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Beyond Power Generation Costs: Strategic Considerations for Singapore's Low-Carbon Electricity Imports

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Beyond Power Generation Costs: Strategic Considerations for Singapore’s Low-Carbon Electricity Imports

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Abstract

Singapore’s strategy of importing 6 GW of low-carbon electricity by 2035 depends on effective regional electricity trade with ASEAN. However, cost-competitive power producers do not automatically translate into capable and willing exporters in the long run. Building on LCOE estimates for 20 Country × Technology pairs, this paper assesses the readiness of ASEAN countries to serve as reliable clean electricity suppliers by evaluating export capability and willingness, and maps cost-competitive Country × Technology pairs onto the ASEAN Power Grid (APG) to identify priority interconnection corridors. On export capability, Malaysia, Vietnam, and Laos emerge as the strongest near-term hydropower candidates, with Vietnam also leading across solar PV and wind. Indonesia’s cost advantages are constrained by domestic demand priorities, infrastructure bottlenecks, and regulatory uncertainty that reduces project bankability. On export willingness, Malaysia and Vietnam are the most committed partners, backed by concrete institutional frameworks and active market mechanisms. Laos signals a strong intent through explicit export targets and an established concession model, despite higher generation costs. Indonesia’s willingness is tempered by protectionist ministerial rhetoric and an absence of operational-level policy frameworks. Mapping cost-competitive Country × Technology pairs onto the APG, we identify five priority source clusters for interconnection development: East Malaysian hydropower, Indonesian hydropower, solar PV and onshore wind, Vietnamese hydropower, solar PV and wind, Cambodian solar PV, and Thai onshore wind. The findings underscore that realising the gains from regional power integration requires sustained institutional investment in transmission infrastructure and effective diplomacy that builds the political trust needed to sustain regional power trade.

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1 Introduction

Singapore aims to import approximately 6 gigawatts (GW) of low-carbon electricity by 2035. This strategy helps the city-state balance energy sustainability, affordability, and reliability amid a scarcity of domestic renewable resources and rising power demand. Crucially, cross-border clean energy imports also serve as a primary catalyst for advancing the ASEAN Power Grid (APG) vision [36, 32]. Singapore currently operates two pilot programmes importing up to 250 megawatt (MW) of renewable power from Laos and Malaysia. Furthermore, the Energy Market Authority of Singapore has granted Conditional Licences for 3 GW of electricity imports from Indonesia, alongside Conditional Approvals for an additional 5.35 GW spanning Indonesia, Australia, Vietnam, Cambodia, and Malaysia [32]. Table A.1 summarises Singapore’s ongoing and planned low-carbon electricity import projects.

While the cost competitiveness of generation technologies, which is typically evaluated via the Levelised Cost of Electricity (LCOE) [72, 39, 77], is paramount for ensuring affordable electricity tariffs for residential and industrial consumers, long-term reliability is equally critical. Developing cross-border interconnection infrastructure is highly capital-intensive and subject to protracted development timelines. Consequently, frequently pivoting between import sources to chase marginal cost saving imposes transition costs. To mitigate this risk, Singapore should identify capable suppliers who are willing to ensure stable, long-term clean energy delivery. This evaluation requires considerations beyond power generation costs, as highly cost-competitive power producers do not automatically translate into viable or cooperative exporters. A supplier may boast low generation costs yet remain an unreliable source due to domestic supply deficits or an absent political mandate for energy export.

Building on our published study at the Asia Competitiveness Institute (ACI) [49], which identifies cost-competitive clean power suppliers in the ASEAN region based on LCOE, this paper further assesses the export capability and willingness of cost-competitive suppliers. Export capability is measured through a multi-dimensional matrix encompassing technology-specific generation profiles, installed power capacity, domestic power surpluses, project pipelines, and untapped renewable potential. As for export willingness, we evaluate it qualitatively based on existing cross-border trading arrangements, national export-oriented policy frameworks, regulatory mandates, and explicit strategic directives from regional energy officials. Finally, we map these empirical LCOE, capability, and willingness findings onto the ASEAN Power Grid (APG) to identify priority interconnection corridors and transmission projects optimised for regional electricity trade.

Our findings suggest that among the cost-competitive clean power suppliers, Vietnam exhibits strong export capability, and willingness across the majority of clean energy technologies. Conversely, while Indonesia demonstrates strong cost competitiveness in hydropower and solar photovoltaics (PV), it faces domestic structural constraints that limit its near-term export capability and exhibits a more reserved export willingness than Vietnam. Standing in contrast to both, Laos maintains high export capability and deep institutional willingness despite its comparatively higher hydropower generation costs. Drawing on cost-competitive Country \times Technology pairs identified in our prior work, and qualifying these selections against export capability and willingness, we identify five priority source clusters for APG interconnection development: East Malaysian hydropower; Indonesian hydropower, solar PV, and onshore wind; Vietnamese hydropower, solar PV, and wind; Cambodian solar PV; and Thai onshore wind.

The remainder of this paper is structured as follows: Section 2 identifies candidate suppliers within ASEAN with high competitiveness in clean energy production costs. Sections 3 and 4 evaluate the export capabilities and willingness of candidate supplier countries, respectively. Section 5 discusses how ASEAN Power Grid can be expanded efficiently by outlining interconnections that connect cost-competitive power generation centres with the broader ASEAN region, qualified by export capability and willingness. Finally, Section 6 concludes.

2 Which ASEAN Countries Are Cost-competitive in Clean Power Generation?

Our previous research calculated the LCOE of 20 Country \times Technology pairs between 2009 and 2025 [49]. Adapting the methodology from Timilsina’s pivotal World Bank publication [77], we utilised project-level capital expenditure (CAPEX) data from the Business Monitor International (BMI) database, and country-level or region-level aggregated data sourced from published reports for discount rate, capacity availability factors, operation & maintenance (O&M) costs, and economic life of power plants. In terms of clean energy technology, the study covered hydropower, solar PV power, and wind power (onshore and offshore). Given that CAPEX accounts for the most variation in LCOE [77], granularity in project-level CAPEX data becomes an important feature of analysing LCOE-based cost-competitiveness. An understanding of the distribution across ASEAN countries of project-level CAPEX data by country, technology, and project size can be found in Figure A.1.

Table 1 presents the ranking of Country \times Technology pairs by the descending order of average LCOE. The higher the ranking, the more cost-competitive this pair is. Hydropower dominates the upper tier, with Malaysia, Indonesia, and Vietnam recording the lowest LCOEs across all assessed pairs. Solar PV from Indonesia, Cambodia, and Vietnam constitutes the next competitive tier, followed by onshore wind, where Indonesia and Vietnam again rank most favourably. Offshore wind from Vietnam, the only ASEAN country with existing installed capacity, records the highest average LCOE across all pairs.¹

Average LCOE alone, however, does not fully characterise cost-competitiveness. Examining the statistical distribution of LCOE based on varying CAPEX data points, and temporal trends of LCOE between 2009–2015, 2016–2020, and 2021–2025, yields important qualifications [49]. Among hydropower leaders, Malaysia’s advantage is concentrated in earlier projects (2009–2015), with more recent costs rising; Indonesian and Vietnamese hydropower, though marginally higher on average, exhibit narrower cost dispersion based on interquartile range, and a declining trend over time. For solar PV, Indonesia’s ranking rests on limited data in only the latest period of 2021–2025. Cambodia’s solar PV projects sample, which is also small, spans two periods and offers a preliminary insight of cost decline. Vietnam, despite ranking slightly below Indonesia on average solar PV LCOE, is a more robust candidate given a larger sample size and a consistent downward trend. In onshore wind, Indonesia, Vietnam, and Thailand lead the LCOE rankings. Indonesia and Thailand’s sparse data serve as a preliminary insight rather than definitive benchmarks, whereas Vietnam’s larger sample size, with narrow cost dispersion based on interquartile range, offers a firmer basis for competitiveness assessment. For offshore wind, Vietnam remains the sole ASEAN candidate with installed capacity as of 2024, according to data from the International Renewable Energy Agency; while current costs are the highest across all pairs, a sharp temporal decline signals improving competitiveness as the technology scales [49].

¹Two adjustments are made to account for data limitations. First, Laos is excluded from the solar PV rankings despite placing second in LCOE, as the sample contains only one project, rendering the estimate unreliable. Vietnam, which ranks fourth, is included in its place: it possesses the largest installed solar PV capacity in the region and a substantially larger project sample, making its LCOE estimate more robust. Second, Thailand is retained in the onshore wind rankings despite a limited sample size. Thailand holds the second-highest installed onshore wind capacity in the region, which supports an inference of cost-competitiveness through learning-by-doing effects, where the accumulation of experience in manufacturing, installation, and operation reduces unit costs of electricity generation. The same is true for Indonesian solar PV and onshore wind.

Table 1: Ranking of LCOE Across Country \times Technology Pairs based on Average CAPEX (USD/kWh)

Country	Technology	No. of CAPEX Entries	LCOE (USD/kWh)
MYS	Hydropower	4	0.0442
IDN	Hydropower	12	0.0480
VNM	Hydropower	14	0.0485
MMR	Hydropower	2	0.0526
KHM	Hydropower	4	0.0572
LAO	Hydropower	27	0.0639
IDN	Solar PV	2	0.0670
PHL	Hydropower	16	0.0771
LAO	Solar PV	1	0.0800
IDN	Onshore wind	3	0.0825
KHM	Solar PV	6	0.0852
VNM	Solar PV	18	0.0891
PHL	Solar PV	46	0.0955
VNM	Onshore wind	23	0.1141
MYS	Solar PV	7	0.1148
THA	Onshore wind	2	0.1306
PHL	Onshore wind	10	0.1426
LAO	Onshore wind	1	0.1546
MMR	Solar PV	5	0.1657
VNM	Offshore wind	15	0.1804

Source: Authors' calculations based on [37, 42, 8, 48], originally published in [49].

Cost-competitiveness is a necessary but insufficient condition for identifying reliable clean power import sources. A country may generate electricity at low cost yet lack the generation capacity, infrastructure, surplus output, or political will required to serve external markets consistently. The following sections, therefore, evaluate whether low-cost clean power producers can realistically supply the volumes that regional power trade, and Singapore's import strategy in particular, would demand.

3 Export Capability: Are Cost-Competitive Suppliers Capable of Exporting?

Ideally, a reliable clean power import source for Singapore should offer more than just a competitive LCOE. It must offer substantial and expanding renewable generation capacity to ensure current and long-term supply

reliability. We evaluate the current export capability across three primary dimensions: technology-specific power generation and installed electricity capacity, as well as power surplus. Power surplus is defined as the margin between gross domestic generation and consumption. Electricity imports are excluded from this surplus calculation to isolate a country’s intrinsic capacity for self-reliant production and export. As power consumption data cannot be disaggregated by source, power surplus does not serve as a technology-specific indicator in this analysis. A positive power surplus indicates that a country’s domestic electricity output exceeds its local consumption, creating a buffer for trade. Conversely, while a country may offer a low LCOE for a clean power technology, insufficient generation volume may restrict its ability to serve external markets after domestic demand has been satisfied.

Policy factors should also be considered. National policies mandating the expansion of renewable energy can potentially enhance a country’s power supply. However, caution is required, as countries currently operating at a power deficit are likely to prioritise domestic demand over external commitments, even when renewable power supply is expected to rise. This may cast doubt on their export capability. For example, despite maintaining a power surplus, Malaysia, a country with a strong reliance on fossil fuel-based electricity, prohibited renewable electricity exports to Singapore in 2021, with the aim of fulfilling its climate change aspirations through boosting its local renewable energy industry [4]. Additionally, regulatory frameworks influence export capability by shaping long-term project stability. For example, in countries that require frequent renewal of export permits, there may be doubts about project stability.

To assess export capability in the future, renewable power projects in their pipelines, policy plans for renewable electricity expansion and latent renewable energy potential should be taken into account. Countries currently unable to export clean power may emerge as reliable import partners in the future, provided their planned pipeline projects commence operations and they successfully harness their full renewable potential.

Table 2 provides a summary of the data sources for export capability assessment. Data regarding installed electricity capacity, generation, and consumption are obtained from the US Energy Information Administration (USEIA) [79], which provides comprehensive longitudinal data coverage of ASEAN countries. Given that USEIA’s data does not differentiate between onshore and offshore wind power but tallies the total under “wind power”, IRENA’s data is used to complement it [41]. Data for pipeline projects comes from the Global Energy Monitor (GEM) [38]. GEM provides detailed project level data on power projects across the world, including technology, capacity, the specific location of a project with information of latitude and longitude, the status of a project.² Pipeline projects refer to those, as of 2025, under the status of announced, pre-construction, and under construction in the GEM database. The renewable energy potential by technology is estimated by the Japan International Cooperation Agency (JICA) [45].

²Status in the GEM database include: 1) Announced: Proposed projects that have been described in corporate or government plans or media releases but have not yet taken concrete steps such as applying for permits. 2) Pre-construction: Projects that are actively moving forward in seeking governmental approvals, land rights, or financing. 3) Construction: Site preparation and equipment installation are underway. 4) Operating: The project has been formally commissioned; commercial operation has begun. 5) Shelved: Suspension of the project has been announced. The status is marked as “shelved – inferred 2 y” if no progress has been observed for at least two years. 6) Cancelled: A cancellation announcement has been made. The status is marked as “cancelled – inferred 4 y” if no progress has been observed for at least four years. 7) Retired: The project has been decommissioned. 8) Mothballed: The project is fully built but is currently disused. However, the project has not been dismantled or decommissioned.

