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Study on an Enabling Agreement amongst ASEAN Member States for Establishing Multilateral Power Trade and ASEAN Power Grid Institutions

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Foreword

ASEAN countries are navigating a period where nations and companies face a turbulent, uncertain, and rapidly changing global energy landscape. The COVID-19-induced economic downturn in 2020 triggered an unprecedented decline in global energy demand, carbon emissions, and investment, followed by a sharp rebound in energy demand and emissions the following year. In this context, Asian countries must seize the opportunity to accelerate the energy transition – once gradual but steady – to meet the goals of the Paris Agreement. This is essential for fostering a greener growth trajectory while ensuring energy security, affordability, and the achievement of climate goals.

At the same time, to meet rising electricity demand while reducing greenhouse gas (GHG) emissions in ASEAN, massive investments are needed in decarbonisation technologies such as renewable energy and power system expansion. Addressing these challenges requires a range of mechanisms and technologies, with one critical solution being the development of multilateral power trading in ASEAN, known as the ASEAN Power Grid (APG).

This research project report introduces a groundbreaking theoretical framework for the ASEAN Power Grid Intergovernmental Agreement – a pivotal step towards regional energy integration and co-operation. Against the backdrop of recent trends in ASEAN energy co-operation, where member states are increasingly working together on renewable energy and grid connectivity, the study highlights the importance of harmonising policies and infrastructure to create an integrated power trade market in the region.

Through meticulous analysis and forward-looking recommendations, this report aims to illuminate the path towards establishing institutions necessary for multilateral power trade in ASEAN. The drafting process has been a collaborative effort, enriched by the contributions of representatives from ASEAN member countries' energy ministries and utility operators. This initiative reflects the collective resolve of the ASEAN community, in collaboration with international think tanks, to overcome institutional barriers. It is expected to serve as a timely and essential reference for policymakers and stakeholders across the region.

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List of Abbreviations and Acronyms

ACE	ASEAN Centre for Energy
ACER	Agency for the Cooperation of Energy Regulators
ADB	Asian Development Bank
AERN	ASEAN Energy Regulators Network
AGTP	APG Generation and Transmission Planning function
AIMS III	ASEAN Interconnection Masterplan Study III
AMEM	ASEAN Ministers on Energy Meeting
AMO	ASEAN Market Operator
AMS	ASEAN member states
APAEC	ASEAN Plan of Action for Energy Cooperation
APG	ASEAN Power Grid
APGCC	ASEAN Power Grid Coordinating Council
APP	ASEAN Power Pool
ASEAN	Association of Southeast Asian Nations
ATC	available transfer capacity
ATSO	APG Transmission System Operator function
BIMP-PIP	Brunei Darussalam-Indonesia-Malaysia-Philippines Power Integration Project
CBES	Cross-border Electricity Sales
DAM	day-ahead market
DEPP	Department of Electricity Policy and Planning
DER	Distributed Energy Resources
DES	Department of Electrical Services
DPPA	direct power purchase agreement
EAC	Electricity Authority of Cambodia
EDC	Electricité du Cambodge
EDL	Electricite du Laos

EGAT	Electricity Generating Authority of Thailand
EMA	Energy Market Authority
ENTSO-E	European Network of Transmission System Operators for Electricity
EPWA	Energy Purchase and Wheeling Agreement
ERC	Energy Regulatory Commission
ERIA	Economic Research Institute for ASEAN and East Asia
ESE	Energy Supply Enterprise
EVN	Vietnam Electricity
GENCO	generation company
GHG	greenhouse gas
GMS	Greater Mekong Subregion
GW	gigawatt
HAPUA	Heads of the ASEAN Power Utilities and Authorities
HVDC	high voltage direct current
HWG	HAPUA Working Group
IEA	International Energy Agency
IGA	intergovernmental agreement
IPP	independent power producer
IT	information technology
LTMS-PIP	Lao PDR-Thailand-Malaysia-Singapore Power Interconnection Project
MEMR	Ministry of Energy and Mineral Resources
MEPE	Myanmar Electric Power Enterprise
MoU	memorandum of understanding
MPT	multilateral power trade (trading)
MW	megawatt
NEMO	Nominated Electricity Market Operator
NGCP	National Grid Corporation of the Philippines
PCI	Projects of Common Interest
PDR	People's Democratic Republic

PJB	PT Pembangkitan Jawa Bali
PLN	PT Perusahaan Listrik Negara
PPA	power purchase agreement
PT	Perseroan Terbatas
RPCC	Regional Power Coordination Center
RPM	regional power market
RPTCC	Regional Power Trade Coordination Committee
SAPP	Southern African Power Pool
SCADA	Supervisory Control and Data Acquisition
SESCO	Sarawak Electricity Supply Corporation
SMO	system and market operator
SOME	Special ASEAN Senior Officials' Meeting on Energy
SPP	small power producer
SWEM	Singapore Wholesale Electricity Market
TNB	Tenaga Nasional Berhad
TOR	terms of reference
TSO	transmission system operator
VWEM	Vietnam Wholesale Electricity Market
WEIM	Western Energy Imbalance Market
WESM	Wholesale Electricity Spot Market

Executive Summary

The ASEAN region is facing an increasing need for energy security and sustainability due to rising global energy prices and concerns about climate change. As one of the world's most dynamic economic areas, ASEAN's energy demand continues to grow. Meeting this demand while reducing greenhouse gas (GHG) emissions requires significant investments in renewable energy and power system expansion. A key mechanism to address these challenges is the development of the ASEAN Power Grid (APG), which enables multilateral power trading across the region.

The Economic Research Institute for ASEAN and East Asia (ERIA) has been actively involved in various initiatives to support the ASEAN Plan of Action for Energy Cooperation (APAEC) and the Heads of ASEAN Power Utilities and Authorities (HAPUA). This report focuses on the creation of two key institutions to advance the APG: the APG Generation and Transmission Planning function (AGTP) and the APG Transmission System Operator function (ATSO).

The study examines a framework for a high-level intergovernmental agreement (IGA) amongst ASEAN Member States (AMS) to establish the AGTP and ATSO functions in supporting the development of multilateral power trade within the APG structure.

The agreement, or its protocols, must address key provisions such as governance structure, institutional arrangements, ATSO and AGTP responsibilities, a framework for facilitating cross-border electricity trade, and funding mechanisms for these new functions. For governance and institutional setup, the study recommends a more decentralised approach than earlier ERIA studies from 2018, which originally proposed new organisations. Instead, the new approach leverages existing APG bodies, creating a decentralised matrix organisation based on secondment.

Establishing a regional electricity market is essential to unlocking the potential of multilateral power trading in ASEAN. This involves the creation of a day-ahead market (DAM) to facilitate short-term cross-border trade. The report suggests a stepwise approach, starting with a regional shadow market focused on capacity building, without initial physical or financial transactions.

To fund the new APG functions, the study proposes a combination of external funding and contributions from AMS, with a long-term goal of self-sustainability. Drawing on models from the Southern African Power Pool (SAPP), the European Network of Transmission System Operators for Electricity (ENTSO-E), and the European Single Day-ahead Coupling market, the report outlines a cost-sharing structure. Contributions from AMS can be based on:

- Base contribution: A fixed amount from all member states.

- Level of participation: Variable contributions based on each state's engagement.

- Proportional component: Contributions scaled by factors like electricity demand, trade volume, and population size.

The road map defined in this study identifies four key milestones for establishing AGTP and ATSO functions:

1. Intergovernmental Agreement (IGA): Achieve consensus on the agreement to support AGTP and ATSO formation.
2. Organisational Establishment: Set up a decentralised secretariat and working groups.
3. Initial Stage of Operation: Start coordination and data sharing amongst AMS, focusing on planning and operational standards; establish a shadow market.
4. Advanced Stage of Operation: Launch the regional electricity market and fully integrate AGTP and ATSO into routine operations.

The benefits of this framework will start to emerge at Milestone 3, during the Initial Stage of Operation, while the greatest advantages will be realised at Milestone 4, once all functions and the regional market are fully operational. The timeline suggests that a regional electricity market could be established within 6 years.

This report provides a comprehensive framework for developing the AGTP and ATSO functions within ASEAN, emphasising a decentralised approach. It outlines the necessary roles, responsibilities, and institutional arrangements to support multilateral power trading and enhance regional energy security and sustainability.

Chapter 1
Introduction

Energy security and sustainability are becoming increasingly important in the ASEAN countries due to the recent increase in global energy prices and the motivation to address climate change. Also, ASEAN is one of the most dynamic and fastest growing economic regions in the world, thus the energy demand is also increasing. To meet the growing electricity power demand while pursuing the reduction of greenhouse gas (GHG) emissions in ASEAN, huge investments in power generation capacity from renewable energy and power system expansion are required. To solve these challenges, it is necessary to introduce various mechanisms and technologies, and one of the keys is the development of multilateral power trading (MPT) in ASEAN, based on the infrastructure known as ASEAN Power Grid (APG).

In the meantime, the realisation of the APG and MPT requires overcoming various challenges, such as technical and commercial feasibility reviews, institutional framework, regulatory capacity, coordinated system planning, open access and common wheeling charge methodology for the transmission infrastructure and harmonising the minimum technical requirements. These challenges are described in the corresponding action plans within the ASEAN Plan of Action for Energy Cooperation (APAEC) Phase II: 2021–2025. The Heads of the ASEAN Power Utilities and Authorities (HAPUA) is taking the lead in these studies in cooperation with the ASEAN Centre for Energy (ACE) and other international organisations.

The Economic Research Institute for ASEAN and East Asia (ERIA) has implemented several research projects related to the APG and MPT, besides providing technical and advisory services to HAPUA. Recent and major efforts in this regard include the studies on the formation of two critical institutions to advance the APG and MPT (ERIA 2018a, ERIA 2018b): (i) the APG Generation and Transmission Planning function (AGTP) and (ii) the APG Transmission System Operator function (ATSO).

The AGTP function is tasked with establishing rules, criteria, and procedures for conducting studies and business related to system planning, including evaluating supply reliability, developing demand forecasts, assessing supply capacity, and proposing interconnection reinforcements.

The ATSO function plays pivotal roles in the operation of the APG as well as the facilitation of MPT. Its key roles include ensuring system security and stability through the System Operation and Coordination department, facilitating regional electricity trading via the ASEAN Market Operator (AMO) function, and managing information technology infrastructure and Supervisory Control and Data Acquisition (SCADA) systems for efficient

grid monitoring and data management. Additionally, the organisation is tasked with the development and harmonisation of APG network codes and guidelines, promoting research and innovation, and fostering environmental sustainability in grid operations. ATSO also aims to enhance transparency through information sharing, incident management, and the publication of annual reports and outlooks, while progressively taking on responsibilities from initial coordination to full system operation and control block management.

The primary objective of the current project is to develop a study of the suggested outline and core content of a high-level intergovernmental agreement (IGA) between the ASEAN Member States (AMS) supporting the formation of the AGTP and ATSO functions. A feasible and appropriate reporting structure for the AGTP/ATSO Institutions into the wider ASEAN governance is also to be proposed. These tasks are aligned with action items from APAEC Phase II: 2021–2025, Programme Area No. 1 APG, which are defined as:

- Action Plan 2.1: Establish intergovernmental coordination and facilitation mechanism and develop institutional and regulatory capacities of the MPT/APG Institutions.
- Action Plan 2.2: Assess the need and feasibility of existing and new regional institutions for implementing MPT.

For the abovementioned purposes, the project provides a platform for discussion between the relevant stakeholders in the ASEAN power sector (including, but not limited to, policymakers, electricity market regulators, and utilities in the AMS). The ASEAN stakeholder working group workshops are convened by the Economic Research Institute for ASEAN and East Asia (ERIA), under the guidance of ACE and with the assistance of consultants, to discuss the principles, framework, and terms of the enabling high-level IGA. The aim is to seek consensus amongst AMS representatives regarding the above points and to determine the way forward.

It is important to note that in parallel with this study, the AMS are in the process of renewing the APG Memorandum of Understanding (MoU) with a successor APG framework agreement, which will comprehensively contain 10 protocols for the implementation of the key functions to enable the APG and MPT, including the two institutions studied in this project. As such, this project literally feeds into the APG framework agreement development process as inputs and references.

1.1. Mapping of ASEAN Institutions and Authorities and Existing Bilateral and Multilateral Agreements for Regional Power Trading

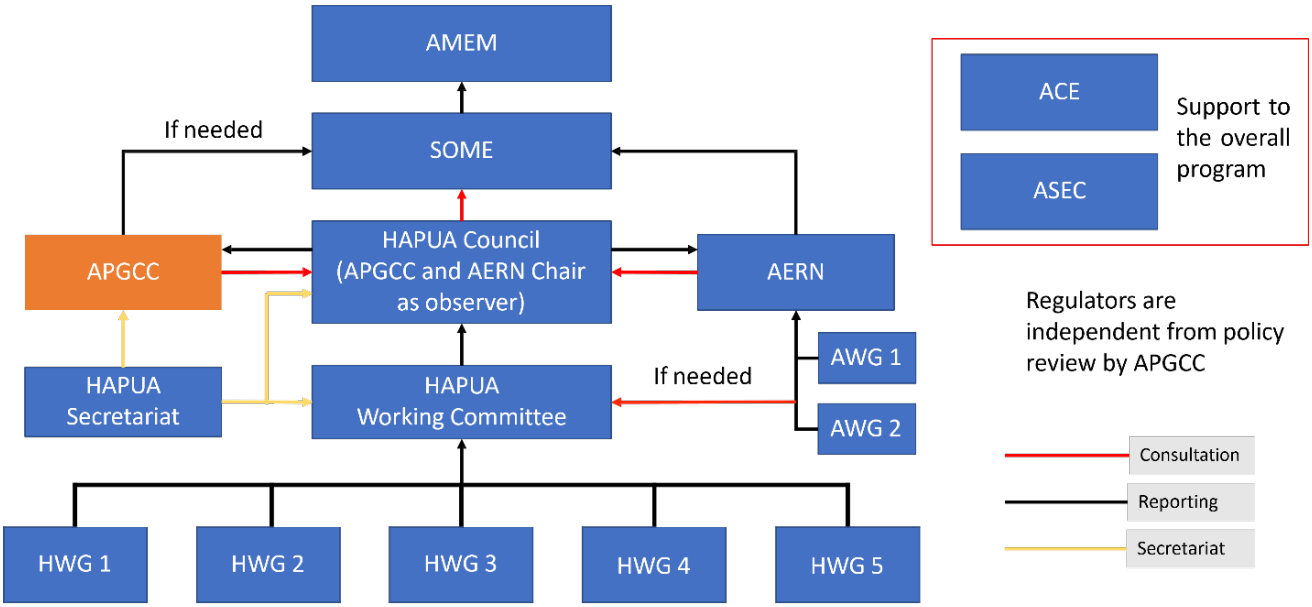
This section outlines the structures of relevant institutions and authorities at the regional and national levels. The information provided will be useful to design and identify which institution will be involved and what kind of frameworks need to be designed should bilateral power trading expand to multilateral or regional trading in the future.

1.1.1. Regional Institutions Structure Related to the ASEAN Power Grid

The 38th ASEAN Ministers of Energy Meeting (AMEM) in 2020 endorsed the APAEC 2016–2025 Phase II: 2021–2025, highlighting the regional ambitious plans to enhance energy connectivity in ASEAN. In the APAEC Phase II, the APG serves as one of the key program areas that focuses on the development of interconnections between the AMS, which will lead to the establishment of an integrated regional power system and, to some extent, an MPT market. To identify the minimum requirements to advance multilateral electricity trading in ASEAN, the APAEC has four action plans, which are to (i) establish intergovernmental coordination and facilitation mechanism and to develop institutional and regulatory capacities of the MPT/APG institutions, (ii) assess the need and feasibility of existing and new regional institutions for implementing MPT, (iii) develop dispute settlement mechanisms, and (iv) analyse appropriate trade models for regional electricity market.

Advancing the progress of MPT under the APG program requires effective coordination and immense support from ASEAN energy sectoral bodies. HAPUA needs to coordinate closely with ACE, the ASEAN Power Grid Consultative Council (APGCC), and the ASEAN Energy Regulators Network (AERN), to develop instutional and regulatory capacity and harmonise minimum technical requirements of MPT, based on prior feasibility studies. AERN is obligated to collaborate with HAPUA on the regulatory issues and support the policymakers on the implementation of MPT through the APG. This will include the regulatory assessment of MPT/APG institutions' development and MPT mechanisms. On the other hand, the APGCC will perform an advisory role in matters pertaining to governmental policies, IGA, and institutional arrangements in implementing MPT. The HAPUA will then report the progress to AERN and APGCC through the HAPUA Council Meeting.

Figure 1.1. Structure of APG-related Sectoral Energy Bodies



Source: Archive of ASEAN Centre for Energy (2023).

AERN: ASEAN Energy Regulatory Network

- AERN was established in March 2012 to forge closer cooperation amongst ASEAN energy regulators with a view to promote sustainability and economic development in the region.
- AERN is obligated to collaborate on regulatory issues related to ASEAN energy cooperation, promote networking and develop communication channels amongst regulators in the region, learn the best practices through knowledge and capacity building, and, most importantly, support policymakers implement multilateral energy projects.
- AERN consists of one senior level representative of each energy regulatory agency of the AMS. The working groups, AERN Working Groups 1 and 2, are the subsidiary working groups under AERN that focus on any topic proposed in the annual meeting or through the AERN chair.
- AERN shall hold one regular annual meeting each year before the Senior Officials Meeting on Energy (SOME) and ASEAN Ministers of Energy Meeting (AMEM) and shall be hosted by the chair country. In addition, special meetings are organised on a case-by-case basis.
- AERN Working Groups 1 and 2 directly report their work to the AERN member through regular or annual AERN meetings. AERN then reports their findings and work to the annual SOME. AERN is also obligated to provide consultation on regulatory matters to the HAPUA Council, where the AERN chair becomes the observer, and to the HAPUA working committee through AERN Working Groups 1 and 2.

AMEM: ASEAN Ministers of Energy Meeting

- AMEM serves as the platform amongst the ASEAN region's ministers of energy to discuss and provide high-level directions for ASEAN energy cooperation.
- The current AMEM was established in 1986 because of the 1980 ministerial level 'ASEAN Economic Ministers on Energy Cooperation' transformation.
- AMEM meets once a year, the most recent meeting being the 41st AMEM held in Bali, Indonesia. The 41st AMEM noted the findings of the ASEAN Interconnection Masterplan Study III (AIMS) Phases 1 and 2 Update and commended the initiatives to further expand MPT in the ASEAN region, including the release of the Joint Statement initiating the Brunei Darussalam-Indonesia-Malaysia-Philippines Power Integration Project (BIMP-PIP).
- The high-level results delivered in the annual SOME will be presented in AMEM, which will later be translated into high-level directives to progress the realisation of energy cooperation in ASEAN.

APGCC: ASEAN Power Grid Consultative Committee

- The formation of APGCC was stated in the initial terms of reference (TOR) for the APGCC on 19 June 2008, with the main function to assist the HAPUA Council in implementing the APG MoU. Later, the 38th AMEM noted the initiative of the APGCC to review its TOR, considering the region's efforts towards regional power integration.
- The establishment of the APGCC aims to provide overall policy guidance on the implementation of regional power integration and multilateral power trade (MPT). The APGCC is obligated to play a consultative role in matters pertaining to governmental policies in implementing MPT, and advisory role on IGAs and institutional arrangements under the MPT along with policy matters for SOME's endorsement.
- The council is composed of AMS representatives from relevant government organisations in charge of policy formulation on the energy and/or power sector. The APGCC is mandated to report the discussion results and other APG-related activities and progress to SOME. The HAPUA Council reports their findings and work to the APGCC, which is obligated to give consultation and policy guidance on implementing power integration.

HAPUA: Heads of ASEAN Power Utilities/Authorities

- Under an MoU between 10 AMS utilities in 2004, HAPUA was established to promote cooperation amongst its members to strengthen regional energy security through interconnection development, enhancing private sector participation, encouraging the standardisation of equipment, promoting joint project development, cooperation in human resources, research and development, and to enhance the quality and reliability of the electricity supply system.

- Upon the 28th HAPUA Council Meeting in 2012, the new structure of the HAPUA Working Groups (HWGs) was adopted, consisting of:
  - HWG No. 1, in charge of generation and renewable energy development to identify potential energy resources for fuel security studies and knowledge-sharing on generation and renewable energy. HWG 1 is chaired by Indonesia with the Lao PDR as its vice-chair.
  - HWG No. 2's main objectives are to facilitate the implementation of ASEAN interconnection power projects and to review and update the ASEAN Interconnection Masterplan Study (AIMS). HWG 2 is currently chaired by Thailand, with Viet Nam acting as the vice-chair.
  - HWG No. 3, in charge of distribution and power reliability and quality. Its main objectives are to share the best practices on the enhancement of power reliability, quality, and losses minimisation; to discuss the impact of distributed energy resources (DER); and to exchange experiences and practices of power reliability and quality projects. HWG 2 is chaired by Singapore and vice-chaired by Myanmar.
  - Policy studies and commercial development are the main fields of work of HWG No. 4, with the objective of studying the limitations and proposing solutions on the legal and regulatory framework for cross-border power interconnection and trade. The study on financing modalities for APG realisation is also in HWG 4's scope of work. HWG 4 is chaired by the Philippines, with Cambodia as its vice-chair.
  - The focus of HWG No. 5 is on human resources within ASEAN. The main objectives are to optimise the expertise within ASEAN utilities, identify human resources development for ASEAN utilities and authorities, and facilitate development programmes through the utilisation of resources from ASEAN utilities and external resources. Malaysia is the chair for HWG 5 and Brunei Darussalam serves as the vice-chair.
- The HAPUA Council consists of the head or one senior representative of the 10 AMS' utilities, with an annual coordination meeting with the main discussion to update the AMS regarding the progress of ASEAN energy cooperation. The release of the HAPUA Council Joint Statement is its output, with the most recent one welcoming the progress of cross-border interconnection on a subregional basis within ASEAN, noting the success of the Lao-PDR-Thailand-Malaysia-Singapore Power Integration Project (LTMS-PIP).
- The HAPUA Secretariat acts as the secretariat for HAPUA working committee and council, along with the APGCC. The high-level findings from the HAPUA working committee will be presented in the HAPUA Working Committee and HAPUA Council annual meetings, to discuss and update the AMS on the progress of APAEC, power integration projects, and the preparation for SOME.

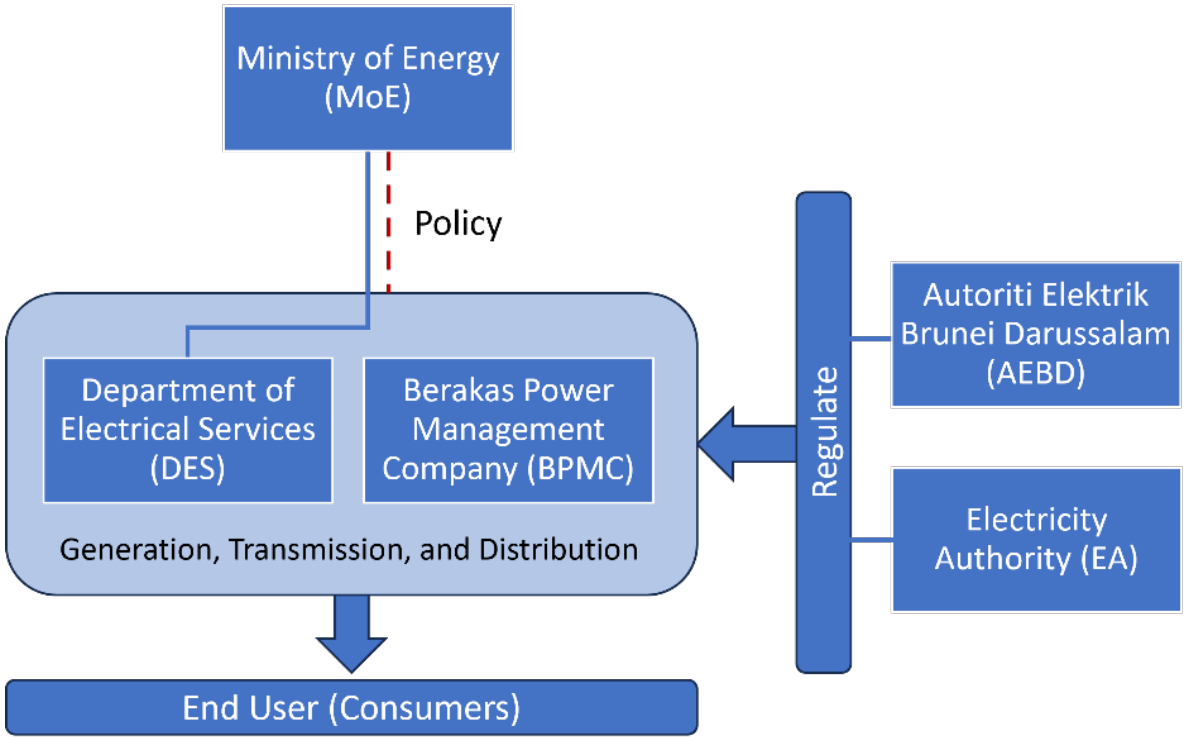
SOME: Senior Officials Meeting on Energy

- The Senior Officials Meeting on Energy or SOME was established in 1980 and acts as a consultative committee to promote and oversee the various cooperation activities envisaged in the framework agreed by the AMS. Various energy Subsector Network (SSN), Specialized Energy Bodies (SEB) and other energy platforms are organised to work under or coordinate with SOME.
- The SSN, SEB, and other energy platforms within ASEAN are mandated to develop and implement the work programmes and activities under the seven program areas of APAEC. The bodies are also mandated to provide technical recommendations to SOME in their area of specialisation and pursue joint and cooperative activities amongst member states. Therefore, the high-level message and findings from the APGCC, AERN, and HAPUA, along with their respective meetings, needed to be delivered and reported in SOME, to be discussed later each body.
- SOME is an annual meeting, inviting all senior energy officials from each ASEAN member state. The 41st SOME in Jakarta pushed the agenda of energy transition through sustainable energy and regional interconnectivity within ASEAN. SOME acts as AMEM's operating arm to gather all the high-level messages and findings to be translated into a high-level directive in AMEM.

1.1.2. National Institutions and Power Structure in the AMS

1.1.2.1. Brunei Darussalam

Figure 1.2. Structure of Brunei Darussalam's Power Market



Source: Archive of the ASEAN Centre for Energy (2023).

Table 1.1. Structure of Brunei Darussalam's Power Market

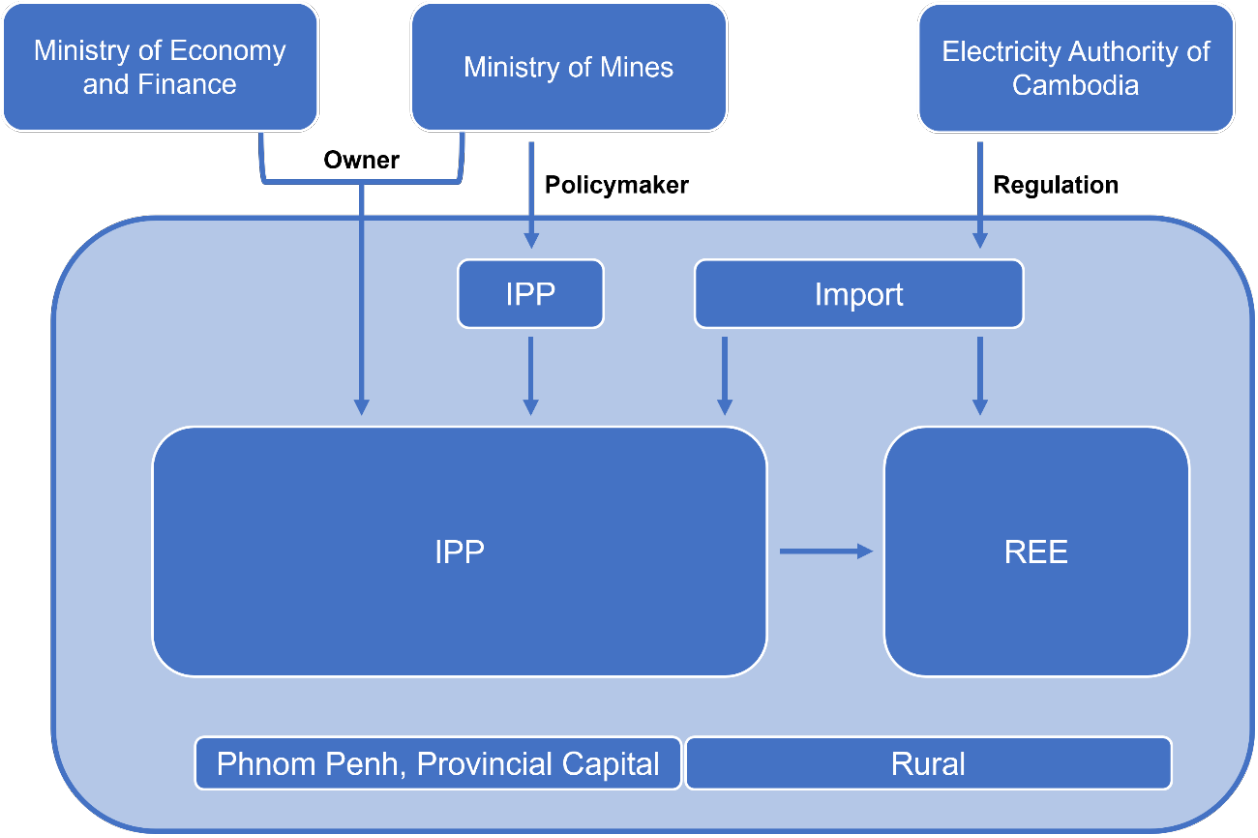
Market Structure	Vertically Integrated Monopolistic Market
Stakeholders and Role	- Ministry of Energy (MoE): Policymakers - Autoriti Elektrik Brunei Darussalam (AEBD) and Electricity Authority: Electricity regulator - Department of Electrical Services (DES) and Berakas Power Management Company (BPMC): Utilities responsible for generation, transmission, and distribution
Description	- DES serves as the one of the two main power utilities and handles the electric power business (generation, transmission to distribution, and retail) under MoE's policy on electricity. The BPMC oversees providing power to royal facilities and the military. - The AEBD enforces and oversees the implementation of Electricity Act, Chapter 223 (formerly known as the Electricity Order 2017),

Market Structure	Vertically Integrated Monopolistic Market
	particularly in regulating activities in the country's electricity industry. The objective is to strengthen the law and safety aspects of electricity in terms of generation, transmission, and distribution and its use to enable the development of a more efficient, competitive, and increasingly sustainable power industry in the country. The Electricity Act issues licences and regulates electrical appliances and consumer products. - Brunei Darussalam applies a progressive commercial and industrial electricity tariff, which offers a discount for increased consumption, and heavy subsidisation to help lower the electricity tariffs.
Additional Remarks related to Bilateral or Multilateral Power Trading (MPT)	- As of November 2023, Brunei Darussalam has yet to have a cross-border interconnection with other neighbouring countries. However, the 41st AMEM back in August released a Joint Statement endorsing BIMP-PIP to further expand the MPT in the subregion.

