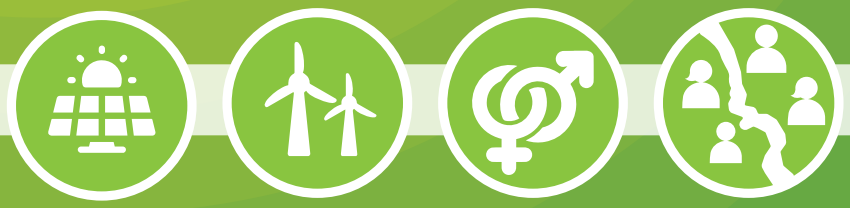
SOUTHEAST ASIA'S ROAD TO RECOVERY: TOWARDS A JUST REGIONAL ENERGY TRANSITION

Laurence L. Delina



This paper is part of a research series on the energy landscape in Southeast Asia.

HEINRICH BÖLL STIFTUNG
SOUTHEAST ASIA

ABSTRACT

Southeast Asia must change its energy development pathway for justice, the planet, and its people. A transition from harmful fossil fuels towards a transformed energy system that is renewable, democratic, and serves people is possible for the region. This report provides a regional analysis of an energy transition that builds on a 100% renewable energy goal for Southeast Asia by 2050 using the region's renewable energy from wind, water, geothermal, and solar sources. This report suggests that this vision of energy future for the region requires changes in technologies, institutions, and policies to usher in a just energy transition. This report offers a valuable opportunity to the public and civil society organizations to encourage and push their governments to change the trajectory by which energy is generated, distributed, and accessed. It suggests opening energy systems to more democratic processes that enable people and communities to access sufficient, affordable, reliable, and renewable energy of their choice. To succeed, this report puts forward the need for deep, systemic, structural, and holistic transformations aimed at decentralizing the sector and opening energy markets to public participation. Southeast Asian governments must recognize that publicly owned and controlled renewable energy is a right, and therefore should be prioritized in COVID-19 post-pandemic stimulus packages. Governments must work to remove the hurdles that may limit progress towards a just energy transition. Political commitment through ambitious renewable energy targets, public funding, regional cooperation, and energy market redesign is essential. A just transition to a 100% renewable energy future for Southeast Asia can unlock new jobs, close energy poverty, empower people, reduce inequality, and increase opportunities for participation.

1. INTRODUCTION

The Association of Southeast Asian Nations' (ASEAN) ambition to source 23% of its energy demand from renewable energy sources by 2025 (ASEAN Center for Energy, 2020) is a regional commitment requiring a regional energy transition. Since fossil fuels still account for the lion's share of the regional energy mix, the scale of the task of decarbonizing this region's energy sector requires both national and regional work. Not to be missed in this work is to aspire for a just energy transition in Southeast Asia, meaning that the energy systems of the future in the region should be more resilient and inclusive. This future is desirable given the region's vulnerability to climate change and the promise of energy transition in creating new job prospects, which could mitigate the economic crisis caused by the COVID-19 pandemic. With built-in mechanisms for public engagement, this transition can also lead to new opportunities for energy consumers to engage in energy generation and distribution. Although some national-level post-COVID recovery plans have underscored environmental sustainability by committing to emissions reduction, ASEAN still lacks a regional post-pandemic plan anchored to a just energy transition narrative.

This report surveys the opportunities, challenges, and strategies for a just renewable energy transition considering post-pandemic planning in Southeast Asia. While the report looks at the regional picture, it also considers national actors, touching upon the role of communities and local governments in pushing forward a just energy transition agenda in the region. The report contains the following four sections, which are described briefly as follows:

