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Clean Energy and Decarbonization in Southeast Asia

Overview, Obstacles, and Opportunities

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Introduction

Southeast Asian nations face the daunting task of maintaining economic growth targets and meeting the energy needs of growing populations while also adhering to ambitious carbon neutrality pledges. For the United States, the Biden administration must also balance its stated goals of promoting renewable energy and deepening partnerships with regional countries, none of which are likely to meet their short- and medium-term energy needs with renewable sources alone.

Across the region, governments are confronted with growing energy demand that is likely to require major investments not only in solar, wind, and other renewables but also in hydrocarbons. If the latter is not provided via natural gas, countries are likely to prolong their dependence on coal, which would undermine both their goals and those of Washington. There is an opportunity for the United States to deepen bilateral and multilateral cooperation across the region by promoting more transparent, sustainable, and high-quality energy infrastructure development and financing.

Coal is entrenched in Southeast Asia's immediate future, with coal-fired power plants accounting for more than 40 percent of the region's power generation. Many regional governments had bet on liquefied natural gas (LNG) as a cost-effective bridge between their current reliance on coal and an eventual transition to renewables. Burning LNG produces far fewer greenhouse gases (GHG) than coal and was expected to be considerably cheaper—and thus more feasible—than an immediate switch to renewables. However, the ongoing conflict in Ukraine has made LNG prices more volatile, and

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Southeast Asian countries are being **outbid** by European nations that must now replace the natural gas they were previously importing from Russia. Southeast Asian states are therefore not expected to import as much LNG as they had originally intended. Most natural gas added to the energy mix in Southeast Asia will likely be used to **meet** growing demand rather than replace existing coal usage.

Rising energy demand and affordability are the largest obstacles to Southeast Asia's decarbonization efforts. The business-as-usual (BAU) scenario is a **pathway** where existing trends in technology development and deployment and policy frameworks continue in a similar manner. The carbon-neutral (CN) scenario outlines a potential pathway where energy efficiency, fuel switching, and technology advancement lead to a significant reduction in carbon dioxide emissions from fossil fuel combustion by 2050. According to **estimates** from the Asia Pacific Energy Research Centre, overall energy demand for the six biggest economies in the region will increase by 218 percent in a BAU scenario and 166 percent in a CN scenario.

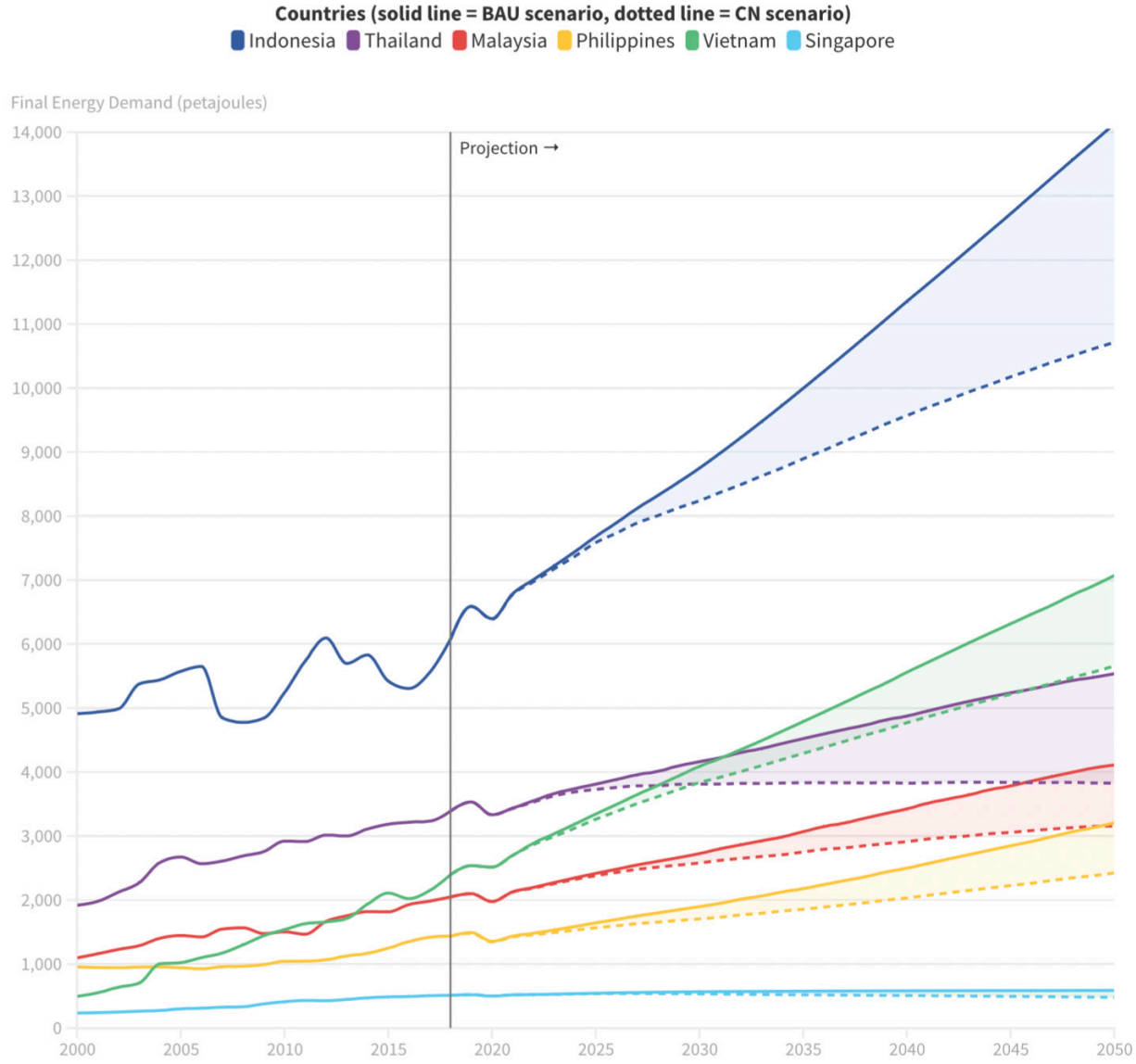
Electricity generation in a CN scenario outpaces that of a BAU scenario due to increased energy demand in all sectors, including electric vehicles in the transportation sector. National budgets are already **constrained** by spending related to the Covid-19 pandemic, supply chain disruptions, and increased energy prices. The energy transition is an issue that Southeast Asian governments recognize as important, especially in the wake of increasingly frequent natural disasters and extreme weather events. But they, and their publics, see it as secondary to overall economic well-being and pandemic recovery.

