

CHALLENGES OF IMPORTING AND EXPORTING RENEWABLE ENERGY IN THE ASEAN POWER GRID — WITH CONSIDERATION OF ITS COMPLEMENTARY RELATIONSHIP WITH GAS DEMAND —

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SUMMARY

- The ASEAN Power Grid (APG) was launched in 1997 with the aim of facilitating cross-border electricity exchange and system integration within the region. Since the 2000s, the integration of renewable energy has also been added as a goal. Countries are scheduled to discuss institutional development and standardization to resolve these issues at the ASEAN meeting in October 2025, against the institutional delays related to the import and export of renewable energy.
- For cross-border renewable energy transactions, the establishment of power purchase agreements (PPAs), renewable energy certificate (REC) systems, and electricity traceability are essential. However, there are still challenges remaining in ASEAN countries, regarding inconsistencies in trading systems, as well as ensuring the reliability of these systems and guarantees of ownership.
- Although natural gas is recognized as a "transition energy," the key to APG's success will be to consider complementary technologies for renewable energy, such as carbon capture and storage (CCS) and nuclear power, while adopting an integrated approach to energy transition.

1. ASEAN POWER GRID PROGRESS AND THE INSTITUTIONAL VOID

The ASEAN Power Grid (APG) aims to establish a sustainable energy system by ensuring a stable supply of electricity within the region and connecting ASEAN countries with power grids. In addition, the role of the APG is growing as ASEAN countries urgently need to decarbonize and adopt renewable energy to achieve net-zero emissions. This section begins with the APG concept, which aims for "renewable energy integration," that is, to integrate renewable energy into the ASEAN region's electricity markets. It then examines trends in renewable energy electricity imports and exports in the ASEAN region to clarify the current status of the APG.

1-1. BACKGROUND OF THE APG SCHEME

Launched in 1997, the APG has focused on promoting renewable energy for ASEAN since the 2000s (Figure 1). It aims to complete 18 transmission projects by 2040. To date, 9 of the 18 projects have been implemented, but there is only one with operational multilateral interconnections, which is the Lao PDR, Thailand, Malaysia, Singapore – Power Interconnection Project (LTMS-PIP). Unlike the EU-style market integration, the APG concept seeks optimal integration of renewable energy while respecting each country's sovereignty.¹

¹ Both the EU and ASEAN aim to integrate electricity markets throughout their regions, and ASEAN is working to achieve EU model multilateral electricity trading. ASEAN policymakers use the EU as a case study to coordinate on how to share electricity market cost-benefits, harmonize regulations, and the like. However, the EU already has a fully integrated electricity market with supranational

Figure 1: History of the APG scheme

| Year | Meeting | Summary |
|------|---|---|
| 1997 | 2nd Informal Summit of ASEAN | The APG scheme was first presented in ASEAN Vision 2020 and Hanoi Plan of Action (renewable energy was not explicitly mentioned). |
| 1999 | 17th ASEAN Ministers on Energy Meeting (AMEM) | ASEAN Plan of Action for Energy Cooperation (APAEC) for 2004-2009 was formulated. |
| 2002 | 20th AMEM | "ASEAN Power Grid's Roadmap" was agreed upon; integration of renewable energy was also mentioned. |
| 2003 | 21st AMEM | Final report of the ASEAN Interconnection Masterplan Study (AIMS) was approved, providing guidelines for APG scheme. It clarified direction for long-term renewable energy integration. |
| 2015 | APAEC 2016–2025 Phase II: 2021-2025 | Integration of renewable energy was set as a major goal for the APG scheme. |
| 2021 | 39th AMEM | Development of renewable energy transmission infrastructure was clearly stated in AIMS III. |

Source: Compiled by MGSSI based on ASEAN Centre for Energy

1-2. CHALLENGES OF THE APG CONCEPT

Institutional development challenges include the lack of legal guarantees for power purchase agreements (PPAs) in international transmissions, the absence of cross-border systems for tracking volumes of electricity (for example, measurement, certification, and attribute certification), and the proliferation of regulated electricity rate systems in each country.