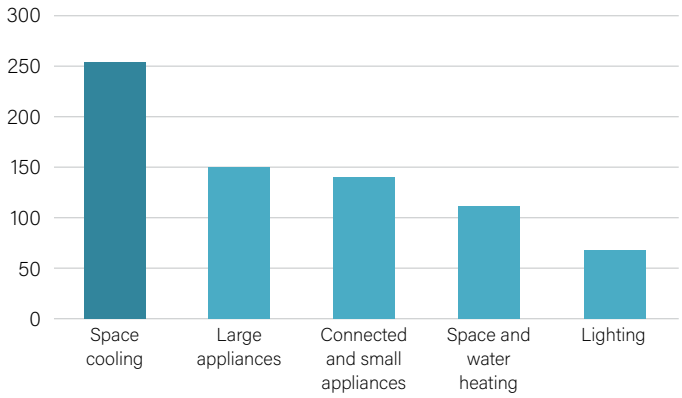
- Section 2 discusses Southeast Asia's renewable energy potential, and looking to the future, describes how a 100% renewable energy future could look like for this region.
- Section 3 reviews the impacts COVID-19 has brought in the region's energy transition, showing evidence of continuing activities to introduce renewable energy capacity despite the limitations of the pandemic. This section also discusses some key drivers and the challenges standing in the way of the transition.
- Section 4 explores the opportunities for accelerating the transition. It does this by laying out the different strategies that could assist in unlocking the region's energy transition potential.
- The report concludes in Section 5 by outlining that growth of renewables has been occurring in Southeast Asia, however a whole-of-system approach is needed, especially in terms of strong political commitments to overcome policy and market barriers.

2. POTENTIAL AND PROSPECTS FOR ENERGY TRANSITION

Southeast Asia's future energy demand

Looking to the future, Southeast Asia's energy demand is expected to grow at a very healthy rate as its economies grow, the populations increase their consumption, and as rural-urban migrations intensify (IEA, 2019). As temperature increases, coupled with heat island effects in the region's urban centers, space cooling, compared to other electricity end uses, will be one of the main drivers of growth in the region's electricity demand (see Figure 1) (ESCAP, 2021).

Figure 1: Sources of electricity demand growth in buildings in Southeast Asia with existing energy policies to 2040, in Terawatt-hours (TWh)

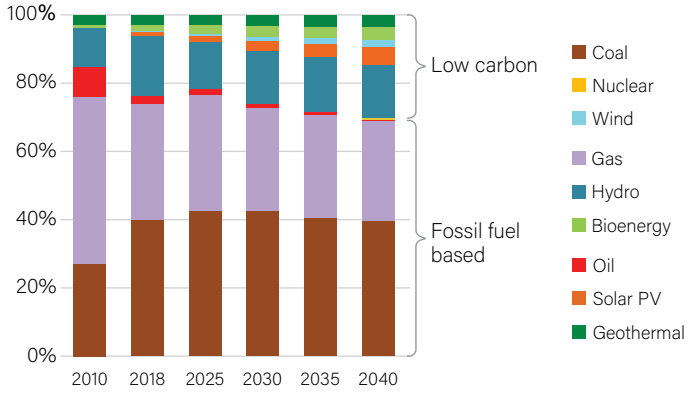


Source: IEA (2019)

However, most countries in Southeast Asia have very low ownership of air conditioning units (ESCAP, 2021). Only between 10% to 20% of the population have cooling systems in their homes. By 2050, the number of air conditioning unit owners is expected to quadruple or quintuple. The drive for space cooling could mean an increase in the use of older air conditioning models that have been imported into this region (Biardeau et al., 2020). Without regulations, the proliferation of inefficient air conditioning units can result in a lock-in of energy inefficiency.

In addition to residential energy demand, energy use, particularly electricity, is projected to increase in other sectors. The International Energy Agency (IEA, 2019), for instance, suggests the doubling up of Southeast Asia's electricity demand over the next 20 years, that is, from about 1,000 to 2,000 TWh (terawatt hours). As electricity demand increases, this gap must be filled not by fossil fuels but by renewables. However, IEA estimates show that with existing policies and plans, the bulk of Southeast Asia's 2040 electricity supply will most likely be generated from fossil fuels, particularly from coal and gas combustion (see Figure 2). Contributions from renewable energy are still projected to increase but only marginally at about 20% of the mix. This forecast does not align with the Paris Agreement (UN, 2015a) and contradicts the United Nations Sustainable Development Goals (SDGs) (UN, 2015b).

