



Unleashing solar and wind in ASEAN

ASEAN needs faster growth in clean electricity to keep up with rising demand and keep the power sector CO₂ emissions down.

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About

Among 10 ASEAN (the Association of Southeast Asian Nations) member states, five countries dominate the region's total electricity generation (covering 89% generation). These major countries consist of Indonesia, Malaysia, the Philippines, Thailand and Viet Nam. The contribution of these major countries will be essential to achieving the electricity transition towards clean energy in the region.

This report analyses the latest electricity data in these five major ASEAN countries. Furthermore, it aims to link the progress of clean energy development and the future renewable energy target to the IEA Net Zero pathway.

Highlights

22%

Rise in ASEAN electricity demand from 2015 to 2021.

39%

Share of electricity demand met by clean energy.

4%

Share of ASEAN electricity supply from solar and wind in 2021.

11%

ASEAN electricity supply from solar and wind in 2030, according to latest national plans.

Executive Summary

ASEAN yet to unleash the potential of solar and wind

Current plans for solar and wind fall short of a road map to limit global temperature rise under 1.5 degrees.

Southeast Asia has emerged as possibly the most crucial region for future energy transition as the pace of transition picks up in China and India. The region offers enormous [potential](#) for renewable energy sources, especially solar and wind. However, they have yet to show significant progress in clean energy deployment.

As one of the world's fastest-growing regions in terms of economic growth and electricity demand, achieving its net zero emissions in the future will depend on the pace of renewables uptake. The progress of clean electricity generation in ASEAN five major countries (Indonesia, Malaysia, the Philippines, Thailand and Viet Nam), henceforth "ASEAN 5", which make up 89% of the region's total electricity generation, shows a positive trend in the past years. Nevertheless, clean electricity could not keep up with the fast rising electricity demand. Therefore, as of 2021 the share of clean electricity remains low with the share of fossil fuel increased in the region compared to 2015.

Around three-quarters of the growth in global clean electricity generation in 2021 came from solar and wind. Most 1.5-degree aligned models suggest that going forward, solar and wind should account for a similar proportion of clean electricity. However, solar and wind generated only 4% of ASEAN 5's electricity last year, lagging behind its peers like China (11%) and India (8%).

Analysis of current power sector development plans show the total share of solar and wind in ASEAN 5 will rise from 4% of electricity in supply in 2021 to 11% by 2030. But even more ambition is needed to put them on a 1.5-degree pathway.

01 Clean power generation only met 39% of ASEAN electricity demand rise from 2015 to 2021

ASEAN electricity demand grew 22% from 2015 to 2021, higher than the global average, which increased by 16%. From 2015 to 2021, clean power generation only met 39% of ASEAN's rise in electricity demand and 48% was met with fossil fuels. 39% of the rise in electricity demand in Viet Nam, 12% in the Philippines and 45% in Thailand was met by clean sources. Electricity generation from fossil fuels increased 21% in all five countries, matched by an increase in power sector CO2 emissions.

02 Solar and wind generated only 4% of ASEAN's electricity last year

Solar and wind generated only 4% of the ASEAN's electricity last year, lagging behind peers like China (11%) and India (8%). Only Viet Nam (11%) exceeds the world average in solar and wind, which generated 10% of global electricity for the first time in 2021. The share of solar and wind in Thailand, the Philippines and Malaysia is 4.6%, 2.6% and 0.9% respectively.

Solar and wind only accounted for 0.2% of total electricity generation in Indonesia in 2020 (the latest data available).

03 The latest energy plans would bring the share of solar and wind up to 11% of ASEAN 5's total electricity supply

Our analysis shows that by 2030, the latest energy plans would bring the share of solar and wind in this region up to 11% of the total electricity supply. Viet Nam is expected to generate 18% solar and wind in its total generation, the Philippines 16.5%, and Thailand 9.6%. Malaysia and Indonesia would reach 3.4% and 2% of solar and wind generation share respectively.

“Governments should unleash the power of solar and wind, as is happening already in China, India, and across much of the world. As fossil fuels prices soar through the roof, solar and wind prices remain low, providing affordable, homegrown energy. Solar and wind are progressing across Southeast Asia, but more aggressive targets and timely execution are needed to utilise the vast potential. Governments need to redress 2030 energy plans.”

