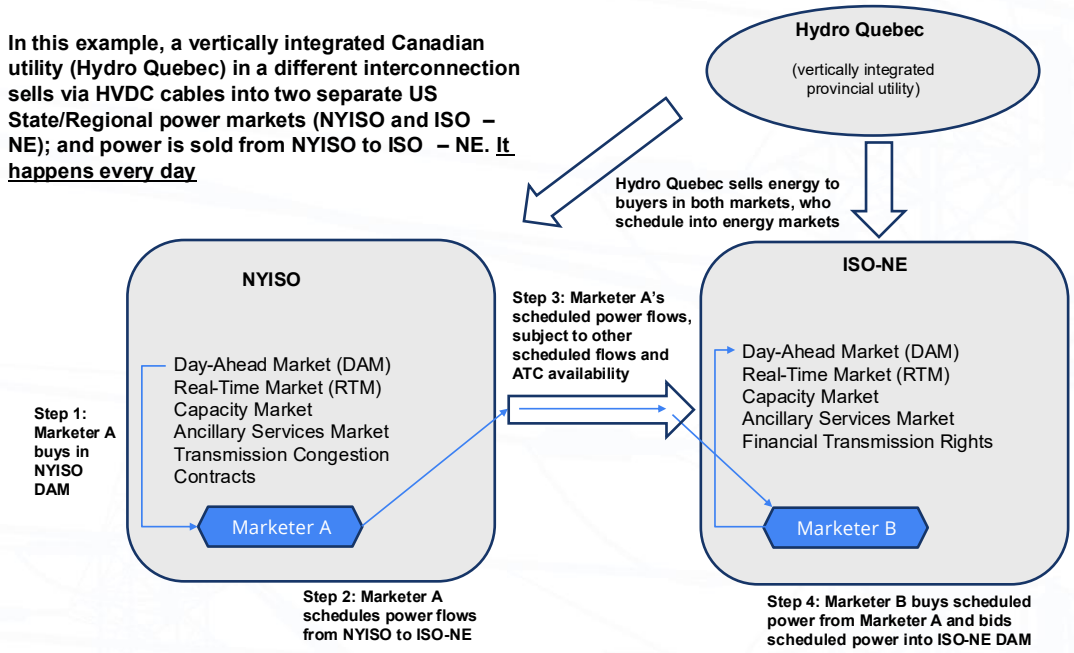


Source: ISO-New England.

Figure C.1-8 demonstrates how energy trading can occur across the distinct power markets of ISO-New England (ISO-NE), NYISO, and HQ. Although these are different markets, similar trading activities are possible across various power markets worldwide. In this example, HQ sells energy through bilateral contracts to buyers in both ISO-NE and NYISO.

The buyers in these markets can either use the energy themselves — if they are energy supply companies with existing customer loads or large industrial/commercial users — or they can bid the energy into short-term markets, such as the Day-Ahead Market or Real-Time Market. Additionally, buyers who initially planned to use the energy themselves might find they have excess supply. In such cases, they use what is needed and sell the surplus energy in the Day-Ahead or Real-Time Market. Furthermore, buyers can also sell energy purchased under contract into neighbouring markets, further increasing trading opportunities across regional grids.

Figure C.1-8 Example of Trade Across Different Types of Markets



Source: Delphos.

Let us assume the buyer in NYISO in this case is a marketer (Marketer A) that has purchased 100 MW for peak hours under a firm one-year contract. Marketer A anticipates that Day-Ahead Market prices likely will be higher in ISO-NE than in NYISO. So, to capture extra value, Marketer A sells under a short-term contract 100 MW for peak hours to Marketer B in ISO-NE at a price that allows Marketer A to earn more than it would have earned by selling into NYISO's short-term energy markets, and that allows Marketer B to profit from selling the purchased energy into ISO-NE's Day-Ahead Market.

Note that since Marketer A has purchased firm supply from HQ, it wants a firm solution to selling that supply, and thus arranges firm transmission rights from NYISO to ISO-NE. There are coordination protocols that confirm the scheduled flows between the two markets. Since the sale from Marketer A to Marketer B is firm, Marketer B will want to ensure that the purchased energy will be sold in the Day-Ahead Market. To do so, Marketer B offers the purchased energy into the ISO-NE Day-Ahead Market at a very low price, probably $0/MWh, making it highly likely the offer will clear the market.

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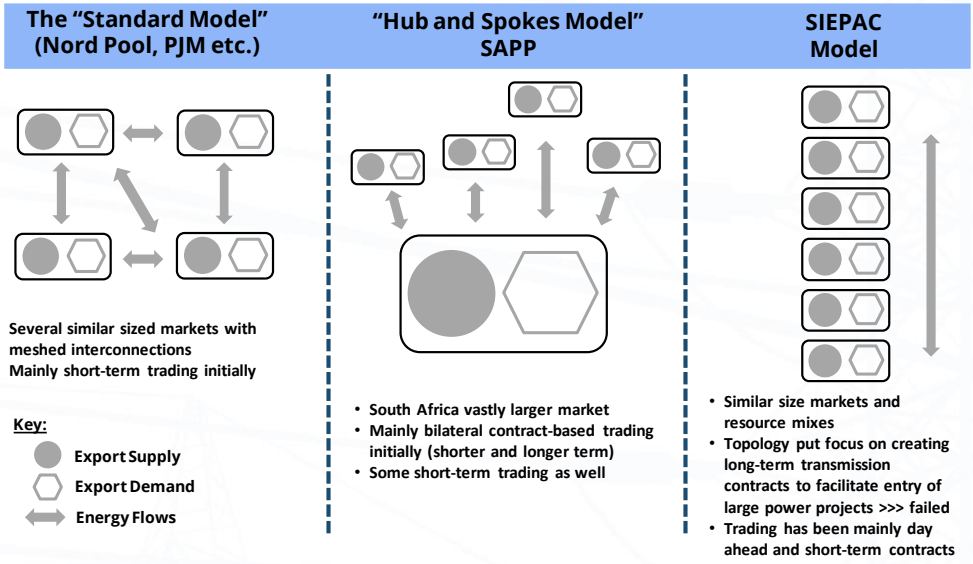
In this case, let us assume the offered energy price is accepted and so Marketer B receives the market clearing price (MCP), not the offer price.[44] The MCP in this case is sufficiently high to provide a profit on the cost of energy purchased from Marketer A in NYISO, inclusive of the cost of firm cross-border transmission and energy losses.

C.2 Minimum Requirements for Different MPT Models

C.2.1 Role of Topology in Market Design

The shape and relationship of national grids (market topology) can play a significant role in the design of MPT markets. Figure C.2-1 shows the main MPT market topologies, whilst the text below the figure links market design and market features to the different topologies.

Figure C.2-1 Topology and Key Drivers in Other Markets



Source: Delphos.

Nord Pool, often cited as an example of the "Standard Model" market design, was initially formed to facilitate hydrothermal energy trade between Sweden and Norway, two countries with similar levels of electricity demand. Finland and Denmark joined later, forming a cluster of countries that are geographically and electrically well-connected, as opposed to the linear arrangement of countries in the LTMS area. In this type of market topology, each national market is directly or nearly directly connected to others, sometimes via a "wheel" through just one other country. As a result, bilateral contracting can be widely used, even before the market becomes fully organised, reducing the need for a formal contract market. This simplifies market operations, allowing the focus to shift toward short-term energy markets, as seen in Nord Pool and many other MPT markets.

One key simplification in such markets is the reduced need for an ATC allocation methodology, since physical energy contracting across borders plays a minimal role. Instead, if a party at Location A wants to sell power to Location B, but congestion occurs on the A-to-B transmission path, the party can purchase power at Location B and sell it to the buyer there. In this scenario, the locational price at B would be higher than at A due to the congestion, and the seller could hedge against price differences by purchasing financial congestion rights. This would provide

[44] In nearly all short-term energy markets, all transactions are settled at the MCP, which is the price of the most expensive energy bid that clears the market. One of the few exceptions is in El Salvador, where for several years, the short-term energy market was operated in a "pay-as-bid" mode, in which offers that cleared were paid the offer price rather than the MCP.

revenues based on the price difference between A and B, multiplied by the volume of the congestion right.

Whilst some markets, like PJM, include physical transmission rights, they exist within a centralised dispatch and market operations system, utilising advanced locational marginal pricing (LMP). However, replicating such a system in the ASEAN region, particularly the West Subregion, is not feasible. The reasons are numerous, but primarily stem from the different grid topology. For example, in the West Subregion, power from Lao PDR would need to pass through two other countries to reach Singapore, making physical contracting challenging. In a financial-only contracting approach, if congestion arose over the Thailand-Malaysia interface, Lao PDR would have to purchase power in Malaysia to complete its sale to Singapore. This arrangement would require full transparency in the Malaysian pricing zone, which the envisioned ASEAN market models do not currently offer. In addition, Malaysia could apply various fuel pricing mechanisms, such as subsidies or heavy taxes, making it difficult for Lao PDR to guarantee the delivery of low-cost energy to Singapore.

In contrast, SAPP developed within a "hub and spokes" grid topology, where bilateral trade between South Africa, the dominant load and supply hub, and its neighbours was common. This allowed for a relatively loose approach to ATC calculation and allocation. As transmission expanded northward, a firm physical transmission rights product was added to manage the increased complexity.

SIEPAC, another relevant example, designed its market to connect six small countries arranged in a line. These countries shared similar resource endowments but had varying demand profiles, allowing for beneficial trade opportunities. However, the linear market topology and limited ATC necessitated firm transmission rights to ensure that energy could be reliably delivered through multiple countries. Whilst one of the original goals of SIEPAC was to support the financing of large new cross-border projects through multi-year firm transmission rights, it was later realised that these projects faced bankability issues unrelated to transmission rights. As a result, the longest-term firm transmission rights offered were for just one year.

Overall, SIEPAC's approach to integrating a short-term energy market with a contract market is highly relevant to the development of MPT markets in ASEAN, particularly in the West Subregion.