Table 2: Data Sources for Export Capability Assessment

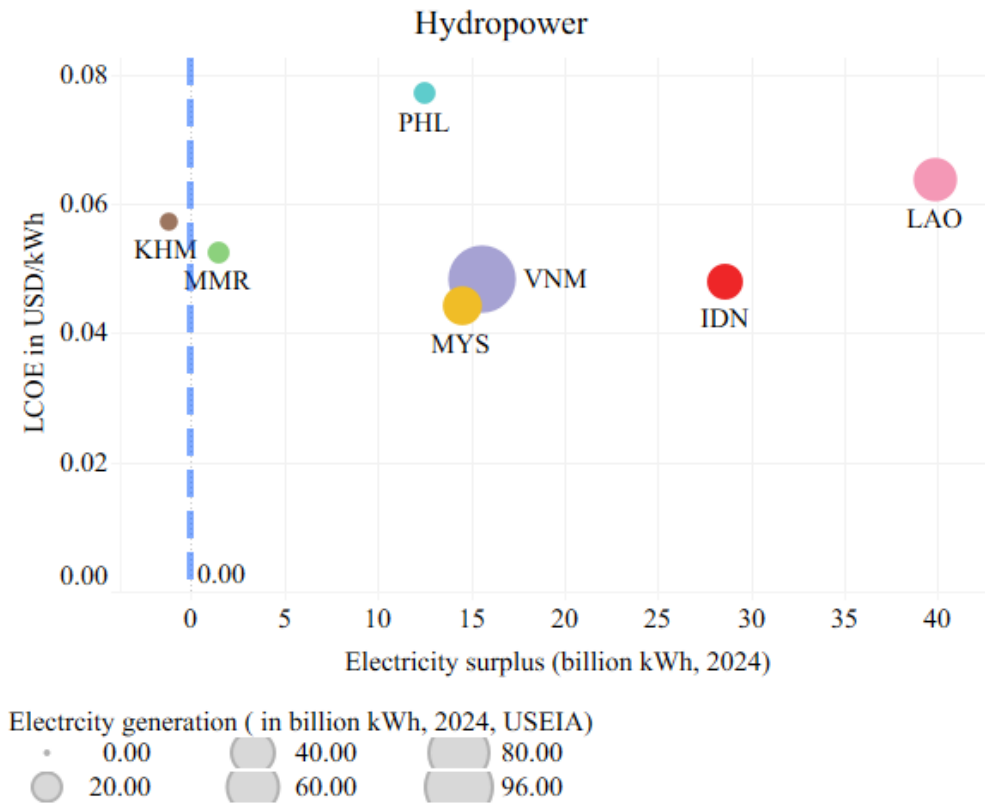
Data Source	
Current Export Capability	
Installed Electricity Capacity and Power Generation by Technology, Power Consumption and Power Surplus	U.S. Energy Information and Administration (USEIA) International Renewable Energy Agency (IRENA)
Future Export Capability	
Pipeline Projects and Capacity by Technology	Global Energy Monitor (GEM)
Renewable Energy Potential by Technology	Japan International Cooperation Agency (JICA)

3.1 Hydropower

Malaysia stands out as a highly capable and reliable hydropower supplier for Singapore. As the most cost-competitive producer in the region, Malaysia generated 32 billion kWh of hydropower in 2024, the third-largest volume in ASEAN and a 17.2% increase from 2020. Notably, this generation growth occurred despite its installed electricity capacity remaining stable at approximately 6 million kW (Figure A.3), indicating a potentially more efficient usage of existing facilities. Furthermore, domestic generation has consistently outpaced consumption, yielding a moderately rising power surplus that reached 14.5 billion kWh in 2024, the fourth-largest among the ASEAN countries (Figures 1 and A.2). Malaysia’s export capability will be further bolstered by fully leveraging its substantial hydro potential, estimated 29 million kW. Its current installed electricity capacity of 6.23 million kW leaves approximately 78.5% of this resource unexploited (Figure A.8).

In terms of institutional frameworks, Malaysia’s Electricity Supply Bill was amended in 2025 to incorporate clearer regulatory requirements for cross-border electricity trade. Notably, electricity exporters and importers should obtain a license granted by the Energy Commission, and the license will be effective for a maximum of 21 years [3], ensuring long-term regulatory certainty for electricity export projects.

Figure 1: Hydropower: LCOE and Electricity Surplus in ASEAN Countries



Note: 1) The blue dashed line indicates a zero power surplus in 2024, with countries situated to the right of the line representing those with an electricity surplus; note that this power surplus metric is NOT a technology-specific indicator 2) In the USEIA database, hydropower encompasses both conventional hydroelectricity and hydroelectric pumped storage. Within the ASEAN region, however, hydroelectricity accounts for the vast majority of total hydropower output. 3) The bubble size represents a country’s hydropower generation amount in 2024.

Source: [79] and authors’ calculations.

Vietnam emerges as a promising hydropower supplier for Singapore. Its average LCOE ranks third in the region, and the cost difference with the regional leader, Malaysia, is marginal, with just 0.0043 USD/kWh (9.7%) higher than Malaysia’s. Furthermore, its LCOE for hydropower reduced significantly from 0.0509 to 0.0339 USD/kWh (33.4%) over periods, as indicated [49], suggesting enhanced cost-competitiveness. Crucially, Vietnam’s robust export capability is underpinned by large and surging hydropower generation as well as a substantial power surplus, ranking regional third in 2024 (Figure A.3 and Figure A.2). As illustrated in Figure A.3, Vietnam’s hydropower generation has been far ahead of other AMS, since 2015. In 2024, its hydropower generation was 3.5 times that of Indonesia and triple that of Malaysia, the top two cost-competitive hydropower sources in the region. Between 2020 and 2024, Vietnam’s hydropower generation grew by 31.7%, rising from 72.9 billion kWh to 96 billion kWh. This marked the most remarkable growth among the top three cost-competitive countries. Vietnam’s significant advantage is also mirrored in its installed electricity capacity, as shown in Figure A.3 (b).

In the future, Vietnam’s hydropower export capability will be further solidified by realising its hydropower expansion plans under the 8th Power Development Plan (PDP8). The Plan sets a goal to have an additional 35.7–40.7 million kW hydropower production capacity ³ by 2030 (Table A.2).

Institutionally, Vietnam’s electricity operation licences for power plants have been extended from 10 to 20 years in 2024 [76], providing enhanced regulatory stability for plant investors and operators.

Laos represents another highly capable hydropower supplier that is well-suited to support Singapore’s

³This includes hydroelectricity (33.3–34.7 million kW) and pumped storage hydropower (2.4 - 6 million kW).

future electricity import expansion, though its cost-competitiveness is not as strong as Malaysia and Vietnam. Laos records the largest power surplus and the second-largest hydropower generation output within ASEAN, in recent years, balancing out its moderate weaknesses in cost-competitiveness – its hydropower LCOE is 0.0197 USD/kWh higher than Malaysia’s and 0.0154 USD/kWh higher than Vietnam’s. In 2024, Laos’s power surplus reached 39.9 billion kWh, the highest within the region and 39.3% greater than that of the second-ranked country, Indonesia (Figure A.2). Notably, its power surplus expansion was also the steepest in the region between 2015 and 2024, indicating rising export capability. Furthermore, unlike Indonesia’s heavy reliance on fossil fuels, Laos’s generation mix is heavily dominated by renewables (Figure A.6); hydropower accounted for 76.4% (40 billion kWh) of total generation in 2024, up from 71.3% in 2020. This 2024 hydropower output comfortably surpassed the country’s entire domestic electricity consumption, signaling a robust capability for clean power export (Figures 1 and A.2). Indeed, Laos already serves as a pivotal regional exporter, with electricity exports absorbing 72.7% of its total domestic generation in 2024 alone. Looking across the recently concluded five-year planning cycle (2021-2025), cumulative exports reached 195,602 GWh, exceeding the state’s official policy target by 52.0% [1].

In the future, Laos’s hydropower export capability is poised to strengthen through the operation of three priority export-oriented hydropower plant investment projects detailed in the 10th Five-Year Socio-Economic Development Plan [1]. Long-term projections indicate that Laotian electricity exports will sustain an average annual growth rate of 2.3% between 2021 and 2026, ultimately scaling to 8.17 Mtoe (approximately 95.02 TWh)⁴ by 2060 [81]. Moreover, harnessing its remaining technical hydropower potential, of which roughly 41% remains undeveloped (Figure A.8), offers a substantial buffer to further scale its long-term export capacity.

Laos’ advantage as a hydropower exporter reinforced by its power plants’ operational stability and a mature export infrastructure. This operational stability stems from a complementary mix of generation technologies – reservoirs and run-of-river. Reservoirs store seasonal water, enabling seasonal adjustments so run-of-river plants can maintain export capacity even during the dry season. For power export, Laos has more than ten designated export lines [82]. If Singapore’s future electricity imports can utilise this existing grid, as demonstrated in the two phases of the Laos-Thailand -Malaysia-Singapore Power Integration Project (LTMS-PIP) [16], the requirement for constructing new transmission infrastructure could be significantly reduced, resulting in substantial cost savings.

In terms of institutional capability, Laos provides long-term stability for power exporters. Foreign investors are allowed to participate in the electricity market through concession agreements under the Build-Own-Operate-Transfer (BOOT) model. Foreign power project developers can finance, construct, and operate hydropower plants for a fixed concession period—25 to 30 years, before transferring ownership to the Laotian government [68]. In addition, the concession agreements are usually underpinned by government guarantees and integrated with power purchase agreements (PPAs) with regional buyers lasting for 25 years. Such institutional frameworks provide substantial regulatory stability and mitigate investment risks, establishing a predictable environment for foreign participation [43].

For Indonesia, while it boasts the region’s second-lowest LCOE in hydropower on average and in the most recent period [49] and a growing power surplus, its reliability as a hydropower exporter remains questionable. Its expanding power surplus is predominantly driven by fossil fuels. Between 2020 and 2024, power generated by fossil fuels grew by 41.0%. In contrast, hydropower generation grew by just 11.6%, vastly trailing the growth in fossil fuel power and ranking as the lowest in ASEAN. As a result, hydropower’s share of its generation mix declined from 8.3% in 2020 to 6.7% in 2024 (Figures A.2 and A.6). Furthermore, Indonesia’s installed hydropower capacity remained stagnant over the same period. Indonesia’s National Electricity Business Plan (RUPTL)⁵ 2025–2034 plans to have 11.7 GW of hydropower additions between 2025 and 2034, with 3.2 GW to be deployed during 2025-2029, and a larger portion of them, 8.5 GW, will be deployed during 2030-2034 [12]. However, the lack of pipeline projects as of 2026 makes the timely achievement of these goals questionable. Even with an expanding hydropower capacity, the capacity will likely be absorbed by its own domestic demand for

⁴According to the IEA, 1 toe = 11.63 MWh.

⁵RUPTL refers to Rencana Umum Penyediaan Tenaga Listrik, which means National Electricity Business Plan.

clean energy before any surplus can be exported. Indonesia’s National Electricity Company (PLN) states that domestic demand is its first priority before cross-border power exchange [12, 83]. To become a viable exporter and capitalise on its low LCOE, Indonesia must aggressively develop its massive 94.6 million kW hydropower potential, 93% of which currently remains underutilised.

Beyond power generation capacity, expensive infrastructure, uncertain institutional frameworks and low bankability also pose challenges for Indonesian exporters [70]. From an infrastructure perspective, Indonesia’s archipelagic geography makes it difficult to connect islands to neighbouring countries. Building such a connection requires subsea cables and high-voltage transmission infrastructure, which are expensive, technically complex, and are in an early stage of development in the ASEAN region.

Institutionally, Indonesia requires renewable electricity exporters to renew their permits every five years, which falls well short of the threshold for a project to be considered bankable and is unfavourable for long-term project development. This is also a period much shorter than regional peers — with Laos’ BOOT offering 30-year concessions and Vietnam recently doubling its license duration to 20 years. For power plant projects to secure external financing,⁶ they need to be considered as “bankable” for about 20 to 25 years, meaning that project developers must be able to fulfil their financial obligations for the entire duration. Yet, should the government determine that electricity exports are disrupting domestic supply and causing local blackouts, in which case the exporter license would be revoked, or the export quota reduced after five years, causing revenue generation to cease and a potential default on financial obligations. Such a mismatch in the duration brings large uncertainty for project investors and thus hinders investment attraction.

Policy uncertainty stemming from inconsistent policies, a symptom of the Cabinet reshuffle, also constrains long-term project development. The previous Indonesian energy minister, Mr Arifin Tasrif, initiated a review of the above provisions in late 2023, after meeting Singapore’s senior officials on solar power exports from Batam to Singapore. However, he was replaced in August 2024, before the revision could be completed. Discussions regarding such a revision have been rarely visible since then. Policy inconsistency is a deep-rooted issue in Indonesia, where the incoming administration often sees limited political capital to complete the projects by their predecessors, leading to the deprioritisation of existing commitments in favour of new initiatives [70]. This largely slows down the project development, hinders investor confidence on long-term power plant construction projects and thereby constrains Indonesia’s capability to be a renewable power exporter.

Furthermore, Indonesia’s electricity transmission and generation are controlled by the state-owned electricity company PLN, and there are legal limits on separating these functions, which restricts private investment and makes it harder to create the open grid access needed for regional trade [6].

3.2 Solar PV Power

ASEAN’s solar PV power landscape presents a striking divergence between cost-competitiveness and actual export capability. Although, according to our LCOE calculations, Vietnam only ranks as the fourth-cheapest solar PV-based electricity producer, the country demonstrates strong export capability, supported by significant generation and installed electricity capacity since 2019. As shown in Figure A.4, Vietnam’s solar PV power generation reached 32.6 billion kWh in 2024, more than tripling that in 2020. Its power generation is also leading in the ASEAN region, fivefold of that of the regional second, Thailand.⁷ Crucially, Vietnam’s growth in solar power generation far outpaced that of installed electricity capacity (12.1%), between 2020 and 2024, indicating an increasing efficiency in solar power generation.

