



ASEAN Energy Security Review

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Abstract

This report reviews ASEAN's energy security considerations and policy options as the region faces rapidly growing energy needs and an increasingly complex energy landscape. Energy security has long been an important priority for ASEAN member states, and its significance has grown alongside economic growth, industrial development, urbanisation and rising living standards, which have continued to drive strong growth in energy demand across the region. Southeast Asia is emerging as one of the main centres of energy demand growth globally. Energy systems remain highly diverse across ASEAN member states and continue to rely on a mix of domestic resources, regional trade and international imports. Ensuring a secure, affordable and sustainable energy supply is therefore essential not only for maintaining economic momentum and social development, but also for strengthening the region's resilience to geopolitical shocks, volatile fuel prices, extreme weather events and the changing dynamics of global energy markets.

The region faces a broad set of interconnected energy security challenges, including rising dependence on imported oil and LNG, exposure to strategic maritime choke points, uneven preparedness for supply disruptions, the need to maintain reliable and affordable electricity systems, and emerging risks linked to clean energy supply chains and critical minerals. As the report shows, energy security will increasingly depend on diversified supply, greater use of domestic resources, and accelerated electrification and efficiency within an integrated, systems-based approach. Next to these policies, the report covers a wide range of additional options to address energy security challenges. These include expanding strategic stocks, investing in infrastructure, and improving demand-side flexibility; accelerating clean energy deployment where it reduces exposure to imported fuels; improving emergency planning and market monitoring; and deepening regional co-operation through more effective mechanisms for information sharing, co-ordinated response, cross-border infrastructure and collective preparedness. Taken together, these measures can help ASEAN manage near-term risks while building a more secure and flexible energy system for the longer term.

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Executive summary

As demonstrated by the energy crisis resulting from the current conflict in the Middle East, the energy security challenge in ASEAN countries is intensifying as they experience growing energy demand, rising import exposure and more interconnected energy systems. Rapid economic growth, industrial development, urbanisation and rising living standards are driving strong increases in energy demand across Southeast Asia, up by almost 30% per capita over the last 10 years. At the same time, the region's energy systems are more exposed to external fuel markets, strategic maritime routes, climate-related risks and the supply chains that underpin clean energy technologies. Energy security increasingly depends on the resilience of integrated systems, the ability to manage shocks and price volatility, and the capacity to align near-term security needs with longer-term transition objectives.

The region faces several interconnected risks. Oil demand continues to grow while regional crude production has fallen by 40% since its peak in the 1990s, increasing dependence on imported crude, which has risen by 30% since 2015, and refined products. Natural gas remains important for power generation and industry but rising LNG import needs expose several economies to regional and global gas market volatility and infrastructure constraints. Coal continues to support electricity security and industrial activity in many ASEAN member states, and transitions need to ensure adequate, affordable and reliable alternatives. Electricity systems face rising demand, the risk of fuel supply disruption, and increasing requirements for flexibility and grid investment as electrification and the share of variable renewable increases, alongside growing climate-related risks. Critical minerals and clean energy supply chains create new opportunities for ASEAN but also expose them to global supply-chain concentrations.

Looking ahead, these challenges are likely to intensify. Electricity demand in Southeast Asia is projected to expand at an average annual rate of around 5.4% during 2026-2030, driven by rising demand for cooling, data centres and industry. Coal demand is expected to continue growing at around 4.4% per year over the same period, the fastest increase of any region worldwide. Gas consumption in the region is projected to rise by more than 3% annually over the coming years. Finally, for the region's most import-dependent fuel, ASEAN net oil product imports are expected to increase by around 5% between 2025 and 2031. These trends point to a clear need for timely action.

While the energy security risks differ by country and fuel, they point to the need for a common policy agenda centred on three broad reinforcing strategies:

diversifying energy supply sources and routes, making greater use of domestically available energy resources; and accelerating electrification alongside efficiency improvements. A holistic systems-based approach is essential, recognising the growing interdependence between electricity, fuels and end-use sectors.

Regional co-operation is central to this agenda and the ASEAN Plan of Action for Energy Cooperation (APAEC) 2026-2030 provides the strategic framework. In addition, energy co-operation through the ASEAN Power Grid (APG), the ASEAN Memorandum of Understanding on the Trans-ASEAN Gas Pipeline Project and the ASEAN Framework Agreement on Petroleum Security (APSA) provides an important foundation for collective action. This review shows that these agreements should be further operationalised and strengthened to bolster regional energy security. A stronger regional approach would complement national resilience measures by helping ASEAN member states prepare for external energy market shocks, manage infrastructure and affordability risks, and share flexibility and emergency support across borders. The following recommendations capture the main actions needed to strengthen energy security across the ASEAN countries' fuels, technologies and enabling systems.

Summary of key recommendations

Area	Key recommendation	Main security objective
Cross-cutting regional co-operation	Further operationalise and strengthen ASEAN energy security mechanisms through stronger information sharing, market monitoring, emergency procedures, implementation follow-up and practical arrangements for regional support during disruption.	Strengthen collective preparedness and resilience to fuel, price and infrastructure shocks.
Oil, petroleum products and liquid biofuels	Further operationalise APSA, strengthen the secretariat role of the ASEAN Centre for Energy (ACE), conduct regular regional emergency exercises, assess national stockholding, demand-side preparedness and sustainable liquid biofuel supply chains and strengthen emergency response measures.	Reduce exposure to crude and product import disruption and improve crisis response capacity.
Natural gas and low-emissions gases	Maintain economically viable domestic production, expand LNG import infrastructure where needed, improve pipeline connectivity and storage where appropriate, develop a co-ordinated gas emergency response mechanism under APSA, and support low-emissions gases.	Improve gas supply availability, flexibility and resilience while avoiding overbuilding.
Coal and solid biofuels	Maintain coal supply security where coal remains important, improve transparency and co-ordination of measures affecting regional trade, assess coal stockholding needs and opportunities for sustainably sourced modern solid biofuels, and develop transition roadmaps that account for adequacy, affordability and replacement capacity.	Preserve reliability while preparing credible and secure transition pathways.

Area	Key recommendation	Main security objective
Electricity and renewables	Update electricity security planning to integrate adequacy, flexibility, grids, climate resilience, fuel security and affordability; accelerate grid investment; and use the APG to share resources, reserves, flexibility and emergency support.	Ensure reliable, affordable and resilient power systems as demand grows and the renewables share increases.
Energy efficiency and demand-side management	Strengthen regional harmonisation, targets, compliance, financing and data; expand efficiency measures in transport, buildings, appliances and industry; and unlock demand-side flexibility through smart meters, time-of-use pricing and aggregation platforms.	Reduce demand growth, import exposure and peak system stress while improving flexibility.
Critical minerals	Develop critical mineral strategies accounting for dependencies, focus on comparative strengths, increase regional co-operation on data sharing and standards, and diversify investment partnerships.	Capture more value from critical minerals while reducing exposure to global supply chains.

Recommendations by fuel and technology

Oil, petroleum products and liquid biofuels. The region's oil emergency preparedness can be strengthened by further operationalising APSA and supporting the effective functioning of ACE as the APSA secretariat with guidance from ASEAN member states. A strengthened secretariat could support regular reviews of APSA procedures, enhance regional oil market monitoring and, subject to member states' agreement, facilitate country-level reviews and assist with putting co-ordinated emergency response measures into operation. The secretariat could also establish a liquid biofuel taskforce to support regional supply chain development, identify import and export opportunities between member states for these fuels, and collectively set sustainability criteria for an integrated regional market. Regular capacity-building activities, including regional oil emergency response workshops and exercises, would help test APSA's strengths and limitations, identify gaps in national preparedness and build confidence in cross-border co-operation during severe disruption.

At the national level, ASEAN member states can strengthen domestic oil resilience by building more robust stockholding policies, demand-side measures and clear crisis procedures, and by the development of sustainable liquid biofuel supply chains. Countries with domestic resources can consider how to increase domestic oil production by adopting fiscal regimes that are predictable and supportive of investment. Member states with high import dependence could assess whether existing commercial inventories are sufficient for severe supply disruption and, where needed, develop sustainable financing and governance models for strategic petroleum reserves. Member states - particularly smaller or highly import-dependent economies - could explore voluntary and commercially based regional stockholding and storage arrangements, to complement national systems. Longer-term, countries could consider supporting the expansion and upgrading of

domestic refining capacity, thereby orienting strategic stockholding measures towards crude oil. For LPG, however, dedicated additional strategic storage may be a more appropriate solution. Leading liquid biofuel-producing member states could continue increasing sustainable production by leveraging commercial production pathways and developing new pathways to capitalise on non-traditional feedstocks. More nascent markets could leverage expertise elsewhere in the region to develop a domestic industry and reduce import dependence.

Natural gas and low-emissions gases. Regional co-operation on gas security through APSA and collaboration with international partners can strengthen ASEAN member states' gas resilience. A dedicated co-ordinated emergency response mechanism for natural gas under the Coordinated Emergency Response Measures framework of APSA could help clarify roles, procedures, data collection and market monitoring during crises. Regional gas market integration should be pursued where projects have a positive cost-benefit case, including through infrastructure that improves interconnectivity and interoperability and allows ASEAN member states to share supply more effectively. Local biomethane production, supported through targeted policies, incentives and experience-sharing, could improve the regional gas balance where it is developed sustainably and at scale.

ASEAN countries could strengthen gas supply availability, flexibility and resilience by maintaining economically viable domestic production, expanding LNG import infrastructure where needed, and, where appropriate, improving pipeline connectivity and developing gas storage capacity. However, investment decisions will need to account for uncertainty over future gas demand, the pace of clean energy deployment and the risk of overbuilding infrastructure. These investments will be increasingly important as several economies become more dependent on LNG imports and more exposed to global gas market shocks. National planning frameworks can benefit from considering not only supply volumes, but also contract flexibility, appropriate infrastructure redundancy, storage options and the ability of gas systems to respond during disruption.

Coal and modern solid biofuels. The role of coal differs significantly between ASEAN member states depending on resource endowment, power sector structure, industrial demand and net zero ambitions. Overall priorities include strengthening regional co-operation and transparency to support reliable coal trade and minimise unintended regional impacts of domestic market interventions.

For member states that rely on coal for power generation or industry, their policy should focus on maintaining security of supply while preparing credible decarbonisation transition pathways. ASEAN member states that rely on coal for power generation can evaluate whether coal stockholding requirements are needed to strengthen power system resilience. Given the relatively low cost of coal storage, member states without stockpiling obligations could assess the benefits of minimum inventories for coal-fired power plants. For ASEAN member

states with net zero commitments, coal transition roadmaps need to explicitly consider security of supply as well as decarbonisation considerations, including co-firing. These roadmaps should assess power system adequacy, the availability of replacement capacity, fuel switching to modern sustainable solid biofuels, grid readiness, affordability and the economic implications of early retirement, particularly in member states with young coal fleets.

Electricity and renewables. Electricity security should evolve to reflect the changing risk profile of power systems. Planning frameworks that integrate resource adequacy, flexibility, grid development, climate resilience, fuel security and affordability are better positioned to identify emerging vulnerabilities. As electricity grids are central to enhancing system resilience, grid infrastructure should be expanded and modernised to keep pace with demand growth and renewables deployment, while being more resilient to the effects of climate change.

Regional co-operation through the APG can complement national investment by enabling ASEAN member states to share renewable resources, reserves, flexibility and emergency support across a wider geographical area. Realising the electricity security benefits of the APG will require participating countries to introduce enabling domestic conditions and effective co-operation arrangements. The region's diverse renewable energy resource potential, including solar, wind, hydropower, geothermal and modern sustainable biomass, can support greater diversification of electricity supply while reducing exposure to imported fossil fuels. As variable renewables expand, key measures to effectively integrate them include flexible power plants, enhanced grid capacity, storage deployment, demand-side measures, accurate forecasting, and improved system operation practices and market frameworks. Alongside renewables, the potential of nuclear to contribute to energy security should be explored.

Demand-side flexibility should become a standard component of electricity security strategies. Better visibility and understanding of demand patterns, rooftop solar PV, behind-the-meter resources, cooling demand, electric vehicles and new large loads will be essential as electrification accelerates. Policies and market frameworks including tariffs, incentives, technical requirements and aggregation platforms should enable demand response and distributed resources to support system reliability, resilience and affordability.

Energy efficiency and demand-side management. Energy efficiency is often the most cost-effective means of strengthening energy security because it reduces energy demand, lowers energy expenditure, and reduces the need for energy infrastructure investment and fuel imports. ASEAN can strengthen energy efficiency by enhancing regional co-operation on policy frameworks, target setting, updating energy efficiency plans and improving compliance monitoring and enforcement across all sectors. A co-ordinated regional framework that supports fuel economy standards for light- and heavy-duty vehicles, vehicle labelling,

electric vehicle regulations and interoperable charging infrastructure could accelerate progress in transport efficiency. For appliances and buildings, ASEAN can further harmonise and strengthen minimum energy performance standards and energy labelling, especially for air conditioners, refrigerators and lighting. Voluntary labelling and building certification schemes could progressively move towards mandatory approaches where appropriate, while building energy codes can be expanded in coverage and stringency.

ASEAN countries can strengthen industrial energy efficiency through energy management programmes, capacity building and incentives for using high-efficiency technologies such as industrial motors. Demand-side flexibility, enabled by measures such as smart meters and time-of-use pricing, can reduce peak demand, improve resilience and support more secure power systems. Greater transparency and more consistent data availability would support implementation and allow policy makers to track whether efficiency gains are reducing demand growth and import exposure. Sharing best practices on financing can help ASEAN member states improve access to finance for projects, replicate successful approaches and scale up investment in cost-effective improvements.

Critical minerals. The main security question on critical minerals for the region is how to capture more value from them while reducing the risk of exposure to concentrated global supply chains. Global processing remains highly concentrated, and recent export controls imposed outside the region have shown how quickly disruption can affect industries. These risks are especially relevant for ASEAN economies seeking to expand manufacturing and clean energy industries, since even resource-rich countries can depend on external suppliers for equipment, technologies, and components. ASEAN member states thus need to manage their reliance on using imported technologies, refined materials and specialised components. A more strategic approach could help ASEAN member states assess where domestic or regional capabilities can be developed, where diversification is needed, and where partnerships with external suppliers will remain essential.

A more integrated ASEAN approach to critical minerals would combine national industrial policies with stronger regional co-operation. Priorities include improving geological data, developing shared standards, supporting responsible mining and processing, expanding recycling and circular economy measures, and identifying opportunities for regional value chains across mining, refining, manufacturing and end-use sectors. This would help ASEAN capture more economic value from its resource base while strengthening resilience to supply disruptions, trade restrictions and external technology dependencies.

Introduction: Energy security context, framework and overview

The strategic importance of Southeast Asia in the global energy landscape has been steadily growing for many years, and the trajectory shows no signs of reversing. The region is projected to account for nearly [20% of the increase in global energy demand to 2035](#) under today's policy settings. At the same time, recent geopolitical tensions, including the conflict in the Middle East, have highlighted Southeast Asia's exposure to energy imports and global energy price volatility.

Against this backdrop, this report – agreed under the ASEAN IEA Work Plan and prepared in co-ordination with ASEAN Centre for Energy (ACE) – is particularly timely as governments across the region consider policy and investment strategies amid the strong prioritisation of energy security.

Reflecting the growing importance of Southeast Asia and the deepening partnership between the IEA and ASEAN, the IEA has significantly expanded its engagement across the region. This includes its co-operation with four ASEAN member states that are Association countries of the IEA: Indonesia, Singapore, Thailand and Viet Nam. This engagement was further strengthened with the opening of the IEA Regional Co-operation Centre in Singapore in late 2024, the IEA's first office outside Paris.

ASEAN regional energy profile

Energy demand trends

Southeast Asia is one of the world's fastest-growing regions. Its GDP grew by nearly 5% in 2024 and is projected to rise by an average of 4% per year through to 2035, supported by the region's role as a global manufacturing hub.

As ASEAN economies have expanded, their [total energy demand has risen by 40%](#) since 2015, reflecting the region's growing industrial, transport and household energy needs.

Industry is the largest end-use sector in Southeast Asia and has been the main driver of energy demand growth since 2015, supported by expanding manufacturing activity, non-energy-intensive industries and non-ferrous metal production. Transport has also been a major source of demand growth, particularly

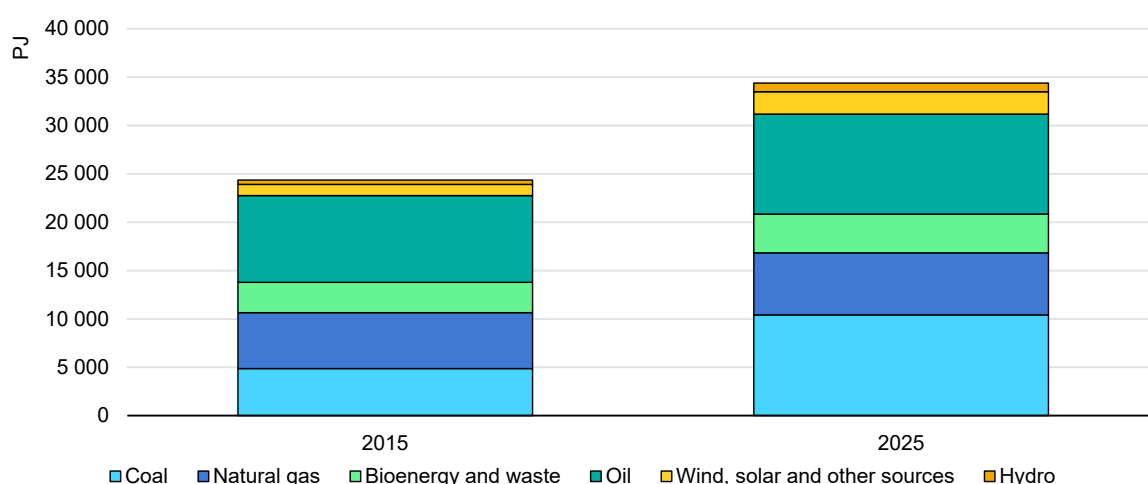
for oil, with rising road freight activity, higher incomes, limited public transport alternatives and growing vehicle ownership shaping mobility needs across ASEAN countries. In buildings, rising incomes, urbanisation and expanding access to electricity and clean cooking have reshaped household energy demand.

Electricity demand has increased by more than 60% since 2015, driven by wider access, higher industrial consumption, urbanisation, and rising demand for cooling and other appliances. About 97% of households now have access to electricity, putting the region on track to achieve universal access by 2030. Over the coming decade, electricity demand is expected to grow faster than overall energy demand.

Composition of the energy mix

Rising energy demand has driven major shifts in Southeast Asia's energy mix over the past decade. Between 2015 and 2025, total ASEAN energy demand increased by more than 40%, driven by strong economic growth and rising electricity demand. To meet this growing demand, energy supply expanded across all major fuel and energy sources. In 2025, coal and oil each accounted for around 30% of the total energy supply – 540 million tonnes of coal and roughly 9 mb/d of oil respectively – while natural gas contributed close to one-fifth, corresponding to 200 bcm of gas. Bioenergy and waste accounted for around 12%, wind, solar and other renewables for around 7%, and hydro for around 3%. LPG consumption, which has grown strongly over the past decade, in particular in Cambodia and Indonesia, makes up about 5% of total final consumption in the region (around 300 mb of total annual consumption in 2025). Taken together, the ASEAN energy mix is gradually diversifying, even as fossil fuels remain central to meeting demand.

Energy supply by source in ASEAN, 2015 and 2025



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Notes: PJ =petajoule. Data for Timor-Leste were not available.

Source: IEA (2026), [World Energy Balances](#), accessed 1 August 2026. Data for 2025 include estimates.

Investment trends provide another indication of how the region's energy system is evolving. Fossil fuels accounted for 60% of total energy investment over the past decade, with coal receiving the largest share. Investment in coal-fired generation has increased steadily over the past two decades, bringing installed capacity to 121 GW last year. However, annual clean energy investment in the region increased from USD 30 billion to USD 47 billion over the last decade, with annual fossil fuel investment falling from USD 70 billion to USD 50 billion during the same period.

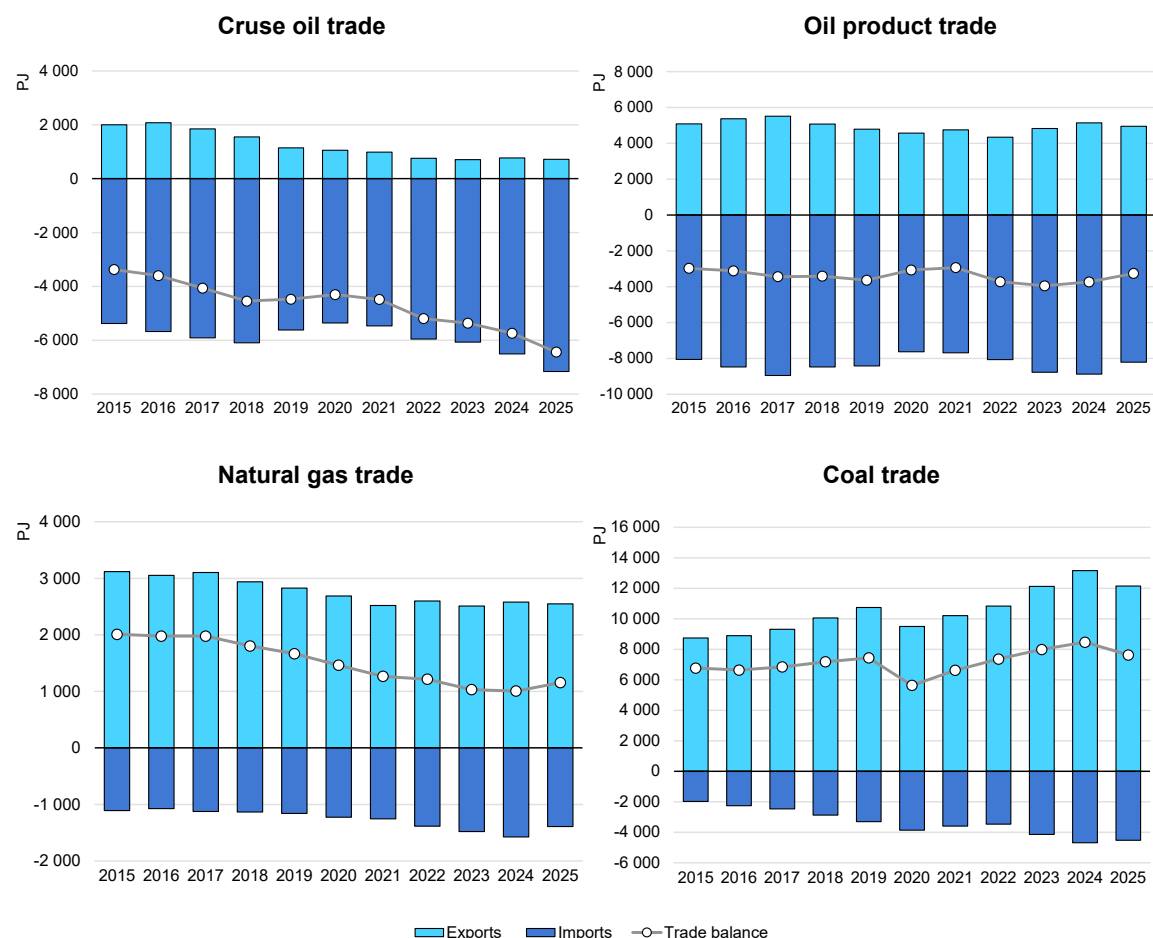
At the same time, Southeast Asia is becoming more important in clean energy supply chains. In 2023, Malaysia, Thailand and Viet Nam were the largest solar PV manufacturers after the People's Republic of China (hereafter, "China"). The region also holds substantial critical mineral resources. Indonesia produces more than 60% of the world's nickel and attracted over USD 50 billion of greenfield mining investment between 2014 and 2023, more than 90% of the global total. Chinese investment has been central to the expansion of Indonesia's nickel refining sector, reaching USD 30 billion in 2024, and Chinese companies now account for around 75% of the country's refining capacity.

Import dependency ratios

Import dependency in the ASEAN region differs markedly by fuel. While crude oil and oil products remain significant sources of import dependency for many ASEAN economies, natural gas and coal continue to exhibit regional net export positions, albeit with a wide variation between countries. These differences reflect variations in resource endowment, production capacity and energy consumption patterns across ASEAN member states. This section provides the current backdrop for the fuel security assessments that follow.

Crude oil is a major source of import dependency in many ASEAN member states. Although Indonesia, Malaysia, Brunei Darussalam and Thailand remain exporters of crude oil, regional oil output has declined by around 40% since its peak in the 1990s. Since 2015, crude oil imports have risen by more than 30%, increasing exposure to international markets and external supply risks. Oil products present a related but distinct source of exposure. Regional refineries meet much of Southeast Asia's refined product demand, providing some buffer against disruption in product markets. However, this downstream resilience remains constrained by reliance on imported crude as refinery feedstock, with around 45% of refined oil products derived from Middle Eastern crude. This dependence, compounded by relatively inflexible refineries configured to process medium and heavy Gulf crudes, represents a structural weakness in the region's energy system.

Trade balances by fuel type in ASEAN, 2015-2025



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Notes: All trade data include intra-regional trade. Data for oil and oil products for the year 2025 are based on estimates. Data for Timor-Leste were not available.

Source: IEA (2026), [World Energy Balances](#), accessed 1 August 2026.

ASEAN remains a net gas exporter, but if current trends continue the region could become a net importer of gas by the end of the decade. Natural gas is largely supplied from within the region, with around 90% of demand met by production within ASEAN, mainly from Indonesia, Malaysia and Thailand. LNG accounts for more than 85% of the region's net gas export balance. However, LNG imports have increased steadily in recent years, reflecting growing import requirements in several ASEAN member states. Countries such as Indonesia and Malaysia both import and export LNG due to regional supply–demand mismatches, infrastructure constraints and long-term export commitments. As domestic production declines and import requirements grow, ASEAN's gas export surplus is expected to narrow, with the region becoming a net gas importer towards the end of the decade.

Coal presents a markedly different picture. ASEAN remains a net coal exporter, but this position rests heavily on Indonesia, which accounts for nearly 90% of

regional production and acts as a key balancing supplier in international coal markets. Despite this regional export position, several ASEAN member states, including the Philippines and Viet Nam, are increasingly reliant on imported coal (often from within the region) for their power sector needs, while limited regional coking coal resources make imports critical for steelmaking and metals processing.

While these indicators provide a regional perspective on energy security, they can mask important differences between ASEAN member states. Resource endowments, infrastructure and fuel trade patterns vary considerably across the region, meaning that national energy security outcomes may differ from the regional picture. The indicators below therefore complement the regional analysis by highlighting these country-level differences.

Import dependency by ASEAN member state and fuel type, latest available year

Country	Crude oil	Oil products	Natural gas	Coal
Brunei Darussalam	43%	0%	0%	100%
Cambodia	n/a	100%	n/a	99%
Indonesia	32%	36%	0%	0%
Lao PDR	n/a	100%	n/a	0%
Malaysia	25%	0%	15%	90%
Myanmar	100%	97%	1%	2%
Philippines	97%	78%	58%	62%
Singapore	100%	0%	100%	100%
Thailand	87%	0%	37%	60%
Viet Nam	56%	42%	9%	55%

Notes: Import dependency = net imports ÷ supply, where net imports comprise both trade from within and outside ASEAN. n/a = not applicable (no domestic consumption). Calculations use 2025 annual data except for crude oil and oil products, which use 2024 annual data. Data for Timor-Leste were not available.

Recent disruptions to global energy markets, including the 2022 global energy crisis caused by Russia's full-scale invasion of Ukraine and the more recent conflict in the Middle East, have brought the energy security implications of fuel import dependency to the forefront. Prior to the Middle East conflict, around 60% of Southeast Asia's crude oil imports and one-third of its natural gas imports originated from the Middle East. The resulting disruption to fuel markets exposed vulnerabilities linked to import dependency, limited diversification and concentrated supply routes, contributing to higher energy prices, inflationary pressures and broader economic risks across the region.

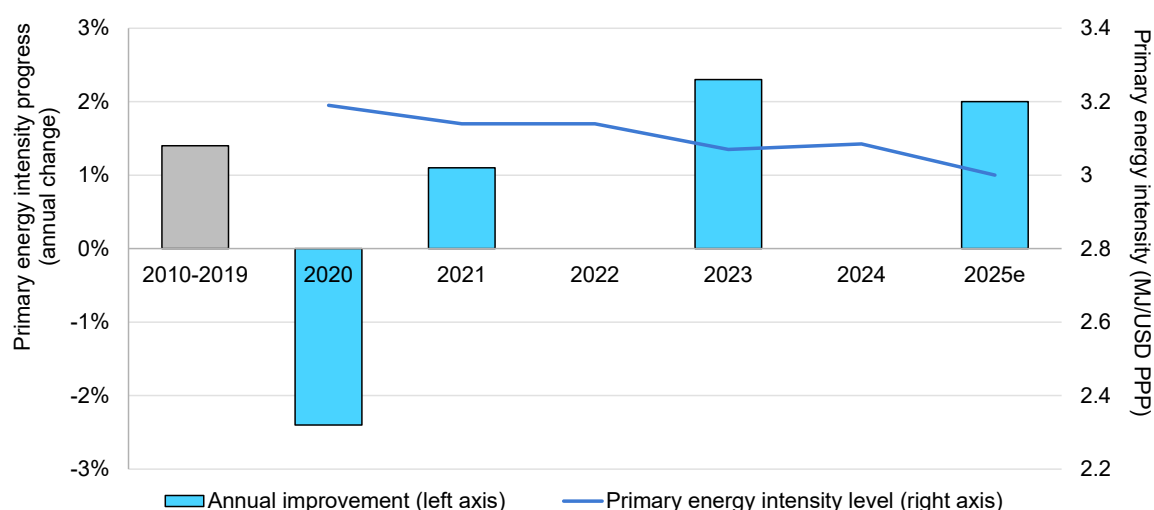
While import dependency provides a useful indication of exposure to external energy markets, fuel security outcomes also depend on factors such as supply diversification, infrastructure resilience, stockholding and the ability to respond to disruption. These broader considerations are examined further in the individual fuel and technology chapters of this review.

Energy intensity and efficiency

Energy intensity and efficiency trends are important indicators of how effectively ASEAN economies use energy as demand continues to grow.

ASEAN's energy intensity has improved modestly, easing from around 3.15 GJ to an estimated 3.01 GJ per thousand USD between 2015 and 2025, but improving more slowly than the global average. At the same time, energy use per capita has continued to climb, from around 38 GJ to 49 GJ, reflecting rising demand across the region's economy.

Primary energy intensity and annual improvement in ASEAN, 2010-2025e



IEA. CC BY 4.0.

Notes: Primary energy intensity = total energy supply ÷ GDP (USD 2021 PPP). PPP = purchasing power parity. Positive energy intensity progress reflects a reduction in energy intensity levels.

Source: IEA (2026), [Energy Efficiency Progress Tracker](#).

Against rising energy demand, energy efficiency has become a growing policy focus across ASEAN. Ten of the eleven ASEAN member states have established energy efficiency or energy savings targets extending to between 2030 and 2060, while under the ASEAN Plan of Action for Energy Cooperation (APAEC) 2026-2030, the region aims to achieve a 40% reduction in energy intensity based on total primary energy supply by 2030, compared with 2005.

While these targets set a common direction, progress varies across sectors. In industry, most ASEAN member states have introduced mandatory energy management requirements, audits and energy-saving measures, with targeted incentives such as tax relief for efficient machinery in Thailand and dedicated financing in Viet Nam. In transport, governments across the region are accelerating EV uptake, but progress in improving the efficiency of conventional vehicle fleets has been slower, with mandatory fuel economy standards for both light- and heavy-duty vehicles still largely absent. In buildings, energy codes that deliver sector-wide savings are in place across most ASEAN member states, although there remains significant scope to strengthen implementation and enforcement to unlock deeper efficiency gains.

Energy efficiency's role in strengthening resilience and reducing import exposure is examined further in the Energy efficiency and demand management chapter.

Assessment framework and time horizon

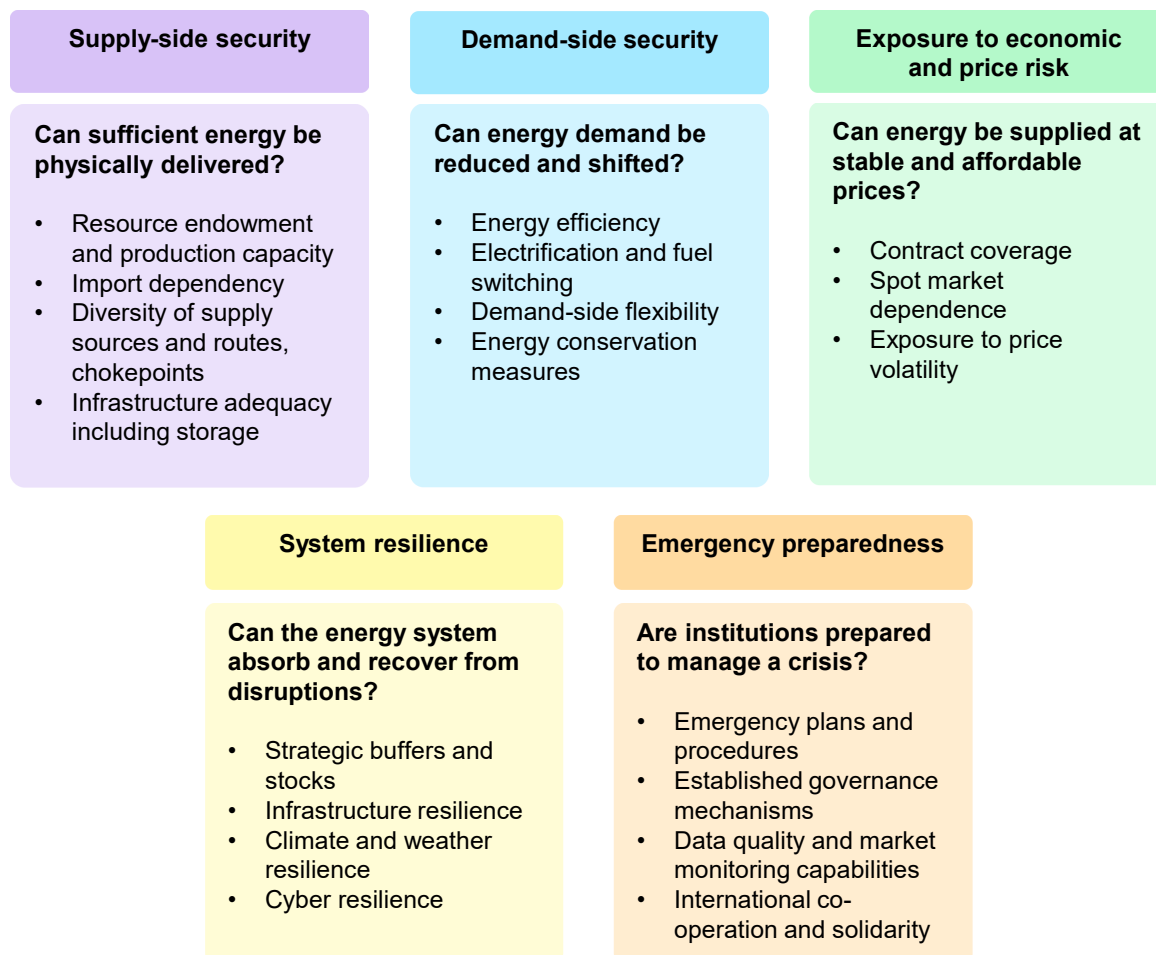
Energy security needs to be assessed across fuels, technologies and systems. Recent energy market disruptions have reinforced the importance of secure, affordable and sustainable energy supply, while also showing that energy security risks are becoming more interconnected. Traditional risks linked to fuel availability, import dependency, infrastructure adequacy and emergency preparedness remain central. At the same time, new risks are emerging from electricity system transformation, growing dependence on critical minerals, clean energy supply chains, climate impacts and cyber resilience. This report therefore applies a common framework across the chapters, while recognising that not every dimension is equally relevant for every fuel or technology.

For the purposes of this review, energy security is understood to be the ability to ensure the uninterrupted availability of energy at affordable prices, while maintaining the flexibility and resilience needed to manage shocks and longer-term stresses. The framework below sets out the main factors considered throughout the report. It should be read as a common reference point rather than a checklist applied mechanically to every chapter. The oil, gas and coal chapters use the framework most directly, while the electricity, critical minerals, and energy efficiency and demand-side management chapters apply it in ways that reflect their specific role in the wider energy system.

The framework considers five interconnected dimensions: supply-side security, demand-side readiness, exposure to economic and price risk, system resilience, and emergency planning. Together, these dimensions provide a structured lens for assessing ASEAN countries' exposure to fuel and technology risks, their ability to reduce or shift demand during stress periods, the affordability implications of energy market shocks, the resilience of infrastructure and systems, and the

preparedness of institutions to respond during crises. They are not meant as a measurement tool to assess the energy security situation quantitatively.

Energy security assessment framework



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The assessment focuses primarily on a five-year horizon. This timeframe is long enough to capture expected changes in demand, supply, infrastructure, investment and policy implementation, and short enough to remain relevant for current government mandates and near-term regional co-operation. Where relevant, the report also refers to longer-term transition objectives, such as net zero targets, coal retirement plans, clean energy supply chains and strategic stockholding goals, but the main emphasis is on risks and policy options that can be addressed in the coming five years. The longer-term outlook to 2050 is covered in the IEA's [Southeast Asia Energy Outlook 2026](#).