C.2.2 Third Party Access

Third Party Access (TPA), as it is generally understood, is a concept that is central to restructured power markets. The term has been used in numerous ASEAN MPT-related documents, sometimes intended to refer to TPA as it is generally understood amongst power market practitioners, and sometimes to mean simply access of MPT market participants to the transmission systems of other AMS MPT trading members for the express purposes of trade within the MPT market. The former concept would require restructuring of most AMS national markets, whereas the latter would require little or no change to national markets, depending on national laws and regulations. The rest of this section provides more detail on TPA as traditionally used and generally understood, together with a discussion of what is required in ASEAN for MPT to occur.

TPA – As it is Generally Understood: TPA is a regulatory mechanism in which electricity network operators are required to provide non-discriminatory access to their transmission and distribution systems to any electricity supplier. This enables multiple electricity suppliers to compete for customers, promoting competition and efficiency within the power market. In restructured or deregulated power markets, the introduction of TPA is crucial for the following reasons:

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1. Promotion of Competition: TPA breaks down the monopolistic control of incumbent utilities over transmission and distribution networks, allowing new entrants to compete in the generation and retail segments.
2. Consumer Choice: It provides consumers with the freedom to choose their electricity supplier based on price, service quality, and other preferences.
3. Efficiency and Innovation: Increased competition encourages efficiency in operations and fosters innovation in product offerings and services.
4. Market Transparency: Ensures transparency in market operations and pricing, which is essential for the effective functioning of competitive markets.

What is Required for MPT in ASEAN: SAPP and SIEPAC are two markets that document TPA, as generally understood, is not required for MPT. What is required is agreement amongst the AMS and AMS utilities that allows mutual access to the transmission grids of other utilities to consummate trades. This type of access can be referred to as "Third Party Access for External Resources," to avoid confusion with TPA as it is commonly understood. This clarification was also made in the International Energy Agency's report, *"Establishing Multilateral Power Trade in ASEAN"* (2019).

Figure C.2.2-1 Difference between TPA and TPA for External Resources

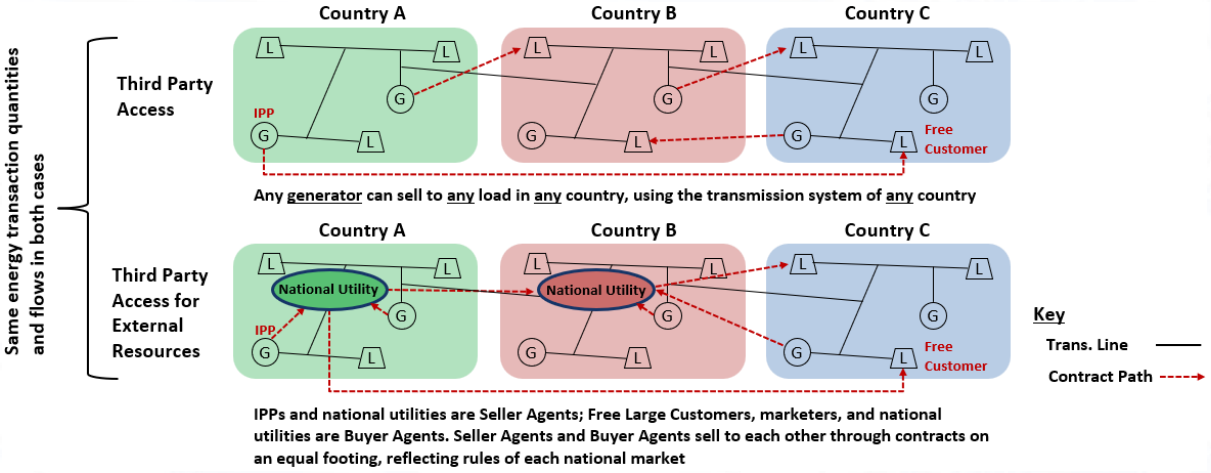

Figure C.2-2 highlights the distinction between traditional TPA and TPA for External Resources. In the top row, three countries are shown, all of which have restructured their electricity markets. In this scenario, full TPA is implemented, allowing any generator in any country to sell electricity to any consumer in another country, or within its own, by using the transmission systems of the other countries. This reflects the type of TPA present across the markets in both the EU and the US.

In contrast, the bottom row illustrates TPA for External Resources, where two countries on the left have not restructured their markets, whilst the one on the right has. Despite the lack of restructuring, similar physical energy flows can still occur, but must be facilitated through the national utilities. For example, the IPP in Country A (bottom left) cannot directly sell power to the Free Customer in Country C, as it could under a fully restructured market. Instead, it sells to the national utility in Country A, which then resells the power to the Free Customer in Country C.

It is important to note that this form of transmission access is neutral regarding national market design. For instance, the IPP in Country C can sell to the national utilities in the other countries, but the same is not true in reverse. This may seem inequitable, as the IPP in Country C has more flexibility in choosing buyers compared to IPPs in the other countries.

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A broader takeaway is that MPT markets can either be agnostic to national market designs or not. If they are agnostic, they do not account for differences in the treatment of market participants across various national markets — those are considered internal matters for the individual countries. In this case, the MPT market operates independently of the specific structures or restrictions of national markets.

C.3 Status of Regional Market Initiatives

There are various important MPT-related initiatives that are ongoing or have been approved. Table C.3-1 summarises the more prominent ones, especially the ones that have been backed by regional frameworks under ASEAN.

Table C.3-1 Regional Market Initiatives

Project / Initiative Title	Types of Activities Included	Years	Funding Entity	Countries involved
APG MOU Extension	Extension of existing APG MOU signed in 2007	2007-2025		ASEAN
APG MOU/ Successor Agreement	Replacement/Renewal of existing APG MOU	2023 - 2025		ASEAN
TOR for APG-Related Bodies	Development of Terms of References for Institutional Arrangements of APG-Related Bodies by APG Taskforce	2023-2025		ASEAN
APAEC 2026-2035 Phase 1: 2026-2030	The preparation of the APAEC 2026-2035 Phase I by taking into consideration the various aspects of the implementation and progress of the APAEC Phase II: 2021-2025	2023-2025		ASEAN
AIMS III Phase 3	As per AIMS III Phase 3 TORs: 1) ETP Project Tender TOR_Output 3_work product 1 2) ETP Project Tender TOR_Output 3_work product 2 3) ETP Project Tender TOR333_Output 3_work product 3 TORs entail detailed analytical work in key areas: minimum requirements for multilateral market development, regulatory framework, grid code and technical standards. Such work will provide the detail on several action items identified in the present Roadmap.	2024-2025	ETP	ASEAN
The Study on the Roadmap for	Establish the roadmap recommendation for enabling MPT under the APG. On-going	2023-2024	ETP	ASEAN

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Project / Initiative Title	Types of Activities Included	Years	Funding Entity	Countries involved
Multilateral Power Trade in ASEAN	Study Development, expected to be delivered in June 2024			
ERIA/ACE Roadmap	Study on Intergovernmental Agreements in enabling MPT/APG institutions resulting in draft agreement & roadmap recommendation.	2023-2024		ASEAN
ACE/ADB RPM Concept Note	In the process of TOR and SoW finalisation of ACE for the ADB RPM study, including a pilot project involving a pilot of short-term energy trading. The project would also entail shadow trading to get the market participants familiar with the rules, processes, and benefits before the actual pilot stage. This activity would help to deepen regional integration by adding another market feature. This activity emerged from the GMS initiatives and has not yet been endorsed by ASEAN institutions.	2024-2025	ADB	ASEAN
USAID SPP projects	Focus on 2024: conducting 4 workshop/capacity building on topics related to Phase 3 work + 1 technical report on RE site assessment from AIMS III		USAID SPP	ASEAN
Workshop & Capacity Building with HAPUA (NREL COP GPST)	Plan to conduct four technical workshops in 2024 regarding power system operation topics with ASEAN Power System Operator & HAPUA WG 5			ASEAN
Regional RECs framework	Developing a regional RECs framework.		USAID SPP	ASEAN
Multilateral Power Trade Playbook	MPT playbook, drawing on LTMS-PIP experience, expected to be conducted latter part of 2024	2024-2025	USAID SPP	ASEAN
Regional market third-party access guidelines	AERN Working Group is collecting reference documents from AMS for guidelines development. Technical report on landscape assessment of TPA in ASEAN to be developed in collaboration with USAID SPP	2024-2025	USAID SPP	ASEAN

Project / Initiative Title	Types of Activities Included	Years	Funding Entity	Countries involved
Dispute Mechanism Development by AERN and IEA	Develop and discuss the draft dispute mechanism Propose and acquire agreement on the draft mechanism	2022-2025		ASEAN
Study on flexible resources, emerging technologies & DSM	The study is under development and is in collaboration with ERIA	2024-2025	ERIA	ASEAN
Memorandum of Cooperation between ACE and JICA	This is for sharing information and exchanging opinions to develop cooperative projects, including studies related to power connectivity in the ASEAN region, especially cross-border power transmission projects, and support for the formulation of energy strategies in ASEAN.		JICA	ASEAN
LTMS-PIP (Lao PDR to Singapore)	Multilateral power trade agreements amongst Lao PDR, Singapore, Thailand, and Malaysia	2022-2024		Lao PDR, Thailand, Malaysia, Singapore
LTMS-PIP (next phase)	Multilateral power trade agreements amongst Lao PDR, Singapore, Thailand, and Malaysia	beyond 2024/ TBD		Lao PDR, Thailand, Malaysia, Singapore
BIMP-PIP	An initiative involving Brunei Darussalam, Indonesia, Malaysia, and the Philippines to study cross-border power trade, enhancing sustainable energy security	2023 onward		Brunei Darussalam, Indonesia, Malaysia, Philippines
Lao PDR-Thailand Interconnection Upgrade/New	Plans to upgrade existing interconnections and adds 1 new interconnection. Upgrading process ongoing	post 2025		Lao PDR, Thailand
Lao PDR-Myanmar Interconnection	An MOU extension aiming for 600 MW capacity. Still at MOU extension phase	COD after 2030		Lao PDR, Myanmar
Thailand-Malaysia Interconnection Upgrade	Conducted FS aiming for COD by 2027 with enhanced capacity of around to 200–1,000 MW. Progressing towards discussion at Government level	COD by 2027		Thailand, Malaysia