Figure 2: Share of power generation by technology in Southeast Asia based on existing policies and plans

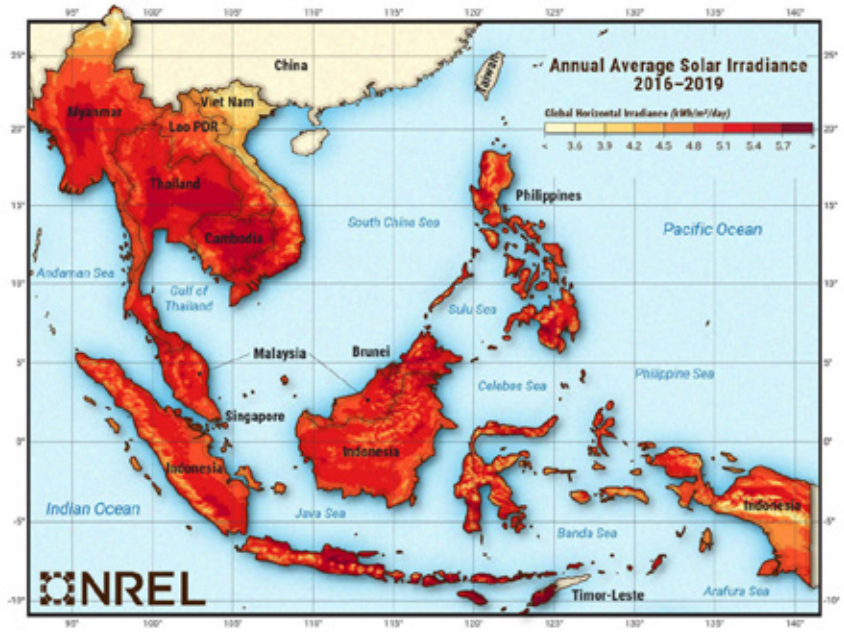


Source: IEA (2019)

Southeast Asia's renewable energy potential

Southeast Asia has vast renewable energy resources, especially from sunlight and wind. Figure 3 shows the region's solar energy potential. The darker the red color, the higher the potential. Except for northern Myanmar and Vietnam, almost all areas in Southeast Asia have access to abundant solar energy.

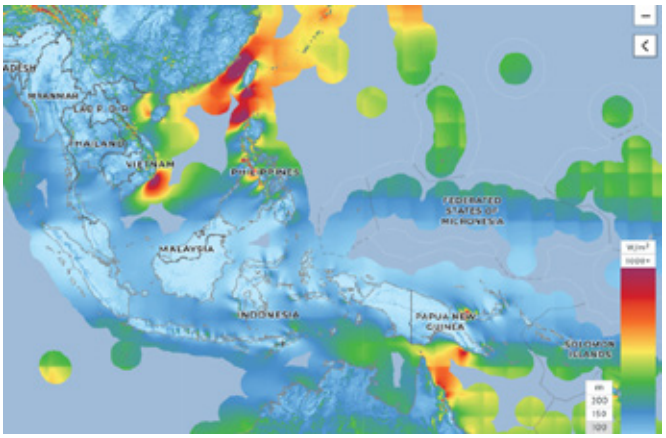
Figure 3: Annual average Global Horizontal Irradiance (GHI), 2016–2019



Source: NREL (2021)

High-quality wind resources are also available, especially along the coastlines of Vietnam and northern Philippines, as shown in Figure 4.

Figure 4: Wind resource potential in Southeast Asia



Source: Global Wind Atlas (2021)
Note: Higher densities indicate better wind resources

Southeast Asian countries with ocean exposures can also potentially exploit tidal and wave energy. Emerging technologies that use ocean energy potential have been piloted and demonstrated in various areas, including Japan, China, South Korea, and the United Kingdom (IRENA, 2020a). Research work on these energy resources has also started in the region. The potential of ocean energy, both using tidal turbines and wave devices, has been reported for all ASEAN countries except for Laos and Cambodia (Quirapas & Taeihagh, 2020).