Overview of chapters

The six thematic chapters that follow cover the main areas of the ASEAN energy system. The oil, gas and coal chapters follow a broadly similar structure: each starts with recent market developments and a five-year outlook, before assessing security risks related to supply, import dependency, infrastructure, price exposure, system resilience and emergency preparedness. The chapters on electricity, critical minerals, and energy efficiency and demand-side management are less directly comparable, as each addresses a different part of the energy system and therefore applies the common energy security assessment framework in a more tailored way.

Oil and biofuels security review. This chapter examines ASEAN countries' growing oil demand, declining regional crude production and continued reliance on imported crude and refined products. It also reviews refining capacity, biofuels, five-year supply–demand trends, oil stockholding arrangements, demand-side response and the scope for stronger regional emergency preparedness.

Natural gas and low-emissions gases security review. This chapter assesses the role of natural gas in the ASEAN energy system, including gas demand and production, LNG and pipeline trade, low-emissions gases and the outlook to 2030. It focuses on rising LNG import needs, exposure to global gas market risks, infrastructure adequacy, demand-side flexibility, system resilience and emergency planning.

Coal and solid biofuels security review. This chapter reviews coal demand, reserves, production, trade and infrastructure across ASEAN countries, highlighting the region's overall net export position and the large differences between ASEAN member states. It also considers the implications of coal use in power generation and industry, import dependency for some ASEAN member states, metallurgical coal exposure, stockholding practices and the interaction between coal security and transition planning.

Electricity and renewables security review. This chapter examines electricity demand and supply trends, the adequacy, reliability and resilience of power systems, and the security implications of increased electrification and rising shares of variable renewables and distributed resources. It considers system flexibility, grid integration, affordability, climate resilience, supply chains for solar PV and wind, and the role of regional co-operation through power system interconnections.

Energy efficiency and demand-side management. This chapter assesses how energy efficiency and demand-side measures can reduce energy security risks by lowering demand growth, easing import dependency and improving system flexibility. It reviews progress on energy intensity, policy frameworks and sector-

specific measures in buildings, appliances, transport and industry, as well as the emerging role of demand-side flexibility in electricity systems.

Critical minerals security review. This chapter focuses on ASEAN countries' role in critical mineral supply chains, with particular attention paid to resource endowments, mining and processing capacity, investment conditions and policy frameworks. It assesses how critical minerals can contribute to economic development and clean energy supply chains, while also identifying risks related to supply concentration, permitting, infrastructure, financing and environmental and social governance.

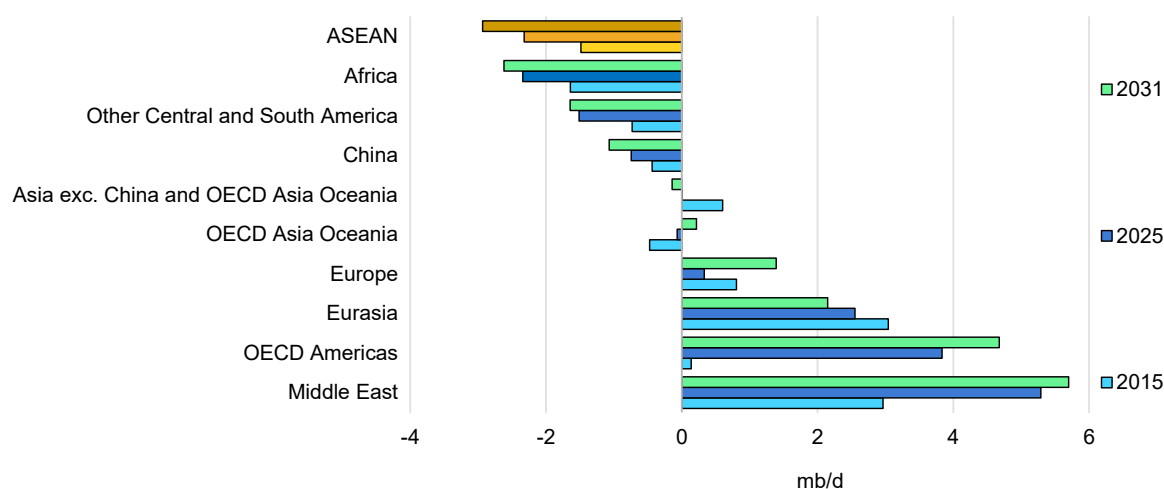
Oil and biofuels security review

The IEA's [World Energy Outlook 2025](#) highlighted the accelerating shift in global oil demand towards Asia. As an increasing share of global oil consumption is concentrated in Southeast Asia, the region is playing an increasingly influential role in shaping global energy markets.

This shift is a direct consequence of sustained economic growth, rapid urbanisation and rising prosperity across the region, and also declining consumption in other regions of the world. Expanding middle classes are driving the surging demand for transport fuels, petrochemicals and electricity generation. This growth story brings with it a series of structural challenges that policy makers need to consider now so that they can develop pathways to strengthen security of supply while continuing to ensure prosperity for their citizens.

In common with many countries in Asia, ASEAN member states are net importers of both crude oil and oil products. Moreover, growing import dependency is contributing to a widening gap between regional product supply and demand.

Net oil product trade, world by region, 2015-2031



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Note: mb/d = million barrels per day.

Consequently, disruptions to global oil and product markets can have significant implications for energy security in the region. Strengthening regional preparedness, including through closer co-operation on emergency planning and co-ordinated government and industry responses, can help enhance resilience to future supply shocks.

Oil demand

ASEAN is a key region for global oil demand growth. During the decade to 2025, consumption rose by an average of 1.7% per year, almost double the global average. This was recorded despite an almost 11% drop in 2020 due to the impacts of the Covid-19 pandemic on international travel, tourism and trade. Strong underlying gains across the product mix saw Southeast Asian nations' share of world oil consumption rise from 6.2% in 2015 to 6.8% in 2025. The overall rise of 1.1 mb/d during the decade accounted for one-eighth of the total global increase. As Chinese demand growth has slowed in recent years, the importance of ASEAN countries has increased, accounting for one-sixth of the global increase between 2022 and 2025.

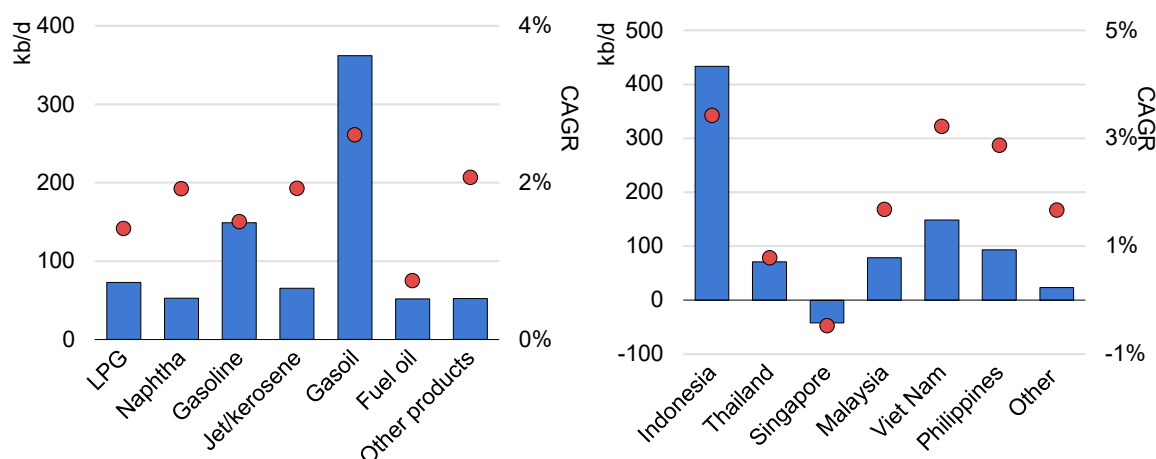
The 2026 Middle East conflict has added headwinds to regional oil demand growth. Demand is now expected to decline by 150 kb/d in 2026, or 2.1%, compared with pre-conflict expectations of growth of around 160 kb/d. Indicators of weaker consumption are already visible, including a 330 kb/d decline in regional demand in the second quarter of 2026 and a 10% drop in net product imports relative to an already weak baseline. Demand is projected to recover by 320 kb/d in 2027, although this would recoup only part of the growth lost in 2026.

The medium-term outlook points to a resumption of the upward trend that prevailed over most of the previous decade. Average demand growth during 2025-2031 is expected to be 1.8%, or 130 kb/d, per year. Premium refined fuels are projected to account for more than 80 kb/d per year of this increase, with the majority of the growth in the form of middle distillates, notably diesel and jet fuel. Although EV penetration is gradually increasing, its effect on transport fuel demand is expected to emerge only progressively, leaving demand for middle distillates supported by continued growth in freight and aviation activity. The remaining 50 kb/d of the average annual increase is overwhelmingly in the form of petrochemical feedstocks, naphtha and LPG (which is also used extensively as a cooking fuel), and fuel oil for bunker demand, centred on Singapore.

Indonesia remains ASEAN's largest economy and oil consumer, with demand approaching 2 mb/d. It is also expected to account for a significant share of demand growth over the medium term, rising by an average of 70 kb/d between 2025 and 2031, equivalent to a compound growth rate of 3.3%. This increase is driven by gasoil and gasoline (up by a combined 50 kb/d per year), with a minor contribution from projected developments in petrochemical capacity. Viet Nam is also expected to make a substantial contribution to regional oil demand growth, with higher GDP translating into a 3.7% annual growth rate. Driven by rising economies like these, ASEAN is expected to become the single largest regional

contributor to oil demand growth in the medium term. The rate of increase has slowed sharply in China, and Southeast Asian nations are also set to exceed India's growth, despite having less than half its population.

Oil demand growth in ASEAN, 2025-2031



IEA. CC BY 4.0.

Notes: kb/d = thousand barrels per day; CAGR = compound annual growth rate.

Crude and product supply

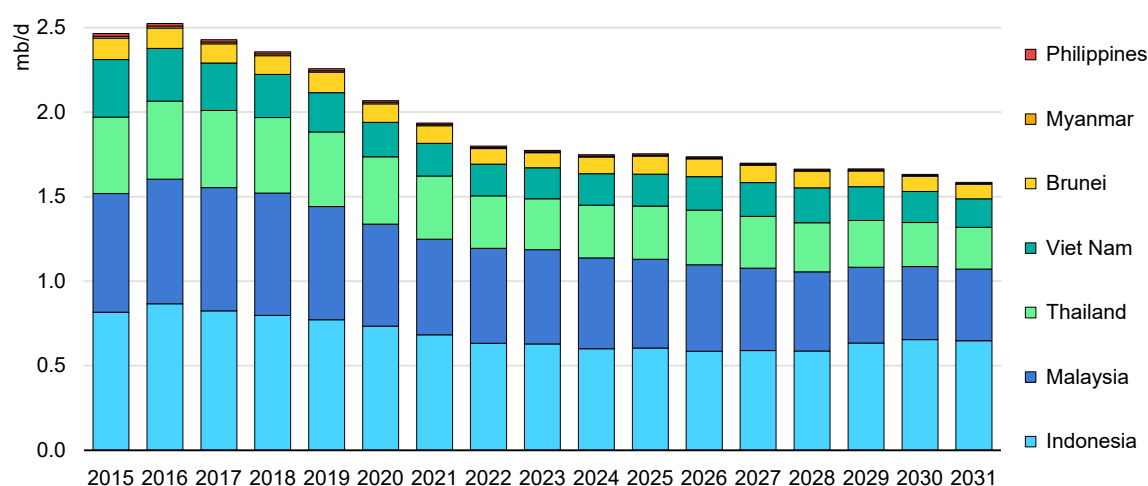
Oil production

ASEAN oil production has been on a downward trajectory for more than two decades, as investment has increasingly been geared towards natural gas in a region with predominantly mature oil basins. Every producer in the region, with the exception of Indonesia, is experiencing managed decline to varying degrees. The region's combined upstream output has dropped from 2.5 mb/d in 2015 to 1.8 mb/d in 2025. Production is forecast to fall by 150 kb/d from 1.8 mb/d to 1.6 mb/d during 2025-2031, with Malaysia accounting for two-thirds of the drop.

After nearly three decades of sustained decline, Indonesia's oil production is expected to return to growth over the forecast period. Having fallen from approximately 820 kb/d in 2015 to 600 kb/d in 2025, output is projected to rise to around 730 kb/d by 2031, making Indonesia a notable exception among ASEAN producers. Almost half of this increase is expected to be driven by condensate volumes from Eni's Ganai Hub development in East Kalimantan, with further gains supported by upstream fiscal reforms, enhanced oil recovery optimisation and continued investment commitments from operators including Petronas and PetroChina.

Viet Nam has seen a number of new upstream developments, including the start-up of the KNT-KTN (White Whale) and the Bach Ho (White Tiger) oilfields by Vietsovpetro in 2025. Looking ahead, Murphy Oil's Lac Da Vang (Golden Camel) project is scheduled to begin operation in 2027. These projects are projected to partly mitigate declines as the country's output falls from 190 kb/d to 170 kb/d through to 2031. Should Murphy Oil sanction the proposed Jai Su Vang (Golden Sea Lion) project, the country's output would remain broadly flat into the 2030s.

Upstream oil production in ASEAN, 2015-2031



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Note: mb/d = million barrels per day.

Refining capacity and throughput

ASEAN refining capacity stands at around 5.5 mb/d, with crude and condensate processing averaging about 4.1 mb/d in 2026. The region remains a net importer of both crude and refined products, while refinery utilisation remains relatively low, reflecting reliability issues at older plants and ongoing modernisation work.

Refining capacity has increased by around 10% since 2015, supported by new crude-to-chemicals refineries and expansion projects in Brunei Darussalam, Malaysia, and Viet Nam. These additions have more than offset closures of older capacity, but the sector continues to face competitive pressure from export-oriented refining centres in the Middle East and China.

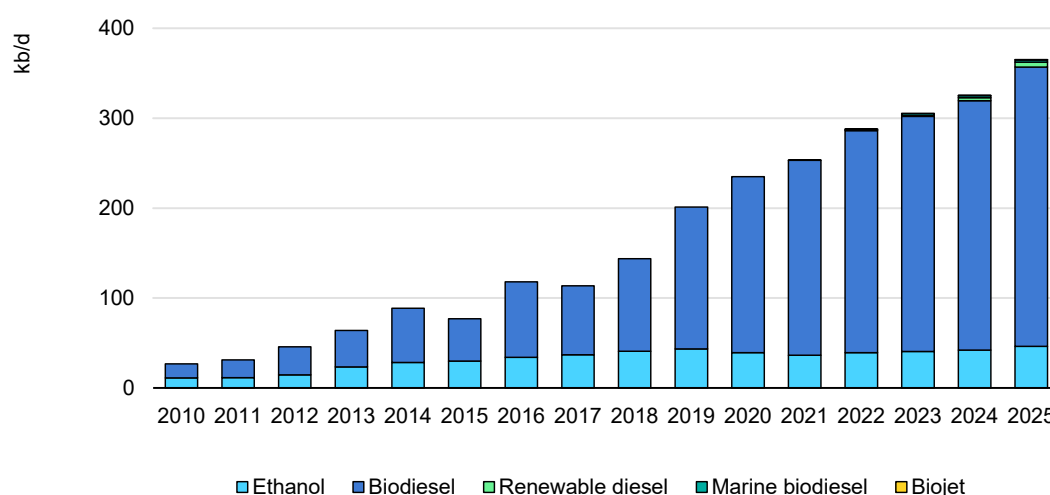
Recent capacity growth has strengthened the region's downstream position, but it has also reinforced the importance of crude supply security. Several major refineries are highly integrated with petrochemicals and designed around specific crude slates, leaving parts of the system exposed to disruption affecting Middle Eastern supply routes.

Further capacity additions to 2031 are expected to be limited. Investment is likely to focus mainly on improving reliability, increasing light product yields, integrating petrochemicals and biofuels, and strengthening logistics, rather than on large-scale expansion of crude distillation capacity.

Liquid biofuels

Liquid biofuel demand in ASEAN has expanded rapidly as member states seek to reduce fossil fuel imports while increasing the share of renewable energy in the transport sector. Since 2010, demand has increased more than twelvefold from just over 25 kb/d to more than 360 kb/d in 2025. Biodiesel accounts for 85% of this growth, ethanol for 10%, and renewable diesel,¹ marine biodiesel and biojet fuel² for the remaining 5%.

Liquid biofuel demand in ASEAN, 2010-2025



IEA. CC BY 4.0

Note: kb/d = thousand barrels per day. Data for Brunei Darussalam, Cambodia, Laos and Timor-Leste were not available.
Source: IEA (forthcoming), Renewables 2026.

Regionally, Indonesia accounts for the bulk of ASEAN liquid biofuel demand growth, contributing around 75% of the increase since 2010. This reflects the rapid strengthening of its biodiesel mandate, which rose from 1% in 2009 to 35% in 2023. Thailand and Malaysia together account for a further 20% of regional growth,

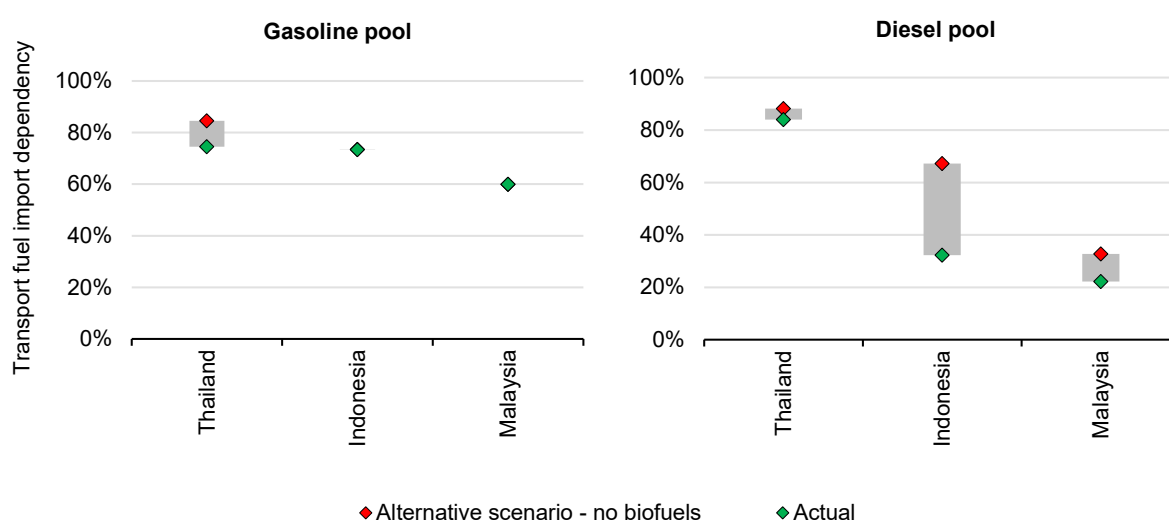
¹ Biodiesel and renewable diesel can reduce greenhouse gas emissions when produced sustainably, but they differ in their production processes and fuel properties. Biodiesel is produced using a process known as transesterification, where feedstocks such as vegetable oils and waste oils react with alcohols in the presence of a catalyst to produce a fuel that is typically blended in limited quantities with conventional diesel. Renewable diesel is produced using a process known as hydrotreatment, where similar feedstocks react with hydrogen at high temperatures to produce a fuel that is chemically similar to petroleum diesel and can be used as a direct replacement.

² Biojet fuel is a sustainable aviation fuel (SAF) produced primarily from biomass feedstocks. SAF can also be produced from low-emissions hydrogen and carbon dioxide (e.g. synthetic fuels). This report only includes SAF produced from biomass (e.g. biojet fuel).

also largely supported by biodiesel blending requirements. Thailand introduced a 5% mandate in 2012 and increased it to 7% by 2024, while Malaysia moved from a 7% mandate in 2019 to 10% by 2025. The remaining growth comes from the Philippines, where ethanol and biodiesel mandates support demand, Singapore, where marine biodiesel production has expanded to serve shipping between Europe and the Asia Pacific region, and Viet Nam with an ethanol blending mandate.

Rising liquid biofuel consumption has helped several ASEAN member states reduce exposure to imported fossil fuels. In 2025, ethanol displaced around 10% of gasoline demand in Thailand, while biodiesel reduced diesel import dependency by around 5% in Thailand, 10% in Malaysia and up to 35% in Indonesia.

Change in fuel import dependency from blending liquid biofuels in selected ASEAN member states, 2025



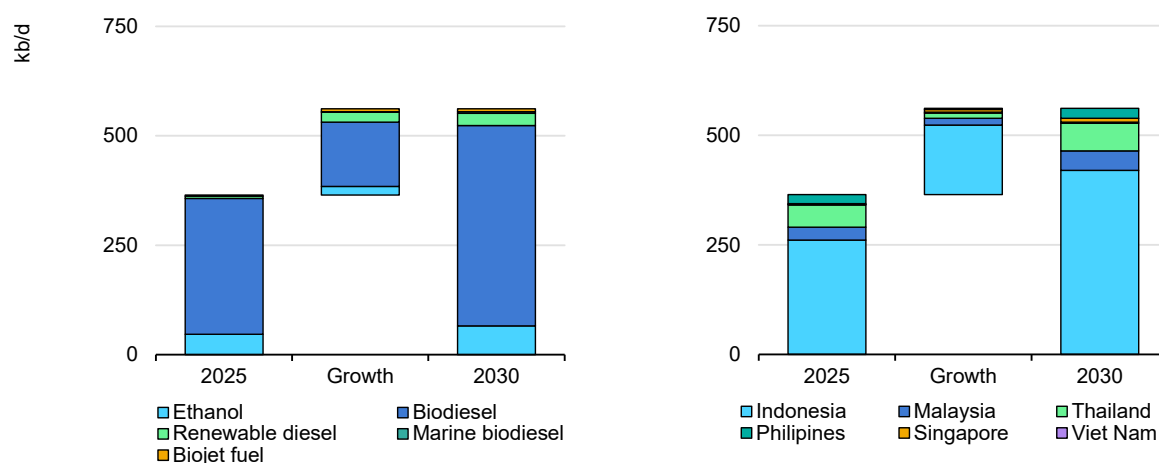
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Notes: Import dependency is calculated as total net imports of oil products (gasoline and diesel), net imports of crude for domestically refined oil products, net imports of biofuels (ethanol, biodiesel and renewable diesel) and net imports of biofuel feedstocks for domestically produced biofuels, divided by the total consumption of oil products and biofuels. The counterfactual scenario assumes that all biofuel consumption in the given year is directly replaced with imported oil products. Source: IEA (forthcoming), Renewables 2026; IEA (2025), [Oil 2025](#).

Liquid biofuel demand in ASEAN countries is projected to increase by 50% by 2030, increasing from more than 360 kb/d in 2025 to over 550 kb/d in 2030. This expansion is supported by stronger transport fuel mandates, rising fuel demand and efforts to reduce fossil fuel import exposure. Biodiesel remains the main source of additional demand, accounting for around 75% of regional growth to 2030, while ethanol and renewable diesel each contribute around 10%. Biojet fuel accounts for most of the remainder, supported by emerging domestic sustainable

aviation fuel (SAF) mandates and future compliance with International Civil Aviation Organization (ICAO) Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA).

Forecast liquid biofuel demand in ASEAN, 2025-2030



IEA. CC BY 4.0

Note: kb/d = thousand barrels per day. Data for Brunei Darussalam, Cambodia, Laos and Timor-Leste were not available.
Source: IEA (forthcoming), Renewables 2026.

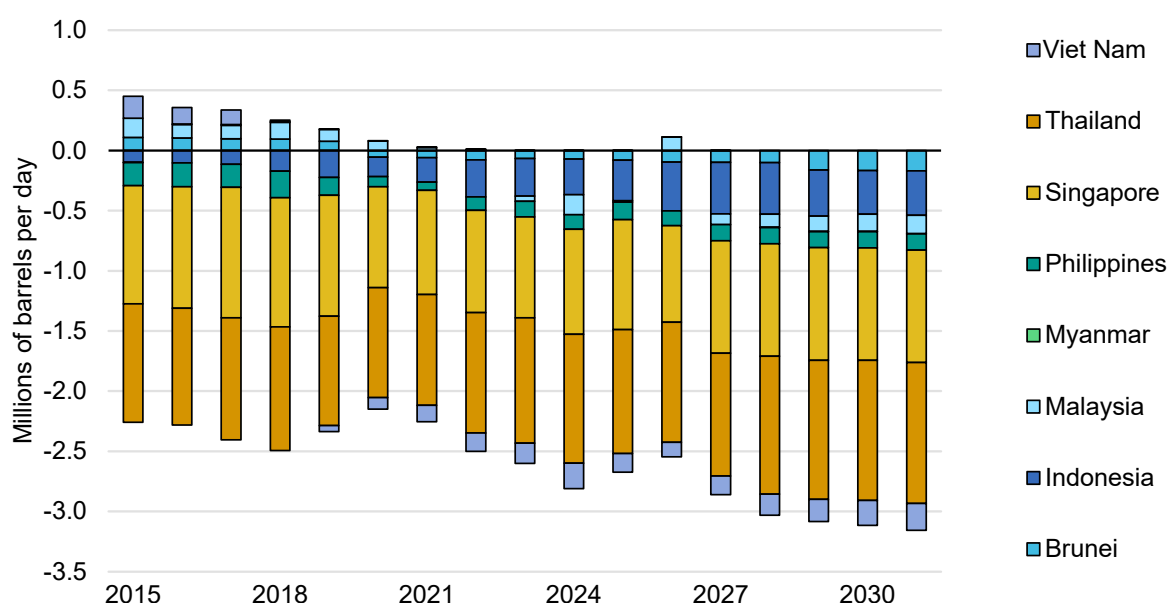
Indonesia again leads regional growth, accounting for more than three-quarters of the increase by 2030. This reflects the continued implementation of its B40 biodiesel mandate amid overall increases in demand for diesel, with further progress towards B50 limited by current production capacity. Growth in Indonesia is also supported by some progress towards domestic blending targets of 10% ethanol and renewable diesel by 2028, as well as a 2.5% SAF target by 2030. Malaysia and Thailand contribute an additional 15% to regional growth, supported by continuing, and higher, blending mandates for biodiesel in both countries alongside the introduction of a 1% SAF mandate in Malaysia beginning in 2027. The remainder of the increase is from the Philippines, supported by rising transport fuel demand and existing mandates; Viet Nam, where consumers can no longer buy unblended gasoline and must purchase E5 or E10 blends amid higher gasoline prices linked to the Middle East conflict; and Singapore, where marine biodiesel expands for Europe-bound shipping under FuelEU Maritime, alongside a domestic 3-5% SAF blending mandate by 2030.

This growth can help further increase the share of renewable energy in the transport sector while reducing reliance on imported fossil fuels; however, sustainability remains the foundation for continued growth. This makes robust sustainability frameworks essential to ensure that rising demand delivers verified emissions reductions and improves energy security without adverse impacts on land, water or biodiversity.

Five-year outlook and implications

Notwithstanding the upstream and downstream projects noted above, ASEAN is expected to remain a net importer of both crude oil and oil products. This underscores the energy security challenge that governments in the region face. Crude imports are expected to dip in 2026, reflecting lower shipments from the Middle East. Over the medium term, import needs are expected to rebound to almost 3 mb/d as declining regional output contrasts with the ongoing increase in crude processing and product demand.

Net crude trade in ASEAN, 2015-2031



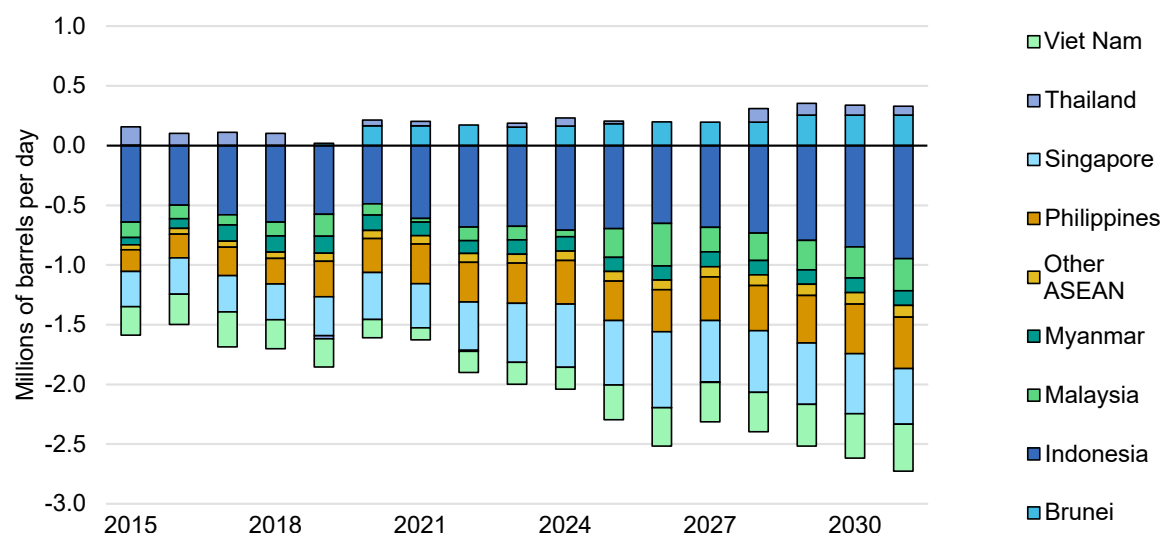
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ASEAN net product imports are set to increase by around 5% between 2025 and 2031, to 2.2 mb/d. The 2026 Middle East conflict temporarily curtailed product imports during the first half of 2026 and reduced product stocks, tightening markets and supporting product cracks and refining margins. The normalisation of product trade should start to accelerate in the second half of 2026 and provide governments with an opportunity to restore and/or build strategic crude and product stocks. However, the positive long-term trend in demand growth will necessitate ever greater imports across all product categories, from LPG to light and middle distillates, as well as fuel oil.

ASEAN countries' net imports of LPG have increased by 50% since the start of the decade and more than doubled over the past ten years to 500 kb/d. The combination of dwindling regional natural gas liquids (NGL) production and strong demand growth will continue to present a particular challenge because refineries

themselves produce only a small amount of LPG as a share of total output. Moreover, exports from the Middle East still constitute nearly 50% of import volumes in 2026, notwithstanding the increase in cargoes from the United States in recent years. Consequently, with limited alternative supply options, careful consideration should be given to how best to improve importing nations' energy security for these niche fuels.

Net oil product balances in ASEAN, 2015-2031



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The global oil market is forecast to see a rebound in Middle Eastern production and exports during 2027. Consequently, oil market balances are expected to flip from undersupplied in Q4 2026 to oversupplied by Q1 2027, with the surplus continuing throughout next year. Consequently, ASEAN national governments have an opportunity to establish or expand government-held stocks of crude and products and absorb part of the surplus.

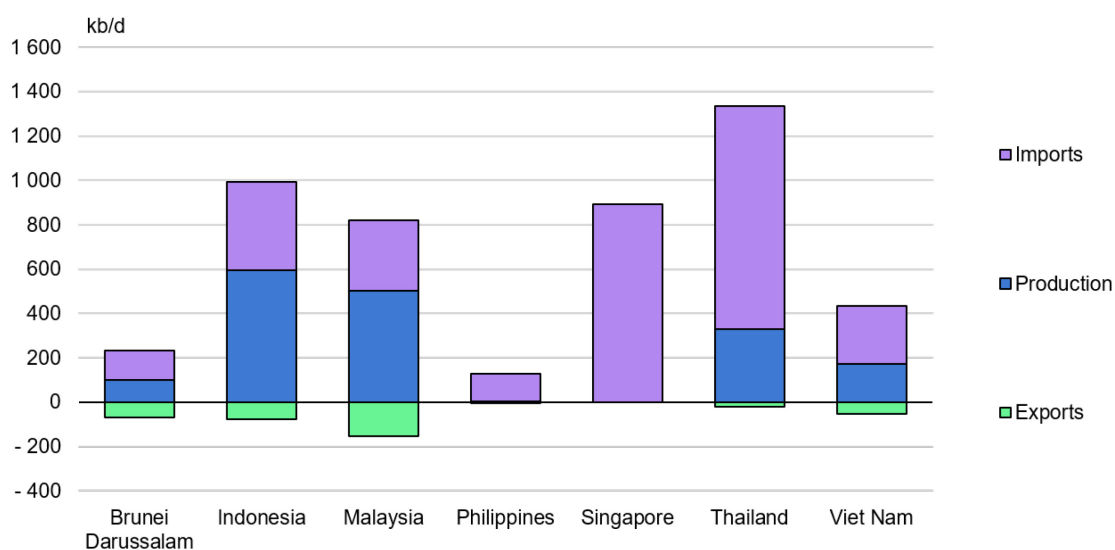
Oil security assessment

Oil security risks in ASEAN are being driven by rising demand, declining regional crude production, growing dependence on imported crude and refined products, and exposure to maritime choke points. The detailed oil market context is covered in the preceding market analysis. This assessment therefore focuses on the main energy security dimensions used across this report: supply-side security, demand-side readiness, exposure to economic and price risk, system resilience and emergency preparedness.

Supply-side security

ASEAN's supply-side security exposure is concentrated in three areas: dependence on imported crude and products, reliance on a limited number of external suppliers, and the risk associated with the use of two of the world's main choke points: the Strait of Hormuz and Strait of Malacca. As mentioned previously, most ASEAN economies face increasing exposure to external supply disruptions.

Crude oil balance for selected ASEAN member states, 2024

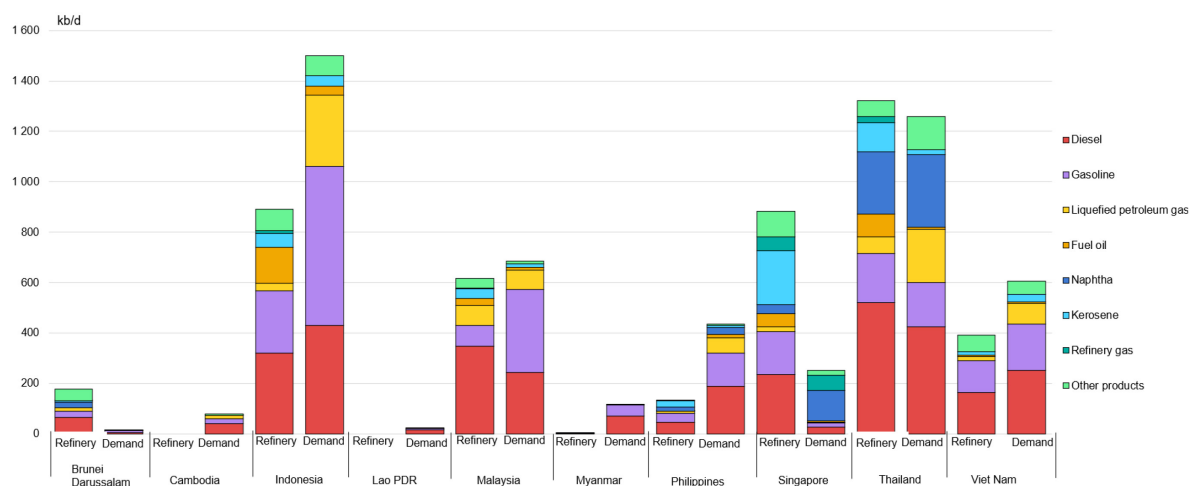


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Note: kb/d = thousand barrels per day.

Regional refining capacity provides an important but incomplete buffer. Approximately 89% of product demand is met by refineries located in Southeast Asia, but many of these refineries depend on imported crude, much of it from the Middle East. While refining capacity reduces exposure to disruptions in international product markets, countries with limited domestic crude production remain exposed to risks affecting crude imports, including disruptions to shipping routes, facilities and systems used to receive and transport imports, and supplies of suitable crude grades. Increasing diversification of crude supply sources and transport routes can help mitigate some of these vulnerabilities.

Refinery output and demand for selected ASEAN member states, 2024



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Note: kb/d = thousand barrels per day.

This exposure is amplified by the concentration of maritime trade through two choke points. The Strait of Hormuz remains the critical exit route for Middle Eastern crude, while the Strait of Malacca is the main corridor for oil flows into East and Southeast Asia. Disruption affecting either route would have immediate implications for regional crude and product supply, especially for ASEAN member states with limited refining capacity or commercial storage.

Recent supply disruptions in the Middle East rapidly translated into price increases, logistical constraints and concerns over the availability of certain refined products across ASEAN economies. These impacts also have implications for factors directly relevant to governments, such as GDP and inflation. The crisis underlined that many national systems are designed for continuity under normal market conditions, but have more limited tools for managing severe international supply disruption. In response, some ASEAN countries are considering additional investment in refining and storage infrastructure, including Cambodia's recently announced plans to develop its first oil refinery. Next to this, ASEAN could consider supporting liquid biofuel developments in the region by setting up a joint liquid biofuels taskforce.

Demand-side readiness

Demand-side readiness is important because oil use in ASEAN countries is concentrated in the transport sector, where short-term alternatives remain limited. In several ASEAN member states, including Indonesia and Malaysia, fuel subsidies and administered pricing mechanisms have historically played an important role in shielding consumers from international oil price fluctuations. More

broadly, fuel subsidies, price stabilisation mechanisms and regulated fuel prices remain common across the region. While these measures can support affordability and social stability, they may also weaken incentives to reduce consumption in response to higher prices, resulting in demand remaining higher than it would under fully market-based pricing.