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Project / Initiative Title	Types of Activities Included	Years	Funding Entity	Countries involved
Sumatra-P. Malaysia Interconnection	Progress in feasibility studies and plans for capacity enhancement from 300 MW to 1,500 MW by 2027. On-going process in establishing grant agreement (USTDA & PLN) & secondary agreement between (PLN & Delphos)	Studies started in 2023	USTDA	Indonesia, Malaysia
Sabah-Kalimantan Interconnection	Technical feasibility studies are ongoing. Joint Feasibility Study between SESB, PLN, and ACE, with USTDA support.	Studies started in 2023	USTDA	Indonesia, Malaysia
Sarawak-Brunei Interconnection	Established bilateral working group to assess the technical and commercial feasibility.	COD 2025		Brunei Darussalam, Malaysia
MOU between ADB and EMA Singapore	Support Singapore's efforts to decarbonise its power sector and import clean electricity		ADB	Singapore
Singapore-Indonesia Green Corridor	Renewable energy related projects in Riau islands (nearby islands around Batam)	2030		Singapore, Indonesia
Singapore-Vietnam Subsea cable	Proposed subsea cable project for RE imports to Singapore	after 2030		Singapore, Vietnam
Singapore - Cambodia Subsea cable	Proposed subsea cable project for RE imports to Singapore	after 2030		Singapore, Cambodia
Singapore-Sarawak Subsea cable	Potential subsea cable project for RE imports to Singapore	after 2030		Singapore, Malaysia
Energy Exchange Malaysia (Initial Phase)	Malaysia's first cross-border platform for selling renewable energy to neighbouring ASEAN countries.	2024		Malaysia, Singapore

C.4 Regional RECs

A core rationale of the APG-AP is that advancements in APG can help meet the region's growing energy demand, including demand for renewable energy, with optimal renewable energy resources. Physical cross-border interconnectors and MPT market models in ASEAN have the potential to increase RE penetration across the region by facilitating direct trade in electricity from RE resources, helping domestic power systems absorb higher levels of VRE penetration and enabling more efficient use of lower cost supply resources. Demand for RE generation is a key driver for potential enhancements to cross-border power trade in ASEAN.

However, the region lacks a sufficiently robust framework to attribute the Renewable Energy Credits (RECs) associated with RE produced in one country to electricity volumes purchased by or consumed in another country. It is not an issue for generator-to-foreign grid projects, for which the energy consumed and energy produced are directly linked. For grid-to-grid connections,

however, it is challenging to tie-in RE attribution. Cross-border RECs transactions on grid-to-grid lines are not currently recognised by international reporting frameworks, except for transactions in North America and the EU. Having internationally recognised frameworks in place for RECs attribution and trading on grid-to-grid ties would help MPT development and the transition to RE resources to happen in parallel in ASEAN. Otherwise, cross-border interconnectors and MPT may not directly facilitate renewable energy development, other than by improving national grid hosting capacity for VRE sources (wind and solar PV), although there may still be indirect environmental benefits from more efficient dispatch of supply resources.

Overview of RECs: A REC documents the renewable power attribute of one megawatt-hour (MWh) of electricity from renewable sources separately from the physical electricity. A REC documents several details on the attributes of the associated MWh of generation, such as location, time, generating entity, and fuel type used. Since each REC captures detailed attributes of the electricity generation, RECs allow electricity consumers (e.g. corporate buyers, utilities) to demonstrate evidence of clean energy delivery and, at the system level, to avoid double-counting.

The primary uses of RECs can be summarised as:

- Purchase of RECs by utilities to comply with regulatory requirements on RE targets: Renewable Portfolio Standards (RPS) or Renewable Portfolio Obligations (RPO). REC purchases by utilities to meet RPS or RPO requirements are sometimes referred to as "compliance RECs". In ASEAN, only the Philippines has a formal RPS. However, other AMS also have targets for RE generation or procurement. In the ASEAN context of state-owned utilities, these policy targets may have the same effect as formal RPS targets would for unbundled and privately-owned entities. Similarly, in Singapore, the EMA's 2 GW RE procurement could have the same effect.
- Voluntary purchase of RECs by corporations to meet their self-stated (voluntary) RE targets. This is a primary driver for RECs globally and in ASEAN. The Authors understand that utilities in several AMS are seeking to respond to demand for RECs and RE supply from their large corporate customers.
- Corporate accounting and disclosure protocols that include RE consumption, as well as other environmental attributes and broader greenhouse gas emissions.
- "Ambition frameworks" set by international organisations like RE100 and the Science-Based Targets initiative (SBTi) that offer guidance on procurement rules designed to add specific criteria to encourage corporations to deliver higher levels of impact through their renewables procurement.

Transaction Structures: RECs can be traded either "bundled" with or "unbundled" from the physical electricity they represent. In bundled transactions, buyers purchase RECs together with the electricity generated from specific renewable sources. These transactions typically occur through mechanisms like power purchase agreements (PPAs) with designated power plants, self-consumption or net-metering schemes for rooftop solar, and bundled green tariffs offered by utilities, as seen in Thailand and Vietnam.

In unbundled or "certificate-only" transactions, RECs are sold separately from the electricity they represent, often through brokers, traders, or exchanges. In this case, buyers purchase RECs independently of their electricity supply, aiming to match the number of RECs with the number of MWh of electricity consumed.

Both bundled and unbundled REC transactions can occur in domestic or cross-border power trading. However, bundled cross-border transactions are much simpler when involving direct generator-to-foreign grid connections. In contrast, both bundled and unbundled transactions across interconnected grid systems (grid-to-grid) are more complex and are generally not recognised under international best practices.

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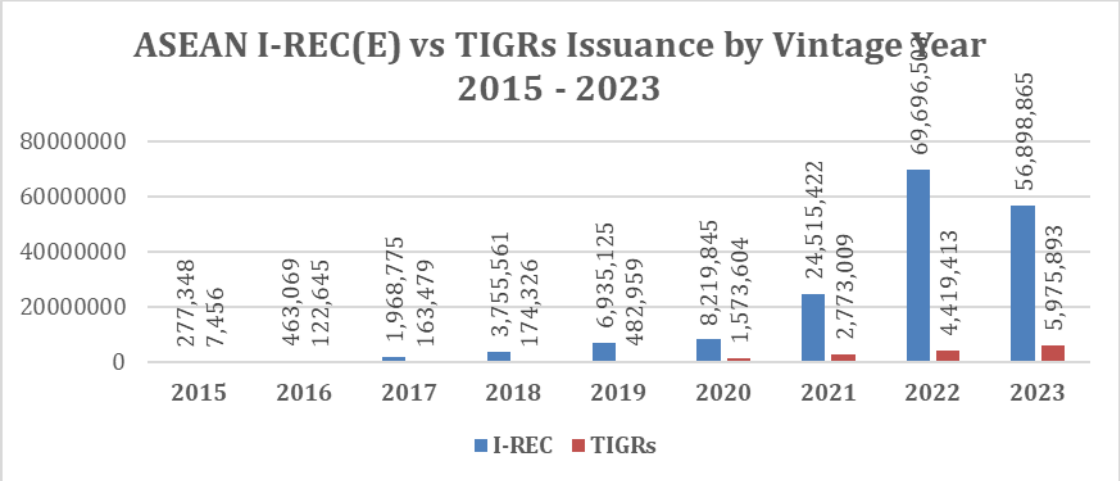
Current Status of RECs in ASEAN: Most AMS already have active domestic REC markets based on credible standards, and government involvement in these markets has grown significantly. For instance, Thailand has appointed the Electricity Generating Authority of Thailand (EGAT) as its designated Local Issuer for RECs, and Malaysia was expected to make a similar appointment by 2024. Several other ASEAN nations, including Lao PDR and Indonesia, are also advancing discussions on REC market structures.

National REC frameworks are becoming increasingly robust. Singapore, for example, introduced the Singapore Standard (SS) 673: Code of Practice for Renewable Energy Certificates (RECs) in 2021. Industry experts anticipate that at least two other ASEAN countries will soon release similar national frameworks.

Figure C.4-1 Growth in RECs Issuance in ASEAN: 2015 - 2023



Source: SuSca Group.
Note: I-TRACK Standard Foundation and APX[45]. Issuance of 2023 vintage is ongoing at the time of writing.

Need for a Regional RECs Framework: Robust REC) frameworks and credible standards are essential to ensure that REC transactions are recognised by both national and international reporting bodies. In ASEAN, national-level buyers of RECs are likely focused on satisfying the requirements of their respective national reporting bodies. However, many corporate RE buyers operating in the region are multinational companies adhering to international reporting standards. For these companies, it is crucial that the RECs they purchase are recognised on a global scale.

Moreover, some ASEAN countries have set ambitious RE targets and aim to showcase leadership in this area internationally. Utilities and domestic entities within these countries are also expected to follow more stringent international reporting frameworks to meet these objectives.

International reporting frameworks tend to view unbundled REC transactions as less credible and ambitious compared to bundled transactions. This perception stems from the higher degree of clarity in REC attribution and verification in bundled structures. Furthermore, bundled transactions are seen as more ambitious because they mobilise financing for RE projects, typically through PPAs that include RECs. As a result, prominent corporate renewable energy buyers, many of whom are active in ASEAN, prefer bundled transactions, particularly for cross-border electricity deals (generator-to-foreign grid projects).

Despite the growing issuance of RECs in ASEAN, the current frameworks are insufficient to support cross-border REC trading based on grid-to-grid power transactions. Presently, international reporting frameworks only recognise cross-border REC transactions between countries in North America (US and Canada) and within the EU. In these regions, buyers in one

[45] I-TRACK Standard Foundation. "*2024 I-REC(E) Market Statistics – April*", 2024. See here.

country can purchase unbundled RECs from another country and still have them recognised. Although cross-border REC trading on grid-to-grid transactions does take place outside of North America and the EU, such transactions are not recognised by international reporting bodies.

Therefore, ASEAN must develop more stringent and robust regional REC frameworks that align with international standards, such as those in North America and the EU. Without such recognised frameworks, large-scale REC buyers, whether utilities or corporates, will be limited to procuring RECs from domestic sources or through cross-border generator-to-foreign grid transactions. The absence of internationally recognised regional REC frameworks will significantly hinder the potential for corporate demand to drive the advancement of the ASEAN Power Grid (APG) and Multilateral Power Trade (MPT).