Two major producers of geothermal energy in the world are also in Southeast Asia: Indonesia and the Philippines. The potential for this technology in these two countries is high, but deployment remains slow. In the Philippines, 1,870 MW (megawatts) of capacity thus far has been exploited out of its 4,335 MW potential, representing about a 45% utilization rate (Bertani, 2016). In Indonesia, only 1,534 MW of the total 28,910 MW potential has been exploited – only a 5.3% utilization rate (Pambudi, 2018).

A transition to 100% renewable energy in Southeast Asia

Modeling work has shown that a complete transition to 100% renewable energy for all energy services, from electricity to transport to heating and cooling, is technically and economically possible for countries in the region, according to Jacobson et al. (2019). This study is the most detailed work on country-scale energy transition made thus far. No regional simulation work has been done yet by Southeast Asian scholars or experts on this energy future. Table 1 summarizes how this future could look like in Southeast Asia. This vision requires no new hydroelectric dams and relies only on existing but more efficient hydro capacity. There is also no biomass combustion. Most of the energy requirements in most countries are either met by offshore wind and rooftop solar installations.

Table 1: A vision for 100% wind, water, and solar energy for all purposes, 2050

	Residential rooftop solar	Commercial and government rooftop solar	Solar plants	Concentrating solar	Onshore wind	Offshore wind	Hydro	Geothermal	Wave	Tidal
Brunei	21.8	19	25.4	4.9	2.3	25.4			1	0.1
Cambodia	11.1	24.6	12.9	4.6	25.6	12.9	8.3			
Indonesia	13.1	29.1	15.3	4.7	15.8	15.3	1.3	4.4	0.9	
Malaysia	21.7	16.3	25.4	4.8	2.7	25.2	3.6		0.2	
Myanmar	8.3	18.4	9.7	4.4	37.7	9.7	10.7		0.9	0.3
Philippines	13	28.8	15.1	4.2	7.7	15.1	4	11.2	0.6	0.3
Singapore	1.1	0.3	0.9			92.7		4.9		
Thailand	22.3	15.6	33.2	4.9	3.7	18.8	1.3	0.1		
Vietnam	21.6	14.1	25.2	4.6	0.7	25.2	8.1		0.6	

Source: Compiled by The Solutions Project (2021)

Southeast Asia's energy transition pathways

In Southeast Asia, energy access and energy transition go hand in hand. The first opportunity lies in electrifying off-grid locations, such as those in islands – both physical islands bound by water and metaphorical "islands" located outside the reach of the electricity grid, such as communities in hinterlands, forests, and national parks (Delina et al., 2020). Renewable energy options, such as solar home systems, have already been widely deployed to close energy poverty in these areas (Yadav et al., 2019). In some communities, hybrid solar and diesel systems were used, as well as micro-hydro solutions (Delina et al., 2020). While there are success stories of these energy projects, there are also stories of failure. The drivers of successes and failures are very context-specific; often, the cases reported in the literature suggest ownership and capacity development drive these outcomes (see for example Ha and Kumar, 2021; Delina, 2020a; Delina, 2018).

Renewable energy deployment in ASEAN thus could assist in closing energy poverty and expanding supply capacity for economic development. Energy transition, however, requires work beyond mere capacity additions; reversing the importance of fossil fuels in the energy mix matters. The transition thus involves a transformation of all energy systems to 100% renewable electricity to meet the demand of all types of energy services, from transport to heating to cooling, across residential, commercial, and industrial sectors (UNEP-DTU, 2020).

Electrifying everything with renewables is a challenging task since it requires a system overhaul: from the material and physical infrastructures to the intangible assets such as institutional arrangements and business models. This transition would require not only the installation of wind, water, and solar energy generation systems but also distribution and storage technologies. The mode of generation in this system also becomes more complex as many actors participate in energy generation and distribution. As heterogeneity is introduced, new ways of doing business are also required. Consumer profiles are also changed since they could now participate in energy generation directly as owners of household- or community-scale renewable energy, or indirectly as shareholders or investors to wind or solar farms.