Recent supply disruptions have demonstrated that governments can reduce demand at the margin through measures such as teleworking, public conservation campaigns, carpooling, reduced travel and fuel purchase restrictions. However, these measures were generally introduced nationally rather than in a regionally co-ordinated manner, which could in some cases enhance their effectiveness. This lack of explicit cross-border co-ordination means that certain measures may fail to fully achieve their intended outcome; for instance, a price freeze introduced in one country can stimulate “tank tourism”, thereby intensifying market tightness in neighbouring states.

For example, Myanmar adopted a targeted approach of an even-odd licence plate system, restricting road traffic on alternating days, which cut transport demand. Fuel rationing and fuel purchase restrictions were introduced in some ASEAN member states, including Myanmar and Viet Nam, reflecting the severity of supply pressures. Lao PDR introduced a temporary three-day school week as part of broader measures to manage the impacts of fuel supply constraints and several ASEAN member states, including Cambodia, the Philippines and Thailand, introduced air conditioning limits, reflecting its significance as a source of electricity demand in tropical climates.

Over the longer term, fuel efficiency, the availability of integrated, modern and affordable public transport, the electrification of two- and three-wheelers, targeted modal shift and sustainable biofuel blending can help reduce exposure to oil import disruption.

Exposure to economic and price risk

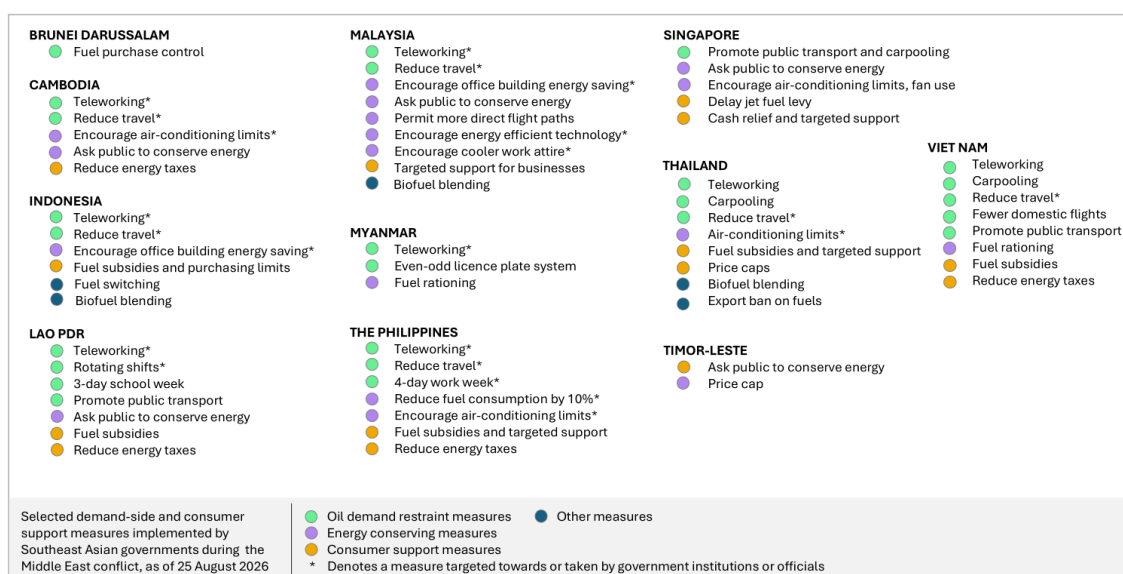
ASEAN's growing oil import dependency increases exposure to international price volatility, import bills and fiscal pressures. Price spikes affect households, businesses and public budgets, especially where transport fuels remain heavily used and fuel subsidies or price controls are deployed to shield consumers. These effects also ripple across the wider economy: higher jet fuel costs push up airfares, natural gas and feedstock price increases can strain fertiliser production and availability, and LPG shortages affect household cooking and heating costs, compounding inflationary pressure across multiple sectors.

During recent oil market disruptions, several ASEAN member states introduced or expanded fuel subsidies, tax reductions, price caps and targeted support for

transport users. These measures can provide short-term relief, but may weaken fiscal space and reduce incentives for demand adjustment if they are broad-based or prolonged.

Unilateral export restrictions can also increase regional price and supply risks. Measures taken to protect domestic consumers may be understandable during a crisis, but they can disrupt supply chains for neighbouring import-dependent economies. This points to the need for clearer regional arrangements that balance national emergency actions with collective resilience.

Selected demand-side and consumer support measures in ASEAN member states



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Oil stockholding as a resilience tool

Oil stocks remain the primary tool for managing physical supply disruption because they can be released rapidly to add liquidity to an increasingly tight market, sustaining economic activity without requiring immediate changes to consumption behaviour. Demand-side measures, while undoubtedly useful in constraining consumption, carry the risk of curbing economic activity itself, with wider negative effects across the economy.

As such, demand-side measures are best reserved for situations of sustained scarcity or prolonged disruption that can no longer be effectively managed through stock releases alone, whereas stock releases offer a supply-side response that buys time and preserves economic continuity in the short term. Stockholding systems vary widely between ASEAN countries, and most rely primarily on commercial or industry-held inventories rather than dedicated emergency buffers.

These commercial inventories are indispensable in ensuring continuity of supply and provide a robust first layer of protection, but in many cases, even if they are ample, they are designed more for normal market operations and a relatively small disruption, struggling to shield the economy from severe and prolonged international supply disruption.

The ASEAN Framework Agreement on Petroleum Security (APSA) provides an important regional foundation for oil emergency co-operation, recognising the value of co-ordinated response and oil stockpiling. However, full operationalisation remains a challenge. Owing to the uneven levels of stockholding capacity across member states, regional co-operation – whereby countries voluntarily provide additional supply to a state facing an oil shortfall (“a member state in distress”) – remains an ambition that is difficult to currently realise.

APSA

APSA is the ASEAN Framework Agreement on Petroleum Security, signed on 16 October 2025 in Kuala Lumpur, which renews and replaces the 2009 ASEAN Petroleum Security Agreement, and exists to enhance member states' collective petroleum security amid ASEAN's growing status as a net oil (and soon natural gas) importer. The APSA is ASEAN's key voluntary regional mechanism for strengthening preparedness and coordinated responses to petroleum supply disruptions. It establishes short-term co-ordinated emergency response measures (CERM), including a commitment for member states to supply petroleum equal to 10% of a distressed state's normal domestic requirement during a "critical shortage" (at least a 10% shortfall lasting 30+ days), all on a voluntary and commercial basis, alongside medium- and long-term measures like resource exploration, supply diversification, energy efficiency, market liberalisation and oil stockpiling. Governance is assigned to the ASEAN Ministers on Energy (AMEM) as the main policy body, supported by the Senior Officials Meeting on Energy (SOME), the ASEAN Centre for Energy as secretariat, and ASCOPE for technical advice, with the agreement entering into force 90 days after the tenth ratification and remaining valid for ten years

The development of dedicated strategic petroleum reserves remains at different stages across the region. Viet Nam has the clearest long-term objective, while Indonesia, the Philippines, Cambodia, Malaysia, Thailand, Myanmar, Lao PDR and Timor-Leste are considering, studying or gradually developing additional storage and reserve arrangements. For many ASEAN member states, the main challenge is to design systems that are affordable, enforceable and suited to national market structures.

Stockholding models

International experience points to several possible models, including government-held stocks, industry obligations, central stockholding agencies and hybrid arrangements. Government stocks are those owned directly by the state, typically financed through the central government budget and held exclusively for emergency purposes. Agency stocks are stocks held by a separate agency, either on behalf of the government or domestic industry. The agency structure and arrangements vary from country to country and can range from government-sponsored schemes to industry-created initiatives, but in all cases compulsory stocks cannot be released without government approval. Government and agency stocks are commonly referred to as “public stocks”. Obligated industry stocks are stocks held by industry in order to meet minimum stockholding requirements set by government. Typically, these are requirements placed on certain companies (e.g. importers, refiners, wholesalers) to hold a minimum level of stocks based on their share of imports or sales in the domestic market.

The appropriate model for ASEAN economies will depend on import dependency, domestic production, refining capacity, storage infrastructure, fiscal resources and market structure, but will also vary according to each country’s appetite for building these stocks. Regional or shared storage arrangements may also be relevant in the ASEAN region and may also better suit smaller economies.

The table below illustrates selected international stockholding models that could inform ASEAN policy design, while recognising that the most appropriate model should be shaped by national circumstances and regional co-operation priorities.

Table of selected IEA countries’ stockholding models

IEA country	Public stocks	Industry obligation	Note on emergency oil stockholding regime
Germany	✓		Industry-based stockholding agency (EBV) required to hold 90 days of net imports; all oil producers and importers are obliged to be members of EBV and pay fees according to their market share.
Ireland	✓		Government agency, NORA, responsible for ensuring Ireland’s 90-day requirement.
Japan	✓	✓	Refineries, specified distributors and importers are obliged to hold 70 days of their average daily imports, sales or production in the previous 12 months. Additionally, industry holds mandatory LPG stocks of 40 days of consumption. Government agency, JOGMEC, holds government stocks.
Korea	✓	✓	Refineries and oil product importers are obliged to hold 40 days of previous year’s sales. Additionally, industry holds mandatory 30 days of LPG stocks and 15 days of naphtha stocks. Government agency, KNOC, holds government stocks.

IEA country	Public stocks	Industry obligation	Note on emergency oil stockholding regime
Netherlands	✓	✓	Oil refiners and traders have an obligation to hold 12% of their sales above 100 kt in previous year. Industry covers about 20% of the national 90-day stockholding requirement (based on inland consumption in previous year), while government stockholding agency (COVA) is required to hold the remaining 80%.
Spain	✓	✓	Industry has an obligation to hold 50 days of previous year's imports and additional mandatory industry LPG stocks of 20 days of previous year's sales. Stockholding agency, CORES, holds remainder to reach 92 days.
Türkiye		✓	Refineries are obliged to hold at least 20 days of oil stocks, and each fuel and LPG distribution licensee is obliged to hold at least 20 days of product stocks, based on average daily sales of the previous year. The refineries must hold the difference to reach the total of 90 days on behalf of the government.
United Kingdom		✓	Refiners are obligated to hold 67.5 days of supply, while importing companies must hold stocks equivalent to 58 days.
United States	✓		The US government Strategic Petroleum Reserve (SPR) has design storage capacity of 713.5 mb over four underground storage sites in Texas and Louisiana with a total of 60 operational caverns.

The establishment of strategic stocks need not constitute a major additional fiscal burden for governments, provided that appropriate institutional and cost-recovery mechanisms are put in place. For ASEAN member states the key question is therefore not only whether to hold strategic stocks, which is a strategic choice to be taken by each nation, but also how to design financing and governance arrangements that make stockholding both affordable and sustainable over the long term.

A key initial consideration in establishing emergency oil stocks is to determine who will hold the stocks and, therefore, who will carry the legal, financial and operational responsibility for them. If stocks are to be held by a central stockholding entity, its legal status should be clearly defined, preferably as an independent, purpose-made legal entity able to purchase stocks, contract storage services, hold assets on its balance sheet and act as the contractual counterpart to industry. Financing arrangements will depend on the chosen stockholding model: costs may be recovered through a small levy or stockholding fee incorporated into retail prices, financed directly through government loans or bonds, or treated as debt whose interest and related carrying costs are recovered over time through fees, including at the pump. Where costs are recovered through levies or stockholding fees, the financial burden is shifted from the general government budget to fuel consumers and market participants, rather than

taxpayers more broadly, creating a direct link between the funding of the system and petroleum consumption. Equally important is the establishment of a transparent and rules-based release mechanism that defines when, how and by whom stocks may be released. This mechanism should ensure that emergency stocks are used for the benefit of the whole population, are insulated from short-term political decisions and are released only in response to genuine physical supply disruptions.

Overview of how emergency oil stocks are financed in IEA member countries

IEA country	Obligated industry stocks financed by companies	Public (government/agency) stocks: financing methods					
		Initial set-up costs			Running costs		
		Government budget	Government-backed loan	Bank loans/bonds	Government budget	Levy on industry	Tax
Australia	✓						
Austria	✓		✓			✓	
Belgium				✓		✓	
Canada							
Czechia		✓			✓		
Denmark	✓			✓			
Estonia		✓				✓	
Finland	✓	✓					✓
France	✓			✓		✓	
Germany			✓			✓	
Greece	✓						
Hungary			✓			✓	
Ireland				✓		✓	
Italy	✓		✓			✓	
Japan	✓	✓			✓		
Korea	✓	✓			✓		
Latvia		✓					✓
Lithuania	✓	✓			✓		
Luxembourg	✓						

IEA country	Obligated industry stocks financed by companies	Public (government/agency) stocks: financing methods					
	Initial set-up costs	Initial set-up costs			Running costs		
		Government budget	Government-backed loan	Bank loans/bonds	Government budget	Levy on industry	Tax
Mexico	✓						
Netherlands	✓		✓				✓
Norway	✓						
New Zealand	✓				✓		
Poland	✓	✓			✓	✓	
Portugal	✓			✓		✓	
Slovakia		✓			✓		
Spain	✓			✓		✓	
Sweden	✓						
Switzerland	✓						
Türkiye	✓						
United Kingdom	✓						
United States			✓		✓		

Regional co-operation

Interest in strategic petroleum reserves is likely to increase as ASEAN's import dependency grows, oil supply routes remain exposed to geopolitical disruption, and petroleum products continue to play an important role in transport, aviation, shipping and petrochemicals.

ASEAN has established a valuable framework for regional co-operation through APSA. Building on APSA's provisions for consultation, information exchange and co-operation during petroleum supply disruptions, further progress could focus on strengthening information-sharing arrangements, especially data transparency, enhancing preparedness activities including through workshops and exercises, and improving understanding of how ASEAN member states could voluntarily co-ordinate their responses and provide each other with assistance during severe supply disruptions.

The main challenges faced by countries in the region are financing, governance and infrastructure development, but also the establishment of practical

arrangements for regional co-operation during emergencies. Strategic reserves require upfront investment, clear rules on ownership and release, sufficient storage and logistics capacity, and an understanding of how voluntary regional co-operation and mutual assistance could operate during a disruption, considering national circumstances, commercial arrangements and individual energy security priorities.

ASEAN member states have made some progress through the imposition of mandatory industry obligations and the development of some emergency response mechanisms. Building on these efforts, continued investment in storage infrastructure, strengthened governance frameworks and deeper regional co-operation can further support the development of robust and resilient oil security arrangements. While approaches will differ between ASEAN member states, effective emergency response and stockholding mechanisms will be central to ASEAN's oil security strategy.

Overview of oil stockholding in ASEAN member states

	Strategic petroleum reserve	Private mandatory stocks	Target
Brunei Darussalam	No	Minimum of 50% of each producer's/importer's existing storage capacity	N/A
Cambodia	No Currently conducting feasibility study on SPR	30 days based on total selling volume	Considering expanding private mandatory stocks and building an SPR for crude
Indonesia	Yes, but not implemented yet Fuel storage capacity: maximum 25 days	20-23 days	Aim to expand reserves up to three months. SPR: By 2035, 9.64 mb of gasoline and 10.17 mb of crude
Lao PDR	No	N/A	N/A
Malaysia	No Currently conducting feasibility study on SPR	N/A	Considering building a SPR
Myanmar	Yes Storage capacity for 60 days of emergency stock	No	30 days by 2020 45 days by 2045 90 days by 2050
Philippines	Currently planning to build a SPR	Inventory policy requires refiners to hold 30 days' worth of crude and products, importers/bulk suppliers to hold 15 days' worth of products, and LPG importers to hold 7 days' worth of LPG	Proposed law (not yet enacted) to build an SPR covering at least 90 days of national consumption on 26 March 2026 Increasing minimum inventory requirements for petroleum products from 15 to 30 days and for LPG from 7 to 21 days.

	Strategic petroleum reserve	Private mandatory stocks	Target
Singapore	No	Power generation companies are required to maintain diesel reserves as a backup to natural gas	No
Thailand	No Completed feasibility study on SPR	25 days	N/A
Timor-Leste	No	15 days	Plans to build SPR for fuel
Viet Nam	Yes	20 days for key traders/ producing wholesalers with distribution systems and 5 days for distributors	Commercial reserve infrastructure: meeting 30-35 days of net imports after 2030 National reserve infrastructure: 15-20 days of net imports in the period 2021-2030; 25-30 days of net imports in the period after 2030

Notes: mb = million barrels; N/A = not applicable; SPR = strategic petroleum reserve.

Source: IEA analysis based on government sources, ACE, and ERIA.

A path forward

The Middle East crisis of 2026 has highlighted both the challenges associated with the ASEAN region's growing import dependency and reliance on vulnerable maritime choke points, and the opportunities to further strengthen regional co-operation and preparedness. It has underscored the value of shared frameworks, strengthened national preparedness and co-ordinated regional response arrangements, as appropriate.

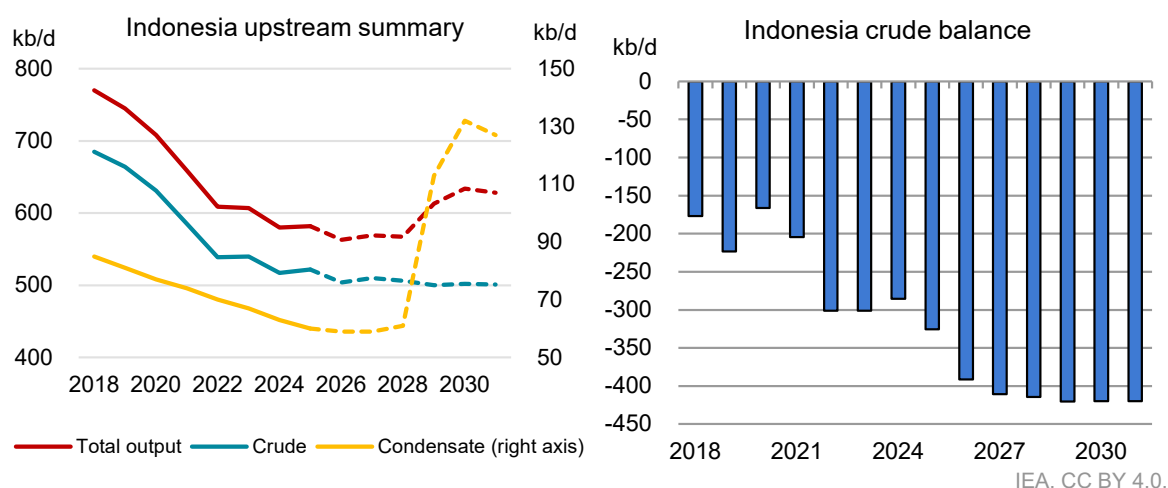
ASEAN already has an important foundation for co-operation through mechanisms such as APSA, which can continue to evolve in line with the region's changing energy security needs. Looking ahead, the post-crisis period presents an opportunity to strengthen the implementation of existing ASEAN energy security mechanisms, including APSA, and to further enhance co-ordination, information sharing and preparedness arrangements. Continued efforts to clarify practical procedures for co-operation and mutual support during severe disruption could help improve the effectiveness of the regional response.

Once the immediate impacts of the crisis recede, there may also be value in reviewing the effectiveness of different policy responses, including measures affecting regional energy trade, from both national and regional perspectives. Sustained political commitment and co-operation among ASEAN member states will strengthen the region's collective resilience as energy markets are increasingly interconnected and vulnerable to supply and price disruption.

In-depth analysis: Indonesia

Indonesia transitioned to being a net importer of crude in 2013. Since then, declining upstream production has increased the country's import requirements. This has been partially mitigated by lower domestic crude processing, resulting in current net crude imports of around 300 kb/d in recent years.

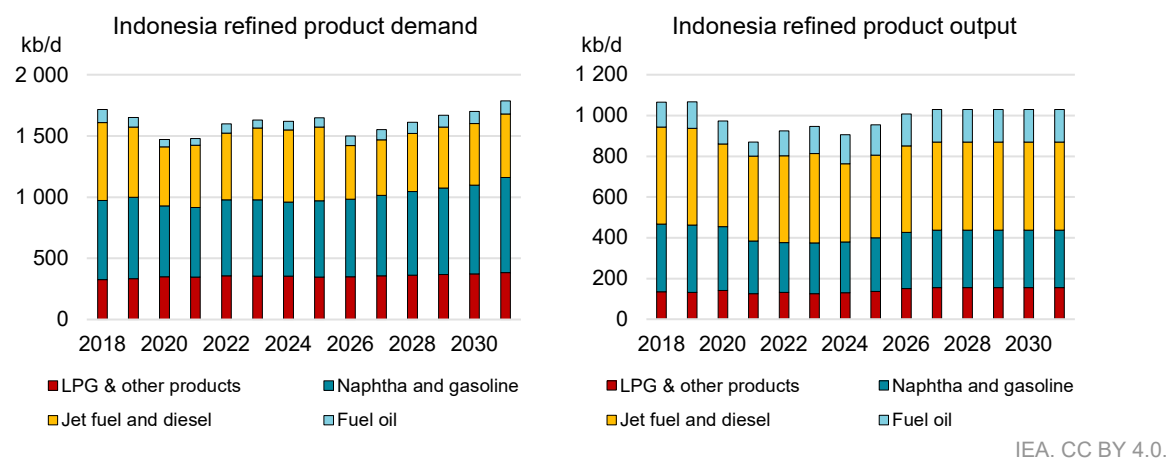
Upstream production and crude balance in Indonesia, 2018-2031



Note: kb/d = thousand barrels per day.

However, the 100 kb/d refinery expansion and upgrade project at the Balikpapan refinery, completed in late 2025, has improved reliability elsewhere in the Pertamina refining system and is expected to sustain crude import requirements at around 400 kb/d for the next two years. Towards the end of the decade, the recovery in upstream output that is expected to follow on from the recent upstream fiscal reforms could narrow Indonesia's net import requirement if the increased condensate production is processed domestically.

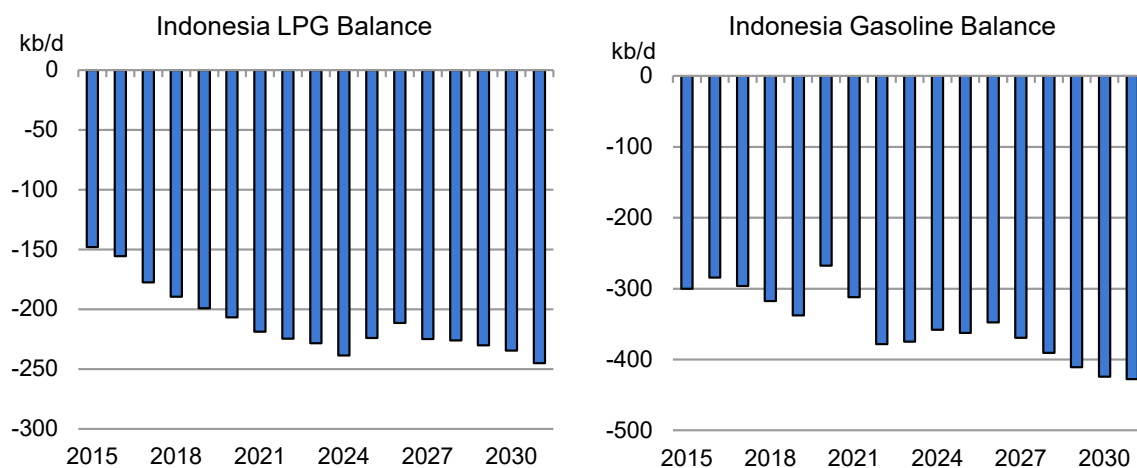
Refined product demand and output in Indonesia, 2018-2031



Notes: kb/d = thousand barrels per day; LPG = liquefied petroleum gas.

Despite the expected increase in refined product output, domestic product supply fails to keep pace with forecast demand growth over the balance of the decade, and thus Indonesia remains a net importer of key products.

Balance of trade in gasoline and LPG by volume in Indonesia, 2018-2031



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Notes: kb/d = thousand barrels per day; LPG = liquefied petroleum gas.

Natural gas and low-emissions gases security review

Natural gas remains a key component of the ASEAN region's energy system, but the region's gas sector is undergoing a period of significant transition. Declining domestic production, rising LNG import requirements and growing exposure to global gas market risks are increasing the importance of gas security. At the same time, the region retains important advantages, including a sizeable domestic resource base, established gas and LNG infrastructure, and opportunities for closer regional market integration. While low-emissions gases are expected to play only a limited role in the ASEAN gas supply–demand balance through to 2030, timely action over the next five years could establish the conditions for sustained growth beyond 2030, particularly for biomethane. This chapter reviews recent and projected gas market developments, assesses the region's gas security across multiple dimensions and examines the outlook for low-emissions gases.

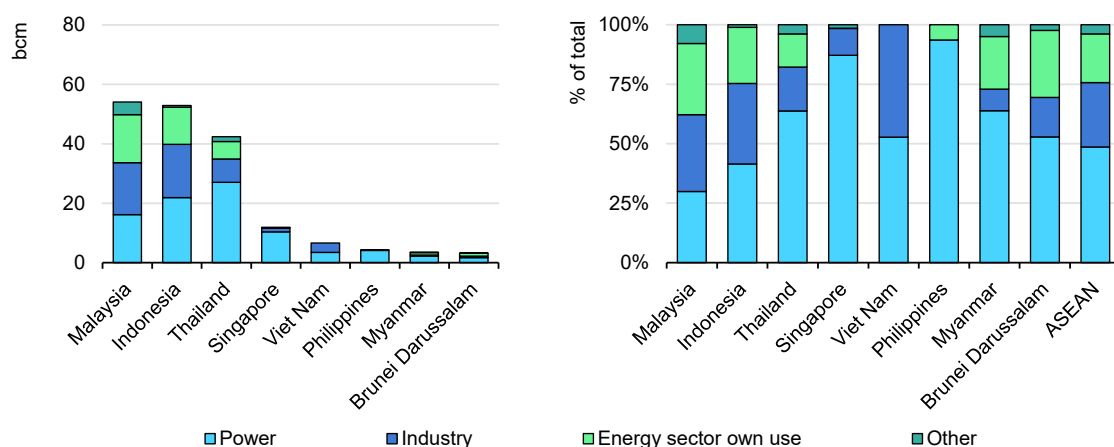
Taken as a whole, ASEAN countries represent a large and growing gas market. At the same time, they are characterised by considerable diversity, with significant differences in the size, maturity and role of natural gas. The region is also a major producer of natural gas, although output from many mature producing areas has entered structural decline. New upstream projects are expected to support production recovery in some ASEAN member states from 2028 onwards, although regional output is projected to stay below 2025 levels by 2030. While the region remains a net exporter of natural gas, rapidly growing LNG imports are steadily eroding its export surplus, and it is expected to become a net gas importer by the end of the decade.

Gas demand

Total gas consumption in ASEAN was close to 180 bcm in 2025 – about twice the size of Japan's gas market, more than half that of the European Union, and roughly equivalent to the total gas demand of the African continent. Around 85% of regional gas consumption is concentrated in three mature markets, with Malaysia and Indonesia each accounting for around 30% of the total and Thailand making up nearly 25%. The remaining ASEAN member states – including Brunei Darussalam, Myanmar, Singapore, the Philippines and Viet Nam – have comparatively small gas markets, while Cambodia, the Lao PDR and Timor-Leste have no natural gas in their domestic energy mix.

The sectoral breakdown of gas demand is similarly diverse across the region. Overall, the power sector is the largest consumer of natural gas, accounting for nearly half of total demand, followed by industry (around 30%) and the energy sector (around 20%). However, this regional picture masks significant differences across ASEAN member states. In the two largest gas markets, Indonesia and Malaysia, as well as in Viet Nam, industry accounts for a considerable share of gas demand, approaching or exceeding that of the power sector. By contrast, power generation dominates gas demand in other gas-consuming ASEAN member states, accounting for more than 70% on average. Gas use in the residential, commercial and transport sectors is negligible across the region, owing to the lack of heating demand and limited or non-existent gas distribution networks; together these sectors accounted for less than 1% of total gas consumption in 2025.

Gas consumption by sector in ASEAN, 2025



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Note: bcm = billion cubic metres.

Between 2015 and 2025, the ASEAN region experienced rapid urbanisation and population growth, sustained economic growth (averaging around 4% per year), rising demand for cooling and growing electricity use in industry, which together contributed to an increase of around 70% in electricity consumption. Despite rapidly rising primary energy demand and electricity consumption, total gas consumption across the region increased relatively modestly, by around 6%, corresponding to an average annual growth rate of around 0.6%.

Gas use in the power sector remained flat in absolute terms, as most of the increase in electricity demand was met by other sources, particularly coal and hydropower, and to a lesser extent solar PV and other renewables. As a result, virtually all growth in regional gas consumption between 2015 and 2025 was in the industrial and energy sectors, where gas use increased by around 21% and 16%, respectively. Industrial demand was supported by the expansion of energy-

intensive industries, such as chemicals and aluminium production, as well as broader growth in manufacturing across the region. By contrast, gas use in the transport sector declined by around 70%, largely reflecting reduced consumption in Thailand.

Gas supply

Natural gas production

The ASEAN region is a significant producer of natural gas, with output of around 210 bcm in 2025, more than 30 bcm higher than the region's gas consumption. Malaysia (80 bcm), Indonesia (70 bcm) and Thailand (30 bcm) are the region's three largest producers, together accounting for around 85% of total output. Brunei Darussalam, Myanmar, the Philippines and Viet Nam also produce meaningful volumes, although at a considerably smaller scale.

Between 2015 and 2025, regional gas production declined by around 10 bcm/yr (4%). Output fell in most of the region's mature gas-producing ASEAN member states, including Brunei Darussalam, Indonesia, Myanmar, the Philippines, Thailand and Viet Nam, as production from ageing fields declined. These losses were only partly offset by production growth in Malaysia, supported by new field developments and capacity expansions.

Low-emissions gases

ASEAN member states, including their energy infrastructure, are highly exposed to the impacts of climate change and extreme weather events. Eight of the eleven ASEAN member states, representing more than 95% of the region's gas consumption, have formally adopted net zero emissions targets. Six of these (Brunei Darussalam, Cambodia, the Lao PDR, Malaysia, Singapore and Viet Nam) aim to achieve net zero by 2050, while Indonesia and Thailand have set targets for 2060 and 2065, respectively.

Low-emissions gases, particularly biomethane, are well positioned to enhance the region's gas supply security while supporting progress towards decarbonisation objectives. However, deployment has so far been limited, and significant policy, regulatory, economic and infrastructure barriers remain to scaling up production materially over the medium term. As a result, low-emissions gases are expected to remain a niche component of the ASEAN gas supply mix through to 2030.

Biomethane

The ASEAN region has considerable potential for biogas and biomethane production, but total output in 2024 amounted to just over 2 bcm of gas-equivalent,

of which only around 0.03 bcm was biomethane. Unlike biogas, biomethane is fully interchangeable with natural gas and can be transported and distributed through existing gas infrastructure.

Current production is dominated by Thailand, which accounts for about 60% of the region's combined biogas and biomethane output, supported by a feed-in tariff introduced in 2022. However, significant untapped potential remains across the region. The ASEAN region as a whole has sustainable feedstock resources equivalent to around 65 bcm of natural gas, about 35% of the region's current gas consumption. Most of this potential is concentrated in Indonesia, followed by Thailand and Viet Nam, with additional resources in Myanmar, the Philippines, Malaysia, Cambodia and Lao PDR.

Cost estimates indicate that biomethane can be produced at a relatively modest premium to imported LNG prices across the region. However, only around one-fifth of the region's technical potential is located within 20 km of existing gas transmission pipelines, posing a significant barrier to wider deployment.

Localised production and use (for example, at captive industrial sites), together with targeted policy support, could help unlock a larger share of the region's considerable resource base over the longer term, strengthening gas supply security, expanding energy access and supporting decarbonisation at the same time.

The ASEAN region is now beginning the transition from traditional biogas towards biomethane production, supported by recent policies such as Thailand's updated Alternative Energy Development Plan 2024 and Malaysia's National Biomass Action Plan 2023-2030. Key policy drivers include the decarbonisation of domestic industry, particularly to help manufacturers meet international requirements such as the European Union's Carbon Border Adjustment Mechanism, as well as reducing methane emissions from the palm oil sector through the treatment of palm oil effluent.

At the same time, a new wave of bio-LNG projects is emerging. The largest announced project in the world, the Straits Bio-LNG plant in Malaysia, is expected to produce around 0.36 bcm per year, while dozens of other bio-LNG projects have been announced across Indonesia, Malaysia and Thailand. These investments are driven by growing demand for low-emissions fuels in maritime shipping, opportunities to export biomethane to Singapore to help decarbonise its gas-dependent power sector, and the potential to displace natural gas imports in domestic markets, particularly during periods of high LNG prices such as those experienced during the Middle East crisis in 2026.

However, despite these initiatives, the scope for scaling up biomethane production is limited over the medium term. Even under a supportive policy environment, biomethane production across the ASEAN region is unlikely to exceed 1 bcm by 2030.

Low-emissions hydrogen

Current low-emissions hydrogen production in the ASEAN region is negligible. Between 2022 and 2025, five ASEAN member states (Indonesia, Lao PDR, Malaysia, Singapore and Viet Nam) adopted national hydrogen strategies or roadmaps, signalling policy interest in the technology. At the regional level, the ASEAN Plan of Action for Energy Cooperation (APAEC) 2026-2030 also supports greater co-operation on emerging technologies such as hydrogen, alongside broader engagement with Dialogue Partners and international organisations. However, deployment remains at an early stage across both supply and demand.

On the supply side, according to the IEA's Hydrogen Production and Infrastructure Projects Database, around 40 low-emissions hydrogen or derivative fuel projects have been announced across the ASEAN region, representing around 5.5 Mt of annual production capacity (equivalent to around 18 bcm of natural gas on an energy-equivalent basis). About 75% of this pipeline is concentrated in Indonesia and Malaysia alone, with additional projects announced in Thailand, the Philippines and Viet Nam. However, only less than 1 Mt of annual production capacity (equivalent to around 3 bcm of natural gas) is associated with projects scheduled to start up by 2030, and the vast majority of these remain at an early stage of development. As of mid-2026, only three projects were under construction, representing around 50 kt of annual production capacity (equivalent to 0.2 bcm of natural gas). In addition, the Philippines and Indonesia have undertaken preliminary exploration for natural hydrogen, although no commercially viable discoveries have been reported to date.

On the demand side, only a handful of small-scale deployment projects have been announced in recent years. These include a planned 55-65 MW ammonia-fired power plant with associated terminal and bunkering infrastructure in Singapore (announced in 2025 and currently undergoing front-end engineering and design), and a 2 MW ammonia-fired gas turbine demonstration at a petrochemical site in Malaysia (scheduled for completion in 2027).

Despite sustained policy interest and a sizeable project pipeline, low-emissions hydrogen is unlikely to achieve meaningful commercial-scale deployment across the ASEAN region before 2030. High production costs relative to conventional fuels and other low-emissions alternatives, combined with high capital costs, limited hydrogen infrastructure, and the absence of certification schemes, binding

targets and demand-side incentives, as well as the high price sensitivity of the region's major gas-consuming sectors, are expected to constrain both supply and demand growth over the medium term.

Gas trade

The ASEAN region as a whole is a net exporter of natural gas, with outflows exceeding inflows by around 30 bcm in 2025. More than 85% of this net export balance was in the form of LNG, while the remainder consisted of pipeline gas exports from Myanmar to China.

The region's three LNG-exporting ASEAN member states – Brunei Darussalam, Indonesia and Malaysia – were among the world's earliest LNG exporters, having shipped their first cargoes in 1972, 1977 and 1983, respectively. Together, they exported around 66 bcm of LNG in 2025, with Malaysia accounting for the largest share (37 bcm), followed by Indonesia (22 bcm) and Brunei Darussalam (6 bcm).

Seven ASEAN member states operate LNG import terminals, which together received about 39 bcm of LNG in 2025. Around two-thirds of these imports (27 bcm) originated from outside the ASEAN region, while just over 30% (12 bcm) were supplied from within the region. More than 8 bcm of these intra-regional flows were domestic deliveries within Indonesia and, to a much lesser extent, Malaysia.

Singapore, Indonesia and Malaysia also have LNG reloading infrastructure, which together reloaded around 1.6 bcm of LNG in 2025, contributing to supply flexibility, not only within the ASEAN region but also across the wider Asia Pacific region.