Most Southeast Asian countries have committed to decarbonizing by 2050 and have published national energy transition frameworks, but many lack concrete implementation plans, including how to fund the expensive move away from coal. Shifting to renewable energy production will cost considerably more than expanding existing infrastructure. In the short term, Southeast Asia will **need** at least $367 billion over the next five years to stay on target for meeting its decarbonization commitments. According to Organization for Economic Cooperation and Development **estimates**, the United States contributed just over $1 billion in climate-related development finance to Southeast Asian countries from 2012 to 2020, more than half of which went to Indonesia. Regional governments are hesitant to take on more debt, especially after borrowing so much during the pandemic. Large-scale investment in renewables remains too costly for the private sector alone to fill the gap—a situation exacerbated by an uncertain regulatory environment in much of the region.

The Indo-Pacific Economic Framework (IPEF) features a clean economy pillar that offers an avenue for the United States to deliver some of the technical and financial assistance that partners want, and perhaps extract agreements on clean energy standards. It is too early to predict what exactly IPEF's clean economy pillar can deliver, but partners have expressed interest in the potential funds and tangible products that can come from it. Although attention has understandably focused on IPEF, the Biden administration already has a mix of bilateral and multilateral energy initiatives underway in the region. Such multilateral initiatives include the **Japan-U.S.-Mekong Power Partnership** (JUMPP) and the Just Energy Transition Partnerships (JETP) announced with **Indonesia** and **Vietnam**, along with the **Energy Transition Mechanism** of the Asian Development Bank, of which the United States and Japan are the largest funders. These energy transition initiatives are welcomed by partners in the region, but most remain anxious about the lack of clear implementation plans and want to see Washington and the U.S. private sector follow through on concrete financial commitments.

Projected Energy Demand for Southeast Asian Countries

Except in Thailand and Singapore, energy demand will increase in both a both a BAU and CN scenario, but at a slower rate in the latter case.



Source: David Wogan et al., APEC Energy Demand and Supply Outlook 8th Edition, Vol. 2 (Tokyo: Asia Pacific Energy Research Centre, September 2022), https://aperc.or.jp/file/2022/9/29/APEC_Outlook_8th_Edition-Appendix.xlsx.

To assess how realistic Southeast Asian countries' current energy transition plans are and how the United States can better tailor programs to help meet those goals, the Southeast Asia Program at CSIS engaged in conversations with experts, officials at U.S. development agencies, U.S. diplomats in the region, and Southeast Asian embassies in Washington. These conversations informed the findings and recommendations in this report, but all opinions presented are solely those of the authors. The authors have chosen to omit Myanmar and Brunei from this report due to the former's political instability and the latter's unique reliance on oil and gas.

Southeast Asian Energy Transition Plans

INDONESIA

Indonesia's **energy mix** is composed of 60 percent coal, 21 percent oil and gas, 8 percent hydropower, 6 percent bioenergy, 5 percent geothermal, and less than 1 percent wind and solar. As Southeast Asia's most populous country, it accounts for 40 percent of the region's energy consumption.

Indonesia's **National Electricity Supply Business Plan** for 2021 to 2030 predicts that energy demand will grow by 4.9 percent annually, with electricity demand expected to rise significantly in the industrial and household sectors. Around 60 percent of the country's electricity is coal generated, and there is a **price cap** on coal that makes it compete with cleaner forms of energy. The Indonesian government has set a goal of generating 23 percent of its electricity from renewables by 2025 but will almost certainly fall short, attaining only 11 percent as of 2022. The biggest gap is financing: mooted investments in clean energy and the shuttering of coal plants would **cost** an estimated $25 billion per year through 2030, but Indonesia invested just $3 billion in renewables for 2017 to 2021. Although Indonesia is the world's **second-largest producer** of geothermal energy, after the United States, affordability, lack of supporting infrastructure, and regulatory barriers also mean that the sector will not contribute to the country's short-term climate goals.

Indonesia is the seventh-largest **exporter** of LNG in the world and is mostly a supplier to Northeast Asian countries. The volume of domestic gas consumption is expected to **increase** by 2025, and the share of gas in electricity usage is expected to **increase** from a predicted 22 percent in 2025 to 25 percent in 2038. In December 2022, Indonesia **extended** an LNG production-sharing contract with BP by 20 years, signaling that the government does not plan to stop LNG production or exploration any time soon.

On the sidelines of the G20 Leaders' Summit in Bali in November 2022, President Joko Widodo and the International Partners Group **unveiled** a JETP agreement to mobilize $20 billion in public and private financing to accelerate Indonesia's net-zero timeline. The Indonesia agreement was the group's second, after inking a partnership with South Africa in 2021. Under the partnership, Indonesia aims to peak total power sector emissions and achieve 34 percent renewable energy mix in power generation by 2030 and reach net-zero emissions in the power sector by 2050. It also set a goal of **freezing** the existing pipeline of coal-fired power plants in its National Electricity Supply Business Plan and aligning local content requirements with the roadmap for renewables adoption in that plan.