Next Steps for Aligning RECs Trading with Advancements in APG and MPT: Developing an internationally recognised regional REC framework for ASEAN is likely to be a complex and lengthy process. As previously mentioned, unbundled RECs traded on cross-border lines are only recognised by international reporting bodies for transactions within North America and the EU. The next steps for aligning cross-border unbundled REC trading in ASEAN with progress towards MPT involve drawing from the EU's institutional and regulatory power sector frameworks, which have contributed to their acceptance by international reporting bodies.

By adapting similar frameworks, ASEAN can work towards creating a regional REC market that is credible, internationally recognised, and supportive of both cross-border power trade and renewable energy targets within the region.

- Shared energy sector regulations: Although regulatory harmonisation in ASEAN is an ongoing activity supported by many development partners, complete alignment may not be realised in the near-term. Activities in the area should focus on aligning regulations between the AMS, at least as it pertains to power trade. Parallel engagement with global reporting bodies on what regulatory aspects require alignment, backed by evidence, may also be important. CDP (formerly known as the Carbon Disclosure Project) and RE100 (a global corporate RE initiative) published a technical working paper in November 2023, establishing conditions for recognising the credibility of cross-border transactions: bilateral government approval of movement of electricity and RECs between nations, physical transmission of electricity that can be verified, uniform RECs tracking instrument between trading partners, and bilateral agreement on carbon accounting practices.[46] The bilateral agreements set as conditions by CDP and RE100 refer to the simplest model of cross-border power trading. By extension, the credibility of RECs traded as part of multilateral cross-border transactions requires similarly robust conditions to be met at the multilateral level.
- Uniform adoption of REC standards: As previously noted, there are common RECs standards in ASEAN that buyers and sellers can follow, such as I-REC Standard and TIGRs. However, these are commonly used standards developed by individual organisations. Some ASEAN countries also have increasingly robust national frameworks. Discrepancies between national standards may create barriers for international acceptance of regional frameworks. Therefore, it is important to work toward greater alignment between national frameworks to ensure that regional frameworks governing RECs trading based on grid-to-grid power trade receive international recognition.
- Regional governance of best practices: In the EU, a regional governance body supports the participation of national-level market participants (buyers, sellers, issuers) in the regional REC market. This has contributed to greater market harmonisation and stability. A core structural difference between the EU and ASEAN is that the EU is considered to have a single market boundary, due to shared energy sector regulation. The role and mandate of a similar

[46] CDP. *"Accounting for Cross-Border Renewable Energy Trade CDP Working Paper"*, November 2023. Can be found here.

regional body would be necessarily different in ASEAN. However, establishing an entity that helps to develop a framework for greater market harmonisation by helping all market participants adopt international best practices would be easier to achieve than establishing a single market in ASEAN. The regional body could work with a designated issuer in each AMS to implement and enforce agreed-upon standards and manage domestic registries.

- Inter-linkages between policy documents: Standardised operational rules for RECs market organisation and implementation were first laid out in 2009, in the European Energy Certificate System (EECS), a voluntary guidance. The CEN 16325 Standard was later introduced to mandate rules for reliable and accurate domestic systems. A similar guidance document for the ASEAN region that the AMS could adopt for national RECs market oversight can make regional cross-border power and REC transactions more credible and internationally recognised.

In addition to the preceding, the Authors propose the following approach that is not based on the EU approach, but may represent a viable strategy for implementation in ASEAN.

- Enable bilateral and subregional frameworks to proceed: Historically, ASEAN institutions have been inclined to proceed on a consensus basis. However, it is important to recognise that progress in getting international recognition for bilateral cross-border grid-to-grid RECs transactions would still be a major step forward. It would also drive similar agreements between other countries or expansion of bilateral agreements into multilateral ones. Further, not all countries are likely to trade directly with each other in the near-term (e.g. Indonesia-Vietnam). Therefore, the Authors believe that supporting RECs frameworks between countries or subregions connected by grid-to-grid interconnectors, based on economics, is important. Over time, a regional governance body can work towards greater harmonisation.

C.5 Legal Steps

This section first characterises the legal *status quo* regarding regional MPT development, and then summarises the key legal steps required to implement potential MPT development pathways.

Legal matters are discussed here in three categories: intergovernmental agreements, being those at the highest level; market-level agreements (may involve intergovernmental agreements), and dispute resolution, as a cross-cutting topic that requires multiple layers of treatment, depending on the nature of the dispute.

C.5.1 Intergovernmental Agreements

Agreements amongst the AMS at the governmental level, critically important to document political will, also constitute the highest-level and most fundamental legal requirement for MPT. These agreements can take the form of treaties, protocols, agreements, memoranda of understanding (MOUs), and joint statements, amongst others.

In international law, the hierarchy of authority and binding nature of various agreements can be broadly categorised. At the top of this hierarchy are treaties, which are formal written agreements between sovereign states or international organisations. Treaties, also known as conventions or agreements, are legally binding upon ratification by the signatories and are governed by the principles laid out in the Vienna Convention on the Law of Treaties.[47] Protocols often serve as supplementary agreements that amend or add to existing treaties, carrying the same binding legal force once ratified.

[47] United Nations Forum on Forests, *"An Overview of International Law Working Draft"*. 2004. The source provides a lengthy and authoritative treatment of the topic in a general sense, notwithstanding its ultimate focus on forests.

The hierarchy of international agreements, from most to least binding, plays a crucial role in the context of ASEAN's efforts to advance MPT. Understanding the different levels of commitment and legal enforceability is essential when analysing the agreements that have been or may be proposed by ASEAN.

At the top of the hierarchy are **treaties** (including **protocols**), which are legally binding and enforceable under international law. These are the strongest forms of commitment between states, often requiring formal ratification and adherence to established obligations. **Protocols**, usually supplements to existing treaties, carry the same legal weight and are used to add specific provisions or clarify aspects of an earlier treaty.

Below treaties and protocols are **agreements**, which are also legally binding but may not require the same level of formal ratification. These are often used for more specific areas of cooperation, providing a legal framework without the full complexity of a treaty.

Moving further down, **declarations** are non-binding but express the intentions or positions of the parties involved. These are often issued at international conferences or summits, and outline shared goals or principles without imposing legal obligations.

Next are **Memoranda of Understanding (MOUs)**, which are formal documents that outline the intention to cooperate on specific issues, but are not legally binding. MOUs express a commitment to work together without imposing the same legal obligations as treaties or agreements, making them a common tool for preliminary cooperation.

At the bottom of the hierarchy are **joint statements** or **communiqués**, which are informal expressions of mutual understanding or agreement. These do not create binding commitments and primarily serve as diplomatic tools to convey shared perspectives or intentions on certain issues.

In ASEAN's MPT development, the use of protocols, agreements, and MOUs has been instrumental in advancing cooperation. Protocols and agreements provide the legal structure for formalised regional power trade, whilst MOUs serve as the groundwork for more flexible, preliminary cooperation between member states. Table C.5-1 details both the existing arrangements and proposed initiatives, indicating the degree of formality and legal commitment involved in each case.

This structured approach ensures that as ASEAN progresses towards MPT, there is a balance between binding commitments and flexible cooperation, allowing member states to gradually build towards more advanced and integrated power markets accepted by international reporting bodies.[48]

Table C.5.1-1 Effective and Proposed Intergovernmental Agreements

Name	Brief Summary	Status
ASEAN Protocol on Enhanced Dispute Settlement Mechanism	Agreed in 2012, this protocol establishes a dispute resolution process for disputes amongst AMS involving a set of "covered agreements". The protocol is not specific to MPT, but could be relevant for dispute resolution efforts for MPT in ASEAN.	Effective
APG MOU	The MOU for ASEAN Power Grid signed in 2007 extended until December 2025	Effective

[48] Few proposed protocols, some of which have yet to be drafted, were shared with the Authors. The "Brief Summary" entries are left blank for such proposed protocols.

Name	Brief Summary	Status
APG Successor Agreement	ASEAN Framework Agreement for Power Trade under the ASEAN Power Grid. The Successor agreement to renew/update existing APG MOU. Note that there have been discussions amongst AMS as to whether a Framework Agreement versus and MOU would be the best way to proceed.	Proposed
TOR for Related APG Bodies	Terms of Reference for Institutional Arrangements of APG Related Bodies	Proposed
Protocol 1: Grid Code for Interconnectors	Framework Guidelines for ASEAN Power Grid	Proposed
Protocol 2: Wheeling Charge Methodology	Guidelines for Wheeling Charge Methodology	Proposed
Protocol 3: Third-Party Access	Guidelines on Third-party access rules	Proposed
Protocol 4: Capacity Allocation Methodology		Proposed
Protocol 5: Data and Information Sharing		Proposed
Protocol 6: Platforms and Settlement and Payment Mechanism		Proposed
Protocol 7: Dispute Resolution		Proposed
Protocol 8: Institutional Arrangements for Interim “Regional Coordinator”	A charter for a multilateral AMS regulatory body (AMSRB) which will oversee multilateral markets	Proposed
Protocol 9: Institutional Arrangements for Generation and Transmission Planning	To establish ASEAN Power Grid Generation and Transmission System Planning Institution (AGTP)	Proposed
Protocol 10: Institutional Arrangements for System &/or Market Operations	To establish ASEAN Power Grid Transmission System Operator Institution (ATSO)	Proposed
Intergovernmental Agreements	The Intergovernmental Agreement (ERIA Work) is to define the steps to be taken by the ASEAN governments to implement the two institutions required to advance the ASEAN Power Grid, the APG Generation and Transmission Planning function (AGTP) and the APG Transmission System Operator function (ATSO).	Proposed
Protocol on Regional Generation & Transmission Infrastructure Planning		Proposed