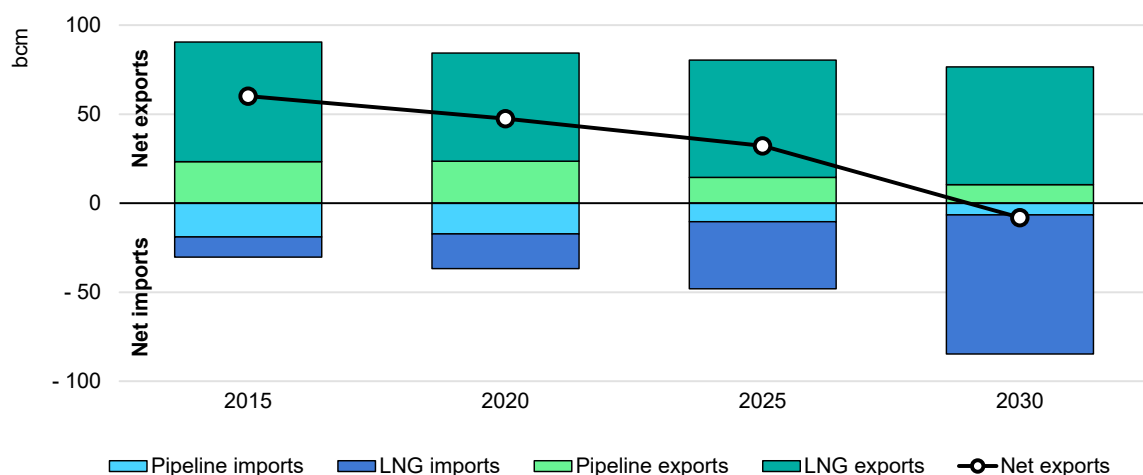
Extra-regional pipeline gas trade is limited to exports from Myanmar to China under a 30-year long-term gas supply contract, which started in 2013. These pipeline exports have averaged around 4 bcm per year in recent years and are expected to remain broadly stable through to 2030. Within the ASEAN region, cross-border pipeline gas trade is concentrated in Singapore, which is connected by pipeline to both Indonesia and Malaysia. In 2025, Singapore imported more than 4 bcm from Indonesia and more than 2 bcm from Malaysia. Imports from Malaysia are expected to continue beyond 2030, whereas the current supply contract with Indonesia expires at the end of 2028. Although the renewal of the Indonesian supply contract remains uncertain, similar concerns were raised before its previous expiry, and the agreement was ultimately extended for a further five years in 2023.

In addition to these commercial cross-border flows, a handful of pipelines transport gas from jointly developed offshore resources. These include the Yadana pipeline, which delivers gas from Myanmar's offshore Yadana field to the grids of both Myanmar and Thailand, and the Malaysia–Thailand Joint Development Area, which supplies gas to both countries. Until production ceased in 2025 due to

resource depletion, all gas produced from Timor-Leste's offshore Bayu-Undan field was also transported by pipeline to Australia's Darwin LNG terminal for liquefaction and export.

Between 2015 and 2025, the region's net gas export balance declined by almost half (around 30 bcm). This reflected a modest decrease in LNG exports alongside a more than threefold increase in LNG imports, while cross-border pipeline trade remained broadly stable over the period. The region's net natural gas surplus is projected to shrink further between 2025 and 2030, and ASEAN is expected to become a net gas importer towards the end of the decade. Import requirements are projected to widen in the period to 2030 and beyond, despite a recovery in indigenous gas production in some ASEAN member states, notably Indonesia and Viet Nam, towards the end of the decade.

Pipeline gas and LNG trade balance in ASEAN, 2015-2030



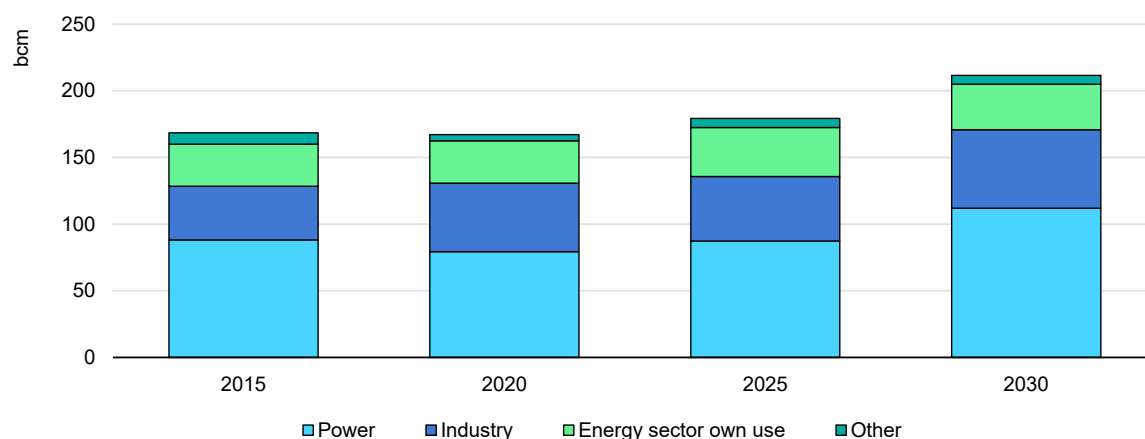
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Notes: bcm = billion cubic metres; LNG = liquefied natural gas.

Five-year outlook

Between 2025 and 2030, gas consumption in the ASEAN region is expected to increase by around 18% (more than 30 bcm/yr), corresponding to an average annual growth rate of more than 3%, significantly higher than the average recorded between 2015 and 2025. This growth is expected to be driven primarily by the power sector, with around 24 GW of gas-fired generation capacity being added across the region, resulting in a nearly 30% (25 bcm/yr) increase in gas consumption for power generation over the five years to 2030. Industrial gas consumption is expected to grow more modestly, by around 20% (10 bcm/yr), while gas use in the energy sector is projected to decline by around 7% (2.5 bcm/yr) as regional natural gas production and LNG exports continue to fall.

Gas demand by sector in ASEAN, 2015-2030

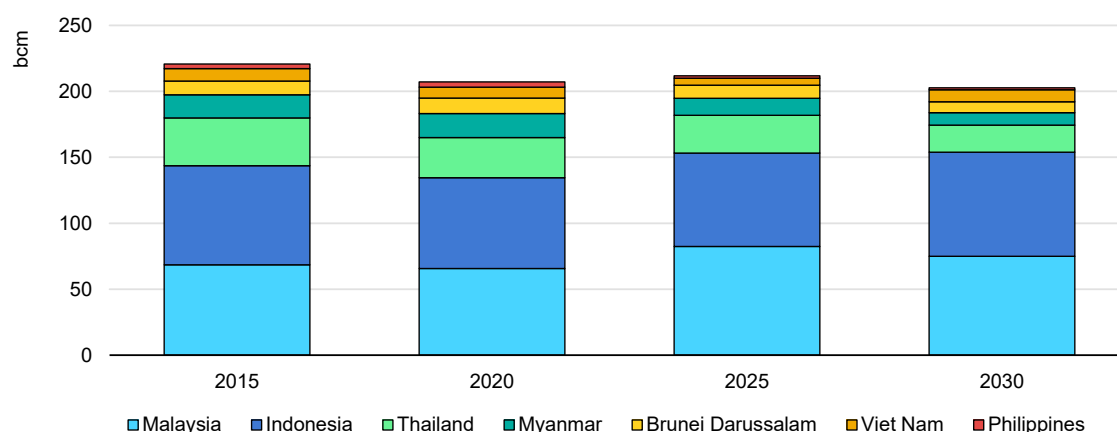


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Note: bcm = billion cubic metres.

During the same period, gas production is expected to decline in several of the ASEAN region's mature producing member states, particularly Malaysia, Myanmar and Thailand. Conversely, Indonesia and Viet Nam are expected to see significant production growth by the end of the decade as a handful of new upstream projects come online. In Indonesia, output is set to be supported by the Geng North, Gehem, Gandang and Gendalo developments, while in Viet Nam additional production is expected from the Block B and Su Tu Trang (White Lion) Phase 2B gas projects. As a net result, regional gas production is expected to continue declining through most of the decade, although the pace of decline is set to slow towards 2030. Even so, total ASEAN gas production in 2030 is projected to fall by close to 10 bcm (or 4%) from its 2025 level.

Gas production by producing ASEAN member state, 2015-2030



IEA. CC BY 4.0.

Note: bcm = billion cubic metres.

Gas security assessment

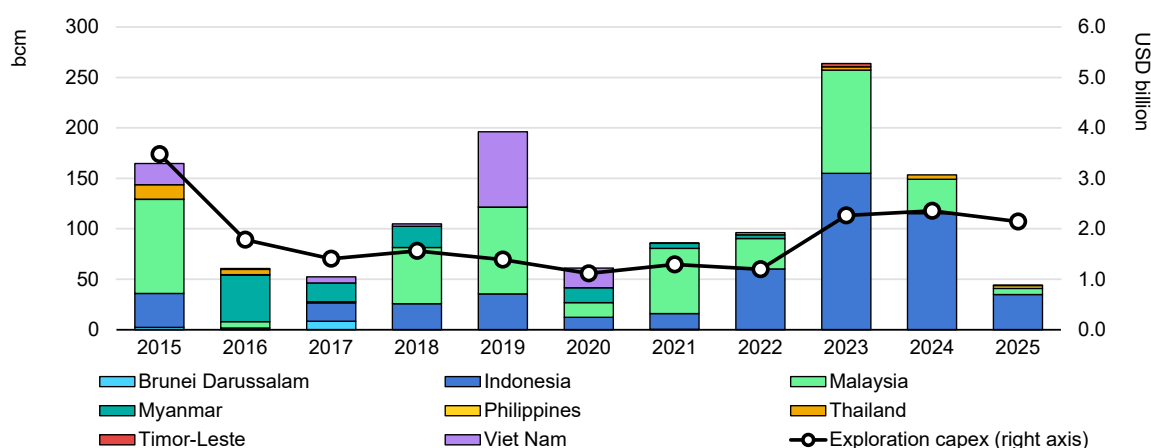
Supply-side security

Domestic production base

The ASEAN region possesses a substantial natural gas resource base and extensive production infrastructure, enabling it to remain a net exporter of natural gas as of 2025. However, this production base has been in structural decline for more than a decade, with maturing fields, declining reserves and limited new discoveries gradually eroding the region's supply capacity.

At the end of 2025, proven natural gas reserves across the ASEAN countries stood at around 3.7 tcm, equivalent to an estimated 18 years of production at current output levels, although a growing share of these reserves is located in higher-cost, technically complex or otherwise challenging areas. Indonesia and Malaysia account for the largest share of these reserves at 26% and 25%, respectively, while Viet Nam and Myanmar, at 19% and 17%, also possess substantial resources but have historically faced greater above-ground challenges in bringing them to market. Other ASEAN member states have comparatively modest and/or rapidly depleting reserves. Total proven reserves in the region declined by more than a third between 2015 and 2025 (from around 5.8 tcm to 3.7 tcm today), reflecting a prolonged period during which reserve additions from new discoveries and field developments failed to keep pace with production.

Natural gas discoveries and exploration CAPEX allocated to gas in ASEAN, 2015-2025



IEA. CC BY 4.0.

Notes: bcm = billion cubic metres; CAPEX = capital expenditure.

Source: IEA analysis based on data from Rystad Energy.

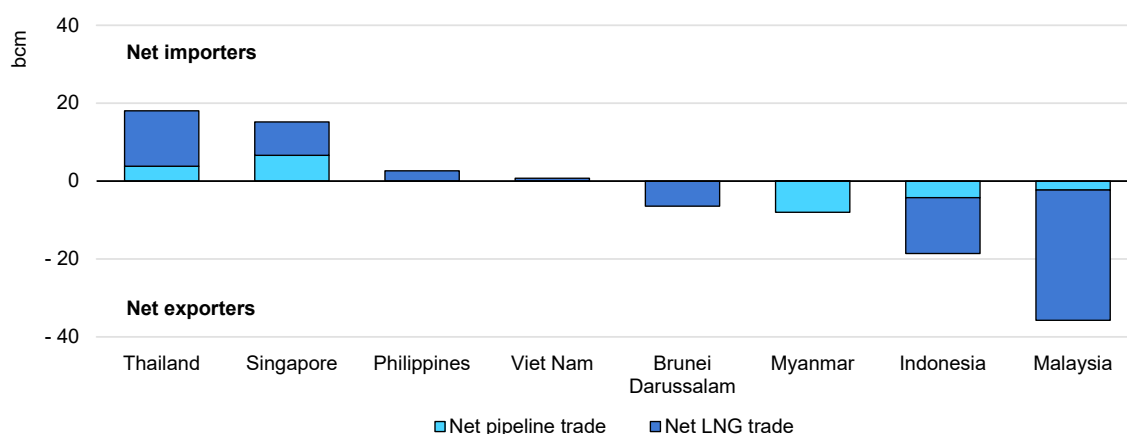
Exploration activity has accelerated since the price spikes and energy crisis triggered by Russia's invasion of Ukraine in 2022. A series of new discoveries –

particularly in Indonesia since 2023 and, more recently, around the Malampaya field in the Philippines in 2026 – together with the development of earlier discoveries in Viet Nam, are expected to temporarily slow the region's production decline towards the end of the decade. Nevertheless, regional gas production in 2030 is still projected to be nearly 10 bcm (4%) lower than in 2025.

Import dependency

The ASEAN region as a whole remains a net exporter of natural gas, with a net surplus of around 30 bcm in 2025. Four of the region's leading producers (Malaysia, Indonesia, Myanmar and Brunei Darussalam) are significant net exporters and are expected to remain so through to 2030. By contrast, the region's four other major gas-consuming economies (Singapore, Thailand, the Philippines and Viet Nam) were net importers in 2025 and are projected to remain net importers throughout the outlook period.

Net pipeline gas and LNG trade in ASEAN by country, 2025



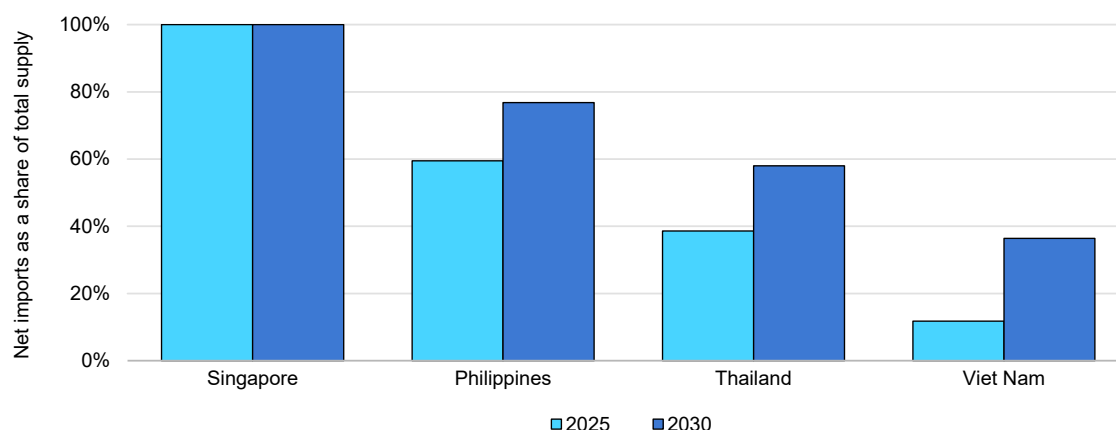
IEA. CC BY 4.0.

Notes: bcm = billion cubic metres. LNG = liquified natural gas. As of 2025, Cambodia and Lao PDR do not produce, consume or trade natural gas. Timor-Leste's natural gas production and exports from the county's only developed gas field, Bayu-Undan, were negligible in 2025, and the field ceased production and exports entirely in mid-2025.

Net import dependency among these four ASEAN member states ranges from just over 10% in Viet Nam to 100% in Singapore. By 2030, import dependency is projected to reach close to 40% in Viet Nam, 60% in Thailand and 80% in the Philippines, while Singapore is expected to remain fully dependent on imported gas throughout the outlook period.

The concentration of supplier countries varies across the net-importing ASEAN member states, but generally remains at manageable levels, with the largest source country accounting for around 20-40% of total imports. The region's largest importers, Singapore and Thailand, have more diversified import portfolios than the smaller net importers, the Philippines and Viet Nam.

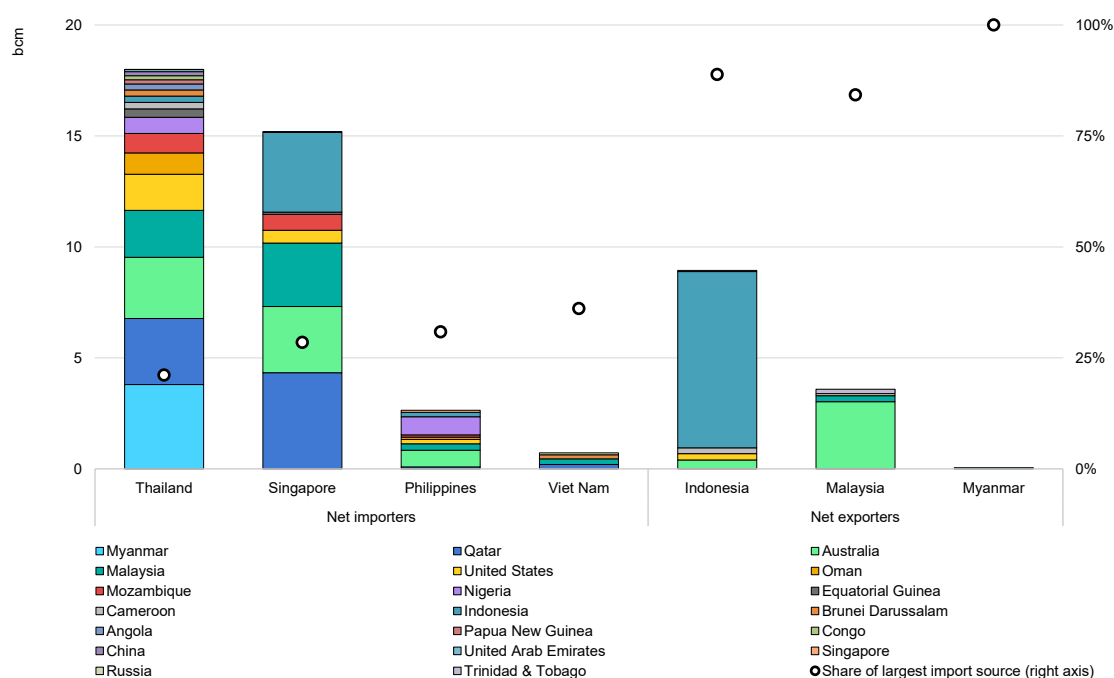
Import dependency of net-importing ASEAN member states, 2025-2030



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Among the net-exporting ASEAN member states that also import gas, supplier country concentration is considerably higher, with the largest source country accounting for 80-100% of imports. However, this is generally less of a concern from a security of supply perspective because these ASEAN member states have a surplus of domestically produced gas or LNG. In Indonesia, for example, the dominant supply source consists of LNG from export terminals located within the country, while in Myanmar only a single LNG cargo was received in 2025, leaving little scope for diversification.

Concentration of import source countries in ASEAN by destination, 2025

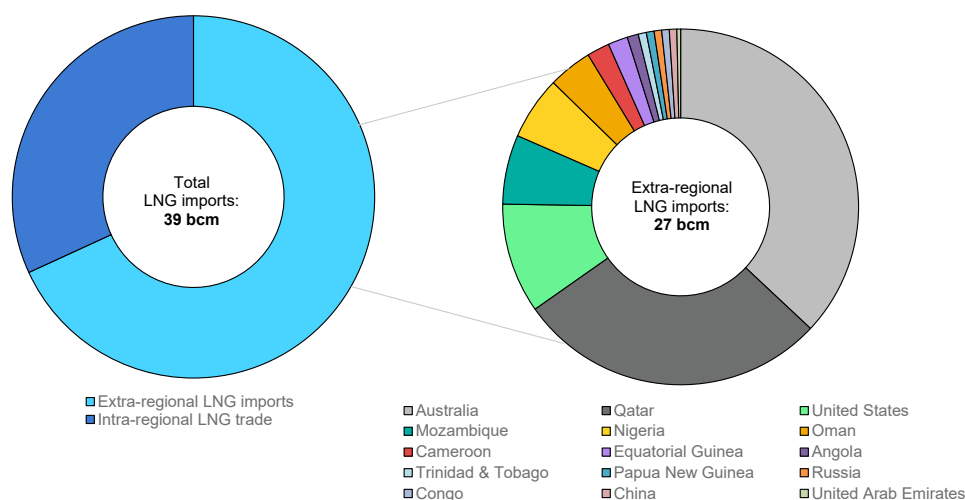


IEA. CC BY 4.0.

Note: bcm = billion cubic metres

The ASEAN region as a whole received more than two-thirds of its LNG imports from outside the region. Of these extra-regional imports, Australia and Qatar were by far the largest suppliers in 2025, together accounting for around 65% of extra-regional imports and 45% of total LNG imports into ASEAN member states.

Concentration of LNG import source countries in ASEAN, 2025



IEA. CC BY 4.0.

Note: LNG = liquefied natural gas.

Exposure to choke points

The ASEAN region, through its growing reliance on LNG imports from outside the region, is increasingly exposed to two of the world's principal maritime choke points: the Strait of Hormuz and the Strait of Malacca.

Strait of Hormuz

The Strait of Hormuz is an international waterway connecting the Persian Gulf with the Gulf of Oman and the Arabian Sea. At its narrowest point the strait is around 50 km wide, with separate navigable channels of around 4 km for inbound and outbound ship traffic. In 2025, around 110 bcm of LNG transited the Strait of Hormuz, the sole maritime outlet for LNG exports from Qatar and the United Arab Emirates beyond the Persian Gulf. Around 20% of ASEAN's LNG imports (7.7 bcm) passed through the Strait of Hormuz, with Singapore accounting for around 55% of these volumes and Thailand for another 40%.

The Middle East crisis, which began on 28 February 2026, highlighted the risks associated with this critical maritime choke point. During the first eight months of 2026, LNG flows through the strait fell by close to 65% (50 bcm) y-o-y, with virtually no LNG exports from Qatar and the United Arab Emirates in April. LNG deliveries to the ASEAN region via the strait declined even more sharply, falling

by around 75%, with no deliveries from either Qatar or the United Arab Emirates between April and August. Affected LNG importers across the ASEAN region responded by increasing spot market procurement rather than curtailing imports, with the United States and Australia supplying the largest share of replacement cargoes from outside the region.

Some ASEAN member states also adopted precautionary measures to mitigate the impact of the disruption. In March 2026, the Philippines invoked emergency powers to regulate electricity prices, increase coal-fired generation and secure assurances from Indonesia that it would not restrict additional coal exports to the country. Around the same time, Thailand instructed power plant operators to increase the share of coal in the electricity mix and ordered the restart of two decommissioned units at the 0.6 GW Mae Moh coal-fired power plant. Despite these measures, however, the ASEAN region's combined LNG imports increased by around 20% y-o-y during the first eight months of 2026, underscoring the region's growing dependence on LNG imports and the limited scope for fuel switching, even in a period of elevated prices.

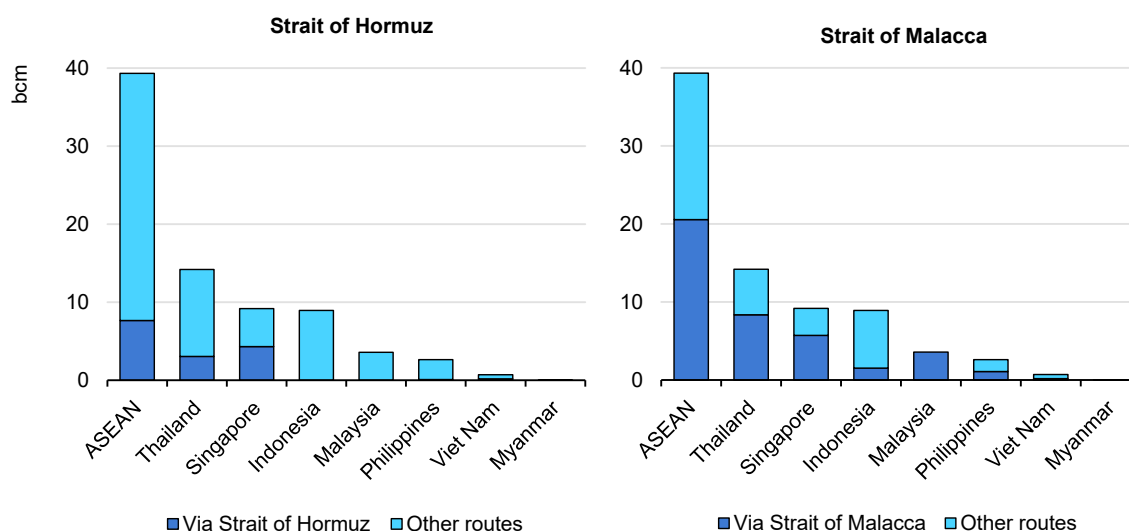
Strait of Malacca

The Strait of Malacca is a maritime choke point between Indonesia, Malaysia and Singapore, linking the Indian Ocean with the Pacific Ocean via the South China Sea. At its narrowest point, the strait is just 3 km wide, making navigation challenging and increasing the risk of disruption from collisions, accidents and – in the past – also piracy. Unlike the Strait of Hormuz, however, the Strait of Malacca can be bypassed via the Sunda Strait (between the Indonesian islands of Java and Sumatra) and the Lombok Strait (between the islands of Bali and Lombok). While these alternative routes add sailing time and cost, they provide flexibility in the event of disruption.

In 2025, an estimated 95 bcm of LNG transited the Strait of Malacca,³ mainly from Middle Eastern exporters to Asian importers. It is estimated that a just over half of ASEAN LNG trade (around 21 bcm out of 39 bcm) involved transit through or within the strait. The largest flows comprised LNG shipments from Qatar to Singapore and Thailand, and Australian cargoes delivered to Malaysia, whose LNG import terminals are located directly on the Strait of Malacca.

³ Based on data for the first half of 2025 only. See: https://www.eia.gov/international/analysis/special-topics/world_oil_transit_Chokepoints.

ASEAN LNG imports transiting critical maritime choke points, 2025



IEA. CC BY 4.0.

Note: bcm = billion cubic metres.

Source: IEA analysis based on data from ICIS LNG Edge.

Infrastructure adequacy

LNG regasification capacity

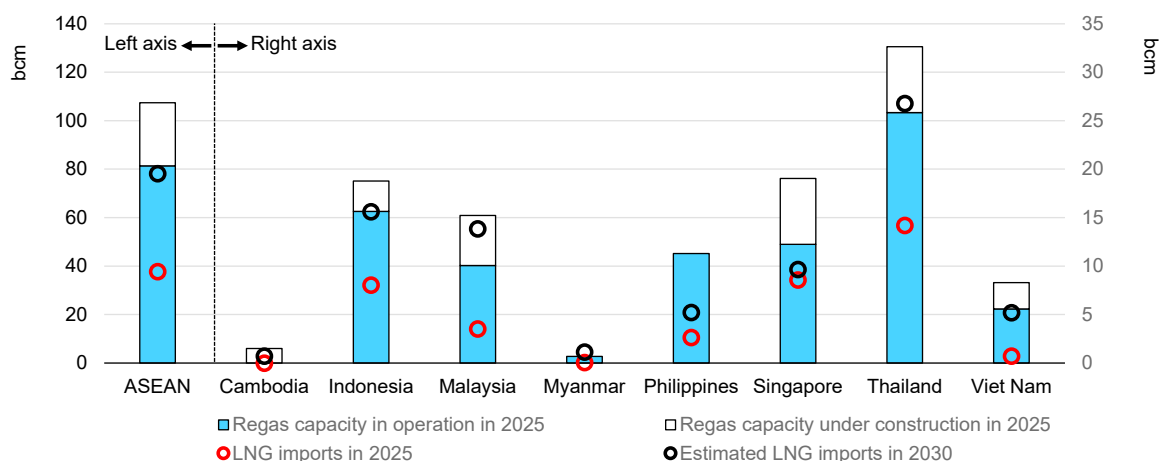
With ASEAN's LNG imports more than tripling between 2015 and 2025, and projected to double again between 2025 and 2030, sufficient regasification capacity will remain critical to the region's gas security and could become a bottleneck to further growth in LNG imports. In 2025, ASEAN member states imported just under 40 bcm of LNG against a total regasification capacity of more than 80 bcm/yr, leaving around 50% as spare capacity.

By 2030, however, the region's LNG imports are projected to reach nearly 80 bcm, bringing aggregate demand close to the limits of currently available capacity. Among the seven ASEAN member states that already import LNG, all but two (comprising Indonesia, Malaysia, Myanmar, Singapore and Thailand) are projected to approach or exceed their existing regasification capacity limit by 2030. Cambodia is expected to become the region's eighth LNG-importing country by the end of the decade, with small but sufficient capacity to cover the gas requirements of the 900 MW combined-cycle gas-fired power plant associated with the Botum Sakor LNG terminal, which is currently under construction.

Across the ASEAN region, more than 25 bcm/yr of new regasification capacity is currently under construction. However, even with these projects completed, the average utilisation of the region's import capacity could still exceed 70% by 2030, more than twice the current global average of just under 35%. In some ASEAN

member states, including Malaysia, Indonesia and Thailand, utilisation rates could reach around 80-90% by 2030 despite the capacity additions underway, highlighting the potential need for further investment in LNG import infrastructure if current trends persist.

LNG import capacity and LNG imports in ASEAN, 2025 and 2030



IEA. CC BY 4.0.

Notes: bcm = billion cubic metres; LNG = liquefied natural gas; regas = regasification.

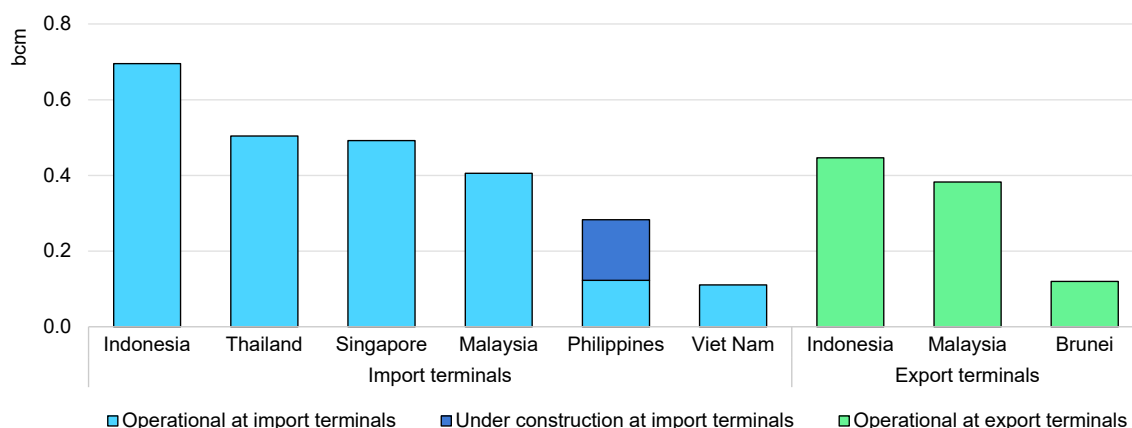
LNG storage

Gas storage capacity in the ASEAN region is entirely in the form of LNG storage tanks, storage at floating storage and regasification units (FSRUs) and floating LNG (FLNG) facilities. Total LNG storage capacity is just over 3 bcm, of which more than 2 bcm is located at import terminals and less than 1 bcm at export facilities.

This capacity is primarily used to smooth operational flows by decoupling LNG cargo arrivals from send-out at regasification terminals and to ensure continuous feedgas flows at export facilities. However, at least one facility in the region has excess LNG storage capacity used for commercial optimisation and regional trading. At the Arun LNG complex in Indonesia, two of the terminal's four storage tanks are used by TotalEnergies under a terminal use agreement with Pertamina, supporting trading and portfolio optimisation in the broader Asian LNG market.

Total storage capacity in ASEAN countries is equivalent to less than 2% of the region's annual gas consumption, owing in part to the region's lack of seasonal heating demand. This is well below the levels in other gas-consuming regions and markets. For example, storage capacity exceeds 25% of annual demand in Europe where seasonal demand swings are more pronounced, while in other LNG-dependent Asian economies, such as Japan and Korea, storage capacity is equivalent to close to 15% of annual demand.

LNG storage capacity in ASEAN by country, 2025



IEA. CC BY 4.0.

Notes: bcm = billion cubic metres; LNG = liquefied natural gas.

Source: IEA analysis based on data from ICIS LNG Edge.

Cross-border interconnections

Cross-border natural gas interconnections within ASEAN remain limited and provide only modest additional resilience in the event of supply disruption. Excluding pipeline connections associated with jointly developed offshore gas fields – notably between Myanmar and Thailand and between Malaysia and Thailand – Singapore is the only ASEAN member state with commercial cross-border pipeline imports, receiving gas from both Indonesia and Malaysia. While these pipelines had a combined nominal spare capacity of more than 3 bcm in 2025, their ability to provide additional supplies during an emergency is likely to be constrained by gas availability rather than pipeline capacity. Moreover, the long-term continuity of these supplies remains uncertain, with Singapore's import contract with Indonesia due to expire at the end of 2028 and its contract with Malaysia in 2031, although similar uncertainty ahead of the previous expiry was ultimately resolved through a contract extension. As a result, for the region as a whole, existing cross-border pipeline interconnections provide only limited operational flexibility for responding to regional gas supply disruption.

Governments across the region recognised the energy security benefits of closer regional gas market integration and greater cross-border connectivity early on, and formalised their support for the Trans-ASEAN Gas Pipeline (TAGP) initiative through the signing of a memorandum of understanding (MoU) in 2002, which entered into force in 2004. However, progress towards an integrated regional pipeline network has been slower than originally envisaged due to a combination of commercial, technical and regulatory challenges, including the high cost and technical complexity of offshore gas pipelines, limited regulatory harmonisation across ASEAN member states, and insufficient multilateral co-operation on market integration and removal of cross-border barriers. Reflecting these challenges, as

well as the growing role of LNG in the region's gas trade, the TAGP concept has evolved over time. The latest extension of the MoU, concluded in 2024 for a further ten-year period through to 2034, places greater emphasis on strengthening regional connectivity through LNG infrastructure and so-called "virtual pipelines", including LNG import terminals, reloading facilities, break-bulk services and small-scale LNG distribution, complementing existing and potential pipeline connectivity where commercially viable, and potentially offering greater flexibility and lower costs than new cross-border pipelines.

Ultimately, strengthening regional gas security will require not only physical infrastructure, including LNG-based connectivity (and an adequately skilled workforce to support its construction and operation), but also deeper regional market integration, stronger multilateral co-operation, and greater regulatory co-operation, compatibility and, where appropriate, alignment. Together, these could facilitate cross-border gas trade, reduce market barriers and improve the region's collective ability to respond to gas supply disruption. More transparent and liquid regional trading arrangements could also support the emergence of a regional gas or LNG price benchmark that reflects supply–demand fundamentals within the ASEAN region, which could improve market flexibility and supply security over time.

Underground gas storage

Due to the limited seasonal variation in gas and LNG demand across the region, there are no operating or planned underground gas storage facilities in the ASEAN region. However, at least one potential site (Indonesia's Parigi formation) has been extensively studied for underground storage development.

Demand-side readiness

Demand-side flexibility is a key component of the gas supply emergency response toolkit in mature gas markets, including in Europe, where the European Union and members of the Energy Community have established a common framework to safeguard gas supplies to protected customers during emergencies. In the ASEAN region, however, the scope for such measures is more limited. Residential, commercial and public services account for only a negligible share of gas demand across the region, leaving little scope to protect these consumers by curtailing demand in other sectors.

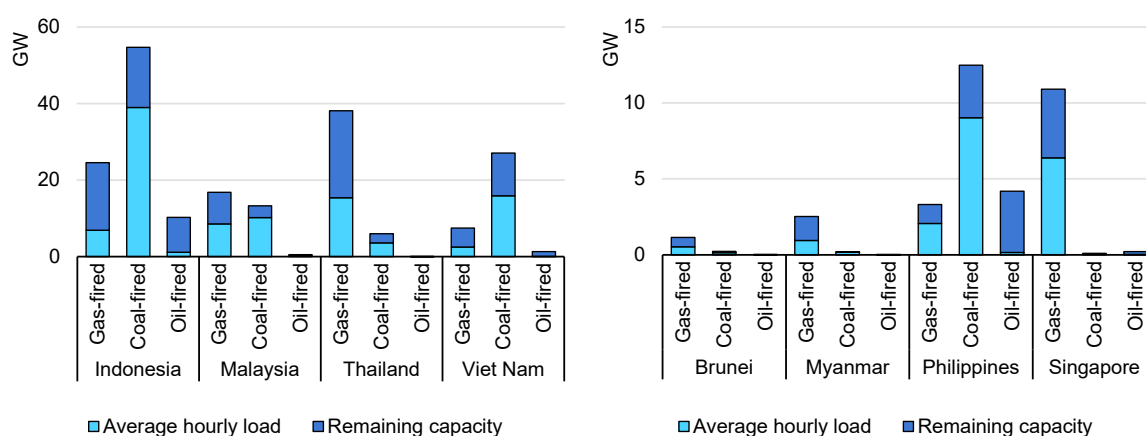
Industrial gas demand, which is typically the greatest source of demand-side flexibility during supply disruption through mechanisms such as interruptible contracts, is heavily concentrated in Indonesia and Malaysia, which together account for almost three-quarters of ASEAN's industrial gas consumption. As both ASEAN member states are major net exporters of natural gas with large upstream

operations and some flexibility in their LNG sales arrangements, the need to curtail gas supplies to domestic industry may be more limited than in import-dependent economies.

Nevertheless, several import-dependent economies, including Singapore, Thailand and Viet Nam, have sizeable industrial gas demand that could, in principle, provide some short-term flexibility during emergencies. In these ASEAN member states, temporary reductions in industrial gas consumption could potentially allow gas supplies to be reallocated to higher-priority uses, including electricity generation and, in the case of Thailand, potentially to the vehicle fleet fuelled by compressed natural gas (CNG) in the transport sector.