Achmed Shahram Edianto
Asia Electricity Analyst, Ember

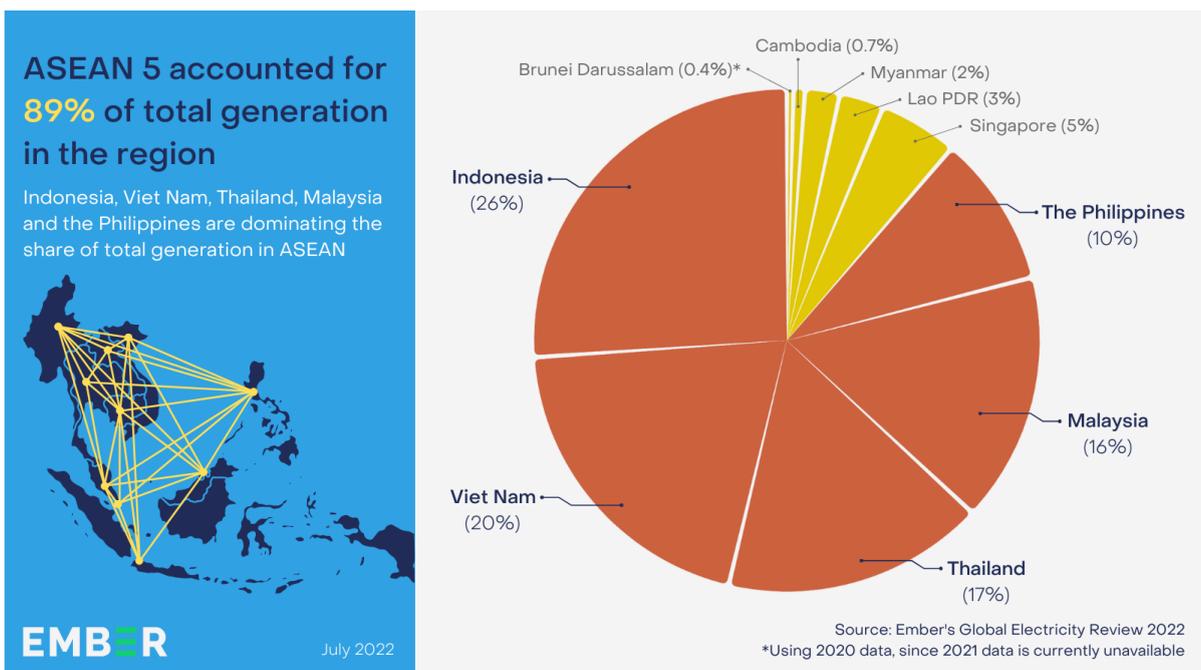
ASEAN electricity demand is rising fast

Electricity demand grew almost 22% in the last 7 years

Indonesia and Thailand's demand slightly outpaced the world average, while almost doubling in the Philippines and Viet Nam.

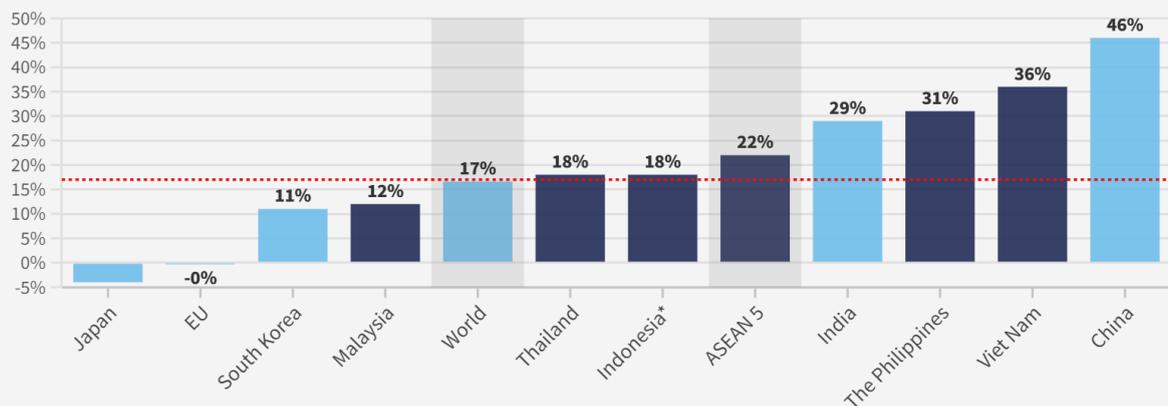
ASEAN is one of the world's fastest-growing economic regions. With over 650 million people and low power consumption per capita, this region has enormous room to grow its electricity demand in the next decade. From 2015 to 2021, 5% of the rise in global electricity demand was in the ASEAN region (192 TWh out of 3834 TWh), showing that the region's demand could imminently take off.

The ASEAN five majors (Indonesia, Malaysia, the Philippines, Thailand and Viet Nam), henceforth "ASEAN 5", make up 89% of the region's total electricity generation. Total electricity demand in the ASEAN 5 grew 22% from 2015, rising more than the global average (17%). The highest growth came from Viet Nam (36%) and the Philippines (31%).



Average electricity demand growth in ASEAN 5 is above world average

2015-2021 change in electricity demand



Source: Ember's Global electricity Review 2022
 Note: 2021 data for Indonesia is currently unavailable

Despite the recent slowdown due to the Covid-19 pandemic, [IEA](#) projected high annual demand growth for ASEAN member countries in the coming years, close to 5% per year. This forecasting is in line with its [previous analysis](#), which predicted that ASEAN electricity demand will double by 2040.