Issues such as the transmission link between Malaysia and Singapore highlight how institutional barriers prevent transactions, although technically the connection is feasible.

There are also political and economic challenges. Electricity rate from hydroelectric power is relatively low in Laos, while Thailand would like to consume that power itself rather than letting it pass through for sale in other countries. As a result, LTMS-PIP transmission from Laos to Thailand has been suspended since 2024. In addition, insufficient legal provisions for compensation obligations and contract enforcement during cross-border PPA transmission interruptions have become barriers to investment.

Furthermore, other challenges have been pointed out in individual APG projects (Figure 2).

Figure 2: Cross-border transmission projects and their challenges

| Cross-border transmission project | Challenges |
|---|---|
| Pasi Budan, Johor - Yishun, Singapore | Electricity prices are unilaterally determined by Tenaga Nasional Berhad (TNB), Malaysia's electricity company, and Singapore has no right to negotiate. A special mechanism for negotiation is needed instead of a TNB monopoly. |
| Sarawak, Sabah (Malaysia) - Singapore | Negotiations have been complicated by Indonesian territorial waters in the sea area on the route from Sabah and Sarawak to Singapore. |
| Brunei Darussalam–Indonesia– Malaysia–Philippines East ASEAN Growth Area (BIMP-EAGA) transmission project | Funding has stopped due to the withdrawal of aid from USAID, and some operations have stalled. |

Compiled by MGSSI based on interviews in Singapore

competent authorities, such as the European Commission, to shape market rules. ASEAN's renewable energy integration, on the other hand, depends on intergovernmental agreements and voluntary cooperation among ASEAN member countries. Therefore, ASEAN is building the APG model based on its own political and economic background, while using the EU model as a reference.

1-3. OVERVIEW OF NEW APG AGREEMENT

To address the challenges of cross-border power trading, the 43rd ASEAN Ministers on Energy Meeting (AMEM) in October 2025 discussed topics such as the development of a legal framework for multilateral power grids, technical standards, pricing systems, and a financing framework known as the ASEAN Power Grid Financing (APGF) Initiative (Figure 3).

Figure 3: Major topics at 43rd AMEM

| Major plans | Details |
|---|---|
| Memorandum of understanding (MOU) for strengthening APG (MOU signing ceremony) | MOU to accelerate the integration of electricity in the ASEAN region as the basic legal framework for implementing cross-border transmission projects |
| Official launch of APGF | Launch of APGF, a new framework to support APG financing, in collaboration with the Asian Development Bank (ADB), the World Bank, the ASEAN Centre for Energy, Secretary-General of ASEAN, and others |
| Review of energy cooperation | Follow-up on the ASEAN Petroleum Security Agreement (APSA), review of priority issues such as the renewable energy certificate (REC) framework, energy efficiency database, etc. |
| Transition of ASEAN Plan of Action for Energy Cooperation (APAEC) | Preparation and formulation of strategy for transition from Phase II (2021-2025) to Phase III (2026-2030) |
| Theme-specific discussions and strengthening collaboration | Promoting partnerships with policymakers, businesses, and the private sector at the ASEAN International Conference on Energy and Environment (AICEE) and the ASEAN Energy Business Forum (AEBF) |

Source: Compiled by MGSSI based on data from the ASEAN Secretariat and local media reports

2. INSTITUTIONAL CHALLENGES AND IMPLICATIONS OF IMPORTING AND EXPORTING RENEWABLE ENERGY

Based on the conditions for establishing cross-border renewable energy trade, this section analyzes how institutional barriers have caused renewable energy trade to stagnate. It will then clarify what kind of realistic approaches are being discussed for the transition to renewable energy in ASEAN.

2-1. INSTITUTIONAL ISSUES IN CROSS-BORDER RENEWABLE ENERGY TRADE

The institutional prerequisites for enabling cross-border renewable energy trade consist of: (1) cross-border PPAs, (2) establishment of renewable energy certification (REC) systems, and (3) electricity traceability (a mechanism to track where and how electricity was generated).