Source: Authors.

1.1.2.2. Cambodia

Figure 1.3. Structure of Cambodia's Power Market



EDC = Electricité du Cambodge, IPP = independent power producer, REE = rural electricity enterprise.
Source: Archive of ASEAN Centre for Energy (2023).

Table 1.2. Structure of Cambodia's Power Market

Market Structure	Vertically Integrated Single Buyer Market
Stakeholders and Role	- Ministry of Mines and Energy (MoME) and Ministry of Economy and Finance (MoEF): Policymakers - Electricity Authority of Cambodia (EAC): Electricity regulator - Electricité du Cambodge (EDC): State-owned utility, owns generation, handles transmission and distribution sector (capital region and some provinces) - Independent power producers (IPPs): Handles the electricity generation sector - Rural electricity enterprise: Handles the distribution sector for rural area

Market Structure	Vertically Integrated Single Buyer Market
Description	- The EDC is owned by the Ministry of Mines and Energy and MoEF under a royal decree in 1996 regarding the conversion of EDC into a limited liability company (World Bank, 2003). The EDC obtains electricity by purchasing power from IPPs and imports from other countries. The EDC distributes to Phnom Penh (capital city of Cambodia), while the rural electric enterprises distribute the power to the rural area consumers under EAC regulations. - The EAC was created by virtue of the 2001 Electricity Law and is responsible for regulating electricity services, including the licensing of power service suppliers and power import regulation. The EAC also regulates the electricity tariffs by reviewing the costs of operation. A subsidy of $150 million is given to stabilise the electricity tariff in 2023.[a]
Additional Remarks Related to Bilateral or Multilateral Power Trading	- Currently, Cambodia is interconnected with the Lao PDR, Thailand, and Viet Nam to allow imports from each country. Cambodia was connected to Viet Nam as of 2009, to Thailand as of 2007, and to the Lao PDR (through Ban Hat–Stung Treng points) as of 2017 (KAS, 2017). - In 2019, Cambodia signed an agreement to purchase 200 MW of electricity from the Lao PDR from 2019 to 2021, to compensate the rising power consumption in Cambodia.[b] - Cambodia's Royal Group Power Company and Singapore's Keppel Energy signed an agreement on 15 March 2023 to export 1 GW of renewable energy from Cambodia to Singapore through submarine high voltage direct current (HVDC) transmission.[c]

[a] Khmer Times website. https://www.khmertimeskh.com/501326253/govt-subsidises-150m-to-stabilise-electricity-tariffs-in-2023/

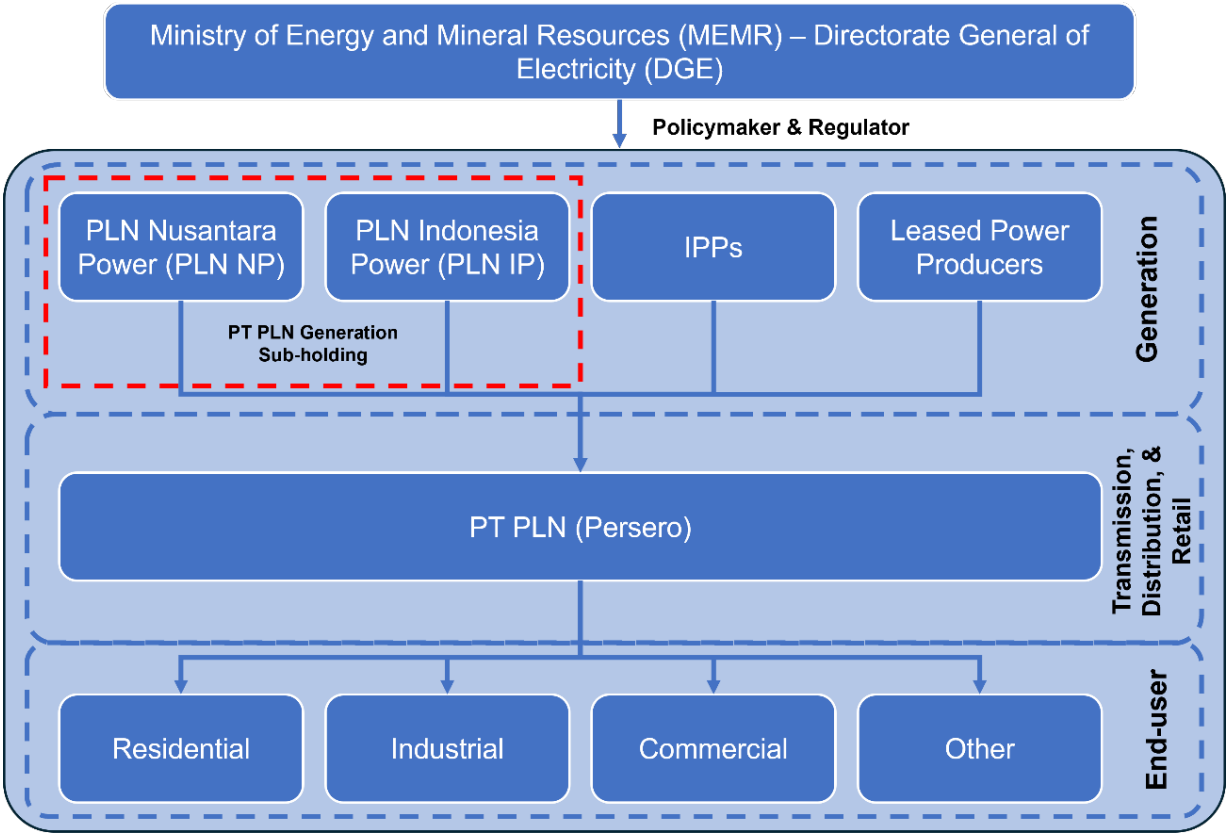
[b] Khmer Times website. https://www.khmertimeskh.com/589805/cambodia-to-buy-200-megawatts-from-laos/

[c] Cambodian People's Party website. https://www.cpp.org.kh/en/details/342162#:~:text=Cambodia%27s%20Royal%20Group%20Power%20Company,via%20submarine%20high%2Dvoltage%20transmission

Source: Authors.

1.1.2.3. Indonesia

Figure 1.4. Structure of Indonesia's Power Market



PLN = PT Perusahaan Listrik Negara.
Source: Archive of the ASEAN Centre for Energy (2023).

Table 1.3. Structure of Indonesia's Power Market

Market Structure	Vertically Integrated, Single Buyer Monopolistic Market
Stakeholders and Role	- Ministry of Energy and Mineral Resources (MEMR): Electricity regulator and policymaker - PT PLN Nusantara Power (previously known as PT Pembangkitan Jawa Bali (PJB)), PT PLN Indonesia Power (previously known as Indonesia Power), independent power producers (IPPs,) Least Power Producers: Handle the generation sector and sell the produced power to the PLN - PT Perusahaan Listrik Negara (PLN): Acts as a single buyer and retailer, system operator (subsidiaries)
Description	- In September 2022, the PLN was restructured into a holding and sub-holding arrangement. The PLN became the holding

Market Structure	Vertically Integrated, Single Buyer Monopolistic Market
	company with four different sub-holdings. PT PLN Indonesia Power (PLN IP) and PT PLN Nusantara Power (PLN NP) are grouped into the generation sub-holding. The utility restructuring changed the overall generation sector where PT PJB was changed into PT PLN Nusantara Power (PLN NP) hopeful for a more improved generation assets optimalisation, reaching outside of the Java–Bali islands. - After the restructuring, PT PJB (PLN NP) and Indonesia Power (PLN IP) generate electricity under the PLN as the holding company, while IPPs and Leased Power Producers generate electricity to sell to the PLN. The PLN acts as the single buyer and retailer; it also provides transmission and distribution services to the end customers. - The generated power from each generation sector company under the PLN or independent company must sell the produced power directly to the PLN. The PLN then buys the produced power and distributes it to the residential, industrial, and commercial consumers through the PLN-owned and operated transmission and distribution systems. - As of July 2023, $3,136 million has been used to subsidise Indonesia's electricity needs. The electricity tariffs remain stable per September 2023, as adjusted by the PLN, with no increase on the 13 non-subsidised consumer groups. The MEMR regulates the electricity sector.
Additional Remarks Related to Bilateral or Multilateral Power Trading	- Indonesia's MEMR is authorised to issue permits for the export and import of electricity trade. The permit is for 5 years and can be extended.[a] - Back in 2022, Indonesia suspended renewable energy exports to meet the nation's needs for green electricity. However, on 8 September 2023, Singapore's Energy Market Authority (EMA) granted Indonesia conditional approval to export 2 GW of low-carbon electricity to Singapore's grid, with the condition of Singapore investing in the development of renewable energy manufacturing industries in Indonesia.[b] - Indonesia has been interconnected with Malaysia through the Kalimantan Barat–Sarawak Interconnection since 2015. The first traded power was from Sarawak to Kalimantan Barat at

Market Structure	Vertically Integrated, Single Buyer Monopolistic Market
	50 MW of electricity in March 2016 under the Power Exchange Agreement between PLN Indonesia and Sarawak Electricity Supply Corporation (SESCO) Malaysia.[c] - Based on Indonesia's Electricity Supply Business Plan (RUPTL) 2021–2030, Indonesia identified the potential to interconnect with other neighbouring countries, such as Malaysia (through Sumatera–Peninsular Malaysia and Kalimantan–Sabah Interconnection) and Singapore (Peranap–Singapore).

[a] Direktorat Utama Pembinaan dan Pengembangan Hukum Pemeriksaan Keuangan Negara Badan Pemeriksa Keuangan website. https://peraturan.bpk.go.id/Details/5254/pp-no-42-tahun-2012

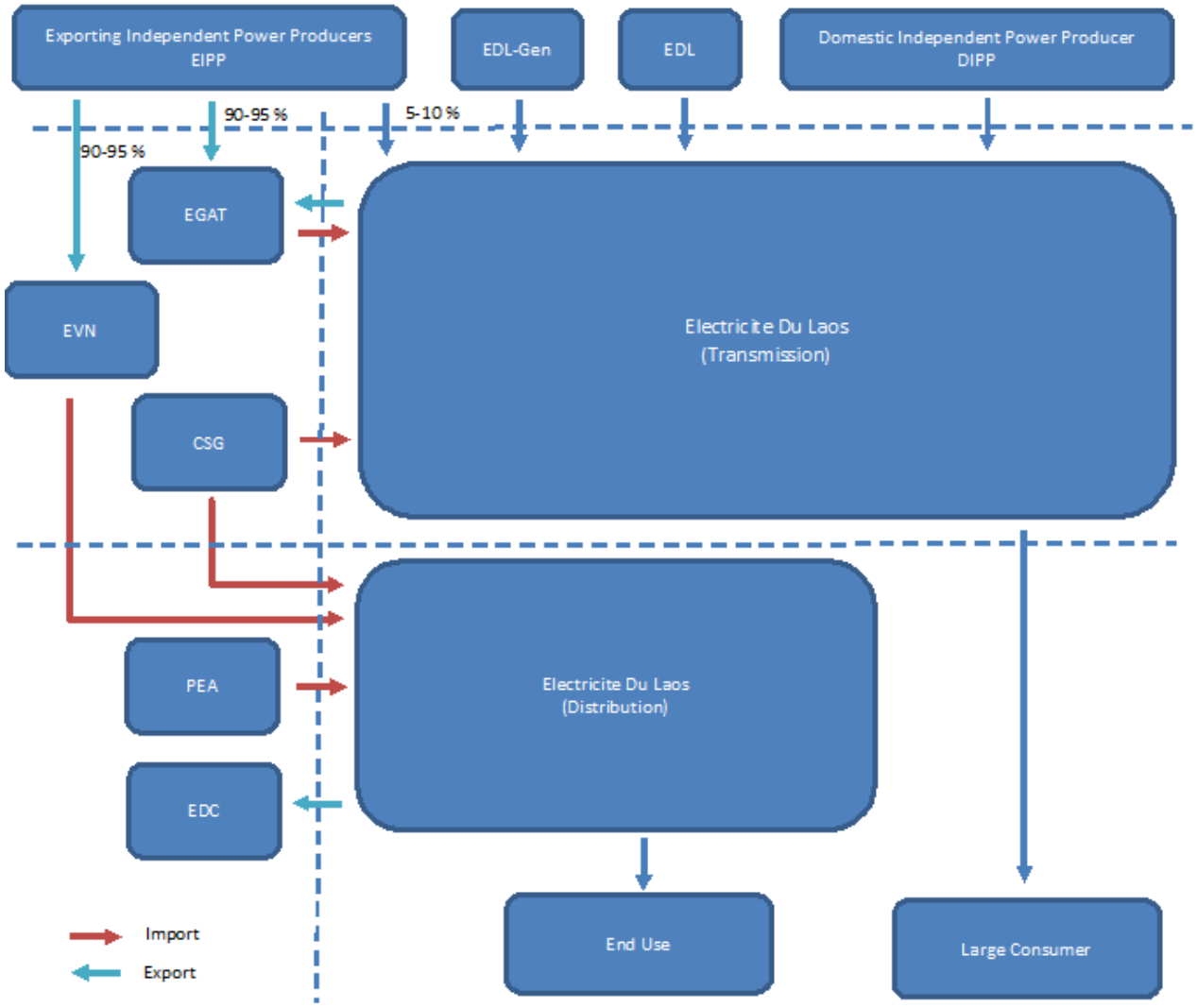
[b]Energy Market Authority of Singapore website. https://www.ema.gov.sg/news-events/news/media-releases/2023/ema-grants-conditional-approvals-for-2gw-electricity-imports-from-indonesia#:~:text=The%20Energy%20Market%20Authority%20%28EMA%29%20is%20granting%20Conditional,%28GW%29%20of%20low-carbon%20electricity%20from%20Indonesia%20into%20Singapore

[c] ANTARA News website. https://en.antaranews.com/news/102688/indonesia-imports-electricity-from-malaysia

Source: Authors.

1.1.2.4. Lao PDR

Figure 1.4. Structure of Lao PDR's Power Market



EGAT = Electricity Generating Authority of Thailand.
Source: Archive of the ASEAN Centre for Energy (2023).

Table 1.4. Structure of Lao PDR's Power Market

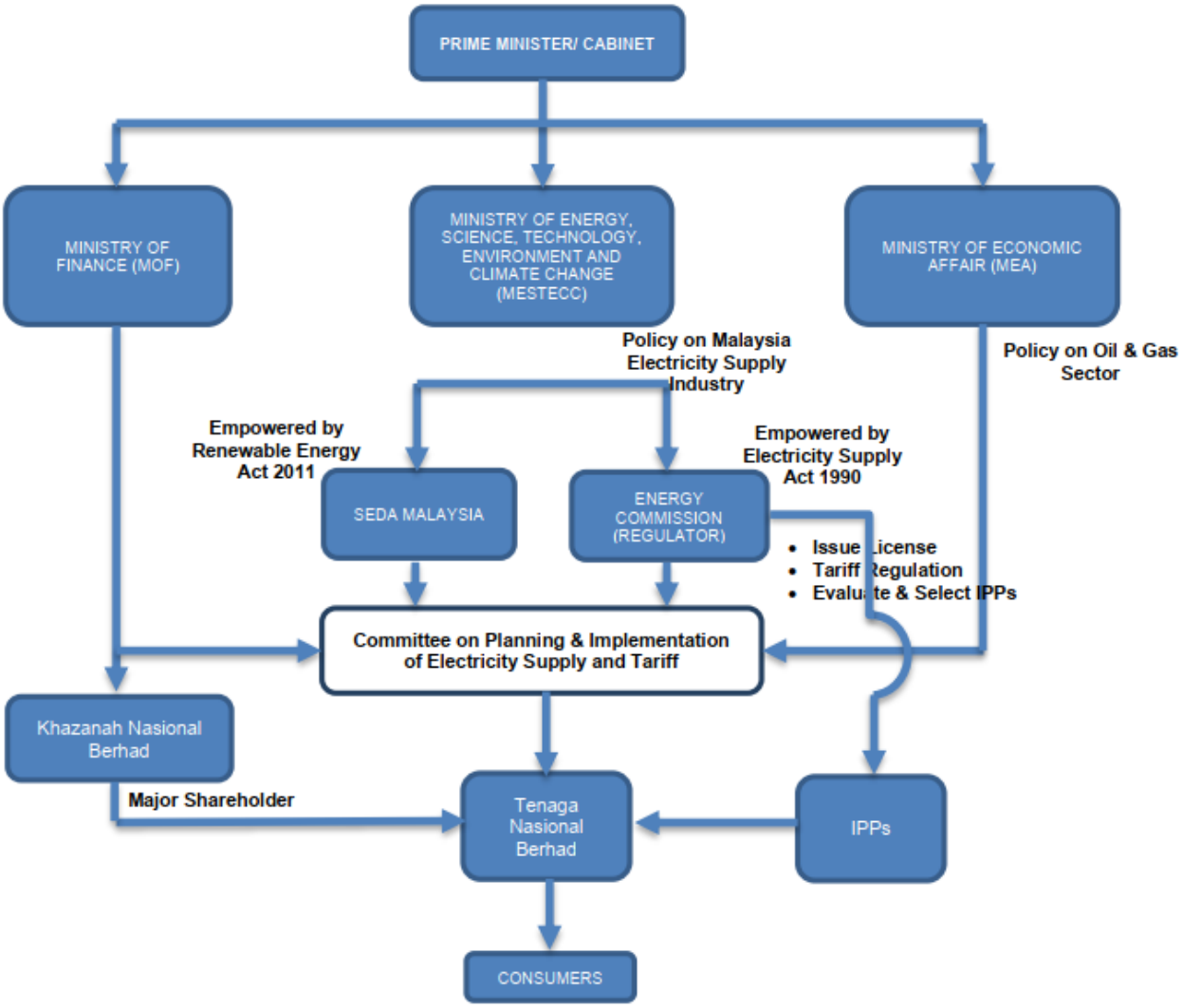
Market Structure	Vertically Integrated, Single Buyer Market
Stakeholders and Role	- Electricite du Laos (EDL): Buys produced power, handles generation, transmission, distribution, and retail - Exporting independent power producers (EIPPs) and domestic independent power producers: Produce and sell power to EDL - Department of Electricity Policy and Planning (DEPP): Electricity Regulator and Policymaker - Electricity Generating Authority of Thailand (EGAT): A Thai utility that

Market Structure	Vertically Integrated, Single Buyer Market
	acts as a power importer from EDL and exporter to EDL through the EDL transmission system. - Electricity of Viet Nam (EVN): Viet Nam utility company that imports power from the Lao PDR's EIPPs and exports surplus electricity to EDL through the distribution system. - China Southern Grid (CSG): China utility that acts as a power exporter to EDL at transmission and distribution level. - Provincial Energy Authority in Thailand (PEA): Thailand utility for the provinces in Thailand (outside of the metropolitan area), that acts as a power exporter to EDL at the distribution level - Electricité du Cambodge (EDC): Cambodia's power utility that acts as a power importer from EDL at the distribution level
Description	- EDL is a state-owned utility that acts as a single buyer in the market and is responsible for generating, transmitting, and distributing electricity to end users. Domestic IPPs sell power to domestic consumers via the EDL and exporting IPPs mostly export power to neighbouring countries, such as Thailand (EGAT) and Viet Nam (EVN). - The weak internal grid of the Lao PDR causes the electricity demand to rely heavily on imports from neighbouring countries, such as Thailand (EGAT and PEA) and China (CSG). Electricity surplus due to abundant supply of hydro resources are exported to Thailand (EGAT) and Cambodia (EDC) through the transmission and distribution network. Lao PDR's industrial and commercial consumers received electricity from the transmission network of the EDL. - DEPP develops the national energy policies; monitors the energy sector to ensure compliance with applicable policies and regulations; and develops strategic plans for generation, transmission, distribution, rural electrification, renewable energy, and energy exports. - The tariff policy is regulated by DEPP. The Lao PDR implemented the subsidisation policy of lower-income households and farmers, which creates pressure on EDL's profit.
Additional Remarks Related to Bilateral or Multilateral Power Trading	- The Lao PDR has developed several interconnections with Thailand which has been importing electricity from the Lao PDR since 1993. Currently, the Lao PDR has 17 interconnections with Cambodia, southern China, Myanmar, Thailand, and Viet Nam, allowing power trade within the Greater Mekong Subregion (GMS). - Based on Lao PDR Electricity Law, the electricity transmission across the Lao PDR must be conducted via the National Electricity Transmission Grid by payment of a service fee, unless the Lao PDR National Electricity Transmission Grid is unable to supply the needs.

Source: Authors.

1.1.2.5. Malaysia (Peninsular, Sabah, and Sarawak)

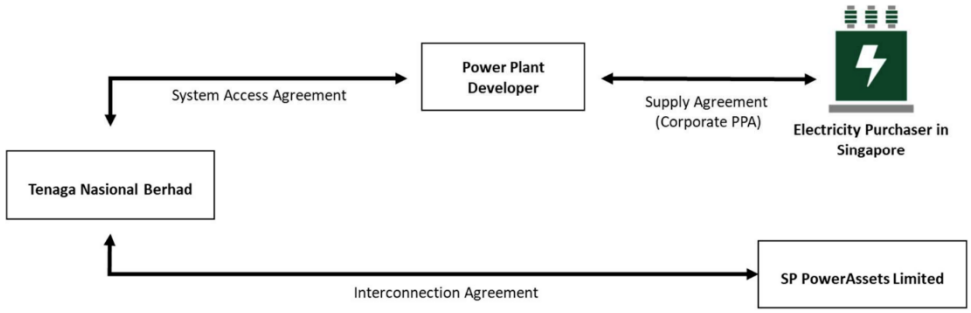
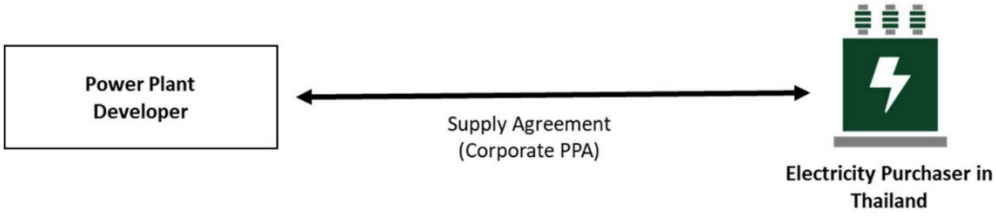
Figure 1.5. Structure of Peninsular Malaysia's Power Market



Source: Archive of the ASEAN Centre for Energy (2023)

Table 1.5. Structure of Peninsular Malaysia's Power Market

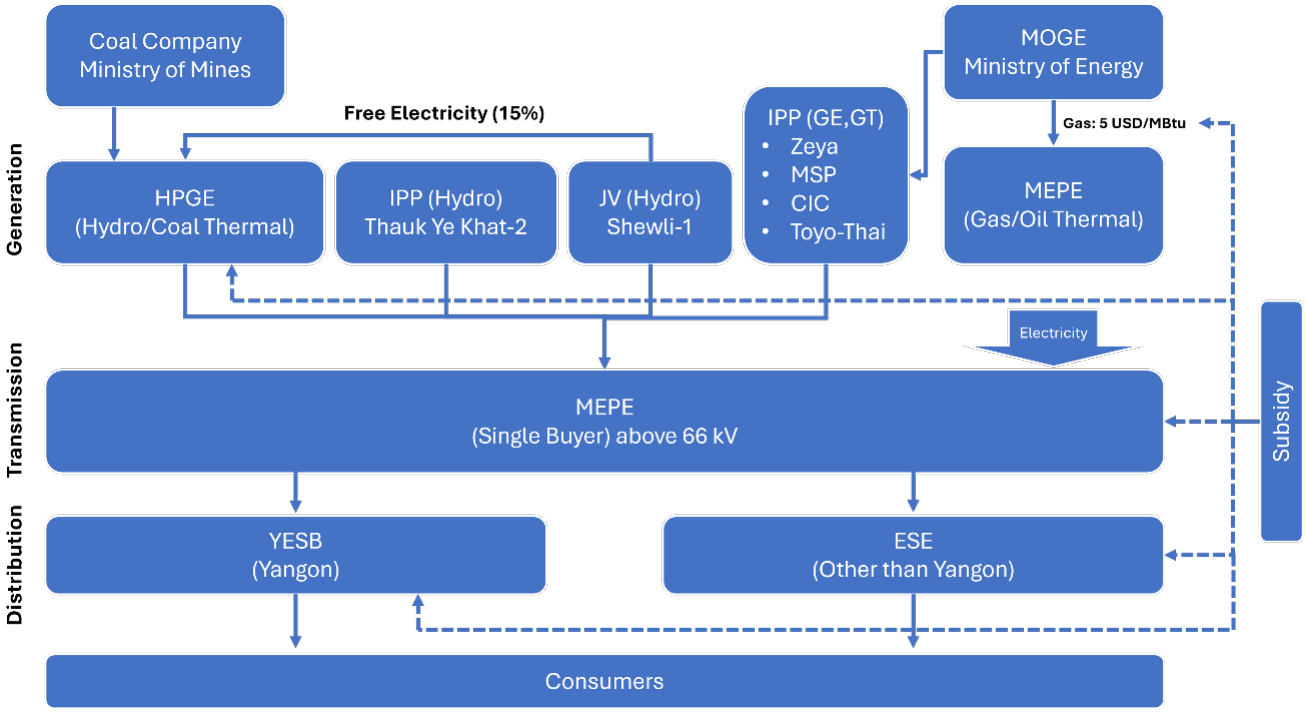
Market Structure	Vertically Integrated, Single Buyer Market
Stakeholders and Role	- Tenaga Nasional Berhad (TNB), Sabah Electricity Sdn Bhd (SESB), Sarawak Energy (previously SESCO): Power utilities responsible for electricity generation, transmission, and distribution, and as single buyers and retailers - IPPs: Power producer and seller to TNB - Suruhanjaya Tenaga or Energy Commission: Electricity regulator - Ministry of Finance (MoF), Ministry of Natural Resources, Environment, and Climate Change; previously Ministry of Energy, Science, Technology, Environment, and Climate Change), Ministry of Economic Affairs (MEA): Policymaker - Khazanah National Berhad: Public limited company under the Minister of Finance that is the major shareholder of the TNB - Committee on Planning and Implementation of Electricity Supply and Tariff (JPPPET): Committee responsible for determining and approving the Generation Development Planning for Peninsular Malaysia and overseeing the TNB. - Sustainable Energy Development Authority: Statutory body that administers and manages the implementation of the feed-in tariff mechanism under the Renewable Energy Act 2011
Description	- The TNB operates the Peninsular Malaysia power system and market, SESB operates Sabah, and SESCO operates the Sarawak system and market. The TNB generates and buys power from IPPs, which is regulated by the Energy Commission, then sells it to the consumers. - The Energy Commission or Suruhanjaya Tenaga regulates the licence issuance for electricity supply and business, electricity tariff for the consumers, and evaluates and selects the IPPs to legally produce and sell power to the TNB. The commission regulates the tariff for electricity in Malaysia, as it is influenced by the cost of importing electricity, capacity payments, and forecasts of efficient operating costs. The Malaysian government allocates an electricity subsidy of RM5.2 billion for the second half of 2023 in Peninsular Malaysia. - The generation sector of Malaysia has been reformed in the early 1990s to allow the entry of IPPs due to the need of private investment. But they must obtain licences from the government to operate (issued by the Electricity Commission). The IPPs produced and sold electricity to the TNB

Market Structure	Vertically Integrated, Single Buyer Market
	through power purchase agreements (PPAs), which are then distributed by the TNB, with special licences to local distributors in certain designated areas (i.e. industrial parks, shopping complexes, hill resorts, etc.)
Additional Remarks Related to Bilateral or Multilateral Power Trading	- As of 2023, Malaysia is interconnected to Thailand (from 2002) and Singapore (commissioned in 1985), which is then used for the Lao PDR-Thailand-Malaysia-Singapore Power Interconnection Project (LTMS-PIP). The interconnection from Thailand was primarily used for imports from the Lao PDR (LTM-PIP). - The Energy Commission is the authority that enables the release of licensing certificates to power plant developers (PPDs) - The TNB acts within each billing period to produce energy delivered to the grid, wheeling charges, and shortfall energy charges shall PPD fail to execute its duty. - Contractual Arrangement of Cross-border Electricity Sales (CBES) CBES to Singapore using existing interconnection.  CBES to Thailand using dedicated interconnection. 

