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ASEAN Power Grid Ambitions in Climate Change Mitigation

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SYNOPSIS

The ASEAN power sector, which is essential to the region's decarbonization efforts, must simultaneously supply the region's rapidly rising energy demands. Not only will the power grid help Singapore to access renewable resources in ASEAN, reducing its dependence on natural gas, but also benefit the whole region to achieve net-zero ambitions. With the expectation of a sharp surge of renewable resources for a carbon-free power sector, power exchange and trade will become essential to enhance energy security, ease the stress on electricity dispatch and improve the affordability of electricity prices. Acting in the near term and facilitating integration will help ASEAN prepare for a carbon-free power system.

KEY POINTS

- The decarbonization goals and the surge of energy demands require ASEAN to transit to a power sector with large shares of variable renewable energy.
- In light of the increasing electricity demand in Singapore, it can benefit from affordable access to clean energy and meet its renewable energy targets.
- The ASEAN power grid has progressed in sharing hydropower within the region. Moving forward, the focus will shift to intermittent renewable resources.
- While more long-term bilateral power purchase of renewable energy is expected in the near future, a flexible power market will be necessary for the long run.

INTRODUCTION

ASEAN's power industry is transforming, due to the pressure from regional energy security and climate change mitigation goals. The portion of renewable energy in the total generation mix will increase to meet the anticipated rapid rise in total electricity needs. Likewise, the penetration of variable renewable energy (VRE) will be deepened by phasing out fossil fuels.

In this context, the ASEAN power grid is a key component of a secure and efficient power system. It is now essential in exploring and sharing renewable energy resources in ASEAN. The interconnected power grids are expected to play a more critical role in enhancing regional energy resilience when a high VRE power system develops, and a flexible power market may benefit all ASEAN member states. It also assists the transition to a fully carbon-free power sector, by attracting more investment and accelerating progress in decarbonization.

ANALYSIS

ASEAN electricity demand and challenges

Over the past two decades, the total primary energy in ASEAN has increased, particularly related to coal, oil and natural gas. At present, fossil fuels dominate the energy systems of the region and contribute to more than 90% of the growth in energy demand. Although the energy mix varies widely among countries due to differences in endowment and policy action, overall, coal has accounted for the largest share of growth in the total energy supply since 2000. According to the *Southeast Asia Energy Outlook 2022* by the International Energy Agency (IEA), the energy demand, fossil fuel imports and emissions are likely to increase with the current policies in place. As

a result, the region's import needs, and energy security vulnerabilities will sharply increase.

Furthermore, electricity demand is projected to triple by 2050, increasing from approximately 800 TWh in 2020 to more than 2250 TWh in 2050, according to the *Southeast Asia Energy Outlook 2022*. Industrialisation, urbanisation and motorisation have been the key contributors to increased fossil fuel use and electricity consumption. This will lead to a great challenge in meeting electricity demand while reducing the reliance on fossil fuels and further diversifying the generation mix. For enhanced energy security and climate change mitigation, ASEAN has pledged to increase the use of renewable energy. As encouraged under Article 4, paragraph 19 of the Paris Agreement, several ASEAN countries have developed Long-term Low Greenhouse Gas Development Strategies (LT-LEDS).

As per the LT-LEDS, all countries aim to increase their share of renewable energy in the energy mix. For example, Cambodia aspires to introduce more renewables in its generation mix, up to a share of 35% by 2050. Likewise, Vietnam seeks to switch from fossil fuels to renewables in several sectors. Lao PDR aims to increase the share of renewable energy to 30% of energy consumption by 2025 for large-scale technologies, and it plans to build extra hydropower plants to export clean electricity to neighbouring countries. Thailand seeks to increase the share of renewable electricity to 33% of total electricity generation by 2050. Similarly, Singapore aims to increase the share of renewable energy in its energy mix to 23% by 2025 and reduce reliance on natural gas (comprising 95% of its electricity) by accessing green electricity from the ASEAN region. It aims to enhance its solar energy capabilities by deploying solar panels in spaces such as reservoirs and building rooftops.