Puzzlingly, despite the goals laid out in the JETP, a 2022 Indonesian presidential regulation **allows** an exemption for the construction of coal plants that contribute to "nationally strategic projects," provided they shut down by 2050 and reduce emissions by 35 percent within 10 years through technology or carbon offsets. Indonesia is already **planning** to build new coal plants for a green industrial park in Kalimantan. This contradiction between Indonesia's stated goals and its actions undermines its credibility and further jeopardizes its net-zero timeline. Other factors explain Indonesia's continued reliance on coal, including government elites' own **assets** in the industry and the country's overcapacity of coal production. Given Indonesia's dependence on fossil fuels and natural gas for electricity generation and the slow pace of renewables development, it is unlikely that the country will meet its carbon neutrality goals.

PHILIPPINES

The Philippines' **energy mix** consists of 55 percent coal, 22 percent oil and gas, 11 percent geothermal, 7 percent hydropower, and 4 percent solar and wind. Its current transition plan, the **Philippine Energy Plan 2020–2040**, calls for ambitious reduction targets over the next few decades. By 2030, the country plans to **reduce** emissions by 75 percent compared to BAU projections and increase the percentage of its renewable energy mix to 35 percent. Close to 97 percent of the Philippines' commitment is conditional on external funding. Without external support, its emissions targets are unlikely to be successful.

The Philippines faces an acute energy crisis. Electricity prices are **among** the highest in Asia, precarious supply is causing **nationwide brownouts**, and the offshore Malampaya gas field—which **supplies** about 20 percent of the country's electricity—is expected to be completely depleted by 2027. The Marcos administration has shown an interest in lowering electricity prices, signaling that coal will play a role in the energy mix for the foreseeable future. The Philippines has also become more reliant on imported coal—the largest contributor of GHG emissions—as the most cost-effective and reliable source of electricity over the past few years. LNG could serve as a transitional fuel from coal, but its introduction to the Philippines has been slow and the government has **no roadmap** to incorporate it as a baseload source. The government has approved seven LNG **terminal projects**, but the two that are expected to become operational this year will not significantly contribute to meeting the country's targets. On top of that, LNG terminals have yet to confirm any long-term contracts. At the same time, pressure from China has prevented the Philippines from developing offshore gas fields in the South China Sea to replace Malampaya.

U.S. vice president Kamala Harris **announced** in 2022 that the United States would collaborate with the Philippines to develop geothermal and nuclear energy. She also highlighted a new energy policy dialogue between the two allies. The Philippines is interested in building a new geothermal power plant in Mindanao, and the government has **considered** reviving the Bataan Nuclear Power Plant, which was built in the 1980s but never entered service. Neither is likely to change the Philippines' coal usage in the short term, and electricity generation from renewable sources has **actually decreased** in recent years. The government hopes that regulatory changes through recently passed legislation such as the **CREATE Act**, amended **Public Services Act**, and amended **Renewable Energy Act** will incentivize enough domestic and international private sector investment to alter these trends.

VIETNAM

Vietnam's **energy mix** is 30 percent coal, 13 percent oil and gas, 28 percent hydropower, 24 percent solar, and 5 percent wind. Vietnam plans to be carbon neutral by 2050, with renewable energy powering 75 percent of its electricity by 2045. Vietnam is overwhelmingly reliant on coal and is one of the world's top 20 coal producers. As a centralized economy in which 75 percent of the coal-fired power plants are owned by state-owned enterprises, the government must be the main driver of the energy transition. Its energy transition plan, Power Development Plan 8 (PDP8), has been repeatedly rewritten and its public release **delayed**, fueling concerns about how committed officials are to the country's stated—and very ambitious—decarbonization goals. The government is already two years behind its original plan to implement its power development plan for 2021 to 2030, and the negotiation of a **JETP** in late 2022 will require PDP8 to be revised yet again.

Vietnam's ambition to become a high-income country by 2045 is at odds with its energy transition plans. Coal-powered industrialization over the past two decades has made energy security a **high priority** for the government, and Hanoi is unlikely to accept any limit on economic growth as the cost of decarbonization. Part of the answer was supposed to be LNG use, which the most recent PDP8 **draft** called for increasing over the next 10 years. It is possible that Vietnam can start **importing** gas at two LNG terminals this year, but it has yet to secure any long-term purchase agreements. Overall, price volatility caused by the conflict in Ukraine, alongside unclear regulatory frameworks, stands in the way.

On the positive side, with a high capacity for both solar and wind power, Vietnam is the **leading** renewable energy market in Southeast Asia. In 2019 alone, Vietnam **increased** its installed solar power capacity by more than 47 times. But its electricity grid has lagged in development, as the intermittent nature of wind and solar makes a reliable energy storage system a necessity. Although Vietnam's **capacity** for renewable energy shows great potential, renewables seem unlikely to provide a complete solution to the country's dependency on hydrocarbons as a baseload source. Vietnam's energy transition will hinge on the government's **ability** to unlock international investment in renewable energy, modernize its transmission grid, and finalize the commitments under PDP8.

THAILAND

Thailand's **energy mix** is composed of 67 percent oil and gas, 11 percent coal, 7 percent bioenergy, 6 percent hydropower, 6 percent solar, and 3 percent wind. Thailand has **pledged** to be carbon neutral by 2050 and reach net-zero GHG emissions by 2065. The 2022 National Energy Plan aims to **generate** 50 percent of the country's electricity from clean energy by 2040. Thailand **expects** to reduce GHG emissions by 40 percent compared to BAU projections by 2030, conditional on international support. Thailand is a net importer of natural gas, oil, and coal, though it is considerably less reliant on the latter than Indonesia and Vietnam.

Thailand has factored LNG into its energy security plans for the medium term. Reserves from the Erawan field, Thailand's largest gas field, are expected to decline sharply by 2030 if no new reserves are found. In July 2022, Thai state-owned energy company PTT **signed** a 20-year sale and purchase agreement with Cheniere Energy to purchase one million tons of LNG per year beginning in 2026. The government also plans to upgrade existing LNG facilities in Map Ta Phut, the site of Thailand's largest industrial park. Natural gas from Myanmar **accounts** for about 15 percent of Thailand's gas consumption, and trade flows have been disrupted following the military coup in February 2021, further underscoring the need for Thailand to strengthen its energy security.