Source: Suruhanjaya Tenaga (2024), modified by the authors.

1.1.2.6. Myanmar

Figure 1.6. Structure of Myanmar's Power Market



Source: Archive of the ASEAN Centre for Energy (2023).

Table 1.6. Structure of Myanmar's Power Market

Market Structure	Vertically Integrated, Single Buyer Market
Stakeholders and Role	- Myanmar Electric Power Enterprise (MEPE): Myanmar's state-owned company that acts as a single power buyer, handles generation procurement from generation companies (GENCOs) and transmission grid operation. MEPE owns the generation sector. - Hydro power generation enterprise, joint venture company, IPPs: Generation companies that function as a power producer from various resources. - Myanmar Oil and Gas Enterprise and Ministry of Mines: Policymakers - Ministry of Electricity and Energy: Electricity regulator - Yangon Electricity Supply Corporation (YESC), Energy Supply Enterprise (ESE): Handles electricity distribution

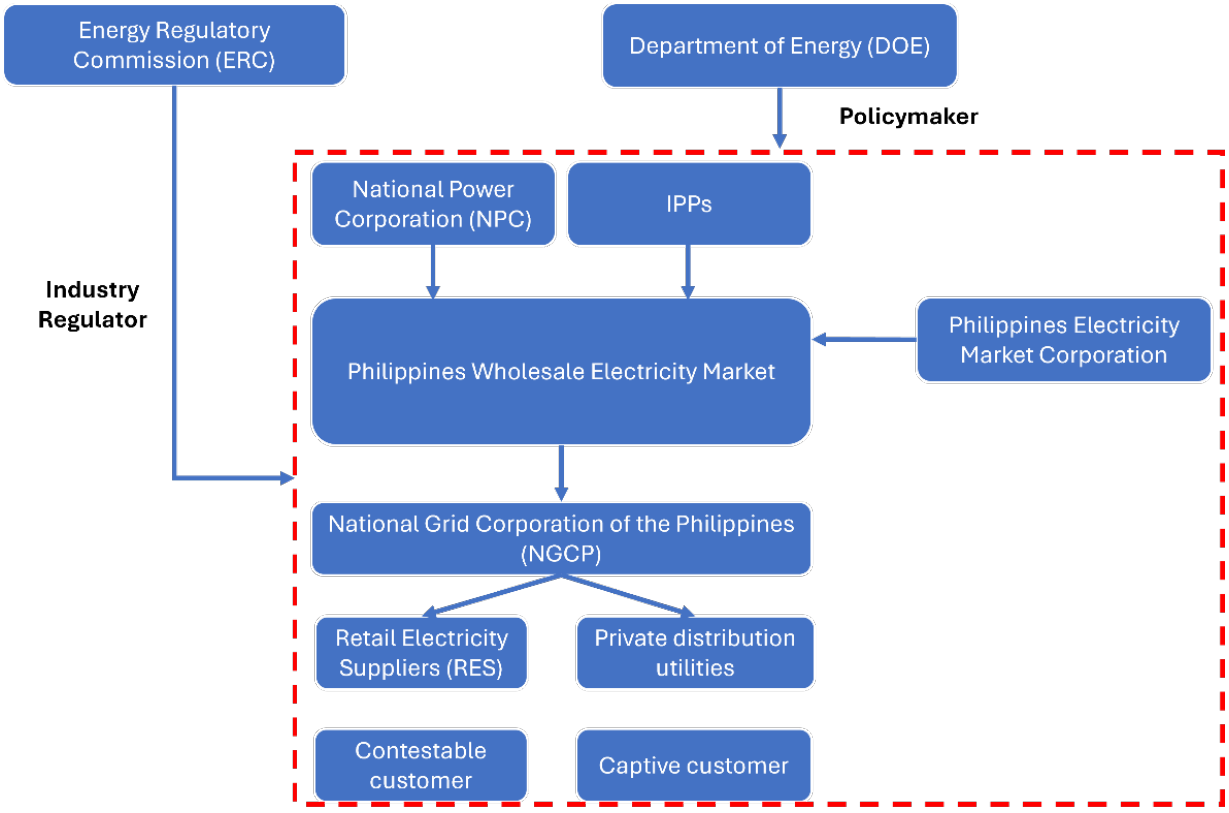
Market Structure	Vertically Integrated, Single Buyer Market
Description	- Myanmar has deregulated the power generation sector, allowing participation in the form of joint ventures and build-operate-transfer projects, with the operators obtaining a licence from the Myanmar Investment Commission. - With abundant hydropower, Myanmar generation companies are divided into thermal and hydro power generation companies. The MEPE, Hydro Power Generation Enterprise, joint venture companies, and IPPs supply electricity from hydropower and thermal power plants, where the MEPE thermal generation receives a special subsidised tariff for the fuel cost. The joint venture hydro power plant, Shweli-1, allows 15% of the total annual produced electricity to be supplied to Myanmar's grid for free under the agreement. - The generated power from the power producers is then transferred into the transmission network operated by MEPE, which is then distributed to Yangon through the YESC and the rest of the country through the Energy Supply Enterprise. - The MOEE as the electricity regulator subsidises the electricity supply to help reduce the possibility of spikes in tariff.
Additional Remarks Related to Bilateral or Multilateral Power Trading	- Myanmar has limited interconnections with other ASEAN countries, particularly Thailand and the Lao PDR. However, Myanmar exports electricity to China from the joint venture project between the two countries, Shweli-1 and Dapein-1 hydropower plants. - In 2018, Myanmar, China, and Bangladesh agreed on trilateral electricity trading.[a]

[a] China Daily website. https://global.chinadaily.com.cn/a/201803/09/WS5aa27fd1a3106e7dcc140b8c.html

Source: Authors.

1.1.2.7. Philippines

Figure 1.7. Structure of the Philippines' Power Market



Source: Archive of the ASEAN Centre for Energy (2023).

Table 1.7. Structure of the Philippines' Power Market

Market Structure	Wholesale Electricity Spot Market (WESM)
Stakeholders and Role	National Power Corporation (NPC) and IPPs: Power producer Philippine Electricity Market Corporation and Independent Electricity Market Operator (IEMOP): Electricity market governors and operators National Grid Corporation of the Philippines (NGCP): Operates power transmission National Electrification Administration: Oversees the electric cooperatives Department of Energy (DOE) and Energy Regulatory Commission (ERC): Electricity market regulator Private distribution utility: Handles power distribution

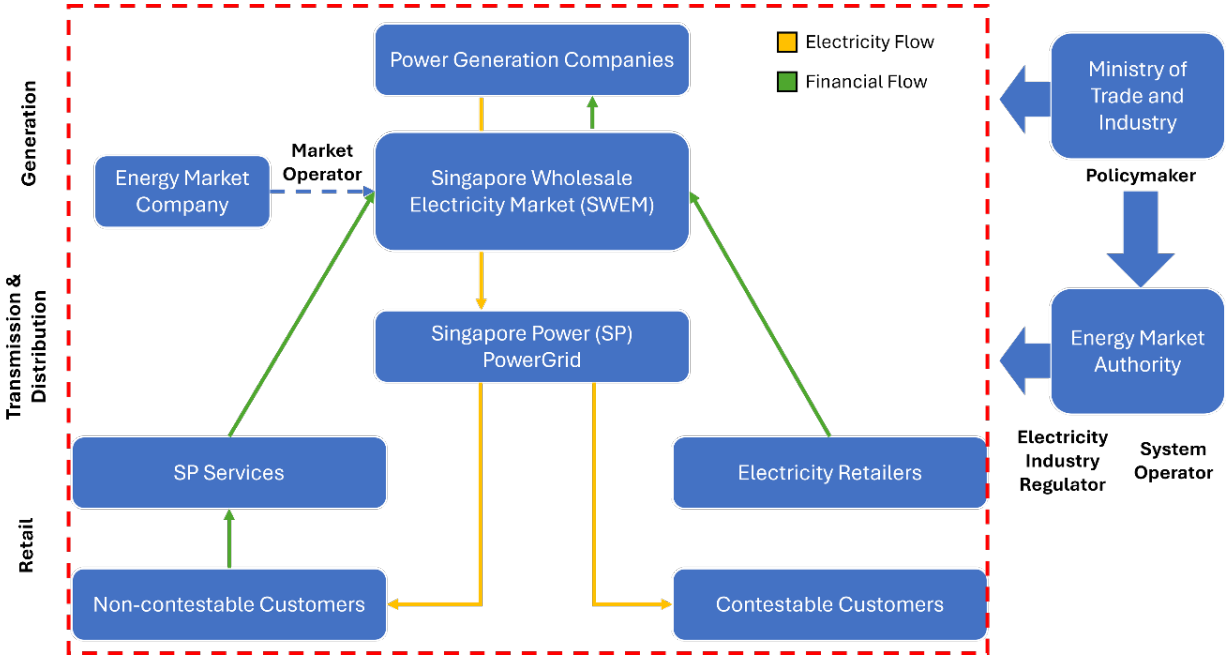
Market Structure	Wholesale Electricity Spot Market (WESM)
Description	- NPC and IPPs produce power and sell it directly to non-contestable consumers through the NGCP and distribution utilities, or to retail suppliers, which can be traded later through the WESM. The traded power then could be retailed to contestable >750 kW consumers. - The pricing determination methodology for the WESM is subject to the approval of DOE and the ERC. Besides the power trade, the government subsidises electricity tariff for low-income consumers. - WESM was opened as part of the Electric Power Industry Reform Act in 2001, with a more recent reform passed in 2018. - ERC regulates the electricity prices for the captive market, while the competitive market is liberalised. - The Philippines has Renewable Portfolio Standard (RPS) rules to mandate power industry participants to produce a specific portion of electricity from eligible renewable energy sources to grow the renewable energy share in generation. The RPS proposed a calculation to determine the minimum annual requirement per mandated participants. The non-compliant participants will receive a penalty of up to 500,000 pesos (₱) or even revocation of mandated participant's licence to operate. - The Philippines' power reserve spot market was expected to commence on 26 December 2023. Test cases for the operation trial had been executed since August 2023.[a] - In September 2023, the Philippines amended its Renewable Energy Act, now allowing full (100%) foreign ownership of renewable energy projects[b] - Working procedure of the WESM[c] Registration to the WESM (prior to injecting or withdrawing electricity) → Scheduling the power dispatch based on offers and bids in the WESM → Pricing procedure, set by offer price of the plant necessary to serve demand → Dispatch of the electricity, self-compliance to the arranged schedules → Settlement of the power purchase with the buyer

Market Structure	Wholesale Electricity Spot Market (WESM)
Additional Remarks Related to Bilateral or Multilateral Power Trading	- As of 2023, the Philippines has yet to have a cross-border interconnection with other countries in ASEAN. However, the 41st AMEM back in August released a joint statement endorsing BIMP-PIP to further expand the MPT in the subregion.

[a] Independent Electricity Market Operator (IEMOP) website. https://www.iemop.ph/market-reports/reserve-market-top-test-cases/
[b] Philippine News Agency website. https://www.pna.gov.ph/articles/1209831
[c] https://doe.gov.ph/sites/default/files/pdf/electric_power/4-introduction-to-wesm.pdf
Source: Authors.

1.1.2.8. Singapore

Figure 1.8. Structure of Singapore's Power Market

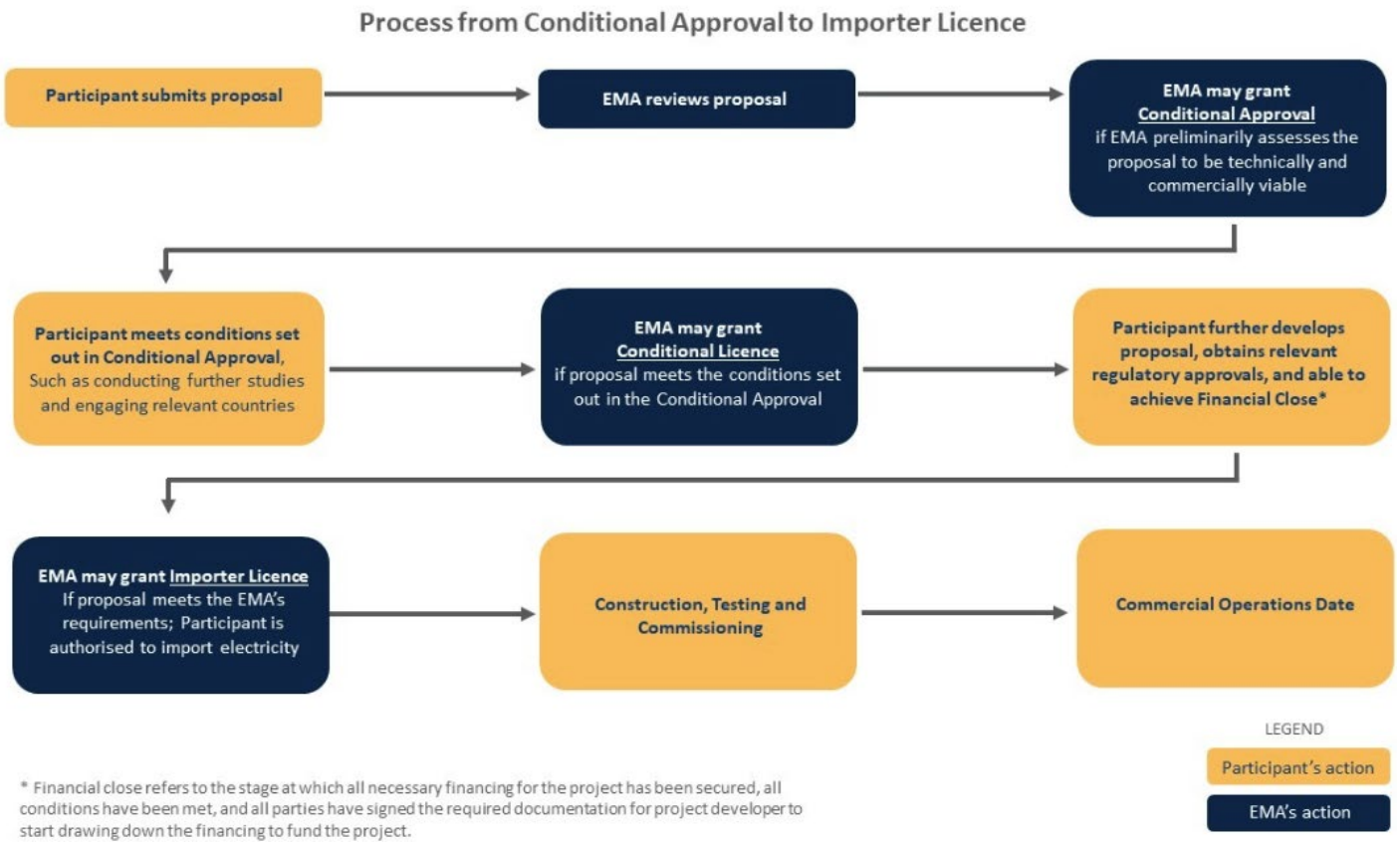


Source: Archive of the ASEAN Centre for Energy (2023).

Table 1.8. Structure of Singapore's Power Market

Market Structure	Competitive Liberalised Market – Singapore Wholesale Electricity Market (SWEM)
Stakeholders and Role	- Ministry of Trade and Industry: Policymaker - Energy Market Authority (EMA): Electricity regulator and market supervisor, and power system operator - Market participant retailers: Electricity retailers to consumers, purchase produced power from the electricity market and sell it to contestable consumers - IPPs: Produce power in a competitive generation sector. - Singapore Power: State-owned utility responsible for maintaining the transmission and distribution system in Singapore.
Description	- The IPPs participate in producing power and selling it through SWEM, which MPRs could then purchase in bulk and sell to contestable consumers. The non-MPRs could purchase electricity indirectly from the wholesale market through Singapore Power services to sell to contestable consumers. - Disruptions in global fuel price will create volatility in Singapore's domestic electricity price and the Energy Market Authority (EMA), as the electricity regulator, does not give subsidies to control the electricity price. EMA introduced a temporary price cap mechanism to further strengthen SWEM from extreme price volatility. - In October 1995, the Government of Singapore privatised the power company sector to promote market competition. By 2014, the power retail market has been fully deregulated. Currently, the challenges are that supplied power exceeds demand by 50%, stagnant gas prices, solar power generation increases competition for gas-fired generators, etc.
Additional Remarks Related to Bilateral or Multilateral Power Trading	- Singapore's electricity import licence granting mechanism. Proposals from participants (energy company) → EMA to review and may grant conditional approval → participants to conduct studies and engage with countries to meet the required conditions → EMA to grant conditional licence → proposal development from participants (regulatory approvals, able to achieve financial close) → EMA to review and may grant importer license → construction, testing, and commissioning → COD[a]

Market Structure	Competitive Liberalised Market – Singapore Wholesale Electricity Market (SWEM)



- EMA granted conditional approval to five projects (Pacific Medco Solar, Adaro Solar International, Energias de Portugal Renewables Asia-Pacific, Vanda RE, and Keppel Energy), to import 2 GW of low-carbon electricity from Indonesia to Singapore (September 2023)

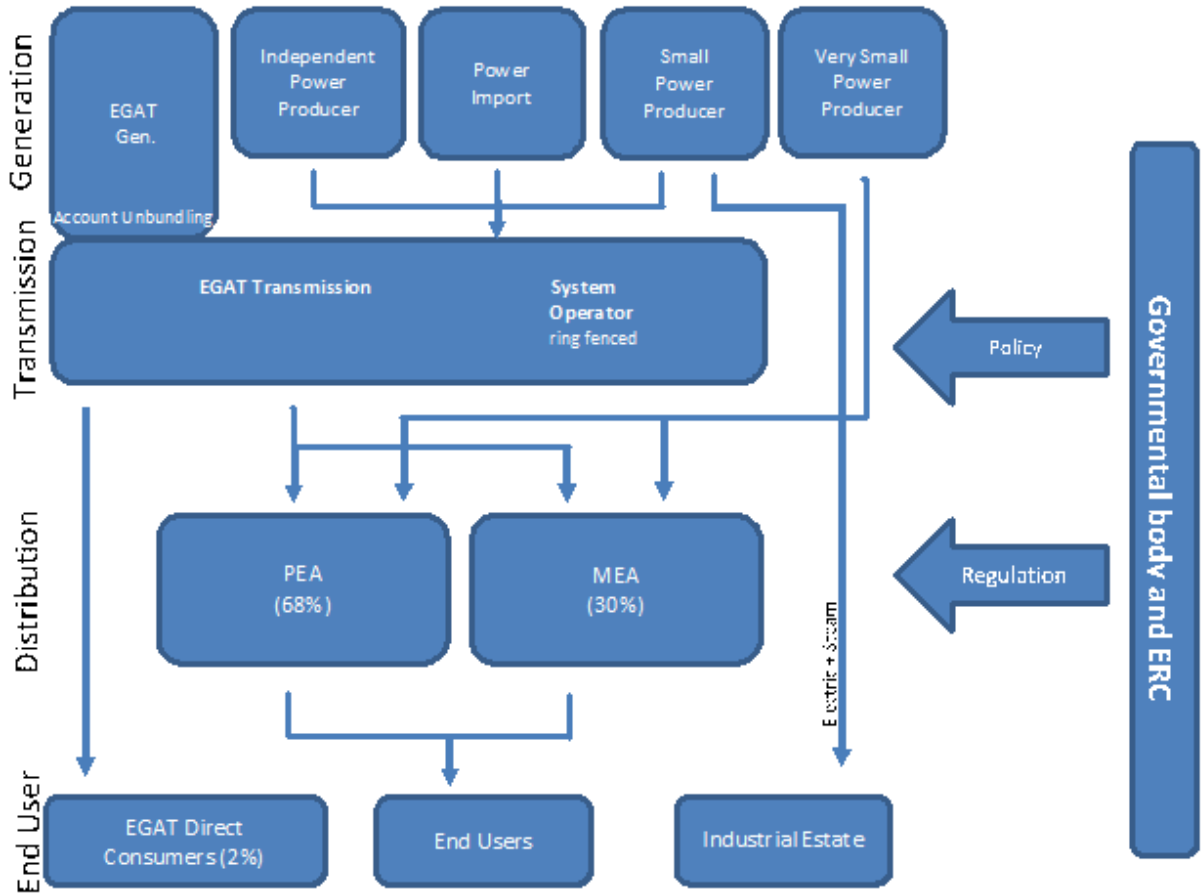
Consortium led by PacificLight Power will import 100 MW of non-intermittent electricity from a solar farm in Pulau Bulan, Indonesia (September 2023)

[a] Energy Market Authority of Singapore website. https://www.ema.gov.sg/our-energy-story/energy-supply/regional-power-grids

Source: Authors.

1.1.2.9. Thailand

Figure 1.9. Structure of Thailand's Power Market



EGAT = Electricity Generating Authority of Thailand, ERC = Energy Regulatory Commission, MEA = Ministry of Economic Affairs, PEA = Provincial Electricity Authority.
Source: Archive of the ASEAN Centre for Energy (2023).

Table 1.9. Structure of Thailand's Power Market

Market Structure	Vertically Integrated, Enhanced Single Buyer Market
Stakeholders and Role	- Electricity Generating Authority of Thailand (EGAT Gen), IPPs, small power producers (SPPs), very small power producers: Generation sector companies that produce power and sell the power to EGAT - EGAT Transmission: EGAT subsidiaries that handle transmission operation - Provincial Electricity Authority (PEA) and Metropolitan area Electricity Authority (MEA): Distribution companies that handles the

Market Structure	Vertically Integrated, Enhanced Single Buyer Market
	power distribution to all provinces in Thailand (PEA) and to the Metropolitan Area, including Bangkok (MEA). - National Electricity Policy Council and Ministry of Energy (MoE): Policymakers - Energy Regulatory Commission (ERC): Electricity regulator
Description	- Thailand's SPPs are private or state enterprises that generate electricity either from non-conventional sources such as wind, solar, and mini-hydro energy or fuels such as waste, residues, or biomass, or from conventional sources and using co-generation under 60 MW (<90 MW on a case-by-case basis). - EGAT acts as the single buyer, transmission operator, and power producer. EGAT purchases produced power from IPPs and SPPs and distributes it through the Ministry of Economic Affairs (serves the Metropolitan Bangkok Area) and PEA (the rest of Thailand). Very small power producers (<10 MW) directly distribute the produced power to industrial estates. - Electricity prices in Thailand include a base rate (fixed cost of electricity generation) plus an automatic tariff adjustment (variable cost, like fuel). The rate is reviewed every few months by the ERC. Thailand also gives electricity subsidies, around 9.13 billion baht, to help alleviate the impact of hikes in electricity bills.
Additional Remarks Related to Bilateral or Multilateral Power Trading (MPT)	- As of now, Thailand has several interconnections with ASEAN members including the Lao PDR, Malaysia, Cambodia, and Myanmar. It also participates in the first MPT in the region, namely, the LTMS-PIP. - Receiver of electricity purchase: EGAT will act as a buyer that transmits electricity from other countries' operator based on existing PPA agreements (Lothongkam and Chusanapiputt, 2020). - Thailand's bilateral power trading mostly operates under a government–government cooperation scheme.[a] - In 2019, Thailand's government announced its ambition to be a power-trading hub in Southeast Asia. The scheme is to buy more electricity than it needed from the Lao PDR and sell it to Malaysia, Cambodia, and Myanmar.[b]

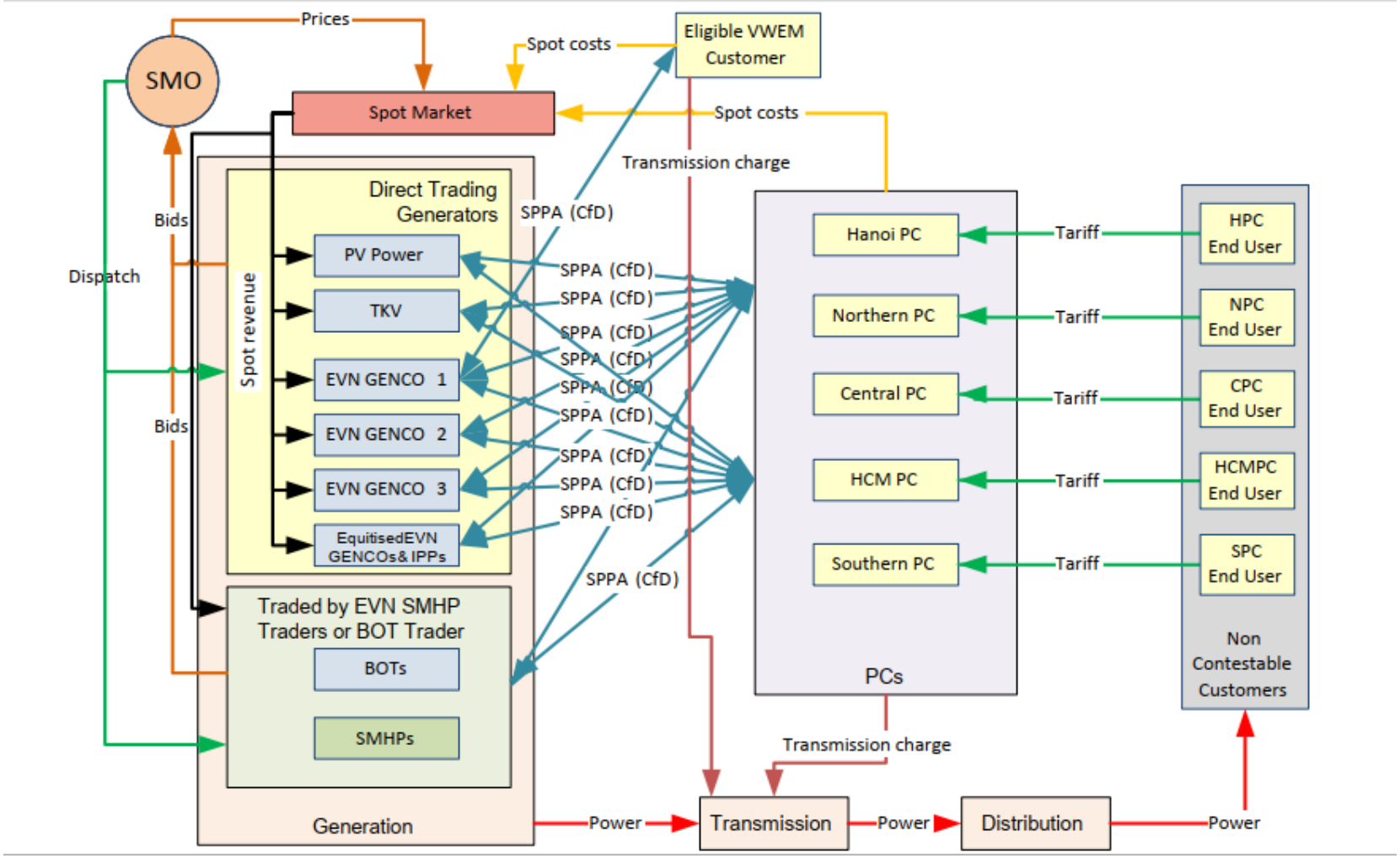
[a] http://www.eri.chula.ac.th/eri-main/wp-content/uploads/2013/12/04-Thai-Perspective-on-Power-Import-from-Myanmar-Jiraporn-Sirikum.pdf

[b] Bangkok Post website. https://www.bangkokpost.com/business/1736995/thailand-aims-to-be southeast-asias-power-trading-middleman

Source: Authors.

1.1.2.10. Viet Nam

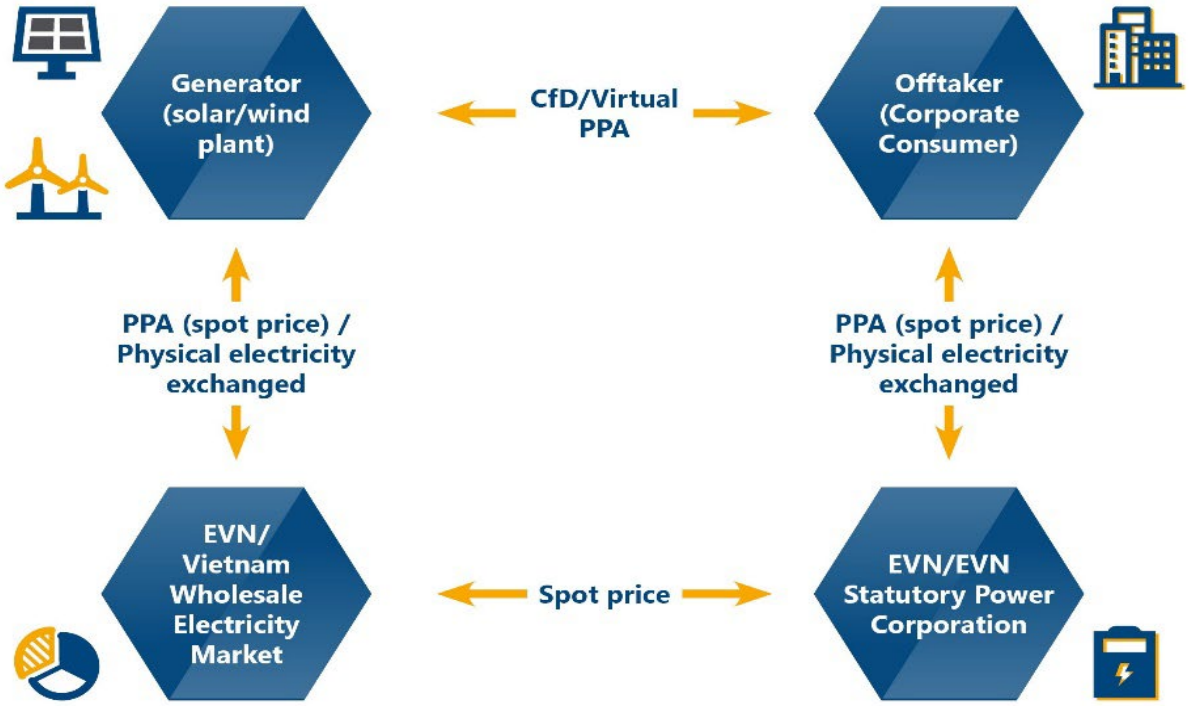
Figure 1.10. Structure of Viet Nam's Power Market



Source: EVN NLDC (2019).