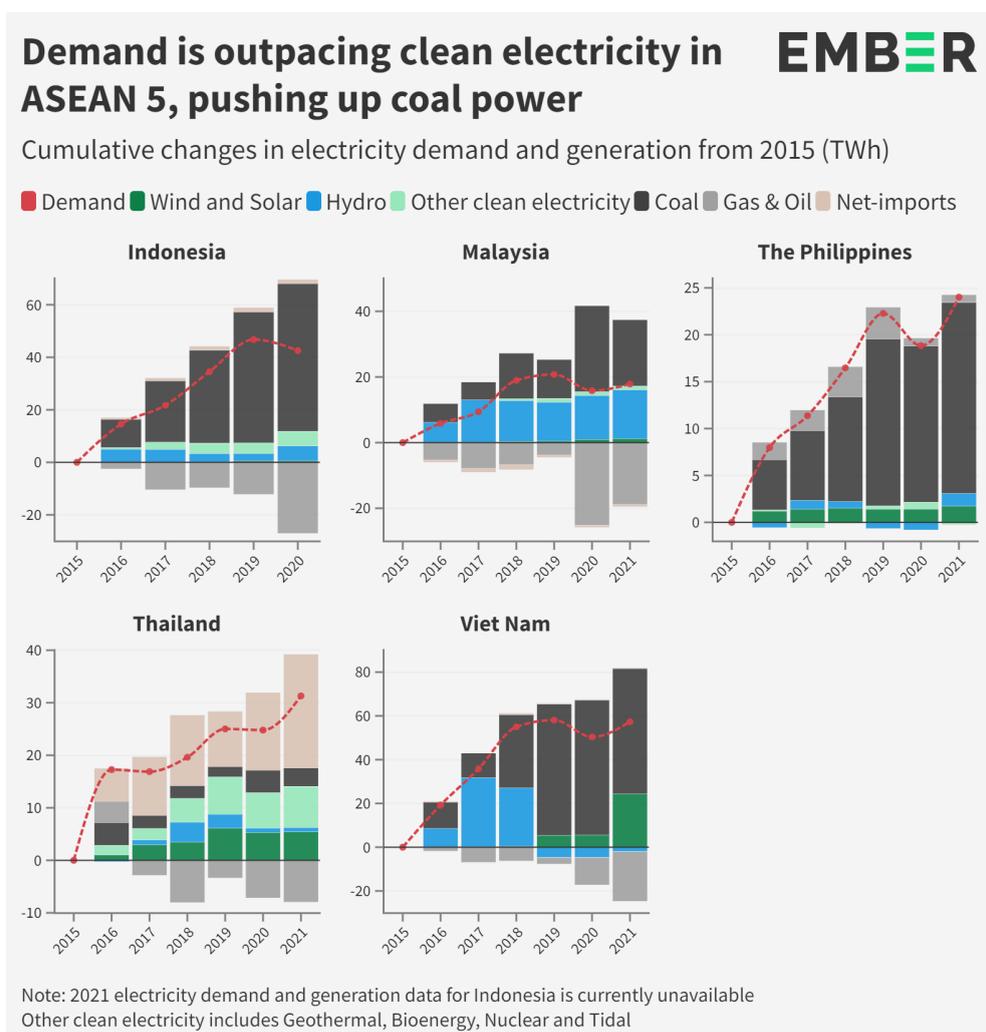
Clean power not keeping pace with electricity demand

The ASEAN 5 saw their electricity demand rise by 22% from 2015 to 2021. Less than half of that (39%) was met with clean electricity. Half (48%) was met with a rise in electricity from fossil fuels. This led to a 21% rise in power sector CO2 emissions.

Change from 2015 to 2021				
Country	Rise in electricity demand	...of which met by clean electricity	...of which met by fossil fuel	Rise in power sector CO2 emissions
Indonesia*	18%	28%	69%	19%
Malaysia	12%	93%	7%	9%
The Philippines	30%	12%	88%	42%
Thailand	18%	45%	-14%	1%
Viet Nam	36%	39%	61%	55%

*2020 data is used, since 2021 data is currently unavailable

Note: Remaining demand was met by imports.



Indonesia

Of the rise in Indonesia's electricity demand from 2015 to 2020, only 28% was met with clean electricity; with 69% met by fossil fuels. Coal generation rose by 45% across the same period, although this was offset somewhat by a fall in gas generation. The rise in clean electricity was driven by hydropower and geothermal (met 27% of the demand increase), while solar and wind only contributed 1%. The absolute amount of electricity from clean sources rose by 49% from 2015 to 2020, however its share in the generation mix only increased by three percentage points from 10% to 13%. On the other hand, coal power's share increased by 13 percentage points from 53% to 66%. Indonesia had the highest coal power generation and share in the ASEAN region in 2020. Indonesia electricity data is lagged relative to most other countries, therefore 2021 data is still not available.

Malaysia

Malaysia's electricity demand increased by 12% from 2015 to 2021, the lowest among the ASEAN 5. 90% of the electricity demand increase was met with increased hydro generation. Solar generation increased by more than five times, but its share in total electricity only rose from 0.18% to 0.87%. There is no wind development in Malaysia. Fossil generation met the remaining 7% of the rise in electricity demand, although a big rise in coal offset a big fall in generation. Coal power rose 31% during the same period. Coal share increased by eight percentage points, from 42% in 2015 to 50% in 2021, meaning that power sector CO₂ emissions rose by 9% in that period.