Thailand has a high potential for solar power. Under Thailand's **Power Development Plan 2018–2037**, solar is expected to account for more than 50 percent of total energy production by 2037. The world's largest floating solar farm **began** operations in October 2021 in Thailand's northeastern province of Ubon Ratchathani, the first of 16 planned facilities. Thailand also heavily promoted the Bio-Circular-Green Economy during its Asia-Pacific Economic Cooperation host year in 2022, part of which involves exploring renewable energy sources using biomass derived from agricultural waste.

The development of the domestic electric vehicle (EV) industry is a key pillar of Thailand's energy transition plan. The **30@30 policy** announced by the National Electric Vehicle Policy Committee aims for 30 percent of domestically made vehicles to be zero emission by 2030, and Thailand's EV

market **represents** almost 60 percent of Southeast Asia's market share. The government has rolled out multiple incentives to attract foreign investment and induce domestic consumption, including subsidies, reduced import duties and excise taxes, and the **allowance** of foreigners to own land for the purpose of industrial EV projects. Financing the energy transition is less of an issue for Thailand than for other countries, as both Thai state-owned enterprises and private companies are well capitalized and willing to make riskier investments; the country is likely to reach its energy goals if current investment momentum persists. Thailand would therefore benefit from U.S. expertise and capacity-building support, rather than finance.

MALAYSIA

Malaysia's **energy mix** is composed of 47 percent oil and gas, 32 percent coal, 15 percent hydropower, 4 percent solar, and 2 percent bioenergy. Its current transition plan, **National Energy Policy 2022–2040**, aims to reach 39 percent natural gas, 27 percent oil, 17 percent coal, 9 percent hydropower, and 4 percent each of solar and bioenergy by 2040. Malaysia's energy sector makes up 80 percent of its GHG emissions, so the transition in this sector is vital to its decarbonization. The national energy policy lays out the roadmap for Malaysia's transition but is largely missing an implementation plan. The national government is generally **responsible** for driving energy policy and is the largest stakeholder in the industry.

The energy sector is **entrenched** in Malaysia's economic growth; energy-intensive industries account for 28 percent of its GDP and 25 percent of its workforce. Malaysia is a **net importer** of coal, petroleum products, and natural gas. It is also Southeast Asia's **second-largest** oil producer and the world's third-largest exporter of LNG, with Malaysian state-owned oil and gas company Petronas holding exclusive ownership rights over all domestic oil and natural gas production and exploration. Malaysia plans to reduce its coal usage in favor of more natural gas and renewable energy, especially solar. Malaysia is the world's **third-largest manufacturer** of photovoltaic solar panels, and its national energy policy emphasizes large-scale and floating solar projects. Although 93 percent of Malaysia's energy comes from fossil fuels, it has considerable **potential** for solar, biomass, and hydro sources for clean energy production. Petronas has also **committed** to achieving net-zero carbon emissions by 2050. If the government can clearly articulate its implementation plans in a timely manner, private sector investments will follow suit.

CAMBODIA

Cambodia's **energy mix** is about 50 percent renewable energy—with about **44 percent** of the total mix coming from hydropower—41 percent coal, and 8 percent oil. Its current transition plan, the **Long-Term Strategy for Carbon Neutrality**, calls for Cambodia to reduce its GHG emissions by 42 percent compared to BAU projections by 2030 and to reach net zero by 2050. It also plans to roll out two new national energy policy plans: the Power Development Masterplan, which is Cambodia's first long-term decarbonization plan for the energy sector, and the National Energy Efficiency policy, which aims to reduce energy consumption 19 percent by 2030. As noted previously, **44 percent** of Cambodia's energy comes from hydropower, but it has pledged to stop building new dams due to biodiversity risks. Other renewable sources—namely solar and biomass—account for just 7 percent of its energy consumption. Its transition plan relies on increasing the uptake of renewable energy, decreasing the role of coal, and incentivizing private sector funding for its transition.

Cambodia is one of the most rapidly electrifying countries in the world. It **shows** promise for solar and wind projects but lacks the grid, technical capacity, and funding to increase their uptake. Implementing large-scale solar and wind projects will require robust private sector investment, which in turn necessitates regulatory incentives to create competitive prices and a reliable grid. **Concessional financing** from international partners has played a role in helping to de-risk investments for renewable energy. Creating a reliable and modernized national grid in a country where 76 percent of the population lives in rural areas will be a challenge. The Cambodian public and investors also evince little **awareness** of clean energy. These factors make it unlikely that Cambodia will reach its energy transition targets.

LAOS

Laos's **energy mix** consists of 66 percent hydropower, 33 percent fossil fuels, and 1 percent solar. Under its revised national determined contributions, Laos has committed to reducing emissions by 60 percent compared to BAU projections by 2030 and **reaching** net-zero emissions by 2050. Its target is to achieve **30 percent** of energy consumption from renewables by 2025. **Two components** of its energy transition are its National Green Growth Strategy and upcoming Climate Change Strategy, which detail the country's sectors of focus but lack clear implementation plans. In a reversal of global trends, Laos has turned to coal in the past decade to minimize the amount of power it imports and to address dry-season shortages. The share of electricity generated from coal **rose** from 0 percent in 2014 to above 40 percent in 2019. Carbon dioxide emissions also grew five times faster from 2015 to 2019 than they did in the previous 50 years. At the current levels of investment and planning, Laos is unlikely to reach its net-zero goals on time.