Table 1.10. Structure of Viet Nam's Power Market

Market Structure	Vietnam Wholesale Electricity Market (VWEM)[a]
Stakeholders and Role	- Vietnam Electricity (EVN), generation companies (GENCOs), IPPs, build–operate–transfers, Strategic multipurpose hydropower plants: Power companies that act as electricity producers and sellers to the wholesale market (trading generators) - Metering Data Management Service Provider: Electricity company that support service providers (data metering) - National Load Dispatch Centre/System and Market Operator (SMO): Power utility services which handle the power dispatch and operate the market. - National Power Transmission: National corporation that handles power transmission to the power retailers - Power companies: Power purchasers and retailers - Distribution companies: Companies that provide distribution services - Electricity Regulatory Authority of Vietnam: Electricity regulator of Viet Nam's electricity wholesale market and operation - Ministry of Industry and Trade: Policymaker and regulator
Description	- The generation companies and power producers could sell the generated power to Viet Nam's five power companies or eligible VWEM customers through the spot market using a standardised power purchase agreement. The end user will pay the tariff set by each power company. The generation components must propose bids to the SMO, where the SMO will put on the purchase price to the spot market. - The electricity prices in Viet Nam are divided into several tiers and groups. Residential consumers are charged by their electricity consumption (kWh), while commercial and industrial consumers are classified based on voltage level and charged by consumption. Monthly subsidy equivalent to 30 kWh electricity usage is given to households classified as poor. - After its successful 1-year pilot in 2018, Viet Nam launched the VWEM in 2019 and implemented the long-term arrangement of the VWEM in 2020.

Market Structure	Vietnam Wholesale Electricity Market (VWEM)[a]
Remarks	- The EVN proposed two direct power purchase agreement (DPPA) models, private-wire DPPA, which allows large consumers to purchase power directly from renewable energy GENCOs without going into the wholesale market, and on-national-grid DPPA, which allows buyers (consumers) to purchase power from renewable energy GENCOs with a contract for fifference through wholesale market.[b] - Viet Nam's power market price is capped at 1,602.3 VND/kWh in 2022. - Proposed DPPA Contractual Mechanism[c] 

Market Structure	Vietnam Wholesale Electricity Market (VWEM)[a]
Additional Remarks Related to Bilateral or Multilateral Power Trading	- On 6 July 2023, the Lao PDR representative and Vietnamese company (AMI Renewables Quang Binh) agreed to develop a large-scale wind project in Savannakhet province, Lao PDR. This deal is part of an ongoing deal of the Lao PDR selling electricity to Viet Nam by 2025. - The Viet Nam Retail Electricity Market, which allows customers (above 110 kV) to buy electricity directly from the spot market, is expected to finish the pilot in 2023 and expected to launch in 2024.

[a] EVN. https://vepg.vn/wp-content/uploads/2019/09/3.-DPPA_VNWholesaleElecMarket_EVNNLDC_20190612_En.pdf

[b] Power Engineering Consulting Joint Stock Company 3 (PECC3) website. https://www.pecc3.com.vn/en/update-on-the-development-of-direct-power-purchase-agreement-dppa-mechanism-in-viet-nam/

[c] Mayer Brown website. https://www.mayerbrown.com/en/insights/publications/2022/03/vietnams-direct-ppa-pilot-scheme-energy-market-update-february-2022

Source: Authors.

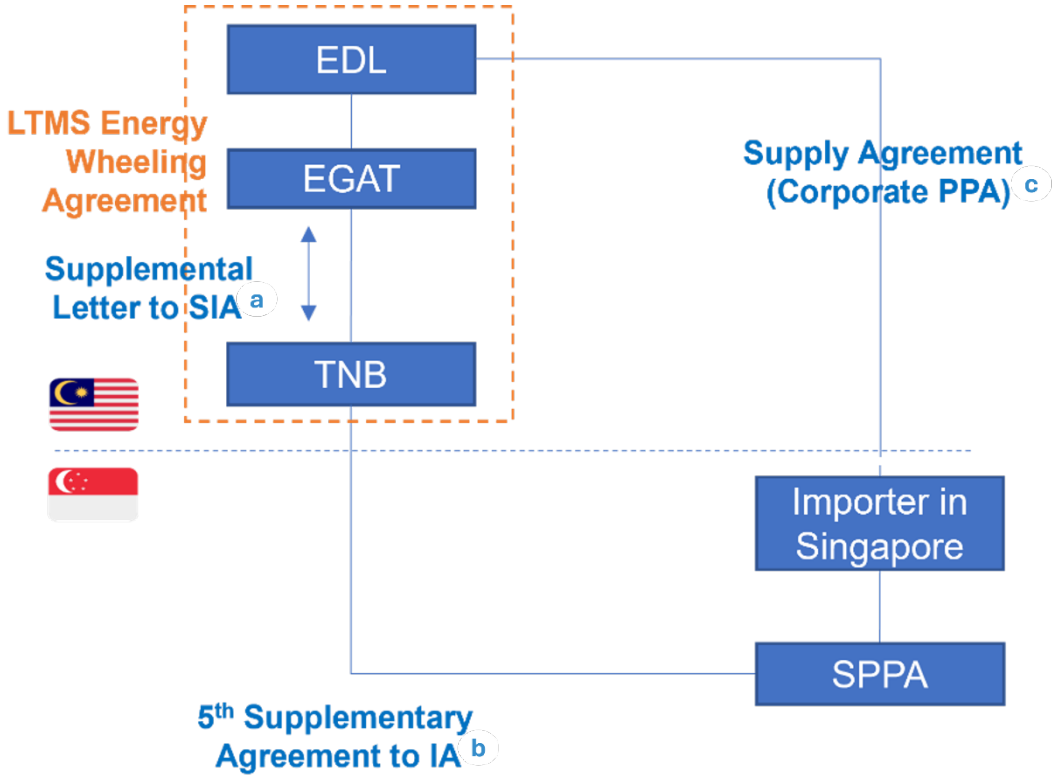
1.1.3. Lao PDR-Thailand-Malaysia-Singapore (LTMS) Power Integration Project (LTMS-PIP) Arrangement

This section outlines the details of arrangements under the LTMS-PIP project as the first MPT project in the region.

MPT in the ASEAN region started from bilateral agreements to trade electricity between two countries. The bilateral agreements then became tripartite agreements, as reflected in the Lao PDR-Thailand-Malaysia Power Integration Project (LTM-PIP). Under the tripartite agreement, Malaysia buys power from the Lao PDR and Thailand acts as the wheeler to transmit the energy. The Energy Purchase and Wheeling Agreement (EPWA), which served as an agreement on the wheeling charges and the purchased electricity price, was signed as a driver to push the LTM-PIP Phase II operation in December 2019.

The LTM-PIP later expanded into the Lao PDR-Thailand-Malaysia-Singapore (LTMS) Power Integration Project after an arrangement was set for the Lao PDR to sell 100 MW of clean energy (from hydropower) to Singapore using existing interconnections, with Thailand and Malaysia act as wheelers. The wheeling charges are applied upon the purchased power, as the process of the power transfer through Thailand and Malaysia requires utilisation of existing countries' transmission network. The duration of the agreement is 2 years, from 2022 to 2024. Based on the agreement, the Lao PDR must generate and sell electricity from hydropower plants to Singapore, which later will be transmitted to Thailand. Then Thailand is obligated to send an equal amount of power to Malaysia. After Malaysia receives power from Thailand, Malaysia must transfer the electricity to Singapore using the existing subsea interconnection.

Figure 1.11. Structure of LTMS Market Structure



[a] HVDC System Interconnection Agreement (SIA) between TNB and EGAT
[b] Interconnection Agreement (IA) between TNB and SPPA
[c] Supply Agreement between EDL and Importer in Singapore
Source: Archive of the ASEAN Centre for Energy (2023).

Table 1.11. Structure of the LTMS Market Structure

Market Structure	Multilateral Power Trade (MPT)
Stakeholders and Role	- Electricite du Laos (EDL): Lao PDR's power utility that acts as the power producer and exporter to Singapore. - Electricity Generating Authority of Thailand (EGAT) and Tenaga Nasional Berhad (TNB): Thailand and Malaysia power utilities, respectively, which act as power wheelers as the electricity, is traded through the countries. - Importer in Singapore and Singapore Power PowerAssets: Power companies which import electricity based on the signed agreement from the Lao PDR.
Description	- Power trade arrangement supplied from system to business in Singapore. The delivery of power from the Lao PDR complies with SWEM's market rules, which include penalty for non-delivery of energy according to existing arrangements.

Market Structure	Multilateral Power Trade (MPT)
	- LTMS-PIP required agreements to transfer electricity: (1) LTMS Energy Wheeling Agreement, (2) Fifth Supplemental Agreement to Interconnection Agreement between the TNB and standardised power purchase agreement, and (3) Supplemental Letter to HVDC System Interconnection Agreement between EGAT and the TNB. - Under the LTM-PIP, there is a similar MPT arrangement from the Lao PDR to Malaysia, which enables the Lao PDR to sell energy to Malaysia based on a 'willing buyer to willing seller' arrangement. Although the framework is like the LTM-PIP, the LTMS-PIP is more complex due to the different electricity market arrangements in Singapore.
Challenges	- Neighbouring countries are interconnected through bilateral arrangements, different power market structures, and MPT alignments with existing bilateral agreements. (Regulatory) - System-to-business trade arrangement since the Singapore power market has been liberalised, and penalty to SWEM's market participant that introduces financial risks to the wheeling countries. (Commercial)
Way Forward	1. Aligning national and regional development priorities Establishment of a regional authority that oversees the power system planning and development in the region, study on the formation of AGTP as a reference. 2. Identification of key interconnection projects for the region The establishment of ASEAN's Projects of Common Interest (PCI), like Europe. 3. Innovative interconnection business models Funding through a fixed payment from existing customer (regulated), by private investors (merchant), or combined both regulated and merchant business models.

Source: Authors.

1.1.4. Cross-border Interconnection Agreements and Mapping of Policies and Regulations to Power Trading in the AMS

This section outlines the existing energy trading agreement and regulations at the national, regional, and subregional levels. The information provided will be useful for designing and identifying possible future frameworks to advance ASEAN cross-border power trading in the form of bilateral power trading, expand to multilateral power trading, or establish regional power trading in the region.

Policies and Regulations

Table 1.12. Existing Policies and Regulations

No.	ASEAN Member State	Policies and Regulations that Facilitate Cross-border Trade	Information on the Respective Regulations
1	Brunei Darussalam	Code of Practice for Large-scale Solar PV Connection to Distribution Grid	A large-scale solar PV developer (existing or new infrastructure) may connect to Brunei's distribution grid through a thorough technical assessment and according to the National Grid Code and distribution service providers.
		Electricity Order (2017)	The authority may grant or extend electricity licence (with the approval of the minister), authorising any person to generate, transmit, and distribute electricity for or on behalf of a distribution licensee.
2	Cambodia	Law of Concession (2007)	Article 5 Concession contracts in relation to infrastructure facility providing direct or indirect services to the general public may be entered into by the relevant institutions in the following sectors, but not limited to power generation, power transmission, and power distribution. Article 6 A Concession Contract may provide the following: - Build, operate, and transfer - Build, lease, and transfer - Build, transfer, and operate - Build, own, and operate - Build, own, operate, and transfer - Build, cooperate, and transfer - Expand, operate, and transfer - Modernise, operate, and transfer

No.	ASEAN Member State	Policies and Regulations that Facilitate Cross-border Trade	Information on the Respective Regulations
			- Modernise, own, and operate - Lease, operate, and manage (type of contract arrangement) or any variant thereof or similar arrangement, including joint public–private implementation of infrastructure facilities.
		Cambodia Electricity Law (2001 – Amended 2015)	- The Ministry of Mines and Energy shall provide the information on policies, strategies, planning, and its decision on several things, including planning and agreements on the export and import of electricity (Article 4 – Amended)
3	Indonesia	Governmental Regulation Number 42, 2012 regarding Cross- border Electricity Trade	Cross-border electricity is allowed under the following conditions: 1. Domestic electricity needs have been met. 2. The selling price of electricity is not subsidised. 3. Cross-border electricity sales must not interfere with the quality and reliability of domestic supply. Every 6 months, the person in charge of electricity trade needs to report to the relevant ministry.
		Policy on RE Electricity Export Restriction	Electricity export ban from renewable energy sources due to self-sufficiency and achieving national target
4	Lao PDR	Law on Electricity (2017)	Article 8 The State broadens the relation and foreign, regional and international cooperation *[sic]* by exchanging experiences and information on electricity activities, such as generation, transmission, distribution, export–import, transit, development, and service of the

No.	ASEAN Member State	Policies and Regulations that Facilitate Cross-border Trade	Information on the Respective Regulations
			electricity business. Article 10 The electricity development plan shall: ....., Determine the electricity export based on the priority of electricity consumption and needs in neighbouring countries Articles 26–42 provide details on concession in the electricity business (grid and power plant investment).
5	Malaysia	Electricity Supply Act (1990)	According to cross-border trade regulation, cross-border facilitation (power plants, grid transmission, etc.) will always need to refer the act (Section 9 for licensing)
		Policy on RE Export Ban (October 2021)	The Malaysian government lifted the renewable energy export ban issued in October 2021 to expand renewable energy capacity in hopes of enabling cross-border trade.
6	Myanmar	Electricity Rules (2016)	Article 62: Allowing Permit for Export and Import for Countries Article 63: The Ministry will issue permit after considering 1. the impact of proposed export or import on the safety, reliability, security, and stability of electric power system of the nations; 2. the impact of proposed export or import on the electricity cost and availability for the customer; 3. the electricity security of state; and 4. such other factors as the ministry

No.	ASEAN Member State	Policies and Regulations that Facilitate Cross-border Trade	Information on the Respective Regulations
			determines relevant.
7	Philippines	Republic Act No. 9136 (Electric Power Industry Reform Act)	Regulating the Philippines' Electricity Sector of distribution, transmission, generation Transforming the electricity sector to competitive mechanism (through the establishment of a wholesale electricity market) that promotes bilateral power supply as mechanism of distribution that can be applied by anyone and subject to review by the ERC (Section 30)
		Executive Order No. 30 (2017)	Harmonising relevant investment agencies to support projects of 'national significance'.
		Amendments on Department Circular DC2022-11-0034 Section 19	Repeals the section that limits foreign ownership of renewable energy in the exploration, development, and utilisation. Now foreign ownership can achieve 100% rate.
8	Singapore	Singapore Act (2001)	Article 3.c, 3ca, 3ea-> Import or export is within administrative duties to regulate (licensing, electricity installation, generation, etc.)
		Second Request for Proposal (RFP2) to Appoint Licensed Electricity Importers	The Energy Market Authority (EMA) targeted to import up to 4 GW of low-carbon electricity by 2035. In doing so, EMA invited interested companies to submit proposals for importing up to 4 GW of electricity in Singapore, advancing the country's renewable energy mix.
9	Thailand	Electricity Generating Authority Thailand Act, B.E. 2511	Section 6 Article 1: EGAT has rights to generate, acquire, transmit, or distribute electric energy to other electricity law, electricity customer under royal law and neighbouring countries

No.	ASEAN Member State	Policies and Regulations that Facilitate Cross-border Trade	Information on the Respective Regulations
			Article 2: EGAT has rights to undertake various activities concerning electric energy, energy sources. Section 9 Article 6: To borrow or to invest Article 9: To collaborate any activities with other entities whether internal or external entities of the private or state or with international organisations, or to hold shares in any limited company or public company limited for the benefit of the activities under EGAT's objectives.
10	Viet Nam	Viet Nam's Electricity Law (2004)	Article 28: Electricity purchase and sale with foreign countries The electricity purchase and sale with foreign countries **must be permitted** by competent state bodies and stated in the electricity operation licences.
		Viet Nam's PPP Law (2020)	Article 4: Allowing PPP investment on five sectors, including building of power plants, power grids with several exceptions.

PPP = public–private partnership, PV = photovoltaic, RE = renewable energy.
Source: Authors.

Existing Intergovernmental Agreement for Power Cooperation in ASEAN Region

Agreement under ASEAN (APG MoU)

- The APG MoU was an agreement signed amongst the AMS to strengthen and promote a broad framework for the member countries to cooperate towards the development of a common ASEAN policy on power interconnection and trade, and ultimately towards the realisation of the APG to help ensure greater regional energy security and sustainability based on mutual benefits.

- The MoU stated the general provisions for the AMS: (1) establish cooperation on power interconnection and trade and the realisation of the APG, (2) initiate studies and updates to support the implementation of power interconnection projects, (3) encourage cooperation and pooling of resources for joint projects subject to commercial viability pertaining to the APG, and (4) take individual and collective initiative to assess and review national and regional legal and institutional frameworks for power interconnection and trade.
- The MoU also touched on the dispute settlement mechanism, institutional arrangements, cross-border issues, and other related existing agreements.

Agreement under Greater Mekong Subregion (GMS)

The GMS was established in 1992, with Cambodia, China, the Lao PDR, Myanmar, Thailand, and Viet Nam as members of the intergovernmental cooperation. The initiative supports the implementation of high-priority subregional projects in various sectors, including energy. The existing GMS electricity sector is well interconnected, allowing cross-border electricity trade between member countries. The following agreements enable cross-border electricity trade amongst the GMS countries (with the link to the documents).

Table 1.13. Agreements under the Greater Mekong Subregion

GMS Documents			
No.	Intergovernmental Agreement	Year Released	Findings
1	The Policy Statement on Regional Power Trade in the Greater Mekong Subregion	1999	- The policy statement set the stage for the GMS governments to develop and sign an intergovernmental agreement (IGA) to implement the policy statement. - The agreement called for the establishment of Regional Power Trade Coordination Committee (RPTCC)
2	The Intergovernmental Agreement on Regional Power Trade in the Greater Mekong Subregion	2002	- The agreement specified main points for cooperation to recognise regional power trade as an integral part of sectoral development, importance of technical performance and standards harmonisation, information sharing, and

GMS Documents			
No.	Intergovernmental Agreement	Year Released	Findings
			protection of the environment while embarking on GMS regional power trading. - Set up the establishment of the RPTCC.
3	Guidelines for the Regional Power Trade Coordination Committee	2004	- Guidelines citing Article 4 of the IGA regarding functions, institutional power (establishment and operation of Power Trade Operating Agreement [PTOA] is subject to approval by the RPTCC), role of IGA ministries and the RPTCC. - Based on the discussion, several things were agreed on: 1. The RPTCC shall report to GMS ministerial conference 2. ADB will play role as special coordinator and co-vice chairperson 3. Election of Vice Chair from the country that will next Chair the RPTCC in alphabetical order
4	The Memorandum of Understanding on the Guidelines for the Implementation of Stage 1 of the Regional Power Trade Operating Agreement (MOU-1)	2005	- MOU-1 sets out the institutional structure and guidelines for the conduct of bilateral power trade in the so-called Stage 1 of regional power trade. Due to the differences in the regulatory frameworks and transmission networks in the GMS. - In Stage 1, the regional power trade is characterised by bilateral trade via power purchase agreements (PPAs) involving independent power producers (IPPs).

GMS Documents			
No.	Intergovernmental Agreement	Year Released	Findings
5	The Memorandum of Understanding on the Road Map for Implementing the Greater Mekong Subregion Cross-border Power Trading (MOU-2)	2008	- Defined the key activities and timelines up to 2012, intended to fully realise Stage 1 and prepare for Stage 2 of GMS Power Trading (Stage 2 begins when trading is possible between any pair of GMS members). - The key activities include the necessary preparatory studies and the update of the 'Indicative Regional Master Plan on Power Interconnection in the GMS' in 2010.
6	The Inter-governmental Memorandum of Understanding of the Regional Power Coordination Centre in the Greater Mekong Subregion (MOU-3)	2012	- Sets the establishment of the Regional Power Coordination Center (RPCC), with its main objective of promoting the synchronised operation of the national power systems towards a unified, fair, and transparent region electricity market. - The MoU defined the RPCC functions, governance, membership, structures of the organisation, financing, dispute settlement, and the special conditions that apply to the RPCC (privileges and immunities).

Source: Authors.

Agreement Related to the LTMS-PIP

Table 1.14. Agreements Related to the LTMS-PIP

Agreements Related to LTMS-PIP			
No.	Agreement	Year Released	Description
1	LTMS Energy Wheeling Agreement	2017	Tripartite agreement between Electricite du Laos (EDL), Electricity Generating Authority of Thailand (EGAT), and Malaysia's Tenaga Nasional Berhad (TNB) regarding the wheeling charges for electricity trade from the Lao PDR to Singapore Additional info on the LTMS-PIP: - Initiate electricity trade from the Lao PDR to Malaysia via Thailand up to 100 MW after signing EPWA - Extending EPWA (Energy Purchase Wheeling Agreement) expansion capacity from 100 MW to 300 MW of multilateral trade - Initiation of trade of 100 MW from the Lao PDR to Singapore Via Thailand and Malaysia (2022–2023) - EDL appoint Keppel as working partner to import 100 MW to Singapore. Both exclusive framework (August 2021) and PPA (June 2022) have been signed)
2	Fifth Supplemental Agreement to Interconnection Agreement	N/A	N/A
3	Supplemental Letter to HVDC System Interconnection Agreement	2002	A 25-year contract allowing the exchange and purchase of electricity using HVDC interconnectors between Thailand and Malaysia, with a capacity of 300 MW.

Source: Authors.

1.2. From the ASEAN Enabling Agreement for Establishing the AGTP and ATSO Institutions to a Framework Agreement for the MPT

The focus of APG in power market development was introduced in APAEC 2016–2025 Phase I: 2016–2020 with the strategy to initiate multilateral electricity trading under the APG programme area. In APAEC 2016–2020, Outcome-based Strategy 2: 'Initiate multilateral electricity trading', Action Plan (b) expressed the necessity to review recommendations to support establishing new APG institutions, the APG Transmission System Operator (ATSO) and APG Generation and Transmission system Planning (AGTP), which would support the advancement of power trading within the ASEAN region. Thus, ERIA, in collaboration with HAPUA, conducted two studies on the formation of the AGTP and the ASEAN Power Grid (APG) Transmission System Operator (ATSO) Institution (hereinafter called the ATSO/AGTP study), which assess international best practices on regional power planning institutions, the governance structure, and the road map to implement those institutions.

The ATSO/AGTP study proposed an institutional arrangement that enables the establishment of an MPT under the ASEAN Power Pool (APP) organisation. The proposal under the study is for the APGCC to be the executive committee to oversee and coordinate the implementation of system planning, system and market operations, and capacity building. Through the study, the AGTP and ATSO institutions are suggested to be established under the APP organisation to fulfil the required institutional arrangements for multilateral electricity trading and the common electricity market in the future. The AGTP will oversee system planning, focusing on evaluating system supply reliability and monitoring the condition of each interconnection, while the ATSO will focus more on the operation and coordination of the power system. As the output recommendation of the study, several high-level IGAs need to be established to ensure the security of data sharing and third-party access, establish an APG wheeling charges and losses calculation methodology, and act as the enabling agreement to establish the institutions.

APAEC 2021–2025 shifted its focus to include the development of a common market under the APG through the initiation of multilateral electricity trading. The remarkable commencement of the LTMS-PIP in 2016 started with a 2-year agreement to trade power with a capacity of up to 100 MW and expanded into 300 MW, marking the initiation of multilateral electricity trading within ASEAN. Upon the initiation of the LTM-PIP, ASEAN aimed to expand the MPT within the ASEAN region by studying the minimum requirements needed for the MPT such as wheeling charges methodology, third-party access, available transmission capacity calculation, and the data sharing framework as reflected in APAEC 2016–2025 Phase II: 2021–2025. Through the likes of the LTMS-PIP and the Brunei Darussalam-Indonesia-Malaysia-Philippines Power Integration Project (BIMP-PIP), which was initiated in the 41st ASEAN Ministers on Energy Meeting (AMEM), the ASEAN region has shown its interest in progressing towards the development of a common regional power market (RPM) through the subregional MPT projects.

All efforts on APG infrastructure and market development were facilitated by the APG MoU), a high-level IGA with the objectives of strengthening and promoting a broad framework for member states to cooperate towards the development of a common ASEAN policy on power interconnection and trade. The APG MoU has been the primary document in the hierarchy of APG official documents. The document was agreed upon and signed by all 10 AMS in 2007 with a duration of 15 years, which was extended for 3 years from its supposed expiration year in 2022. Following the forthcoming expiration of the APG MoU and the growing complexity of the APG infrastructure and market implementation process, it has become a necessity for ASEAN to establish a successor high-level agreement and to map the roles and responsibilities of APG-related bodies in supporting the implementation of APG. Hence, the 41st AMEM appointed and mandated the APGCC to lead the development of a new APG successor agreement along with the terms of reference (TOR) of APG bodies, with support from all AMS and APG-related bodies, including HAPUA and the ASEAN Energy Regulators Network (AERN) (ASEAN Secretariat, 2023).

The relevance of this study to the APG MoU renewal process mentioned above is that it provides a reference for ASEAN to consider, especially in revisiting the 2018 ERIA–HAPUA ATSO/AGTP study and exploring the institutional arrangements for MPT, looking at the existing APG-related bodies' functions and roles. This study will result in the required high-level IGA between the AMS and the implementation plan of MPT institutions, supporting the implementation of the AGTP and ATSO functions within the APG if the ASEAN country decides to have it. The study will map the existing APG-related bodies and analyse how the proposed ATSO/AGTP functions would fit in the current APG bodies.

To establish and mandate the existing APG bodies with the functions of the AGTP and ATSO, which support MPT as intergovernmental institutions, a high-level regional agreement needs to be in place to set a clear regional ambition for the institutions. Furthermore, more detailed protocols giving the appropriate authority to the relevant organisations to perform the relevant functions are needed. This is because the regional institutions will require mandates to be operationalised, based on certain agreed principles and processes within ASEAN. When looking at other international examples of established similar regional institutions and their approach to granting authority for decision-making, a high-level IGA between all involved member states is clearly a good starting point. It is equally important to establish the most efficient and appropriate reporting structure for these institutions through such agreements. Creating and pushing through the enabling agreement therefore is the first of several activities and a major stage that needs to be finalised during APG and MPT development.

The key findings and recommendations of the study could be considered as a reference and input for exploring the regional institutional setup on facilitating MPT and the development of the APG MoU successor agreement (along with its implementing protocols) and TOR of APG bodies. As the APG MoU renewal process is ongoing, the proposed successor agreement should have enough flexibility to explore different pathways of MPT that would

evolve in the region, including the necessary regional function to be in place to facilitate MPT and the establishment of a coordinating institution to facilitate APG implementation and power market implementation in ASEAN. Therefore, the recommendation of this study on the proposed road map and implementation plan in operationalising the MPT institutions and the advanced operation stage of the MPT institutions under the APG is a valuable insight for developing APG and the MPT power market in the future.

On a more general level, on establishing the functions of the AGTP and ATSO institutions, the relevant ministry from each AMS should be the contracting party, able to nominate a party or parties for different roles (e.g. the TSO for system operation) under the new institutions. Each country would have a set of bodies appointed in relation to the institutions or functions to be established, depending on the current and envisioned structure of the electricity market, policymaking, and regulation in the respective country.

While this study focuses on AGTP and ATSO institutions, the wider framework of APG and MPT coordination must include the function of market operation. Although the operation of the market is a goal to be pursued in the long term, the establishment of AGTP and ATSO institutions with the proposed agreement should be designed with such a future scenario in mind. In this study, the specifics of market operations will be reserved for more specialised future research. The proposed agreement thus is prepared for seamless integration of market operation function at a later stage.

1.3. Implementation of the Project

The 'Study on an Enabling Agreement amongst ASEAN Member States for Establishing Multilateral Power Trade/ASEAN Power Grid Institutions' is a collaborative initiative aimed at fostering regional electricity market integration within ASEAN. Spearheaded by ERIA, the project has navigated through various stages of planning, consultation, and validation with the active involvement of consultants like Nord Pool and stakeholders, such as ACE.

Project Initiation (September–December 2023): The project, aimed at establishing an enabling agreement amongst AMS for the MPT/APG Institutions, formed a project team amongst ERIA, ACE, and Nord Pool. This was affirmed with the signing of non-disclosure agreement and consultant contracts in September 2023. This was a critical step before the project could officially commence. ERIA actively participated in APG-related conferences, presenting the study's progress and engaging with potential stakeholders. By December, ACE, acting in its dual role as a consultant and a stakeholder, had delivered a compilation of institutions and regulatory documents, laying the groundwork for the project's inception.