The Philippines

Of the Philippines' electricity demand rise from 2015 to 2021, only 12% has been met with clean electricity, while electricity from coal generation met 85% of the demand. The remaining 3% was met with gas generation. The rise in clean electricity generation was driven by growth in solar and wind which saw a near-double increase in generation. On the other hand, coal power generation increased by 75%. Accordingly, its share jumped from 27% to 47%. It was the only country among ASEAN 5 to see a rise in coal generation every year since the Paris Agreement. This resulted in a rise in power sector CO₂ emissions by 42%.

Thailand

45% of the rise in electricity demand between 2015 and 2021 has been met by clean electricity, driven by the increase in biomass, solar and wind. In the same period, coal met 11% of the demand increase. Clean electricity generation increased by 106%, the highest among the 5 countries. The share of clean electricity generation doubled from 8% to 16%. Despite this, coal power increased by 11%, with its share also increasing from 19% to 20%. This meant that power sector CO₂ emissions rose by 1%.

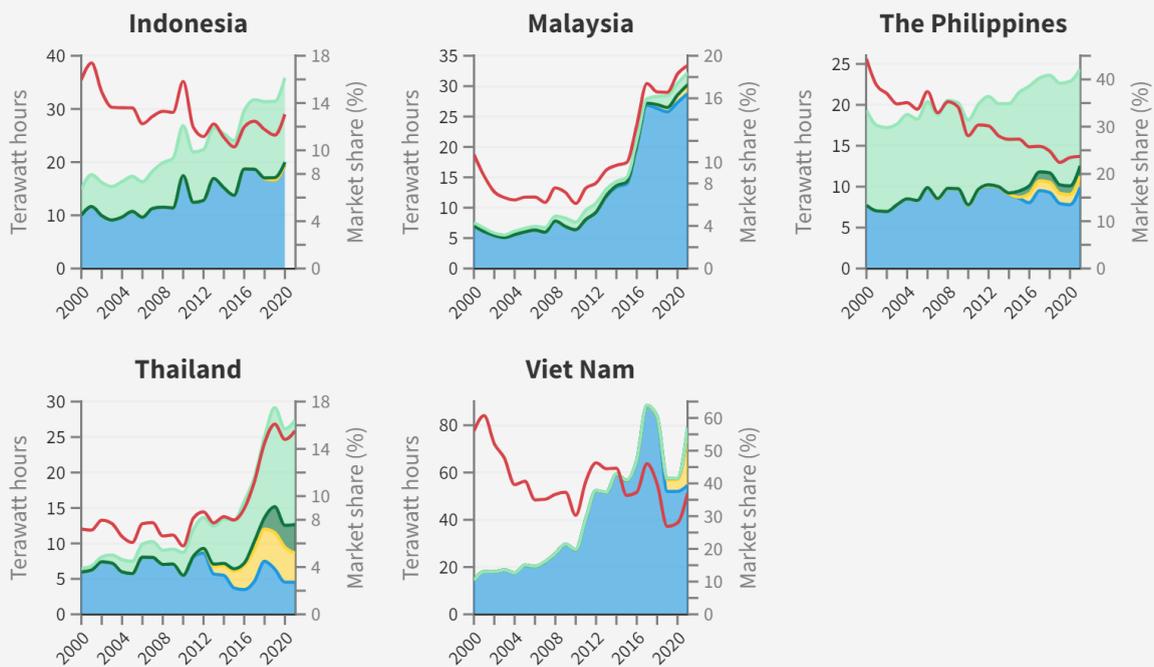
Viet Nam

39% of the rise in electricity demand has been met by clean sources. Electricity from coal was two times higher than the demand increase. The rise in clean was driven by growth of solar and wind. Clean electricity generation increased by 39%, but its share of total electricity generation only increased by one percentage point. Viet Nam saw the highest percentage change in coal power generation, which more than doubled. Accordingly, coal share increased from 33% to 51%. This resulted in the power sector CO2 emissions rising by 55%.

Clean electricity generation is constantly increasing, but the share remains low **EMBEER**