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Name	Brief Summary	Status
Protocol on Regional Project of Common Interest		Proposed
Energy Purchase and Wheeling Agreement (EPWA)	Energy Purchase and Wheeling Agreement (EPWA) with Malaysia as purchaser and Willing buyer-willing seller basis	2018-2021 (LTM 1.0 and 2.0)
Energy Wheeling Agreement (EWA)	Energy Wheeling Agreement (EWA) with Malaysia as wheeler	2022-2024 (LTMS)
LTMS Energy Wheeling Agreement	Agreement between the three utilities; Électricité du Laos (EDL), Electricity Generating Authority of Thailand (EGAT) and Tenaga Nasional Berhad (TNB);	2022-2024 (LTMS)
Supplemental Letter to HVDC System Interconnection Agreement (SIA)	Supplemental Letter to HVDC System Interconnection Agreement (SIA) between EGAT and TNB. SIA between EGAT and TNB remains effective.	2022-2024 (LTMS)
Fifth (5th) Supplemental Agreement	Supplemental Agreement to Interconnection Agreement (IA) between TNB and SP Power Assets (SPPA). IA between TNB and SPPA remains effective.	2022-2024 (LTMS)
Supply Agreement between EDL and Importer in Singapore	Corporate PPA between EDL and Singapore Corporate Importer	2022-2024 (LTMS)

C.5.2 Key Market-Level Agreements

This topic is addressed very well at a high-level in the IEA report, *"Establishing Multilateral Power Trade in ASEAN"*, both as to the overall recommended approach, and as to the nature of the agreements themselves.[49] Regarding the overall recommended approach, the IEA report says:

> *"In the ideal case, a package of agreements would be developed covering all relevant topics and including all ten AMS. At the start, however, the signers of the relevant agreements could be limited to subsets of AMS. Even in such a case, however, this package of agreements should be developed in an open, inclusive manner that allows AMS stakeholders (including, for example, national utilities and system operators, transmission owners, and IPPs) to contribute even if they do not initially sign on or are not initially allowed to participate."*

Some of the specific regional market documents required could include agreements on connection and usage, market participation, and transmission licenses.

The general approach to establishing sensitive requirements, such as data access and handling, market oversight, market security – how much money market participants must post with the market operator to backstop financial obligations – and complex methodologies, such as those for ATC values, firm/non-firm transmission rights, wheeling charge establishment and reset

[49] International Energy Agency, *"Establishing Multilateral Power Trade in ASEAN"*. 2019. pp 76 – 78.

timelines, should be documented at as high an international legal level as possible, ideally through protocols.

Such protocols should be based on principles and identifying objectives, rather than being prescriptive as to methodology. As noted in the previous IEA excerpt, it is not absolutely required that all AMS sign on to all relevant protocols. The more detailed the protocols for a given MPT market, the more difficult it could be to achieve agreement.

Two examples of agreements that should be addressed at the intergovernmental agreement level, but which would be expected to be agreed only amongst the AMS market members for a given market, are: (i) a "common use" infrastructure development and financing mechanism; and (ii) market institutional fees.

Regarding a "Common use" infrastructure development and financing mechanism, as discussed in *Section 5 "Financing Plan"*, considerable investment in transmission infrastructure may be required on some cross-border interfaces and within some national markets to facilitate higher levels of grid-to-grid energy flows. Yet, it is not clear that the relevant utilities have the incentives or perhaps resources to make the investments in these types of projects.

The standard approach to develop and finance such projects is to designate them "common use", i.e., for the benefit of all market participants, and to finance them through charges committed to be paid by market members.[50]

Market institution fees are intended to cover costs involved in setting up and running power markets. These costs tend to be relatively modest by comparison to the costs of building cross-border transmission infrastructure, but since arrangements require payment by market members both on an upfront and on-going basis, developing a budget and a fee collection mechanism can be challenging.

A critical requirement is that market members should not be permitted to exit the obligation to pay fees too easily, such as by simply stating they are exiting the market, since this requires all remaining market members to pay higher fees. Usually, market institution costs are recovered through a non-circumventable surcharge on market transactions.

The overall approach to fees might be addressed in a regional (ASEAN-wide) or subregional protocol at a high level, as well as at the level of the market institutional constitution and market membership agreement. Arrangements should explicitly specify the dispute resolution approach regarding fees, which might involve binding international arbitration. It is recommended to investigate approaches taken elsewhere regarding market institutional fees.

Some legal market documents might be unique to a given national market. If national electricity sector laws or regulations require *any* participant in the national market to execute relevant agreements (e.g. a transmission license, marketing license, etc.), it may be practical to accept such requirements, so long as they do not unduly discriminate against external parties.

The practical consideration resides in the need to balance the objectives of achieving an absolutely level playing field for MPT, with the challenges that can come with amending existing national laws and regulations.

An important topic that should be addressed early in the market design process for a given market is which national law to use for key market agreements. Whilst dispute resolution provisions should in all cases specify the law under which dispute resolution will occur, it is common for documents to state upfront the governing law.

[50] The SIEPAC market, which includes a 230 kV purpose-built common use transmission line linking all six member countries, may merit examination as a model regarding documentation and approach for multinational common-use infrastructure arrangements. Approaches take in other sectors could be examined as well, such as international transport.

Since a variety of market developments will be required, and since it is possible that some AMS may prefer not to use the law of another AMS for this purpose, it is recommended that the governing law be agreed at the outset for those documents that are not strictly national level.

This topic can be addressed under an AMS-wide protocol, a protocol amongst those AMS participating in the regional market, or even potentially through statements by all or some AMS.

Relatedly, some AMS utilities prefer for complex documents to be translated and for the binding language to be the local language, which could complicate the process of MPT agreements. It is recommended to assess whether such preferences reflect national laws or regulations.

C.5.3 Dispute Resolution

There is a tendency amongst politicians and policy makers to regard dispute resolution as something that, though important, is best addressed once all other matters are agreed, and in general terms rather than in specific terms. After all, most disputes can be resolved well before the need for a binding ruling on a disputed matter. Within ASEAN, there is a belief in consensus-based and low-key approaches to managing disputes.

For those involved in the development and financing of infrastructure projects, or indeed for those involved in anything involving considerable investment, having an acceptable dispute resolution mechanism is a basic requirement. When finance practitioners speak of whether a project is "bankable," for instance, one of the features of particular interest is the dispute resolution language embedded in the transaction agreements.

Whilst various approaches can be taken to resolving disputes, what is ultimately required for project bankability for MPT is a means to definitively resolve those disputes for which such approaches fail, and to enforce binding decisions.

Achieving an adequate dispute resolution mechanism for MPT in ASEAN is complicated by several factors:

- There is a need to deal with multiple countries that could be parties to a dispute and indeed, could be the disputing parties themselves. By contrast, for an infrastructure project, disputes involving a national government normally would be between private-sector parties (or development banks) and the host-country government. When the national government is perceived as too untrustworthy or high-risk by project lenders, the national government might be required to forego sovereign immunity and agree to binding international arbitration in a neutral jurisdiction in order for the project to secure financing. Many countries have, for various reasons, adopted policies prohibiting sovereign guarantees, waiver of sovereign immunity, or binding international arbitration.[51] In such cases, lenders and equity investors either need to accept undertaking the project under local law without binding international arbitration, or accept binding arbitration without the means to enforce a binding ruling. However, for MPT in ASEAN, it may be politically unacceptable for some AMS to submit to the legal jurisdiction of another AMS in the context of dispute resolution.
- There is the potential for high-cost disputes in MPT. For instance, if a given market member country failed to implement a critical common-use transmission project or to maintain its grid to allow adequate ATC, it could impose significant costs on other national and private participants in the market.
- Whilst power infrastructure project agreements might last 10 years to 30 years, MPT agreements need to last indefinitely, especially when it comes to basic structural features, such as dispute resolution.
- Energy is a highly strategic industry, which elevates the level of attention at political levels for energy-related multilateral endeavours.

[51] Further legal review would be required on this topic as part of developing a dispute resolution mechanism.

- MPT is exceptionally complex. The range of potential disagreements is wide, and as previously mentioned, the monetary value of disputes can be quite high.

Reflecting the aforementioned factors, the dispute resolution mechanism should be understood as a driver for evaluation of MPT market design choices, not an afterthought that is bolted onto whatever market design has previously been elected. Thus, for instance, if a potential market structure would require a well-developed regional regulatory structure and established case law to function, then that market would not be appropriate for ASEAN on that basis alone, since it would not be possible to develop a functional dispute resolution in ASEAN for that market.

Different approaches are taken in existing multilateral power markets, as summarised here.[52]

- EU markets (but not Nord Pool). The Energy Charter Treaty, which entered into force in 1998, provides a multilateral framework for energy cooperation. There are currently fifty-three Signatories and Contracting Parties to the Treaty, including all members of the EU. The Treaty, which only addresses inter-state disputes rather than disputes involving other parties, establishes that UNCITRAL Arbitration Rules apply unless national parties to the dispute have agreed otherwise. It appears likely that the EU is in the process of withdrawing from the Treaty. It is not clear whether this would void the Treaty for country-signatories as opposed to other bodies such as the EU.[53] It appears that EEX and EPEX energy exchanges are incorporated under national laws (Germany and France, respectively). In assessing the relevance of the dispute resolution approach taken in the EU, apart from confirming the Treaty's status, it is important to bear in mind that the EU is more like a country with constituent states than it is like the distinct member states of ASEAN. This is especially so as it relates to energy markets, given that such markets are governed by the Electricity Directive, under the European Parliament. The willingness of market participants to accept the jurisdiction of a specific country within the EU should be appreciated in this context.
- SAPP: Officially, disputes are settled by the Southern African Development Community Tribunal, whose members include SAPP members. The Tribunal was suspended in 2010, and remains suspended. It is unclear whether there is any dispute resolution mechanism at all. If there is no dispute resolution mechanism, then the overall success of SAPP, including since 2010, would beg the question: how important can dispute resolution be if lack of a dispute resolution mechanism does not cause the market to fail? The Authors speculate that three factors may reduce need for dispute resolution for SAPP. First, SAPP's "hub and spokes" market topology reduces scope for potential disputes in one of the thorniest areas for MPT – ATC calculation and allocation. Second, there was sufficient time after SAPP's formation to resolve ambiguities and make agreements specific enough that the potential for disputes is acceptable to market participants. Third, and related to the first and second factors, once SAPP's members had already joined and benefitted from trading, countries may have assessed the cost of withdrawing because of lack of a dispute resolution mechanism as too high.
- WAPP. The dispute resolution replicates the approach under the Energy Charter Treater for the EU. That is, it points all inter-state disputes to UNCITRAL arbitration unless the parties agree otherwise. Since the market has yet to begin meaningful functions, it is difficult to assess with respect to its dispute resolution approach.