Kick-off and First Workshop (January 2024): The project officially commenced with a merged kick-off meeting and the first workshop held online between 15–16 January 2024. This event was well-attended by representatives from HAPUA, APGCC, AMS, and experts from ERIA, ACE, and Nord Pool. Nord Pool, in its consulting role, sought to develop the draft agreement using technical language, a request that ERIA agreed to, ensuring the

document's accessibility to a broader audience. Information and comments were collected at the first workshop for the Nord Pool's analysis and moved into the next stage of drafting research reports and other deliverables, including an implementation road map and the outline of the IGA.

Drafting and Coordination (February–March 2024): During this phase, Nord Pool, as the consulting body, was tasked with producing a draft final report, road map, and IGA, incorporating the latest updates from ACE. ERIA and ACE continued to coordinate on key issues, including the nomination of attendees for the second workshop and the review of Nord Pool's draft documents, ensuring alignment with ASEAN stakeholders' expectations and the project's objectives.

Preparation for the Second Workshop (April 2024): As the project progressed into April, the Nord Pool team submitted the first draft of the final report, road map, and IGA to ERIA for review. Feedback was provided to Nord Pool for revisions, ensuring the documents met the project's standards. ERIA also prepared a separate summary report for the Asia Zero Emission Centre, highlighting the project's significance within the broader Asia Zero Emission Community initiative.

The Second Workshop and Validation (May 2024): The second workshop, held in Jakarta on 7–8 May 2024, served as a validation platform for the study's findings. It confirmed the integral role of the study in providing the recommendations in developing an intergovernmental agreement for enabling the establishment of multilateral power trade institutions under APG. Nord Pool's role as a consultant, supported by Ricardo, was pivotal during this phase, as they were responsible for finalising the deliverables based on the feedback and information collected during the workshop.

Finalisation and Reporting (End of May 2024): In the final stages of the project, Nord Pool worked closely with ERIA to finalise the deliverables, which included the main body of the final project report and the road map for publication. Other documents will be kept as internal references to ASEAN until the achievement of the framework agreement. ERIA, in collaboration with ACE, prepared the ERIA project report for public release. ERIA and Nord Pool are committed to further assist ACE in reporting the project's outcome to the upcoming SOME and AMEM.

Project Management: Throughout the project, ERIA played a central role in project management, coordinating the efforts of all parties involved, and ensuring the project's objectives were met. The team facilitated communication, managed the project's timeline, reviewed the deliverables, and ensured their alignment with AMS' expectations, and prepared necessary documents for workshops and reports. ACE acted as a critical channel to communicate and coordinate with the ASEAN stakeholders, while providing invaluable advice and guidance on strategic decisions, such as the scope, methodology, and deliverables of the project.

Chapter 2
Requirements for an Agreement to Implement the AGTP and ATSO

2.1. Objectives of the Study

This study originally aimed to develop a proposal outlining the core content of a high-level IGA amongst the AMS. The agreement would support the formation of institutions for the implementation of the AGTP and ATSO. The roles and functions of these institutions form part of a bigger structure to be set out in the APG MoU successor agreement, currently being discussed by the AMS. Part of the protocols, proposed for inclusion in the ASEAN MoU successor agreement, will describe areas of activity to be undertaken by the AGTP and the ATSO.

This study serves as input feeding into this bigger agreement and its protocols.

The study primarily focuses on the planning and system operations functions of the AGTP and ATSO. The detailed functioning of market operation is out of the scope of this study and is currently being discussed in a separate ongoing project led by the Asian Development Bank (ADB).

As an introduction, sub-section 2.2.1 describes the key recommendations from the previous work on the formation of ATSO/AGTP (Study on the Formation of the ASEAN Power Grid Transmission System Operator Institution (ERIA, 2018a) and Study on the Formation of the ASEAN Power Grid Generation and Transmission System Planning Institution (ERIA, 2018b) referred to as 'the 2018 studies'. Following this, sub-section 2.2.2 discusses a decentralised approach to organising these functions. Sub-section 2.2.3 presents the updated recommendation for organising the ATSO/AGTP functions.

2.2. APG Governance Structure and Institutional Arrangements

One objective of this study is to address a fundamental question: how to implement the functions of the initially proposed ATSO/AGTP institutions, as recommended in previous research, while incorporating the developments that have occurred since the conclusion of that work.

The key developments since 2018 studies comprise:

- The APG MoU renewal: a framework agreement and the associated protocols
- Feedback received from AMS in this study, indicating a preference for a more decentralised approach when it comes to the organisation of the proposed institutions.

- The aim of the AMS to utilise the existing APG bodies for the functions ATSO/AGTP rather than establishing a completely new organisation.
- Ongoing discussions on establishing a decentralised regional shadow trading platform.

The principles for the revised recommendations for the ATSO/AGTP functions are:

1. Building on the recommendations from previous work
2. Incorporating developments that have occurred since the conclusion of previous studies
3. Considering flexibility in organisations and systems, e.g. decentralised organisations, functions, and systems

2.2.1. Recommendations from Previous Work on Governance Structure and Institutional Framework

This sub-section provides an overview of recommendations from previous studies on the establishment of ATSO and AGTP as institutions with the intention of informing stakeholders who are not necessarily familiar with this work. This study builds on this work but does not necessarily endorse all the past recommendations. The recommendations of this study are presented separately in the following sections.

The 2018 studies on the formation of ATSO/AGTP (ERIA 2018a, ERIA 2018b) envisaged an intergovernmental institution, the APP, with the primary role of acting as a coordinating body between the AMS transmission system operators (TSOs), focusing on harmonising operational standards across ASEAN to achieve a more efficient operation of the future APG. Better coordination and alignment of the system operation and generation within the region is anticipated to provide heightened efficiency in operations. In the 2018 studies, the APP is expected to be a key institution to enable multilateral trading of electricity amongst ASEAN countries, while maintaining the balance, stability, and reliability of the interconnected power grids across borders. In addition, having the role of coordinating the APG system planning and grid developments will be of great importance to make the APG more efficient and better coordinated.

As envisioned in the 2018 studies, the APP would resemble a forum where operational, technical, and multilateral trading topics can be discussed and agreed. It will also have an important information-sharing role for the region. The responsibilities suggested for the APP would be to lead and coordinate the development of the regional market, establish and have ownership of the APG network codes and guidelines, and produce a regional system planning and development plan which would be continuously revised going forward. The APP reporting structure and organisation charts proposed in the 2018 studies are presented in Figure 2.1 and Figure 2.2, respectively.

In the 2018 studies, the APGCC) is proposed as the intergovernmental organisation or committee within the ASEAN structure which represents the AMS interests in the APG. Hence, it is a suitable body to initiate the APP establishment. The APGCC further reports to

HAPUA.

To establish this intergovernmental organisation, the 2018 studies recommend high-level regional agreements to be in place to set a clear regional ambition for the organisation, together with more detailed agreements giving the appropriate authority to the organisation and its function as a regional body. The APGCC would require a mandate to facilitate and own certain processes and agreed principles within the APG.

HAPUA supports the ASEAN Economic Community through the ASEAN energy market and the implementation of the APG. HAPUA's main objectives are to 'promote cooperation among its members to strengthen regional energy security through interconnection development, enhancing private sector participation, encouraging standardisation of equipment, promoting joint project development, cooperation in human resources, research and development, and to enhance quality and reliability of electricity supply system.'[a]

The APGCC holds 'the objective to strengthen and promote a broad framework for Member Countries 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.'[b]

'The current activity of APGCC is to prepare the ASEAN Electricity Exchange where the Multilateral Electricity Trading happens among the ASEAN Member Countries.'[c]

To make the establishment of the APP as straightforward and efficient as possible, it is suggested in the previous work that the APP Executive Committee be formed out of the APGCC. The APGCC would be a solid point of contact towards the wider ASEAN organisation as the APGCC is an organisational body under HAPUA and focuses on the realisation of the APG. The 'APGCC consists of chairman and vice chairman, members (governments and utilities representative), alternate members, and chair of HWGs No. 1, 2, 4, and 5.'[d] The existing APGCC voting system is suggested to be used for APP purposes.

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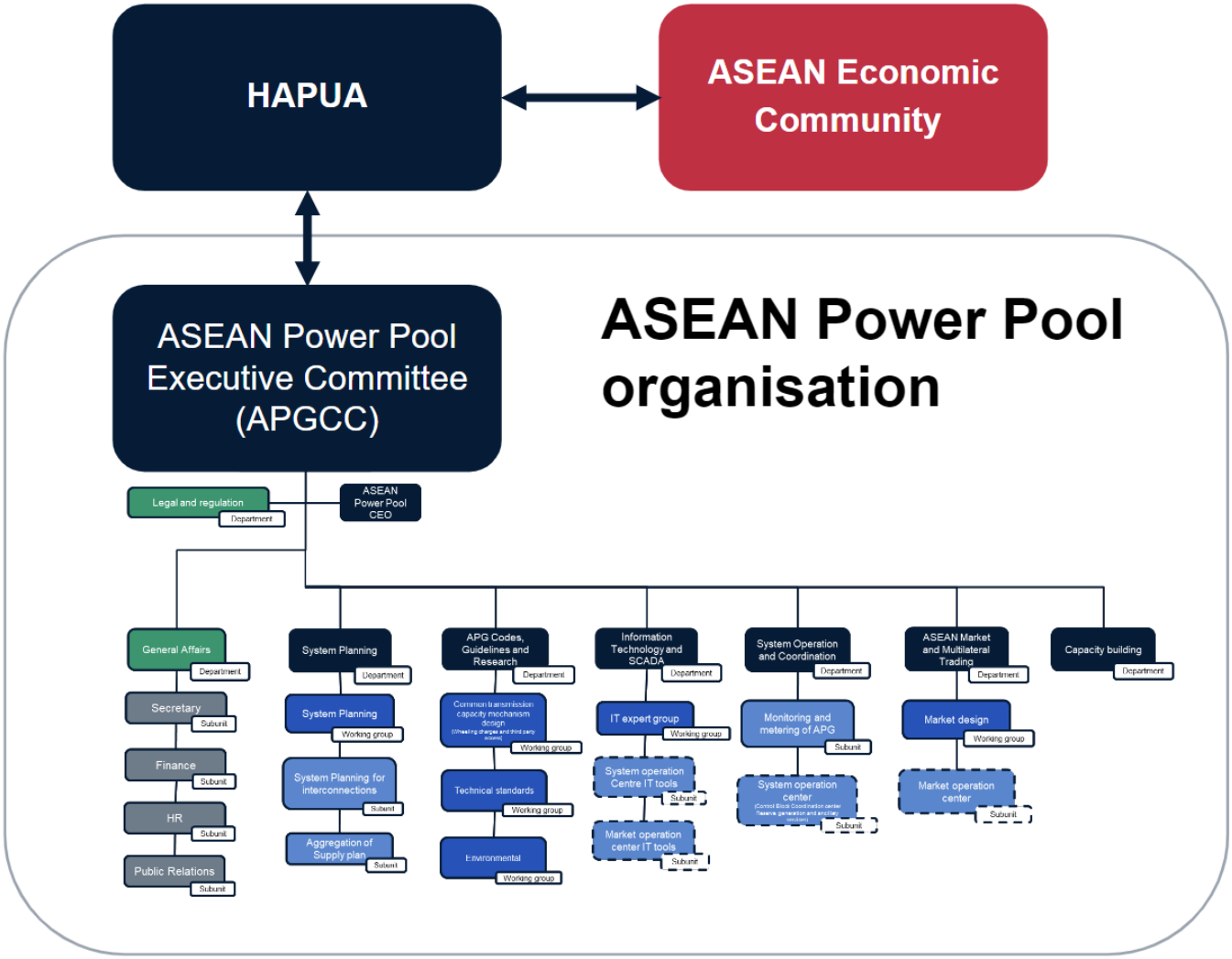
[a] HAPUA website. http://hapua.org/main/hapua/about/

[b] HAPUA website. https://hapua.org/main/hapua/about/#:~:text=Objectives%3A,on%20Generation%20and%20Renewable%20Energy

[c] HAPUA website. http://hapua.org/main/apgcc/about-apgcc/

[d] http://hapua.org/main/apgcc/about-apgcc/

Figure 2.1. Reporting Structure for the ASEAN Power Pool (APP) towards the ASEAN Economic Community using APGCC as APP Executive Committee, as Proposed in the 2018 Studies



APG = ASEAN Power Grid, ASEAN = Association of Southeast Asian Nations, HAPUA = Heads of ASEAN Power Utilities/Authorities, HR = human resources, IT = information technology, SCADA = Supervisory Control and Data Acquisition system.
Source: ERIA (2018a).

The 2018 studies suggest each APP department may have one or several sub-units and semi-internal working groups to carry out the relevant functions.

Table 2.1 shows the sub-units identified in the high-level structure discussed.

Table 2.1. Initial Sub-units in the ASEAN Power Pool Organisation Proposed in Previous Work

Department	Sub-units
Legal and Regulatory	None at the Beginning
General Affairs	• Secretary • Finance • Human relations • Public relations
System Planning (further elaborated in the AGTP reports)	• System planning for interconnections • Aggregation of supply plan
System Operation and Coordination	• Monitoring and metering of APG • System operation centre (in the future)
ASEAN Market and Multilateral Trading	• Market operation centre (in the future)
Information Technology and SCADA	• System operation centre IT tools (in the future) • Market operation centre IT tools (in the future)
APG Codes, Guidelines, and Research	None at the beginning, only working groups
Department	Sub-units
Legal and Regulatory	None at the Beginning
General Affairs	• Secretary • Finance • Human relations • Public relations
System Planning (further elaborated in the AGTP reports)	• System planning for interconnections • Aggregation of supply plan
System Operation and Coordination	• Monitoring and metering of APG • System operation centre (in the future)
ASEAN Market and Multilateral Trading	• Market operation centre (in the future)
Information Technology and SCADA	• System operation centre IT tools (in the future) • Market operation centre IT tools (in the future)
APG Codes, Guidelines, and Research	None at the beginning, only working groups

Source: Authors.

In addition to the sub-units, each department was seen to establish specific regional working groups under them. The primary objective of these working groups would be to gather specific field experts from each AMS to be taken into the development process of APP tasks. Essentially, the working groups would comprise part-time (consultancy contracted) employed experts from each AMS. These working groups would bear significant responsibility and could assist APP departments on creating, such as network codes or

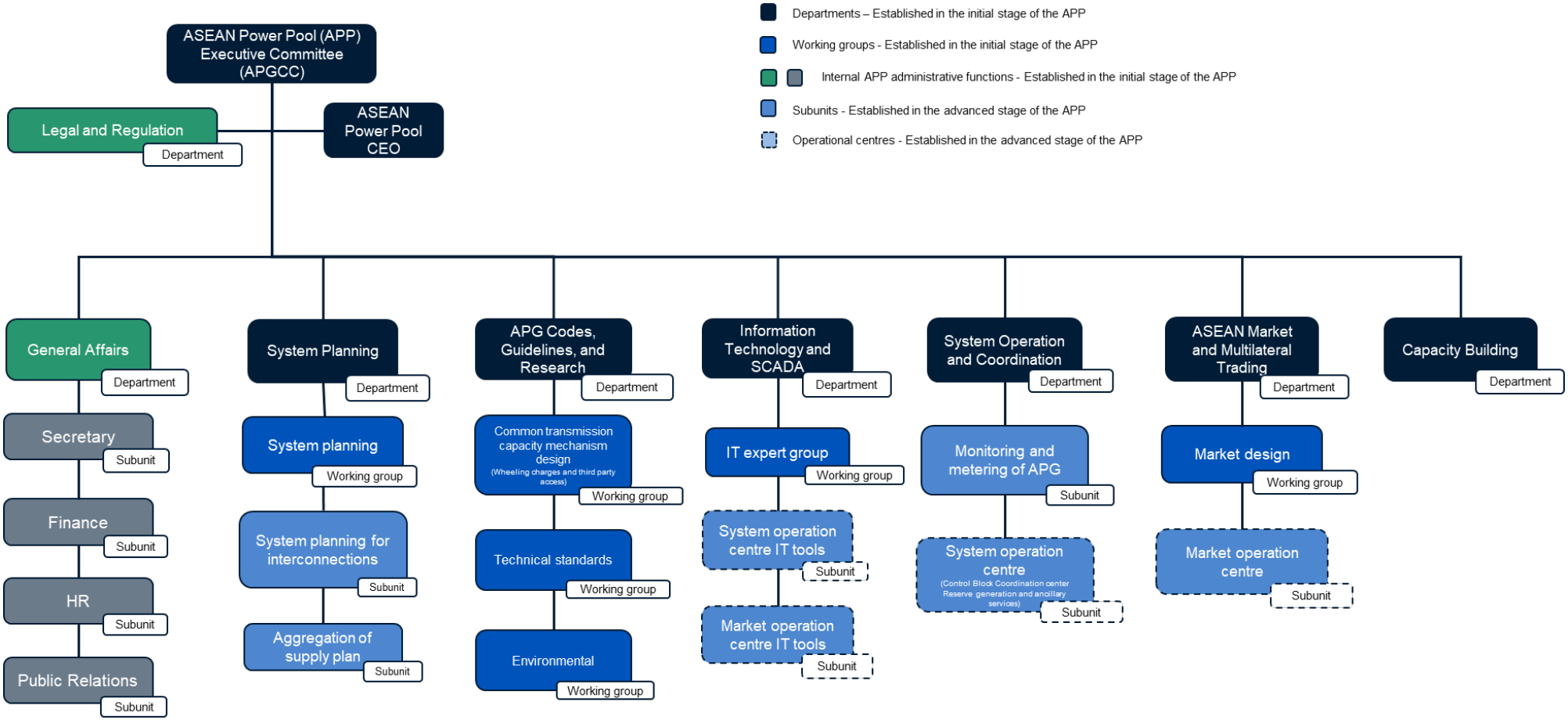
operation standards. Thus, the working groups would be an important gateway for harmonising the standards and procedures in the ASEAN region. It is important to recognise that some of the AMS have multiple TSOs and the establishment of the working groups would need to consider this to ensure comprehensive representation. The working groups would report directly to the respective departments and departmental leads and should be endowed with formal decision-making authority for the tasks assigned to them. Table 2.2 lists the semi-internal working groups identified in the 2018 studies for the initiation phase of the APP.

Table 2.2. Proposed Working Groups in the ASEAN Power Pool Organisation in Previous Work

Department	Working Groups
Legal and Regulatory	None at the beginning
General Affairs	None at the beginning, the work in this department is very internal APP tasks
System Planning	• System planning
System Operation and Coordination	None at the beginning, the work in this department is very internal APP tasks. Regional inputs will come through the System Planning and Development Department and the APG Codes, Guidelines, and Research Department.
ASEAN Market and Multilateral Trading	• Market design
Information Technology and SCADA	• Information Technology expert group
APG Codes, Guidelines, and Research	• Common transmission capacity mechanism design • Technical standards • Environmental
Capacity building	N/A

Source: Authors.

Figure 2.2. ASEAN Power Pool Organisational Chart, as Proposed in the 2018 Studies



Source: ERIA (2018a).

2.2.2. New Recommendations for a Decentralised Approach to Organising AGTP and ATSO Functions

Reflecting the proposal from the 2018 studies for the centralised organisation of ATSO and AGTP presented in the previous sub-section and keeping in mind the current context described in Chapter 1 for a different approach, this sub-section discusses the options for establishing the AGTP and ATSO functions in both centralised and decentralised manners. During the consultation workshop for this project, a pertinent discussion surfaced regarding the formal establishment of the functions of the AGTP and ATSO. It has become increasingly evident that to create a large new entity (like the APP as proposed in the 2018 studies on the formation of ATSO/AGTP) might not be the solution preferred by the AMS. This sub-section provides a description and recommendations for a more decentralised approach to establishing the AGTP and ATSO functions.

The centralisation and decentralisation discussion can be split into addressing decentralisation of the organisation and decentralisation of the functions of the organisation. These points are addressed below for both the centralised and decentralised approaches.

Centralised Approach

The attributes of a centralised structure, in this case for the organisation of the AGTP and ATSO functions, would generally include some of the following:

- Organisational structure: Hierarchical with centralised control
- Decision-making process: Centralised decision-making process
- Governance: Strong central governance with strict oversight
- Resource management: Centralised allocation and management of resources
- Information flow: Top–down communication, potential bottlenecks
- Response to changes: relatively slow to respond to market and environmental changes

Decentralised Approach

In a decentralised approach, the bulk of the work within the AGTP and ATSO functions would be delegated to the AMS participating in various working groups, rather than being centralised in a single entity.

The attributes of a decentralised structure for the organisation of the AGTP and ATSO functions, would generally include some of the following:

- Organisational structure: Networked with distributed control
- Decision-making process: Decision-making distributed across APP bodies and working groups
- Governance: Regional governance with autonomy within guidelines

- Resource management: Decentralised management, AMS manage resources allowing for more dynamic resource allocation
- Information flow: Open and horizontal communication
- Response to changes: Quick to adapt and respond to changes

In a decentralised approach to organisation, there will still be a need for a secretariat responsible for administering and coordinating the various functions and working groups. There are two options on how this could be organised, each with its implications and advantages, as outlined below:

1. Central Secretariat
2. Decentralised Secretariat

The first option, Central Secretariat, entails the creation of a physical (central) secretariat that will have an office.

Alternatively, the second option involves a decentralised secretariat where the functions are fulfilled or through types of secondment from the AMS and convened through an appropriate combination of virtual working utilising appropriate online platforms and periodic physical meetings (which could, for example, rotate around the AMS).

There are several reasons for the second option:

- It will ensure commitment from the AMS by having direct engagements in performing the functions and will not create a new regional body.
- It will provide more flexibility on the required participation as this could more easily be varied over time instead of having permanent employees.
- It will also make coordination easier as it will be a well-defined interface between the regional and national responsibilities where the responsibilities for the planning and system operations remain with the national utilities, and where the main role of the AGTP and ATSO will be to coordinate and harmonise both planning and operation from a regional perspective.

Implementing the second option of a decentralised secretariat requires a predefined set of protocols or procedures to ensure efficient implementation.

This approach is based on and supported by international experience, for instance, for the Single Electricity Market operation in Europe. The ENTSO-E (European Network of Transmission System Operators) and the Southern African Power Pool (SAPP) have similar setups on regional coordination and planning. But both have a physical secretariat with some permanent personnel while many of the resources are seconded.

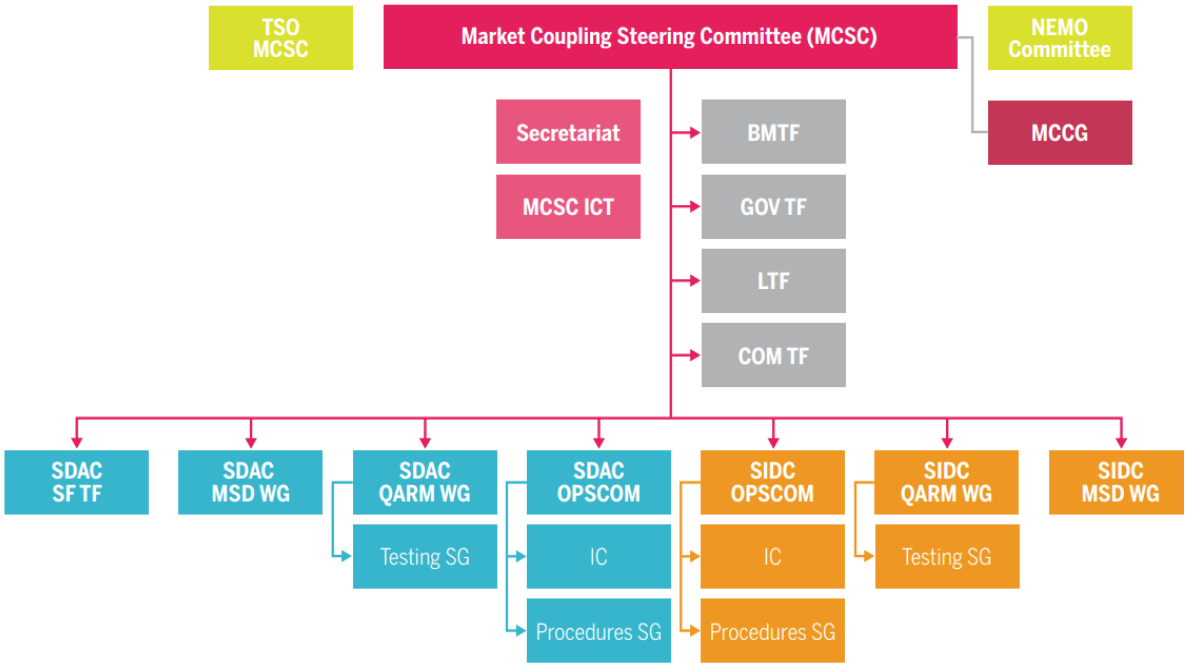
Figure 2.3. The European Market Governance Structure

Case Example: The European Single Electricity Market Operation

The European Single Electricity Market consists of the Single Day-ahead Market and the Single Intraday Market that are operated by the Nominated Electricity Market Operators in Europe and the European Transmission System Operators (TSOs). The Single Electricity Market operation and its governance is based on a virtual organisation without a physical secretariat. Some of the main components of this organisation include:

- A steering committee: the 'Market Coupling Steering Committee' with a representative from each of the participating market operators and TSOs.
- Multiple working groups under the Market Coupling Steering Committee. The activities of the committee are supported by horizontal joint working groups that, for example, address the legal or communication aspects. In addition, the market operation relies on dedicated working groups: Operations, Quality Assurance and Release Management, and Market and System Design.
- A secretariat of hired consultants supports the coordination and facilitation of the governance structure. There is no physical secretariat.
- Members of all working groups are representatives of their organisations.
- Chairs of the working groups represent their respective working group, not necessarily their organisation. The chairs of the working groups are not necessarily in that role full time and have other tasks in their organisation. Their hours for the chair position are recorded, and the cost is shared amongst the parties.

For reference, the governance structure of the European markets is presented in the following Figure 2.3.



Source: NEMO Committee (2022).

An additional argument in favour of this decentralised approach is that it would also cater to the fact that the level of unbundling and organisation of the power sector in the AMS is at different levels. Some have already unbundled their sector and operate an organised power market, while the power sector in others is still vertically integrated. Allowing each AMS to assign their relevant organisations to participate in the AGTP/ATSO working groups will ensure the required flexibility of a decentralised secretariat.

For the avoidance of doubt, this does not preclude the creation of a larger regional organisation over time. As an example, both in SAPP and ENTSO-E, separate Grid Control Units have been established to increase the coordination between the participating countries. These are established as physical centres. At a later stage of development, some ATSO functions are realistic to be implemented in a physical location, considering the requirement for SCADA systems, discussed in section 2.4.

Table 2.3. A Chart Categorising the Different Design Options

	Centralised Function	Decentralised Function
Centralised organisation	Centralised decision-making Centralised secretariat Centralised organisation ATSO and AGTP Functions performed by a single regional body	Centralised decision-making Centralised secretariat Centralised organisation ATSO and AGTP Functions performed by relevant AMS national bodies, seconded to the central organisation
Decentralised organisation	Decentralised decision-making Decentralised secretariat Decentralised organisation ATSO and AGTP Functions performed by a single regional body	Decentralised decision-making Decentralised secretariat Decentralised organisation ATSO and AGTP Functions performed by relevant AMS national bodies in coordination in various working groups

Source: Authors.

Recommendation

As outlined above, it is recommended to establish the ATSO/AGTP functions based on a decentralised approach and more specifically the second option, namely Decentralised Secretariat. This is recommended for the following reasons:

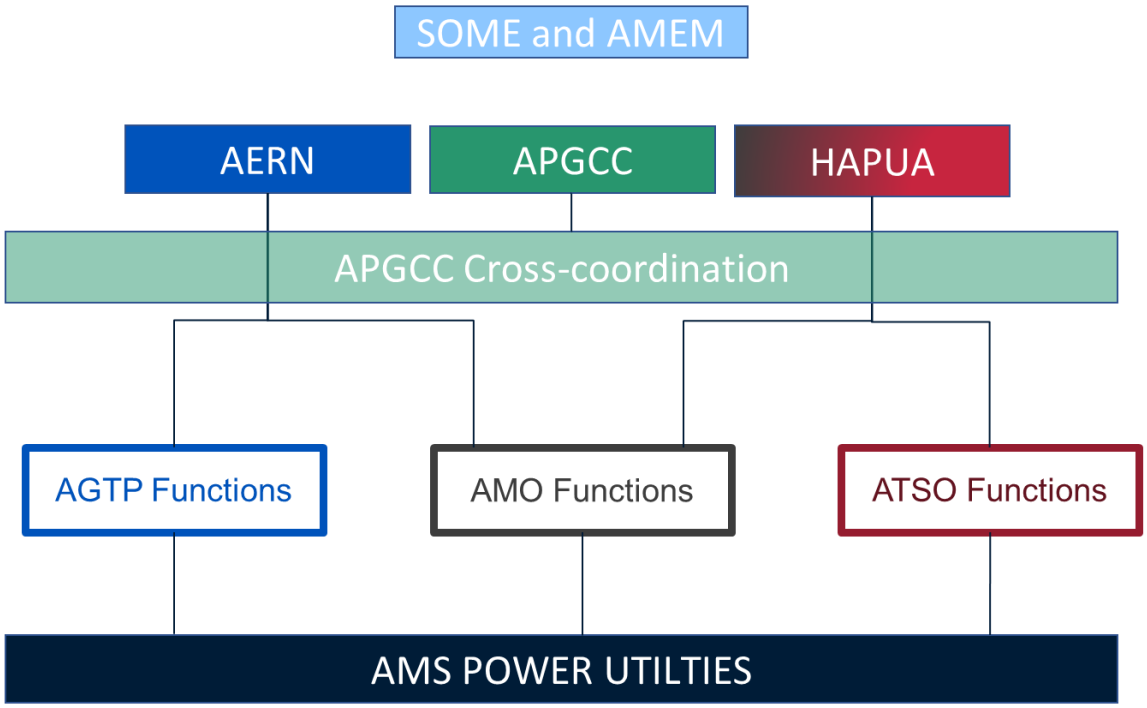
1. Commitment and Flexibility: This approach ensures commitment from ASEAN Member States and provides flexibility in participation over time.
2. Ease of Coordination: Coordination becomes easier, maintaining a clear interface between regional and national responsibilities.
3. Efficiency: This approach allows for efficient resource management and decision-making, with a well-defined interface between regional and national levels.
4. International Support: This approach is supported by international experiences, such as ENTSO-E in Europe and SAPP.
5. Adaptability: This approach accommodates the varying levels of unbundling and organisation within the AMS, ensuring required flexibility.