Clean electricity generation and market share in the ASEAN 5, 2000-2021

■ Clean electricity ■ Hydro ■ Solar ■ Wind ■ Other clean electricity



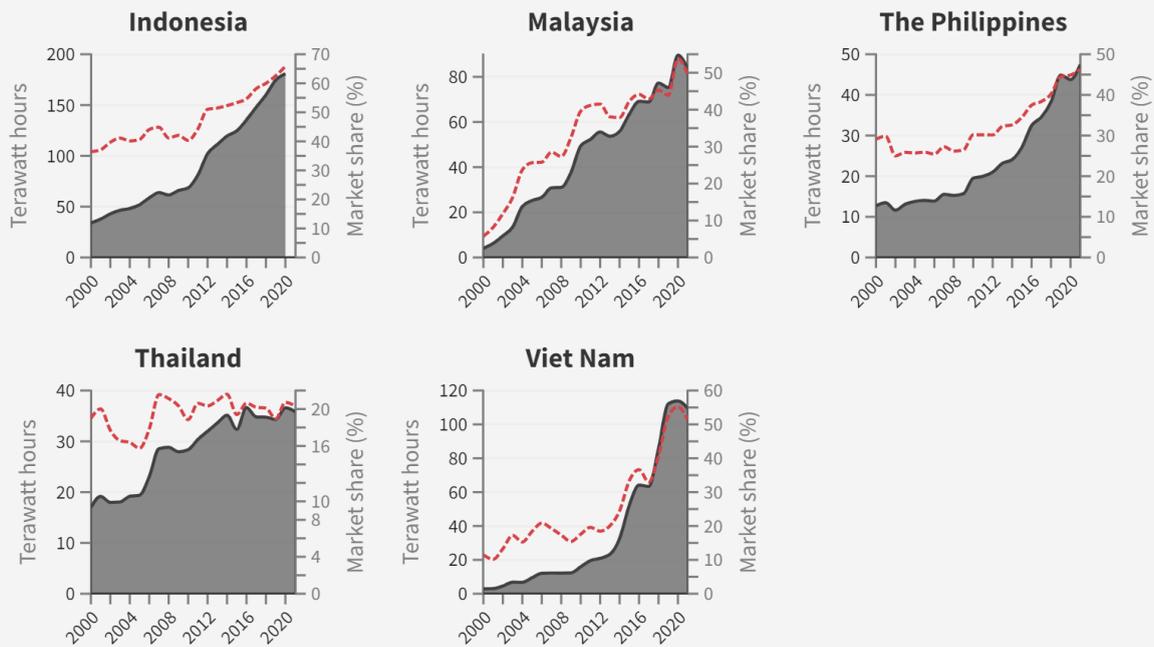
Note: 2021 electricity demand and generation data for Indonesia is currently unavailable
Other clean electricity includes Geothermal, Bioenergy, Nuclear and Tidal

Coal power dominates as its generation increased rapidly



Coal energy generation and market share in the ASEAN 5, 2000-2021

■ Coal market share ■ Coal



Note: 2021 electricity demand and generation data for Indonesia is currently unavailable

Progress on solar and wind

Solar and wind lag in ASEAN 5, compared to the rest of the world

Solar and wind generated only 4% of the ASEAN 5's electricity last year, lagging behind peers like China (11%) and India (8%). Among the ASEAN 5, only Viet Nam (11%) exceeds the world average in solar and wind, which generated 10% of global electricity for the first time in 2021. The rest is still below 5%.

The share of solar and wind in Malaysia and Indonesia is less than 1%. Solar and wind only accounted for 0.2% of total electricity generation in Indonesia, showing little progress from 2015. In Malaysia, the share of solar is only 0.9% of the total generation, while wind is still unavailable (0%).

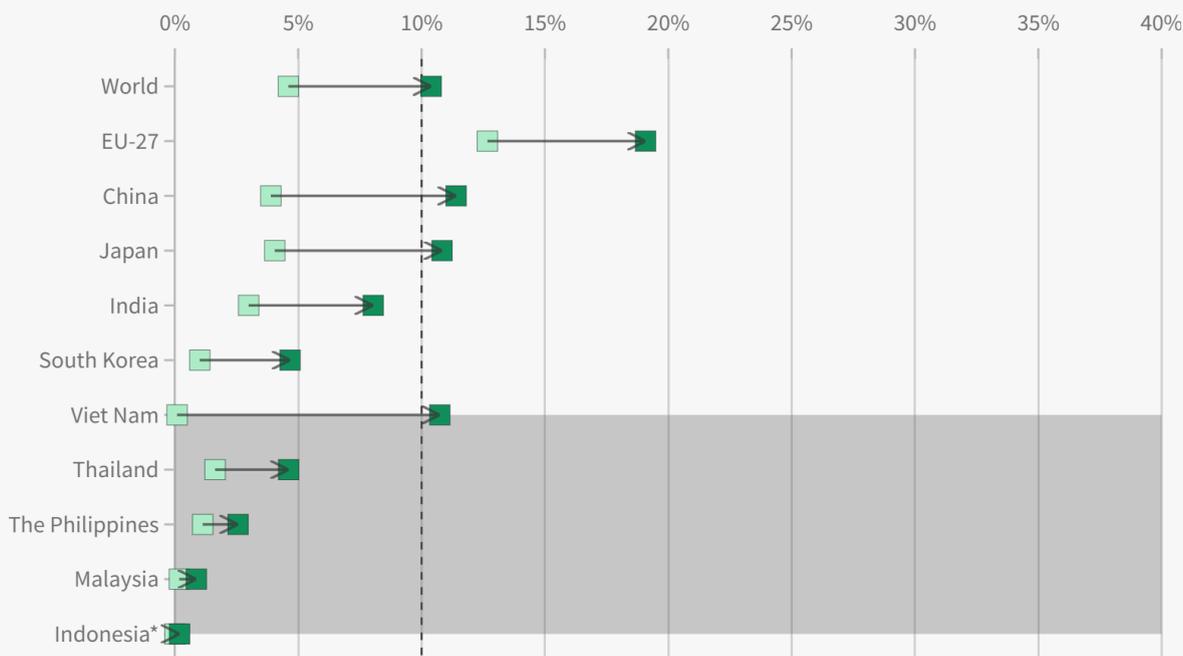
From 2015 to 2021, there is slow progress in Thailand and the Philippines. The share of solar and wind rose from 1.6% to 4.6% and 1.1% to 2.6%. As mentioned, the progress of clean energy in Thailand and the Philippines relies on bioenergy and geothermal.