[52] The following source, which is authoritative and topical on dispute resolution in the MPT context in general, also informed summaries of EU markets (not including Nord Pool, which is not discussed in the source), and recommends an inter-state dispute resolution mechanism that should be examined in detail for potential applicability in ASEAN. Lee, Kevin, *"Study to Develop a Template for a Dispute Settlement Mechanism between SAARC Member States regarding the Interpretation and Implementation of the SAARC Framework Agreement for Energy Cooperation (Electricity) Prepared for the SAARC Energy Centre and SAARC Arbitration Council, Islamabad,"* December 2017.

[53] Source: https://www.europarl.europa.eu/news/en/press-room/20240419IPR20549/meps-consent-to-the-eu-withdrawing-from-the-energy-charter-treaty

- SIEPAC.[54] The market and several of its institutions were created by a treaty (the "Tratado Marco" or "Framework Agreement") ratified by market member countries. The Regional Electrical Interconnection Commission (CRIE) created by the treaty is the regulator for the market, with binding dispute resolution power and punitive authority. These powers and authorities pertain to all market disputes, except for those disputes that are both state-to-state and pertain to interpretation of the treaty itself, not in relation to market rules.[55] Such state-to-state disputes would be referred to the Central American Court of Justice, which has not developed a specific approach to such disputes. An important perceived weakness of the SIEPAC market design and implementation is that the CRIE is not sufficiently independent or powerful in a practical sense, and has not enforced rules.
- Nord Pool. The approach taken in this market is unique and reflects the history of Nord Pool's formation. Norway has never joined the EU. The 1996 EU Electricity Directive, amongst other things, mandated EU member states to provide cross-border market access, that is, it required EU national markets to take steps to form regional markets. Sweden and Finland joined the EU in 1995. Nord Pool was formed in 1996, with Norway and Sweden as members, with Finland joining in 1998 and Denmark (the fourth Nordic country) joining in 2000. In 2005 and 2010, Nord Pool expanded to Germany, and in 2010 to the UK (which at the time was an EU member). Thus, for the first 14 years of its existence, Nord Pool involved one non-EU country and several EU countries. The dispute resolution approach, which involves binding arbitration in all unresolved cases, depends on which law members have opted into upon joining Nord Pool,[56] as follows: "If Norwegian law, by arbitration in accordance with, the Norwegian Arbitration Act of 14 May 2004 nr 25, with the seat in Oslo, Norway. If under English Law, by arbitration under the LCIA Arbitration Rules, which rules are deemed to be incorporated by reference into this clause. The number of arbitrators shall be three. The seat, or legal place, of arbitration shall be London. If under German law, arbitration by the German Institution of Arbitration (DIS) and decided according to its rules, "ousting the jurisdiction of the ordinary courts"." It is unclear how governing law and approach would be determined if the dispute involves parties that entered under different laws. It is believed, however, that the different national laws pertain to the different subregional markets that Nord Pool operates, such that disputes across one of those markets to another market would be rare or impossible. In any case, it is important to bear in mind that the named arbitration venues are well-regarded and reasonably insulated from political pressures. It is difficult to envision a similar approach being workable in the ASEAN context.

In considering dispute resolution approaches for MPT in ASEAN, it bears considering ASEAN-specific factors by contrast to factors and approaches in other MPT markets. For instance, approaches taken within the EU stand upon a pre-existing overarching energy dispute resolution structure (the Energy Charter Treaty), and an EU-wide Electricity Directive under a quasi-federal structure that sets overall electricity market requirements.

Nord Pool benefits from these structures as well (only Norway as a founding member was not in the EU). There was a high level of electricity sector institutional trust across the EU that had existed for many decades before multilateral markets formed there. These factors do not obtain in ASEAN.

[54] One of the Authors has worked in and consulted extensively in relation to Central American markets, including for the IEA's MPT in ASEAN study.

[55] The Lee study asserts the Marco Treaty "would only provide a mechanism for disputes between market agents, and not State-to-State disputes." This is incorrect, in part. The only member state issue is with respect to interpretation of the treaty itself; all other issues reside with the CRIE. Also, market agents include the national utility companies, national system operators, etc.

[56] *"General Terms – Nord Pool"*, effective September 2021.

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One promising feature that exists within ASEAN is the ASEAN Protocol on Enhanced Dispute Settlement Mechanism, agreed in 2012. This protocol establishes a dispute resolution process for disputes amongst the AMS. Final decisions, which are not strictly binding, are in relation to disputes involving 46 "covered agreements," including the "*Protocol Amending the Agreement on the ASEAN Energy Cooperation, Kuala Lumpur, Malaysia, 23 July 1997*".[57]

In principle, the ASEAN Protocol on Enhanced Dispute Settlement Mechanism seems a good foundation for national-level dispute resolution amongst AMS in relation to MPT markets in ASEAN, which would require bringing relevant MPT market agreements into the covered agreements list, and may require other enhancements to cater to MPT requirements.

For dispute resolution involving MPT in ASEAN, several main types of disputes may be distinguished, for which different approaches may be appropriate, as tentatively proposed here:

1) Design stage. The approach might involve multiple tiers of escalation from the working group level, through senior officials, and then to ministries. One basic question is which AMS countries should have the ability to participate in resolution of a dispute at the design stage for a market that does not involve them. For instance, should the Philippines be able to dispute a market design issue for LTMP-Plus PIP?
2) Operational stage:
    a) Amongst AMS members of the market, and only for those disputes hinging on interpretation of provisions of any intergovernmental agreements established to enable MPT in ASEAN, the dispute resolution mechanism should balance the legitimate interests of AMS to retain national autonomy with the necessity of achieving a definitive and binding resolution of the matter at hand. It is possible that the structure embedded in the ASEAN Protocol on Enhanced Dispute Settlement Mechanism could be appropriate; and
    b) For disputes amongst market participants, including national utilities, and potentially including AMS, binding internation arbitration under an accepted international arbitral body such as UNCITRAL is recommended. English law, or potentially Singapore law is recommended as the language for market agreements, as these are both well-established and tested national laws that serve internation trading arrangements well. A three-member panel seated in a neutral jurisdiction outside of ASEAN is recommended.

Thus, under the provisionally recommended approach, a government could become subject to binding arbitration if there are insufficient grounds for dispute on relevant intergovernmental agreements. To avoid disputes in the first place, it will be important to focus on developing clear market rules, with adequate mechanisms to adjust rules fairly going forward, as circumstances change. It will also be very important to include multiple formal alternative dispute resolution steps so that visibility on disputes can be gained and an opportunity for political resolution of disputes can emerge, before disputes arrive at the binding arbitration stage.

It is imperative that any system of dispute settlement for MPT in ASEAN must be sufficiently nimble to cater for ASEAN attitudes and preferences.[58] This is particularly so in the State-to-State context, where dispute settlement is predicated on consent and based on the willingness of a party to participate in the dispute settlement process. Incorporating the ASEAN context and culture in a dispute resolution mechanism would enhance the chances of quick and acceptable resolution of MPT disputes, as well as increase the likelihood of compliance with any binding decision.

In this regard, a deeper look at the various dispute settlement preferences indicates that all AMS share overarching preferences arising out of ASEAN regional culture: informality and flexibility,

[57] It is noted that the covered agreements do not include any agreements dated after 2004. It is recommended to investigate why this is the case.

[58] The discussion reflects input from Kevin Lee, a dispute resolution expert who has been published on the topic of dispute resolution in MPT settings. See footnote 52.

respect for authority figures, importance of relationships, and social harmony, avoidance of confrontation, and saving "face". It is therefore critical for the appropriate MPT dispute settlement system to provide avenues for such features of ASEAN culture to be built into the process of dispute resolution.

In this regard, the ASEAN Protocol on Enhanced Dispute Settlement Mechanism stands as a useful example of what kind of dispute resolution mechanism might be acceptable to the AMS. However, this protocol is a general one in nature, and in our view does not sufficiently grapple with several important details as previously noted, especially in the area of MPT. Consequently, special effort needs to be dedicated to designing an MPT dispute settlement mechanism that is built-for-purpose, and specific to the subject matter of MPT.

Based on research to this point and the Authors' assessment that little specific work has been conducted on potential dispute resolution approaches for MPT in ASEAN, it seems clear that considerably more work required is required in this area.[59]

C.6 Donor Coordination

Several donor agencies and other development partners (referred to as "donors" as a group) are engaged on MPT in the ASEAN region, working with regional and national stakeholders. Donor-funded projects and initiatives in the power sector, as well as other related sectors like water, climate policy, and economic development, are directly or indirectly supportive of APG objectives. Donors have different mandates, funding mechanisms, and approaches to working at national vs. regional levels. Given the breadth of national and regional stakeholders, as well as donor programmes involved, donor coordination is necessary to ensure support from donor organisations is efficient and effective.

The objectives of donor coordination are:

5. Facilitate information sharing: Inform national and regional bodies, as well as private sector partners, on different donor agencies' programmes and activities, both current and planned; focus sectors and countries; types of support provided; and engagement processes.
6. Improve efficiency of donor support: Whilst some overlapping of activities may be inevitable, providing clarity on what areas of work or initiatives are already supported can help donors design their programmes more effectively. The efficiency improvement benefits are likely to be realised gradually, since many donors may already have multi-year programmes and activities budgeted and underway.
7. Identify gaps in funding support and facilitate partnerships: If some work areas need additional funding support from development partners, it is helpful to identify what the gaps are to inform engagement with donors for potential *ad hoc* support or longer-term strategic partnerships.
8. Consultative Partners Forum: A regularly convened forum where national and regional stakeholders, and donors can meet to discuss progress and challenges on projects supportive of MPT in ASEAN. The forum would also be helpful to continuously update activities and share lessons learned.