Besides changes in the electricity system, the transport sector is also affected as it is decarbonized via renewable electricity. This change requires the complete overhaul of mobility options and systems built around oil for a long time. Mobility transition opens opportunities for electricity-powered public transport systems, cycling, walking, biofuels, electric charging, and others.

Decarbonizing heavy fossil fuel-dependent industries is also essential; yet it is one of the most challenging aspects of the energy transition. Southeast Asia's diverse agriculture, manufacturing, and service sectors require sector-specific transition programs if energy transition occurs. Most of the work in these sectors has been towards energy efficiency. The transition towards greater use of renewable electricity, meanwhile, lags. Opportunities in this area exist and include, among others, the generation of combined heat and power for industrial and manufacturing purposes. The region's vast biomass potential offers the opportunity for using agricultural residues as feedstock for these power plants. Concentrated solar thermal facilities provide another avenue of delivering both electricity and heating needs.

Beyond these large-scale shifts, energy transition also requires ensuring energy access for communities and households neglected or bypassed by industry-led energy policies. In addition to 47 million people in Southeast Asia still lacking access to electricity, millions more are in difficult situations requiring reliable, legal, and affordable electricity. A number of these populations live in informal settlements in Southeast Asia's many dense urban

locations. Energy transition must emphasize their vulnerability to climatic impacts, such as intense heat, storm surges, and flooding, as well as to their long-standing and persistent development challenges.

There are differing views on how the energy transition can be achieved. On the one hand, proponents suggest leapfrogging directly to wind, water, and sunlight. Green recovery plans are some examples of this narrative. Proponents suggest using wartime mobilization-like approaches to superintend capital, policy, and labor mobilizations to affect an economy-wide transition to renewable energy (Delina, 2016; McKibben, 2016). On the other hand, proponents suggest a phased or staged approach, where existing fossil fuel capacity, such as coal-fired power plants, are retired in phases, replacing them first with low carbon natural gas or nuclear energy. The first pathway is more likely to be aligned with the speed and scale requirements of the Paris Agreement but requires intense work across governments, the public sector, and citizens. However, most governments are aligned with the second pathway, risking the opportunity to achieve the target set in the Paris Agreement promptly.

A green recovery plan developed by a Stanford University team for Southeast Asia provides more details on how the transition to 100% renewable energy could look. They suggest a cost of USD 7.1 trillion up-front, which could pay for itself over time from the sale of energy and energy services (Jacobson et al., 2019). This cost includes renewable electricity from wind, water, and solar resources, industrial heating, and transmission and distribution. With this transition, the study also projects 4.5 million new long-term and full-time jobs created. About 2.2 million job losses are projects mainly in the mining and fossil-related sectors. There will also be jobs producing efficient electric appliances, vehicles, and machines or increasing building energy efficiency. The plan could also save up to 471,000 lives from air pollution per year. In terms of land footprint, the Stanford plan requires 0.65% of Southeast Asian land.

The following section describes the ongoing energy transition in the region, its drivers, and the challenges that stand in the way of accelerating the necessary transformation.

3. PANDEMIC IMPACTS ON, AND DRIVERS AND CHALLENGES FOR ENERGY TRANSITION

Energy transition and the pandemic

COVID-19 impacts the power sector. Lockdowns lowered electricity consumption to Sunday-use levels, with intense reductions in industry and services but partially offset by higher residential use (IEA, 2021). However, reductions in electricity demand were primarily due to reduced economic activities, which means that once restrictions are lifted, electricity use will most likely increase. This reduction suggests that short-term wins in energy reduction must be coupled with large-scale structural changes in how energy is generated, distributed, and used if energy transition occurs.