Extremely well situated for hydropower, Laos has billed itself as the "**battery of Southeast Asia**." There are almost **80 dams** in the country, and more are planned along the Mekong River and its tributaries. More than **90 percent** of the country's electricity is generated by hydropower, and more than 66 percent of its current hydropower capacity is exported. The rapid development of dams has contributed to Laos's ballooning debt, much of which is owed to China. The **Lao PDR-Thailand-Malaysia-Singapore Power Integration Project**, which exports hydropower from Laos to Singapore, was established in June 2022. It is the first renewable energy import pipeline into Singapore and serves as a pathfinder toward developing a framework for multilateral electricity trading on a subregional basis through the Association of Southeast Asian Nations (ASEAN) power grid. Although the power integration project was hailed as a milestone, **multiple studies** have shown that further hydropower development on the Mekong will negatively impact ecosystems, reduce soil fertility and rice production, and displace local populations, making further dam projects in Laos unsustainable.

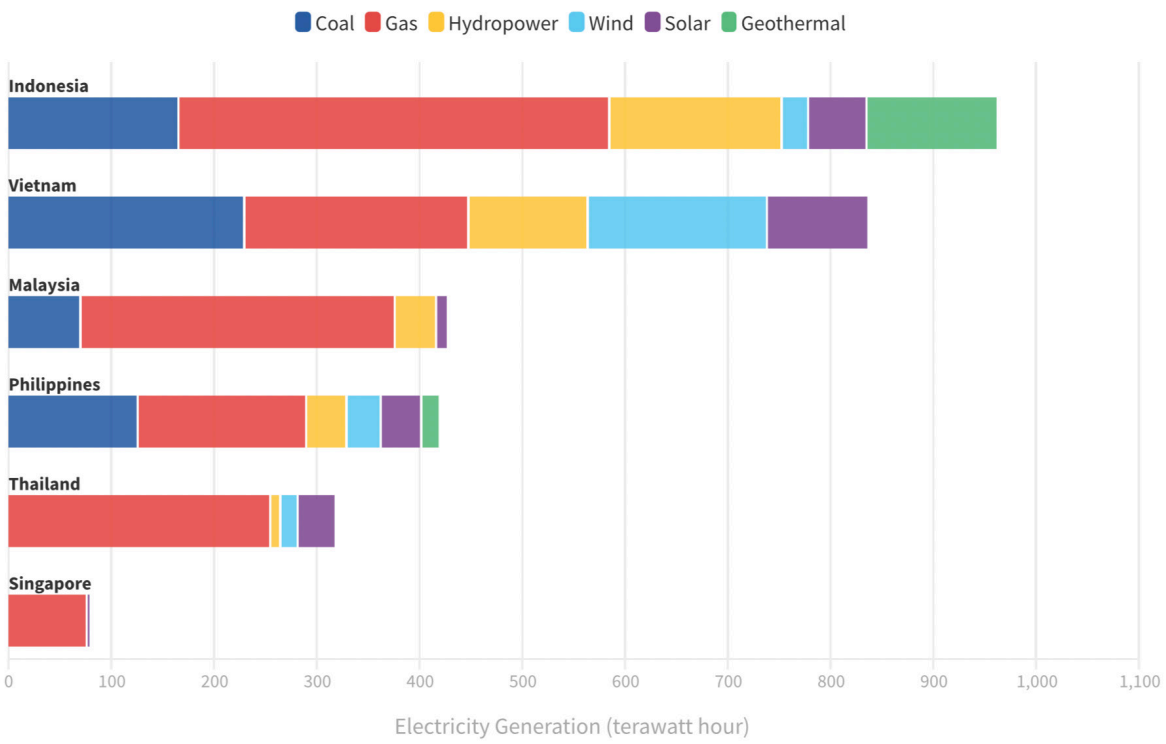
Laos is also looking to grow its solar, wind, and geothermal capacity by 2030 but will require significant foreign investment to avoid further coal-fired power expansion. A new wind power project that is **expected** to begin commercial operations in 2025 will export and sell electricity to Vietnam as Asia's first cross-border wind project. Construction also **began** in 2022 on Laos's first large-scale solar farm, which is expected to supply power to state-owned utility Électricité du Laos under a 30-year power purchase agreement. Given Laos's lack of clear implementation plans, continued reliance on coal, and lack of utility-scale solar and wind infrastructure, it is unlikely to meet its carbon neutrality goals.

SINGAPORE

Singapore's **energy mix** is composed of 97 percent oil and gas, 2 percent bioenergy, 1 percent coal, and 1 percent solar. Southeast Asia's smallest but richest country has ambitious plans to **achieve** net-zero emissions by 2050 and peak emissions before 2030. Singapore is the only Southeast Asian country predicted to achieve an **emissions reduction** in 2030 compared to 2019 levels, though it has readily acknowledged that the success of its energy transition is contingent on international cooperation and technological advances.