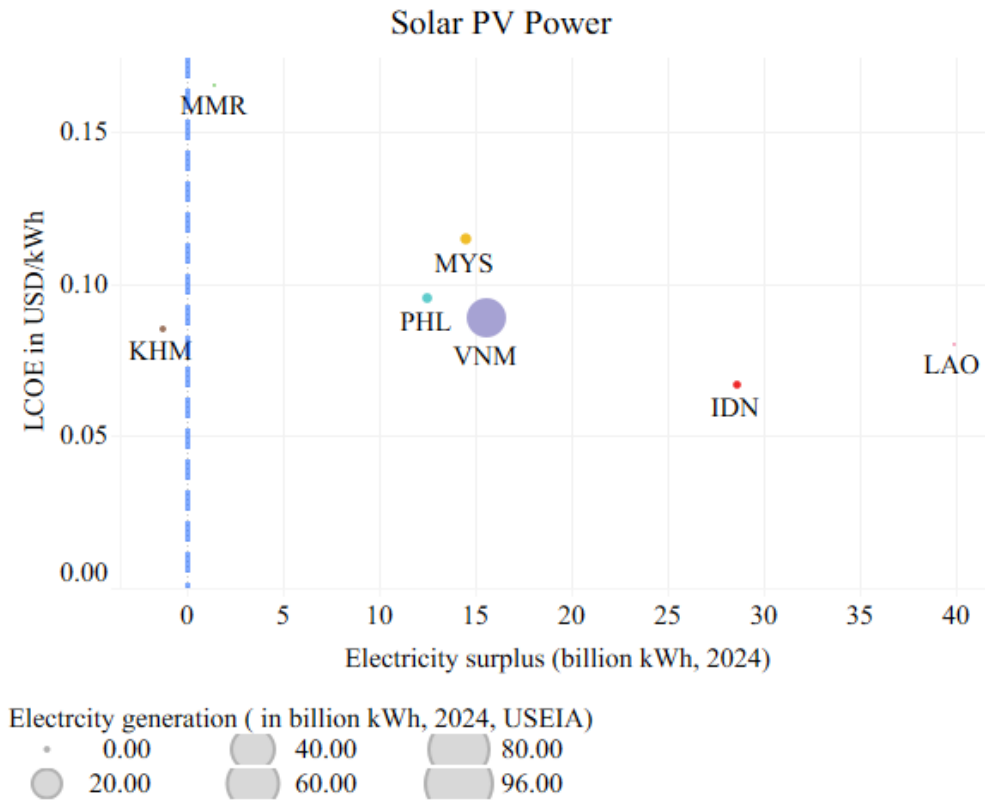
Vietnam’s dominant position is poised to strengthen further under its PDP8, which plans to expand solar power capacity by 130.2–163.5 million kW by 2030 (Table A.2). GEM data also show that Vietnamese solar PV power pipeline projects tally at 8274 MW, the third-largest pipeline in the ASEAN region (Figure A.7). Additionally, Vietnam also has significant untapped solar potential, 844 million kW in total (Figure A.8), but

⁶Generally, no Indonesian company can fully rely on internal funding for construction. They usually need a bank loan to support it. So securing external financing is critical for their project development.

⁷Although Thailand has a significant amount of solar PV power generation, it was excluded from our analysis here since its CAPEX data is not available for our LCOE-based cost-competitiveness analysis.

only around 2% has been used as of 2024. Should the goal and the pipeline projects be realised and the solar power potential be further utilised, Vietnam’s export capability will be further strengthened. However, ensuring the realisation of pipeline projects remains challenging, as Vietnam has historically had the highest cancellation rate for clean energy projects among the ASEAN-6. Among the capital expenditure committed, 63% of them were either stalled or cancelled, far ahead of that of the regional second, Thailand (49%) [21].

Figure 2: Solar PV Power: LCOE and Electricity Surplus in ASEAN Countries



Note: 1) The blue dashed line indicates a zero power surplus in 2024, with countries situated to the right of the line representing those with an electricity surplus; note that this power surplus metric is NOT a technology-specific indicator 2) The bubble size represents a country’s solar PV generation amount in 2024.

Source: [79] and authors’ calculations.

In contrast, Indonesia, Laos and Cambodia demonstrate lower LCOE in solar PV than Vietnam, but these three countries’ current export capabilities are limited by an exceptionally low amount of solar PV power generation. In 2024, solar PV generation reached only 1.4 billion kWh in Indonesia, 0.92 billion kWh in Cambodia, and 0.09 billion kWh in Laos. Similarly, installed solar power capacity in these countries remained under 1 million kW (Figure A.4), significantly lower than that of Vietnam. Additionally, Cambodia runs a domestic power deficit, and fossil fuels account for a rising share of its power generation mix (Figure A.6), between 2020 and 2024. These further constrain its export capability.

Looking ahead, Indonesia’s export potential in the medium term could strengthen considerably if its pipeline projects materialise. Indonesia has 29 solar PV projects in the pipeline, totalling 16.5 million kW, the second-largest in ASEAN, as demonstrated in Figure A.7. This largely aligns with its RUPTL, which calls for adding 17.1 million kW of solar power between 2025 and 2034 [12]. However, similar to Vietnam, Indonesia also has a high cancellation rate for clean power projects, 48% historically, the third highest in the region. Mitigating constraints in grid capability, land use, and regulations are crucial to enhance the realisation rate [21]. In the long term, utilising its solar power potential, which is the second-largest among ASEAN countries, as exhibited in Figure A.8, can significantly elevate its export capability. In contrast, the pipeline capacity in Laos and

Cambodia is relatively small, totalling only 6.87 million kW, indicating limited potential to become exporters in the near and medium term. In terms of potential, Cambodia's is way more than that of Laos (Figure A.8). For both countries, the utilisation rate of solar PV potential is below 1%, leaving huge potential in the future.

Besides Indonesia, another country that holds ambitious solar PV pipelines is the Philippines. Despite currently being neither cost-competitive nor a capable exporter, from 2025 onwards, the country has 233 projects in its pipeline, totalling 44.68 million kW in capacity, the largest among ASEAN-10 (Figure A.7). Should these projects successfully commence operations, the Philippines would have the largest installed solar PV capacity in ASEAN, approximately 47.65 million kW. However, realising this future potential remains a medium-to-long-term endeavour, as these pipeline projects will start construction between 2025 and 2029, and success is contingent on accelerating domestic transmission upgrades and addressing the gaps in regulation, technical coordination, market structure, and investment [6].

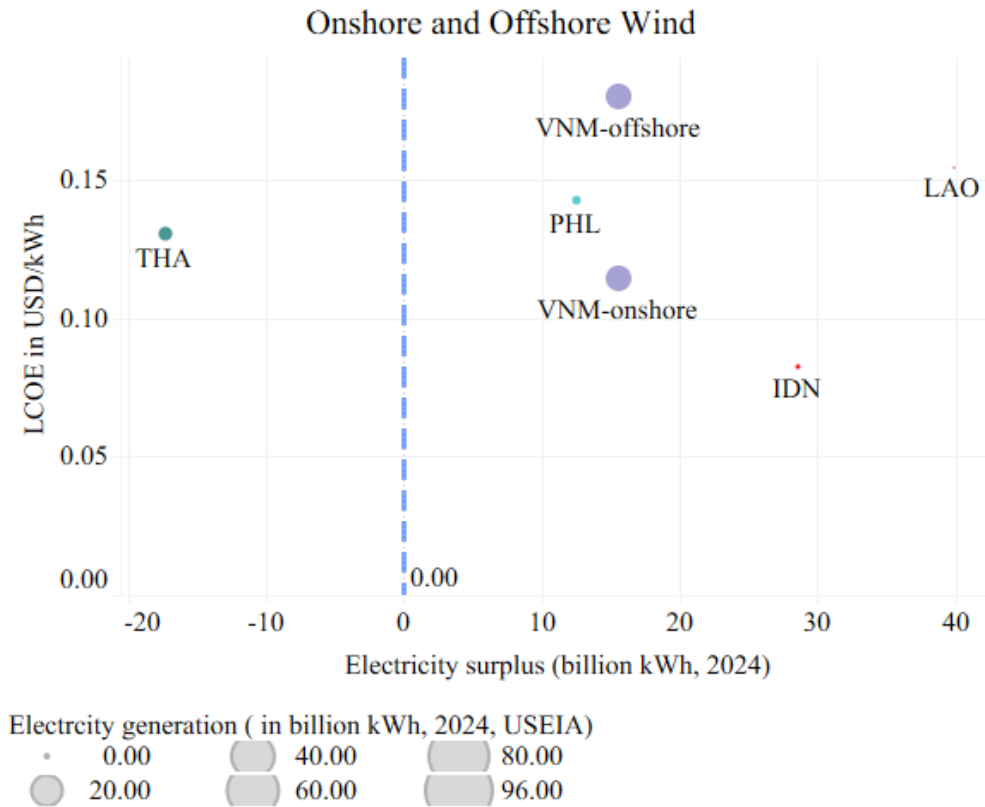
3.3 Wind Power

Vietnam currently has the strongest wind power export capability and the second-lowest onshore wind LCOE in the region. The strong capability is underpinned by the highest installed electricity capacity for both onshore and offshore wind as of 2024.⁸ Vietnam's wind generation output surged from just 1 billion kWh in 2020 to 13.5 billion kWh in 2024. This rapid growth was driven by a more than tenfold expansion in installed electricity capacity over the same five-year period (Figure A.5).

Looking ahead, Vietnam's export capability will be further solidified by its massive plans. It currently has 63.0 million kW of offshore wind pipeline projects, the largest in ASEAN, along with 7.0 million kW of planned onshore wind projects, trailing only the Philippines (Figure A.7). Additionally, Vietnam has the region's second largest amount of offshore wind potential, with 98% of it being underutilised (Figure A.8), leaving huge room for improving its wind power export capability in the long term.

⁸Figure A.5 is based on USEIA data, which does not differentiate between onshore and offshore wind generation due to data limitations. However, IRENA data indicates that as of 2024, Vietnam is the only ASEAN country with offshore wind power generation, with 2173.8 GWh in 2023. It also leads the region in onshore wind installed electricity capacity (5.1 million kW), followed by Thailand (1.5 million kW) and the Philippines (0.4 million kW) in 2024. In terms of onshore wind power generation, the latest available data (2023) shows Vietnam generated 9.4 billion kWh, Thailand 3.5 billion kWh, and the Philippines 1.4 billion kWh. Data source: IRENA Data Query.

Figure 3: Wind Power: LCOE and Electricity Surplus in ASEAN Countries



Note: 1) The blue dashed line indicates a zero power surplus in 2024, with countries situated to the right of the line representing those with an electricity surplus; note that this power surplus metric is NOT a technology-specific indicator 2) The USEIA database does not differentiate between onshore and offshore wind generation, hence the bubble size represent a country’s wind power generation amount in 2024.

Source: [79] and authors’ calculations.

Indonesia, despite having the lowest onshore wind LCOE in the region, possesses limited wind capacity and generation. From 2020 to 2024, Indonesia’s installed wind capacity stagnated at just 0.2 million kW, yielding an average generation of 0.4 billion kWh, trailing regional peers such as Thailand (3.4 billion kWh) and the Philippines (1.2 billion kWh). Indonesia’s export capability is unlikely to experience robust growth in the near-term, within five years, given that it has only 1.5 million kW of wind projects in its pipeline. But in the medium term, Indonesia plans to add 7.2 GW of wind power between 2025 and 2034 [12]. Realising the goal could potentially strengthen its export capability. Furthermore, as shown in Figure A.8, Indonesia has the region’s largest offshore wind potential (an estimated 589 million kW), far exceeding second-place Vietnam. Effectively tapping this massive reserve will significantly strengthen Indonesia’s long-term export capability.

The Philippines’ potential export capability is also poised for significant enhancement once its pipeline projects commence operations. These include 55.2 million kW of planned offshore wind capacity (second only to Vietnam) and 23.1 million kW of onshore wind, which represents the largest planned onshore capacity in the region (Figure A.7). However, it will take a long time for these projects to commence commercial operation, with 55% of the pipeline projects commencing construction between 2025 and 2030, and 20% of them do not have a specific start year of construction, according to the GEM database.

3.4 Summary

The export capability assessment shows that only some cost-competitive ASEAN suppliers currently have the scale, surplus, and institutional conditions needed to serve as credible clean electricity exporters. Malaysia,

Vietnam, and Laos emerge as the strongest hydropower candidates, with Vietnam also standing out as the most capable supplier across solar PV and wind. Indonesia offers low LCOE across three technologies, hydro, solar and onshore wind power, but its near-term export capability remains constrained by limited renewable generation, domestic demand priorities, infrastructure challenges, and regulatory uncertainty. Cambodia and Laos are cost-competitive in solar PV but lack sufficient generation scale currently, while the Philippines has significant future potential in solar PV and wind if its large project pipeline is successfully realised. However, a lack of export capability does not automatically bar countries from power export. This is illustrated by Indonesia’s plans to export solar energy to Singapore, and Cambodia’s plan for solar, hydro, and wind exports (Table A.1). These cases demonstrate that political willingness also plays a critical role in driving renewable power export.

4 Export Willingness: Are Capable Power Suppliers Willing to Export?

This section seeks to answer the question: are ASEAN countries with strong cost competitiveness and export capabilities willing to export their power? For countries expressing interest in exports, we will further discuss 1) whether they are interested in exporting clean power to Singapore and other neighbouring countries; 2) what type of technology they have exported or plan to export, and whether these align with their strengths in cost-competitiveness and export capability; 3) whether there are concrete policy and/or business actions to facilitate power exports. We will focus on five ASEAN countries: Malaysia, Vietnam, Indonesia, Laos and the Philippines. These are countries with cost-competitiveness in renewable power generation and export capability, currently or in the future.

4.1 Malaysia

Malaysia demonstrates a strong willingness to export renewable electricity. It has been an active player in the regional power grid, connecting Singapore, Indonesia and Thailand (Table A.3). Malaysia has exported 50 MW of renewable electricity to Singapore. An additional 1 GW export project will commence operations by 2032, featuring hydropower (Table A.1), aligning with significant cost competitiveness in hydropower. Additionally, it has exported electricity to Kalimantan, Indonesia and has conducted feasibility studies to export electricity to Brunei [10].

Malaysia’s export willingness has enhanced in recent years, as evidenced by its recent developments in institutional frameworks for cross-border electricity trade. In 2023, Malaysia lifted the ban on renewable electricity exports to Singapore.⁹ This pivot aimed to leverage Singapore’s substantial electricity demand to attract investment and accelerate Malaysia’s own renewable generation capacity [78, 62]. Following the lift, Malaysia’s National Energy Transition Roadmap explicitly outlines the country’s ambition to establish itself as a regional renewable energy hub and support the development of the APG [50].