Across ASEAN, and particularly in the region's import-dependent economies, the power sector is by far the largest consumer of natural gas. As a result, fuel switching in the power generation sector offers the greatest potential source of demand-side flexibility during gas supply disruption, although the available potential varies considerably between ASEAN member states. In Brunei Darussalam, Myanmar, Singapore and Thailand, gas-fired power plants have little or no ability to switch to alternative dispatchable generation sources, although some gas-fired fleets, notably Singapore's have dual-fuel capability. Malaysia has a sizeable coal-fired generation fleet, but it already operates at utilisation rates above 75%, leaving limited scope to substitute coal-fired generation for gas in the short term. Indonesia, the Philippines and Viet Nam have sufficient spare coal-fired capacity, in principle, to replace most or all gas-fired generation. In practice, however, the extent to which fuel switching could be used during an emergency is limited by geographic constraints in Indonesia and the relatively high utilisation of existing coal-fired plants in the Philippines and Viet Nam, leaving only less-efficient units available to increase output.

Utilisation of dispatchable fossil fuel generation capacity in selected ASEAN member states, 2024



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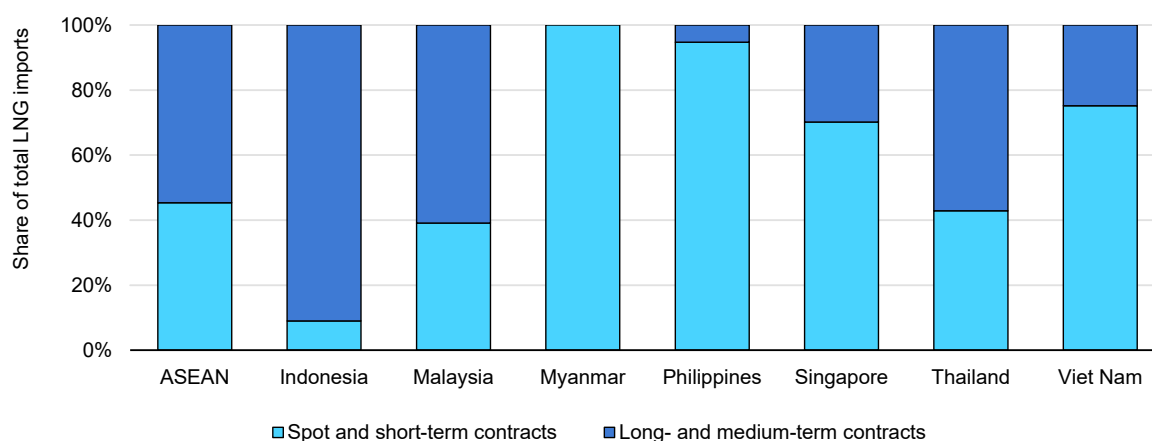
Notes: GW = gigawatts. Countries with smaller and larger generation fleets are shown on two separate graphs for better visibility.

Exposure to economic and price risk

In 2025, ASEAN countries sourced approximately 45% of their LNG imports through spot markets and short-term contracts, slightly above the global average of around 43%. Exposure to spot and short-term procurement varied considerably between ASEAN member states. Indonesia secured most of its LNG imports under long-term contracts, primarily from domestic suppliers, while the Philippines and Viet Nam, for example, relied on spot market purchases for the majority of their imports. Thailand and Malaysia had a more balanced procurement portfolio, with spot and short-term volumes accounting for a share of imports broadly in line with the regional and global averages.

Among the region's LNG importers, Singapore and Thailand were the most directly affected by the closure of the Strait of Hormuz during the Middle East conflict in 2026, having received around 4 bcm and 3 bcm of LNG from Qatar, respectively, in 2025. Following the disruption of these supplies at the end of February 2026, both ASEAN member states turned to the spot market to secure replacement cargoes, exposing them to higher LNG procurement costs.

LNG imports by sales basis in ASEAN, 2025



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Note: LNG = liquefied natural gas.

Source: IEA analysis based on data from GIIGNL and ICIS.

System resilience

Strategic buffers and stocks

Given the absence of underground gas storage, limited LNG storage capacity, constrained fiscal resources in at least some ASEAN economies, and the fact that the region as a whole remains a net exporter of natural gas, strategic gas reserve

mechanisms are not widely used. Singapore is currently the only ASEAN member state to operate a dedicated strategic gas reserve scheme through its Standby LNG Facility (SLF).

The SLF was introduced by Singapore's Energy Market Authority in 2021 in response to tightening global LNG market conditions and heightened concerns over gas supply security following the sharp LNG price spike in early 2021. The facility is designed to ensure the availability of gas for electricity generation during supply disruption or periods of severe market stress. The scheme maintains physical LNG buffer stocks within Singapore's existing LNG import terminal infrastructure, allowing emergency gas supplies to be made available to power generators when required. In 2025, the Singapore government established the state-owned Singapore GasCo to further strengthen supply security by centralising gas procurement. Since April 2026, in response to the Middle East crisis, the company has taken over responsibility for managing the SLF and has stepped up short-term and spot market LNG purchases, alongside its medium- and long-term procurement activities. Although Singapore's approach reflects the specific characteristics of its gas market – including complete import dependency, limited domestic storage options and a power system overwhelmingly reliant on natural gas – it demonstrates that strategic LNG buffer mechanisms can strengthen supply resilience without requiring dedicated underground storage facilities. As LNG import dependency increases across parts of the ASEAN region, similar approaches, adapted to national market conditions and institutional arrangements, could warrant further consideration as part of broader efforts to strengthen gas security. This applies in particular to the possibility to establish a co-ordinated gas emergency response mechanism under APSA.

Infrastructure resilience

While a comprehensive assessment of the ASEAN region's gas infrastructure resilience is not readily available, the history of outages at its LNG liquefaction terminals offers insight into the main vulnerabilities affecting its upstream, pipeline and LNG infrastructure.

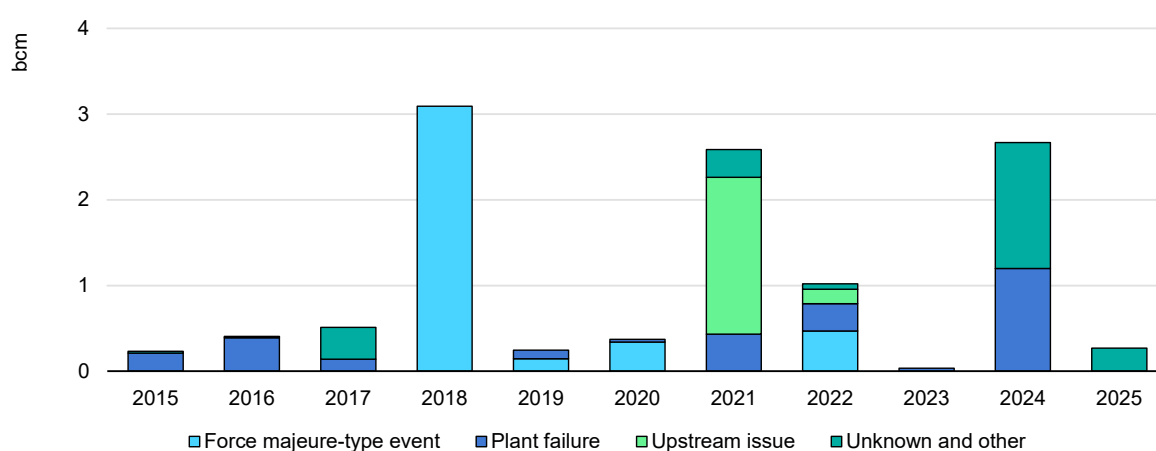
Of the roughly 11 bcm of LNG production disrupted between 2015 and 2025,⁴ the largest share (35%) was associated with force majeure-type events. The most significant single point of failure was Malaysia's Sabah-Sarawak Gas Pipeline, which transports feedgas produced offshore Sabah to the Bintulu LNG complex in Sarawak. Between 2015 and 2025, unplanned disruptions affecting the pipeline alone accounted for a combined 4 bcm of lost LNG supply. Since entering service in 2014, the pipeline has experienced a series of integrity-related incidents,

⁴ Disrupted volumes linked to unplanned LNG outages are calculated on the basis of the prevailing production rate over the preceding 12 months.

including a fire in 2014, gas leaks in 2018 and 2019, a rupture and fire in 2020, and a further leak in September 2022 linked to soil movement and subsidence. Following this series of failures, Petronas announced plans to decommission the pipeline by the end of 2027.

Plant failures (25%) and upstream feedgas supply issues (17%) were also among the leading causes of LNG production outages in Brunei Darussalam, Indonesia and Malaysia, reflecting in part the age of the region's legacy infrastructure. A further 22% of unplanned outages were attributed to unspecified causes, limiting the extent to which the underlying vulnerabilities can be assessed.

Unplanned LNG capacity outages in ASEAN, 2015-2025



IEA. CC BY 4.0.

Notes: LNG = liquefied natural gas; bcm = billion cubic metres. Disrupted volumes linked to unplanned LNG outages are calculated on the basis of the prevailing production rate over the preceding 12 months.

Source: IEA analysis based on data from ICIS.

Climate and weather resilience

Natural gas infrastructure and gas-fired power plants across ASEAN are highly exposed to weather-related hazards, including extreme heat, flooding, droughts and tropical cyclones, with flood risk posing the greatest threat. Nearly 25% of the region's existing and under-construction gas-fired power plants are located in river floodplains, increasing their vulnerability to disruption from extreme rainfall and flooding. Extreme heat also reduces the performance of gas-fired power plants, lowering output by up to 1% for every 1 °C increase in ambient temperature above 16 °C. More than 30% of the region's gas-fired power plants are exposed to extreme heat (daily maximum temperatures exceeding 35 °C) for at least 40 days per year.

Levels of climate hazard and exposure by ASEAN member state, 2025

	River flooding	Coastal flooding	Drought	Tropical cyclones
Brunei Darussalam	4.8	3.3	2.1	0.0
Cambodia	8.6	3.7	4.2	1.8
Indonesia	8.4	8.1	3.3	1.6
Lao PDR	8.2	0.0	1.1	1.4
Malaysia	6.8	6.4	3.1	0.0
Myanmar	8.8	8.0	0.9	5.8
Philippines	6.7	8.9	3.5	9.2
Singapore	0.0	2.0	0.0	0.0
Thailand	9.8	5.6	5.4	1.6
Timor-Leste	0.0	3.3	1.9	0.5
Viet Nam	9.9	9.6	4.5	5.9
Global average	4.5	3.5	3.4	1.6

Notes: Each cell colour in the table indicates the level of climate hazard and exposure. The levels of climate hazard and exposure to river flooding, coastal flooding, drought and tropical cyclones are assessed using the indicators in the INFORM Risk Index 2026 and are defined as Low (0-2.99), Medium (3-6.99) and High (7-10). In the figure, exposure was calculated for floodplains with a 1-in-500-year return period. It includes operational power plants and power plants under construction.

Source: IEA (2026), [Southeast Asia Energy Outlook 2026](#).

Tropical cyclones pose an additional risk, particularly in Myanmar, the Philippines and Viet Nam, where they threaten gas infrastructure and power generation assets. Cyclone-related disruption can also affect LNG supplies from Australia, the largest external supplier of LNG to the ASEAN region, as several export terminals are located in cyclone-prone regions in northern and western Australia. These climate-related risks underscore the importance of [strengthening the resilience](#) of both domestic gas infrastructure and international LNG supply chains to support regional energy security.

Coal and solid biofuels security review

Coal plays a significant but highly varied role across the ASEAN region and is used in every member state except Timor-Leste. While coal accounts for only a small share of the energy mix in Brunei Darussalam, Myanmar and Singapore, ASEAN is an important driver of global coal demand, led by Indonesia and Viet Nam. Taken as a whole, ASEAN is a net exporter of coal due to Indonesia's large export volumes, but this masks considerable diversity between member states in demand, available supply and production. The following sections examine coal demand and its drivers, the region's reserves, production and trade, and the implications for energy security.

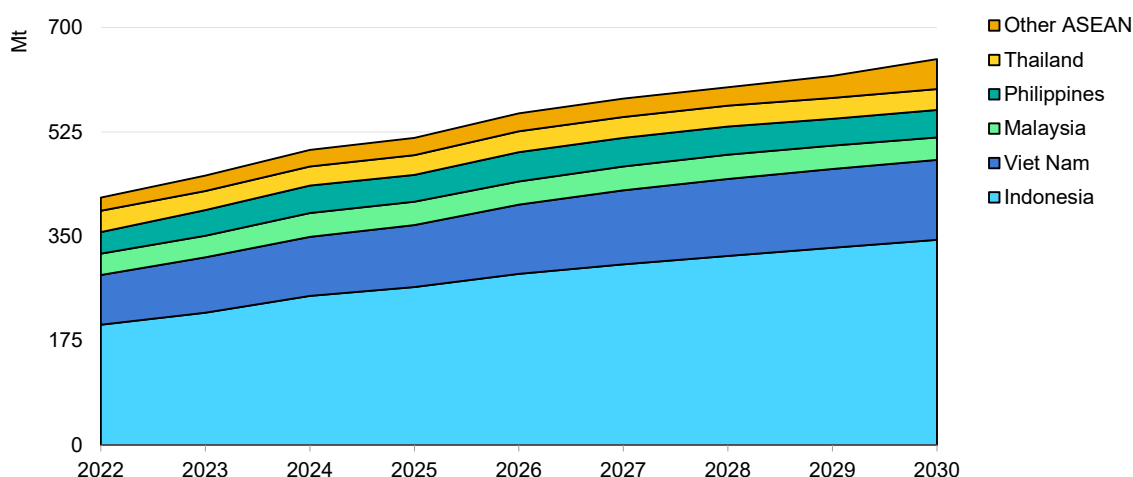
Coal demand

Coal demand in ASEAN is underpinned by electricity generation, which accounts for about 75% of overall consumption, with industry making up the remainder. Demand is projected to continue rising over the next five years, driven by strong economic and electricity demand growth, including from potential data centre demand, new coal-fired power generation capacity and expanding industrial activity. Indonesia continues to lead regional consumption, representing over half of the total, followed by Viet Nam, the Philippines, Malaysia, Thailand and Lao PDR.

According to the latest IEA forecasts, ASEAN is expected to record the world's fastest growth in coal demand at 4.4% per year on average through to 2030. Indonesia and Viet Nam account for most of this growth. By 2029, Indonesia is expected to become the third-largest coal consumer in the world after China and India, surpassing the United States. Despite the expansion of renewables deployment, coal demand in the power sector remains resilient due to strong growth in electricity demand. In addition, the availability and affordability of coal, industry's reliance on it, and contractual aspects such as the existence of coal-fired power plants with long-term power purchase agreements (PPAs) makes substitution challenging. In Indonesia and to a lesser extent Viet Nam, social and economic aspects related to jobs also play a role in maintaining coal's dominant position in the energy mix, particularly in regions with a high geographical concentration and historical legacy of coal production, such as East and Central Kalimantan

While expectations of abundant LNG supply later in the decade had been anticipated to strengthen competition with coal, ASEAN member states across the region may reassess the role of LNG in their energy mix after the recent crisis in the Middle East. In Indonesia, the transition away from captive coal generation remains particularly challenging, as replacement technologies must provide reliable 24/7 electricity in a logistically feasible way, and compete with the country's low-cost domestic coal. Coal consumption in industry is also expected to grow, with steel, nickel and aluminium production driving demand growth.

Coal demand in ASEAN, 2022-30



IEA. CC BY 4.0.

Notes: 2022-2024 are historical data, 2025 are preliminary estimates and 2026-30 are forecasts. Mt = million tonnes.

Coal in metal production

The production of critical minerals, in particular nickel and aluminium, is an important driver of coal demand in Indonesia. The country's nickel processing and refining sector has rapidly expanded over the past decade, producing around 60% of the global nickel supply and operating over 50 nickel smelting facilities. Most nickel production relies on rotary kiln electric furnace technology, which uses thermal and metallurgical coal both as a process input and as a source of heat and electricity.

Aluminium smelting is also expanding, notably in North Kalimantan, adding around 30 TWh of baseload electricity demand and reinforcing reliance on coal-fired generation in the near term. Without substantial changes to processing routes or power generation technology, coal demand from the metals sector will increase as smelter capacity and output increase.

Opportunities exist to reduce metal production's carbon intensity and its demand for coal. In nickel production, generating electricity to power the furnace is responsible for over 60% of coal use in rotary kiln electric furnaces, highlighting the potential role of lower-emission power sources to vastly reduce coal demand and carbon emissions from nickel production. For example, Vale has integrated hydropower into its nickel smelting operations in Indonesia, reducing the amount of coal needed and 60% of the emissions from the process. Other companies are exploring solid biomass solutions to replace coal directly without major modifications to existing boilers, particularly through the use of torrefied wood pellets ("black pellets" or "bio-coal"). Viet Nam, for example, has a domestic torrefaction facility. Such fuels could provide a lower-emissions alternative to coal and help reduce coal dependency while longer-term investments in renewable power and industrial decarbonisation are developed. The contribution of biomass will depend on the sustainability of feedstock production, processing and supply chains, underlining the importance of robust sustainability standards and certification frameworks.

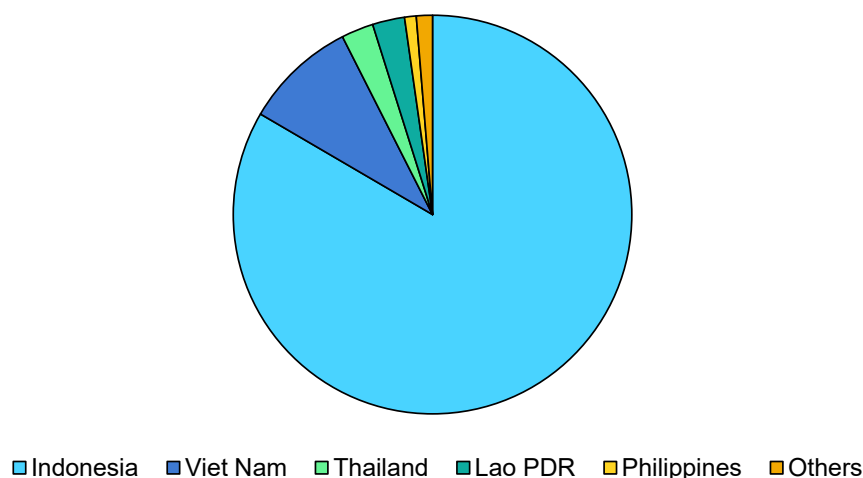
Coal supply

Coal reserves

ASEAN holds nearly 40 billion tonnes of coal reserves, representing 3% of the global total and equivalent to approximately 80 years of supply at the region's current consumption rate. While several ASEAN member states have coal reserves, only Indonesia, Lao PDR, Thailand and Viet Nam each hold over one billion tonnes. Indonesia ranks among the top ten countries globally for coal reserves, accounting for 83% of total coal reserves in ASEAN. However, these reserves are primarily lower-grade thermal coal. Notably, the region does not have significant coking coal deposits, which are essential for blast furnace steel production.

Coal is categorised by its calorific value (CV), with higher-CV coals considered higher grade and commanding a price premium. Generally, low-CV refers to a CV below 4 200 kcal/kg, mid-CV refers to a CV between 4 200 kcal/kg and 5 700 kcal/kg and high-CV refers to a CV above 5 700 kcal/kg. Indonesia holds 32 billion tonnes of coal reserves, of which 24 billion are low CV, 4.5 are medium CV and 3.5 are high CV. Most of the reserves are in Kalimantan and Sumatra, with smaller volumes in other islands like Sulawesi and Papua. Coking coal reserves are very limited, located in Central Kalimantan.

Distribution of coal reserves among ASEAN member states



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Viet Nam holds 3.5 billion tonnes of coal reserves, mostly anthracite and some bituminous coal. Thailand holds over 1 billion tonnes of lignite reserves in the north of the country. Lao PDR has over 1 billion tonnes of identified reserves, primarily lignite in the north of the country and anthracite in the south. Malaysia has coal reserves of around half a billion tonnes (sub-bituminous coal) in the Sarawak region of Borneo island.

In the Philippines, around 360 Mt of mostly sub-bituminous mineable coal reserves have been identified across 19 coal districts located on different islands, although production is centred on Semirara. Under the Philippines Conventional Energy Contracting Program, 3 predetermined areas comprising 18 coal blocks are being offered for development and production, including reserves on Semirara and in Cagayan and Isabela.

In Cambodia, two companies are conducting exploration along the Cambodia-Thailand border with an estimated total about 110 Mt of reserves. A state-led exploration project, Coal for National Security, is underway and expects to identify around 100-200 Mt of reserves. Other privately held licences for exploration have also been granted.

Domestic production

Coal production in the ASEAN region is highly concentrated, with Indonesia accounting for around 90% of its output and ranking as the world's third-largest producer after China and India. Unsurprisingly, the largest coal producers in the ASEAN region are the holders of its largest reserves: Indonesia, Viet Nam, Lao PDR, the Philippines and Thailand.

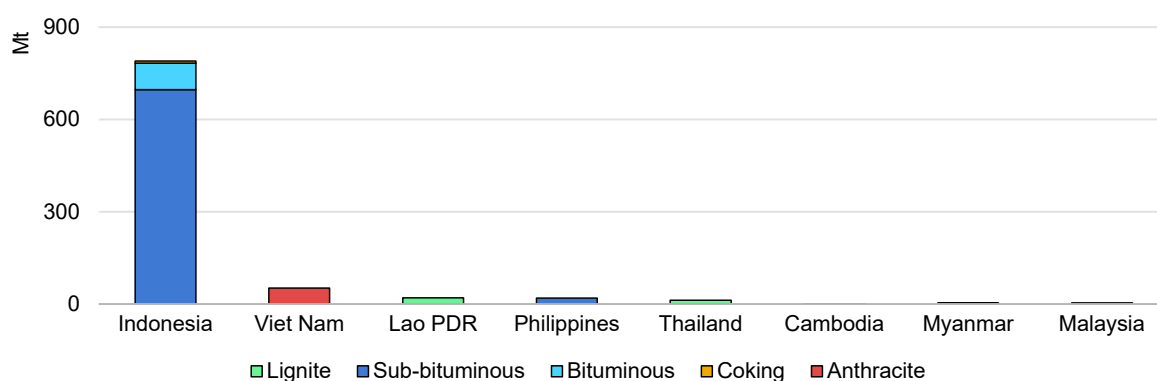
Indonesia produces primarily sub-bituminous coal for thermal purposes, which includes some lignite, with limited production of metallurgical coal. Since 2010, Indonesia's coal production has expanded by an average of 6% annually, the fastest-growth among major coal-producing countries. While most production in Indonesia is carried out by private companies, the Domestic Market Obligation requires producers to sell a regulated portion of their output to the domestic market.

Viet Nam is ASEAN's second-largest coal producer. Viet Nam National Coal and Mineral Industries Holding Corp Ltd (Vinacomin), a company owned by the government of Viet Nam, is the owner of all operating coal mines in the country.

Lao PDR, the Philippines and Thailand are the next largest producers of coal. Coal production in Lao PDR expanded significantly about a decade ago when the Hongsa mine in the north of the country began supplying the Hongsa power plant, which exports electricity to Thailand. The Philippines surpassed 20 Mt of coal production in 2025; 90% of its domestic production is sub-bituminous coal mostly for export, but it also serves domestic needs. In Thailand, the Mae Moh coal mine supplies the Mae Moh power plant.

Cambodia and Malaysia have a number of small mines. In Malaysia, limited production in Sarawak, on Borneo island, meets demand from nearby power plants. In Cambodia, licences for exploration and mining have been granted along the northern border with Thailand. Coal production is 100% lignite, and coal exports are not permitted.

Coal production by type in ASEAN, 2025



IEA. CC BY 4.0.

Note: Mt = million tonnes.

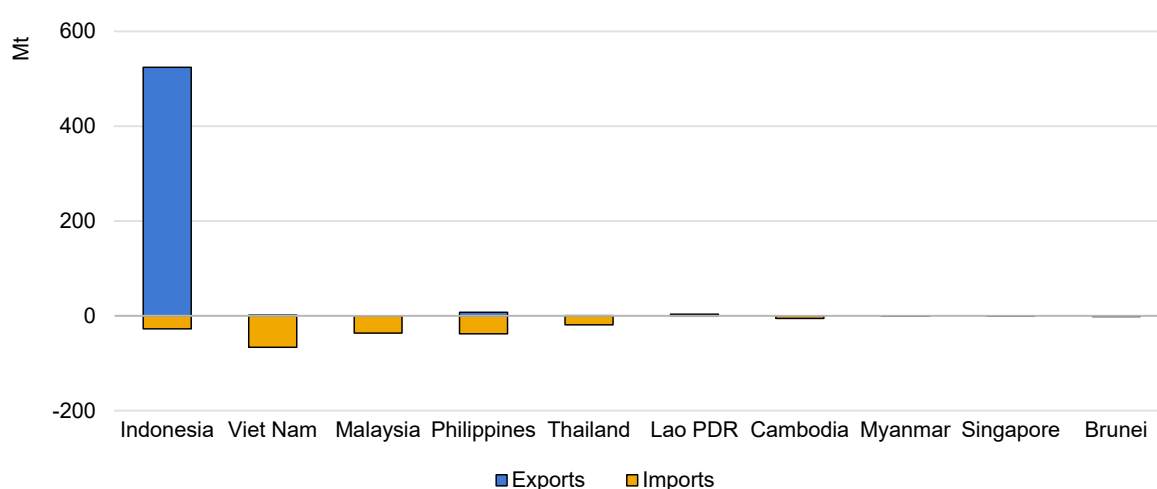
Import dependency and supply diversification

ASEAN is a net exporter of coal, with exports in 2025 at 538 Mt and imports at 194 Mt, resulting in a net surplus of 344 Mt, about two-thirds of its total consumption. However, only Indonesia and Lao PDR are net exporters of coal.

Of the coal imported into ASEAN member states, Indonesia is the largest supplier (102 Mt), with ships typically loaded at ports in East and South Kalimantan, where the bulk of exports originate. Australia (39 Mt) and Russia (17 Mt) are the next largest exporters to ASEAN countries. Over 70% of Lao PDR's coal exports are intra-ASEAN.

ASEAN member states are far more dependent on outside countries for metallurgical coal: of the region's 30 Mt met coal demand, just 6 Mt is supplied by Indonesia. The majority comes from Australia (12 Mt), Russia (5 Mt), the United States (1.5 Mt), Mozambique and Canada.

Imports and exports of coal in ASEAN, 2025



IEA. CC BY 4.0.

Note: Mt = million tonnes.

Indonesia is the largest coal exporter in the world, exporting over 500 Mt in 2025. China (213 Mt in 2025) is the largest destination of Indonesian exports, followed by India (101 Mt), the Philippines (38 Mt), South Korea (29 Mt) and Malaysia (27 Mt). This export dominance can be attributed in part to its efficient logistics, in which coal is transported from river ports by barges to ocean jetties and loaded onto ships for international delivery. Using barges is less expensive, requires lower capital investment and is more flexible than rail, while being far more efficient than trucks. This logistical advantage has allowed Indonesia to expand its export capacity from low-cost mines. However, barge transport does expose trade to weather risks. For instance, dry weather and low water levels in Indonesia's Barito River in Central Kalimantan this year affected producers' ability to export.

Cambodia and Malaysia have a small number of mines. While Indonesia is a major thermal coal exporter, it has become increasingly reliant on imports of coking coal to support growing demand from its metallurgy and smelting sectors. Its main suppliers are Australia, Canada, Russia and the United States. Simultaneously,

Indonesia is increasing its coke production capacity and became the world's second-largest coke exporter after China at over 7 Mt, and the largest metallurgical coke exporter in 2025 (excluding China's semi-coke exports).

Viet Nam has undergone a significant shift, moving from net coal exporter to net coal importer in 2015 as domestic demand growth outpaced production, which is constrained by geological conditions and rising costs. Coal imports reached around 65 Mt in 2025, making Viet Nam the world's fifth-largest coal importer; Indonesia (23 Mt in 2025) and Australia (22 Mt) are its main suppliers. Efforts are underway to expand cross-border coal trade with Lao PDR, including via a conveyor belt project.

The Philippines imported 38 Mt of coal in 2025, falling for the first time since 2020 (down 5% y-o-y), with Indonesia supplying 99% of the volume. All imports are thermal coal, used almost entirely for power generation, with about 2 Mt for other industrial uses. Most coal-fired power plant boilers are designed specifically to function at highest efficiency with Indonesian coal or a blend with Indonesian coal.

Malaysia imported 36 Mt in 2025, a record for the country. Indonesia is the main supplier (27 Mt), followed by Russia (3 Mt). Imports are mostly thermal coal, but Malaysia also imported 3 Mt for industrial purposes.

Thailand imported 19 Mt in 2025, a 21% decrease over the past decade. Indonesia is its largest supplier (14 Mt in 2025), followed by Australia (4 Mt). All imports are thermal coal.

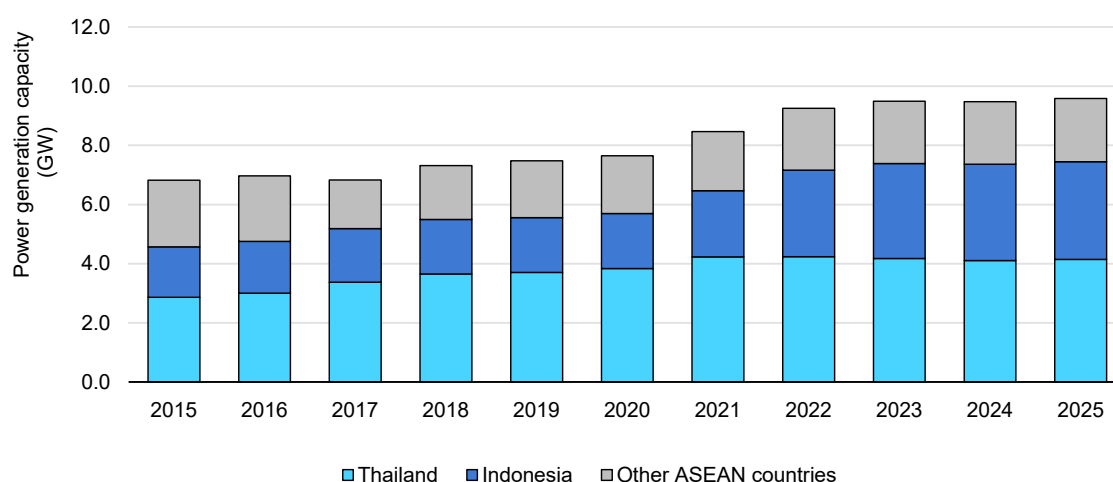
Modern sustainable solid biofuels

Modern sustainable solid biofuels are organic material derived from agricultural, forestry, industrial or municipal solid waste residues (e.g. bagasse, wood pellets, wood waste). When sourced sustainably they can be combusted directly or upgraded mechanically, thermally or thermochemically to improve fuel properties, to generate renewable heat and electricity. Solid biomass can also partly substitute for coal through co-firing in existing coal-fired plants, an approach established in Indonesia and being considered elsewhere in Southeast Asia. They can complement intermittent renewables, such as solar PV and wind, to provide dispatchable renewable electricity, diversify power supply and support grid integration. In addition, they can reduce dependence on fossil fuel imports while supporting sustainable land and waste management practices when integrated with existing agricultural, forestry and waste management value chains.

Since 2015, the capacity of power generation fuelled by solid biofuels in the ASEAN region has increased by around 40% from roughly 6 GW to almost 10 GW. Feedstock for these fuels has consisted primarily of agricultural, organic industrial waste and forestry residues, including bagasse from sugar production, rice husks,

palm oil residues such as empty fruit bunches and palm kernel shells, and timber by-products such as wood chips. The resource base is concentrated in ASEAN member states with large agricultural sectors, particularly Thailand and Indonesia, which account for almost 80% of solid biofuel-based electricity generation in the region.

Solid biofuel-based power generation capacity in ASEAN, 2015-2025



IEA. CC BY 4.0.

Notes: GW = gigawatts. Other ASEAN member states with noteworthy solid biofuel-based power generation capacity are Malaysia, Viet Nam and the Philippines.

Sources: IEA (2025), [Renewables 2025](#); IRENA (2026), [Renewable Energy Statistics 2026](#); and based on data from S&P Global.

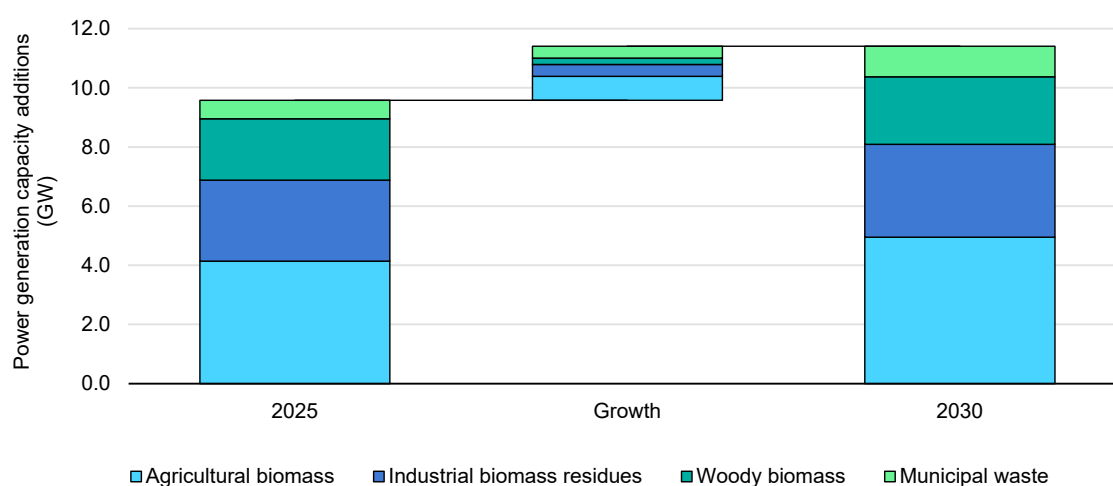
Several ASEAN member states are also significant exporters of solid biofuels. Viet Nam is the world's second-largest wood pellet exporter, supplying around 6-7 Mt annually primarily to Japan, Korea and Europe. Other noteworthy exports are forestry-based wood pellets from Malaysia and Indonesia, each close to 1 Mt annually, and Thailand at slightly less than 0.5 Mt. Additionally, Indonesia produces 14 Mt of palm kernel shells, of which around 35% are exported, most notably to Japan.

The capacity of power generation fuelled by sustainable solid biofuels in ASEAN is expected to increase by an additional 20% by 2030, reaching more than 11 GW. Additions are expected to be spread across different sustainable solid biofuels such as agricultural, industrial and forestry residues, as well as municipal waste. Growth is led by agricultural biomass, reflecting the availability of low-cost residues from sugar, rice and palm-oil value chains, while industrial residues continue to provide a stable resource base from agriculture and pulp and paper industries.

Municipal waste is expected to record the strongest relative growth from a small base (up by 60% between 2025 and 2030), supported by national waste-to-energy

ambitions. These include Thailand's Alternative Energy Development Plan 2024-2037 target of 1.1 GW of municipal waste power capacity by 2037. The strategy also aims to increase bioenergy-based power generation capacity to 5.5 GW by 2037, increasing today's installed capacity by a third. Thailand's biomass feedstock resource base is dominated by agricultural feedstocks and residues. Sugar cane, cassava, rice straw, bagasse and palm residues are considered the most promising resources due to their large domestic availability, established supply chains and suitability for bioenergy and biorefinery applications. Viet Nam also envisages the development of electricity production from solid waste and solid organic by-products through a power generation capacity target of 2.2 GW by 2030 in its latest National Power Development Plan (PDP8). In contrast, Indonesia's 10-year national strategy (RUPTL 2025-2034) envisages renewables being dominated by solar PV, wind and hydro, albeit co-firing solid biofuels in existing coal-fired power plants to reduce coal consumption.

Solid biofuel-based power generation capacity forecast in ASEAN, 2025-2030



IEA. CC BY 4.0.

Notes: GW = gigawatts. Agricultural biomass covers rice husks, bagasse, palm residues, energy crops and other residues; industrial biomass residues cover sugar and pulp and paper industry residues, black liquor and other by-products; woody biomass covers wood waste solids, forestry residues, sawdust, bark, wood chips and pellets.

Sources: IEA (2025), [Renewables 2025](#); IRENA (2026), [Renewable Energy Statistics 2026](#); and based on data from S&P Global.

Continued use of these fuels will depend on a sustainable, cost-competitive feedstock supply. Because transport and handling costs can significantly affect power generation costs, solid biofuels are most competitive when sourced locally or regionally. However, several ASEAN member states are major exporters of white wood pellets, suggesting scope to reassess potential expansion of sustainable supply which could be directed to domestic energy production. This could strengthen energy security and reduce reliance on imported fossil fuels.

Emerging solid biofuel technologies could further expand their contribution to renewable heat and power in the region by improving energy density and flexibility. Torrefied or steam-exploded wood pellets, for example, have higher energy density, better water resistance and improved grindability than conventional pellets, reducing storage costs and making them more suitable for co-firing or making viable the conversion of existing coal-fired power and industrial heat systems. Similarly, bio-coal, an advanced solid biofuel also known as biocarbon, can replace metallurgical coal as a chemical reductant in metals production, reducing both operational emissions and the embodied carbon of finished metals. Companies such as Arbaflame and AIREX have begun producing these fuels as demand for lower-emissions industrial fuels grows in Europe and North America.