The framework for the proposed organisation for the new APG institutions is a decentralised matrix organisation based on secondment.

2.2.3. Institutional Arrangements

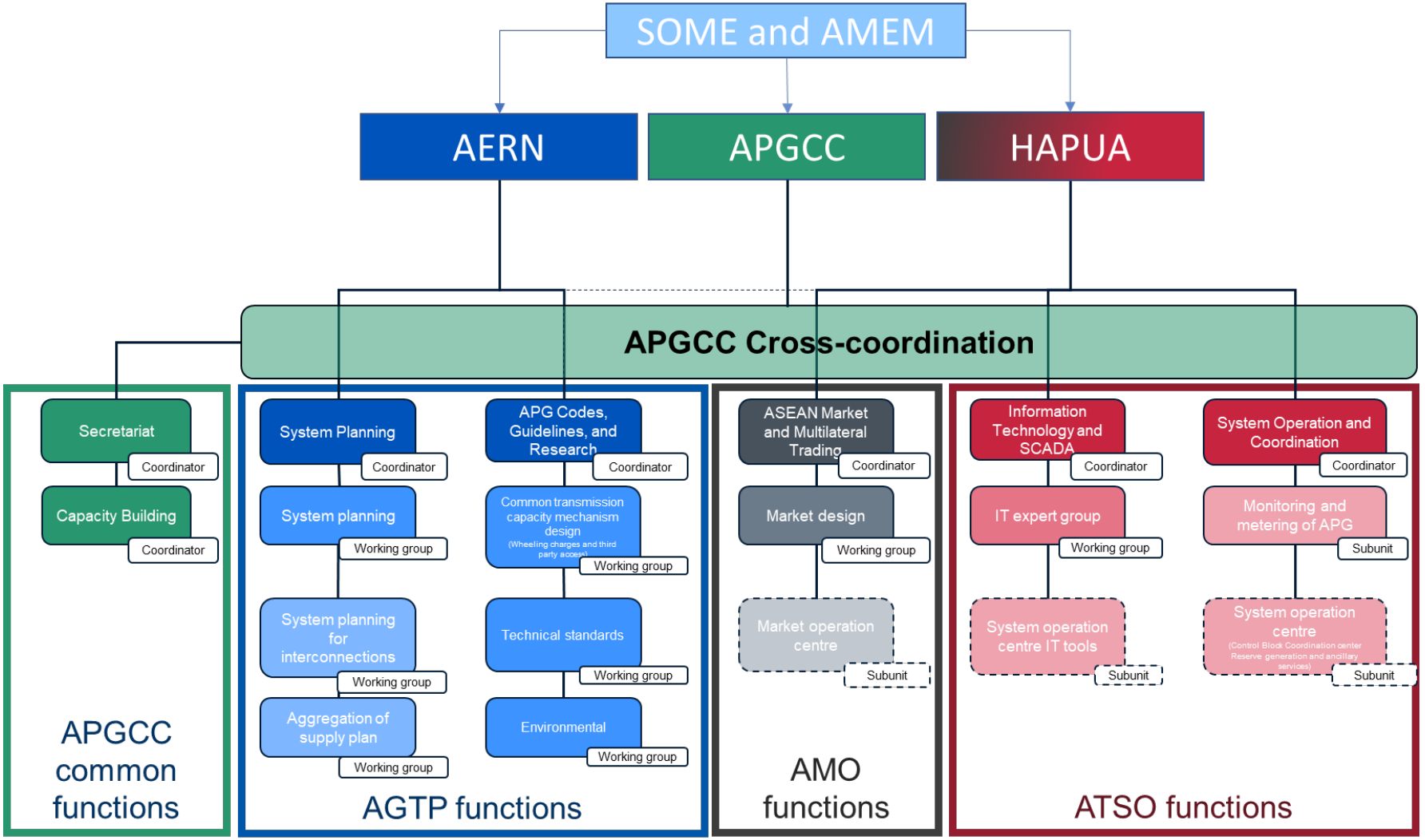
Building on the recommendations from the previous sub-section 2.2.2, and the structure proposed in the 2018 studies summarised in sub-section 2.2.1, this sub-section presents a revised recommendation on institutional arrangements for the AGTP, ATSO, and MPT functions in APG. In the institutional arrangements originally proposed in the 2018 reports on establishing the AGTP/ATSO functions, the work focused on the creation of a new regional body, the APP. After these reports were prepared, it has become clear based on feedback from ACE and the AMS that to establish another body in the already complex setup might not be beneficial. The ongoing work that ACE and the AMS are doing at the time of writing has an approach that aims to leverage the existing APG bodies (AERN, HAPUA, and APGCC). One of the key changes proposed in this report is to utilise the already-established APG bodies (AERN, HAPUA, and APGCC) to implement the functions of ATSO, AGTP, and market operation for MPT. This proposed approach follows the latest thinking on the establishment of the regional (multilateral) power market emphasising decentralised organisation and operation instead of the creation of a single new regional institution. Figure 2.4 presents the relationship and hierarchy of the existing APG bodies and the new functions at a high-level and Figure 2.5 presents the recommended organisation for implementing the ATSO and AGTP functions.

Figure 2.4. The New APP: ASEAN Hierarchy for the Implementation of ATSO and AGTP Functions



Source: Authors.

Figure 2.5. The New APP: An Overview of the Implementation of ATSO and AGTP Functions



Source: Authors.

APGCC as a Decentralised Secretariat

The recommendation of this study is to establish a decentralised secretariat under the APGCC to implement the new functions as recommended in sub-section 2.2.1, and as shown in Figure 2.4 and Figure 2.5.

This recommendation is in line with the feedback ACE has received from the AMS. It is also in line with the discussions of the APG working group before the Validation Workshop and the discussion in said workshop. As depicted in Figure 2.5, roles will be clearly defined between AERN, HAPUA, and the APGCC when developing the regional planning and system operations forward.

One important aspect of this institutional arrangement is the relationship between the existing HWGs and the existing working groups under the APGCC. Some of the existing HWGs already have tasks and roles that overlap with the envisioned working groups to be coordinated by the APGCC in the proposed structure. In the work going forward in determining the terms of reference (TOR) for the APG bodies, it is important to map the tasks, roles, and activities of these existing working groups and to cross-reference these to the AGTP and ATSO functions. The recommendation of this study is, where possible, to utilise the existing HWGs as the working groups within the proposed organisation by updating their TOR, and where not applicable and where an existing working group would not fill the required roles, to implement working groups and sub-units based on the proposed structure. These new working groups or sub-units can be based on the heads of relevant HWGs being part of the new working groups for AGTP and ATSO functions organised by the APGCC as the secretariat.

The recommended organisation of Figure 2.5 comprises four separate functions: the ATSO function, the AGTP function, the ASEAN Market Operator (AMO) function, and the secretariat function. Each of these functions has a coordinator for each of the main components, as this role resides within the APGCC. In most instances, this is done by one person, but the coordination role can also be taken by a team. The APGCC coordinator will manage the day-to-day coordination and administration of the tasks of the function, while the participants in the various working groups are nominated from the AMS. It is suggested that the coordinator does not chair the working groups; rather, each working group should elect a chairperson, which position should rotate amongst the AMS. The chairperson's term shall last for 2 years. This rotational system enhances transparency, promotes leadership development, and encourages active engagement and ownership amongst the AMS in driving the agenda of the working groups.

For the members of the secretariat and the coordinators, there is merit in considering secondment for some, if not all, of the positions from the AMS. If these positions are seconded, it will be important to ensure that the individuals seconded from different national bodies represent ASEAN rather than their individual country in performing their roles. In contrast, the participants in any of the working groups will represent their utility

or country. Having said that, the chair of these working groups necessitates a broader regional representation to ensure that all voices are heard and considered. Therefore, the chairperson should be tasked with representing the region, facilitating consensus-building and fostering collaboration amongst the AMS. To provide longevity and institutional memory to balance the rotation of chairpersons and other seconded personnel, the role of the coordinator may be considered as a permanent position.

Regarding market operation–related functions, the proposed institutional structure includes a separate function for market operation in parallel to the AGTP and ATSO functions, depicted as AMO. The framework for organising this function follows the same logic as for the AGTP and ATSO functions. A separate ongoing project for developing an RPM for ASEAN and the Greater Mekong Subregion led by ADB is working on this topic. Regarding the relationship between some of the existing HWGs and the working groups under the APGCC, the recommendation is to cross-reference the roles of the required new working groups and the existing HWGs. Where the existing HWGs fit the requirements, they need to be authorised by an IGA (or terms of reference [TOR]). Also, it is recommended to follow the proposed structure of working groups, potentially splitting some existing working groups and creating new ones to maintain clarity of roles and responsibilities.

2.3. AGTP Roles and Responsibilities

This section expands on the high-level roles and responsibilities of the ASEAN Power Grid Generation and Transmission System Planning function (AGTP), as first described under the 2018 Study on the Formation of the ASEAN Power Grid Generation and Transmission System Planning Institution (ERIA, 2018b). The AGTP function plays a pivotal role in overseeing and coordinating the planning processes for power generation and transmission within the APG framework. For establishing the AGTP function, the roles and responsibilities of this function would need to be described either in an article in an IGA or in the envisaged protocols of the APG MoU successor agreement.

The topics outlined in this section include the evaluation of supply reliability, the development of interconnection reinforcement proposals, and the harmonisation of demand forecasting methods across the AMS. It emphasises a standardised approach to demand forecasting, generation expansion planning, and transmission planning, ensuring a consistent and integrated regional power system.

Relevant conclusions underscore the importance of the AGTP in defining planning criteria, developing a common regional grid code, and identifying priority regional interconnectors as 'Projects of Common Interest' (PCI). This section highlights the AGTP's critical role in enabling a cohesive and sustainable expansion of the APG, thus supporting regional power trade and enhancing energy security.

Overview

The AGTP Guideline, produced under the 2018 Study on the Formation of the ASEAN Power Grid Generation and Transmission System Planning Institution (ERIA, 2018b), has a section defining the functions of the system planning department to be created in the organisation of the APP within the framework proposed in that study. In the updated organisation, this is now referred to as a function rather than a department, led by a coordinator. The AGTP function is charged with the following high-level tasks:

1. Evaluating supply reliability, by checking and confirming the supply and demand plan for the region; and
2. Developing proposals for the reinforcement of interconnections, by studying long-term reinforcement policy and acting in an advisory capacity to the AMS in respect of individual transmission projects.

Specific Duties

In the revised structure of the APG functions, responsibility for the oversight of generation and transmission planning rests with the AGTP. This would be organised under the oversight of AERN, and its work would be led by two overarching coordinators, the system planning coordinator and the coordinator leading the development of APG codes, guidelines, and research.

The principal role of the AGTP function is to provide oversight and coordination of the planning processes implemented by the AMS power utilities themselves. The AGTP system planning function led by the coordinator will therefore be responsible for evaluating the supply plan submitted by each country, focusing on the following key issues:

- Whether each country has a supply capability for 10 years of demand – this will involve reviewing the assumptions made in the demand forecast for each country regarding the growth of power demand in the commercial, industrial, and residential sectors; the macroeconomic assumptions underpinning these; and the use made of base, high, and low forecast sensitivities to explore the effects of key variables on future demand assumptions.
- Reviewing the demand forecasting methods applied by each country to ensure that as far as possible a common approach is adopted for demand forecasting, to enable regional expansion plans to be developed on a sound and consistent basis.
- Examining the supply–demand balance predicted for each of the AMS to assess whether significant power import or export is anticipated. The AGTP function will be responsible for reviewing the corresponding assumptions made in neighbouring countries to ensure that a common understanding is achieved regarding the requirements for international interconnector capacity and that these are clearly reflected in the region's expansion plans.

- Engaging with study teams working on major regional studies (such as AIMS III) to ensure that the findings of these are fully represented in the country-specific implementation plans produced by each member state.

The AGTP function will therefore act as the focal point for several key activities:

- Facilitating data collection and sharing between the AMS to ensure coordination of national development plans
- Monitoring the execution of the ASEAN Interconnection Masterplan Study (AIMS III) to ensure that this models credible and agreed scenarios that can be accepted by the AMS – the AGTP system planning coordinator would act as the focal point for counterpart engagement in regional studies.
- Defining a process for identifying priority regional interconnectors and transmission reinforcements that will be treated as PCI. These projects would be agreed by the AMS to be in the interest of all member states to develop, as part of the expansion of regional power trade. Depending on the governance arrangements that are developed, these projects could be approved by AERN for addition to the asset base to be remunerated through transmission charges as part of the operation of the ASEAN market for MPT. The PCI would be identified by the AGTP function as a core part of its role.

Planning Criteria

Key to the development of regional power masterplans and the successful coordination of national generation and transmission plans is the agreement of a set of planning criteria that will be adopted in carrying out the associated technical studies.

This is a role that should involve both the AGTP and ATSO functions, as there is a close interaction between planning and operational standards. To achieve this coordination, AERN and HAPUA will engage with the AGTP and ATSO functions. The process of agreeing standards will be overseen by the APGCC to ensure that common standards are proposed for adoption throughout the ASEAN region. This will include the development of a common regional grid code, specifying the conditions that are to be applied for planning, connecting to, and operating the region's power systems. The grid code will also specify the arrangements that must be adopted for information exchange to support system planning and operations.

The AGTP function will specifically focus on the development of planning standards in the following areas:

- transmission voltage standards, to be maintained in normal and contingency conditions;
- system frequency tolerances, in normal and contingency conditions;

- maximum fault clearance times that are to be achieved for faults at different transmission voltage levels, to ensure stable system operation;
- provisions relating to automatic generation control and the way in which interconnector flows are controlled;
- the minimum requirements for maintaining reserves across the ASEAN power systems, to cater to events such as the loss of the largest generating unit in each member state, and the fluctuating output of variable renewable energy sources (principally solar and wind generation).

Standard Planning Methodologies

The System Planning Working Group, under the oversight of the System Planning Coordinator, will be responsible for developing standardised methodologies for key planning activities. These should encompass the core stages in regional power planning, including

- demand forecasting,
- generation expansion planning, and
- transmission planning, particularly focusing on international interconnectors and the identification of PCI.

Underpinning the above key elements of the planning process will be the importance of maintaining an accurate database of the region's power systems, to enable coordinated modeling of generation and transmission expansion requirements to be undertaken. This modelling may be undertaken either by the AGTP function itself or by consultants working under the AGTP function's supervision.

The group's work on demand forecasting will include, but will not be limited to

- assessment of macroeconomic approaches to demand forecasting, focusing on the variability of demand in the industrial, commercial, and domestic sectors in relation to key economic forecast parameters, such as gross domestic product growth rates, predictions of disposable income levels, and government policies incentivising economic activity in specific sectors;
- reviews of historic demand trends, including analysis of demand data from power utilities;
- the handling of microeconomic factors such as price elasticity of demand across the different sectors;
- seasonal, monthly, weekly and time of day factors.

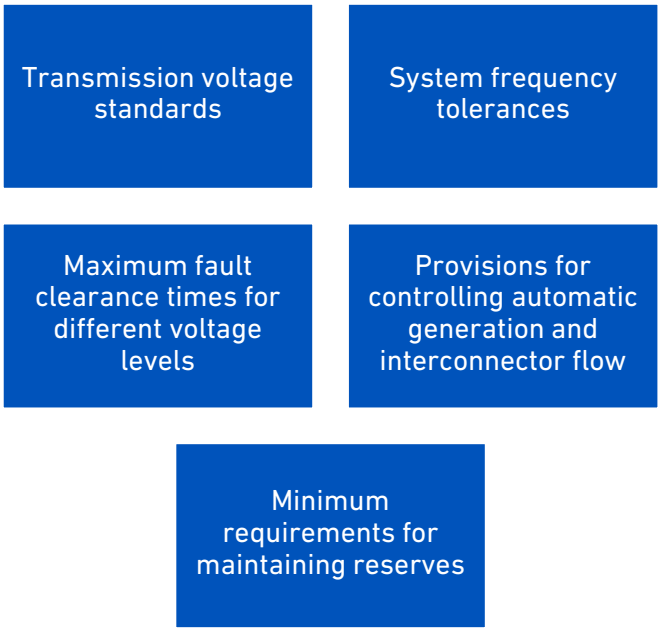
This will enable a set of forecasting guidelines to be developed supporting best practices in demand forecasting across the ASEAN region.

For **generation expansion planning**, key considerations will include:

- The optimum planning tools to be used for generation expansion planning. Previous work suggests that Plexos, WASP, and Strategist are the dominant generation planning tools used in the region. But part of the working group's activity should be to survey suitable planning tools and recommend those that are best suited to the requirements of regional generation expansion planning.
- Planning guidelines on topics such as the setting of target Loss of Load Probability and Loss of Energy Expectation figures for each country, and a methodology for defining this at a regional level. The objective of this sort of planning would not be to develop a deterministic expansion plan for the region but to give guidance on the parameters that should be considered in the planning process.
- Guidance on the modelling of the broad range of generation technologies, particularly, the approach to modelling variable renewable energy sources, both in terms of resource assessments and modelling the output of wind and solar farm installations.
- Guidance on the modelling of hydropower outputs, including the simulation of hydrological conditions, the modelling of storage hydro facilities.
- Consideration of emerging technologies such as hydrogen production and the role that this can be planned alongside variable renewable energy sources, together with the associated modelling challenges.

Figure 2.6 summarises areas of the planning standards.

Figure 2.6. Areas for Planning Standards to Be Developed by the AGTP



Source: Authors.

Transmission expansion planning needs to consider fundamental issues such as the level of system security that is incorporated into the network. Typically, power systems are designed to an 'N-' security standard, under which stable and unconstrained steady-state system operation can be achieved with the loss of a single transmission circuit. Some countries design a higher 'N-2' standard, and more advanced techniques such as probabilistic analysis may be undertaken. Dynamic line ratings may also be considered in planning the system such that additional line capacity can be utilised, particularly, system operating scenarios and climatic conditions. The AGTP function's System Planning Working Group should define the optimum approach to transmission planning studies, considering steady state and transient modelling (load flow, fault level and transient stability analysis). An important focus of the group's work should be on the planning required for international interconnectors and the importance of ensuring that this is integrated into national planning processes such that capacity constraints within national networks are identified where these could lead to restrictions on transfers between systems.

A sub-unit of the AGTP function will focus specifically on system planning for interconnectors, which will require close cooperation of neighbouring power utilities in the planning, design, construction and commissioning processes.

The main network planning and analysis tools is in use across the ASEAN region are Power System Simulator for engineering and DigSILENT. The AGTP may decide to support both these tools in its work as the central planning advisory body.

An accurate and up-to-date database of the interconnected power systems in ASEAN will need to be maintained by the AGTP function, and the unit will need to communicate routinely with the AMS power utilities to obtain updated submissions and to ensure that the databases used for studying expansion options are accurate. An important aspect of this will be to ensure the compatibility of the database with the modelling tools that are being used.

The database will be important both for enabling the AGTP function to undertake its role in carrying out studies of the interconnected power systems and for providing a source of information that can be drawn on by consultants undertaking regional expansion planning studies.

Methods and Software to Be Employed

As noted in the section on Planning Methodologies, various software tools are available for carrying out generation and transmission expansion studies. The AGTP function should not be prescriptive about which tools any of the AMS are permitted to use for carrying out national studies. However, the AGTP function should guide the countries towards the use of tools that can provide input and output data in a form compatible with the models that it uses for planning future interconnectors.

In defining the roles and responsibilities of the AGTP function as part of an IGA on institutional arrangements, it will be important to ensure that decisions about software and databases can be taken by the AGTP function in consultation with the AMS, and that the agreement itself does not need to be modified if the AGTP function chooses to change the software it uses for specific purposes.

2.3.1. Interface between the AGTP and AMS

Data Collection

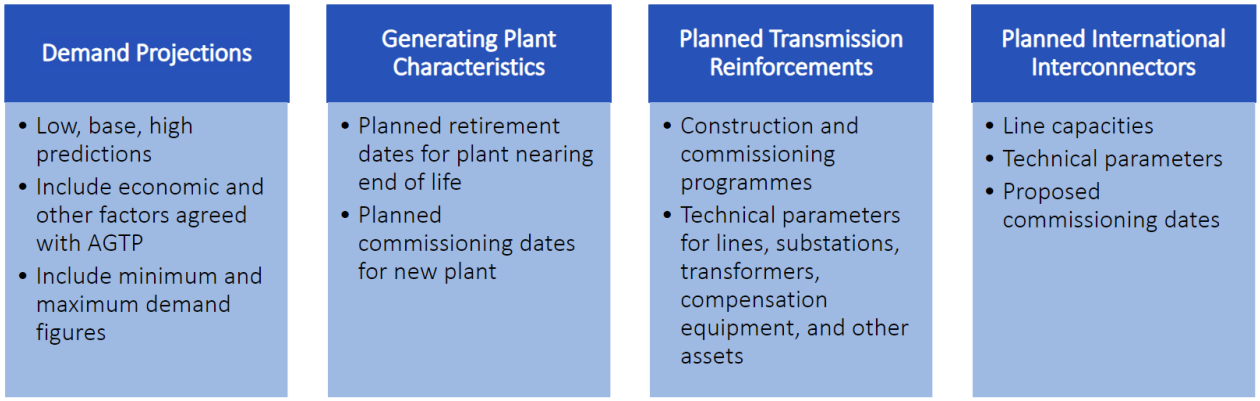
A key activity requiring liaison between the AGTP function and the AMS will be the exchange of data to inform the planning process. An annual process will likely be needed for updating a wide range of planning data submissions from the AMS, upon which the AGTP function will be highly dependent for the accuracy of its work.

The AGTP function is proposed to undertake a long-term planning process to evaluate generation adequacy and network adequacy over a horizon of 10 years, with annual updates to the plan. The AMS should therefore provide data relating to the 10-year period ahead, relating to:

- Demand projections – this should be prepared with base, high and low demand growth predictions, using economic parameters and other factors agreed with the AGTP function in advance, providing maximum and minimum demand figures for inclusion in regional system modelling
- Generating plant characteristics, including information about planned commissioning dates for new plant and proposed retirement dates for plant nearing the end of its economic life
- Planned transmission reinforcements, including details of construction and commissioning programmes, and full technical parameters for the lines themselves and associated substations, transformers, compensation equipment, and other assets
- Planned international interconnectors, including full details of line capacities, technical parameters, and proposed commissioning dates.

A summary of the data to be provided by the AMS to AGTP function for the 10-year period ahead is provided in Figure 2.7.

Figure 2.7. Summary of the Data to Be Provided by the AMS to AGTP Function



Source: Authors.

The AGTP function should also release draft study results on an agreed time frame to the AMS and put in place a regular programme of meetings at which the 10-year assessment can be presented and discussed.

2.4. ATSO Roles and Responsibilities

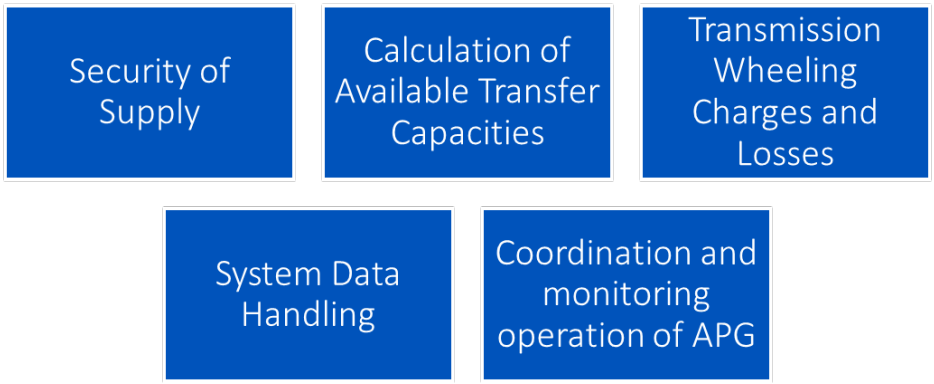
This section expands on the high-level roles and responsibilities of ATSO, as first described under the 2018 Study on the Formation of the ASEAN Power Grid Transmission System Operator Institution (ERIA, 2018a). The roles and responsibilities of the ATSO function would need to be described either in an article in an intergovernmental agreement or in the envisaged protocols of the APG MoU successor agreement.

This sub-section explains the roles and responsibilities of the ATSO function, focusing on its advisory and coordinating roles and how ATSO works with national TSOs. It covers different areas like ensuring a secure power supply, calculating available transfer capacities, setting transmission charges, handling data, and managing IT systems.

The ATSO function will be responsible for coordinating and monitoring the operation of the APG, liaising closely with national TSOs to maintain the security, stability, and reliability of the regional power systems. It will do this in compliance with regionally agreed procedures, including a harmonised Regional Grid Code, and will be responsible for liaising with national TSOs in applying regionally agreed procedures.

It is important to note that the ATSO function will have a coordinating and advisory role, but it is not intended to take an active role in controlling the regional power networks directly or issuing dispatch instructions to generators within the national networks. These responsibilities will rest with the national TSOs. The high-level roles and responsibilities described in the following sub-sections are summarised in Figure 2.8.

Figure 2.8. The Broad Roles and Responsibilities of ATSO



Source: Authors.

2.4.1. Security of Supply

The maintenance of regional supply security will require the ATSO function to liaise with the AGTP function on issues associated with the long-term planning of national power systems and cross-border interconnectors. The ATSO function will play a key role in coordinating the operation of control blocks in the APG region and assisting the TSOs to coordinate the overall operation of the APG holistically.

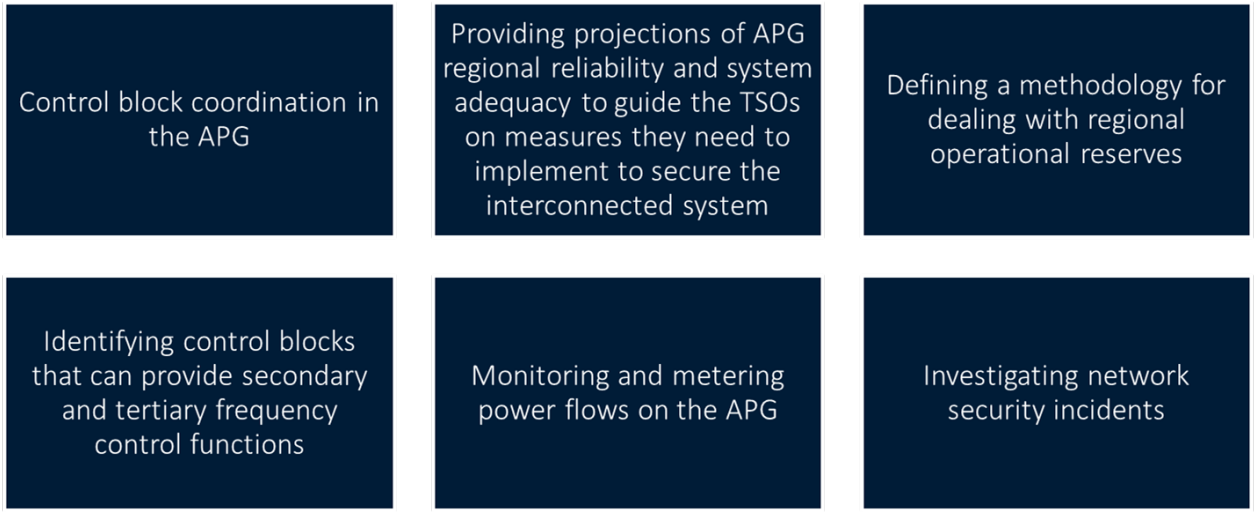
The ATSO function will coordinate with the national TSOs particularly in relation to the following items, also depicted in Figure 2.9:

- Control block coordination within the APG in a secure manner according to the operational standards and network codes (control block coordination and ancillary services coordination).
- Providing projections of APG regional reliability and system adequacy – these will guide the national TSOs regarding specific measures they may need to be implemented to secure the interconnected system. This will involve static and dynamic system modelling.
- Defining a methodology for dealing with regional operational reserves, drawing on the Operating Code provisions in the Regional Grid Code and applying common definitions of the reserve categories that are required to maintain stable system operation.
- Related to this, identifying control blocks within the APG that can provide secondary and tertiary frequency control functions.
- Monitoring and metering power flows on the APG – this will be particularly important in relation to the interconnectors between the AMS power systems, as the ATSO function will have visibility of the available transfer capacity (ATC) values for the interconnectors and be able to assess the extent to which there is short-term

capacity available or, conversely, whether security margins on the system are being infringed.

- Carrying out investigations of incidents that affect the security of the networks, particularly post-fault investigations, which will involve static and dynamic studies of the networks.

Figure 2.9. ATSO Coordination with the National TSOs



Source: Authors.