Electricity has and is projected to play a significant role in the global response to the pandemic. Electricity has enabled health systems, facilitated deliveries, and to a large extent, also sustained social interactions. However, this is not a universal picture since 47 million people living in Southeast Asia still have no access to electricity. Even if people have access, there are remaining challenges regarding their electricity's quality, reliability, and affordability. Challenges that need addressing in this regard include reliability, affordability, and, of course, sustainability. While there are efforts to introduce more renewables in the energy mix, we have very little evidence of whether these new renewable energy deployments are replacing existing fossil fuel systems.

In Southeast Asia, coal-fired power plants remained the energy generation system of choice over the last decade, not solar and wind projects. Around 2018, however, this trend started to shift towards more renewable energy projects. By 2019, solar and wind capacity additions became more prominent in number compared to new coal-fired power plants. Vietnam holds most of these new renewable energy additions. At the end of 2019, Vietnam had installed 379 MW peak of solar capacity (Vu, 2021). By the end of 2020, Vietnam connected 9.3 GW (gigawatts) peak of rooftop solar power to the grid from over 101,000 residential, commercial, and industrial rooftop solar PV systems (Vu, 2021). The increase in capacity was due to an April 2020 policy decision that awarded rooftop solar projects a feed-in tariff of USD 0.084 per kWh (kilowatt-hour) over 20 years (Vu, 2021).

Myanmar and Malaysia have also made strides in solar power, with utility-scale solar PV tender announcements in 2020. Myanmar's 1 GW solar tender in April 2020 was, thus far, the largest in ASEAN history (Bellini, 2020). Wind energy is also fast becoming an energy system of choice, especially in wind resource-rich Vietnam, where more than a hundred wind projects are on the pipeline.

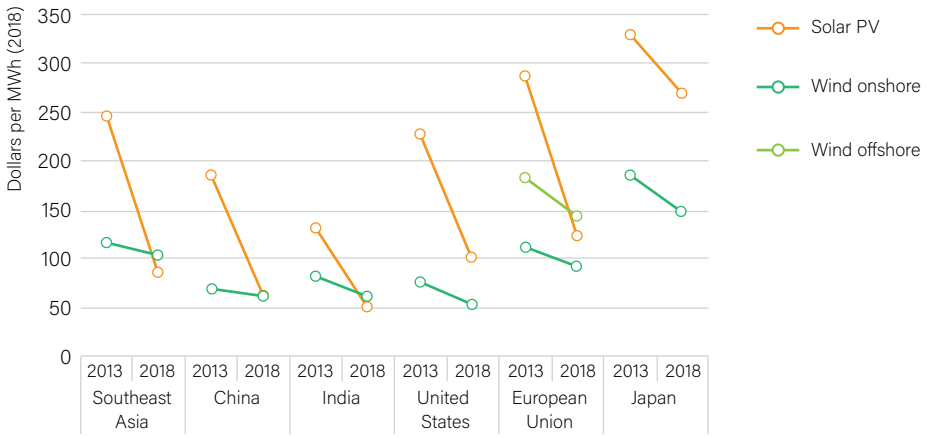
Drivers of the Southeast Asian energy transition

One might identify five significant drivers of Southeast Asia's ongoing energy transition. First is the declining cost of renewables versus fossil fuels. Second is the introduction of new policies that nudge investments away from coal. Third is the advent of new technologies, such as floating solar and offshore wind, which are particularly relevant to the region's geography. Fourth is corporate consumers' demand for renewable power. Fifth is digitalization, which is transforming the electricity sector and enabling new actors and new business models.

Cost declines

The prices of renewable energy technologies have been declining over the last decade (IRENA, 2020b). Figure 5 shows the declining costs of wind and solar in selected countries and regions, including Southeast Asia, over the last five years. However, solar and wind prices in Southeast Asia are still higher compared to China and India.

Figure 5: Levelized cost of electricity in selected regions and countries, 2013–2018



Source: IEA (2019)

Policy nudges

The commitments made by Southeast Asian countries to the Paris Agreement provide some directions towards energy transition. However, governments must revisit their determined contributions to ensure alignments with the temperature target of the agreement (see Table 2). The majority of Southeast Asian countries have made climate action commitments on the condition that they will receive international support, especially in terms of technology transfer.