To operationalise these ambitions, Malaysia updated its Guide for Cross-Border Electricity Sales (CBES) in 2024 and introduced the CBES RE Scheme, establishing a comprehensive regulatory framework for renewable power sales from Peninsular Malaysia to Singapore and Thailand [28]. Notably, the scheme features solar and hydropower exports, which align with Malaysia’s competitive LCOE and established export capability in hydropower. Under this scheme, 300 MW of electricity with Renewable Energy Certificates (RECs) has been allocated for export to Singapore. As of March 2025, an export pilot project of 100 MW has commenced operation, and around 15,000 MWh of electricity has been traded under the scheme [11]. Furthermore, to streamline transactions on cross-border power trade, the government launched Energy Exchange Malaysia (ENEGEM) in 2024. ENEGEM acts as a platform to manage cross-border trading, auction processes, and REC administration [28]. Malaysia has worked with Singapore to develop a

⁹This ban was introduced in 2021 with the aim of boosting domestic consumption.

cross-border REC framework to catalyse demand for cross-border electricity trading projects [59]. Together, these institutional developments signify that Malaysia not only has the capacity to export clean energy but has established the dedicated market mechanisms required to be a willing, long-term supplier.

4.2 Vietnam

Vietnam also shows a strong willingness to export electricity to neighbouring countries, highlighting offshore wind power, which aligns with its strengths in cost-competitiveness and export capability. It gained conditional approval for 1.2 GW of offshore wind power export to Singapore in 2023 and plans to export an additional 2 GW via Malaysia, with the initial phase slated for completion by 2034 [73]. Beyond Singapore, Vietnam has had a 200-MW interconnection to export electricity to Cambodia since 2009 and plans to further export 400 MW to Cambodia by 2030 [15], although details on the project size and involved renewable energy technology remain unclear. Furthermore, the PDP8 expects that there will be 5–10 GW of additional power production capacity by 2035, serving for renewable electricity exports to neighbouring countries, such as Singapore and Malaysia. In the list of potential electricity export projects to neighbouring countries, offshore wind is featured, with five projects totalling a capacity of 8–10 GW [47, 80, 53]. In May 2025, an agreement was signed to explore exporting renewable power, especially offshore wind power from Vietnam to Malaysia and Singapore via subsea cables [46, 66].

However, the export pricing mechanisms under the updated Electricity Law in 2024 appear to be unfavourable to electricity exports. For electricity exports not through the national grid, the export price must meet or exceed the maximum domestic generation price bracket. If electricity is exported through the national grid, the price must be no lower than the maximum average domestic retail price [22]. This mechanism could diminish Vietnam’s cost-competitiveness in power generation and thereby reduce its attractiveness as a candidate for import sources for Singapore.

4.3 Indonesia

Indonesia’s export willingness shows a mixed picture. It has seven planned electricity export projects to Singapore, with a total capacity of 3.4 GW, the largest among Singapore’s import sources. Notably, 3 GW of the projects were awarded Conditional Licences, due to their substantial progress, which is ahead of other partners in Singapore’s current power import agreements, as they are still at the Conditional Approval stage (Table A.1). Indonesia’s current import agreements with Singapore feature solar PV power, aligning with its cost-competitiveness. Additionally, Indonesia signed three Memoranda of Understanding (MoU) on Cross-Border Electricity Trade (CBET) with Singapore in 2025, aiming to facilitate policies, regulatory frameworks, and business arrangements for CBET within 12 months of the signing of the MoU. An interconnection for exporting electricity from Sumatra, Indonesia, to Singapore is also under discussion, with commercial operation expected by 2034 [54, 12].

Despite these planned projects, Indonesia’s export willingness is discounted by senior officials’ scepticism about power export to Singapore and its institutional settings. The scepticism originated from the Indonesian Minister of Energy and Mineral Resources, Bahlil Lahadalia. He questioned whether current cooperation frameworks offer sufficient mutual benefits, emphasising that Singapore should direct manufacturing investment into Indonesia as a reciprocal gesture [57]. Given that power export project developers must obtain domestic permits from the government to commence operations, this sceptical stance introduces regulatory uncertainty.

In fact, exporting electricity to Singapore yields substantial economic benefits for Indonesia. Research indicates that Indonesia stands to gain substantially from the revenue generated from electricity exports, given that Singapore’s electricity tariff is much higher than that of Indonesia (approximately US\$ 22.2¢/kWh versus US\$ 9.9¢/kWh) [83].¹⁰ Realising the targeted 3.4 GW of exports could contribute an estimated US\$4.2–6 billion in annual foreign exchange, totalling US\$105–150 billion over a 25-year period.¹¹ Furthermore, the

¹⁰The price for Singapore was in the second quarter of 2024, and that for Indonesia was in the third quarter of 2024.

¹¹Based on an assumed export tariff of 14–20 US¢/kWh.

government could increase state revenue by imposing royalties on transmitted electricity [83]. Beyond direct revenue, this export demand creates a critical market pull for the domestic solar PV manufacturing industry, which Indonesia’s recent revisions on industrial policies aim for. In 2024, Indonesia updated its regulations on local content requirements (LCRs) for power plants. Electricity infrastructure for cross-border electricity transactions is subject to distinct LCR provisions intended to support a local manufacturing base by leveraging export demand [51].

From an institutional perspective, Indonesia lacks concrete operational-level institutional efforts, such as Malaysia’s CBES RE Guide, to facilitate power exports. Additionally, satisfying domestic demand remains its top priority, according to its latest National Electricity Business Plan (RUPTL), discounting its export willingness. Its willingness might be strengthened when it has sufficient clean energy capacity to meet its domestic consumption. Yet, this will not be achieved in the short or medium term given its strong reliance on fossil fuel-generated electricity and its existing plans on renewable power expansion, as discussed in Section 3.

4.4 Laos

Laos shows strong willingness to become a clean energy hub in the ASEAN region and states that its hydropower generation expansion will ensure both a consistent domestic electricity supply and surplus for export [1]. Its Electricity Law stipulates that the state should exploit all available potential to satisfy energy demands, which includes treating electricity as an exportable commodity. Furthermore, the law mandates that national Electricity Development Plans should determine export based on the priority of electricity consumption and demand in neighbouring countries [58].

Currently, Laos exports electricity to six neighbouring countries, including Myanmar, Cambodia, China, Singapore, Thailand, and Vietnam [43]. It sets an electricity export target of 283,028 GWh from 2026 to 2030, 119.9% up from the target between 2021 and 2025. This export target accounts for about 86.5% of the total power generation target and will generate a revenue of LAK 271,706 billion (about 12 billion USD) [1].¹² There is positive progress on achieving the goal in early 2026. Laos electricity exports to Vietnam reached 2,920 GWh, from January to March 2026, approximately 120% up from the same period in 2025 [75].

In terms of power sources for exports, Laos mainly focuses on hydropower [81], which is its most competitive source compared to solar PV and wind. Although not cost-competitive, Laos also exports onshore wind power. Its first onshore wind power farm (Monsoon) commenced commercial operation in August 2025. With a capacity of 600 MW, it will export wind power to Vietnam under a 25-year power purchasing agreement [56]. Beyond the Monsoon project, there are also 3.3 GW of onshore wind projects in Laos’ pipeline.

4.5 The Philippines

As a country possessing huge potential to be a power exporter in the future, the Philippines does not show strong export willingness. Its renewable power expansion plans included in the energy and power development plan (updated in 2025) are mostly inward-looking, aiming to decarbonise the domestic electricity sector and enhance energy security [25, 26]. Its participation in regional power trade is invisible, even though it participates in the Brunei–Indonesia–Malaysia–Philippines Power Integration Project (BIMP-PIP), which is under the feasibility study stage as of 2026.

Nevertheless, as ASEAN’s chair in 2026, the Philippines will spend efforts to facilitate regional power trade. It will prioritise executing the APG by operationalising dedicated task forces across policy, legal, regulatory, and technical domains. To foster an investment-ready environment for cross-border connectivity and regional renewable energy integration, it will focus on initiating bilateral interconnection talks with Malaysia and establishing comprehensive governance, financial, and technical guidelines for the Submarine Power Cable Framework. Furthermore, the Philippines aims to complete critical feasibility studies on integrating Battery Energy Storage Systems (BESS) alongside advanced grid technologies to support variable

¹²1 USD = 21.859 LAK. Exchange rate as of 4 April 2026, according to the Central Bank of Laos.

renewable energy, while assessing the viability of a cross-border Renewable Energy Certificate (REC) market to facilitate regional power trade [24].

4.6 Summary

Among the countries possessing low LCOE and robust export capability, Malaysia and Vietnam exhibit the most pronounced export willingness. Notably, Malaysia has provided concrete institutional frameworks for cross-border trade, a commitment currently lacking in most other ASEAN countries. While Indonesia also demonstrates intent to export to Singapore, this is tempered by its protectionist ministerial rhetoric, prioritisation of domestic demand and a lack of institutional efforts at the operational level. Laos signals a strong export intent through explicit project pipelines despite its higher LCOE. In contrast, the Philippines possesses future export potential but lacks the willingness and policy actions necessary to pursue power export.

5 Implications for Developing the ASEAN Power Grid (APG)

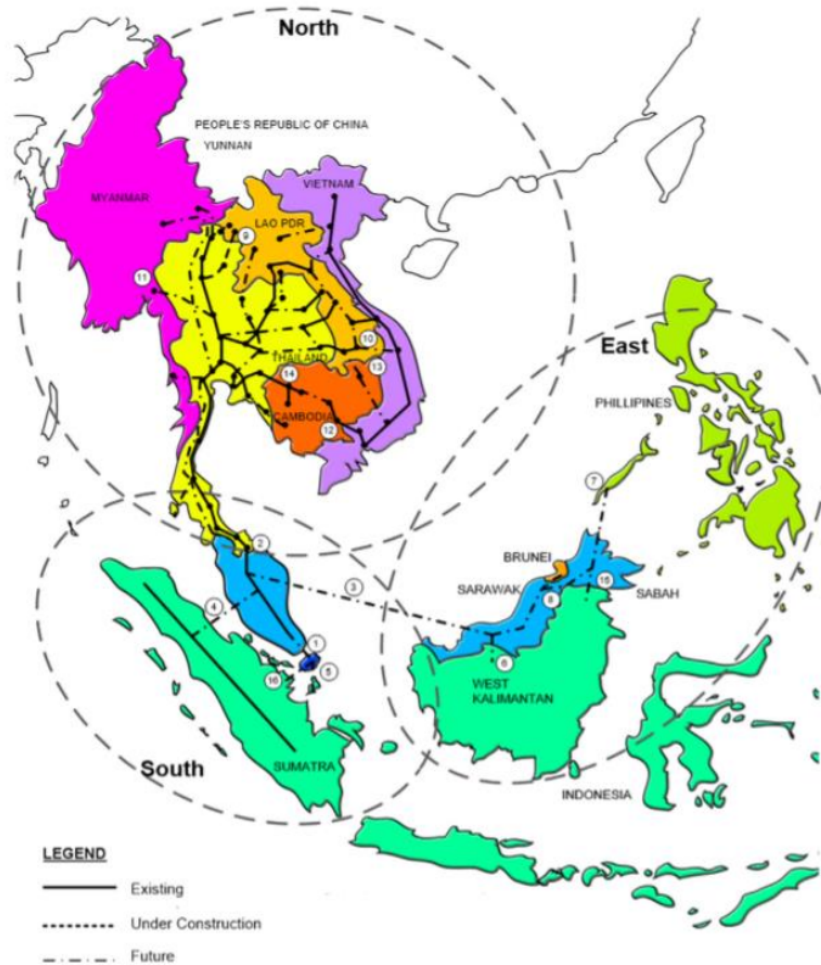
Regional electricity trade is becoming increasingly important for ASEAN’s energy transition. For Singapore, decarbonised electricity imports from neighbouring ASEAN countries are central to overcoming domestic land and resource constraints. Strategising for decarbonised electricity trade requires accounting for the uneven distribution of renewable energy potential across ASEAN. As demonstrated in Figure A.8, hydropower potential is concentrated in Indonesia; solar PV in Thailand and Indonesia; onshore wind in Thailand and Vietnam; and offshore wind in Indonesia [45]. For the ASEAN region, cross-border trade can therefore support the more efficient mobilisation of renewable resources as well as help manage the intermittency of solar PV and wind. Under ambitious ACE and IEA scenarios, wind and solar PV could account for more than 70% of the regional electricity mix by 2050, increasing daily and seasonal fluctuations in net load [8, 40]. The APG is therefore critical to enabling cross-border electricity trade, balancing surplus and deficit generation, and integrating variable renewable energy across the region [5].

ASEAN Power Grid has made tangible progress: as of 2025, nine of the eighteen priority interconnection projects under the ASEAN Interconnection Masterplan Study III have been completed, providing 10.2 GW of regional interconnection capacity [9]. Key initiatives such as the Lao PDR–Thailand–Malaysia–Singapore Power Integration Project (LTMS-PIP) and the Brunei–Indonesia–Malaysia–Philippines Power Integration Project (BIMP-PIP) demonstrate growing momentum towards multilateral power trade [8].

Electricity trade is most feasible within three sub-regional corridors (Figure 4). The Northern corridor comprises Myanmar, Laos, Vietnam, Cambodia, and Thailand; the Southern corridor links Peninsular Malaysia, Singapore, and western Indonesia, particularly Sumatra; and the Eastern corridor covers East Malaysia, Brunei, the Philippines, and Indonesian territories on Borneo and nearby islands [16]. These corridors matter because geography, grid readiness, and system constraints mean that cost-competitive generation cannot automatically be transmitted across the whole region.

Progress to date suggests that these sub-regional corridors are gradually becoming more connected. LTMS-PIP and expanded Thailand–Malaysia interconnections are strengthening links between the Northern and Southern corridors [14, 74]. Planned projects linking Sumatra to Peninsular Malaysia and the Riau Islands (Indonesia) to Singapore could further consolidate the Southern corridor [13, 71]. Meanwhile, proposed links between Peninsular Malaysia and East Malaysia, and between Singapore and East Malaysia, point to early steps toward connecting the Southern and Eastern corridors [7, 20].