Viet Nam had the most significant progress over the past couple of years. Solar and wind share has risen from close to 0% in 2015 to 11% in 2021. Most of this was from a [solar boom](#) in the country: solar generation increased by 337% from 2020 to 2021. Viet Nam's generous Feed-in Tariff (FiT), income tax and land-lease payment exemption for utility-scale investors are the supportive policies accelerating solar deployment.

Solar and wind now generate over 10% of **EMBER** world electricity

But the progress in ASEAN 5 remain slow

Year ■ 2015 ■ 2021



Source: Ember's Global Electricity Review 2022.
*use 2020 data, since 2021 data is currently unavailable

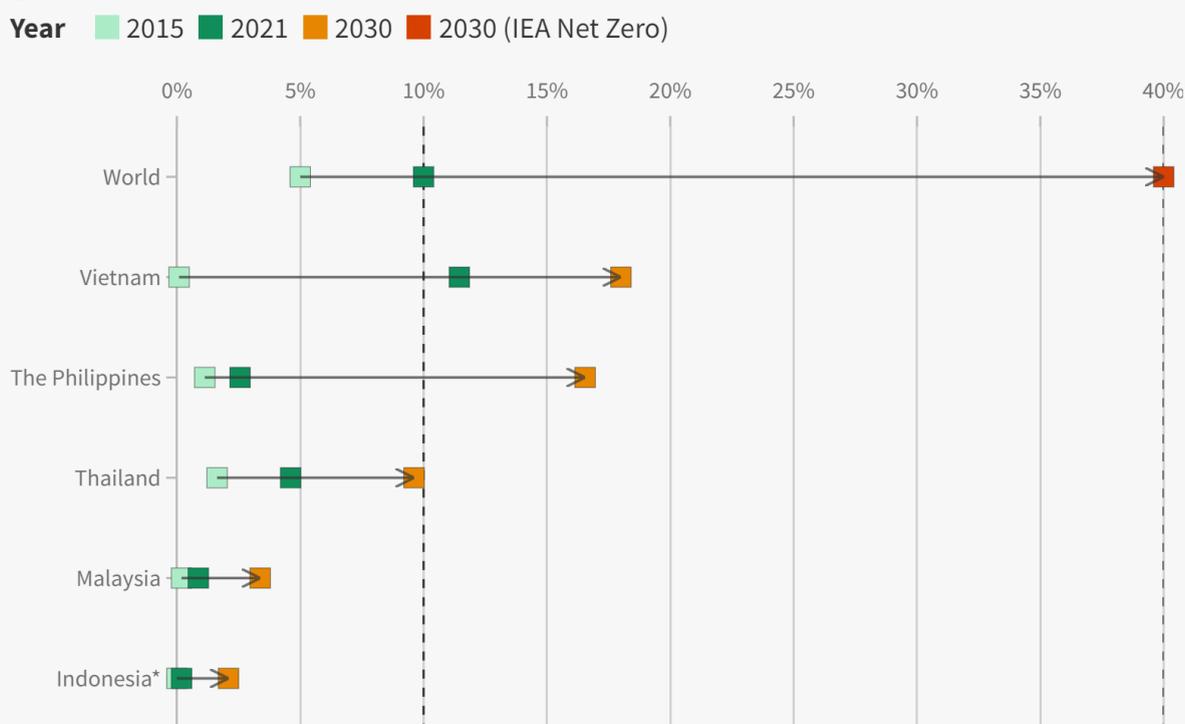
What are current plans for solar and wind development to 2030?

For the world to limit the global temperature rise under 1.5 degrees, the world must [phase out unabated coal power by 2040](#). Solar and wind are the most economic and fastest way to replace coal. The [IEA's Net Zero by 2050 roadmap](#) suggests that solar and wind should be the backbone of the clean electricity transition, providing [at least 40% of global electricity demand by 2030](#).

Having an ambitious policy target for solar and wind development and integrating it into national development plans are important steps toward a clean electricity transition. Cross-country comparison of solar and wind deployment plans provides a unique perspective that helps better understand individual countries' climate ambitions. Hence, this section analyses what percentage of total electricity supply will be generated with solar and wind in 2030 under current plans for solar and wind power development of each country.