Table 2: Emission reduction targets in Southeast Asia

Brunei	Reduce CO2 emissions from morning peak-hour vehicle use by 40% from the business-as-usual (BAU) level by 2035.
Cambodia	Reduce greenhouse gas (GHG) emissions by 27% from baseline emissions by 2030 with international support.
Indonesia	Reduce GHG emissions by 26% by 2020 and 29% by 2030 from BAU levels, and 41% by 2030 with international support.
Malaysia	Reduce GHG intensity of GDP by 35% by 2030 from 2005 level, increase to 45% reduction with enhanced international support.
Philippines	Reduce GHG emissions by 70% from the BAU level by 2030 with the condition of international support.
Singapore	Reduce GHG emissions by 16% below BAU level by 2020, stabilize emissions with the aim to peak around 2030.
Thailand	Reduce CO2 emissions from the power sector to 0.283 kg CO2 in 2037 from 0.413 kg CO2 in 2018; Reduce GHG emissions by 20% from BAU level by 2030, increase to 25% with enhanced international support.
Vietnam	Reduce GHG emissions by 8% by 2030 and by 25% from BAU levels with international support.

In addition, there are also fuel-specific policies that signal the transition in some Southeast Asian countries. In the Philippines, the government committed to a moratorium on new coal-fired power plant applications, albeit approved coal projects continue (Ahmed & Brown, 2020). Although the suspension does not necessarily prohibit future coal development since the government can still lift the ban once it finds it necessary to increase capacity, this policy still sent a solid message for energy investors. Alongside the announced ban on coal, the Philippine government also mentioned its support towards exploiting the country's rich geothermal potential, signaling support to renewables. However, restrictions around foreign investments stand in the way of geothermal energy expansion in the Philippines (Santos, 2020).

Vietnam's solar energy performance in 2020 was mainly due to the country's increasing energy demand. With weak grid conditions, however, the rooftop solar market became more attractive than utility-scale projects. The Vietnamese government thus decided to promote this technology with attractive investments (Vu, 2021).

New renewable energy technologies

In Southeast Asia, where land is at a premium because of high population densities, energy generation systems that do not compete with land use offer new opportunities. Solar installations in existing rooftops have thus been attractive, such as to some local governments in the Philippines, which have collaborated with private partners to solarize the roofs of their public buildings.

Floating solar is also fast becoming a critical renewable energy technology. A number of these projects are already executed in some ASEAN countries. The region's largest floating solar project is a 47.5 MWp (megawatt peak) facility located at Vietnam's Da Mi hydropower plant's reservoir (Isaac, 2020). In 2021, 6,000 solar panels were installed over a 4.3-hectare pond of a Thai agri-food company providing 2.8 GWh of electricity per year and covering about 20% of the site's annual energy consumption (Deboutte, 2021). Another large-scale floating solar installation at 45 MW capacity has also been deployed in the Sirindhorn Dam's 121-hectare reservoir in Thailand (Thai PBS World, 2021). There are also floating solar installations in the Philippines (e.g., the 200-kW (kilowatt) project in the Magat Dam reservoir) and Singapore (e.g., the 60 MWp facility on a reservoir in western Singapore).

Offshore wind power is also an emerging renewable energy technology in the region – and one that has the most significant potential for meeting the transition requirements of Southeast Asia (see Jacobson et al., 2019). These projects, which have already taken off in Nordic countries and China, are gaining traction in the region, especially in Vietnam, where 140 onshore and offshore wind farms are on the pipeline.