[59] The following source suggests work on the topic of dispute resolution for South Asian regional power markets may have been initiated recently. This work should be relevant as well for ASEAN. https://sarepenergy.net/wp-content/uploads/2023/11/TOR-of-the-Knowledge-Study-on-Regional-Dispute-Settlement-Framework-and-Mechanism-for-Advancing-CBET-in-SA-by-Rajiv-Panda-PMS-SAREP.pdf.

9. Coordinating Entity: A regional body, such as ACE, that works closely with various donors and national stakeholders should be responsible for leading coordination efforts.

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Annex D: Existing and In-Progress Transmission Projects

The table below presents information about existing and in-progress transmission projects as of June 2024. There were multiple data sources. These included the *AIMS III Phases 1 and 2 Summary Report*, with recommendations for 18 priority APG transmission projects ("18 Projects" list), an updated APG Map produced in January 2024 by ACE (showing the 18 Projects in more detail), presentations by AMS delegations at HAPUA events, discussions with stakeholders and utilities, open-source research, and others.

The approach was based on the objective of providing a "best guess" about projects based on limited and frequently conflicting information. Where there is definitive information, or at least some information, a value is provided for each item. If there is little to no information, the value is left blank. Where information was especially conflicting or seemed implausible, "TBC" is added to indicate that that information should be confirmed. However, all information in this table should be confirmed by AMS utility representatives.

The AIMS III Phases 1 & 2 Summary Report generically lists projects by interface only. Thus, there may be multiple projects on a given interface that are covered by the same number in the 18 Projects list. The APG Map produced by ACE breaks out projects being tracked on different interfaces.

The table notes in various instances whether a particular project should be removed from the 18 Projects list. Where more than a single project is shown for a given interface, the recommendation applies only to that specific project. Projects that exist on a given numbered interface that is not specifically identified in the APG Map are listed by the corresponding interface number for ease of reference, since the AIMS III 18 Projects list does not break out specific projects.

Explanations of those column headings that are not self-explanatory include:

- "SN" stands for "Serial Number" and is used to quickly identify specific projects.
- The "AIMS III Project Number" corresponds to the number a project was given in the AIMS III study.
- "Ckts" stands for the number of circuits for a project.

Table D-1. Existing and In-Progress Transmission Projects

SN	AIMS III Project Number	Project Name, and Notes	From Country	To Country	From Substation	To Substation	Voltage (kV)	Ckts	Project Type	Existing Rating or Planned Capacity (MW)	Technology	Distance (km)	Entry Date
1	1	P. Malaysia - Singapore	West Malaysia	Singapore	Plentong	Senoko / Woodlands	275		Grid to Grid	1050	HVAC	15	2022
2	2	Thailand – P. Malaysia	Thailand	West Malaysia	Sadao	Chuping	115/132	1	Grid to Grid	80	HVAC	25	1981

SN	AIMS III Project Number	Project Name, and Notes	From Country	To Country	From Substation	To Substation	Voltage (kV)	Ckts	Project Type	Existing Rating or Planned Capacity (MW)	Technology	Distance (km)	Entry Date
3	2	Thailand - Malaysia Transmission line. Studies being performed on replacement of this aging facility.	Thailand	Malaysia	Khlong Ngae	Gurun	300	1	Grid to Grid	300	HVDC	120	2002
4	6	APG Project No. 6. Planned to expand to 830 MW	Malaysia (Sarawak)	Indonesia (West Kalimantan)	Mambong	Bengkayang	275		Grid to Grid	230	HVAC	127	2016
5	8	Sarawak – Sabah - Brunei APG Project No.8b. Planned to expand to 150 MW.	Malaysia (Sarawak)	Malaysia (Sabah)	Lawas	Mengalong	275		Grid to Grid	100	HVAC	35	2024 (Q4 possible)
6		Thailand - Laos Transmission line 6.	Thailand	Laos	Ubon Ratchathani 3	Xe-Pain Xe-Namnoy	230	2	Generator to Foreign Grid	390	HVAC		2019
7		Thailand - Laos Transmission line 5.	Laos	Thailand	Hong Sa	Nan-Mae Moh 3	500	2	Generator to Foreign Grid	1473	HVAC	324	2015
8		Thailand - Laos Transmission line 7.	Thailand	Laos	Thali	Xayaburi	500	2	Generator to Foreign Grid		HVAC		2019
9		Laos North - Thailand Project.	Laos (North)	Thailand	Nam Ngum 2 - Nabong (Ban Na Bong)	Udon Thani 3	500	2	Generator to Foreign Grid	596.6	HVAC	171.5	2017
10		Thailand - Laos Project	Laos (North)	Thailand	Ban Na Bong - Nam Theun 1	Udon Thani 3	500	2	Generator to Foreign Grid	523	HVAC	254	2022
11		Laos - Thailand Project.	Laos	Thailand	Nam Theun 2	Roi Et 2	500	2	Generator to Foreign Grid	948		304	2009
12		Laos - Thailand Transmission Line 2.	Thailand	Laos	Ubon Ratchathani 2	Houay Ho	230	2	Generator to Foreign Grid	145/500		250	1999
13		Laos – Thailand Project.	Laos	Thailand	Pak Xe (Ban Lak 25)	Ubon Ratchathani 3	500		Generator to Foreign Grid	1300	HVAC	150	2019
14	9	Laos - Thailand Project	Laos (north)	Thailand	Paklay/Paklai	Thali	115	1	Grid to Grid		HVAC		2020
15	9	Thailand - Laos Project	Thailand	Laos	Nong Khai	Thanaleng (Vientiane)	115	1	Grid to Grid	75	HVAC	50	
16	9	Thailand - Laos Project	Thailand	Laos	Nong Khai	Dongphosy	115	2	Grid to Grid		HVAC	0	

SN	AIMS III Project Number	Project Name, and Notes	From Country	To Country	From Substation	To Substation	Voltage (kV)	Ckts	Project Type	Existing Rating or Planned Capacity (MW)	Technology	Distance (km)	Entry Date
17	9	Bangyo - Sirindhon 2 Transmission Line	Laos	Thailand	Bang Yo	Sirindhorn 2	115	2	Grid to Grid		HVAC	42	2020
18	9	Laos - Thailand Project 4	Laos	Thailand	Pakbo / Savannakhet	Mukdahan 2	115	1	Grid to Grid	75	HVAC	30	
19	9	Lao PDR - Thailand Project. Should be removed from AIMS III 18 Projects list because is not grid-to-grid.	Laos	Thailand	Theun Hinboun-Thakhek	Nakhon Phanom 2	230 TBC	2	Generator to Foreign Grid	440	HVAC	176	1998
20	9	Thailand - Laos Transmission line 1	Thailand	Laos	Nakhon Phanom	Thakhek	115	2	Grid to Grid	75	HVAC	70	
21		Laos - Thailand Project	Laos	Thailand	Luang Prabang	Nan	500	2	Generator to Foreign Grid	1400	HVAC	185	2028
22		Laos North - Thailand Project.	Laos (North)	Thailand	Xayaburi	Loei 2- Khon Kaen 4	500		Generator to Foreign Grid	1220	HVAC	300	2019
23	10	Vietnam - Laos Project. Should be removed from AIMS III 18 Projects list because is not grid-to-grid.	Laos	Vietnam (central)	Xekaman 3	Thanh My	220	2	Generator to Foreign Grid	250		250	
24	10	Vietnam - Laos Project. Should be removed from AIMS III 18 Projects list because is not grid-to-grid.	Laos	Vietnam (central)	Xekaman 1	Pleiku	220	2	Generator to Foreign Grid	320	HVAC	250	
25	11	Thailand – Myanmar (Myawaddy) Line	Thailand	Myanmar	Mae Sot	Myawaddy	115		Grid to Isolated Load				
26	11	Thailand - Myanmar Project	Thailand	Myanmar	Chiang Rai	Tachileik	110		Grid to Isolated Load	75		50	
27	12	Vietnam – Cambodia	Vietnam (South)	Cambodia	Chau Doc	Takeo - Phnom Penh	230	2	Grid to Grid	400	HVAC	160	2009
28	13	Laos - Cambodia Project	Laos (South)	Cambodia	Ban Hat	Stung Treng	230		Grid to Grid	445 TBC	HVAC	85	
29	13	Laos - Cambodia Project	Laos	Cambodia	Ban Hat	Kampong Sralau	115	1	Grid to Grid	70 TBC	HVAC		
30	14	Thailand - Cambodia Project	Thailand	Cambodia	Wathana Nakhon	Banteay Meanchey	115	1	Grid to Grid	240	HVAC	50	2007

SN	AIMS III Project Number	Project Name, and Notes	From Country	To Country	From Substation	To Substation	Voltage (kV)	Ckts	Project Type	Existing Rating or Planned Capacity (MW)	Technology	Distance (km)	Entry Date
31		Lao PDR – Myanmar Grid to Isolated Load Project	Laos	Myanmar	Tonpheung	Tachileik	115		Grid to Isolated Load	30	HVAC		
32		Myanmar - China Project	Myanmar	China	Dapein 1	Dayingjiang /Dehong	500	1	Generator to Foreign Grid	880		120	2011
33		Myanmar - China Project	Myanmar	China	Shweli 1	Dehong /Hannong	220	2	Generator to Foreign Grid	600		120	2009
34		China - Myanmar Project 3	China	Myanmar	Menglong	Jingyang	110	1	Grid to Isolated Load				2015
35		Vietnam - China Project	Vietnam (North)	China	Ha Giang	Maguan (Malutang)	220	1	Grid to Grid	350		320	2007
36		Vietnam - China Project	Vietnam (North)	China	Lao Cai	Xinqiao (Guman)	220	2	Grid to Grid	450	HVAC	350	2006
37		China - Vietnam Project	China	Vietnam	Hekou	Lao Cai	110	1	Grid to Grid	70	HVAC	300	2004
38		China - Vietnam Project	China	Vietnam	Maomaotiao	HaGiang	110	2	Grid to Grid	110		300	2005
39		China - Laos Project	China	Laos	Mengla	Namo (Oudomxai)	115	1	Grid to Grid	60	HVAC		2009
40		Vietnam - China Transmission Line	Vietnam	China	Mong Cai	Shengou	110	1	Grid to Grid	75		300	2023
41		500 kV Phayargyi - Hlaingthayar Transmission Line	Myanmar	Myanmar	Phayargyi	Hlaingthayar	500		Internal		HVAC	97	2020
42		230 kV Mawlamyine-Ye-Dawei Transmission Line	Myanmar	Myanmar	Mawlamyine	Dawei	500		Internal		HVAC	290	2020
43		500 kV Taungoo to Phayargyi	Myanmar	Myanmar	Sabakywe	Karmanat / Phayargyi	500		Internal		HVAC	200	2021

Annex E: Planned and Proposed Transmission Projects

The table below presents information about planned and proposed transmission projects as of June 2024. There were multiple data sources. These included the *AIMS III Phases 1 and 2 Summary Report*, including recommendations for 18 priority APG transmission projects – the "18 Projects" list – an updated APG Map produced in January 2024 by ACE (showing the 18 Projects in more detail), presentations by AMS delegations at HAPUA events, discussions with stakeholders and utilities, open-source research, and others. The approach was based on the objective of providing a "best guess" about projects based on limited and frequently, conflicting information.