Five-year outlook

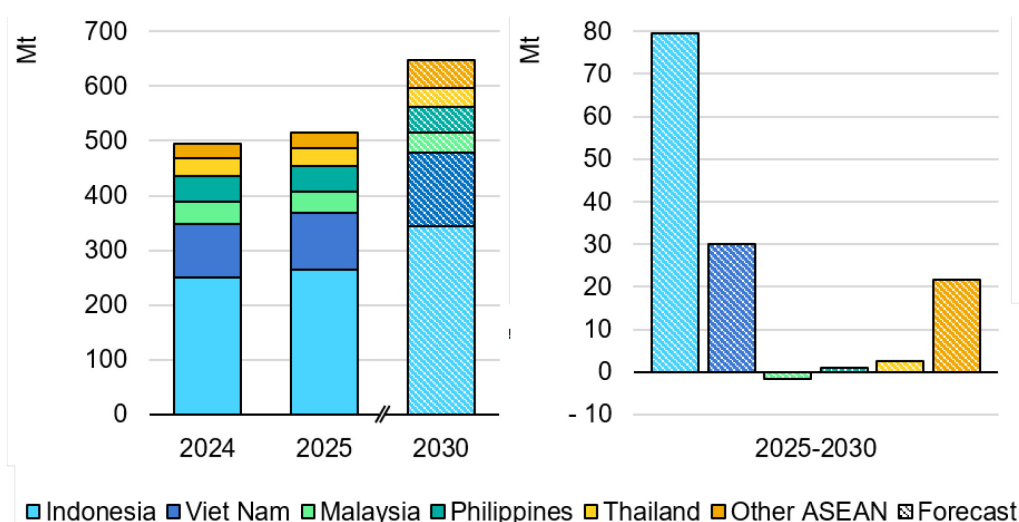
Demand

Coal demand in the ASEAN region is projected to continue rising through to 2030, growing by around 4.4% per year to reach 647 Mt, the fastest growth of any region worldwide. Indonesia is projected to account for over 56% of this growth, while Viet Nam and the Philippines also see steady increases linked to power sector development.

Indonesia's coal demand is projected to rise to 344 Mt by 2030, with power generation and metals processing accounting for the bulk of incremental volumes. Coking coal consumption, both to meet demand from the domestic steel industry and for coke exports, is forecast to increase by over 60% through to 2030. This trajectory positions Indonesia as the largest coal consumer in ASEAN and on track to become the third-largest globally. Coal demand in Viet Nam is projected to rise steadily to 134 Mt by 2030, with power generation driving the majority of growth and industry providing additional support.

Outside Indonesia and Viet Nam, coal demand remains tied mainly to power generation. In the Philippines, consumption is forecast to reach 57 Mt by 2030 as coal-fired generation continues to provide baseload supply alongside accelerating renewables deployment. Malaysia's coal use is expected to remain broadly stable to 2030. In Thailand, demand is forecast to remain at around 35 Mt in 2030, as higher electricity demand and the extended operation of the Mae Moh lignite plant sustain output despite renewable additions and greater LNG availability. In Lao PDR, coal-fired generation remains primarily export-oriented, with the Hongsa power plant supplying Thailand and new projects in Xekong and other provinces targeting Cambodia and Viet Nam, reinforcing regional interconnections.

Evolution of coal consumption in ASEAN and forecast change by country, 2024-2030



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Note: Mt = million tonnes.

Supply

Indonesia and Lao PDR are the only net exporters of coal in the ASEAN region. As regional demand continues to grow and no major production increases are expected in other ASEAN member states, import dependency across the rest of ASEAN is likely to rise further. For metallurgical coal, the supplier mix is not expected to change materially over the forecast period, with Australia remaining the largest source of imports, followed by Russia, the United States, Canada and Mozambique.

Phase-out plans and transition pathways

Coal has significant environmental impacts throughout its life cycle – from mining and transport to consumption. Open pit mining, common in Indonesia, disturbs land, while underground mining can cause subsidence and affects water resources. These effects can persist long after a mine closes if land rehabilitation measures are inadequate.

Coal-fired power generation is also the world's largest source of CO₂ emissions. Carbon capture, utilisation and storage (CCUS) technologies can reduce emissions from coal-fired power plants, but their economic competitiveness relative to other low-carbon technologies remains uncertain in many markets, particularly without substantial policy and commercial incentives to become economically feasible. Their deployment in ASEAN will likely remain limited through to 2030.

Coal consumption, especially in power plants, is also a primary source of local air pollution, which can be reduced by improving the adoption of existing technologies to efficiently capture particulates, sulphur and nitrogen oxides. Methane emissions from coal mining represent an additional environmental concern, with difficulty measuring them in open pit mining.

ASEAN member states have set out a range of long-term energy transition and emissions reduction objectives in their Nationally Determined Contributions, which are expected to influence future coal demand and investment patterns. Transition pathways vary considerably between ASEAN countries, reflecting differences in resource endowments, energy systems and development priorities. In this section we explore the ambitions and challenges of the six largest coal consumers in the region, with impacts on their coal phase-out plans.

Indonesia has committed to reach net zero by 2060 or earlier. This presents some challenges as coal is expected to remain important for both the power and industrial sectors, particularly for nickel processing. Coal is also an important provider of jobs, as well as state revenues through taxes and royalties. Some regions in Indonesia, such as East and South Kalimantan, are among the most coal-dependent regions in the world.

Different transition pathways involve different risk profiles. The expansion of renewable energy is an important pathway, while its large-scale deployment requires extensive investment in generation assets, transmission infrastructure and energy storage. In addition, as a result of the dependence of those technologies on critical mineral supply chains, energy security risks may shift from fuel supply chains to technology and material supply chains during the transition process. On the other hand, greater reliance on natural gas may increase exposure to international fuel markets. These risks should be assessed alongside the risks associated with continued coal use while reducing its emissions footprint, through efficiency and flexibility upgrades, biomass or hydrogen co-firing, fuel switching, methane abatement, and CCUS.

In 2021 Viet Nam announced its target to reach net zero by 2050. The country's updated Power Development Plan VIII foresees no new coal-fired power plants being built after 2030, coal capacity being capped at 31 GW (from the current 28 GW) and plants that exceed 40 years of operation being closed if they cannot be converted into clean fuels, such as hydrogen or ammonia.

Malaysia is committed to achieving net zero by 2050. This requires a dramatic reduction in the coal-fired share of power generation, from over 50% today to near zero. In principle, coal-fired power plants in Malaysia will be retired as their PPAs expire, the first in 2029 and the last in 2044. This signal provides predictability and sufficient time to prepare substitution. The period from 2028 to 2033 needs to be prepared properly, as coal-fired power generation is set to halve in five years.

While the Philippines has not set a formal net zero emissions target, it has set a target to increase renewables' share of generation to 35% by 2030 to reduce its greenhouse gas footprint. The country has also introduced policies to limit the development of additional coal-fired generation beyond those already under construction.

In October 2025, Thailand moved its net zero target to 2050, 15 years earlier than the previous 2065. The country, with only 6 GW of coal plants in operation accounting for 15% of total generation, is well placed to remove coal-fired power generation from the electricity mix.

Cambodia has had a moratorium on new coal-fired power plants beyond those already approved up to 2021, and a coal-fired power plant sited near Botum Sakor National Park was cancelled in 2023, to be replaced by an LNG plant.

Several ASEAN member states, including Indonesia, Viet Nam and the Philippines, are also participating in international initiatives designed to support energy transitions, including Just Energy Transition Partnerships (JETPs) aimed at accelerating investment in cleaner energy technologies and power system development, and the Energy Transition Mechanism aimed at achieving an early phase-out of coal-fired plants. Some components of these initiatives have faced funding challenges.

Coal security assessment

Coal security risks differ significantly between ASEAN member states. The region remains a major coal producer and net exporter overall, but this position is heavily shaped by Indonesia's dominant role in regional production and exports. Several ASEAN member states remain highly dependent on imported coal for power generation, while demand for metallurgical coal and coal-based industrial energy is expected to grow in selected markets. This assessment focuses on three dimensions of the energy security assessment framework most relevant to coal: supply-side security, demand-side readiness, and exposure to economic and price risk. In contrast to the other thematic chapters, for coal the demand-side readiness section addresses the longer-term issue of the transition towards a net zero future. This reflects coal's status as the most carbon-intensive fuel.

Supply-side security

ASEAN's coal supply-side risks are defined by member states' ability to access sufficient coal supplies at an affordable price. ASEAN is a net exporter of coal, and so its supply-side risks are shaped less by aggregate regional scarcity than by concentration, trade dependency and fuel-specific differences between thermal and metallurgical coal.

Indonesia provides the bulk of regional coal output and is the main supplier for several ASEAN importers. While coal is generally a liquid and globally traded fuel, this concentration creates a regional vulnerability if Indonesian supply is constrained, domestic demand rises sharply or export restrictions are introduced during periods of market stress. For instance, as Indonesia is the dominant supplier for ASEAN thermal coal importers, policies set in Indonesia relating to licensing and permitting requirements, production quotas and the Domestic Market Obligation can all have an impact on coal supplies for importers. Additionally, transport disruption caused by meteorological events, such as low river levels, can create supply risks.

For thermal coal, the main security challenge is therefore not the absence of regional resources, but the dependence of several ASEAN member states on a limited set of suppliers and logistical routes. Cambodia, Malaysia, the Philippines, Thailand and Viet Nam are all net importers, mainly for power generation. Their exposure differs according to the role of coal in their power mix, the availability of domestic alternatives, port and stockyard capacity, supplier concentration, coal dependency among end-use sectors, and the flexibility of power systems to switch to other fuels or generation sources during disruption.

Metallurgical coal presents a more specific vulnerability. ASEAN has limited coking coal resources, which are mainly concentrated in Indonesia, while metallurgical coal demand is expected to grow with steelmaking and metals processing in Indonesia, Malaysia, Viet Nam and, potentially, the Philippines. Current procurement is diversified across at least five external suppliers, including Australia, Canada, Mozambique, Russia and the United States, and no one country supplies more than 50% of ASEAN's consumption. However, the strategic importance of metallurgical coal for industry warrants continued monitoring of supplier concentration, contract coverage, transport routes and stockholding practices to ensure supply security. Given the relatively low cost of storing coal and coke, strategic or commercial stockpiles can provide a practical buffer against temporary supply disruptions for both thermal and metallurgical coal.

Demand-side readiness

Demand-side readiness for coal is defined here as the ability of the energy system to adjust in the face of disruption in a secure and resilient manner, reducing coal dependency without compromising electricity security or industrial output. Unlike oil, where short-term behavioural measures can temporarily reduce demand, coal demand in ASEAN is concentrated in power generation and industrial processes, where short-term demand reduction options are more limited. This makes advance planning especially important, as different pathways carry different types of risks and timelines. For instance, large-scale renewable deployment requires grid and flexibility upgrades, greater reliance on natural gas can increase exposure

to international fuel markets, and CCUS development carries financing challenges. Thus, the question is not necessarily which pathway is chosen, but ensuring the transition is achieved in a secure, resilient and orderly manner.

The most important fuel-switching challenge is managing the transition away from coal while maintaining secure and affordable electricity supply. Several ASEAN member states, including Indonesia, Malaysia and Viet Nam, have adopted net zero targets or long-term decarbonisation objectives. Achieving these goals will require coal plant retirement, reduced utilisation, conversion or retrofitting with technologies such as CCUS where feasible.

In ASEAN member states with large and relatively young coal fleets, premature retirement without sufficient replacement capacity could create risks if power system adequacy is not properly addressed, particularly as building new power generation capacity and expanding the electricity grid can face extended timelines. It can also increase reliance on imported fuels if coal is replaced with gas, or raise electricity costs in particular if the non-depreciated coal assets need to be recovered.

The risk of stranded assets is particularly relevant in Indonesia and Viet Nam, where substantial coal-fired capacity has been added since 2015 and many plants have remaining technical and economic lifetimes extending well beyond current transition timelines. [An ACE study](#) found that around 30 GW of coal-fired capacity could be at risk of becoming stranded by 2055 under a scenario with greater renewable energy deployment and carbon pricing. While the age profile of the ASEAN coal fleet suggests that a [large share of plants will be more than 25 years old by 2040](#), early retirement will nevertheless require careful planning. This includes mobilising appropriate financing mechanisms to recover non-depreciated assets while co-ordinating replacement capacity, grid expansion, system flexibility and the timing of investments in renewable energy, storage, transmission and, where appropriate, other dispatchable resources. In some cases, repurposing or co-firing existing coal assets with lower-emission fuels may provide an alternative pathway to reducing emissions while limiting the risk of stranded assets and supporting system reliability.

Industrial coal demand also requires forward-looking demand-side planning, particularly with the growth of nickel processing-linked captive coal power in countries such as Indonesia. In nickel processing, coal-based captive power and coal-intensive processing routes currently provide reliable and low-cost energy for industrial production, albeit with high emissions. The dominant rotary kiln electric furnace route relies heavily on coal for process heat, metallurgical use and reliable captive power generation. This creates a structural source of coal demand that may persist even as grid-connected power systems decarbonise.

However, continued reliance on these assets may raise future transition costs, complicate net zero pathways and create export risks if importing ASEAN member

states apply stricter sustainability standards to nickel supply chains. ASEAN governments can reduce these risks by encouraging cleaner power supply and industrial planning for industrial clusters, assessing alternative processing technologies such as high-pressure acid leaching where appropriate, and avoiding further lock-in of captive coal infrastructure where lower-carbon options are viable.

Exposure to economic and price risk

Coal price and affordability risks vary across ASEAN depending on whether member states are producers, exporters, importers or large consumers. Import-dependent ASEAN member states are exposed to international coal price volatility, freight costs and currency movements, particularly where coal plays a major role in electricity generation. At the same time, coal exporters and producers face risks from changing global demand, evolving environmental standards and policy measures that may affect future trade and investment.

Domestic coal pricing policies can support affordability and supply security, but they can also create unintended risks if they weaken producer incentives. Indonesia's Domestic Market Obligation and regulated domestic coal prices have helped shield the power sector from international price volatility, but such mechanisms need careful design and periodic review. If regulated prices are set too low or procurement mechanisms are insufficiently flexible, producers may have weaker incentives to supply the domestic market, increasing potential risk of shortages, load-shedding or emergency interventions.

The June 2026 load-shedding and rolling blackouts in Indonesia highlighted the importance of maintaining capacity adequacy, reliable fuel supply arrangements, adequate stockpiles and sufficient flexibility in procurement and logistics systems to respond to unexpected disruptions. While the causes of such events can be multifaceted, they underscore the need to ensure that domestic pricing and supply arrangements remain compatible with secure and reliable electricity provision. As the largest supplier in ASEAN, domestic shortages or changes in export policy can therefore affect neighbouring countries that rely on Indonesian coal. This underlines the need for transparent market monitoring, early warning mechanisms and regional co-operation to avoid abrupt measures that could amplify supply risks across the ASEAN region.

More broadly, coal security policies need to balance affordability, reliability and transition risks. Broad price controls or untargeted subsidies may protect consumers in the short term, but can distort investment and supply incentives if maintained for too long. A more resilient approach would combine targeted affordability measures, transparent pricing and procurement frameworks, adequate stockholding at power plants and industrial facilities, and transition planning that reduces exposure to coal price volatility over time.

Electricity and renewables security review

Southeast Asia's electricity systems are undergoing rapid transformation, driven by rising electrification and rapid demand growth, changing generation mixes with increased penetration of variable renewable energy (VRE) and distributed energy resources, and evolving market structures. The share of electricity in final consumption has been rising across the region, with electricity currently accounting for [23% of final consumption](#), higher than the global average. Ensuring secure, reliable and affordable electricity supply is becoming increasingly vital as systems expand and integrate new technologies while transitioning away from fossil-fuel generation.

Electricity demand

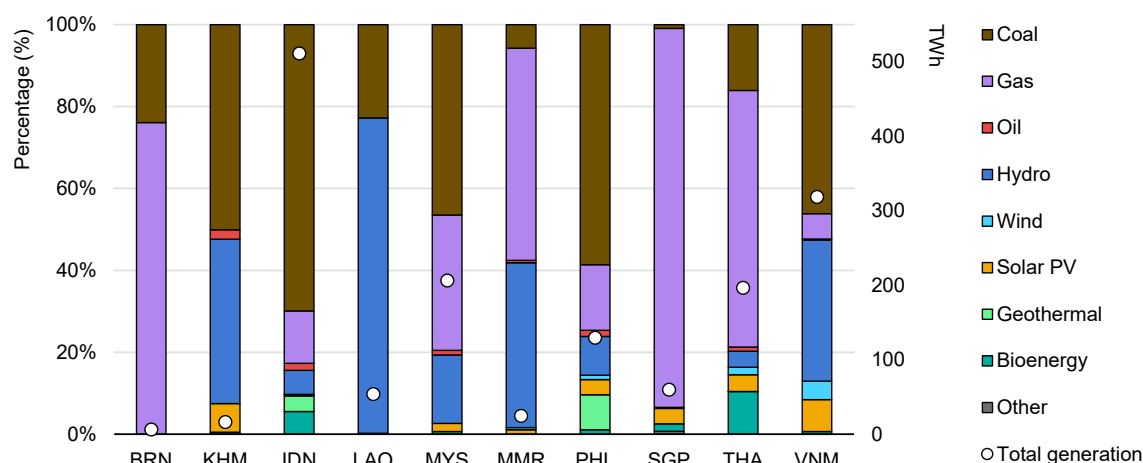
The ASEAN region has experienced some of the world's fastest growth in electricity demand, with an average annual increase of 6% since 2015. In 2024, regional electricity demand increased sharply by 8.6%, before easing to close to 3% in 2025 as milder weather and slower economic growth moderated electricity consumption. Indonesia accounts for around one-third of total electricity consumption in the region and is also the largest contributor to demand growth. Electricity use is currently concentrated in industry and buildings, with transport electrification still at an early stage. However, national targets and plans across the region emphasise the electrification of transport as a core pillar of long-term energy and climate strategies. For example, transport electrification is promoted in the [APEC 2026-2030](#) as well as in [Malaysia's National Energy Transition Roadmap](#).

Electricity supply

On the supply side, despite strong growth in renewable energy over the past decade, coal remains the backbone of ASEAN's power system, providing nearly half of total electricity generation. Coal accounted for around 70% of generation in Indonesia, almost 60% in the Philippines and nearly 50% in Viet Nam. The coal fleet is relatively young, with an average age of around 15 years, implying limited retirements in the near term. Natural gas also plays a central role in several ASEAN member states, particularly in Brunei Darussalam, Singapore and Thailand. Hydropower dominates the generation mix in Lao PDR and contributes substantially in Cambodia, Myanmar and Viet Nam.

While hydropower remains the dominant renewable resource in the region, solar PV has driven most renewable capacity expansion in recent years. Installed solar capacity reached [nearly 38 GW in 2025](#), more than 15 times the capacity installed a decade ago. This deployment of variable renewables remains concentrated in a few members states, with only Viet Nam exceeding 10% in its generation mix. However, with a technical potential for utility-scale solar PV and wind estimated at around [20 TW](#), there is significant scope to expand these resources.

Power generation mix by fuel and total power generation in ASEAN by country, 2025



IEA. CC BY 4.0.

Notes: Other includes manufacturing gases, chemical heat, industrial waste, non-renewable municipal waste and any other non-specified. TWh = terawatt hours. Three-letter country codes: BRN = Brunei Darussalam; KHM = Cambodia; IDN = Indonesia; LAO = Lao PDR; MYS = Malaysia; MMR = Myanmar; PHL = Philippines; SGP = Singapore; THA = Thailand; VNM = Viet Nam. No data available for Timor-Leste.

Electricity markets

Power sector structures in the ASEAN region range from vertically integrated utilities to liberalised market frameworks, creating different implications for ensuring reliable and affordable electricity supply. Most member states apply least-cost or merit order dispatch principles, although the implementation and transparency of these mechanisms vary depending on market structure and institutional arrangements. In vertically integrated systems, centralised planning and procurement can support resource adequacy by allowing governments or utilities to co-ordinate generation investment with expected demand, but may also reduce competitive pressure and weaken incentives for efficient operation and investment. In more liberalised markets, competition can strengthen price signals and support efficient short-term dispatch and investment decisions, although ensuring adequate capacity and managing price volatility can require separate market and regulatory arrangements.

In several member states, including Thailand, Indonesia and Viet Nam, dispatch decisions are influenced by contractual obligations such as PPAs and fuel offtake

contracts. Where contracted generation is not aligned with demand or system needs, this can sometimes lead to oversupply situations and limit operational flexibility, resulting in uneconomic curtailment of VRE. The balance between long-term contracting and exposure to market signals is therefore an important consideration for both system security and the cost of electricity supply.

By contrast, the Philippines and Singapore operate competitive wholesale electricity markets based on market bidding. These systems feature relatively short dispatch intervals, five minutes in the Philippines and thirty minutes in Singapore, with gate closure close to real time. Both countries have also developed mechanisms to procure ancillary services. For example, the Philippines launched an ancillary services market in 2024 to complement the contracted capacity procured through the [Ancillary Service Procurement Agreement](#).

These market-based arrangements can improve operational efficiency and provide stronger price signals, but they do not necessarily translate into lower electricity prices for consumers. The Philippines and Singapore also have among the highest electricity prices in ASEAN, reflecting a combination of market conditions, fuel costs, import dependency, network charges and other policy costs.

Market frameworks and key system operation practices of ASEAN member states

	Market structure	Procurement of system services	Dispatch interval	Gate closure
Brunei Darussalam	Vertically integrated	No formal market	60 min	N/A
Cambodia	Single buyer	No formal market	60 min	N/A
Indonesia	Single buyer	No formal market	60 min	N/A
Lao PDR	Single buyer	No formal market	60 min	N/A
Malaysia	Single buyer	No formal market	30 min	N/A
Myanmar	Single buyer	No formal market	60 min	N/A
Philippines	Liberalised market	Market + contract	5 min	9 min ahead
Singapore	Liberalised market	Market + contract	30 min	65 min before dispatch
Thailand	Single buyer	No formal market	30 min	N/A
Timor Leste	Vertically integrated	No formal market	60 min	N/A
Viet Nam	Single buyer + retail competition	No formal market	30 min	N/A

Notes: Dispatch interval refers to a given time interval in which generators are scheduled to operate. For market-based systems, the dispatch interval determines how often the market operator clears bids and schedules generation. In non-liberalised markets, the dispatch interval refers to the period during which system operators issue dispatch instructions to generators. However, they may redispatch at any desired time according to system needs. Gate closure timing is only applicable to liberalised markets. N/A = not applicable.

Source: IEA (2025), [Integrating Solar and Wind in Southeast Asia](#).

Market structures are also evolving in the region. At a regional level, the expansion of multilateral power trading through the ASEAN Power Grid (already operational between Lao PDR, Thailand, Malaysia and Singapore) is a chance to broaden access to electricity markets and improve the ability of system operators and market participants to respond to changing system conditions. Viet Nam is progressively developing more competitive wholesale and retail electricity markets, including through its [direct power purchase agreement framework](#) and [ongoing review of competitive market design](#). Thailand is considering greater competition in electricity supply through [third-party access](#) and wheeling arrangements, while Malaysia is introducing greater short-term competition within its single-buyer model through the [New Enhanced Dispatch Arrangement](#), which allows generators without long-term PPAs to participate in electricity supply.

Five-year outlook

Demand

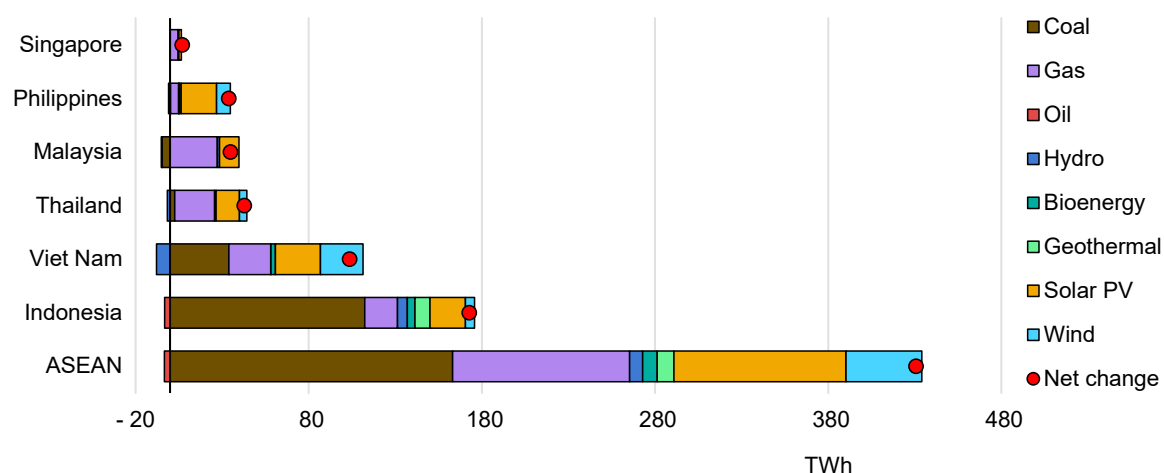
Electricity demand in Southeast Asia is projected to continue expanding rapidly, growing at an average annual rate of 5.4% during 2026-2030, driven by rising demand for cooling, data centres and industry. Indonesia is expected to drive the largest share of this growth, accounting for about 40% of additional electricity demand over the period. Viet Nam is projected to account for 26% of demand growth, followed by Thailand and Malaysia at 8%, and the Philippines at 7%.

Supply

On the supply side, coal-fired generation is forecast to increase at an average annual rate of around 4% during 2026-2030. Despite this growth, coal's share in the electricity mix is expected to decline slightly over the outlook period. Gas-fired generation is expected to expand by 5% per year on average through to 2030, slower than previously anticipated before the Hormuz crisis.

Renewable generation is expected to expand at a strong pace as ASEAN member states accelerate the deployment of wind and solar PV. Wind generation is projected to grow by around 26% annually, while solar PV is expected to increase by about 23% per year over the forecast period. As a result, the combined share of wind and solar PV in the electricity mix is expected to rise from around 5% in 2025 to 11% by 2030. Hydropower will remain the dominant renewable resource in the region, although its share of total renewable generation is projected to fall to below 50% by 2030 as wind and solar PV expand.

Electricity generation change in ASEAN and selected ASEAN member states, 2025-2030



IEA. CC BY 4.0.

Note: ASEAN data do not include Timor-Leste due to lack of available data.

The outlook remains sensitive to fuel market and geopolitical developments, including those in the Middle East. Continued reliance on imported LNG and coal for power generation means that disruption to fuel supply chains or international fuel prices could affect generation costs and, depending on market and tariff structures, wholesale electricity prices and retail tariffs over the outlook period. These risks are likely to be more pronounced in gas-reliant systems and those with wholesale electricity market exposure, where changes in fuel costs can be reflected more quickly in electricity prices. While the baseline outlook points to continued growth in both fossil fuel and renewable generation, fuel market volatility could affect the cost, affordability and reliability implications of this expansion, particularly in systems with high import dependency.

Electricity security assessment

Electricity security is the electricity system's capability to ensure uninterrupted availability of electricity by withstanding and recovering from disturbances and contingencies. The ASEAN region is facing a widening set of electricity security challenges due to a tightening supply and demand balance, changes in the generation mix with more VRE, and constrained electricity networks. The region is also becoming increasingly reliant on imported LNG and coal for power generation, as outlined in the previous chapters, which exposes it to fuel supply disruption and price volatility. At the same time, cybersecurity threats and more frequent climate-related events such as droughts and heavy storms are already affecting system security. These trends create complex policy trade-offs between maintaining reliability and affordability while advancing emissions reduction and renewable energy deployment.

Electricity security should be assessed across several dimensions of the energy security assessment framework. Supply-side security depends on the adequacy of the systems to meet rising demand, including sufficient availability of generation and grids (including interconnections). Demand-side readiness depends on the ability to manage peak loads, improve efficiency and mobilise demand-side flexibility as electrification expands; this is assessed in the chapter on Energy efficiency and demand-side management. Exposure to economic and price risk is shaped by fuel import dependency, power sector cost recovery, tariff design and investment needs. System resilience depends on the ability of power systems to absorb and recover from disruptions, including extreme weather events and infrastructure failures, and the flexibility of the system to accommodate solar and wind generation. Emergency planning requires clear operational procedures, reliable data, effective system operation and regional co-operation. These dimensions highlight the need for integrated electricity security planning, stronger grid and flexibility investment, and greater attention to climate resilience in infrastructure and system operation.

Supply-side security

System adequacy

In electricity systems, a key dimension of supply-side security is system adequacy, which refers to the system's ability to meet all levels of demand under normal operating conditions. Adequacy assessment is forward-looking and a key part of power system planning to identify potential reliability risks and inform investment decisions. The metrics used for adequacy assessment can be grouped into two broad categories: deterministic metrics such as reserve margin,⁵ and probabilistic metrics including loss of load probability (LOLP), loss of load expectation (LOLE) and expected energy not served (EENS).⁶ These metrics provide some information on the likelihood of lost load and primarily give a signal as to whether the system has sufficient capacity.

Most ASEAN member states continue to rely primarily on traditional deterministic reserve margin metrics for reliability targets. In several countries, including Indonesia and Brunei Darussalam, reserve margin criteria are often set well above international standards, which can result in overinvestment in generation capacity. However, as power systems become more complex, driven by increased uncertainty in demand and supply and an increasing share of VRE, there is a growing trend towards probabilistic metrics to capture system risk and extreme

⁵ Reserve margin is the available capacity margin expressed as a percentage of peak demand.

⁶ LOLP is the probability that supply will be insufficient to meet demand during a given timeframe (hr/year). LOLE is the expected duration that demand will not be met (hr/year). EENS is the magnitude of unserved energy (MWh).

conditions. A number of countries, including Malaysia, Singapore, Thailand and Viet Nam, have already adopted or are moving towards probabilistic reliability criteria as part of their adequacy assessment.

Power system reliability metrics and criteria in ASEAN

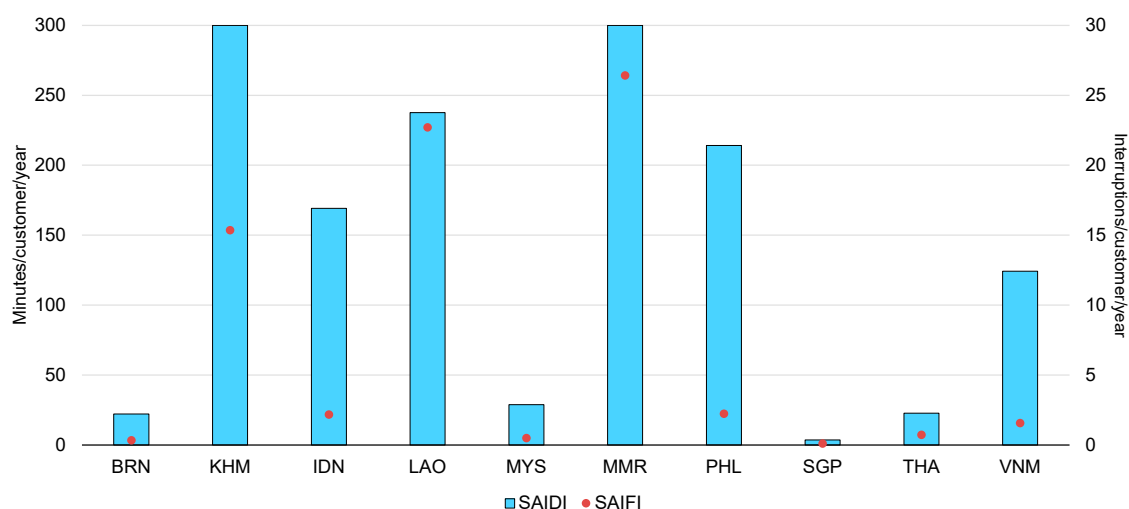
Country	Metrics and criteria
Brunei Darussalam	Reserve margin: 45%
Cambodia	Reserve margin: 20%
Indonesia	Reserve margin: 35% for Java-Bali LOLP: 1 day/year
Lao PDR	Reserve margin: 15%
Malaysia	Peninsular Malaysia reserve margin: 25% (20% in 2037); LOLP: 1 day/year
	Sabah reserve margin: 35%
	Sarawak reserve margin: 30%
Myanmar	Reserve margin: 15% (20% from 2027)
The Philippines	Reserve margin: 25%
Singapore	LOLH: 3 hours/year; reserve margin 27%
Thailand	Reserve margin 15% (moving to LOLP: 0.7 day/year)
Timor-Leste	No data
Viet Nam	LOLE: 12 hours/year
	Reserve margin: 15%

Source: ACE (2026), [AIMS III Phase 3 – Integrated Resource and Resilience Planning](#).

The diversity of reliability metrics and criteria across ASEAN reflects differences in system characteristics and planning practices. No single assessment or indicator can provide a complete picture of electricity security. While system adequacy assesses whether sufficient resources are expected to be available to meet demand, it does not have a direct link with actual quality of electricity service experienced by consumers. A system with a high reserve margin may still experience frequent power outages.

System average interruption frequency index (SAIFI) and system average interruption duration index (SAIDI) reflect the quality of electricity services by measuring the frequency and duration of interruptions experienced by consumers. Network reliability varies widely across the region. Singapore records among the lowest interruption frequency and duration globally, as reflected in SAIFI and SAIDI indicators. Cambodia, Lao PDR and Myanmar experience more frequent and longer electricity supply interruptions, pointing to persistent reliability challenges due a combination of generation, transmission and distribution disruption.

System average interruption duration index and system average interruption frequency index in ASEAN, 2020



IEA. CC BY 4.0.

Notes: BRN = Brunei Darussalam; KHM = Cambodia; IDN = Indonesia; LAO = Lao PDR; MYS = Malaysia; MMR = Myanmar; PHL = the Philippines; SGP = Singapore; THA = Thailand; VNM = Viet Nam; SAIDI = system average interruption duration index; SAIFI = system average interruption frequency index.

Source: IEA analysis based on data from the World Bank archive (2020), [Doing Business \(Getting Electricity\)](#) (accessed 29 April 2026).

System resilience

Climate-related disruption is emerging as one of the region's main electricity security risks, impacting every segment of the electricity system and potentially leading to large-scale outages. Southeast Asia is among the regions most exposed to extreme weather events and its energy infrastructure is particularly vulnerable to weather-related hazards. More frequent and intense heatwaves, floods, droughts and tropical cyclones have had significant impacts on the electricity system through increased peak demand, lower power plant performance, reduced hydropower availability and physical damage to grid infrastructure.

Electricity grids are among the most climate-vulnerable elements of power systems and a leading source of climate-related outages in the region. [Around 20% of electricity grids in Southeast Asia](#) face the threat of tropical cyclones. Several countries have experienced major disruption associated with extreme weather events in recent years. Tropical cyclones have caused major outages in Viet Nam and the Philippines by damaging electricity networks; severe flooding and storm-related events have disrupted power supplies in Indonesia; and droughts and heatwaves have contributed to power supply shortages in Cambodia and Lao PDR.

As disruptions become more frequent and severe, electricity systems will need to be more [resilient and able to absorb, accommodate and recover from both short-term shocks and long-term changes](#). This can be done with procedures including reserve management, emergency operating procedures, load shedding arrangements, special protection schemes and system restoration plans.

Selected major supply disruptions in Southeast Asia

Country	Year	Key factors	Extent of outages
Viet Nam	2024	Tropical cyclones	• Damage to power plants and electricity grids with estimated costs of nearly USD 33 million • Supply disruption to more than 6.4 million customers
The Philippines	2021	Tropical cyclones	• Damage to transmission and distribution lines in Visayas and Mindanao • Supply disruption to more than 3 million customers
Cambodia	2019-2020	Drought	• 400 MW power deficit due to unavailability of hydropower plants • Disruption to 41% of the country's power generation
Lao PDR	2024	Drought	• Power outages that lasted as long as 26 hours
Indonesia	2026	Storm	• Faults in 500 kV and 275 kV transmission line • Blackout in Sumatra

Sources: ACE (2025), [Before the next dry season](#); Lao News Agency (2024), [Laos urges consumers to conserve electricity](#).

Strengthening electricity grids also plays a key role in enhancing system resilience. Beyond climate-related risks, electricity grids in several ASEAN member states also face challenges with congestion and bottlenecks, which present electricity security risks. Grid infrastructure development in the region is not keeping pace with electricity demand growth and renewable deployment. Viet Nam has experienced grid congestion in transmission and distribution networks, leading to renewable curtailment as solar and wind capacity has expanded much faster than grid infrastructure. The Philippines faces transmission bottlenecks between generation-rich areas and major demand centres, inter-island constraints and dependence on submarine cable infrastructure. Lao PDR faces limitations on its domestic grids and the need to strengthen its transmission backbone to improve system reliability and maximise utilisation of its hydropower resources. For Timor-Leste, the medium-voltage distribution networks have been

the primary source of outages, with ongoing upgrades to substations, network automation, digitalisation and a transition away from radial network structures.⁷

The rapid expansion of data centres is adding a further emerging challenge for grid resilience. Data centre electricity demand in Southeast Asia is expected to [more than double between 2025 and 2030](#), with much of this growth concentrated in regional hubs. Their large and geographically concentrated loads can require significant additions to local generation and network capacity, while their high reliability requirements leave limited tolerance for supply interruptions. In Singapore, where data centres already account for a [sizeable share of electricity demand](#), continued expansion requires additional power supply and grid capacity, alongside access to low-emissions sources as new tenders for data centres have [minimum requirements for clean electricity procurement](#). As data centre development accelerates across the region, insufficiently planned network and generation investment could create localised capacity and congestion constraints, while increasing competition for affordable and clean electricity.