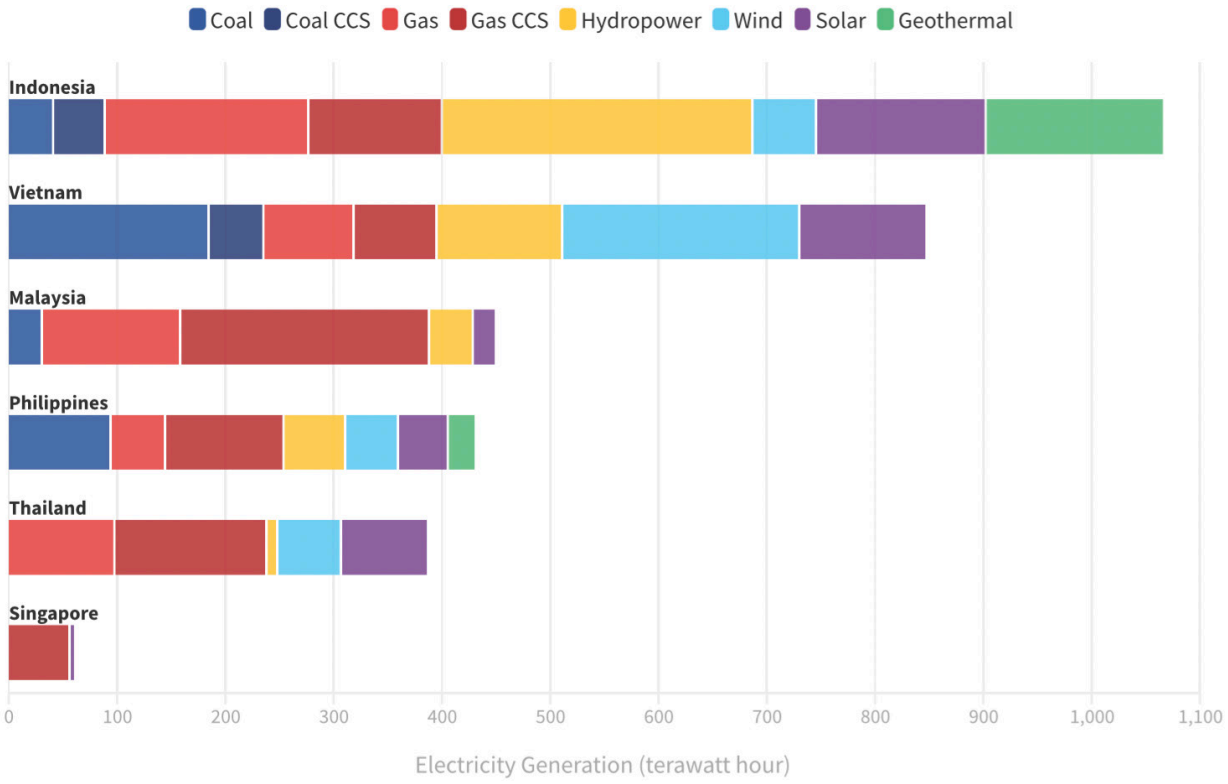
Solar power is expected to supply **28 percent** of peak power demand by 2030. The city-state's biggest challenges are land scarcity and a lack of other renewable sources, which eliminates the possibility of significantly deploying nuclear, geothermal, or hydroelectric power. Below-average wind speeds and the lack of offshore wind opportunities have made **solar power** the most viable and efficient renewable energy option for Singapore. In July 2021, Singapore **unveiled** one of the world's largest floating solar farms, which aims to produce electricity for powering the city-state's five water treatment plants and is part of the government's plans to quadruple solar energy production by 2025. Another component of its energy transition plan is a **national hydrogen strategy** that could enable hydrogen to supply 50 percent of Singapore's power needs by 2050, contingent on technological developments. The power sector currently accounts for around 40 percent of the state's carbon emissions.

Projected 2050 Electricity Generation by Source (BAU scenario)



Source: David Wogan et al., APEC Energy Demand and Supply Outlook 8th Edition, Vol. 2 (Tokyo: Asia Pacific Energy Research Centre, September 2022), https://aperc.or.jp/file/2022/9/29/APEC_Outlook_8th_Edition-Appendix.xlsx.

Projected 2050 Electricity Generation by Source (CN Scenario)



Note: CCS denotes carbon capture and storage.

Source: David Wogan et al., APEC Energy Demand and Supply Outlook 8th Edition, Vol. 2 (Tokyo: Asia Pacific Energy Research Centre, September 2022), https://aperc.or.jp/file/2022/9/29/APEC_Outlook_8th_Edition-Appendix.xlsx.

Singapore has recognized that it can play a pathfinder role in the energy transition. In October 2022, Singapore and Australia signed a landmark **Green Economy Agreement** that aims to facilitate the flow of environmental goods and services, green and transition finance, and clean energy. Singapore and Malaysia also **signed** a green economy agreement during Prime Minister Anwar Ibrahim's visit to Singapore in January. The agreement will deepen bilateral cooperation in environmental standard setting and jointly explore projects in low-carbon solutions, such as carbon capture, utilization, and storage (CCUS). Singapore's government is eager to negotiate more such green economy agreements, including with the United States. Singapore has also demonstrated leadership in carbon taxing, credits, and trading and **implemented** Southeast Asia's first carbon pricing scheme in 2019 as a signal to encourage companies to reduce emissions. Clear government directives, a trustworthy business environment, and dedication to exploring new technologies suggest that Singapore is likely to achieve its carbon neutrality goals despite the challenge of steeply reducing the role of natural gas in electricity generation.

Challenges to the Regional Energy Transition

FUELING DEVELOPMENT

The projected increase in energy demand across the region threatens to make Southeast Asia's current decarbonization targets unachievable, as current policies do not address how countries can balance the

competing priorities of development and decarbonization. With energy demand expected to triple by 2050 and funding and policy alignment on decarbonization goals already lagging, Southeast Asia will continue to rely on fossil fuels in the short term to keep the lights on. If increased electrification targets are met by coal use, even the assumed benefits of EV uptake in the region would be undermined.

Coal-fired power generation in Southeast Asia has grown in the past few years, contrary to global trends. Even though coal usage in the region is **expected** to peak in 2027 before slowing down, it will likely remain a baseload fuel source for countries such as Indonesia and Vietnam in the short and medium term. Nearly **90 percent** of Southeast Asia's coal production comes from Indonesia and Vietnam, and as long as coal remains a reliable, easily available, and cost-effective source of energy, it will be difficult for developing countries to stop buying it. The transition away from coal will require substantial international financing to make a transition to renewables more cost effective. Although countries in Southeast Asia have committed to halting the construction of new coal-fired power plants, those they already have are relatively young and can continue to operate for decades. Multiple governments in the region are also large stakeholders in fossil fuel production and use due to the role of state-owned energy companies, which complicates their incentives when it comes to the energy transition.