(1) Cross-border PPA already exists with LTMS-PIP. However, regulatory frameworks for electricity markets differ across countries, such as in transmission and retail liberalization. Institutional development is necessary for the spread of cross-border PPAs. Ensuring transparency of power grid access rights and pricing is especially an issue for direct contracts involving private companies. These institutional inadequacies hinder the expansion of private-sector-led renewable energy trading.

(2) REC systems have been institutionalized in Singapore and Malaysia, and are being developed in Vietnam, Indonesia, and the Philippines. Singapore has two international schemes: the International Renewable Energy

Certificate (I-REC) and the Tradable Instrument for Global Renewables (TIGR). These REC systems were established based on Singapore Standard 673, a code of practice for renewable energy certificates. Certification requires mandatory data, such as power generation facilities and the volume of electricity generated. The

transaction volume under I-REC is rising as more and more companies join the RE100,² including Microsoft. Malaysia has the mercy³ for domestic solar and hydroelectric power, and it can be traded by domestic and foreign companies.

However, cross-border REC trading faces challenges due to insufficient international rules for environmental reporting, and there remain issues of additionality⁴ and traceability to determine, whether trade is having a positive environmental impact. Also, there is no unified ASEAN-wide certification body for RECs, and differences in national systems make it difficult to prove the environmental value of renewable energy across borders. When legal frameworks for renewable energy imports are underdeveloped, incentives for investment in transmission infrastructure decline, potentially delaying grid development. In order to overcome these challenges, it is necessary to promote green finance that balances investment profitability with environmental value, and to establish a system that enables investors to quantitatively assess the environmental value of renewable energy businesses through REC certification.

(3) Electricity traceability is a system to ensure the reliability of RECs by recording and managing attribute information, such as the type of power plant, location, and generation method. International tracking systems such as the Evident Registry and I-TRACK have been introduced in the ASEAN region as a means for companies filing environmental reports to prove which power plants supplied the electricity they have used. However, the technical and institutional complexity of linking electricity to RECs during cross-border transmission requires the development of an REC system that can track the flow of electricity trade across borders.⁵

The above challenges undermine the credibility of cross-border renewable energy transactions to resolve the issues. It is essential to design a system that is more effective and to improve the financing and investing environment.

2-2. CURRENT STATUS OF RENEWABLE ENERGY ADOPTION AND THE ROLE OF NATURAL GAS

The development of legal frameworks for the imports and exports of renewable energy is advancing steadily in Malaysia and Singapore. Malaysia, in particular, is transitioning from a feed-in tariff (FIT) system to a Net Energy Metering (NEM) system, where surplus electricity is sent to power companies and reduces electricity bills. The use of diverse energy sources such as solar and hydroelectric power is also advancing there.⁶ Malaysia is also expected to pass a national climate change bill in 2025, which will establish a legal framework for making international power connections and promoting renewable energy. In the Malaysian state of Johor, plans for a dedicated zone for renewable energy trading are underway, and discussions on cross-border renewable energy

² Formed in 2014, RE100 is a coalition of companies with a target of powering 100% of their operations with renewable energy.

³ The mREC (Malaysia Renewable Energy Certificate) system began commercial trading through the mGATS (Malaysia Green Attribute Trading System) operated by TNBX, a wholly owned subsidiary of Tenaga Nasional Berhad (TNB), Malaysia's state-owned electricity company. It complies with international standards. Under Malaysia's Cross-Border Electricity Sales (CBES) Scheme, certified renewable energy is being transmitted from Johor to Singapore. Institutional development is underway, with an emphasis on additionality in the evaluation process.

⁴ Additionality is the expected effect of encouraging the adoption and widespread use of renewable energy by purchasing renewable energy.