Where there is definitive information, or at least some information, a value is provided for each item. If there is little to no information, the value is left blank. Where information was especially conflicting or seemed implausible, "TBC" is added to indicate that that information should be confirmed. However, all information in this table should be confirmed by AMS utility representatives.

The *AIMS III Phases 1 & 2 Summary Report* generically lists projects by interface only. Thus, there may be multiple projects on a given interface that are covered by the same number in the 18 Projects list. The APG Map produced by ACE breaks out projects being tracked on different interfaces.

The table notes in various instances whether a particular project should be removed from the 18 Projects list; where more than a single project is shown for a given interface, the recommendation applies only to that specific project.

Explanations of those column headings that are not self-explanatory include:

- "SN" stands for "Serial Number" and is used to quickly identify specific projects.
- The "AIMS III Project Number" corresponds to the number a project was given in the AIMS III study.
- "Ckts" stands for the number of circuits for a project.
- "Earliest COD" stands for "Earlier Commercial Online Date" or the entry date for the project, based on the Author's assessment of the information available.

Table E-1. Planned and Proposed Transmission Projects

SN	AIMS III Project Number	Project Name, and Notes	From Country	To Country	From Substation	To Substation	Voltage (kV)	Ckts	Project Type	Existing Rating or Planned Capacity (MW)	Technology	Distance (km)	Earliest COD
1	2	Thailand - Malaysia Transmission line, (as upgrade of existing 300 MW facility). As of Q2 2024, studies had been done and Thailand/Malaysia were discussion next steps.	Thailand	Malaysia	KhlongNgae	Gurun	300	1	Grid to Grid	600	HVDC	110	2030

2	2	Thailand - Malaysia Transmission line. Listed (no COD given) in "Deep Dive on the 18 APG Interconnectors Identified in AIMSIII", EGAT, Dec. 2023.	Thailand	Malaysia	Su Ngai Kolok	Rantau Panjang	132		Grid to Grid			12	2030
3	3	Western Malaysia – Sarawak Project	Malaysia (P. Malaysia)	Malaysia (Sarawak)			500		Grid to Grid		HVDC	1000	Post 2040
4	4	Western Malaysia – Indonesia (Sumatra) Project. Subject of ongoing USTDA study.	Malaysia (P. Malaysia)	Indonesia (Sumatra)	Telok Gong Malaka	Perawang	500		Grid to Gird	2000	HVDC	272	2030
5	5	Singapore – Indonesia (Batam). Would be for IPP-to-grid projects. Capacity of lines depends on the final projects, not clear if there will be multiple lines. Since this is not grid-to-grid, should be removed from AIMS III list.	Singapore	Indonesia (Batam)					IPP to Grid			30	2030
6		Sumatra-Batam project. This project is likely to appear in the new RUPTL, expected by Q4 2024. All other details unknown. COD is a best guess.	Indonesia (Sumatra)	Indonesia (Batam)									2035
7	6	APG Project No. 6. Existing line, planned to expand to 830 MW, per Jan. 2024 APG map. Timing unknown.	Malaysia (Sarawak)	Indonesia (West Kalimantan)	Mambong	Bengkayang			Grid to Grid	830	HVAC		2035
8	7	Philippines – Malaysia Project	Philippines (Palawan)	Malaysia (Sabah)	Palawan	Kudat	275		Grid to Grid	200	HVDC	230	Post 2040
9	8a	Malaysia (Sarawak) – Brunei Line. Based on input from Brunei delegation in June 2024, this project is still at study stage, so earliest COD is delayed from 2025 as previously reported to 2030.	Malaysia (Sawarak)	Brunei	Miri/Tudan	Kuala Belait	275		Grid to Grid	100	HVAC	45	2030
10	8b	Sarawak – Sabah - Brunei APG Project No.8b. Planned to	Malaysia (Sarawak)	Malaysia (Sabah)	Lawas	Mengalong	275		Grid to Grid	150	HVAC	35	2030

		expand to 150 MW, timing unknown.											
11	9	Lao PDR to Thailand Transmission Interconnection Project. TBC.	Laos	Thailand	Ton Pheng	Mae Chan	115		Grid to Grid	400		60	2025
12		230 kV Laos-Thailand from TonPhueng - Meachan, COD claimed 2030.	Thailand	Lao PDR	Mae Chan	Ton Pheng	230		Grid to Grid: TBC			60	2035
13		115 kV from Dongphosy-Nongkhai, upgrading conductor of 3 circuits conductor 240 sq.mm to 600 sq.mm, COD 2027	Thailand	Lao PDR	Nong Khai	Dongphosy	115	3	Grid to Grid		HVAC	5	2027
14		Upgrading single circuit 115 kV Pakxan-Bungkhan to 230 kV with double circuit (New line route).	Thailand	Lao PDR	Bungkhan	Pakxan	230	2	Grid to Grid		HVAC	200	2027
15		Pakbo-Mukdahan, additional new 1 circuit	Thailand	Lao PDR	Mukdahan	Pakbo	115	1	Grid to Grid		HVAC	10	2024
16		Lao North - Thailand Project	Laos (North)	Thailand	Muang Houn	Nan 2	500		Grid to Grid	800	HVAC	150	2024
17		Laos North - Thailand Project	Laos (North)	Thailand	Nam Ngum 3-Nabong (Ban Na Bong)	Udon Thani 3	500	2	Generator to Foreign Grid	440	HVAC	200.5	2026
18	10	Laos - Vietnam Project. Since this is not grid-to-grid, should be removed from AIMS III list.	Laos (North)	Vietnam (North)	Luang Prabang-Xam Nau (Lao-N)	Nho Quan	500	2	Generator to Foreign Grid	1500 / 2500 / 3500	HVAC	400	2040
19		Laos - Vietnam Power Transmission Interconnection 2	Laos (South)	Vietnam (centre)	Hatxan	Pleiku	500	2	Grid to Grid	620	HVAC	94	2040
20		Dedicated IPP Project. Since this is not grid-to-grid, should be removed from AIMS III list.	Lao PDR (North)	Vietnam	Nam Mo (Nam Ou)	Ban Ve	220		Generator to Foreign Grid	570	HVAC	90	
21		Dedicated IPP Project	Lao PDR	Vietnam	Namxam1	Huana	220		Generator to Foreign Grid				
22		Monsoon wind project	Lao PDR	Vietnam		ThanhMy	500		Generator to Foreign Grid				
23	11	Myanmar - Thailand Project. As a generator to foreign grid	Myanmar	Thailand	Hutgyi	Phitsanulok 3	500		Generator to Foreign Grid	1250	HVAC	370	NA

		project, this should be removed from AIMS III list.											
24		Mae Sot - Myawaddy Transmission Line	Thailand	Myanmar	Mae Sot	Myawaddy	230	2	Grid to Grid	300	HVAC	29	2030
25	12	Cambodia - Vietnam Project	Cambodia	Vietnam (South)	Stung Treng	Tay Ninh	500		Grid to Grid	250	HVAC	100	2035
26	14	Thailand – Cambodia	Thailand	Cambodia	Prachin Buri	Battambang	500	2	Grid to Grid	250	HVAC	300	2035
27	15	Sabah - Kalimantan Project	Malaysia (Sabah)	Indonesia (Kalimantan)	Malinau	Kalabakan	275		Grid to Grid	200	HVAC	140	2030
28	16	Singapore - Sumatra Project. This project is now expected to go through Batam.	Singapore	Indonesia (Sumatra)	Singapore	Paranap	275		Grid to Grid	1600	HVDC	260	2035
29	17	Lao PDR - Myanmar Power Interconnection. (As listed in APG Map, same project as below).	Laos	Myanmar	M. Long	Keng Tung	230/500	2	TBC	300	HVAC	300	2030
30	17	230 kV Laos-Myanmar from M. Long – Kenglatt. (This project is as described in Lao HAPUA Dec 2023 deck).	Laos	Myanmar	M. Long	Kenglatt	220 or 230 TBC		TBC			260	2027 (Again, this COD is as listed in the referenced deck)
31	18	Sumatra - Java Project. To confirm per new RUPTL expected in Q4 2024.	Indonesia (Sumatra)	Indonesia (Java)	Muara Enim	Bogor	500		Grid to Grid	6200	HVDC	500	2040
32	18	Java – Kalimantan Project. To confirm per new RUPTL expected in Q4 2024.	Indonesia (Java)	Indonesia (Kalimantan)					Grid to Grid		HVDC	350	Post 2040
33		China – Lao PDR Project	China	Lao PDR	MengLao	Namo (Nam Ou) 3	500		Grid to Grid			300	2025
34		Singapore Subsea cable project	Singapore	Cambodia					Generator to Foreign Grid		HVDC	1000	2035
35		Singapore Subsea cable project	Singapore	Vietnam					Generator to Foreign Grid		HVDC	1000	2035
36		Singapore Subsea cable project	Singapore	Malaysia (Sarawak)					TBC		HVDC	1000	TBC

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ASEAN Centre for Energy
6th Floor, JL.H.R. Rasuna Said, Block X-02,
Kav. 07-08, Kuningan, Jakarta 12950

www.aseanenergy.org
Phone: 62-21-527-9332
Fax: 62-21-527-9350