How much electricity will current plans for solar and wind development generate in 2030? EMBER

Comparison of national power development plans in % of solar and wind in total generation



Source: National power development plans of respective countries, Ember calculations.
*2021 data is currently unavailable

Viet Nam's solar and wind to rise from 11% in 2021 to 18% in 2030

In the 7th National Power Development Master Plan (2011-2020), Viet Nam planned to reach 6 GW of wind and 12 GW of solar capacity by 2030. Viet Nam met the goal for solar nine years earlier, as solar capacity quadrupled in 2021 compared to the previous year. Having shown the world that rapidly scaling up solar is possible, Viet Nam is now ratcheting up its clean electricity ambition in its draft of the 8th National Power Development Plan (2021-2030), which will be made official in 2022.

Since the initial draft was released, numerous updates have been made to reflect Viet Nam's pledge at COP26 to achieve net-zero emissions by 2050. In the most recent update [in May 2022](#), solar and wind power account for 50.7% of total electricity generation in 2045. While details of the draft are not officially announced, Vietnam Initiative for Energy Transition (VIET), a local independent think tank, reports that 18.5 GW of wind power will be installed by 2030, and there will be [no additional solar capacity by 2030](#).

Based on the available information, we estimate that about 18% of electricity will be generated from solar and wind by 2030. This is seven percentage points higher than the current share (11%), and the highest among the countries profiled in this report. However, the increase in wind would only meet 23% of the increase in total electricity demand.

We arrived at this figure first by estimating total solar and wind capacity by 2030. To do this, we simply added planned capacity additions (18.5 GW of wind) to the current solar and wind capacity. Then, we estimate the amount of electricity that can be generated by applying a capacity factor of 16% and 28% for solar and wind, respectively. These factors are used consistently throughout this report. We divide this estimation by projected power generation in 2030, as reported by VIET on the latest update of the PDP 8 draft, to obtain its share.

The Philippines' solar and wind to rise from 2.6% in 2021 to 16.5% in 2030

The Philippines plans to install additional 0.76 GW of wind and 18.5 GW of solar power capacity by 2030, as established in the [Philippines Energy Plan \(2020-2040\)](#). If the plans are fully deployed, then solar and wind will account for 16.5% of the total projected generation in 2030. This is a significant jump from a mere 2.6% in 2021. This increase would meet 38% of the Philippines' demand increase in the upcoming decade.

The future share of solar and wind generation was calculated based on an estimation of expected electricity generation from total capacity in 2030, assuming all the planned capacities are deployed. Projections for total generation and demand in 2030 were taken from the [Philippines Energy Plan](#) (190 TWh).

Thailand's solar and wind to rise from 4.6% in 2021 to 9.6% in 2030

In the [2018 Renewable and Alternative Energy Development Plan](#), Thailand lays out plans to install 1.49 GW of wind and 12 GW of solar capacity by 2037. If the plan is being deployed along a linear trajectory, then solar and wind would reach 9.6% of total power generation in 2030, doubling the share in 2021. At this pace of development, solar and wind power would only meet 10% of Thailand's growing electricity demand in 2030.

Electricity generated from solar and wind in 2037 was estimated based on the expected total capacity in 2037, which was calculated by adding the planned capacity additions to actual

capacity in 2017. Total electricity generation and demand was estimated by projecting historical compound annual growth rate from 2015 to 2021 to the year 2037. The 2030 share was calculated using a straight line method.

Malaysia's solar and wind to rise from less than 1% in 2021 to 3.4% in 2030

In Peninsular Malaysia, 1.1 GW of solar is planned for deployment by 2025 ([Report on Peninsular Malaysia Generation Development Plan \(2021-2039\)](#)). There is no wind development under this plan. If the planned pace of growth continues linearly until 2030, then solar and wind would account for 3.4% of total generation that year, a two percentage-point jump from 2021. However, this is only one third of where the world stands now. As Malaysia's economy grows, solar and wind will only meet 15% of the increase in electricity demand.

Electricity generated from solar and wind was estimated based on the expected total capacity in 2025. This was calculated by adding the planned capacity additions to actual capacity in 2020. Total electricity generation and demand was estimated by projecting the historical compound annual growth rate from 2015 to 2021 to the year 2037. The 2030 share was projected using a straight-line method. Note that this analysis does not include Sabah or Sarawak, as they had no official plans for future solar development.

Indonesia's solar and wind to rise from close to 0.2% in 2021 to 2% in 2030

Indonesia plans to add 4.68 GW of solar and 0.6 GW of wind capacity by 2030, as made official in [PLN's Electricity Business Plan \(RUPTL\) 2021-2030](#). Under the plan, 2% of total electricity generation in 2030 would be supplied with solar and wind, the lowest share among the countries covered in this report. On the other hand, Indonesia's power demand growth projection is one of the highest, growing annually at 4.9%. At this pace, only 5% of the increase in demand will be met with solar and wind.

The 2030 share of solar and wind generation was estimated by calculating electricity generation from the expected total capacity in 2030, assuming all the planned capacities are deployed. Total electricity generation and demand were given in the RUPTL.