More broadly, ageing grid infrastructure in the region will require substantial investment to expand and modernise networks, both to keep pace with growth in renewables and demand, and to withstand impacts related to climate change. A meshed grid topology, particularly around major generation and demand centres, [can offer flexibility with multiple paths for power flows](#), enhancing redundancy by adding extra backup layers in case of failure, and reducing the impact of localised outages. Annual investment in grids and storage in the region will need to substantially increase to meet announced targets, reaching [USD 30 billion by 2035 from USD 13 billion today](#).

Solar PV and wind supply chains

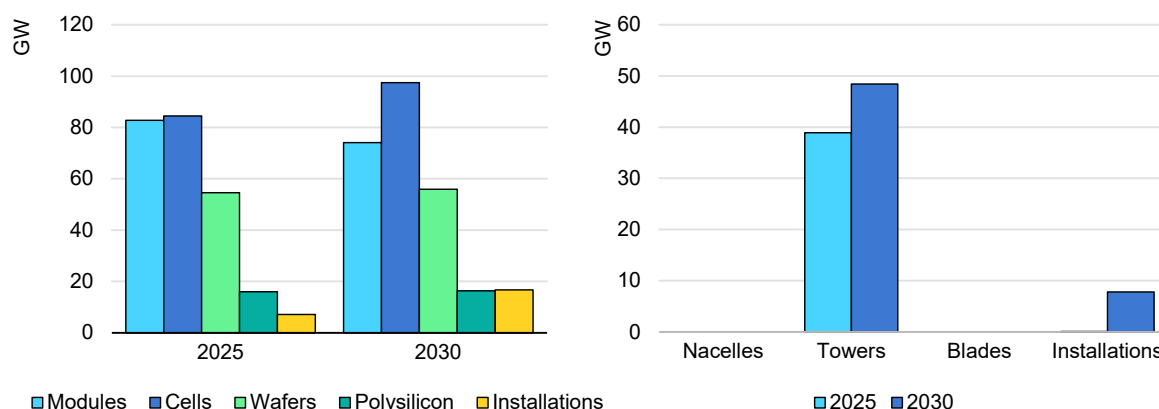
The ASEAN region is one of the world's largest solar PV manufacturing bases and is the only major manufacturing hub outside China with production capacity across the entire value chain. In 2025, regional manufacturing capacity exceeded 80 GW for modules, 85 GW for cells, 55 GW for wafers and 16 GW for polysilicon. The region is particularly important for wafer production, representing the largest manufacturing centre outside China. Manufacturing capacity is concentrated primarily in Malaysia, Thailand, Viet Nam and, increasingly, Indonesia.

Regional manufacturing capacity substantially exceeds domestic demand for solar PV equipment. Most production facilities were developed to serve export markets, particularly the United States, making ASEAN an important contributor to the geographical diversification of global solar PV supply chains. The region has

⁷ The information on grids in Lao PDR, the Philippines and Timor-Leste was gathered during country consultations.

benefited from competitive manufacturing costs, established industrial ecosystems and favourable trade access, attracting substantial investment from international manufacturers over the past decade.

Solar PV (left) and wind (right) manufacturing capacity and annual capacity deployment in ASEAN, 2025-2030



IEA. CC BY 4.0.

Note: GW = gigawatts

Source: IEA (2025), [Renewables 2025](#).

ASEAN manufacturing capacity is expected to remain broadly stable through to 2030. Production capacity for cells, wafers and polysilicon is projected to remain close to current levels, while module manufacturing capacity is expected to decline moderately as manufacturers relocate part of their production in response to evolving international trade policies and import restrictions, particularly in the United States.

Overall, ASEAN is among the world's most secure regions in terms of solar PV supply chain self-sufficiency. Existing manufacturing capacity is sufficient to supply projected regional demand across modules, cells and wafers throughout the forecast period. Only polysilicon production could become a limiting factor by 2030, with regional demand expected to exceed domestic manufacturing capacity as solar PV deployment accelerates.

However, manufacturing ownership remains highly concentrated. Approximately 70% of module manufacturing capacity, 55% of cell production and almost 80% of wafer manufacturing are owned by Chinese companies. While these facilities are physically located within ASEAN, the concentration of ownership may create vulnerabilities through dependence on foreign investment decisions, technology transfer and corporate supply chain strategies.

The security of wind turbine supply chains is considerably weaker than for solar PV. Of the main wind turbine components, ASEAN currently has manufacturing

capacity only for towers, with annual production estimated to be equivalent to approximately 40 GW of wind capacity, expected to increase to close to 50 GW by 2030. These facilities are located primarily in Viet Nam and largely serve export markets rather than regional deployment. As a result, ASEAN remains almost entirely dependent on imported equipment for other major turbine components – nacelles and blades – limiting supply chain resilience and reducing opportunities for local industrial value creation.

This dependency has had limited implications to date because regional wind deployment has remained modest, averaging less than 1 GW annually since 2021. However, wind installations are expected to accelerate significantly during the second half of this decade, reaching almost 8 GW per year by 2030 as more ASEAN member states introduce competitive procurement schemes and expand renewable energy targets.

Without corresponding investment in domestic manufacturing capabilities, growing wind deployment will increase reliance on imported equipment and associated exposure to global supply chain disruptions.

Exposure to economic and price risk

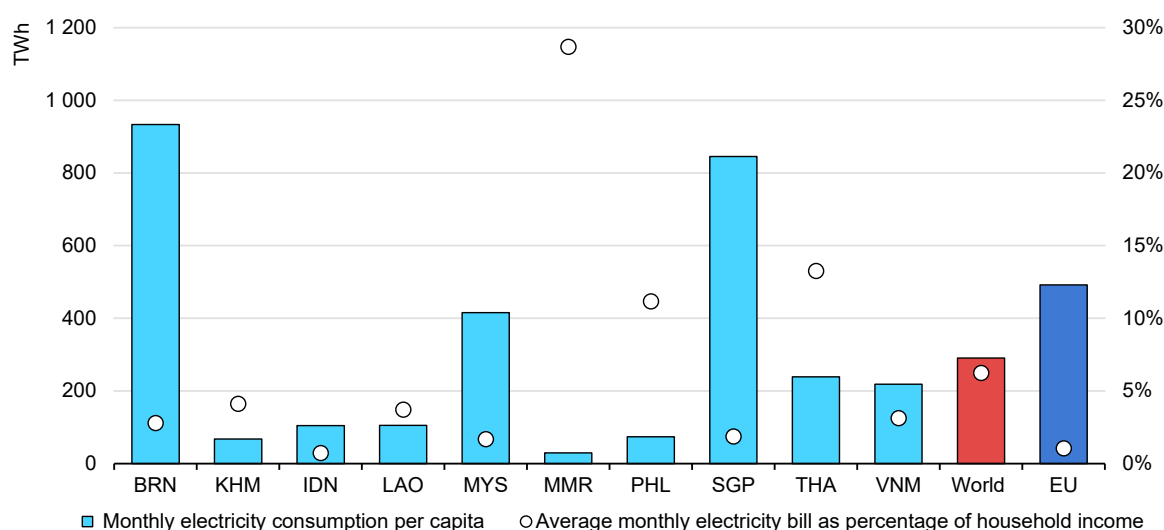
Electricity security in ASEAN is closely linked to exposure to imported fossil fuels, particularly natural gas and oil, which can transmit international fuel-price volatility into electricity costs. The degree of exposure varies across the region, but is particularly high in countries that rely heavily on imported fuels for power generation. Singapore, for example, imports the natural gas that [accounts for around 95% of its electricity generation](#), while the share [exceeds 60% in Thailand](#). Exposure can also increase temporarily when domestic resources are constrained, such as during Viet Nam's dry season, when lower hydropower output increases reliance on thermal generation.

The recent disruption affecting the Strait of Hormuz illustrates how exposure to imported fuels can translate into electricity price pressures. The effects have been most apparent in the two Southeast Asian countries with wholesale spot electricity markets, the Philippines and Singapore. In the Philippines, higher fuel costs significantly increased prices in its wholesale electricity spot market, prompting the government [to suspend the market on 26 March](#) as part of a series of emergency measures to address energy supply risks and price volatility. An administered pricing mechanism was introduced before [market operations resumed on 1 May](#). In Singapore, wholesale electricity prices [generally increased after the start of the conflict](#), in line with the increase in gas prices. Although long-term contracting arrangements limit the spot price impact on Singapore's consumers, [these increases have fed through to end-user prices with a lag](#), with a [17% increase](#) in the regulated tariff announced for the July-September period.

The economic impact of fuel price shocks also depends on how costs are distributed between households, industry, utilities and governments. Across the region, subsidies and regulatory mechanisms often limit pass-through to households, including through lifeline tariff programmes in Thailand, the Philippines and Lao PDR, or subsidies provided to small businesses, as in Indonesia. These measures can protect vulnerable consumers, but may increase fiscal costs or shift costs between consumer groups, including to industrial users through cross-subsidisation.

In several countries, including Myanmar, the Philippines and Thailand, electricity bills already represent a substantial share of household incomes. This limits the scope for passing higher fuel and system costs through to consumers, even as utilities need sufficient revenues to expand and modernise electricity systems. Governments therefore face a trade-off between preserving affordability and recovering the costs required to maintain reliable supply and support rising electricity demand, with regulated retail tariffs currently often [set below system costs](#). The appropriate balance will depend on countries' existing affordability pressures, subsidy burdens and fiscal space, with phased tariff increases or concessional financing for system investments potentially needed where affordability constraints are greatest.

Monthly electricity consumption and bills as a percentage of average household income in ASEAN, 2024



IEA. CC BY 4.0.

Notes TWh = terawatt hours. BRN = Brunei Darussalam; KHM = Cambodia; IDN = Indonesia; LAO = Lao PDR; MYS = Malaysia; MMR = Myanmar; PHL = the Philippines; SGP = Singapore; THA = Thailand; VNM = Viet Nam; EU = European Union. No data available for Timor-Leste.

Source: IEA (2025), [Integrating Solar and Wind in Southeast Asia](#).

Some ASEAN member states are also exploring structural measures to limit electricity price increases for end-use consumers. In Thailand, electricity tariff

reforms are underway, which include [removal of public levies from household electricity bills](#), [differentiated tariffs for large consumers such as data centres](#) and revised [electricity rates for residential consumers](#).

Reducing reliance on imported fuels can provide a longer-term route to improving affordability. Solar PV can reduce the fuel component of electricity costs by displacing generation from imported fossil fuels. In Thailand, several [solar tax incentive programmes](#) support residential and commercial deployment, such as income tax deductions and corporate tax exemptions. In Timor-Leste, where virtually all electricity is generated from diesel, solar PV constitutes a central part of the country's strategy to diversify its power mix while maintaining affordability. The Hormuz crisis has also accelerated interest in solar in some markets; for example, the import value of panels into the Philippines increasing by [145%](#) during the three months following the start of the crisis. However, the affordability benefits of solar will depend on how fuel savings translate into lower electricity costs for consumers, including through tariffs for grid-supplied consumers and avoided electricity purchases for self-consuming consumers, as well as how network and system integration costs are recovered.

System flexibility

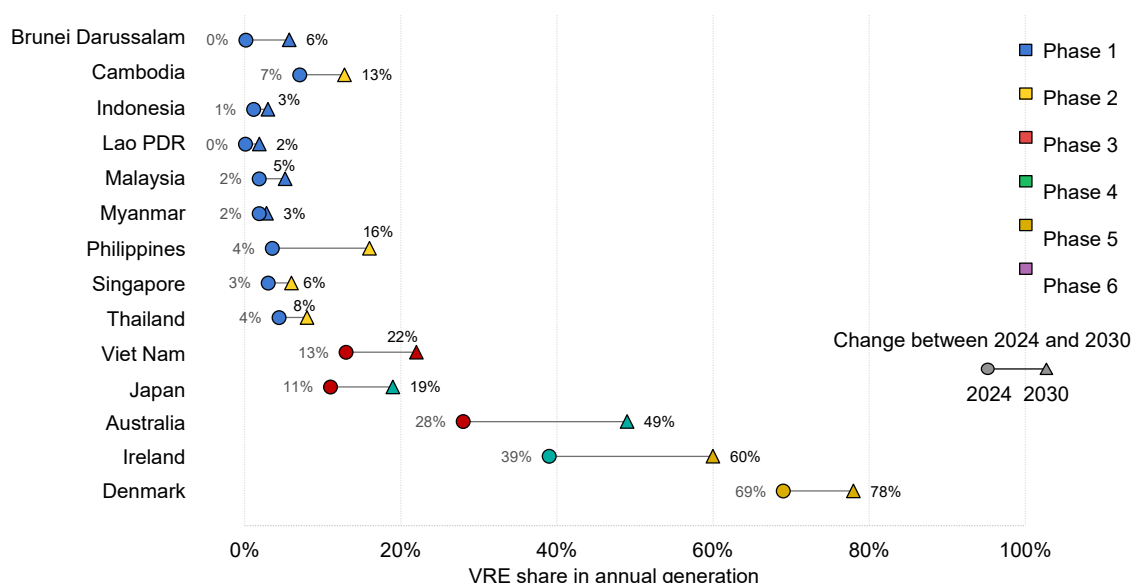
System flexibility⁸ is critical to electricity security. It enables the system operator to maintain a continuous balance between electricity supply and demand, which is becoming less predictable because of increasing VRE penetration. There are four main sources of flexibility: power plants; electricity grids; energy storage; and demand response. In addition, [accurate forecasting of generation and demand and enhanced operational rules](#) are key measures to effectively integrate VRE and meet flexibility needs. While renewable forecasting accuracy has significantly improved, demand forecasting is becoming increasingly challenging with increased electrification across end-use sectors. In most systems, flexibility resources and operational arrangements are not keeping pace with evolving system requirements.

The IEA's [phases of VRE integration framework](#) provides a basis for identifying system-level challenges and priority measures to enable the secure and cost-effective uptake of VRE according to the context of each country's power system. Radical changes to manage greater variability are generally not required until Phase 3. From now until 2030, [most ASEAN member states are expected to remain in Phases 1 and 2](#), where VRE integration has minor to moderate impacts at the system level and remains manageable. Flexibility requirements can be met

⁸ Power system flexibility is the ability of a power system to reliably and cost-effectively manage the variability and uncertainty of supply and demand across all relevant timescales, from ensuring instantaneous stability of the power system to supporting long-term security of supply.

through improved operational practices and more efficient use of existing system assets, particularly conventional generation and electricity grids. Viet Nam is currently the only country in ASEAN in Phase 3, with around 13% of generation from VRE in 2024; it has been experiencing greater swings in the supply–demand balance, prompting the need for flexibility that goes beyond using existing assets and operational practices. As countries progress to Phase 3, the need emerges for fast-responding flexibility resources including battery storage and demand-side flexibility (see in the chapter on Energy efficiency and demand-side management).

Phase assessment of VRE integration in ASEAN countries and comparison with higher-phase systems, 2024 and 2030



IEA. CC BY 4.0.

Notes: VRE= variable renewable energy. The phase assessments for 2030 are based on the IEA's Renewables forecast (main case). The assessments are not based solely on VRE share of annual generation, but also include a set of indicators that evaluate a power system's ability to balance generation across multiple timescales. The methodology used is part of the IEA's phases of VRE integration assessment framework provided in the [IEA Integrating Solar and Wind in Southeast Asia report](#). No data available for Timor-Leste.

As the share of VRE increases, ASEAN member states are adopting various measures to increase system flexibility and ensure electricity security, including improved renewables forecasting, system operational practices and rules and market frameworks. [Malaysia](#), [the Philippines](#), [Singapore](#), [Thailand](#) and [Viet Nam](#) have introduced sophisticated renewables forecasting systems to support cost-effective and secure system operation with VRE. The Philippines and Singapore have the most advanced market frameworks in the region, which play a key role in meeting system flexibility needs across different time horizons, including short dispatch and settlement intervals, and ancillary service procurement mechanisms.

Beyond operational improvements, ASEAN member states are gradually diversifying flexibility resources. Hydropower reservoirs continue to provide seasonal and daily flexibility in Lao PDR, while battery energy storage systems are playing an increasingly important role in Malaysia, the Philippines and Singapore. At the distribution level, improving visibility and control of distributed energy resources, including rooftop solar PV, is becoming an emerging priority, particularly in the Philippines and Timor-Leste, with the need for greater real-time monitoring and operational control.

As the ASEAN region's power systems continue to evolve, investments in grids, flexibility resources and operational capabilities are expected to play a larger role in maintaining security of supply.

Regional co-operation

Regional co-operation through cross-border interconnections can strengthen electricity security while reducing overall system costs and fossil fuel dependency. By linking power systems across large geographical areas, regional interconnections allow ASEAN member states to share renewable resources and flexibility services. This can help manage demand fluctuations and extreme weather events, reduce vulnerability to supply disruptions and strengthen system resilience.

The ASEAN Power Grid (APG) is a key strategic initiative for regional power co-operation and electricity connectivity. It was first formalised through the APG memorandum of understanding (MoU) signed in 2007 and strengthened through the [APG Enhanced MoU in 2025](#) with the goal of accelerating regional interconnectivity and multilateral power trade. The APG is also one of the key programme areas under the [ASEAN Plan of Action for Energy Cooperation 2026-2030](#). The momentum behind the APG is building with several key milestones in 2025, including: the [endorsement of the terms of reference](#) for the Submarine Power Cable Development Framework and the ASEAN Regional Renewable Energy Certificate Framework; the launch of the [APG Financing Initiative](#), with financing support of up to USD 12.5 billion announced by the World Bank and the Asian Development Bank; and the [Lao PDR-Thailand-Malaysia-Singapore Power Integration Project entering Phase 2](#).

The scale and complexity of APG interconnectors are also set to increase as much of the project pipeline consists of subsea cable and grid-to-grid projects, areas where the region has relatively limited experience. [Around USD 27 billion](#) of investment will be required between 2025 and 2040 to deliver the pipeline of projects proposed in the [ASEAN Interconnection Masterplan Study III](#) and other announced interconnection projects – a 14-fold increase compared with total interconnector investment in Southeast Asia since the 1970s. Realising the full

benefits of cross-border interconnection will also require domestic grid investment. This underscores the importance of clear implementation responsibilities and stronger regional co-operation, alongside credible financing structures.

Priorities to support APG implementation

Realising the electricity security benefits of the APG will require enabling domestic conditions and effective co-operation arrangements among participating countries to support cross-border power trade and move the APG from vision to implementation. These cover governance, regulatory framework, and technical and commercial arrangements that participating countries should align in order to develop and operate cross-border interconnectors and undertake power trade.

Priority areas for co-operation arrangements to support cross-border power trade and the implementation of the APG include effective institutional co-ordination, transparent approaches to transmission tariff and wheeling charges, cross-border cost-benefit analysis and cost allocation, co-ordinated system planning, grid code interoperability and data sharing.⁹ These arrangements will be essential to facilitate cross-border power trade, attract investment in regional interconnectors and enable the APG to fully contribute to electricity security in ASEAN.

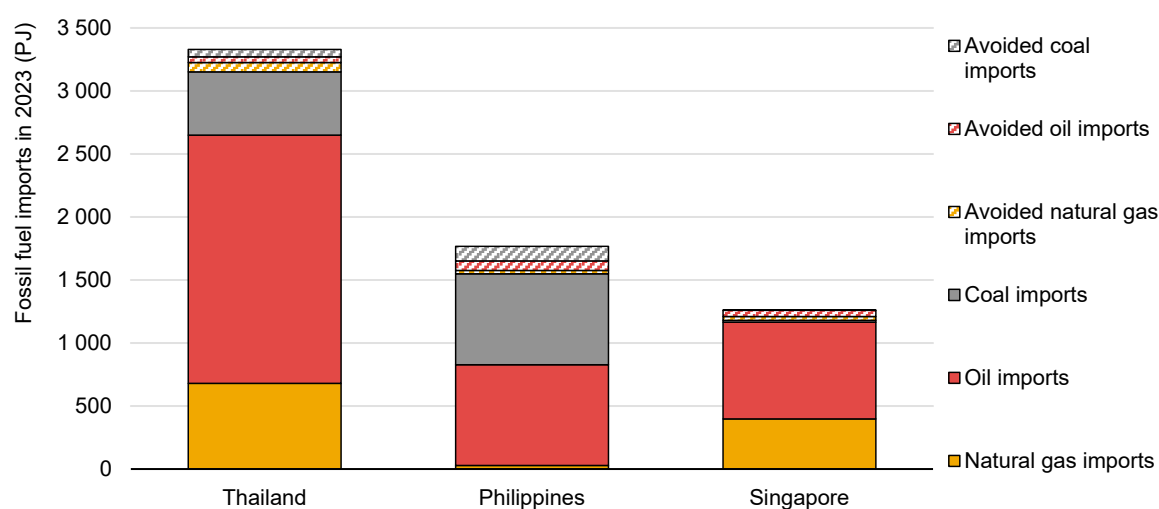
⁹ The priority co-operation arrangements were identified from a survey and stakeholder consultations conducted as part of the 2026 Singapore - IEA Regional Training, involving ASEAN ministries, regulators, utilities and international partners.

Energy efficiency and demand-side management

Energy demand in the ASEAN region is expected to grow by [2.6%](#) per year through to 2035 if no new policy actions are taken, with electricity increasing at a faster pace, rising by around 4% per year, as a result of increased industrial activity, growing populations and higher incomes. The conflict in the Middle East has [exposed the region's dependence](#) on imported fossil fuels to cover these growing needs, resulting in fuel shortages, rising costs and disrupted supply chains. Governments have reacted with [emergency measures](#) to reduce the impact on consumers.

Energy efficiency can become a key pillar of ASEAN member states' energy security strategy and help mitigate these risks by alleviating demand growth, thus reducing the reliance on fuel imports, improving grid reliability and acting as a buffer to supply shocks. Long-standing efficiency policies, such as building codes, performance standards and energy efficiency obligations, have contributed to a [20% reduction](#) in fossil fuel imports across major IEA economies in the past 20 years. In ASEAN member states, while energy intensity progress has been slower, the energy savings achieved mean that imports today are around 10% lower than they otherwise would have been. This difference suggests that ASEAN member states have substantial scope to further reduce fuel imports and enhance energy security through accelerated energy efficiency improvements.

Fuel imports in 2023 and annual avoided imports due to energy efficiency improvements since 2000



IEA. CC BY 4.0.

Notes: PJ = petajoules; Fuel imports are net of exports, marine bunkers and aviation bunkers. Savings in the Philippines comprise industry and buildings efficiency progress. Savings in Singapore comprise industry, buildings and transport efficiency progress. Savings in Thailand comprise industry and buildings efficiency progress.

In the electricity sector, the implementation of energy efficiency, demand-side response and flexibility measures can help reduce peaks and smooth demand profiles. This in turn increases energy system resilience and contributes to a reduction in costs by lowering required capacity reserves and avoiding the operational costs of gas-fired peaking plants. Energy efficiency measures targeted towards electricity demand reduction can defer costly infrastructure upgrades and free up capacity for new users, [at a lower cost](#) compared with new supply and transmission infrastructure.

The 2026 energy crisis has prompted the implementation of an array of measures in the region to slash energy demand, improve energy security, and relieve pressure on households and businesses. Some ASEAN member states were among the first globally to respond with policy action at the onset of the crisis, as many were hardest hit by their high dependence on oil imports from the Middle East. Within a week of the crisis, the Philippines and Thailand had already taken action to reduce oil consumption. [Responses](#) globally and in the region included energy conservation measures for immediate and short-term energy demand reductions, structural measures to reduce energy intensity and achieve longer-term energy security benefits, and consumer price support. The range of measures implemented provides important lessons on the variety and breadth of options available. Fuel subsidies or increased subsidy budgets were among the more popular response measures. While subsidies can help to relieve pressure on energy bills, when untargeted they can run counter to energy efficiency objectives and reduce the life cycle cost advantages of energy efficiency technologies.

Common measures implemented in ASEAN in response to the 2026 energy crisis

Energy conservation	Structural (energy efficiency, electrification, other)	Price support
Awareness campaigns asking energy consumers to save energy Encouraging working from home Efforts to limit private travel and promote use of public transport Limits on official travel and greater use of online meetings Transport restrictions Encouraging adjustment of cooling temperature set points	Scaling up energy efficiency programmes and measures Accelerating electrification, particularly in the transport sector Promoting electric cooking Encouraging renewable energy supply	Fuel tax cuts, fuel subsidies or increased subsidy budgets Fuel-price caps or stabilisation measures Targeted support to cushion households and vulnerable groups

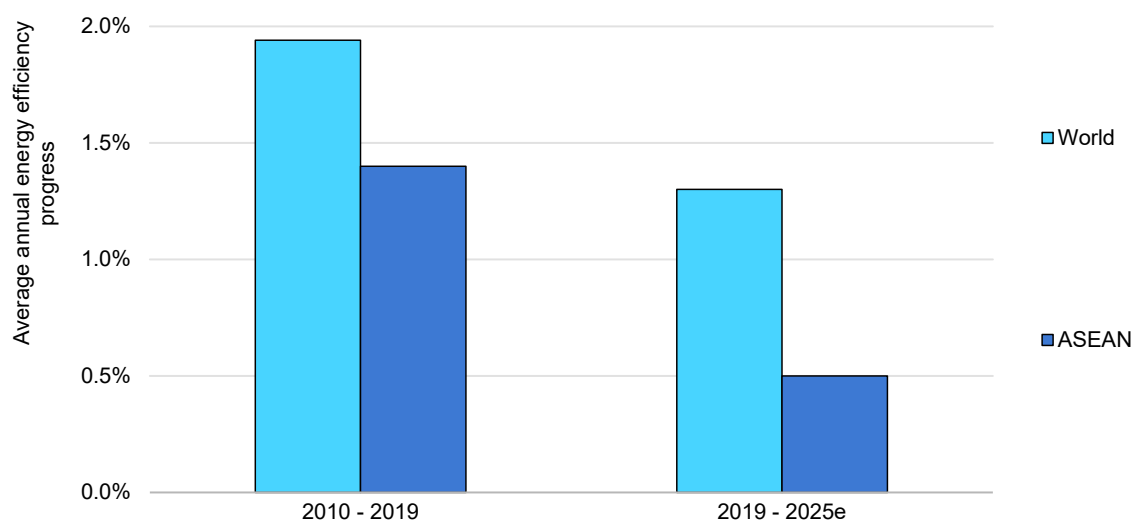
Energy efficiency

Energy intensity, measured as the primary energy required per unit of economic output (GDP), has seen a slow improvement in ASEAN so far this decade, staying below 0.5%. Average progress in the region has been well below the global average both in the period 2010-2019 and 2019-2025.

Current trends show significant potential for energy efficiency progress in the region through more stringent standards for appliances, further adoption of building energy codes, increased coverage of fuel economy standards in transport, the promotion of energy audits and energy management systems in industry, and increased and smart electrification of end uses.

The energy efficiency potential is acknowledged across ASEAN member states in the region. Most have set energy intensity progress targets through to 2030 and 2040 that are generally more ambitious than current trends. Additionally, an ASEAN efficiency target was established in the [ASEAN Plan of Action for Energy Cooperation \(APAEC\) 2026-2030](#), aiming to achieve a 40% reduction in energy intensity based on total primary energy supply by 2030, compared with 2005. This target represents an average annual energy improvement target of over 4% per year for the rest of the decade.

Average annual energy intensity progress in ASEAN, 2010-2019 and 2019-2025e



IEA. CC BY 4.0.

Source: IEA (2026), [Energy Efficiency Progress Tracker](#).

A common barrier to realising this potential is access to finance, a critical enabler of energy efficiency progress. ASEAN member states have introduced a range of fiscal measures to encourage investment in energy-efficient technologies and practices. Expanding and refining these mechanisms can help overcome

constraints, accelerate the deployment of efficiency and electrification measures, and strengthen energy security by moderating energy demand, reducing exposure to fuel price volatility and lowering reliance on imported energy.

Policy landscape

Buildings

Energy demand in buildings currently represents about 20% of total final demand in the region. However, population growth together with progress in energy access, rising living standards and higher incomes are reshaping energy consumption trends in the region. The implementation of energy efficiency policies can support the region's future energy security. Building energy codes can ensure that new and renovated buildings comply with minimum standards of energy efficiency, while energy certificates provide information to make better purchasing decisions and fiscal and non-fiscal incentives encourage households and developers to invest in energy-efficient equipment and solutions. Enabling smart, grid-interactive buildings can help manage peak loads and the integration of higher levels of VRE supplies. Some of these measures are already in force in ASEAN member states, but there is significant scope for greater ambition.

At the regional level, the ASEAN Centre for Energy (ACE) is working to encourage improvements in building sector energy efficiency through targeted activities, such as the Programme for Energy Efficiency in Buildings in ASEAN. ACE also issues [awards](#) that recognise leading private sector efforts to implement building energy efficiency.

Most ASEAN member states have adopted building energy codes, which are commonly set through a broader policy framework of legislation, regulations, technical standards and implementation guidelines rather than a single legislative instrument. [Singapore](#) stipulates mandatory energy efficiency requirements for large new buildings and renovations. The [Philippines](#), [Thailand](#) and [Viet Nam](#) stipulate mandatory energy efficiency requirements for many types of large new buildings and renovations, while [Indonesia](#) specifies mandatory energy efficiency requirements for commercial buildings, and additional requirements through the [Smart Building Regulation](#). [Malaysia](#) requires all building types to meet a roof thermal performance standard, and new or renovated non-residential buildings with large air-conditioned areas must meet a building performance standard and implement an energy management system. [Brunei Darussalam's](#) energy efficiency guidelines are mandatory for government buildings and voluntary for commercial buildings. [Cambodia](#) and [Myanmar](#) have green building or passive cooling criteria in place, and Cambodia is [progressing](#) efforts to develop its building energy code.

Participation in building energy certification and labelling schemes is voluntary in many ASEAN member states, including Brunei Darussalam, the Philippines, Singapore, Thailand and Viet Nam. Cambodia has a voluntary scheme available and is [progressing](#) the development of a [building rating and certification scheme](#) for possible implementation by the government. [Malaysia](#) sets a mandatory requirement for office buildings with a gross floor area of 8 000 m² or above to display an energy intensity label. Indonesia's [Smart Building Regulation](#) has established mandatory, recommended or voluntary classifications according to building type, with certification delivered through a national platform. Cambodia's Green Building Council offers green building certification and the country is currently [progressing](#) the development of a green building rating system.

[Indonesia](#), [the Philippines](#), [Thailand](#) and [Viet Nam](#) incentivise building energy performance through their national energy efficiency awards. [Indonesia](#) and [Malaysia](#) offer incentives in the form of government-funded building energy audits. [Singapore](#) provides cash incentives for building energy efficiency retrofits and allows developers up to 3% additional gross floor area for developments that achieve higher sustainability performance, including energy efficiency standards. [Thailand](#) provides revolving funds and subsidies for energy-conserving activities, and [Malaysia](#) offers a green building tax incentive. Several ASEAN member states are fostering the involvement of energy service companies (ESCOs), including [Indonesia](#), [the Philippines](#), [Singapore](#) and [Viet Nam](#). [Malaysia](#) and [Thailand](#) have focused on deploying ESCOs to improve the energy efficiency of government buildings.

Building sector energy efficiency regulations, information and incentives in ASEAN

	Building energy codes	Building energy certificates and labelling	Incentives for higher building performance
Brunei Darussalam	Mandatory (government buildings); voluntary (commercial buildings)	Voluntary (govt)	-
Cambodia	Voluntary guidelines; energy code in development	Voluntary (non-govt) In development (govt)	-
Indonesia	Mandatory (commercial buildings)	In force (govt)	Available
Lao PDR	-	-	-
Malaysia	Mandatory (selected non-residential buildings)	In force (govt)	Available (non-fiscal, fiscal)
Myanmar	Voluntary; compliance methods in development	In development (hybrid)	-

	Building energy codes	Building energy certificates and labelling	Incentives for higher building performance
The Philippines	Mandatory (large new buildings and renovations)	Voluntary (non-govt)	Available (non-fiscal, fiscal)
Singapore	Mandatory (large new buildings and renovations)	Voluntary (hybrid)	Available (including fiscal)
Thailand	Mandatory (large new buildings and renovations)	Voluntary (hybrid)	Available (non-fiscal, fiscal)
Timor-Leste	-	-	-
Viet Nam	Mandatory (large new buildings and renovations)	Voluntary (non-govt)	Available (non-fiscal)

Notes: govt = a government-led scheme; non-govt = a non-government led scheme such as a green building council scheme; hybrid = a scheme that is co-delivered by a government and non-government entity.

Data centres are creating a new source of electricity demand in the region, with their electricity demand in Southeast Asia set to more than [double](#) between 2025 and 2030, partially due to the establishment of regional hubs in Malaysia and Singapore. Both ASEAN member states have adopted policy mechanisms in this regard. Malaysia has introduced a [guideline](#) and [technical code](#) establishing voluntary power usage effectiveness (PUE) standards, and [incentives](#) are available for qualifying new data centre investments that meet a range of sustainability, green technology and other eligibility criteria. Similarly, under its [Green Data Centre Roadmap](#), Singapore has introduced a green building [certification process for data centres](#), introduced technical standards on [efficient data centre IT equipment](#) and on [safely running facilities at higher temperature and humidity levels](#), and a [grant](#) to help data centre businesses procure equipment meeting the standards. Companies applying to enter or expand in Singapore's data centre market through its [second Data Centre Call for Application](#) process need to meet these stringent energy efficiency standards.

Appliances

Rising appliance ownership has led to electricity becoming the main energy source in buildings today, and appliances are a major driver of electricity demand growth in the region. Appliance usage is also a driver of increasing oil demand – growing LPG consumption for cooking and water heating has increased LPG demand in buildings by around [30%](#) in the past decade. Almost all ASEAN member states have introduced a mix of measures to improve the energy efficiency of appliances, with MEPS and energy labelling chief among them. Regionally, foundational steps have been taken to harmonise efforts to facilitate improved implementation and effectiveness.

ASEAN has set an [ambitious target](#) for harmonised MEPS for room air conditioners, aiming for a cooling seasonal performance factor (CSPF) of 6.09 Wh/Wh by 2030, a level broadly aligned with international benchmarks for highly efficient room air conditioners. Although most countries in the region have MEPS in place, these are not yet fully aligned with the regional target. [Singapore](#) has already reached and exceeded the regional benchmark, with MEPS equivalent to 6.1 Wh/Wh for single-split air conditioners and stringent requirements also applying to multi-split systems, and Malaysia is set to achieve the target [in 2030](#) for smaller air conditioners (<4.5 kW rated cooling capacity). Most ASEAN member states are still well below, falling in the 3-4 Wh/Wh range. This means that there is potential to nearly double the stringency of the lower MEPS levels by 2030.

Air conditioners are a major driver of electricity demand in the ASEAN region. Only [18%](#) of households had an air conditioner in 2019, compared with almost [30%](#) today. The stock of air conditioners is set to [triple](#) by 2035. Ownership levels today [vary](#), from around 80% in Brunei Darussalam and Singapore to below 20% in Indonesia and the Philippines, and around 5% in Myanmar. As incomes rise, significant increases in ownership rates are projected. For example, in Indonesia the share of households with air conditioning is set to increase to [85%](#) by 2050. Cooling demand in the region is set to further accelerate due to the increase in the number of cooling degree days expected in the region in the absence of additional measures to mitigate climate change. These trends could drive up cooling demand in Southeast Asia [sixfold](#) between 2024 and 2050, placing a significant new load on electricity grids. The implementation of well-designed MEPS and labelling can help mitigate the growth of electricity demand for air conditioners by ensuring a minimum level of efficiency for new models and guiding consumers to more efficient models, while complementary policies to improve building envelope performance can ensure intended efficiency gains are realised.

For lighting equipment, ASEAN member states are advancing efforts to [harmonise MEPS](#). They agreed to progress towards introducing [mandatory MEPS](#) with a minimum efficacy threshold of 80 lm/W for LED and fluorescent lamps. Five member states have so far introduced such MEPS. To help achieve these regional targets, ASEAN's [Mutual Recognition Agreements](#) facilitate compliance by ensuring test reports and certifications are recognised across ASEAN member states, easing conformity assessment procedures. Most countries in the region have aligned with the regional targets, while others have lower efficiency requirements. Additionally, in some cases MEPS are not technology-neutral, which allows low-efficiency products such as incandescent or halogen lamps to be sold in the market, despite being below the efficiency requirements for LEDs.

Mandatory MEPS for fans and rice cookers have been introduced by a handful of ASEAN member states, and Thailand has introduced energy labelling for these

appliances. Five member states have introduced MEPS for refrigerators with another three having developed drafts. Many other types of appliances and equipment are covered by MEPS and labelling. [Thailand's](#) energy labelling scheme covers 27 product types, while [Viet Nam's](#) covers 19 and the [Philippines'](#) covers 8. By comparison, MEPS and labelling regulations in both [Malaysia](#) and [Singapore](#) cover 10 product categories, while [Indonesia](#) covers 8. Several ASEAN member states have implemented accompanying information tools, including campaigns and interactive product registers, including [Indonesia](#), [Malaysia](#), [Singapore](#) and [Thailand](#).