Although each of the ten countries is distinctive in terms of its stages of development and financial, human and technological capacities, and thereby, reliance on fossil fuels, a commitment to regional cooperation has been acknowledged as a means to meet future demand.

Progress in ASEAN power grid

With the aim of sharing energy resources within the region, enhancing energy security and promoting energy efficiency, the ASEAN Power Grid was initiated as a flagship programme in 1997. The power grid is currently the primary means to transmit renewable energy in ASEAN.

The programme was led by the Heads of ASEAN Power Utilities/Authorities (HAPUA). The first stage of the ASEAN Power Grid programme involves the construction of infrastructure. By April 2020, 8 interconnections were in place with a total existing capacity of 7720 MW. Most of the interconnections are underpinned by bilateral power purchase agreements or power exchanges, which mostly occurred among the Mekong countries. Currently, the largest electricity exporter in ASEAN is Lao PDR, with net electricity exports of 27 TWh in 2018, due to its abundance of hydropower.

The need for renewable energy drives ASEAN beyond the bilateral power agreements towards multi-lateral power trading schemes, though the progress is sometimes stalled. The Lao PDR-Thailand-Malaysia-Singapore Power Integration Project (LTMS-PIP), first mooted in 2014, was recently launched in June 2022. The first phase of the project successfully traded up to 300 MW from Laos to Malaysia. In 2020, an Energy Purchase and Wheeling Agreement (EPWA) was signed to extend the trade to Singapore and to determine the wheeling charge paid to the transit countries, i.e., Thailand and Malaysia.

The LTMS-PIP project is a unidirectional long-term power transmission between predetermined pairs of buyers and sellers, but the electricity passes through multiple countries. The success of LTMP-PIP marks a milestone, as it proves the technical and institutional feasibility of long-distance power transmission across countries. For exporters that are mostly less developed, this provides more economic benefits to enter international markets that are distant from their domestic markets. For importers that usually lack sufficient renewable resources, such as Singapore, this provides a more diversified portfolio of energy and an opportunity to tap

into more clean energy. The success may encourage more trades of green energy between countries that are not directly connected or are geographically distant, to help the region achieve its renewable energy goals.

On the other hand, replicating the success of the LTMS-PIP requires better governance and coordination. The multilateral involvement would especially complicate the negotiation process and the implementation. Therefore, supporting guidance, both technical and regulatory, needs to be in place.

Integrate renewable energy into the grids

Apart from the use of hydropower, other sources of renewable energy have come into ASEAN's focus. Although ASEAN has abundant wind and solar potentials, renewable targets are made difficult by the heterogeneous geographic distribution of these natural resources. Wind power is primarily available in Indonesia, Vietnam, and the Philippines, while the solar PV potential is highly dependent on the geographical area available. This may result in excessive renewable potential in some countries and insufficient renewable energy capacity in others.

Transmitting the excess energy to countries having insufficient renewable capacity and matching the supply and demand requires integrating renewable energy into the grids through adequate infrastructure to connect the renewable energy generators to the load centres. With better connectivity, more bilateral trading and multi-lateral trading within ASEAN countries can help decarbonize the power sector collectively.

However, scaling up intermittent energy, such as solar and wind power brings additional challenges to integrating renewable energy into the grid. Energy availability may be less predictable due to the variability of weather conditions. The temporal variability of energy prices, due to the high penetration of intermittent generation, may add to the difficulty of negotiating reasonable power trading prices for long-term contracts that are designed for hydropower. It will be natural to call for a more flexible electricity market that reflects more instant energy prices and enables day-ahead, intraday, or even real-time power trades. IEA has identified a primary trading model and a secondary trading model by learning from the experience of other electricity markets. Forming a more integrated market early prepares ASEAN for high intermittent-energy penetration.