Figure 4: Map of the ASEAN Power Grid (APG) Corridors



Note: This map is intended solely for illustrative purposes to depict the three sub-regional corridors within the APG network. The designations 'Existing', 'Under Construction', and 'Future' reflect project statuses as of 2024; subsequent status updates and newly introduced projects are not represented.

Source: [16]

ASEAN governments are also increasingly aligned on the institutional and financing requirements for APG development. Under APAEC 2026–2030, priorities include operationalising the enhanced APG Memorandum of Understanding, strengthening regional frameworks for subsea and high-voltage direct current interconnections, advancing market integration, and expanding cross-border renewable electricity trade [9]. Financing support is also emerging through the ASEAN Power Grid Financing Initiative, under which the ADB and World Bank have committed resources to support feasibility studies, bankable project pipelines, institutional strengthening, and sustainable finance mechanisms [2, 17].

Overall, the APG provides a practical pathway for translating ASEAN's clean energy cost advantages into regional energy security and sustainability gains, though its benefits depend on whether interconnection priorities align with the region's most cost-competitive renewable energy resources. This study contributes to the APG discussion by linking regional interconnection planning to clean power generation cost competitiveness, with a full mapping of relevant interconnections (existing, expanding, and planned) provided in Table A.3 in the Appendix.

Our analysis centres on the most cost-competitive Country × Technology pairs and highlights the APG interconnections that may provide other ASEAN countries access to electricity generated by cost-competitive power plants in those countries, subject to the geographic and grid infrastructure constraints discussed previously. This analysis prioritises cost-competitiveness because it seeks to inform ASEAN member states'

APG diplomacy, which involves negotiating with cost-competitive partner countries to expand regional power trade and increase export willingness even where capability constraints exist. Singapore’s planned solar PV PPAs with Indonesia and Cambodia illustrate precisely this dynamic [31, 33].

We select the top three ranking countries by LCOE for each of the four clean energy technologies studied, as illustrated in table 1. Two adjustments are made to account for data limitations. First, Laos is excluded from the solar PV rankings despite placing second in LCOE because our sample contains only one project, due to the unavailability of CAPEX data, rendering the estimate unreliable. Vietnam, which ranks fourth, is included in its place: it possesses the largest installed solar PV capacity in the region and a substantially larger project sample, making its LCOE estimate more robust. Second, Thailand is retained in the onshore wind rankings despite a limited sample size. Thailand holds the second-highest installed onshore wind capacity in the region, which supports an inference of cost-competitiveness through learning-by-doing effects, where the accumulation of experience in manufacturing, installation, and operation reduces unit costs of electricity generation. [49, 61, 44, 63].

Of the resulting set of cost-competitive producers, including Malaysia, Indonesia, Vietnam, and Cambodia, Malaysia and Vietnam combine strong export capability with clear export willingness, while Indonesia shows potential capability tempered by domestic demand priorities and regulatory uncertainty. Cambodia and Thailand currently demonstrate more limited capability and willingness. The following analysis examines which APG corridors have the greatest potential to support low-cost clean electricity trade, and which interconnections should be prioritised to maximise gains.

5.1 East Malaysian Hydropower

Based on LCOE estimates, Malaysian hydropower is among the most cost-competitive in ASEAN, driven by large-scale projects in Sarawak such as the Baleh Dam and the Sabah Hydroelectric Power Plant [37]. This positions East Malaysia as a potential net exporter of low-cost clean electricity within the Eastern corridor.

Realising this potential hinges on the pace and direction of transmission infrastructure. The Sarawak–Sabah Power Interconnection, completed in 2025 [65], marks a significant step in consolidating supply within East Malaysia. Beyond this, expanding connectivity to neighbouring systems becomes critical. Brunei stands to benefit directly from planned grid expansions. The broader Eastern corridor can be integrated through initiatives such as the BIMP-PIP [18], which remains at a formative stage but carries substantial long-term potential.

More consequentially, extending East Malaysia’s hydropower beyond the Eastern corridor could unlock significant gains. The completion of a pre-feasibility study for the Sarawak–Peninsular Malaysia interconnection [7] and the conditional approval of the Sarawak–Singapore link in 2025 [35] signal early movement toward this objective. If executed, these projects would allow low-cost hydropower to flow into higher-demand, import-dependent markets, particularly Singapore. These interconnections therefore represent high-impact, near-term candidates for acceleration, with the potential to anchor a more integrated and cost-efficient regional power market.

5.2 Indonesian Hydropower, Solar PV, Onshore Wind

Indonesia represents a second major cluster of low-cost clean energy potential, with geographically dispersed resources that can anchor trade across both the Southern and Eastern APG corridors.

Hydropower projects in North Sumatra (such as the Batang Toru development) and West Java (including Jatigede) [37] are well-positioned to supply the Southern corridor, particularly if transmission links between Sumatra, Peninsular Malaysia, and Singapore are strengthened. At the same time, hydropower projects in North Kalimantan can contribute to supply within the Eastern corridor, particularly within Borneo.

Upcoming utility-scale Solar PV development projects in the Riau Islands are especially significant given their proximity to Singapore. In parallel, onshore wind projects in South Sulawesi and Java present longer-term

opportunities [37]. These islands are deeper within Indonesia, and inter-island connectivity will need to expand to integrate these projects for regional power trade. Therefore, these projects could become viable export contributors in the future as Indonesia’s domestic transmission network matures.

Unlocking this multi-resource potential depends critically on both domestic and cross-border infrastructure. Key enablers include the expansion of Singapore–Indonesia electricity trade frameworks (agreed in 2025) [55], conditional approvals for Riau solar PV export projects [34], and broader efforts to strengthen inter-island connectivity across Sumatra, Java, and Kalimantan [60]. In the Eastern corridor, BIMP-PIP will be central to integrating eastern Indonesian clean power into the APG [18].

5.3 Vietnamese Hydropower, Solar PV, Onshore and Offshore Wind

Based on LCOE estimates, Vietnam emerges as a regional leader across all major renewable energy technologies. Its role in regional electricity trade will depend on how effectively both overland and subsea interconnections are scaled.

Within the Northern corridor, Vietnam is already relatively well-integrated. Existing transmission links with Laos and Cambodia provide a strong foundation for expanding cross-border trade, with planned increases in electricity exports to Cambodia under PDP VIII (2025) [15] signalling early movement in this direction. As interconnections across the APG Northern corridor [16] and the broader Greater Mekong Subregion (GMS) [19] deepen, a more consequential opportunity emerges: enabling indirect electricity trade between Vietnam and Thailand via Laos. Unlocking electricity trade with Thailand could greatly benefit both countries.

Beyond overland connectivity, subsea cable development introduces a second, potentially transformative pathway. Vietnam’s lead in offshore wind deployment creates a natural basis for exporting power to demand centres in the Southern corridor. The Vietnam–Malaysia–Singapore Offshore Wind Interconnection Project (agreed in 2025) [73] reflects this shift. If realised, this model could extend beyond the Southern corridor, serving as a template for future subsea interconnections into the Eastern corridor.

5.4 Cambodian Solar PV

Cambodia has emerged as a fast-growing and low-cost solar PV power producer. Its solar PV power generation tripled from 2020 (0.31 billion kWh) to 2024 (0.92 billion kWh) (Figure A.4). This positions Cambodia as a potential export node for solar PV power within the Northern APG corridor. Existing transmission links with Laos, Vietnam, and Thailand provide a functional base for expanding cross-border electricity flows. However, recent geopolitical tensions, particularly the escalation of conflict with Thailand, have disrupted momentum [23]. As the APG Northern sub-system [16] and the broader Greater Mekong Subregion (GMS) [19] continue to scale, these interconnections can be leveraged to integrate Cambodian solar PV into a wider regional market.

Beyond overland trade, Cambodia has also been identified as a potential supplier to Singapore. The conditional approval granted in 2023 for electricity imports through subsea cables [33] signals interest in linking Cambodia’s low-cost solar generation to high-demand, import-dependent markets in the Southern corridor.

5.5 Thai Onshore Wind

Thailand’s onshore wind generation is expanding rapidly and ranks just behind Vietnam among regional leaders in cost-competitive deployment. Thailand sits at the core of the APG Northern sub-system while simultaneously acting as a bridge to the Southern corridor through Peninsular Malaysia and, by extension, Singapore. This dual positioning allows it to channel electricity flows across corridors, making it a critical intermediary in scaling cross-border trade.

In practical terms, multiple interconnection pathways already exist. The Thailand–Malaysia

interconnections provide a direct link into the Southern corridor [74], and the LTMS-PIP is a multi-country success [16]. Thailand’s connections with Laos further reinforce its role in the Northern corridor, and its interconnections with Cambodia, though currently constrained by geopolitical tensions [23], represent additional capacity that can be reactivated.

6 Conclusion

Cost-competitiveness alone is insufficient to guide Singapore’s low-carbon electricity imports and ASEAN’s regional power trade. The export capability and willingness of clean power suppliers are equally decisive to ensure long-term reliability and stability. As ASEAN operationalises the APG under APAEC 2026–2030, maximising the gains from regional power integration will require aligning interconnection investment with cost-competitive suppliers, while boosting renewable energy share in ASEAN countries’ power mix, export capability, and political trust and willingness to sustain regional power trade.

Only a subset of cost-competitive producers is currently capable of supporting meaningful electricity trade. Malaysia, Vietnam, and Laos are the strongest hydropower candidates, with Vietnam also leading across solar PV and wind. Indonesia holds low LCOE across three technologies but faces significant near-term constraints in export capability: limited renewable generation growth, domestic demand prioritisation, infrastructure bottlenecks, and regulatory uncertainty. Cambodia has competitive solar PV costs but lack generation scale. The Philippines holds substantial future potential in solar PV and wind, contingent on its large project pipeline being realised.

On export willingness, Malaysia and Vietnam are the most committed partners, backed by concrete institutional frameworks, signed agreements, and active market mechanisms. Laos also signals a strong intent through its export-oriented national plans and established hydropower concession model, despite higher generation costs. Indonesia’s willingness is real but discounted by protectionist ministerial rhetoric and the absence of operational-level policy frameworks. The Philippines, despite its future potential, remains primarily inward-looking in its energy planning.

The APG corridors with the greatest near-term potential for low-cost clean electricity trade are centred on five Country \times Technology pairs. East Malaysian hydropower can serve the Eastern corridor and, via planned subsea links, the Southern corridor including Singapore. Vietnamese hydropower, solar PV, and wind can anchor the Northern corridor and, through the Vietnam–Malaysia–Singapore offshore wind corridor, reach the Southern corridor. Indonesian hydropower, solar PV, and onshore wind hold significant potential across both the Southern and Eastern corridors, though realisation depends on resolving domestic regulatory and infrastructure constraints. Cambodian solar PV can contribute within the Northern corridor and, through conditional import approvals, to Singapore via subsea cable. Thai onshore wind, positioned at the junction of the Northern and Southern corridors, can serve as a critical intermediary for cross-sub-regional electricity flows.

Ultimately, Singapore’s conditional import agreements with Indonesia and Cambodia demonstrate that APG diplomacy, negotiating with partner countries to prioritise regional power trade, can unlock export willingness even where capability is limited. The broader lesson is that gains from regional power integration will only be realised if there is sustained institutional investment in transmission infrastructure that connects cost-competitive clean power generation to demand centres, and in effective diplomacy that boosts ASEAN countries’ political trust and willingness to participate in regional power trade.

References

- [1] 10th 10th Five-Year National Socio-Economic Development Plan (2026 - 2030).
- [2] ASEAN Power Grid Financing (APGF) Initiative.
- [3] Electricity Supply (Amendment) Bill 2025.
- [4] Malaysia's Energy Ministry to limit renewable energy exports to Singapore.
- [5] Ahmed, T., S. Mekhilef, R. Shah, N. Mithulananthan, M. Seyedmahmoudian, and B. Horan (2017, Jan). Asean power grid: A secure transmission infrastructure for clean and sustainable energy for south-east asia. *Renewable and Sustainable Energy Reviews* 67, 1420–1435.
- [6] Alfatarah, S. Plugging into Reality: The ASEAN Power Grid.
- [7] Amin, L. (2025, October). Tenaga seeks partners for sarawak–peninsular malaysia power link. *The Edge Malaysia*. Reproduced in Tenaga Nasional Berhad newsclip.
- [8] ASEAN Centre for Energy. 8th ASEAN Energy Outlook.
- [9] ASEAN Centre for Energy. ASEAN Plan of Action for Energy Cooperation (APAEC) 2026-2030.
- [10] ASEAN Centre for Energy. ASEAN Power Grid Interconnections Project Profiles.
- [11] ASEAN Centre for Energy. Policy Insight - Malaysia: Guide For Cross-Border Electricity Sales (CBES).
- [12] ASEAN Centre for Energy. Policy Insight - Vietnam's Revised PDP8 and Indonesia's RUPTL 2025-2034.
- [13] ASEAN Centre for Energy (ACE) (2025a, May). The 3rd feasibility study of indonesia–malaysia cross-border interconnections steering committee meeting.
- [14] ASEAN Centre for Energy (ACE) (2025b). Asean plan of action for energy cooperation (apaec) 2026–2030. Technical report, ASEAN Centre for Energy.
- [15] ASEAN Centre for Energy (ACE) (2025c, August). Policy insight: Vietnam's revised pdp8 and indonesia's ruptl 2025–2034. Technical report, ASEAN Centre for Energy.
- [16] ASEAN Centre for Energy (ACE) and H. /Authorities (HAPUA) (2024). ASEAN Interconnection Masterplan Study (AIMS) III Report. Technical report, ASEAN Centre for Energy.
- [17] ASEAN Main Portal. ADB and World Bank Group Launch the ASEAN Power Grid Financing Initiative with the ASEAN Secretariat and the ASEAN Centre for Energy (ACE).
- [18] ASEAN Secretariat (2023, September). Joint statement of brunei darussalam, indonesia, malaysia and the philippines power integration project (bimp-pip).
- [19] Asian Development Bank (2012). Greater mekong subregion power trade and interconnection: 2 decades of cooperation. Technical report, Asian Development Bank, Manila.
- [20] Azmi, H. (2025, October). Work on singapore–sarawak undersea power cables to start in 2026, says sarawak minister. *The Straits Times*.
- [21] BAIN & COMPANY, Standard Chartered, and TEMASEK. Southeast Asia's Green Economy Report 2026.
- [22] Baker McKenzie. Vietnam adopted new Electricity Law 2024.
- [23] bne IntelliNews (2025, July). Energy under siege: How conflict between thailand and cambodia threatens regional power security.