⁵ [Powering ASEAN's clean energy future: Business-driven pathways to regional integration](#)

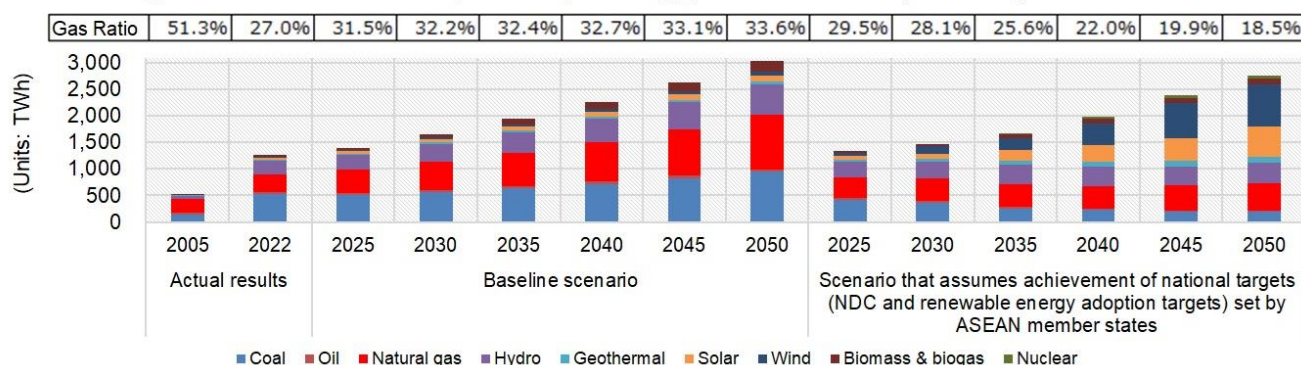
⁶ According to *Renewable energy trade among the ASEAN countries and the road to net-zero carbon emissions*, in ASEAN countries, cross-border electricity trading is the most cost-effective way to generate electricity from solar and hydroelectric power, rather than relying on expensive battery energy storage systems.

trading through international collaboration are gaining momentum.⁷ In Singapore, on the other hand, demand from data centers is growing rapidly, and electricity demand is expected to reach 12 GW by 2030. With a renewable energy share of only 4.7% and domestic adoption is limited, cross-border trade is essential to complement supply. For this reason, Johor is considering developing cross-border infrastructure to export renewable energy, mainly solar power, to neighboring Singapore. These developments highlight the importance of cross-border trading within the ASEAN region to make up for domestic mismatches between renewable energy supply and demand.

ASEAN countries are adopting renewable energy to move away from their dependence on coal-fired power. However, natural gas is becoming an increasingly important power source as a complementary source for a stable supply of electricity. In the Asia Zero Emissions Community (AZEC), where Japan is helping to lead ASEAN's energy transition, the concept of a "realistic energy transition" is emphasized. A rapid transition from fossil fuels to renewable energy, as pursued by Western nations, is considered unrealistic, and natural gas is seen as an important power source for the transition to renewable energy. ASEAN countries also recognize natural gas as a "transition energy," and there are new decarbonization policies in ASEAN countries based on future demand projections and integration with carbon capture and storage (CCS).⁸ To achieve carbon neutrality, it will be important to combine CCS technology with natural gas infrastructure, and movements toward introducing CCS in ASEAN gas-producing countries are expected to accelerate.⁹

In the main energy scenarios of the 8th ASEAN Energy Outlook (AEO8), natural gas is projected to account for 20% to 30% of ASEAN's power generation mix through 2050 (Figure 4).¹⁰

Figure 4: Main scenarios for composition of power supply of ASEAN countries, 2025-2050, as assumed in AEO8



Source: Compiled by MGSSI based on data from AEO8

⁷ The Southern Johor Renewable Energy Corridor (SJREC) zone is envisioned for the southern part of the state of Johor, Malaysia. This is a strategic region with an eye on cross-border electricity trade with Singapore. It plans to meet domestic and international demand for renewable energy, mainly with such projects as large-scale solar power and battery energy storage systems (BESS). This is considered part of the Johor-Singapore Special Economic Zone (JS-SEZ) initiative.

⁸ Demonstration projects meant to facilitate CCS implementation are proceeding in Malaysia and Indonesia, while other ASEAN countries have yet to make arrangements for such implementation.