Transition to Net-zero

Beyond the renewable energy targets, ASEAN also prepares for longer-term mitigation goals. As presented by the ASEAN State of Climate Change Report (ASCCR), countries should (i) Achieve net-zero greenhouse gas (GHG) emissions as early as possible in the latter half of the 21st century and (ii) Cap peak GHG emissions as soon as possible after 2030 to ensure that the progress of the net-zero goal is on track.

However, as indicated by the Nationally Determined Contributions (NDCs), the current trajectory may not contribute to achieving the net-zero goal by 2050. Currently, several countries in the region are not on track to meet their initial net-zero targets. These targets imply the need for greater and immediate changes in the energy systems.

The ambition for a carbon-free power sector is likely to lead to a surge in the share of VRE. The existing dominating fossil fuel generators will be phased out, and a massive expansion of clean energy will be required to meet the total electricity demand. Among the "low-hanging" zero-emission technologies accessible, for example, hydropower, solar PV, wind, geothermal and nuclear, VREs are believed to have the largest potential and the least costs, and therefore, they are the most promising option for ASEAN. The *Renewable Energy Outlook for ASEAN* published by the International Renewable Energy Agency (IRENA) revealed that renewable energy will dominate the generation mix in most scenarios, and if ASEAN aims to achieve the 1.5-degree Celsius goal by 2050, VREs are expected to contribute approximately 80 per cent to the total generation. Of them, solar PV accounts for more than 70 per cent of total electricity generation capacity, while wind contributes another 10 per cent. Therefore, it is essential to prepare for the upcoming challenges of the high intermittent-energy power sector.

ASEAN power grid – key to net-zero

The ASEAN power grid could be a key approach to achieving ASEAN's net-zero targets, not only because its role in distribution and dispatch, but also because it may act as a catalyser to unlock a higher proportion of renewable integration.

ASEAN power grid brings great economic benefits to the power system. *Southeast Asia Energy Outlook 2019* from IEA shows that the optimized transmission flows tend to reduce the annual operational cost, due to the drop in the VRE curtailment rate. The economic savings are reported to increase with higher renewable energy penetration. Such savings will lower the average electricity price generated by renewables, and more competitive prices over traditional fossil fuels will encourage governments to build more renewable energy infrastructure and phase out fossil fuel generators.

More importantly, cross-border trade on renewable energy promotes more investment in advancing renewables. In comparison to thermal power plants, renewable energy infrastructure typically needs a much larger upfront investment. This requires local policy support as well as enhanced regional power trade. The profitability in selling cheap renewable energy to wealthier countries, such as Singapore will be an important factor in attracting external investment and achieving the decarbonization goal at an early stage.

Notably, the LTMS-PIP would draw more foreign direct investment into Laos, and the successful experience can be replicated for solar and wind power. For Singapore, the potential electricity importer, a foray into the power trading of bi-lateral intermittent energy could be a new trailblazer after LTMS-PIP, to scale up renewable energy and explore the possibility of closer and more diverse cooperation between ASEAN countries, including the trial of short-term power purchase contracts.

CONCLUSION

The construction and expansion of the ASEAN power grid, together with more enhanced cross-border power trade plays an important role in improving energy security and achieving ASEAN's net-zero ambitions.

In the near future, Singapore may benefit from long-term bilateral trading on renewable energy to reduce its dependence on natural gas for electricity and tap into the abundance of renewable energy in the region. This will help Singapore to reduce energy costs while achieving renewable energy targets.

In the long run, the transition to a deeply integrated power grid is necessary, despite the economic, technical, institutional, and geo-political barriers. Gradually evolving into a more flexible power market ensures energy resilience, reduces electricity prices and encourages a higher renewable energy penetration.

WHAT TO LOOK OUT FOR

- An acceleration in the construction of power grid infrastructure for improved regional connections.
- Increased installation, together with cross-border bilateral trading on wind power and solar power within ASEAN.
- Refined regulatory and technical frameworks in preparation for large-scale electricity imports in Singapore.
- Studies and actions on a short-term power trading market to support the trading of intermittent renewable energy.

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