- [24] Department of Energy, Philippines. ASEAN Energy Senior Officials Endorse 2026 Priorities; Philippines to Drive Enhanced ASEAN Power Grid Implementation.
- [25] Department of Energy, Philippines. Philippine Energy Plan 2023-2050.
- [26] Department of Energy, Philippines. Power Development Plan (2023-2050).
- [27] Economic Development Board, Singapore. Deal to explore exporting renewable energy from Vietnam to Singapore, Malaysia inked at ASEAN Summit.
- [28] Energy Commission, Malaysia. Guide for Cross-Border Electricity Sales (Third Edition, Revised April 2024).
- [29] Energy Market Authority (EMA), Singapore. EMA Grants Conditional Approval for 1.2 Gigawatt (GW) of Electricity Imports from Vietnam.
- [30] Energy Market Authority (EMA), Singapore. EMA Grants Conditional Approval of 1.75 GW of Electricity Imports from Australia.
- [31] Energy Market Authority (EMA), Singapore. EMA Grants Conditional Approvals for 2 Gigawatt of Electricity Imports from Indonesia.
- [32] Energy Market Authority (EMA), Singapore. Regional Power Grids.
- [33] Energy Market Authority (EMA), Singapore (2023, March). Ema grants conditional approval for 1 gigawatt (gw) of electricity imports from cambodia.
- [34] Energy Market Authority (EMA), Singapore (2024, September). Singapore and indonesia make substantive progress on electricity imports.
- [35] Energy Market Authority (EMA), Singapore (2025, October). Ema grants conditional approval for electricity imports from sarawak.
- [36] Energy Market Authority of Singapore. Our Energy Story.
- [37] Fitch Solutions (2026). Bmi industry research.
- [38] Global Energy Monitor (2026). Global integrated power tracker. <https://globalenergymonitor.org/projects/global-integrated-power-tracker>. March 2026 release, accessed May 8, 2026.
- [39] Hansen, K. (2019, April). Decision-making based on energy costs: Comparing levelized cost of energy and energy system costs. *Energy Strategy Reviews* 24, 68–82.
- [40] International Energy Agency (IEA). Decarbonisation Pathways for Southeast Asia.
- [41] International Renewable Energy Agency. Renewable Energy Statistics 2024.
- [42] International Renewable Energy Agency (IRENA) (2025, July). Renewable Power Generation Costs in 2024. Technical report.
- [43] International Trade Administration, US. Laos - Energy Sector.
- [44] Jamasb, T. and J. Kohler (2007, October). Learning Curves For Energy Technology: A Critical Assessment.
- [45] Japan International Cooperation Agency (JICA) and The Institute of Energy Economics, Japan (IEEJ). Study on ASEAN Power Grid Final Report.
- [46] Kim, L. Viet nam to export renewable energy to malaysia, singapore.

- [47] KPMG. Revised Power Development Plan VIII of Vietnam under Decision 768/QD-TTg dated 15 April 2025 and its implementation guidance under Decision 1509/QD-BCT dated 30 May 2025.
- [48] Lee, N., F. Flores-Espino, R. Cardoso De Oliveira, B. Roberts, T. Brown, and J. Katz (2020, June). Exploring Renewable Energy Opportunities in Select Southeast Asian Countries: A Geospatial Analysis of the Levelized Cost of Energy of Utility-Scale Wind and Solar Photovoltaics. Technical Report NREL/TP-7A40-71814, 1527336, MainId:20963.
- [49] Liu, J., P. Dass, Y. Huang, and B. Yan. Comparative Study on the Clean Energy Production Cost Competitiveness Among ASEAN Countries.
- [50] Ministry of Economy, Malaysia. National Energy Transition Roadmap (NETR).
- [51] Ministry of Energy and Mineral Resources, Indonesia. Peraturan Menteri Energi dan Sumber Daya Mineral Nomor 11 Tahun 2024 Penggunaan Produk Dalam Negeri Untuk Pembangunan Infrastruktur Ketenagalistrikan (Use of Domestic Products for Electricity Infrastructure Development).
- [52] Ministry of Finance (MOF), Singapore. Budget Statement - Onward Together for a Better Tomorrow.
- [53] Ministry of Industry and Trade of Vietnam. Decision 1509/QD-BCT on approving plan for implementation of amendment to National Electricity Development Planning of 2021 – 2030 period and vision to 2050 – Vietnam-Energy-Partnership-Group.
- [54] Ministry of Trade and Industry (MTI), Singapore. Singapore and Indonesia sign Three Memoranda of Understanding with Indonesia on Cross-Border Electricity Trade, Carbon Capture and Storage, and Sustainable Industrial Zone.
- [55] Ministry of Trade and Industry (Singapore) (2025, June). Singapore marks enhanced cooperation with indonesia with milestone ceremony for project development. Technical report, Ministry of Trade and Industry.
- [56] Monsoon Wind. Press Release: Achieving Commercial Operation, Delivering Clean Energy Across Borders.
- [57] Muthiariny, D. E. Minister Bahlil on Electricity Exports to Singapore: What Are They Giving to Indonesia?
- [58] National Assembly, Laos. Law on Electricity.
- [59] Oh, T. Singapore, Malaysia exploring renewable energy certificates framework for cross-border electricity trade.
- [60] PwC Indonesia (2025, June). Sumatra–java interconnection adopts hvdc technology.
- [61] Qiu, Y. and L. D. Anadon (2012, May). The price of wind power in China during its expansion: Technology adoption, learning-by-doing, economies of scale, and manufacturing localization. *Energy Economics* 34 (3), 772–785.
- [62] Reuters. Malaysia to lift export ban on renewable energy in accelerated transition plans.
- [63] Rubin, E. S., I. M. L. Azevedo, P. Jaramillo, and S. Yeh (2015, November). A review of learning rates for electricity supply technologies. *Energy Policy* 86, 198–218.
- [64] Saieed, Z. Sarawak in talks to supply 1GW renewable energy to S’pore by 2032: Sarawak Energy.
- [65] Sarawak Energy (2026, January). Energisation of sarawak–sabah interconnection strengthens regional grid network.
- [66] See, S. Four energy companies from Malaysia, Singapore, Vietnam ink deal to explore clean energy export from Vietnam.

- [67] Sembcorp. Sembcorp Awarded Conditional Approval by EMA to Import Renewable Energy from Sarawak to Singapore.
- [68] Shang, Y. Laos Hydropower Investment: Opportunities, Policies, and Future Trends.
- [69] Singapore Energy Interconnections. Singapore Energy Interconnections (SGEI).
- [70] Soeriaatmadja, W. ‘Should have started by now’: Indonesia’s plan to export solar energy to Singapore hits a snag.
- [71] S&P Global Commodity Insights (2025, October). Cross-border clean energy imports: Powering singapore’s future.
- [72] Supriyanto, E., J. Sentanuhady, W. H. Hasan, A. D. Nugraha, and M. A. Muflikhun (2022, January). Policy and Strategies of Tariff Incentives Related to Renewable Energy: Comparison between Indonesia and Other Developing and Developed Countries. *Sustainability* 14(20), 13442.
- [73] Teoh, S. (2025, October). Vietnam–malaysia–singapore offshore wind project to complete first phase by 2034, malaysia dpm says. *The Straits Times*.
- [74] The Nation Thailand (2025, May). Malaysia and thailand to enhance power grid interconnection facilities.
- [75] Thongsavanh, S. Lao Electricity Exports to Vietnam Hit Record High on Renewable Boom.
- [76] Thuy, H. Legal reforms powering Vietnam’s energy transformation.
- [77] Timilsina, G. R. (2020, June). Demystifying the Costs of Electricity Generation Technologies. Technical Report 9303.
- [78] US-ASEAN Business Council. Malaysia Lifts Renewable Export Ban, Opens Purchasing Opportunities for Singapore.
- [79] U.S. Energy Information Administration (USEIA). International Electricity Imports (billion kwh).
- [80] Vu, N. H. Vietnam Revises PDP8: Key Targets of the National Power Development Plan.
- [81] Xaneth, D. and S. N. Haya. Lao People’s Democratic Republic Country Report. In *Energy Outlook and Energy Saving Potential in East Asia 2025*, pp. 186–206. Economic Research Institute for ASEAN and East Asia (ERIA).
- [82] Yogo, M. and K. Sudo. A Resilient Power System and Power Market in Lao PDR. In *Energy Security White Paper: Policy Directions for Inclusive and Sustainable Development for Lao PDR and the Implications for ASEAN*, pp. 70–87. Economic Research Institute for ASEAN and East Asia (ERIA).
- [83] Yustika, M. Maximizing reciprocal benefits from Indonesia’s green electricity export to Singapore.

Appendix

Table A.1: Singapore’s Power Import Agreements

Source Country	(Expected) Trading Volume	Power Sources	Current Status
Import Trials			
Lao–Thailand–Malaysia	200 MW Phase 1: up to 100 MW; Phase 2: up to 200 MW (additional capacity from Malaysia)	Phase 1: renewable hydropower	Pilot programme (commenced on 23 June 2022)
Malaysia (Peninsular)	50 MW	Renewable electricity	Pilot programme (December 2024 – December 2026)
Large-scale Electricity Imports			
Indonesia	3.4 GW (7 projects)	Solar PV power supported by battery energy storage	Conditional Licences: 3 GW Conditional Approvals: 0.4 GW
Australia	1.75 GW	Solar power	Conditional Approval
Vietnam	1.2 GW	Offshore wind Others (potentially)	Conditional Approval
Cambodia	1 GW	Solar power; Pumped storage hydropower; Wind power (potentially)	Conditional Approval
Malaysia (Sarawak)	1 GW (by 2032)	Hydropower (mainly)	Conditional Approval

Note: Current status refers to the status as of May 2026.

Source: Authors’ compilation based on [31, 29, 30, 52, 64, 69, 67, 27], originally published in [49].

Table A.2: Important and Priority Electricity Projects under Vietnam’s Implementation Plan of PDP8

Technology	Power production capacity (MW) by 2030	Share of total domestic capacity in important and priority electricity projects (%)
Renewable energy	130,183 – 163,532	76.6 – 72.9
Solar power (centralised solar power and rooftop solar power)	46,459 – 73,416	27.3 – 32.7
Onshore wind	26,066 – 38,029	15.3 – 16.9
Hydroelectricity	33,294 – 34,667	19.6 – 15.4
Pumped-storage hydropower	2,400 – 6,000	1.4 – 2.7
Offshore wind power	6,000 (17,032 by 2035) *Both serve for domestic demand	3.5 – 2.7

Note: PDP8 refers to the 8th Power Development Plan.

Source: [53] and authors’ calculations.

Technology	Power production capacity (MW) by 2030	Share of total domestic capacity in important and priority electricity projects (%)
Biomass power	1,523 – 2,699	0.9 – 1.2
Waste-to-energy and solid waste	1,441 – 2,137	0.8 – 1.0
Non-renewable energy	39,858 – 60,974	23.4 – 27.1
LNG thermal power	22,524	13.3 – 10.0
Domestic gas-fired thermal power	14,930	8.8 – 6.6
Nuclear power	4,000 – 6,400	2.4 – 2.9
Co-generation, residual heat, blast furnace gas, and technology by-products	1,404	0.8 – 0.6
Total domestic production	170,041 – 224,506	100 – 100
Import electricity from Laos	9,360 – 12,100	–
Electricity export to Cambodia	400	–
Electricity export to regional countries (e.g. Singapore and Malaysia)	5,000 – 10,000 (by 2035)	–

Note: PDP8 refers to the 8th Power Development Plan.

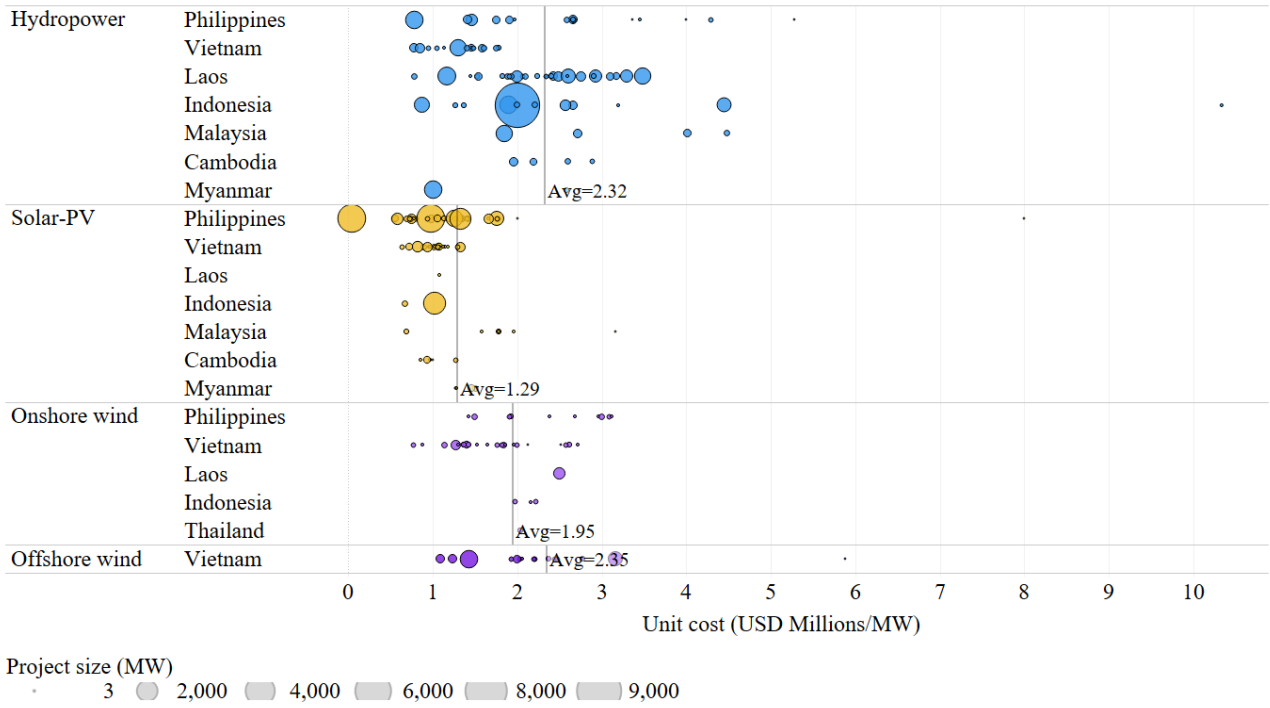
Source: [53] and authors' calculations.