2.4.2. Calculation of Available Transfer Capacities

The ATSO function will be responsible for defining the methodology to be used for calculating the ATC values across the APG. These will be important inputs to the market clearing process to be operated by the unit fulfilling the APG Market Operator function. The ATC calculation should consider the thermal, voltage, and stability-constrained limitations on interconnectors in the network, together with the required transmission reliability margin to be maintained to support power flows associated with reserve activation. The ATSO function must be able to calculate ATC values in changing system circumstances, catering, for example, to the impacts of changing variable renewable energy generation output across the region and the need for reserve activation in neighbouring countries resulting in increased interconnector flows. It will then be responsible for publishing the revised values to the region's TSOs to enable coordinated system control actions.

If system events take place that significantly constrain ATC values, ATSO will have a role in notifying the TSOs and advising on possible mitigating actions.

2.4.3. Transmission Wheeling Charges and Losses

The calculation of transmission charges for users of the APG is an important technical function required to support the operation of the market. The primary requirement for calculating the charges is an accurate system model of the whole APG region. For this reason, either the ATSO or the AGTP functions are the natural organisations to perform the required tasks. The calculation of transmission charges that accurately reflect the use being made of transmission assets requires consideration of seasonal and time-of-day factors that influence power flows across the APG. And the ATSO will likely have the clearest visibility of these from its overall system monitoring activities. It will also need to maintain accurate models of the transmission networks for fulfilling its other functions, so it should have an accurate and up-to-date database of the transmission networks, including the ability to model generation and demand conditions in various operating scenarios.

The methodology to be used for calculating transmission charges will need to be agreed by the AMS, and the APGCC will be well placed to coordinate the necessary research and studies, which could be carried out by the ATSO function. The ATSO function would need to coordinate closely with the AGTP function however, since a key component of the calculation of transmission charges will likely be the investment costs of the different transmission assets on the AMS's transmission systems. This information tends to reside in databases of planning information rather than being available to the TSOs. To maintain the AMS power utilities' confidence in the confidentiality of commercial information, it will be important to have strict confidentiality agreements in place between the AGTP and the ATSO functions so that it is clear how commercially sensitive data will be handled.

The same system models as are used for calculating transmission charges can potentially be used for the calculation either of explicit system losses, in particular, operating scenarios or loss factors that can be applied to traded volumes of energy in the settlement process operated by the APG Market Operator function. The calculation of loss factors requires an accurate transmission system model to be available, and the creation of a set of demand and generation scenarios representative of system operating conditions across the year. The duration for which each scenario is valid should be defined to enable the weighting of the scenarios in calculating average loss factors.

2.4.4. System Data Handling

For the ATSO function to fulfil its responsibilities as outlined above, access to a combination of offline and real-time data relating to the operation of the APG and the associated planning and market operation data is required.

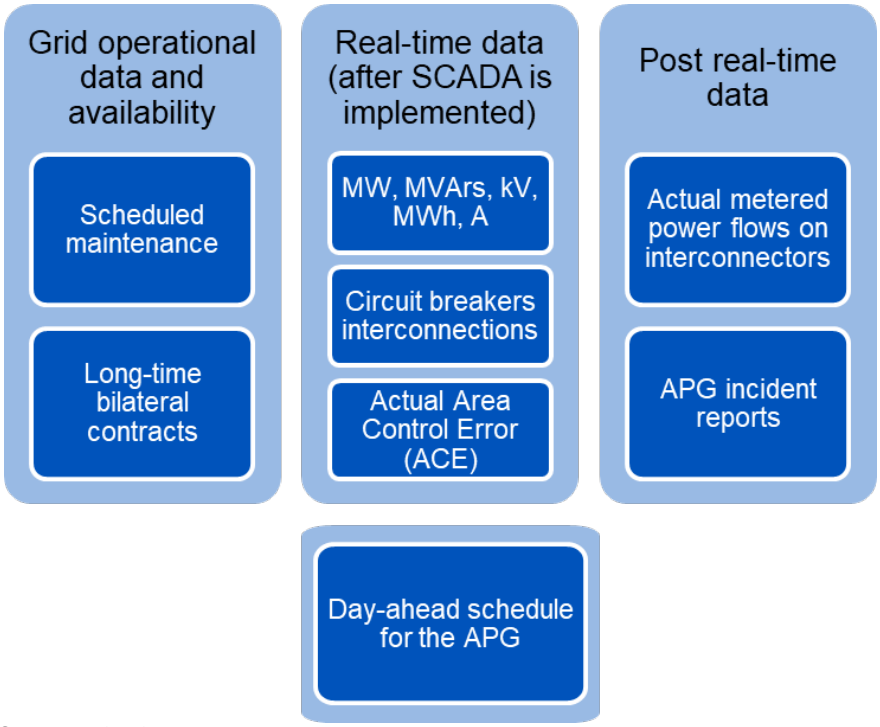
The information exchange requirements should be defined in the Regional Grid Code, so that all the region's power utilities, independent power producers, and large consumers are clear on the information that needs to be available relating to their equipment

installations. The grid code should also specify the time frames in which this data has to be supplied and how much of this information can be obtained through the interrogation of national TSOs' SCADA systems and how much requires specific data submissions in accordance with agreed timetables.

Examples of the data to be collected and maintained by the ATSO function are given below. However, these are not exhaustive; these are not recommended to be detailed in high-level agreements relating to the creation of the APG institutions. Rather, they should be contained in the appropriate schedules of the operating procedures in the Regional Grid Code.

The minimum data requirements that should be gathered and managed by ATSO should include the items presented in Figure 2.10.

Figure 2.10. Minimum Data Requirements



Source: Authors.

As noted earlier, confidentiality issues will be connected to the APG data provided by AMS power utilities. Clear provisions are also required to specify the way in which confidentiality will be managed, including the signature of non-disclosure agreements and the specification of security requirements in the relevant sections of the Regional Grid Code.

2.4.5. IT and SCADA Requirements

One of the coordinating functions shown in the proposed structure of the APG institutions in Figure 2.5 covers IT and SCADA. This is an important cross-cutting function within ATSO, which initially will be responsible for ensuring that ATSO is suitably equipped with the hardware and software required for it to fulfil its role. Once market operations commence, the role of the unit will increase significantly, as it will need to operationalise the functions of data exchange between the national TSOs and ATSO.

It is recommended that the IT and SCADA coordinator draws on IT and telecommunications experts from within the AMS power utilities to form the nucleus of the System Operation Centre IT sub-unit. This will ensure that the APP has the expertise on the different IT systems and communication protocols used in the APG that will be necessary to ensure efficient receipt and processing of data from the AMS power networks. The sub-unit will be responsible for defining and developing an IT structure that will ensure that ATSO can collect and distribute the required data to fulfil its obligations. The unit will therefore be responsible for implementing and maintaining the SCADA system to be utilised by ATSO to monitor the status of the region's power networks. It would be focused on the IT requirements of the system operation function; it is assumed that the IT and system requirements for market operation would be coordinated from within the AMO function.

2.4.6. Other Functions

The formation of ATSO, through the provisions of the APG MoU successor agreement, should be sufficiently and broadly defined to enable specific functions to be added to ATSO's remit (i.e. ATSO's roles, responsibilities, and mandate) later without requiring the renegotiation of the over-arching agreement (except if there is a substantial reorganisation of ATSO's responsibilities). While the above sections of this report outline the broad roles and responsibilities of ATSO, they are not intended to preclude other activities that the AMS may agree from time to time should be included within the scope of the ATSO role. This means the ATSO may assume additional activities to what has been described in the above sections.

2.5. Facilitation of Cross-border Power Trade in the APG

This sub-section discusses the facilitation of MPT in the APG, recommended to be established under an AMO function under the APGCC. For establishing a market for MPT in ASEAN and a market operator, this function and the trading concept would need to be described either in an article in an IGA or in the envisaged protocols of the APG MoU successor agreement.

Part of the APG harmonisation and joint development includes the establishment of a regional (multilateral) electricity market to allow trading between the connected ASEAN countries to happen based on short-term requirements from any party interested to buy

or sell electricity through a flexible electricity market. This establishment of a regional electricity market should be seen as a complementary solution to any bilateral and/or multilateral trading focusing on a fixed trading path, like the Lao People's Democratic Republic–Thailand–Malaysia–Singapore (LTMS-PIP) regional project. Operating the regional electricity market should be coordinated within the proposed APGCC coordinated organisation under the AMO function.

The APGCC is not expected to host regional power trade from the outset, but the AMO function is foreseen to evolve outside in parallel with the implementation of the AGTP and ATSO functions. As presented in Figure 2.5, the AMO function is connected to the AGTP and ATSO functions under the same coordination framework.

The integrated APG, as envisioned by the ASEAN Interconnection Masterplan Study III (AIMS III), is expected to bring numerous benefits to the region. One key advantage is the cost reduction achieved by pooling renewable energy resources from countries with abundant clean energy resources to supply power to those with limited renewable sources. Additionally, an integrated power grid enables ASEAN nations to balance their power loads more efficiently by accessing low-cost energy from neighbouring countries. This diversification of power supply also promotes stability, as a single power plant failure would have a less significant impact on the overall power supply across the region. With a more optimised utilisation of resources and reduced expenses for reserve margins, an integrated power grid maximises efficiency while minimising costs.

Currently, within the ASEAN, no integrated regional electricity market is in place. While limited cross-border interconnections within the region are at 115 kV, there are several interconnections at 230 kV and 500 kV between ASEAN countries, particularly involving hydropower plants in the Lao PDR. These interconnections allow for power exports to Cambodia, the People's Republic of China, Thailand, and Viet Nam, through long-term power purchase agreements (PPA). These cross-border PPAs have allowed project-sharing and granting renewables a greater role in the supply mix and enabled the development of cross-border infrastructure in the region. However, the infrastructure built for the bilateral trade is used exclusively for the dedicated power plants. A notable exception to this model is the LTMS-PIP MPT initiative launched in 2021 between the Lao PDR, Thailand, Malaysia, and Singapore within ASEAN.

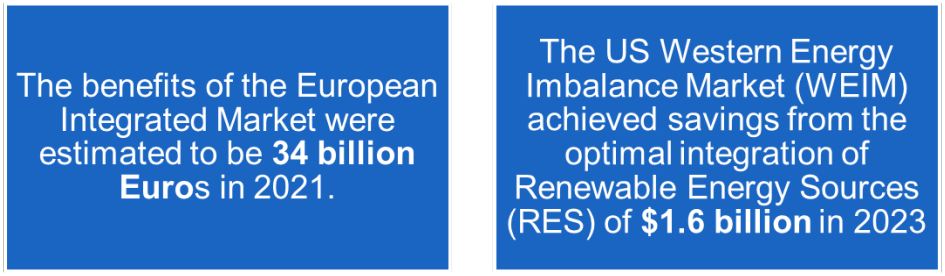
In this context, ASEAN has acknowledged the importance of establishing an RPM and increasing open-access cross-border interconnection to ensure reliable and sustainable energy supply as this will optimise energy resource allocation, promote cross-border electricity trade, and thereby enhance energy security and resilience. As such, an RPM and increased cross-border interconnection will play a key role in enhancing energy security beyond what can be achieved purely on a country-by-country basis and enable accelerated renewable energy development.

Besides, with the increasing use of renewable energy in the region, it will be beneficial to have a flexible and short-term market for cross-border trade, such as a day-ahead market (DAM). DAM is often considered the fundamental foundation upon which other shorter-term market platforms, such as intraday trading and balancing markets, can be developed. The Day-ahead market is crucial in optimising power purchases for short-term needs, enabling power utilities to complement their long-term bilateral agreements with more adaptable transactions. Additionally, it facilitates the effective management of congestion and transmission capacity. Moreover, it simplifies the process of ensuring fair compensation for interconnections and aligning with the utilisation of cross-border bilateral agreements.

In addition to the benefits of RPM optimisation itself, there are good examples of secondary markets such as those in renewable energy certificates, which provide both an additional income source for renewable energy sources (as they are tradeable certificates) and an assurance to buyers of the source of the renewable energy they have purchased by issuing a 'green certificate'. Different options for implementation of these can be investigated further based on the experience of guarantees of origin in Europe, for example.

The European Union experience has shown that the overall social benefits of the European Integrated Market were estimated at an annual savings of 34 billion euros for the year 2021 (ACER, 2022). The same experience can be seen in the Western Energy Imbalance Market (WEIM) in the Western United States where savings are achieved from the optimal integration of renewable energy sources as $3.82 billion, out of which the savings in Q1 2024 is estimated as $436 million.[5]

Figure 2.11. The Scale of Savings in the European Union and the United States Electricity Markets



Sources: ACER (2022); WEIM (2024), https://www.westerneim.com/pages/default.aspx.

[5] Western Energy Imbalance Market (WEIM) (2024), https://www.westerneim.com/pages/default.aspx

In the ASEAN context, similar benefits could be achieved in the region with the installed generating capacity from diversified energy resources. The opportunity to optimise the resources on a regional level instead of a national level will allow the same benefits to be acquired. Each renewable energy source has its unique characteristics, and it is essential to diversify these resources within the region, not within a country, to mitigate variability and increase the overall capacity factor, ensuring a more stable and reliable energy supply for the entire region. Despite the huge potential, however, ASEAN has seen a small increase in power trade volume over the years, mainly driven by bilateral agreements and regional initiatives.

However, the rapid growth of renewable energy sources and their inherent volatility and variability present huge benefits for establishing a short-term and flexible regional market platform. Successful international experiences have shown a stepwise and evolutionary approach, beginning with a small group of countries, and gradually including additional nations over time. This incremental process enables stakeholders to learn and adapt as the market evolves, fostering a collective understanding and adjustment to market dynamics. As a result, the RPM serves as an extension of the national markets rather than a complete replacement. Overall, regional coordination and national sovereignty can be balanced, allowing for a cooperative and efficient RPM while ensuring that each country maintains authority over its own power system, targets, and market participants.

In this context, ASEAN can adopt an evolutionary approach that begins with a select group of countries, particularly those already interconnected as the pilot project, while embracing a decentralised structure in which, for example, the Day-ahead Market platform would be run as a cloud-based system without the necessity for a centralised market operator organisation to be created. In the initial phases of the market operation, the ATSO function could operate as a virtual entity undertaking offline studies of system adequacy and reporting to the national TSOs. This approach allows for gradually expanding RPM integration while leveraging existing interconnections. This is based on previous studies that have been carried out investigating regional electricity trading, including the AIMS III study and the International Energy Agency study 'Establishing Multilateral Power Trade in ASEAN' (IEA, 2019) that also formed part of the inputs to the AGTP/ATSO reports.

Case Example: International Experience of a Virtual Organisation based on Cloud-based Systems

A practical example of running a cloud-based system without the necessity for a centralised market operator organisation is the European Single Day-ahead Coupling, the joint project of European market operators and TSOs, where the European market operators operate the single European market in a distributed manner with a central cloud-based market system co-owned by several market operators.

Each European market operator operate their own trading systems, which are connected to a cloud software that performs the market result calculation. The cloud instances of each market operator perform this calculation in parallel to ensure robustness, and the responsibility for the oversight of the whole process, the so-called coordinator role, rotates amongst the market operators. Each day the results from the coordinator's cloud instance are distributed to all market operators. In case of any issues in the calculation or communication, the calculation results from a backup coordinator would be distributed to the market operators instead.

This market is governed by joint working groups that have representation from the various market operators and TSOs, with rotating chairpersons and external consultants hired as project managers and secretaries to coordinate and facilitate the work of the working groups.

Source: Authors.

The plan in ASEAN is now to explore the potential benefits of the RPM with a pre-pilot market based on shadow trading,[6] supported by capacity building where a proper market trading platform will be used, but there will be no physical or financial transactions settled as part of this phase.

This shadow market system should be based on a 'close to real' system with built-in flexibility. This has many different meanings:

- Flexibility in the market design itself to be able to adapt to future changes in the market(s) themselves – for the pilot, the design should be able to showcase different

[6] Shadow trading is a simulation based dry run market trading with no physical or financial settlement, in which the benefits of trading can be signaled. This would form the basis of the full pilot RPM trading in the future. This will allow market participants to gain firsthand insight into the level of benefits through short-term power trading. This would focus on demonstrating the opportunities in the short-term optimisation to allow the participating countries to assess the real opportunities (without financial impact). If the results of the shadow trading show the expected benefits, it will move into full pilot RPM trading where the transactions will be fulfilled physically and financially. Simulation will include several scenarios including unlocking dedicated cross-border interconnection infrastructure and developing new regional interconnectors (overhead and submarine cables) and testing the feasibility of selected interconnections and impact of various market design options.

solutions. The design should not preclude later implementation of different markets such as day-ahead markets, intraday markets, balancing markets, or any other potential markets, while providing easy opportunities for integrating such additional markets. One example is a rule or regulation that would prevent trading already purchased or sold energy, preventing trade on any additional markets.

- Flexibility in market rules, allowing access to the market depending on the national market differences and market opening. This means that countries with national markets in various stages of development and regulation or different national market concept would be compatible, and that the market rules would allow participants based on the potentially differing national requirements for market participation.
- The technical market platform needs to have the built-in flexibility to easily adapt to changes in the market framework (such as new market areas, new interconnections, new market participants etc.).
- Allowing legacy contracts to coexist with the introduction of new market(s) – supporting an easier implementation of the market(s) as there is no fundamental need to change these.
- Allowing national market opening and reforms to take place at a different pace while still maintaining access to the regional market(s) for any eligible market participant, based on both national and regional rules and regulations.

The ASEAN regional shadow market system should be able to demonstrate:

- How to integrate bilateral contracts
- How to trade shorter-term energy contracts in a Day-ahead Market
- Include a simplified balancing mechanism to allow to manage deviations. A simplified balancing mechanism allows for settling power imbalances in a newly established interconnected regional market, while not requiring a sophisticated design seen in mature markets. This approach would allow for achieving the most benefit with least cost.

In addition, depending on how realistically it will be implemented, there is a need for wheeling arrangements for the flows between the countries and some form of cooperation on capacity calculation and congestion (and emergency or outage) management.

As outlined above, the regional shadow market system should be based on a simple self-dispatched, portfolio-based, and zonal market focused on cross-border trading allowing for the different countries to manage internal trade individually.

The RPM, when fully ready, is dependent on several functions and tasks performed by ATSO. It is therefore envisioned that even though the RPM will be implemented based on its own plan, the coordination and harmonisation that is foreseen to be performed by the ATSO functions will be crucial. This is why the market operation function is included in the functions described in this report, while not covered in as much detail.

Key recommendations:

1. Establishment of a regional shadow market: To demonstrate how a regional market can be operated and provide feedback for a complete market design, a pre-pilot regional shadow market should be established. This should begin with a pilot project of interconnected countries, expanding gradually. Shadow trading would be used for capacity building without initial physical or financial transactions.
2. Stepwise establishment of a regional electricity market: Develop a multilateral electricity market for flexible, short-term trading amongst ASEAN countries, coordinated under the AMO function based on the results of the regional shadow market.
3. Implement a Day-ahead market: Create a Day-ahead market as the foundation for short-term cross-border electricity trade, evolving into intraday trading and balancing markets.
4. Leverage ATSO Functions: Coordinate and harmonise RPM implementation with ATSO functions to ensure successful integration and operation.

2.6. Cost-sharing and Funding Arrangements

One of the important discussions for the establishment of the AGTP and ATSO functions – either centralised or decentralised (or any hybrid models in between) – is the funding of these functions as well as the activities to be performed within these functions. This section presents a perspective from previous research, some international case examples and finally recommendations for cost-sharing and funding arrangements that aim to ensure fair and transparent contributions from the AMS and stakeholders. This section proposes a structured approach to divide costs into distinct components.

Perspective from Previous Research

In the 2018 studies (ERIA 2018a, ERIA 2018b) , the focus was on the larger organisation and when and how it should be implemented. In the 2018 studies, the recommendation was that the APP institution will be established only after the organisational establishment stage is finished. A critical consideration highlighted in the 2018 study was the necessity for external funding to kickstart the initial phases of APP implementation. It was anticipated that there would be a transition phase during which the organisation would rely on a hybrid funding model, consisting of support from external sources as well as contributions from the AMS. However, the goal was that the APP shall be self-sustaining and able to operate independently by its own means.

These recommendations from the 2018 studies still stand for the revised recommendations of this study for the AGTP, ATSO, and AMO functions.

We foresee that a similar process towards self-sustainability as was observed in SAPP will take place in ASEAN. Crafting a definitive road map for this transition presents

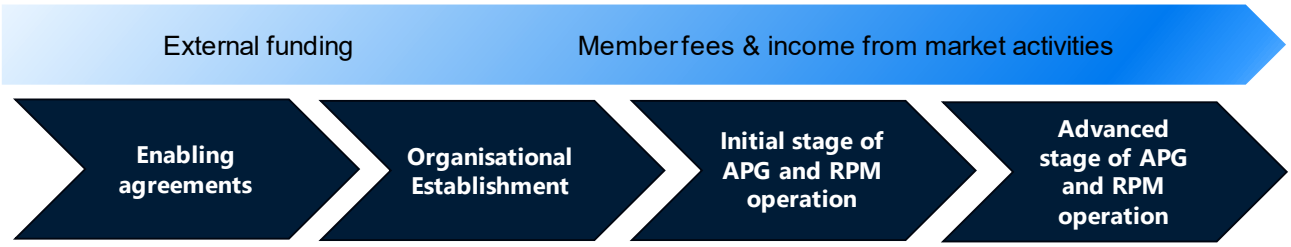
challenges as this at the end will be very dependent on the establishment and trading volumes in a regional market. The road map outlines the market establishment. Based on this, a market is expected to be established within 3 years. After the regional market is established, income from market activities will increasingly support the operation of the AGTP, ATSO, and AMO functions. An example on how the funding of the functions can evolve is illustrated in Figure 2.12.

Case Example: Southern African Power Pool

There are relevant experiences on this evolutionary process of a power pool to become self-sustainable in the end. The Southern African Power Pool (SAPP) was established in 1995 and while SAPP implemented a membership fee for the participating utilities from the outset, this was far from covering the required cost. In the first decade of operation, the focus was on infrastructure development where most, if not all, projects and activities had external funding. The same applied for the SAPP coordination centre where staff was employed. After the start of SAPP markets from 2007, the income from the trading activities increased. Now SAPP is self-sustainable while it still obtains external funding for projects. The daily operations and management of the pool activities are funded by SAPP members and their market activities.

Source: Authors.

Figure 2.12. A Gradual Process from External Funding to Self-sustainable Operation



Source: Authors.

Case Example: ENTSO-E

ENTSO-E, the European Network of Transmission System Operators, is an organisation representing 40 TSOs of 36 countries, which are not only the European countries, while ENTSO-E has tasks from the EU legislation. ENTSO-E's mission is to ensure the security of the power system at a pan-European level and facilitate the functioning and development of the European electricity markets. In principle, ENTSO-E is a non-profit organisation and funded through membership fees paid to the association by its member TSOs, and other revenues and incomes. Its annual budget for 2022 was €58.5 million, of which €31.8 million was through members' fees and the rest from ENTSO-E reserves and other TSO funding (the UK TSO). The member fees are divided into the membership subscription fee, associated membership fee, and observer membership fee.

The membership subscription fee is paid annually by members as determined by their voting power – with 30% being proportionate to the first part of their voting power while 70% being proportionate to the second part of their voting power. The first part of the voting power is based on the 'one country one vote' principle, while the second part of the voting power is determined by the population of the country. Following its approval of the budget for the following year, the ENTSO-E assembly shall approve the amounts to be paid by the members for the ensuing financial year.

The principle for cost sharing comes from EU CACM regulation Article 11 (European Commission 2015):
'The costs related to the activities of the ENTSO for Electricity referred to in Articles 4 to 12 shall be borne by the transmission system operators and shall be taken into account in the calculation of tariffs. Regulatory authorities shall approve those costs only if they are reasonable and proportionate.'

Source: Authors, European Commission (2015).

Case Example: The European Single Electricity Market

The European Single Electricity Market consists of the Single Day-ahead Market and the Single Intraday Market, which are operated by the Nominated Electricity Market Operators in Europe and the European TSOs. The cost sharing of these markets can be simplified as follows:

- The cost sharing between the market operators and TSOs is based on the Day-ahead Operations Agreement and the Intraday Operations Agreement, signed by all market operators and TSOs.
- Costs resulting from activities made to the benefit of all market operators and all TSOs are considered joint costs using inter alia the following principles:
  - The parties ensure that all costs shall be appropriately and fairly recorded in timesheets and sufficiently documented.
  - The costs must be either within an approved yearly budget or subject to specific prior approval of the steering committee.
  - All input data for the calculation of cost sharing will be updated at least yearly.
- The components for cost sharing between countries participating to the joint costs consist of
  - Component 1 – 1/8 of costs: equal share between participating countries
  - Component 2 – 5/8 of costs: Based on electricity consumption in the country
  - Component 3 – 2/8 of costs: Based on traded volume in the country
- These costs for each country are then distributed between the TSOs and market operators in that country per separate percentage sharing keys, 50% of the country costs are allocated to the TSO(s) active in the country, and 50% allocated to the market operators in the country. This 50% of cost is then further divided between the market operators based on their share of the traded volumes in the respective country.

Source: NEMO Committee (2019).

The willingness of the AMS to contribute through generic fees will be crucial for establishing the organisation. The AMS will likely agree to follow a model that resembles the current membership fee model for HAPUA.

Recommendations

The following recommendations are proposed to ensure effective cost sharing and funding:

1. Key principles:
   - Transparency and equality: Funding mechanisms must be transparent and equitable, ensuring fair contributions from all member states.
2. Evolution of funding
   a. Establishment phase: Initially, external funding is essential for setting up the organisation.

b. Initial stage of operation: During the early stages, a combination of external funding and member fees should be utilised.

c. Advance stage of operation: As the organisation matures, it should increasingly rely on member fees and income from market activities. Throughout all stages, external funding remains crucial for infrastructure projects and studies.

3. Functions:

   - Any permanent staff and infrastructure of the functions: Permanent staff and infrastructure of ATSO and the AGTP are recommended to be funded by member state contributions.
   - Working group members: Employment should be facilitated through secondment, leveraging the expertise of member states.

4. Cost sharing based on multiple components

   - Base contribution: A fixed contribution from all member states
   - Level of participation: Adjust contributions based on the engagement level of each member state
   - Proportional component: Contributions should be scaled based on factors such as electricity demand size, the volume of electricity traded in the RPM per country, and the population of each country.

2.7. Intergovernmental Agreement for Establishing the Outlined Functions

The new APG institutions – AGTP, ATSO (and AMO) functions – in the context of this study will fall under the coverage of the APG MoU or the APG MoU successor agreement, which is being revised at the time of writing. As noted in the introduction to this report, the APG MoU successor agreement is expected to contain a series of protocols covering the key roles and responsibilities of the AGTP and ATSO. It is not therefore anticipated that the creation of the functions outlined in this study will necessarily be covered by one or more standalone IGA(s).

For this reason, this report does not describe in detail the important provisions relating to the handling of confidential information, dispute resolution between AMS stakeholders and the new APG institutions, intellectual property arrangements, force majeure situations and other legal clauses that will need to be covered within the APG MoU successor agreement and its protocols.

This report provides as Annex 1 an outline of an intergovernmental agreement (IGA) that aims to serve as a reference for the case such an IGA would be needed in addition to the APG MoU successor agreement, or in case the successor agreement is not achieved in time. More general principles recommended for the potential drafting of IGA are presented below.

General Principles

The formulation of an IGA for the new APG institutions should consider several key principles to ensure effective collaboration, governance, and ultimately operational success. These principles include:

1. Mutual benefit and reciprocity: The IGA should be designed to provide mutual benefits to all AMS involved, ensuring that the outcomes of the agreement are equitable and advantageous to each member state. Reciprocity is essential, where each party commits to providing and receiving benefits proportionately.
2. Sovereignty and respect: While fostering regional cooperation, the IGA should respect the sovereignty of each AMS. The agreement should acknowledge the individual policies, regulations, and priorities of each member state, ensuring that national interests are harmonised with regional ASEAN goals.
3. Transparency and accountability: Transparency in decision-making processes, data sharing, and operations is a cornerstone of the IGA. This principle ensures that all actions and decisions are made openly, with clear accountability mechanisms in place to monitor and evaluate performance and compliance.
4. Flexibility and adaptability: Given the dynamic nature of the energy sector, the IGA should incorporate provisions for flexibility and adaptability. This should allow the agreement to evolve in response to market developments, new technological advancements, and changing regional needs in ASEAN.
5. Inclusive participation: The agreement should ensure the inclusive participation of all relevant stakeholders, while allowing countries to adopt the RPM and proceed at a different pace depending on the state of their current markets, regulations and level of interconnection.

Chapter 3

Road Map

This section discusses key activities and milestones identified for developing the ATSO, AGTP, and AMO functions. Generally, the aim of this road map is to lay out a general overview on what should be prioritised and finalised chronologically within the ATSO–AGTP–MPT development process and what can be left for future enhancement to gain maximum efficiency of development and adoption of the functions. The study has identified high-level milestones and respective activities (Table 3.1). Each milestone has a respective road map presented in Figure 3.1 to Figure 3.4.

The dates and timing are only indicative but provide an overview of key activities in each phase, and what should be prioritised in which order to gain maximum efficiency. One lesson learned from international experience is that in establishing regional electricity markets, the requirement should not be that all countries in the region need to be ready for the launch of the market and the related institutions. This is relevant for the ASEAN case in that the expectation in this section is that only a subset of the ASEAN countries take part in the regional market at its launch. The rest of the countries may join when their national markets, regulations, and potential interconnections are ready.