Dwindling gas fields are another common issue faced by Southeast Asian countries. Some, such as the Philippines and Thailand, have major gas fields that are expected to be depleted within the next decade. The previously assumed role of LNG as a transition fuel in the region has been thrown into question because of price volatility caused by the Russian invasion of Ukraine. In as much as LNG is a capital- and infrastructure-intensive investment, countries must often commit to long-term import contracts of 20 to 25 years, which carry risks if they do not already have the proper infrastructure in place.

New LNG infrastructure scheduled to go online after 2030 will lock in natural gas as a baseload fuel for decades. But the alternative is likely worse. If Southeast Asian countries do not invest in LNG alongside renewables, surging energy demand will likely outstrip the uptake of renewables alone. This would force a continued reliance on—and perhaps even expansion of—coal use, putting net-zero targets even further from reach.

AFFORDING RENEWABLES

The affordability of infrastructure and technology required to harness renewable energy sources remains a significant obstacle for Southeast Asian countries. **The Southeast Asia Energy Outlook 2022** report from the International Energy Agency (IEA) finds that Southeast Asia needs an annual investment of $190 billion to reach its climate goals by 2030. The average annual investment from 2016 to 2020 was only $70 billion, with the majority going to Vietnam.

Wind and solar photovoltaics have experienced major cost reductions over the past 10 years, but they remain relatively expensive compared to hydrocarbons due to opaque regulations that have hindered long-term predictability for investors. Although more countries have increased their solar photovoltaics capacity as that technology has become more affordable, other renewable technologies are still not mature or cost competitive. That includes hydrogen and geothermal power. The challenge of deploying intermittent renewables such as solar and wind also underscores the need to invest in battery storage, which is a relatively new technology that has not been **factored** into previous grid or energy capacity planning.

Countries are exploring other nascent technologies to aid the energy transition, but all remain unproven. Indonesia and Malaysia, for instance, are exploring ways to co-fire ammonia in coal-fired power plants and modify LNG infrastructure for liquified hydrogen. Ammonia is itself a potent GHG, so the risks of leakage during transport make it a risky proposition as an alternative fuel. Hydrogen development is further along, and the conversion of existing LNG infrastructure to use it would theoretically ensure that LNG really is a transition fuel on the path to a renewable future. But the production of "green hydrogen"—created from renewables rather than hydrocarbons—is still unproven at scale.

Other emerging renewable energy and decarbonization technologies, such as small modular nuclear reactors and CCUS, face similar questions around feasibility and affordability. Multiple countries in Southeast Asia have expressed interest in deploying nuclear power, and the United States has recently signed agreements with a number of countries to explore small modular reactor (SMR) technology. During Vice President Harris's visit to Thailand and the Philippines in November 2022, she **announced** plans to build the countries' capacity for deploying SMRs. Additionally, the U.S. Trade and Development Agency (USTDA) **awarded** a grant to PLN Indonesia Power in March 2023 to assess the viability of a proposed nuclear plant in West Kalimantan. However, given the associated risks and public wariness toward it, nuclear power is not likely to play a significant role in the region's energy transition by 2050.

If properly deployed, CCUS has great potential to reduce carbon emissions generated during the production of electricity or hydrogen from hydrocarbons. It may be one of the few scalable solutions available for **decarbonizing heavy industries** such as cement and steel. The IEA predicts that to meet their emissions reduction goals, Southeast Asian countries will **require** almost $1 billion per year in CCUS investment between 2025 and 2030. Along with improvements in energy efficiency, this offers the best hopes of reducing emissions from hard-to-abate sectors such as heavy industries and long-distance transportation.

PRIVATE SECTOR HESITANCY

About **60 percent** of clean energy investments in Southeast Asia has relied on public financing, compared to 90 percent in advanced economies. After racking up debt during the Covid-19 pandemic, Southeast Asian governments are reluctant to take on more loans. The IEA estimates that over 70 percent of spending needs in a sustainable development scenario must come from private capital.

Private investment remains low compared to other regions, despite Southeast Asia's high potential for renewable energy. Multiple factors explain this hesitance, including unclear and opaque regulatory policies, political instability and corruption, complex permitting and licensing procedures, and protectionism, all of which heighten unpredictability. Investors are more likely to invest in countries that have predictable rule of law, contract sanctity, and clean energy transition roadmaps. Inflexible and long-term power purchase agreements have also **locked in** fossil fuel-based electricity sources, making investment in renewable energy projects less attractive. The private sector is reluctant to devote its money toward risky projects where the rate of return is unclear. As a result, private sector involvement in supporting renewable energy varies across the region.

Low-income countries, such as Cambodia and Laos, rely more on concessional finance and loans to push their transition forward because the enabling environment to promote private sector investment is weak. Countries such as Vietnam and Thailand, which can afford to offer financial investments

such as feed-in tariffs to the private sector, have experienced a rapid increase in renewable energy. Protectionist policies that create ceilings on foreign investment and ownership are meanwhile restricting investment in renewable energy in Indonesia.

INTEGRATION IN GLOBAL SUPPLY CHAINS

Southeast Asian countries such as Indonesia and the Philippines have the potential to be part of the global supply chain for critical minerals that will help drive the global energy transition, but they currently lack the domestic capabilities to process raw minerals. Strengthening Southeast Asia's critical mineral supply chains is crucial for its nascent battery and EV industries, and therefore the decarbonization of the transportation sector, which accounts for more than **20 percent** of the region's carbon emissions.

Indonesia and the Philippines are the world's largest producers of nickel, a key component in lithium-ion batteries. Indonesia and Myanmar are the second- and third-largest producers of tin, and Myanmar accounts for 13 percent of global rare-earth elements (REE) production. However, **90 percent** of REEs are processed and refined in China. Myanmar accounts for 70 percent of the total value of China's REE imports, officially valued at almost $500 million per year. Because mining activities are often underreported, the actual volumes could be much larger, especially as illegal extraction has increased under Myanmar's military government. In some cases, Southeast Asian countries may also be undervaluing the raw ore they export to China because Chinese refinement capabilities are able to extract other trace minerals such as cobalt, copper, or gold. Implications of great power competition notwithstanding, it would be in the United States' strategic interest to increase the diversity of its downstream supply chains so that the processing of raw materials critical to the clean energy sector is not concentrated in China.