Table A.3: High potential interconnections for ASEAN clean energy trade

	MYS (Hydropower)	IDN (Hydropower, Solar PV, Onshore Wind)	VNM (Hydropower, Solar PV, Onshore Wind, Offshore Wind)	KHM (Solar PV)	THA (Onshore Wind)
MYS	Sarawak-Peninsular Malaysia Interconnection (pre-feasibility study completed 2025)	BIMP-PIP conceptualised 2023	Vietnam-Malaysia-Singapore Offshore Wind Interconnection Project (agreed 2025)	NA	LTMS-PIP commenced 2022
	Sarawak-Sabah Power Interconnection (completed 2024–25)	Sarawak-West Kalimantan Interconnection (since 2016)			Expanding Thailand-Malaysia Interconnections (2025)
IDN	BIMP-PIP conceptualised 2023	Expanding renewables transmission in the Java-Bali grid (2022)	NA	NA	NA
	Sarawak-West Kalimantan Interconnection (since 2016)	Expanding Sumatra-Java HVDC Interconnection (2025)			
VNM	Vietnam-Malaysia-Singapore Offshore Wind Interconnection Project (agreed 2025)	NA	Well-developed domestic grid integration	Expanding VTN electricity exports to KHM in PDP VIII (2025)	APG North Corridor Expansion
				APG North Corridor Expansion	Greater Mekong Subregion Electricity Interconnection
				Greater Mekong Subregion Electricity Interconnection	Greater Mekong Subregion Electricity Interconnection
MMR	NA	NA	APG North Corridor Expansion	APG North Corridor Expansion	APG North Corridor Expansion
			Greater Mekong Subregion Electricity Interconnection	Greater Mekong Subregion Electricity Interconnection	Greater Mekong Subregion Electricity Interconnection
BRN	BIMP-PIP conceptualised 2023	BIMP-PIP conceptualised 2023	NA	NA	NA
	Expanding Sarawak-Sabah Power Interconnection (2025)				
KHM	NA	NA	Expanding VTN electricity exports to KHM in PDP VIII (2025)	Well-integrated domestic grid systems	Existing Thailand-Cambodia Power Interconnection for Thai electricity exports
			APG North Corridor Expansion		APG North Corridor Expansion
			Greater Mekong Subregion Electricity Interconnection		Greater Mekong Subregion Electricity Interconnection
LAO	LTMS-PIP commenced 2022	NA	Multiple transmission lines since 1998	Champasak-Stung Treng transmission line (2016)	Existing Laos-Thailand Power Interconnection for Lao hydropower exports
			Expanding hydropower imports along existing infrastructure	APG North Corridor Expansion	LTMS-PIP commenced 2022
			APG North Corridor Expansion	Greater Mekong Subregion Electricity Interconnection	APG North Corridor Expansion
			Greater Mekong Subregion Electricity Interconnection		Greater Mekong Subregion Electricity Interconnection
THA	LTMS-PIP commenced 2022	NA	APG North Corridor Expansion	Existing Thailand-Cambodia Power Interconnection for Thai electricity exports	Well-developed domestic grid integration
	Expanding Thailand-Malaysia Interconnections (2025)		Greater Mekong Subregion Electricity Interconnection	APG North Corridor Expansion	
			Greater Mekong Subregion Electricity Interconnection	Greater Mekong Subregion Electricity Interconnection	
PHL	BIMP-PIP conceptualised 2023	BIMP-PIP conceptualised 2023	NA	NA	NA
SGP	LTMS-PIP commenced 2022	Conditional approval for Riau solar PV import projects (2023)	Conditional approval for offshore wind import projects (2023)	Conditional approval for solar PV import projects (2023)	LTMS-PIP commenced 2022
	Expanding Singapore-Malaysia Interconnectors (2025)	Agreement on expanding cross-border electricity trade (2025)	Vietnam-Malaysia-Singapore Offshore Wind Interconnection Project (agreed 2025)		
	Sarawak-Singapore Interconnection conditionally approved (2025)				
	Vietnam-Malaysia-Singapore Offshore Wind Interconnection Project (agreed 2025)				

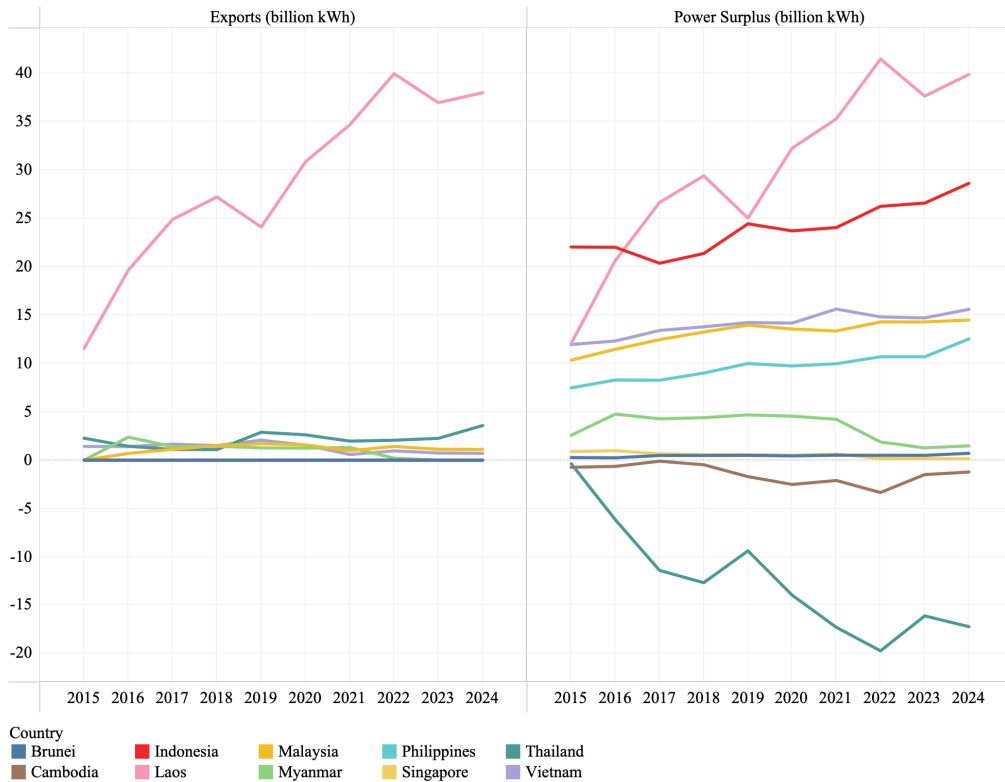
Source: Authors' creation based on [9, 8, 16, 14, 74, 13, 71, 7, 20, 65, 18, 55, 34, 60, 15, 19, 73, 33, 23].

Figure A.1: Distribution of Project-level CAPEX Data by Country, Technology, and Project Size



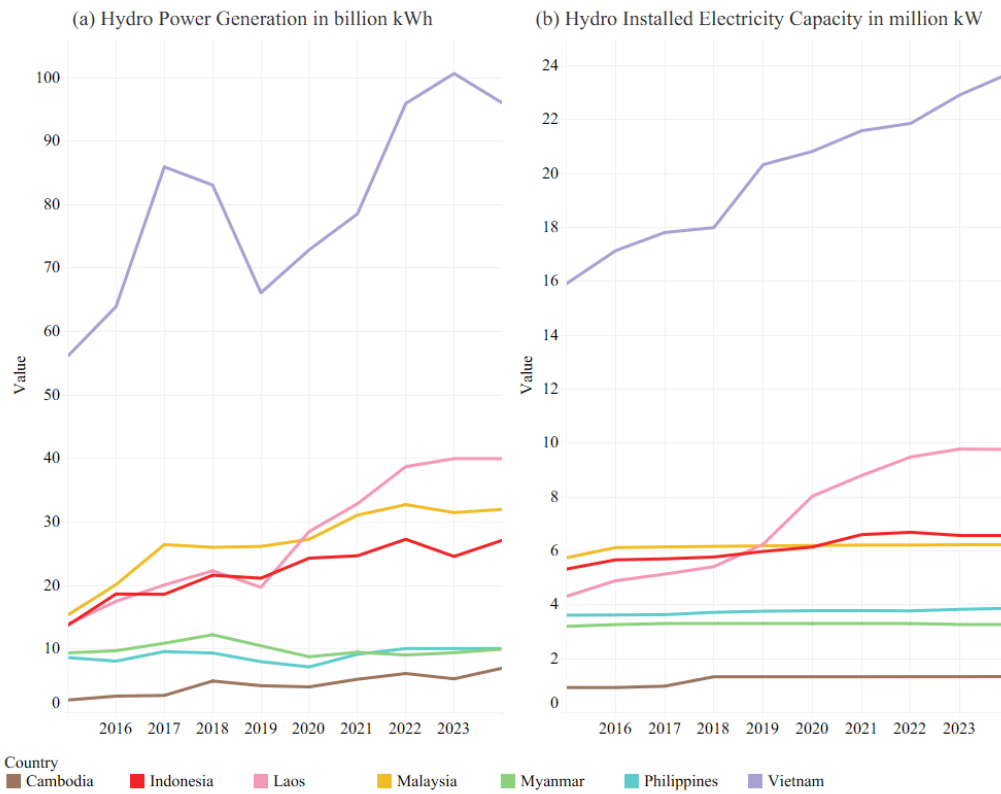
Source: Authors' creation based on BMI database.

Figure A.2: ASEAN Countries' Electricity Exports and Surplus, 2015–2024



Source: [79] and authors' calculations.

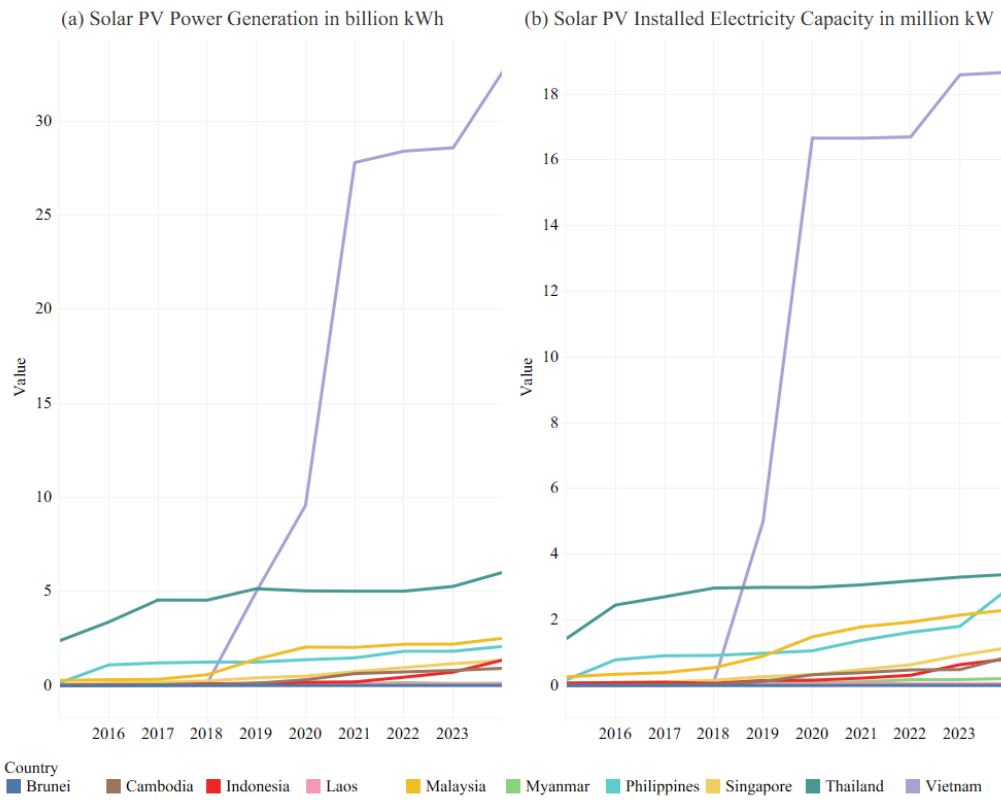
Figure A.3: ASEAN countries' Hydropower Power Generation and Installed Electricity Capacity, 2015-2024



Note: In the USEIA database, hydropower encompasses both conventional hydroelectricity and hydroelectric pumped storage. Within the ASEAN region, however, hydroelectricity accounts for the vast majority of total hydropower output.