In addition, only four countries have carbon neutrality targets for 2050: Malaysia, Thailand, and Vietnam. There are net-zero targets in Thailand (by 2065), Indonesia (2060 or earlier, with no target for carbon neutrality), Vietnam, Singapore, Brunei, Cambodia (2050), and Laos (2050 or earlier). Myanmar has set a target, limited to forestry and other industries, of net zero (2040); carbon neutrality and net zero targets vary from region to region based on economic and other factors.

⁹ Malaysia and Indonesia have, in fact, actively formulated policies for the implementation of CCS in recent years.

¹⁰ In addition to Figure 4's Baseline Scenario and a scenario that assumes the achievement of national targets (NDC and renewable energy adoption targets) set by ASEAN member states (commonly known as the AMS Targets Scenario), AEO8 also has an ASEAN-wide decarbonization scenario that integrates regional targets and least-cost optimization (Regional Aspiration Scenario, RAS) and a scenario that assumes that ASEAN will achieve net zero by 2050 (Carbon Neutrality Scenario, CNS).

As also shown in Figure 4, natural gas is expected to remain a major power source to complement renewable energy even in 2050. Even if renewable energy becomes widespread, natural gas will be an essential regulating power source. On the other hand, if progress is not made in regulatory frameworks, the introduction of renewables will be limited, resulting in continued or increased dependence on gas-fired power. Therefore, regulatory adjustments are needed to stabilize natural gas trading and establish an integrated renewable energy electricity market.

3. OUTLOOK FOR AN ASEAN INTEGRATED ELECTRICITY MARKET

3-1. THE FUTURE OF THE MULTILATERAL POWER GRID

First, the new APG agreement scheduled for adoption in 2025 is expected to advance regulatory standardization. Specifically, progress is anticipated in establishing frameworks for multilateral PPAs to legalize cross-border electricity contracts, implementing common rules for transmission fee settlement, and promoting technical standardization and harmonization. These developments will make electricity trading within ASEAN more efficient and transparent, and make the cross-border use of renewable energy a realistic option (Figure 5).

Figure 5: APG-related standardizations

| Item | Details | Objective of standardization |
|--|--|--|
| Regulatory standardization | Coordination of rules and legal systems in different countries' electricity markets | Increase transparency and predictability of cross-border power trading |
| Coordination of technical requirements | Unification of power grid infrastructure specifications, connection standards, and operating protocols | Ensure inter-grid compatibility and stable power supply |
| Establishment of financial model | Investment framework in collaboration with ADB and World Bank, including APGF | Establish a mechanism to attract private investment with support from ADB, World Bank, etc. |
| Establishment of regional regulatory body | Proposal for creation of an "ASEAN regulator" to oversee entire ASEAN region | Establish an organization to act as coordinator among countries to ensure consistency in system operations |
| Submarine cable project maintenance guidelines | Guidelines for infrastructure development, including hydroelectric power transmission from Sarawak, etc. | Assist in addressing technical, environmental, and legal issues for new projects |
| Clarifying role of APG-related institutions | Clarification of definitions of duties for the ASEAN Power Grid Consultative Committee (APGCC), ASEAN Energy Regulators Network (AERN), and Heads of ASEAN Power Utilities/Authorities (HAPUA) | Increase efficiency of business operations and clarify the division of responsibilities |

Source: Compiled by MGSSI based on data from ASEAN Secretariat

3-2. DEVELOPMENT OF DECARBONIZATION INFRASTRUCTURE BASED ON COMPLEMENTARY STRATEGIES FOR RENEWABLE ENERGY AND GAS

The institutional role of gas-fired power as a regulating power source is crucial to complement the instability of renewable energy. The feasibility of the APG scheme will be enhanced if institutional design and gradual market integration proceed, including the development of an electricity market that incorporates renewable energy and natural gas in a balanced manner and the establishment of a legal framework through a new APG agreement. In particular, a realistic energy transition would be the development of a decarbonization infrastructure that can use natural gas as a transition energy source, in conjunction with natural gas infrastructure and CSS technology. In that sense, it is necessary to take an integrated approach to the transition to renewable energy and the use of natural gas while developing the decarbonization infrastructure.