Although Indonesia's nickel sector shows promising growth, the United States' Inflation Reduction Act could impact the industry. EV provisions in the act **stipulate** that EV buyers will only receive tax credits if a certain percentage of the value of critical minerals in batteries is extracted or processed in the United States or its free-trade partners. Because IPEF is not considered a free trade agreement, a lack of concessions from the United States around EV supply chains could cause Indonesia to lean toward China for manufacturing and assembly and would also cause other **foreign companies** who are manufacturing in Indonesia to reevaluate their supply chains.

As more countries turn to the EV industry to decrease carbon emissions, Indonesia has implemented increasingly nationalist policies in its natural resources sector and capitalized on the demand for nickel to develop its domestic supply chain, processing capabilities, and downstream industries. Indonesia is **estimated** to account for 22 percent of global nickel reserves and 37 percent of global production. President Joko Widodo banned nickel ore exports in 2020, which has forced companies to build processing and manufacturing facilities in-country. From 2015 to 2020, Indonesia's processed nickel exports grew from $1 billion to $30 billion. Indonesia also **plans** to ban the export of copper ore, bauxite, gold, and tin and is **considering** removing incentives for less-refined goods. These bullish policies have increased foreign direct investment in the metal industry, with investments **surpassing** that of mining in 2019. Also in 2019, the European Union filed a case against Indonesia at the World Trade Organization (WTO) arguing that its export restrictions on raw materials were hurting the stainless steel industry. The WTO **ruled** in November 2022 that Indonesia's nickel export ban and its

domestic processing requirement for nickel ore were not in line with global trade rules, but Jokowi has promised to appeal the case.

The U.S. Department of Commerce's decision to **impose tariffs** on solar panels exported from Malaysia, Thailand, Vietnam, and Cambodia could also stall projects in the region. In December 2022, the Department of Commerce found that four Chinese solar panel and cell producers were skirting import duties by assembling their products in Southeast Asian factories. The four countries above accounted for more than 80 percent of photovoltaic panels imported to the United States in the third quarter of 2022. Although President Biden **instituted** a two-year tariff waiver on solar panels from those four countries in June 2022 in a bid to accelerate domestic clean energy product development, solar industry representatives have protested that two years is insufficient to establish the manufacturing supply chains to meet domestic demand. Although the tariffs are meant to target Chinese companies with manufacturing operations in Southeast Asia, the tariff decision would also impact Southeast Asian companies if they are required to prove that they do not source components from Chinese suppliers.

Recommendations

Recognize that the United States is not the "partner of choice" in some countries, and support climate initiatives led by allies and partners. Although the Biden administration has led a strong effort to reestablish U.S. leadership on global climate issues, the United States has undoubtedly lagged in economic engagement in Southeast Asia. Countries such as Cambodia and Laos are also not IPEF member states, meaning they may not be able to reap the benefits of the clean economy pillar. U.S. allies such as Japan, Australia, and South Korea have been active in the region for longer and have established government-to-government and private sector partnerships. The U.S. government should seek to supplement and support these initiatives where appropriate, especially because other allies and partners may be more trusted in the region.

Maintain better coordination and synergy between existing U.S.-led initiatives. U.S. government agencies have a confusing array of climate and green energy-related partnerships in Southeast Asia. These include the U.S.-ASEAN Climate Solutions Hub and the Southeast Asia Smart Power Program launched at the U.S.-ASEAN Special Summit in May 2022. The U.S. Agency for International Development has the Corporate Clean Energy Alliance and Vietnam Low Emission Energy Program, the State Department leads a Clean Energy Investment Accelerator and the Clean Energy Demand Initiative, and the USTDA and the U.S. International Development Finance Corporation (DFC) both have pipelines for existing projects in Southeast Asia. And then there are the various multilateral efforts with U.S. involvement. More options are better than none, but the existing alphabet soup of initiatives may confuse partners who are unsure of the implementing agency, scope, and timeline of each project.

Follow through with technical assistance, technology transfer, and capacity-building efforts through IPEF and other partnerships. The Biden administration is trying to demonstrate its economic engagement with Southeast Asia through IPEF and other deliverables announced at the sidelines of major summits. The ambition in these efforts falls well short of what regional partners want to see: U.S. engagement in the Comprehensive and Progressive Agreement for Trans-Pacific Partnership or other multilateral trade liberalization efforts. However, they still welcome IPEF, and it is critical that

the United States follows through on technical assistance, technology transfer, and capacity building under the clean economy pillar of the framework and other efforts. In addition to financing, Southeast Asian nations need technical assistance from the United States. The IPEF Upskilling Initiative, JUMPP, and reverse trade missions through the USTDA and Department of Commerce are all promising areas where the United States can demonstrate leadership and fill a much-needed gap in the region.

Conduct more bankability and feasibility studies on de-risking energy markets through the DFC and USTDA. In many cases, the U.S. private sector has been reticent to invest in clean energy projects in Southeast Asia due to concerns over political risk and the bankability of projects. Local governments should play a role in helping to de-risk climate investments so they can attract more private sector funding, which will be crucial in Southeast Asia's energy transition. More project preparation initiatives through the USTDA for specific projects in Southeast Asia would also be welcomed in the region.

Establish a mechanism to better coordinate standards around energy efficiency. Improvements in energy efficiency should progress simultaneously with renewables deployment in the region. One opportunity to do so in Southeast Asia is the decarbonization of the steel and cement industries, which are highly emission intensive and still rely on coal inputs. As in the rest of the world, demand for steel and cement in Southeast Asia is expected to grow as urbanization rates increase. The United States can utilize existing initiatives such as IPEF and the Partnership for Global Infrastructure and Investment to coordinate standards for energy efficiency and green products. ■

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