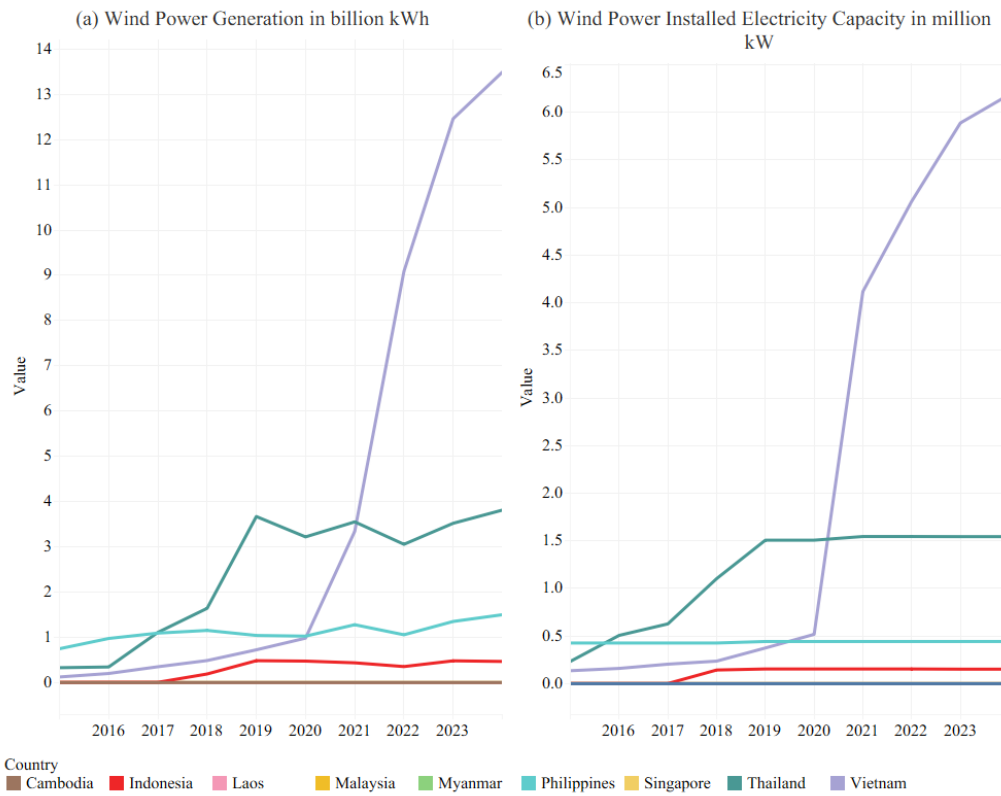
Source: [79] and authors' calculations.

Figure A.4: ASEAN countries' Solar PV Power Generation and Installed Electricity Capacity, 2015-2024



Source: [79] and authors' calculations.

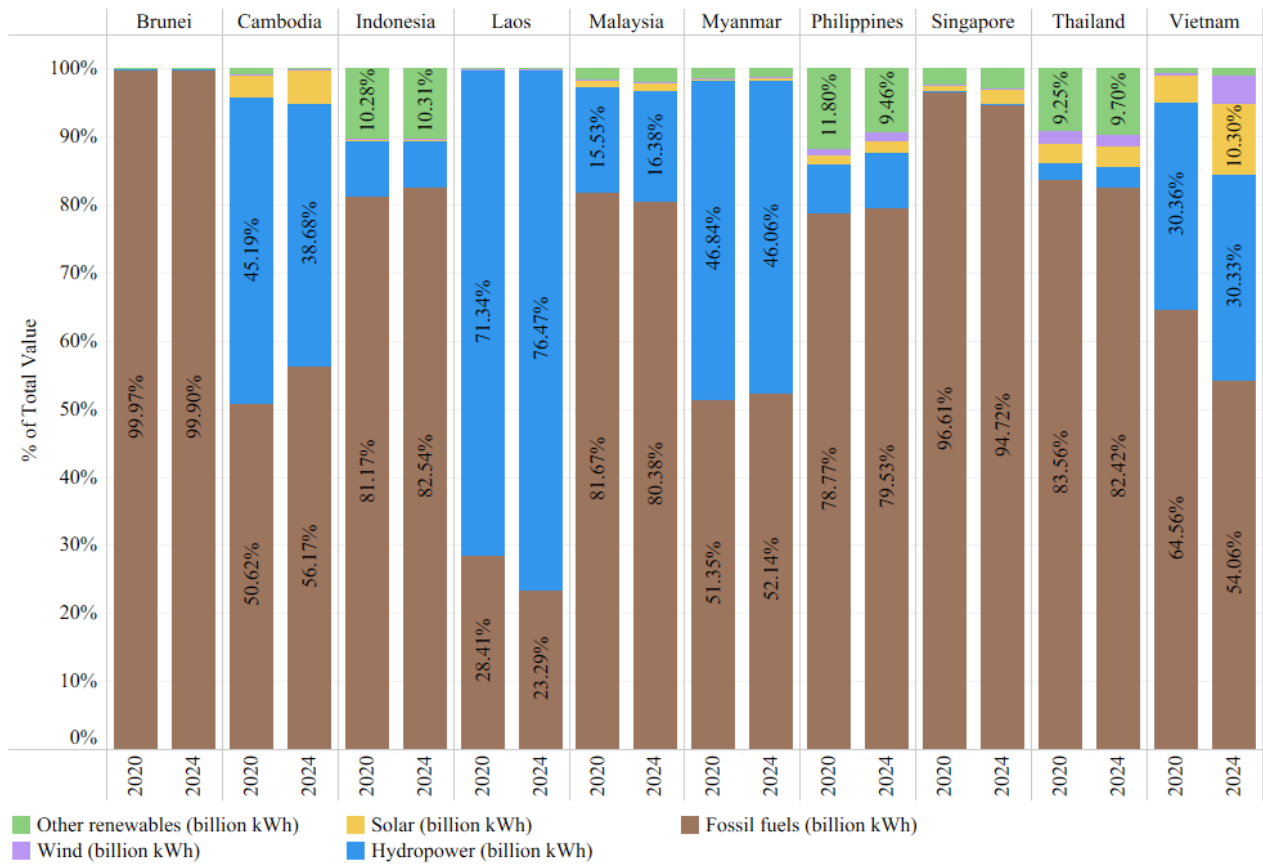
Figure A.5: ASEAN countries' Wind Power Generation and Installed Electricity Capacity, 2015-2024



Source: [79] and authors' calculations.

Figure A.6: Power Generation Structure by Technology in ASEAN Countries

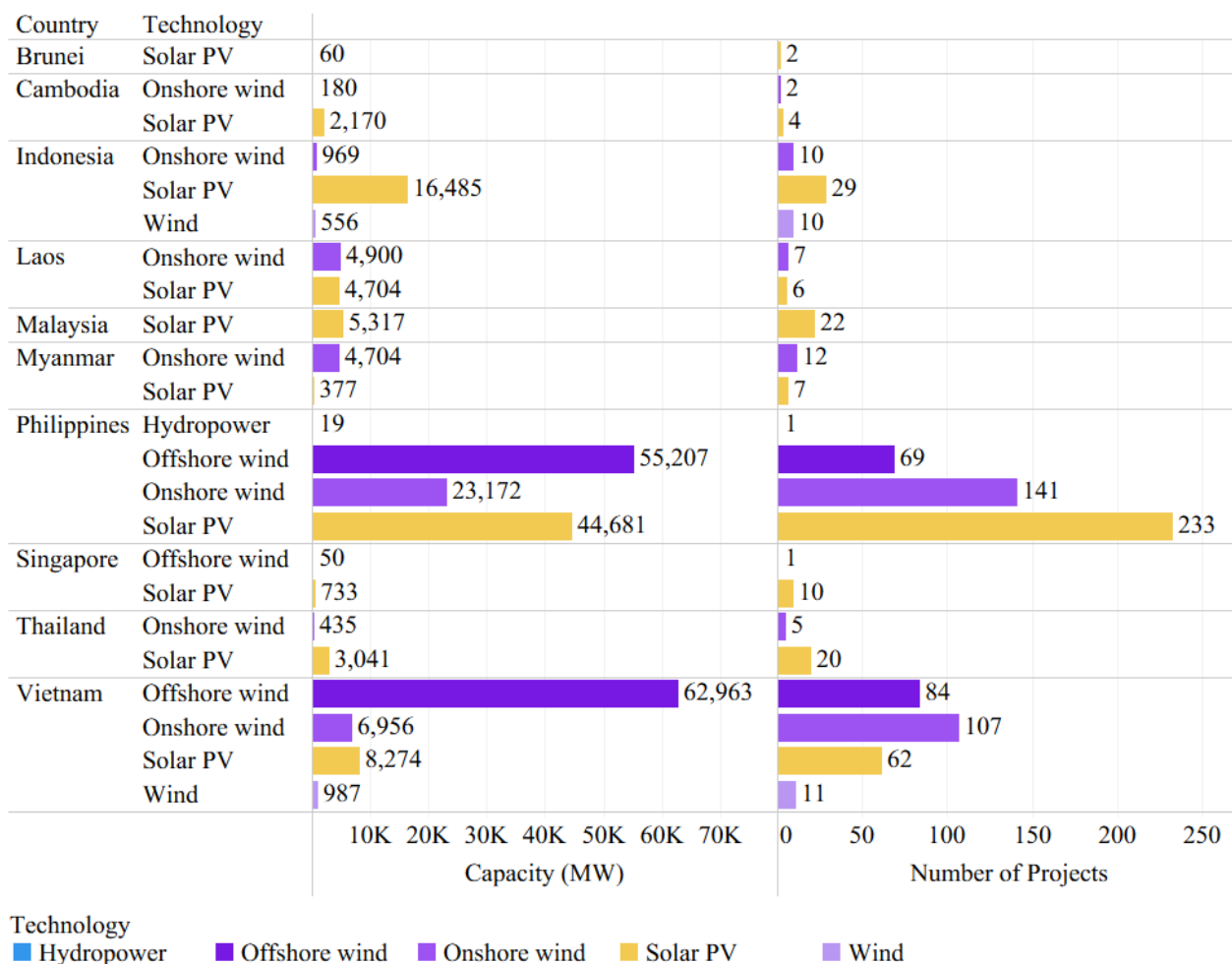
Power Generation by Technology in ASEAN Countries, 2020 VS 2024



Note: Hydroelectricity include hydroelectricity and hydroelectric pumped storage. Other renewables include power generated by biomass and waste, nuclear, tide and wave, and geothermal.

Source: Authors' calculations based on USEIA.

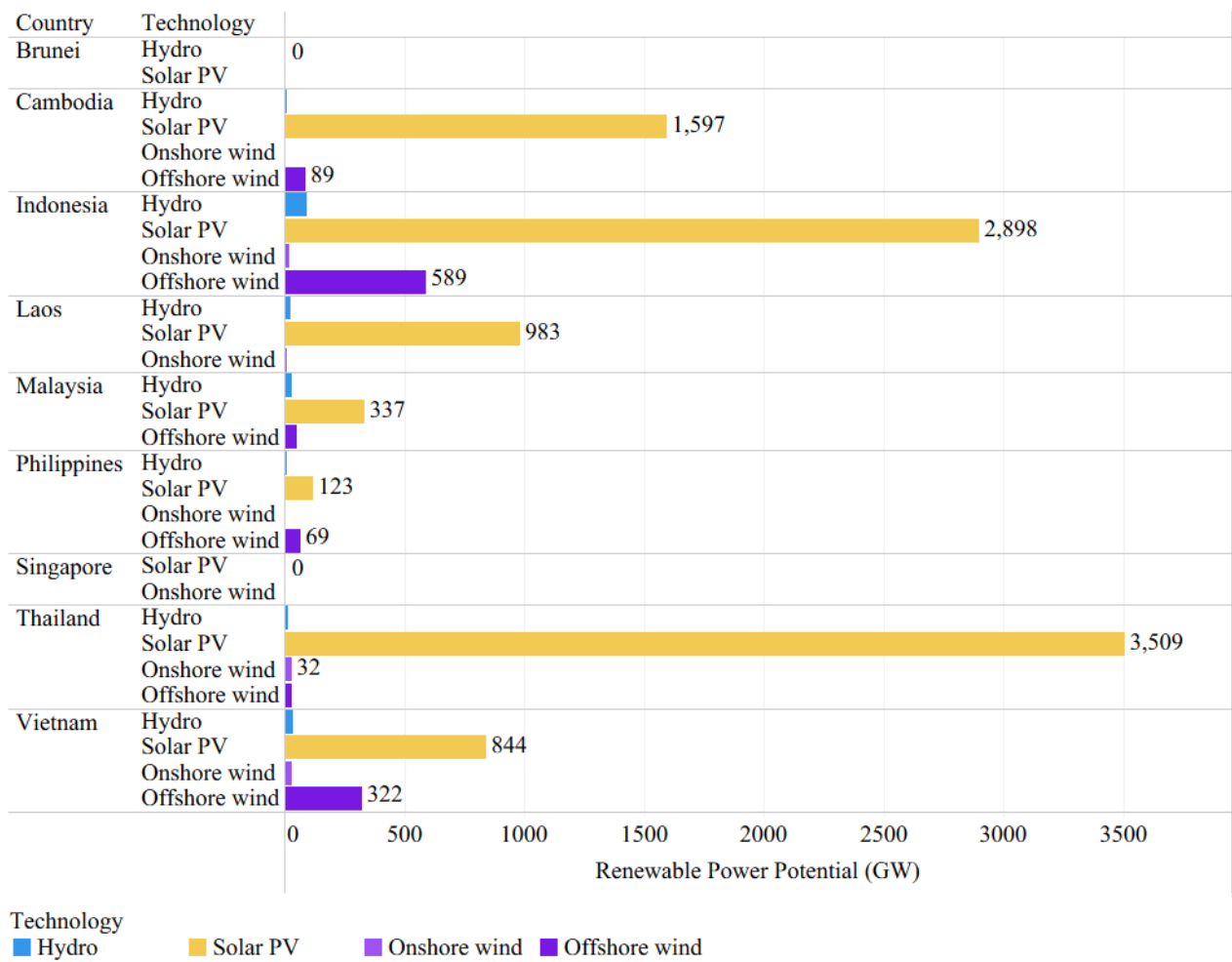
Figure A.7: Renewable Power Projects under Announced, Construction, and Pre-construction Status by Technology in ASEAN Countries



Note: In the legend, “Wind” refers to wind projects without specification on onshore or offshore wind in the database.

Source: Authors’ calculations based on the Global Energy Monitor database.

Figure A.8: Renewable Energy Potential by Technology in ASEAN Countries



Source: [45].