In 2025, ACE [launched](#) an online database of registered appliances from all ASEAN member states, including air conditioners, refrigerators and lighting products. The system aims to support effective and harmonised energy efficiency implementation in the region by enabling regulators to upload and share product compliance data, reducing trade barriers and facilitating compliance with efficiency standards across the region.

Appliance sector minimum energy performance standards in ASEAN

	Air conditioners (capacity <8 kW)	Rice cookers	Refrigerators	Lighting equipment	Fans
Brunei Darussalam	COP ≥ 2.9	-	Draft	-	-
Cambodia	- (Draft)	-	-	-	-
Indonesia	CSPF ≥ 3.4	Yes	Yes	Yes (>80 lm)	Yes
Lao PDR	-	-	Draft	-	-
Malaysia	CSPF ≥ 4.1	Yes	Yes	Yes (<80 lm)	Yes
Myanmar	-	-	Draft	Yes (>80 lm)	-
The Philippines	CSPF ≥ 3.08	-	Yes	Yes (>80 lm)	Yes
Singapore	WCOP > 4.86	-	Yes	Yes (>80 lm)	-
Thailand	CSPF ≥ 3.9	- (Voluntary label)	Yes	Yes (>80 lm)	- (Voluntary label)
Timor-Leste	-	-	-	-	-
Viet Nam	CSPF ≥ 3	Yes	Yes	Yes (<80 lm)	Yes

Notes: COP = coefficient of performance; CSPF = cooling seasonal performance factor; WCOP = weighted coefficient of performance; lm = lumen; kW = kilowatt.

Transport

The [transport sector accounts for about 30%](#) of total final consumption in the region, consumes around 60% of oil products and is the main [driver of rising oil demand](#). Road transport alone accounts for over 90% of the sector's energy demand. Fuelled by population growth, rising incomes and increasing

urbanisation, the light-duty vehicle (LDV) fleet in ASEAN is growing rapidly, with EVs playing an important role in improving fleet efficiency. In many countries in the region, two- and three-wheelers are the most prevalent mode of transport, being more numerous than cars and highly amenable to electrification. Heavy-duty vehicles (HDVs), where energy demand is also growing rapidly, are less readily electrified. Improving transport energy efficiency requires both more efficient vehicles and greater use of energy-efficient modes such as public transport.

The region is highly dependent on imported oil to fuel the transport sector, with [around 66%](#) of oil demand in ASEAN being met by imports in 2024. For this reason, the conflict in the Middle East is having a substantial impact on ASEAN member states, as fuel prices increase and as some oil products, such as diesel, face tight supply constraints. This highlights the role of energy efficiency and demand-side measures to ease the impact and shelter consumers from shocks.

Meeting the growing demand for transport services while increasing regional energy security will require implementation of a suite of policies. Several [national plans or strategies](#) exist, many containing ambitious [targets for EV adoption](#). The APAEC provides regional strategic direction for the sector's energy transition, as did the [ASEAN Fuel Economy Roadmap](#) (2018-2025). The roadmap set a target for a 26% reduction in new LDV fuel consumption in the decade to 2025, while the APAEC envisages the sector decarbonising through strengthened fuel economy standards, fuel switching, low-carbon mobility solutions and public transport adoption. To date, concrete action on improving LDV fuel economy has been limited to a few ASEAN member states and a few key policies.

The import of inefficient used vehicles hinders transport sector energy efficiency progress. Used vehicle imports are banned in Indonesia, the Philippines and Thailand, while Brunei Darussalam, Malaysia, Singapore, Timor-Leste and Viet Nam permit them subject to certain age and emission [limitations](#). Cambodia, Lao PDR, and Myanmar are yet to establish similar restrictions.

Light-duty vehicle fuel economy standards and labelling, import limitations and EV incentives, ASEAN

	Fuel economy standards and labelling	Used import limitations	Incentives for electric vehicles
Brunei Darussalam	-	<4-5 yr, Euro 4	-
Cambodia	-	-	Purchase tax preferences for EVs
Indonesia	None, but LCGC	Banned	Purchase tax preferences for local EVs
Lao PDR	-	-	Temporarily suspended imports of fuel-powered light vehicles
Malaysia	None, but LCMB	<4-5 yr, Euro 4	Road and purchase tax benefits

	Fuel economy standards and labelling	Used import limitations	Incentives for electric vehicles
Myanmar	-	-	-
The Philippines	Labelling	Banned	Excise tax exemption for EVs
Singapore	Tax-driven (implicit)	<3 yr, Euro 5	Comprehensive policy package
Thailand	CO ₂ excise (implicit) Labelling	Banned	Purchase tax preferences and subsidies for local EVs
Timor-Leste	-	<4-5 yr	Proposed EV purchase tax incentives
Viet Nam	Labelling	<4-5 yr, Euro 4	Purchase tax preferences for EVs

Notes: LCGC = Low Cost Green Car scheme, which provides tax incentives for small-engine cars that meet specified criteria, including a minimum fuel efficiency of 20 km/l and local content requirements. LCMB = Low Carbon Mobility Blueprint contains a progressive average fuel economy target for all new vehicles and commits to introducing labelling. “<4-5 yr”, “Euro 4” and other entries in the Used import limitations column refer to banning the importation of vehicles that do not meet these restrictions, adapted from [United Nations Environment Programme](#). Used import bans and limitations may apply to certain vehicle types or classes and exemptions may apply. EV = electric vehicle; yr = year.

Transport fuel policies can support energy security by reducing demand for oil imports. Implementation varies across the region. As a whole, ASEAN member states are making progress towards improving [diesel fuel quality](#), a necessary enabler for best practice Euro 6 or equivalent air pollutant emissions standards, with synergies for fuel economy improvements. Fossil-fuel subsidies, which totalled more than [USD 30 billion in the region in 2023](#), place a substantial burden on government finances, and universal subsidies can counter progress towards improved energy efficiency and energy security progress.

Electrification

Intense competition among key manufacturers has allowed the cost of EV production to fall dramatically and accelerate [the uptake of EVs](#) in emerging market and developing economies faster than previously projected. This dynamic has been a key enabler for increasing the share of EVs in LDV sales in Thailand (22%), Indonesia (11.5%), Malaysia (6.8%) and the Philippines (4.6%) by the end of the [first half of 2025](#). Lao PDR has introduced a [temporary ban](#) on the import of fuel-powered LDVs, which is set to accelerate the uptake of EVs this year. In other ASEAN member states, incentives for imported EVs are generally declining or have been removed but they remain in place for domestically manufactured or assembled EVs. Member states such as [Indonesia](#), [Malaysia](#) and [Thailand](#) are looking to capture the value of increasing EV sales by introducing policies that spur investment in domestic EV manufacturing or assembly. [Viet Nam](#) has seen particular success with its domestic EV brand, VinFast, helping Viet Nam reach a 35.1% EV sales share in the first half of 2025.

More rapid EV deployment can contribute to a reduction in the demand for road fuels and thus oil imports, increasing energy security in the region. Investing in

manufacturing capacity could help ASEAN member states meet their own ambitious EV targets. Additionally, efforts to improve the fuel economy of internal combustion engine vehicles remain important given the expected growth in the demand for transport services and the large proportion of vehicles sold on the ASEAN market that still depend on fossil fuels.

Industry

Energy demand in the industrial sector comprises about 35% of total final consumption in the region, and the sector is a major consumer of coal, natural gas and electricity. Despite the relevance of the sector, energy efficiency policies are lagging. Energy efficiency policies in the industrial sector include the implementation of requirements for energy management systems for large energy consumers or mandating annual audits of industrial and commercial premises to identify energy-savings measures. The implementation of these measures can be accelerated with fiscal incentives such as low interest loans and grants, and non-fiscal incentives such as awards. A mix of incentives is currently being implemented by ASEAN member states. Additionally, regulating the efficiency of industrial equipment, such as motors, through MEPS can prevent low-efficiency equipment from entering the market.

In the region, only three countries have MEPS for industrial motors, with requirements linked to the International Electrotechnical Commission (IEC) motor efficiency classes. [Singapore](#) has set minimum efficiency requirements at the IE3 level, while Thailand and Viet Nam have set the IE1 efficiency level as the threshold. These are significantly below today's world's best MEPS, which sit at IE4, exposing ASEAN's industrial participants and business partners to low-efficiency models.

Many ASEAN member states have set requirements for large companies to undertake mandatory energy audits and implement energy management systems, based on minimum annual energy demand thresholds. Indonesia has a requirement for the implementation of energy management systems at facilities consuming more than 167 TJ per year. Malaysia requires the implementation of management systems and cost-effective savings measures for companies with annual demand above 21.6 TJ, while Singapore has similar requirements for specific energy-intensive companies consuming 54 TJ of energy or more per year. In the Philippines, medium-sized and large energy-consuming establishments are subject to mandatory energy management requirements, including annual reporting of energy consumption and the implementation of energy management systems, while larger establishments must also employ certified energy professionals and conduct periodic energy audits to verify energy management

performance. In Thailand, energy audits and energy management systems are mandatory for designated companies with consumption above 1 000 toe (42 TJ) or those with peak electricity demand above 1 MW.

The ASEAN Energy Management and Accreditation System (AEMAS) has provided capacity building, training and certification in energy management across the region through a harmonised regional curriculum, strengthening the recognition of energy managers as professionals and helping member states to address energy management skills shortages. Building on the foundations of AEMAS, ASEAN is preparing the Sustainable ASEAN Energy Management Certification Scheme (SAEMAS), an enhanced regional standard for certifying energy management professionals through an integrated curriculum of classroom and practical energy audit training that will strengthen the region's energy management training system and advance mutual recognition of professional competencies across ASEAN member states. Support from international partners will be critical to accelerating its implementation and scaling its impact. Across the region a lack of publicly accessible information on the level of regulated entities' compliance with mandatory requirements makes it difficult for peer monitoring to occur and for stakeholders more broadly to understand policy effectiveness and results achieved.

Industrial sector energy regulations and incentives, ASEAN

	Energy management requirements	MEPS for motors	Incentives
Brunei Darussalam	Published handbook with advice on audits and energy management for companies	-	-
Cambodia	Offers training for energy managers; currently developing regulatory framework	-	Available: revolving fund
Indonesia	Mandatory energy audits and energy management systems for facilities with demand over 167 TJ	-	Available: awards ; potential green finance
Lao PDR	No formal energy management/audit programme but some support for training energy managers	-	-
Malaysia	Companies consuming over 21.6 TJ annually must implement energy management and cost-effective savings measures	-	Available: awards , tax incentive , energy audit grant
Myanmar	Currently offers support and training for energy managers; work ongoing to develop a policy framework	-	-
The Philippines	Medium-sized and large companies must annually report energy consumption and implement energy management, with larger establishments also required to conduct energy audits, employ energy professionals and verify energy management performance	-	Available: awards , tax incentive, green financing

	Energy management requirements	MEPS for motors	Incentives
Singapore	Companies consuming over 54 TJ annually must implement energy management and enact cost-effective saving measures	IE3	Available: grants
Thailand	Mandatory audits and energy management for designated companies consuming over 1 000 toe annually or 1 MW peak demand	IE1	Available: awards , tax incentives
Timor-Leste	No policy framework identified	-	
Viet Nam	Mandatory audits and energy management for companies consuming over 1 000 toe	IE1	Available: awards , fund (in progress)

Many ASEAN member states have developed free energy efficiency guidance for industry. [Brunei Darussalam](#) has published information on concepts regarding energy management and energy audits, Thailand has published information on [energy management](#) and [energy conservation](#) for factories, while Viet Nam regularly releases [videos](#) on a range of energy efficiency topics and case studies, and has published [information](#) on saving electricity in industrial buildings. [Malaysia](#) and [Singapore](#) have developed accessible guidelines that support stakeholders to understand and implement industrial sector energy efficiency requirements. Informational resources such as these fulfil an important role in driving energy efficiency improvements in the region and helping to moderate increasing energy demand.

Demand-side flexibility

The combination of energy efficiency, electrification and demand-side flexibility can deliver extensive and responsive energy security outcomes in the ASEAN region. Demand-side flexibility can facilitate the integration of variable renewables into the grid by shifting demand to periods of high electricity production, and can improve grid reliability by flattening demand curves, while also reducing reliance on fossil fuels during peak demand hours. Demand-side flexibility coupled with end-use efficiency measures can offer a cost-effective route to enhancing energy security, helping to protect consumers from high energy costs. [IEA analysis](#) shows that demand-side flexibility in Thailand could reduce national peak demand by up to 13%, free up to 15% of transmission capacity on many network corridors, and lower power system operating costs by around 9-11% by 2030. ASEAN member states have begun to implement demand-side flexibility strategies, with several policies already implemented and a number under development.

Several ASEAN governments have sought to harness the shifting potential that can be achieved through demand-side response programmes, widely implemented in the industrial sector and increasingly at the residential level.

[Singapore's](#) Interruptible Load and Demand Response programmes have been in place since 2004 and 2016 respectively, with [enhancements](#) made since, including those tested through regulatory [sandboxes](#); Singapore also conducted a household demand response [pilot](#) that concluded in 2025. Thailand's [Demand Response Control Center](#) co-ordinates demand-side management, compensating power users for reduced power consumption; and Viet Nam has conducted pilots and programmes for commercial and non-commercial users respectively.

Smart meter deployment is critical to underpin demand-side flexibility initiatives. Smart meters for residential users are being rolled out to varying degrees within ASEAN member states. [Brunei Darussalam](#) and [Singapore](#) are working towards a complete rollout of smart meters in the near term. Both countries offer free installation of smart meters in existing homes. Singapore's rollout, expected to be completed this year, targets households, while Brunei Darussalam is rolling out smart prepayment meters for all electricity consumers. Bangkok's Metropolitan Electricity Authority is aiming to install [4.3 million smart meter units](#) by 2032, while a rollout of around [12 million smart meters](#) is planned for Manila and surrounding provinces in the Philippines.

Several ASEAN member states have time-of-use (ToU) electricity pricing that encourages consumers to shift demand according to market signals, or variable electricity pricing with cheaper rates for lower energy consumers and higher rates for higher energy consumers. Malaysia, the Philippines, Singapore, Thailand and Viet Nam have variable or ToU pricing for residential, commercial and industrial consumers, whereas Cambodia and Indonesia have variable or ToU pricing only for the industrial and commercial sectors. In some ASEAN member states, such as in Viet Nam, the pricing is set in legislation, while in others it is established by electricity retailers and may be voluntary, such as in the Philippines and Singapore. Brunei Darussalam, Lao PDR, Myanmar and Timor-Leste are yet to introduce any variable or ToU electricity pricing.

Achieving fully scaled and successful demand-side flexibility capability requires interoperability across the energy system, ensuring that end-use technologies can communicate and exchange information effectively. Thailand has already adopted communications standards for buildings automation and control networks through the [Building Automation and Control Network](#), while it uses [Open Automated Demand Response](#) (OpenADR) to provide a standardised information exchange model for demand response.

End-use devices and equipment need a minimum level of smart capability to interact with the grid and be utilised for demand-side flexibility. [Singapore](#) has made a start addressing this challenge, introducing its national standard for EV [charging systems](#), new guidance on smart grid integration and provisions for wireless and smart charging capabilities.

Cross-sectoral demand-side flexibility policies, ASEAN

	Smart meter installation	Dynamic or flexible tariffs
Brunei Darussalam	Yes – a complete rollout is underway	-
Cambodia	-	Yes (industrial; commercial)
Indonesia	Yes – rollout underway	Yes (industrial ; commercial)
Lao PDR	Plans for a limited rollout	-
Malaysia	Yes – rollout underway	Yes (industrial ; commercial ; residential)
Myanmar	-	-
The Philippines	Yes – rollout underway	Yes (industrial ; commercial ; residential)
Singapore	Yes – a complete rollout is underway	Yes (industrial ; commercial ; residential)
Thailand	Yes – piloted and planned limited rollout	Yes (industrial; commercial; residential)
Timor-Leste	Limited installations	-
Viet Nam	Required for all new residential and commercial buildings	Yes (industrial; commercial; residential)

Smart meters and interoperability are important enablers of [efficient grid-interactive buildings](#), and enable consumers to become active participants in maintaining system reliability and energy security. By providing the data and communications infrastructure needed to co-ordinate flexible demand and distributed energy resources, they facilitate the development of aggregation models that can reduce peak demand, improve system resilience and support the integration of VRE.

Virtual power plants (VPPs) represent one of the key enablers of demand-side flexibility. These are networks that aggregate distributed resources using advanced data analytics to provide flexibility to the market. As the ASEAN region's electricity demand grows and the deployment of VRE sources scales up, ASEAN member states are exploring the role of VPPs. [Singapore](#) is conducting a two-year VPP regulatory sandbox pilot, while Thailand ran a [regulatory sandbox](#) programme between 2020 and 2023 to test technologies including behind-the-meter solar and battery systems, demand-side flexibility tools and peer-to-peer energy trading. Thailand plans to upgrade its Demand Response Control Center to a Virtual Power Plant Platform by 2027.

Critical minerals security review

Critical minerals overview

Critical minerals are becoming an increasingly important part of ASEAN's energy security agenda. The region holds significant mineral resources, has been rapidly expanding processing capacity, and is already embedded in clean energy and industrial supply chains. This creates major opportunities for investment, industrial development and export growth, but also introduces new sources of vulnerability linked to supply concentration, environmental performance, infrastructure constraints, technology dependence and exposure to changing trade policies. The [ASEAN Ministerial Meeting on Minerals \(AMMin\)](#) is ASEAN's highest policymaking body for co-operation on minerals.

The ASEAN region occupies several positions across critical mineral value chains. It is a producer of key minerals, an emerging processing centre, and a growing manufacturing hub for energy technologies for both regional deployment and export. These roles are closely connected: stronger upstream production can support midstream processing and downstream manufacturing, while expanding clean energy industries will increase the region's own demand for reliable material inputs. The [ASEAN Minerals Development Vision \(AMDV\)](#) and the [4th ASEAN Minerals Cooperation Action Plan \(AMCAP-IV\) 2026-2030](#) recognise this opportunity by emphasising the need to leverage ASEAN's mineral endowment, attract investment, support sustainable economic development and expand the region's presence across integrated value chains. In addition, the [ASEAN Principles for Sustainable Minerals Development](#) provide a shared framework to advance sustainability in minerals exploration, extraction and processing. With global demand for critical minerals [projected to grow substantially by 2040](#) – with nickel demand almost doubling, cobalt and rare earth elements increasing by around 50-60%, and copper by around 30% – ASEAN can play a strategic role in diversifying global supply chains.

ASEAN's current position is strongest in nickel. Indonesia is now the world's largest nickel producer and the leading nickel refiner, supported by rapid investment in mining and processing. This has made the region an increasingly important player in global battery and EV supply chains. At the same time, the concentration of regional activity in Indonesia creates risks, including a link between nickel processing and [growth in captive power requirements, largely supplied through emissions-intensive coal-based generation](#), pressure on power and port infrastructure and the need to manage environmental and social impacts as production and refining expand.

Other ASEAN member states also have important roles and potential. The Philippines is a major nickel producer, Viet Nam has rare earth resources and growing manufacturing capacity, and Malaysia, Thailand and Viet Nam are relevant to electronics, solar PV and battery-related supply chains. However, many parts of the regional value chain remain underdeveloped. Gaps remain in geological data, upstream project development, midstream processing, refining, recycling, technology capabilities and the infrastructure needed to connect mineral resources with industrial demand.

For ASEAN, the main security question is therefore not only access to critical minerals, but how to capture more value from the sector for local communities and the economy while reducing exposure to concentrated global supply chains. Global processing remains highly concentrated, particularly in China for graphite, rare earths and several battery minerals. Recent export controls affecting rare earths, magnets and battery-related supply chains have shown how quickly disruption can affect automotive, electronics, defence, energy and digital industries. These risks are especially relevant for ASEAN economies seeking to expand manufacturing and clean energy industries, since even resource-rich ASEAN member states can remain dependent on external suppliers for processing equipment, refining technologies, magnets, battery components and advanced manufacturing inputs.

The regional policy challenge is twofold. First, ASEAN can strengthen its position as a reliable supplier of responsibly produced minerals and processed materials. This requires clearer permitting processes, stronger environmental and social governance, investment in infrastructure, skills and power supply, and better alignment between mining policy and industrial strategy. Second, ASEAN needs to manage its own exposure to imported technologies, refined materials and specialised components. A more strategic approach could help ASEAN member states assess where domestic or regional capabilities can be developed, where diversification is needed, and where partnerships with external suppliers will remain essential.

A more integrated ASEAN approach to critical minerals would combine national industrial policies with stronger regional co-operation. Priorities include improving geological data, developing shared standards, supporting responsible mining and processing, expanding recycling and circular economy measures, and identifying opportunities for regional value chains across mining, refining, manufacturing and end-use sectors. This would help ASEAN capture more economic value from its resource base while strengthening resilience to supply disruptions, trade restrictions and external technology dependencies.

Critical minerals supply

As laid out in the IEA's [Southeast Asia Energy Outlook 2026](#), the ASEAN region has significant potential to consolidate its position as both a major producer of critical minerals and a key region supporting efforts to diversify global supply chains. The region holds a substantial share of global mineral reserves, accounting for around 51% of global nickel reserves, as well as approximately 20% of bauxite reserves and 17% of tin reserves. It also hosts important reserves of cobalt, rare earth elements and copper, which are critical for energy, transport, advanced manufacturing, electronics and other strategic industries. Although most processing and manufacturing currently take place outside ASEAN, these resource endowments underline the important role the region can play in contributing to more diversified critical mineral supply chains. Mined output across cobalt, copper, nickel and rare earths in Southeast Asia is projected to increase by a weighted average of 30% by 2035 in the base case, based on current policies, announced projects and expected market developments, although mined copper production is expected to decline by one-quarter over the same period. By 2035, Southeast Asia's refined output is projected to increase by a weighted average of 130%, driven primarily by nickel refining in Indonesia, as well as threefold growth in rare earths and cobalt refining. As global demand for critical minerals is projected to rise substantially by 2040, with nickel demand almost doubling, cobalt and rare earth elements increasing by 50-60% and copper growing by 30%, Southeast Asia's expanding supply positions the region as an important source of additional supply to meet this rising demand.

Indonesia anchors supply in the region, accounting for 63% of global mined nickel production and 12% of global cobalt output in 2024, both of which are widely used in batteries for EVs and consumer electronics. [Indonesia's 2020 ban on unprocessed nickel exports](#) accelerated domestic refining, attracting almost USD 14 billion in smelter investment and expanding domestic capacity from 2 facilities to more than 30.

An important co-benefit has been the increased recovery of cobalt, which is produced as a by-product of nickel laterite processing and has enabled cobalt output to scale rapidly. Indonesia also imports nickel ore from the Philippines, the region's second-largest global nickel producer, which accounted for 10% of global mined output in 2024. While Indonesia hosts more than 40% of global refined nickel production, Indonesian companies own only around 10% of that capacity, with most ownership held by Chinese companies.

In May 2026, Indonesia and the Philippines formalised a co-ordinated nickel supply corridor under an MoU, committing to move 200 000 tonnes of ore per month from Philippine mines to Indonesian smelters starting June 2026 and establishing a structured partnership between upstream Philippine producers and Indonesia's downstream processing capacity.

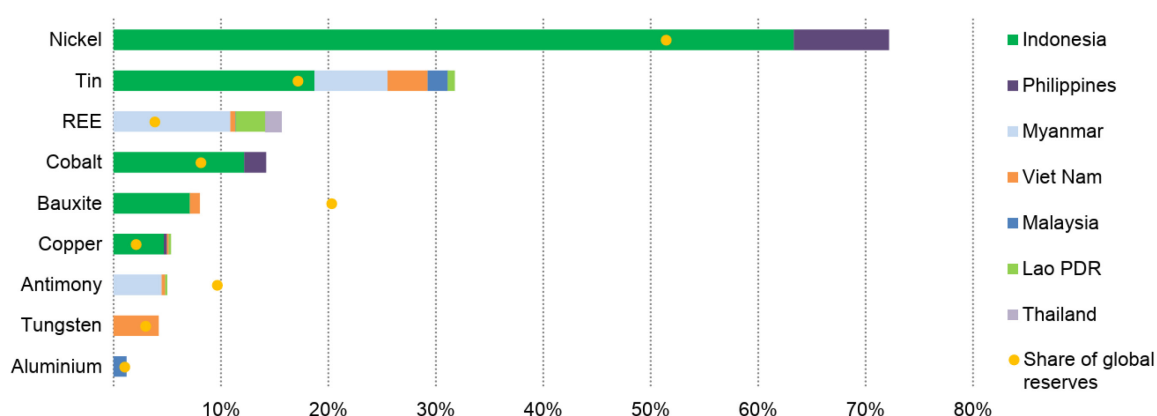
Indonesia enforces strict export bans on unprocessed minerals like bauxite and iron ore and stopped all raw bauxite ore exports in June 2023. Iron ore and iron sand also face strict export prohibitions under national mining laws and the government continues to uphold these bans in 2026, refusing to reopen raw material export channels. While this policy is aimed at forcing companies to build local smelting and processing plants, there are clear delays in such investment transpiring in this area.

Rare earth elements, including light rare earth elements such as neodymium and praseodymium, and heavy rare earth elements such as dysprosium and terbium, are essential for permanent magnets used in EV motors and a wide range of energy and high-tech applications where high temperature resistance is required. Upstream mining of these magnet rare earth elements is concentrated in Myanmar, which accounted for just under 20% of total global mined rare earth supply and more than 40% of heavy rare earth elements, while Thailand contributed around 2% of both as of 2024.

It is notable how Asian performance in critical mineral exploration spending has remained robust. While spending globally fell by over 10% in 2025, with the largest declines reported in Australia and the United States at around 25%, Asia Pacific recorded a 20% increase in spending on critical mineral exploration in the same year.

As extraction expands in ASEAN, the region has an opportunity to move up the critical minerals value chain and become a critical minerals hub that leverages its mineral resources to support downstream manufacturing, create new industrial bases and produce higher-value products rather than mostly exporting raw materials.

ASEAN's share of global mined production and reserves for selected minerals, 2024



IEA. CC BY 4.0.

Notes: REE = rare earth elements. Reserves data for rare earth elements in Myanmar are not accounted for in the chart due to lack of reliable data, but the country is one of the largest mined producers of medium and heavy rare earths in the world.

Sources: Production based on data from IEA (2025), [Global Critical Minerals Outlook 2025](#). Reserves from the US Geological Survey.

Five-year outlook

In Southeast Asia, the regulatory landscape is characterised by strengthening state intervention and industrial policy. Governments throughout the region are prioritising strategies to increase local value addition from extracted resources. These strategies include policies such as restrictions on the [export of unprocessed materials](#) and a particular emphasis on developing integrated EV ecosystems. Multilateral and regional institutions are giving greater attention to the minerals sector, reflecting the region's growing role in critical mineral supply chains.

The AMDV and AMCAP-IV provide a regional framework to support value-chain and workforce development, attract investment and promote responsible supply. In parallel, the Asian Development Bank launched the Critical Minerals-to-Manufacturing Financing Partnership Facility in March 2026 to de-risk early-stage investments in midstream processing, manufacturing and recycling through co-financing, risk-sharing and knowledge-sharing. The region is capitalising on fast-growing regional demand while facilitating financing and expanding partnerships across the value chain.

Some major critical mineral producers in the region, such as Indonesia, Malaysia, the Philippines, Singapore, Thailand and Viet Nam, have signed strategic partnerships with major consuming countries to increase co-operation in the critical minerals sector. Whilst partnerships and collaborations entered into by individual countries on their own are valuable, countries can capture additional value if such partnerships have a regional dimension and scale, to aggregate opportunities across ASEAN member states and build a larger, more diversified and comprehensive portfolio.

A short summary of the critical minerals policies of selected ASEAN countries is provided in the “Securing critical minerals” section of the IEA's [Southeast Asia Energy Outlook 2026](#).

Critical minerals security assessment

The ASEAN region's dual role as both a producer of critical minerals and a consumer of material inputs for its manufacturing sector creates opportunities and risks across the value chain. The crisis in the Middle East has affected global critical minerals markets by inflating energy and logistical costs for mining and processing operations, adding to existing vulnerabilities linked to market concentration, price volatility and technological uncertainty. These pressures come at a time when global capital expenditure on critical mineral projects fell by 9% year-on-year in 2025, underscoring the need for ASEAN to strengthen resilience across both mineral supply and downstream industrial supply chains.

Supply-side security

The rapidly expanding clean energy technology manufacturing sector in ASEAN countries requires mineral inputs. The localisation of manufacturing capacity does not necessarily translate into supply chain security, as facilities may be dependent on technologies, precursor materials and upstream inputs that are concentrated outside the region. Battery cell manufacturing capacity across ASEAN [increased from 16 GWh in 2023 to 26 GWh in 2024](#), and committed projects would lift that capacity to over 80 GWh by 2030. The level of exposure to global supply chain concentration varies by mineral. The ASEAN region is the world's leading producer of nickel and home to the largest refined rare earths production facility outside China, providing a strong production base to underpin manufacturing and exports. However, while the region's mineral resources are vast, in view of the current lack of processing and refining capacity, ASEAN's overall competitiveness in this area remains low and, despite ore extraction and exports, the countries in the region remain highly dependent on imports of critical minerals in a form ready for technological applications.

The region also supplies around one-quarter of global sulphur and half of the global seaborne sulphur trade passes through the Strait of Hormuz, which poses additional challenges during the ongoing conflict and related restrictions on passage. Sulphur is a key feedstock for sulphuric acid, which is essential for fertiliser production and the processing of a range of critical minerals such as copper, lithium, cobalt, nickel and rare earths. Disrupted sulphur supplies prompted China to curb sulphuric acid exports in May 2026, creating ripple effects across both mineral and fertiliser value chains. The resulting surge in acid prices increased production costs for several critical minerals, with acid costs overtaking energy costs to become the largest cost component in some cases.

In Indonesia, high-pressure acid leaching (HPAL), a process used to refine nickel ore into the nickel intermediate mixed hydroxide precipitate (MHP), relies heavily on sulphuric acid for leaching. Although Indonesia produces most of its sulphuric acid domestically, it depends heavily on imported sulphur and roughly 75% of its supply is sourced from the Middle East. In 2025, Indonesian sulphur imports increased sharply to 5.35 Mt – up by around 48% from 3.6 Mt in 2024 (for more details, see the IEA's [Southeast Asia Energy Outlook](#)).

While Indonesia is less exposed due to domestic production, China's ban on sulphuric acid exports from May until the end of 2026 could remove the flexible supply that HPAL producers have relied on to cover shortfalls. Reduced availability and higher prices of sulphuric acid could further increase cost pressures on Indonesian nickel production.

Exposure to economic and price risk

Attracting investment into minerals production, processing and downstream manufacturing is central to the AMDV. The way in which such investment is applied can introduce further dependencies and risks.

The concentration of investment sources and trade relationships can introduce risks. [An estimated 75% of nickel refining capacity in Indonesia is linked to investment from Chinese companies](#), and the Philippines is the world's largest exporter of nickel ores, with [72% of its 55 Mt of nickel exports in 2025 destined for China](#). Even as these investments and exports provide economic and revenue benefits, they can create increased exposure to domestic market dynamics in the dominant offtaker and create reliance on external technology and expertise if concentration risks are not carefully managed. The development of durable domestic expertise and technology should be considered alongside attracting investment, including efforts to build workforce skills, technical and managerial expertise, local supplier ecosystems, R&D capacity and mechanisms for technology and knowledge transfer.

Mining and processing activities have often come with environmental and social costs in ASEAN. They include [water and land pollution](#), and impacts on coastal communities dependent on fisheries for livelihoods. In the Philippines, mining activities that affect indigenous communities require [free, prior and informed consent](#). At the same time, investors from OECD countries and development finance institutions may apply environmental and social safeguards as a precondition for investment. Failure to adequately identify, mitigate and manage environmental and social impacts can undermine community acceptance, constrain access to finance, and result in permitting delays, disputes or project disruption. The [ASEAN Principles for Sustainable Minerals Development](#) set out a shared framework to advance sustainability in the sector.

Further risks may be introduced where minerals processing is linked to emissions-intensive processes and energy sources such as coal power. This may have implications for competitiveness and market access – such as through exposure to policies like the EU Carbon Border Adjustment Mechanism – and for access to financing where investors consider the emissions intensity of investments. In response, countries may consider measures to reduce emissions associated with minerals production. For example, Indonesia [launched the National Roadmap for Nickel Industry Decarbonisation in 2025](#), targeting emissions reduction of up to 81% in the nickel industry by 2045 through measures such as energy and material efficiency, fuel substitution, material substitution and use of low-carbon electricity.

Oil-driven cost inflation driven by the impacts of the Strait of Hormuz crisis can further dampen the investment signals for new mines and refineries. This poses potential challenges for emerging markets such as those in ASEAN, where

nascent processing capacity is already vulnerable to shifts in investor confidence (for more details, see the IEA's [South-East Asia Energy Outlook](#)). ASEAN member states – Indonesia in particular – face more direct exposure to the crisis. Against heightened geopolitical tensions, a sustained rise in sulphur prices could weaken the economics of hydrometallurgical nickel production. Some Indonesian MHP producers have already suspended long-term sales to reassess exposure to sulphur supply disruption.

Regional co-operation

Mineral endowments, industrial structures and value chain presence differ across the ASEAN region. Each country has the potential to play a role in regional value chains. For example, [Myanmar and Lao PDR are among the world's largest producers of mined rare earths](#). Malaysia hosts the world's largest rare earth processing facility outside China. Indonesia and the Philippines hold world-leading nickel reserves, with Indonesia also leading processing, while multiple ASEAN member states are seeking to develop battery and EV manufacturing sectors. Singapore is the regional hub for finance and commodities trading.

ASEAN has established institutional foundations for co-operation through sectoral bodies such as AMMin, and sectoral visions and plans through the AMDV and AMCAP-IV 2026-30. Although external partners will continue to be of critical importance as the region develops its minerals sector, expanding intra-regional trade, investment and value chain co-operation can support the creation of more diversified and resilient mineral supply chains.

Annex

Abbreviations and acronyms

ACE	ASEAN Centre for Energy
AEMAS	ASEAN Energy Management and Accreditation System
AMCAP-IV	4th ASEAN Minerals Cooperation Action Plan
AMDV	ASEAN Minerals Development Vision
AMMin	ASEAN Ministerial Meeting on Minerals
APAEC	ASEAN Plan of Action for Energy Cooperation
APG	ASEAN Power Grid
APSA	ASEAN Framework Agreement on Petroleum Security
ASEAN	Association of Southeast Asian Nations
CAGR	compound annual growth rate
CAPEX	capital expenditure
COP	coefficient of performance
CCS	carbon capture and storage
CCUS	carbon capture, utilisation and storage
CNG	compressed natural gas
CSPF	cooling seasonal performance factor
CV	calorific value
EENS	expected energy not served
ESCO	energy service company
EV	electric vehicle
GDP	gross domestic product
HDV	heavy-duty vehicles
HPAL	high-pressure acid leaching
Lao PDR	Lao People's Democratic Republic
LDV	light-duty vehicle
LNG	liquefied natural gas
LOLE	loss of load probability
LOLP	loss of load expectation
LPG	liquefied petroleum gas
MEPS	minimum energy performance standards
met	metallurgical
MHP	mixed hydroxide precipitate
MoU	memorandum of understanding
NGL	natural gas liquids
PPA	power purchase agreement
PV	photovoltaic
SAF	sustainable aviation fuel
SAIDI	system average interruption duration index
SAIFI	system average interruption frequency index

SLF	Standby LNG Facility
SPR	strategic petroleum reserve
TAGP	Trans-ASEAN Gas Pipeline
ToU	time of use
VPP	virtual power plant
VRE	variable renewable energy
WCOP	weighted coefficient of performance

See the [IEA glossary](#) for a further explanation of many of the terms used in this report.

Units of measure

bcm	billion cubic metres
bcm/yr	billion cubic metres per year
GJ	gigajoule
GW	gigawatt
GWh	gigawatt hours
kb/d	thousand barrels per day
kcal/kg	kilocalories per kilogram
km	kilometre
km/l	kilometres per litre
kt	thousand tonnes
kW	kilowatt
lm	lumen
MJ	megajoule
mb	million barrels
mb/d	million barrels per day
mt	million tonnes
m ²	square metre
MW	megawatt
PJ	petajoule
tcm	trillion cubic metres
toe	tonnes of oil equivalent
TJ	terajoule
TW	terawatt
TWh	terawatt hour
Wh	watt hour

Energy conversion factors

	Multiplier to convert to:					
	EJ	Mtoe	MBtu	bcme	Mtce	TWh
EJ	1	23.88	9.478×10^8	27.78	34.12	277.8
Mtoe	0.04187	1	3.968×10^7	1.163	1.429	11.63
MBtu	1.0551×10^{-9}	2.520×10^{-8}	1	2.931×10^{-8}	3.60×10^{-8}	2.931×10^{-7}
bcme	0.036	0.860	3.412×10^7	1	1.228	10
Mtce	0.02931	0.700	2.778×10^7	0.8141	1	8.141
TWh	0.0036	0.086	3.412×10^6	0.1	0.1228	1

Notes: There is no generally accepted definition of barrel of oil equivalent (boe); typically the conversion factors used vary from 7.15 to 7.40 boe per tonne of oil equivalent. Conversions to and from billion cubic metres of natural gas equivalent (bcme) are given as representative multipliers but may differ from the average values obtained by converting natural gas volumes between International Energy Agency (IEA) balances due to the use of country-specific energy densities. Lower heating values (LHV) are used throughout.

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