ASEAN 5's plans for solar and wind deployment are not aligned with the 1.5 degree pathway

Collectively, these solar and wind deployment plans would bring the share of solar and wind in the region up to 11% of total generation by 2030, more than double the share in 2021. However, this increase is not enough to meet the rapidly rising demand for power, let alone to put the region on the IEA's 1.5 degree pathway.

“Under current policies, solar and wind are projected to supply only one tenth of total electricity generation in 2030. This is not nearly enough to meet the rapidly growing power demand. This will make coal phase-out and gaining energy independence very difficult for this region. Rapid scaling-up of solar and wind and grid modernisation is going to be a crucial piece of the puzzle to solve the climate and energy crisis in this region.”

Uni Lee

Asia Electricity Data Analyst, Ember

Conclusion

More ambitious solar and wind deployment plans are needed

Solar and wind will be the backbone of the world's future electricity system, but electricity plans in ASEAN countries do not currently reflect this.

ASEAN countries have targets in place for accelerating clean energy deployment, individually (national energy plans) and regionally (through the [ASEAN Plan of Action for Energy Cooperation](#)). However, our report shows that in the ASEAN 5, clean energy planned under these targets could not keep up with rising demand. Despite clean energy generation constantly increasing in recent years, its share remains low. This trend is what has led to the current domination of coal share in the electricity mix.

While the world is shifting to solar and wind [following cost declines](#), solar power is still at the margin of the region's generation mix, and wind power is almost invisible. Only Viet Nam surpassed the world average with 11% solar and wind generation in 2021. Other countries in the region have solar and wind shares below 5%, lagging behind their peers.

[The vast potential of clean energy](#) in the ASEAN 5 is unfortunately not reflected in its latest 2030 plans. Our analysis shows that by 2030, the current energy plans would bring the share of solar and wind in this region up to 11% of total generation. To be aligned with the IEA Net Zero pathway, solar and wind uptake should be accelerated rapidly. The current solar and wind deployment target would only be less than half of the IEA target. More ambitious solar and wind deployment plans are needed.

Way forward

Momentum is building for a clean electricity transition in ASEAN. This has started to create an environment that encourages more sustainable growth and opportunities in

some ASEAN countries, which then may translate into more ambitious commitments to decarbonise the power sector across the region.

ASEAN's power systems, however, are structured around large-scale centralised and dispatchable power plants. They are becoming increasingly incompatible with the changing generation mix, with rising outputs from variable solar and wind power. This incompatibility, if left unattended, is likely to affect the security and reliability of electricity supply, which could make the region's transition towards a clean electricity future more difficult. Rather than a quick technological fix, the resolution of this issue requires a holistic policy approach to reorganising all aspects of the power system: from technology to market, regulation and consumer behaviours.

Recommendations for policymakers

01 Raise ambition

Raising clean energy development targets, especially for solar and wind, is a reasonable step that should be taken. The existing trend shows that if the respective country's targets are not increased, high demand growth will be met by coal.

02 Reconfigure the electricity grid

Raising ambition alone is not enough. For developing countries, maintaining supply sufficiency of electricity is also essential. Limited grid capacity, for instance, may affect efforts to attain higher levels of wind and solar penetration while ensuring supply reliability and affordability. This is illustrated by [Viet Nam](#) and [Indonesia's](#) experiences with grid capacity. Although both countries have strategies that support the acceleration of solar development through supportive policies, the limited capacity of grid transmission is hindering the implementation of the target.

Reconfiguring the electricity system to ensure that the grid infrastructure can accommodate the penetration of various renewable sources is important to accelerate solar and wind deployment.

03 Multilateral cooperation

Promoting and accelerating cross-border power connectivity among ASEAN countries could support the region to better allocate their energy resources and to meet the energy demand. For example, [the first multilateral cross-border electricity trade](#) involving Lao PDR, Thailand, Malaysia and Singapore, which will provide 100 MW renewable energy from Lao PDR to Singapore. This power integration project will not only contribute to Singapore's sustainability goals, but also ensure electricity supplies and enhance cost-competitiveness of the power sector in the region.

Supporting Materials

Methodology

Scope of study

This study focuses on 5 ASEAN countries (Indonesia, Malaysia, the Philippines, Thailand and Viet Nam), which make up 89% of the total electricity generation in ASEAN. From a climate mitigation perspective, clean electricity transition in these countries will significantly contribute to the region's emissions reductions. However, contributions from Singapore, Lao PDR, Myanmar, Cambodia and Brunei Darussalam are equally important for the region to achieve their climate goals.

Draft of PDP 8 Viet Nam

Our analysis on Viet Nam is based on the most recent update of PDP 8 version 29/4/2022 (letter 2297/tt-bct) as presented by Vietnam Initiative for Energy Transition (VIET), a local independent think tank, in ADB's Asia Clean Energy Forum (ACEF) session 1.1 on 14 June 2022. The presentation material can be accessed by all participants on the ACEF website.

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