Table 3.1. Milestones in the Development of ATSO and AGTP Functions

Milestone	Key Activities
Milestone 1	Enabling agreement
Milestone 2	Organisational establishment
Milestone 3	Initial stage of operation
Milestone 4	Advanced stage of operation

Source: ERIA (2018b).

As a summary of this road map, the second stage after achieving the milestone of establishing an IGA is envisaged to be completed in mid-2026. This will enable the initial stage of operation, which will proceed with establishing more detailed technical standards grid codes, data requirements, procedures, and criteria for system planning. The market design for the RPM will be completed during this stage, enabling a regional shadow market to be run. This will mark the end of the initial stage of operation and transition to advanced stage of operation, where system and market operation will be finally established, resulting in an active regional market by 2030.

3.1. Intergovernmental Agreement to Achieve Milestone 1

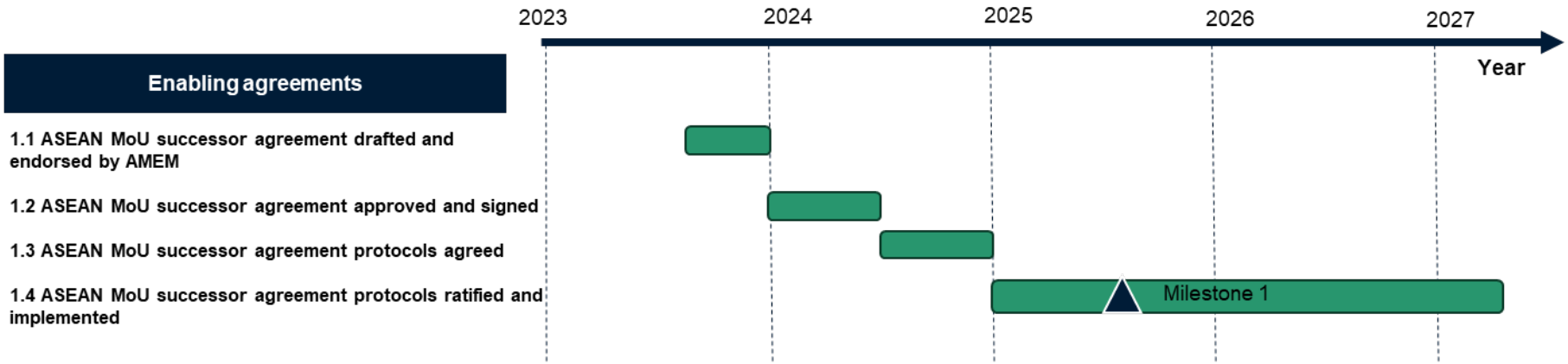
To establish the ATSO and AGTP functions as an intergovernmental institution, the APG MoU successor agreement and its protocols must be in place first to set a clear regional ambition for the organisation and lay out in some detail the roles, responsibilities, and delegation of appropriate authority to the ATSO and AGTP as regional institutions. It is important that the protocols identify the correct reporting structure for the ATSO, AGTP, and APGCC secretariat into the wider ASEAN context. Finalising, agreeing, and signing the APG MoU successor agreement and its protocols will conclude the achievement of Milestone 1.

Table 3.2. Key Activities in Enabling Agreements

Task No.	Key Activities during the Establishment Process	Responsible Entity
1.1	ASEAN MoU successor agreement drafted and endorsed by AMEM	APGCC/HAPUA
1.2	ASEAN MoU successor agreement approved and signed	APGCC/HAPUA
1.3	ASEAN MoU successor agreement protocols agreed	APGCC/HAPUA
1.4	ASEAN MoU successor agreement protocols ratified and implemented	APGCC/HAPUA

Source: Authors.

Figure 3.1. Stage 1 Road Map



Source: Authors.

3.2. Organisational Establishment to Achieve Milestone 2

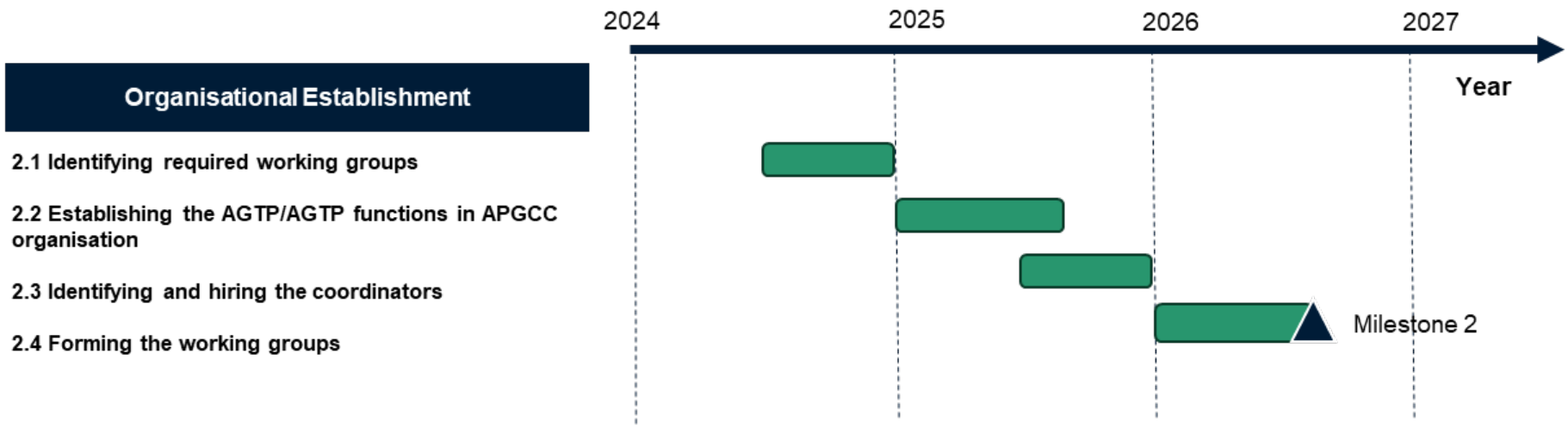
Once the APG MoU successor agreement and its protocols have been concluded, the next stage can begin. This covers the setup of the organisation of the functions, including hiring of coordinators as well as establishing the various working groups under each function necessary for the initial stage of operation.

Table 3.3. Organisational Establishment

Task No.	Key Activities during the Establishment Process	Responsible Entity
2.1	Identifying required working groups	APGCC/HAPUA
2.2	Establishing the AGTP/AGTP/AMO functions in the APGCC organisation	APGCC/HAPUA
2.3	Identifying and hiring the coordinators	APGCC/HAPUA
2.4	Forming the working groups	APGCC/HAPUA

Source: Authors.

Figure 3.2. Stage 2 Road Map



Source: Authors.

3.3. Initial Stage of Operation to Achieve Milestone 3

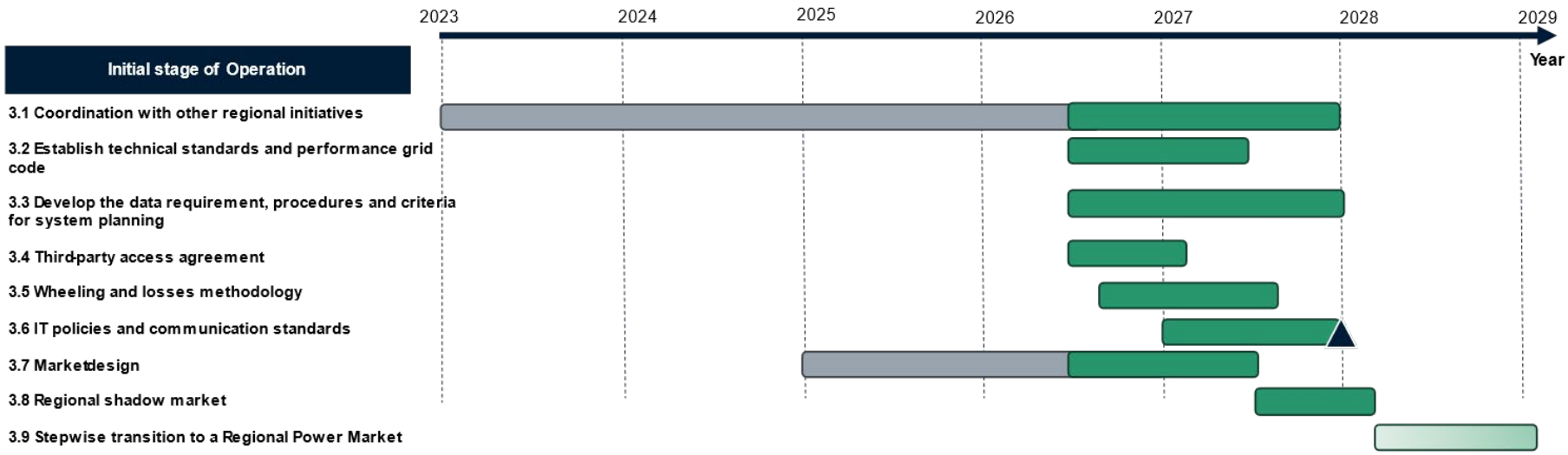
This section covers the implementation of the first stage of operations for ATSO, AGTP, and AMO under the organisation coordinated under the APGCC. This stage is the enabling stage where all detailed functions and methodologies are developed. In this stage, the established working groups of the functions will continue cooperation with the existing regional initiatives. The relevant AGTP working groups will establish technical standards and the performance grid code, and develop the data requirements, procedures, and criteria for system planning. Third-party access arrangements need to be developed during this stage to enable the establishment of a regional market. The relevant ATSO working groups will develop wheeling and losses methodologies and the ATSO IT expert working group will develop IT policies and communication standards. In parallel to these activities, the market design working group of the AMO will, in coordination with the APGCC, HAPUA, and AERN, develop a market design for the RPM. Based on this market design, a regional shadow market will be run for a fixed period in preparation for the RPM.

Table 3.4. Initial Stage of Operation

Task No.	Key Activities during the Establishment Process	Responsible Entity
3.1	Coordination with other regional initiatives	APGCC/ATSO/AGTP/AMO
3.2	Establish technical standards and performance grid code	AGTP
3.3	Develop the data requirements, procedures, and criteria for system planning	AGTP
3.4	Third-party access agreement	APGCC/HAPUA/AERN/AMO
3.5	Develop wheeling and losses methodology	ATSO
3.6	IT policies and communication standards	ATSO
3.7	Develop market design	APGCC/HAPUA /AERN/AMO
3.8	Regional shadow market	AMO

Source: Authors.

Figure 3.3. Stage 3 Road Map



Source: Authors.

3.4. Advanced Stage of Operation to Achieve Milestone 4

After the stage of initial operation, an advanced stage of operation follows. This is the stage where the functions are put fully into operation and the full benefit from regional cooperation and coordination will be achieved, including the benefits from a regional market. This stage provides further focus and structure for the operational responsibilities for the different functions and the underlying working groups and sub-units. The key activities in this stage are listed in Table 3.5.

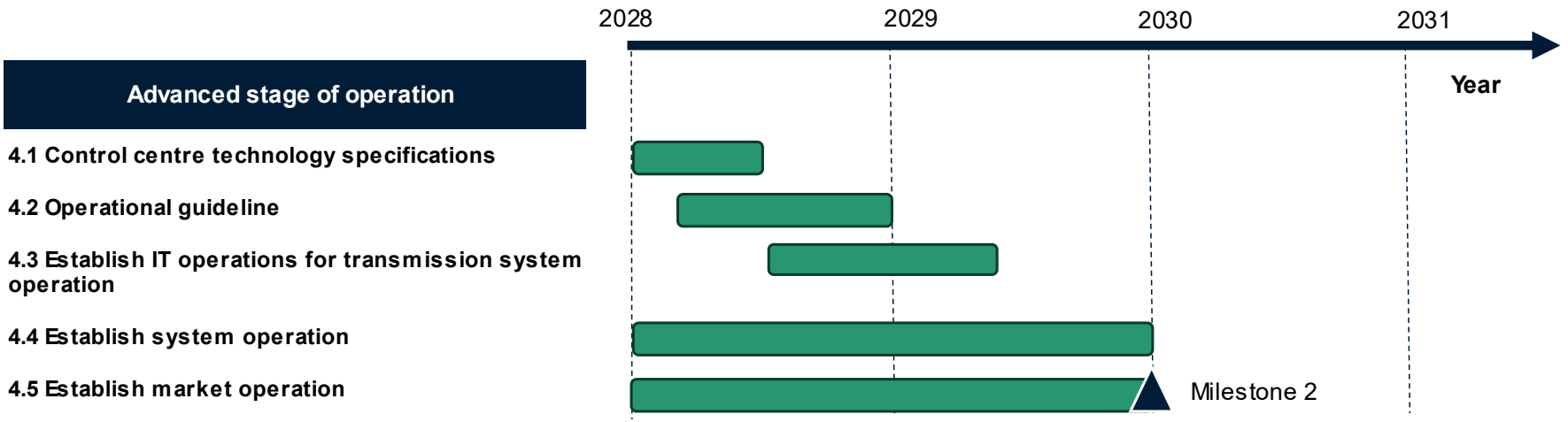
Table 3.5. Advanced Stage of Operation

Task No.	Key Activities	Responsible Entity
4.1	Control centre technology specifications	ATSO
4.2	Operational guideline	ATSO
4.3	Establish IT operations for transmission system operation	ATSO
4.4	Establish system operation	ATSO
4.5	Establish market operation	AMO

Source: Authors.

The control centre technology specifications are defined under the ATSO function and include inter alia IT systems, energy management system software, SCADA, and communication. The operational guidelines also established under the ATSO function aim to define the relationship between ATSO and the various AMS control centres, covering communication, jurisdiction, and operational boundaries. After the control centre technological standards are in place, the ATSO function will establish the system operation centre IT tools. In parallel to these processes, the ATSO will work on establishing system operation. Also, in parallel to the previously listed activities, the AMO function will work on establishing market operation. This activity of establishing market operation includes multiple sub-activities, including adjusting the market design from the previous stage based on the lessons learned from the regional shadow market, IT systems establishment, and market rules development.

Figure 3.4. Stage 4 Road Map



Source: Authors.

After Milestone 4 has been achieved, the APG and MPT are considered as operational. This does not mean everything is complete. Rather, the APG has operational ATSO, AGTP, and AMO functions with an active RPM, and the gradual improvement of coordinated system and market operation can be started to fully reap the benefits of efficiencies and markets, evolving to a full-fledged market over time, following the path of other RPMs around the world

Chapter 4
Final Remarks

A Decentralised Approach to Organising AGTP and ATSO Functions

Through literature review, expert consultation, and workshop discussions, this study found that establishing a large new organization (such as the APP proposed in the 2018 study on the establishment of ATSO/AGTP) is not the solution preferred by the AMS under the current circumstances. In addition, decentralised approaches of operating ATSO and AGTP are preferred. Furthermore, it would not be beneficial to establish another organisation, given that there is already a complex APG-related organisational structure in place within ASEAN. However, restructuring the current organisations with expansion to enable the necessary functions of ATSO and AGTP is necessary. Accordingly, this report recommends a tentative scheme of establishing the ATSO/AGTP functions based on a decentralised approach and more specifically a decentralised secretariat, making use of the already-established APG bodies (AERN, HAPUA, and APGCC) to implement these functions as well as the market operation for MPT. Such a recommendation is based on the considerations of commitment, flexibility, ease of coordination, efficiency, and international experience.

This report also makes recommendations on the hierarchy and coordination between existing APG organisations to carry out the new functions with the decentralised approach (see Figures 2.4 and 2.5). This proposal aligns with feedback received from ACE and discussions within the APG Working Group. Specifically, to establish clear terms of reference (TOR) for APG bodies, it is essential to map the tasks, roles, and activities of existing HAPUA groups and align them with AGTP and ATSO functions. The study recommends integrating existing HAPUA groups into the new organisation by updating their TOR, where possible. In cases where existing groups do not fulfil required roles, new groups or sub-units aligned with the proposed structure should be established. Heads of relevant HAPUA groups could transition into roles within AGTP/ATSO functions under the APGCC secretariat.

Accordingly, it is recommended that the ATSO, AGTP, AMO, and secretariat functions have a coordinator for each main component, this role residing within the APGCC. The APGCC coordinator would manage the day-to-day coordination and administration of the tasks of the function, while the participants in the various working groups are nominated from the AMS. It is also proposed that each working group, in addition to the coordinators, elect a chairperson, which would be a position rotating amongst the AMS. This rotational system enhances transparency, promotes leadership development, and encourages active engagement and ownership amongst the AMS in driving the agenda of the working groups. The chair of these working groups necessitates a broader regional representation to

ensure that all voices are heard and considered. Therefore, the chairperson should be tasked with representing the region, facilitating consensus-building, and fostering collaboration amongst the AMS.

Roles and Responsibilities of the AGTP and ATSO

The AGTP function underpins the development of a cohesive and sustainable APG by coordinating planning efforts, setting standards, and identifying critical infrastructure projects. Its role is pivotal in enhancing regional energy security, promoting renewable energy penetration through energy trade, and ensuring the long-term sustainability of the ASEAN energy sector. Its key roles and responsibilities include the following:

1. Evaluation of supply reliability: The AGTP evaluates the supply and demand plans submitted by each AMS to confirm the region's ability to meet demand over a 10-year horizon. This involves reviewing assumptions underlying demand forecasts, economic growth factors, and sensitivity analyses to ensure robust planning.
2. Development of interconnection reinforcement proposals: It formulates proposals for enhancing interconnections amongst the AMS, studying long-term reinforcement policies, and advising on transmission projects critical for regional energy integration.
3. Harmonisation of demand forecasting methods: Ensures consistency in demand forecasting methodologies across the AMS, facilitating coherent regional expansion plans, and system integration.
4. Coordination of regional studies: Engages with major regional studies like the ASEAN Interconnection Masterplan Study (AIMS III) to align findings with national implementation plans, promoting regional cooperation and infrastructure development.
5. Development of planning criteria: Establishes criteria for regional power masterplans, including technical standards for transmission voltage, frequency tolerances, fault clearance times, and reserve requirements. This includes developing a common regional grid code to govern system operations and connectivity.
6. Identification of priority interconnectors: Identifies strategic interconnector projects as 'Projects of Common Interest' (PCI) beneficial to all AMS, facilitating MPT and enhancing energy security.
7. Standard planning methodologies: Develops standardised methodologies for demand forecasting, generation expansion planning, and transmission planning. This involves maintaining accurate databases and using appropriate modelling tools to support coordinated planning efforts.
8. System planning for interconnectors: Focuses on planning interconnectors, ensuring cooperation amongst neighbouring utilities in design, construction, and operation phases. Tools like the Power System Simulator for Engineering and DigSILENT are

utilised for network planning and analysis.

9. Software and database management: Ensures compatibility and accuracy of databases used for planning studies, supporting effective communication and data sharing amongst AMS and consultants.
10. Operational coordination: Collaborates with ASEAN bodies like AERN and HAPUA to align planning standards with operational requirements, fostering regional energy market integration.

The ATSO function serves as a pivotal coordinator and advisor within the APG framework, ensuring operational cohesion, system reliability, and security across AMS. By facilitating effective communication and collaboration amongst national TSOs and stakeholders, the ATSO plays a crucial role in advancing regional energy integration and sustainable development goals. Its key roles and responsibilities include:

1. Advisory and coordination Role: The ATSO function operates primarily as a coordinator and advisor, collaborating closely with national TSOs across the AMS. It facilitates the implementation of regionally agreed procedures, including a harmonised regional grid code, to maintain operational standards and ensure system security.
2. Security of supply: The ATSO coordinates control block operations within the APG to uphold regional supply security. It collaborates with the ASEAN Power Grid Transmission Planning (AGTP) function to integrate long-term national power system plans and cross-border interconnections into cohesive regional strategies.
3. Coordination with national TSOs: Key responsibilities include:
    - Coordinating control block and ancillary services within the APG
    - Providing projections of regional reliability and system adequacy to guide national TSOs in implementing necessary measures
    - Defining methodologies for managing regional operational reserves and identifying control blocks for frequency control functions
    - Monitoring and metering power flows across interconnectors to assess available transfer capacities (ATC) and system security margins.
    - Conducting investigations of post-fault incidents through network studies.
4. Calculation of ATCs: The ATSO defines methodologies for calculating ATC values across the APG. These values are crucial inputs for market operations managed by the APG Market Operator. ATC calculations consider thermal, voltage, and stability constraints, ensuring reliable power flows, and supporting reserve activations across borders.
5. Transmission wheeling charges and losses: The ATSO is responsible for accurately calculating transmission charges, essential for market operations. This involves maintaining comprehensive system models of the APG region to reflect seasonal and time-of-day variations influencing power flows. It ensures transparency and

confidentiality in handling commercial data related to transmission asset investments.

6. System data handling: To fulfil its role effectively, ATSO manages a wide array of data related to APG operations and planning. This includes offline and real-time data on system status, transmission network configurations, and operational parameters. Data exchange protocols are specified in the Regional Grid Code to ensure compliance and confidentiality.
7. IT and SCADA requirements: ATSO oversees IT and SCADA systems crucial for monitoring and managing the APG. It establishes and maintains IT infrastructure for data collection, processing, and distribution amongst national TSOs and stakeholders. This ensures efficient system operation and supports future market operations.
8. Expansion of functions: ATSO's mandate is designed to accommodate additional responsibilities over time without necessitating renegotiation of foundational agreements. This flexibility allows for the evolution of its role as the APG matures and expands.

Facilitation of Cross-border Power Trade in the APG

An AMO unit is envisaged as necessary to facilitate an organised market of multilateral electricity trading in ASEAN. This function would also need to be included either in the articles of the intergovernmental framework agreement or in the protocols of the APG that follow the agreement. While it is not anticipated that the APGCC will host regional power trading from the beginning, the AMO function is expected to be developed separately and in parallel with the implementation of AGTP and ATSO functions.

A day-ahead market (DAM) is not the only way to enable multilateral trade of electricity in ASEAN. However, a DAM is crucial in optimising the investment, operation, and allocation of power resources and complementary to long-term bilateral or multilateral trade agreements. Additionally, it facilitates the effective management of cross-border transmission capacity and relieves congestion. Moreover, it simplifies the process of ensuring fair compensation for interconnections and aligning with the utilisation of cross-border bilateral agreements.

As the AMO is a more advanced level of developing the APG institutions, this study has only briefly touched the issue and recommends dedicated research to follow up.

Cost-sharing and Funding Arrangements

The 2018 studies pointed out the need for initial external funding to start the implementation of the APG institutions, and the subsequent transition into a hybrid funding model combining external support and contributions from the AMS. The goal was for the APP to become self-sustaining and operate independently. These recommendations from 2018 remain relevant for the revised recommendations in this study concerning the AGTP,

ATSO, and AMO functions. A similar pathway towards self-sustainability, drawing lessons from the Southern African Power Pool (SAPP) and the European ENTSO-E, is anticipated for ASEAN.

Intergovernmental Agreement for Establishing the Outlined Functions

This report summarises the key issues and principles to be reflected in the IGA for establishing the AGTP and ATSO institutions as Annex 1, bearing in mind that the successor agreement to the APG MoU may only consider it as a partial reference. It also provides detailed references to develop the relevant protocols under the ASEAN framework agreement for APG. The key principles recommended for the IGA include (1) mutual benefit and reciprocity, (2) sovereignty and respect, (3) transparency and accountability, (4) flexibility and adaptability, and (5) inclusive participation.

In sum, this study emphasises the strategic value of a decentralised approach to organising the AGTP and ATSO functions for the APG, aligning with the region's existing organisational landscape and operational realities. The proposed restructuring of current organisations to accommodate these functions, following a decentralised approach and without the need for establishing a new overarching body, offers a pragmatic path towards enhancing regional energy security and promoting economic growth. The study's focus on defining clear roles, responsibilities, and coordination mechanisms amongst the AMS ensures a harmonised and efficient integration of power systems. By advocating for a flexible and inclusive participation model, the report lays the groundwork for an integrated power market that facilitates multilateral trade, optimises resource allocation, and supports the long-term sustainability of the ASEAN energy sector. Moreover, the study provides a blueprint for cost-sharing and funding arrangements that aim for self-sustainability, drawing on international best practices. The principles outlined for the IGA reflect a commitment to mutual benefit, respect for sovereignty, transparency, and inclusiveness, setting a solid foundation for the collaborative advancement of the APG.

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Annex 1

Outline of an Intergovernmental Agreement

To promote the development of the APG Generation and Transmission Planning (AGTP) and the APG Transmission System Operator (ATSO), one option could be for the ASEAN Member States (AMS) to sign a specific Intergovernmental Agreement (IGA) that would commit the countries to working together for the creation of these two bodies. The advantage of an IGA over a memorandum of understanding (MoU) is primarily in the level of commitment that it requires from the signatories. While an MoU can be valuable in defining the broad nature of the collaboration between countries and national institutions, an IGA can set more specific conditions for participation and expectations of the contributions to be made by the signatories towards furthering a defined set of goals.

The following headings define the core content of a potential IGA that the AMS could consider for the specific implementation of the AGTP and ATSO as envisaged in this study.

Preamble

The Preamble needs to capture the policy objectives, key meetings, and relevant decisions that have been made since the original APG MoU was ratified. This should include cross-references to the enabling policies and agreements that authorise the enacting of the IGA. It will also need to cross-refer to the successor to the APG MoU, if this is a new framework agreement and not just a revision to the original MoU.

Article 1: The Parties

Article 1 defines the parties to the agreement, who will be government representatives from national ministries.

Article 2: Effective Date and Conditions for Effectiveness

Article 2 defines the date on which the agreement will come into full effect. This Article also sets out any conditions precedent that may need to be met, not covered by the Preamble.

Article 3: Objective

Article 3 sets the objective of the agreement. The core purpose of the IGA is to define the steps to be taken by the ASEAN governments to implement the institutions required to advance the ASEAN Power Grid (APG), the AGTP function, the ATSO function, and facilitation of cross-border power trade. The objective should be extended to summarise the key commitments that the ASEAN members states are required to make to support

the broader objectives behind the creation of the AGTP and ATSO functions.

Article 4: Definitions

Article 4 will need to define technical terms and abbreviations for ease of reference.

Article 5: Hierarchy of APG Documentation

Article 5 should indicate which ASEAN documents relate to this agreement directly. It should also make clear the order of precedence, such that in the event of a conflict between two or more of the documents, it is clear which one takes priority.

Article 5 should indicate which ASEAN documents relate to this agreement directly, including but not limited to the APG MoU, the APG MoU successor agreement and its protocols.

Article 6: APG Governance Structure

Article 6 should define the bodies to which the AGTP and ATSO functions report, based on the structures decided by the AMS, informed by the recommendations from the studies carried out by Nord Pool on ATSO and AGTP functions, this study and the APG MoU renewal process.

Article 7: Institutional Arrangements

Article 7 should identify the government bodies and other organisations with over-arching responsibilities under the IGA. This article will define the structure of the AGTP, ATSO, and ASEAN Market Operator (AMO) functions and will consider issues such as the APGCC coordination and the rotating chairing of the various working groups. It will also define the relationships between the APGCC coordinated AGTP, ATSO, and AMO functions, HAPUA, AERN and other national and regional bodies.

Article 8: AGTP Roles and Responsibilities

Article 8 should contain a high-level statement of the AGTP roles and responsibilities in relation to generation and transmission planning. This Article should provide a summary of interfaces between the AGTP and other national and regional organisations, including the ATSO. The core content can be based on Section 2.3 of this report, with detailed provisions being contained in a Schedule to the agreement.

Article 9: ATSO Roles and Responsibilities

Article 9 should contain a high-level statement of the ATSO roles and responsibilities in relation to operating the APG. This Article should provide a summary of interfaces between the ATSO and other national and regional organisations, including the AGTP. The core content can be based on Section 2.4 of this report, with detailed provisions being contained in a Schedule to the agreement.

Article 10: Facilitation of Cross-border Power Trade

Article 10 should set out the issues on which collaboration between the ASEAN Member

States and the APG bodies will be required. These should include the issues covered in the previous APG MoU (technical, financing, taxation and tariffs, regulatory and legal frameworks, power trade and third-party access), as modified by the successor framework agreement. Additional specific areas of collaboration could include harmonisation of regional Grid Code documents, interfaces with the market operation function within ATSO/AGTP, external interactions with neighbouring countries, national and regional electricity networks and markets.

Article 11: Cost-sharing and Funding Arrangements

This Article 11 should define out the principles for cost sharing and funding arrangements and is included because in setting up the AGTP and ATSO functions there could be staffing costs that need to be met ahead of fees from membership being available. The planned transition from external funding support to membership fees should be summarised, and the principles of membership fee-based funding described, in line with the principles explained in Section 2.6 of this report.

Article 12: Confidentiality

Article 12 would cover confidential information and the arrangements for handling this between the AMS. The principles of confidentiality should align with those defined in other regional MoUs and agreements. Particular attention should be paid to maintaining the confidentiality of commercially sensitive information associated with electricity trading.

Article 13: Intellectual Property

Article 13 should address arrangements for sharing any intellectual property generated during the IGA and any restrictions on its use by the parties.

Article 14: Dispute Resolution

Article 14 defines the process for handling disputes between two or more parties. This could include reference to a third-party arbitration body, following the principles used in ASEAN bodies already to date.

Article 15: Duration of Agreement

Article 15 defines the duration of the agreement being in force. In defining this, reference should be made to other related agreements and/or MoUs.

Article 16: Withdrawal from Agreement

In some jurisdictions it is possible for one or more party to withdraw from an IGA or MoU without this leading to the agreement having to be terminated. This clause should include notice periods and any post-withdrawal restrictions that should continue to bind parties.

Article 17: Entire Agreement

The last article should contain the Entire Agreement and any other standard legal boilerplate clauses.