New renewable energy demand

Corporate consumer demand for renewably sourced electricity is also driving the transition. Globally, corporations have been pressured to procure renewable-based power directly from projects (Schechner, 2021). Some of these multinational corporations have operations in Southeast Asia. Thus, corporate renewable energy targets, although set by boards outside Asia, will also trickle down to their Southeast Asian operations. Asia Pacific Breweries had put up solar panels in its Singapore facility (Boh, 2016), while Apple has been sourcing 100% of its electricity needs from Singapore's rooftops via a deal with a solar energy developer (Volcovici & Love, 2015). As interest in the corporate purchase of renewable energy rises in Southeast Asia, governments must enact new regulations surrounding third-party grid access, contracting, reselling, utility reforms, and certification.

Digitalization

Innovations, including smart grids with renewable energy and other Energy 4.0 technologies, such as renewable electricity-powered mobility, storage, microgrids, and the Internet of Things (IoT), are also driving Southeast Asia's energy transition using technology analytics. The COVID-19 pandemic provided examples of the opportunities the digital economy has opened for consumers and citizens. These include online buying and selling, learning and teaching, collaborations, online events, and fintech. Digital systems will continue to help change the way consumers use electricity. Changes include intelligent methods to time electricity use with information on electricity prices.

Digitalization also challenges the traditional role of utilities as sole providers or distributors of electricity. Whereas the energy system is captured mainly by energy elites in a conventional energy business system, the rise of renewables and the advent of digitalization democratize the energy business landscape. With distributed renewable energy generation technology, storage, and other services, electricity consumers can now produce, consume, store, and sell electricity into the grid and to the final consumers. As prosumers, the public can now be direct electricity generators from their rooftop solar or indirect generators as participants in a fintech-enabled peer-to-peer system.

Southeast Asia's energy transition challenges

Despite the drivers mentioned above, the region's energy transition is still beset by several hurdles. In addition to solar and wind energy variability, these challenges also include policy, governance, and market barriers.

Policy gaps

The longer-range requirement of the transition is significantly impeded by rapidly changing government priorities. Without plans and targets that go beyond three to four years, countries stand to miss, if not lose, the opportunities the transition provides. Present energy transition targets also need to be ramped up, especially since current renewable energy targets in the region (see Table 3) are still not aligned with the temperature targets set in the Paris Agreement.

Table 3: Renewable energy targets in Southeast Asia

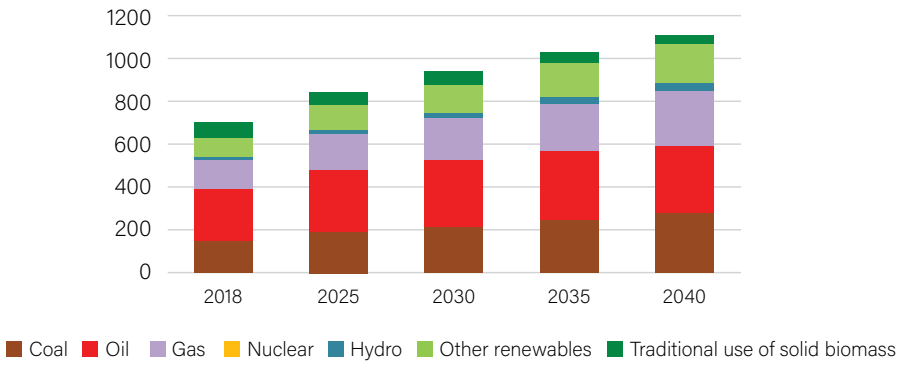
Brunei	Achieve 10% of electricity generation from renewables by 2035
Cambodia	Achieve 55% hydro and 10% other renewable energy in generation mix by 2030
Indonesia	Increase the share of renewable energy in the primary energy supply to reach 23% by 2025 and 31% by 2050
Laos	Achieve 30% share of renewables in primary energy supply by 2025
Malaysia	Achieve 31% of renewable energy installed capacity by 2025
Philippines	Renewable energy in installed capacity to reach 15.3 GW in 2030 and 20 GW in 2040
Singapore	Increase solar PV capacity to 1.5 GWp in 2025 and 2 GWp in 2030
Thailand	Increase the share of renewables to 30.18% in total final energy consumption in 2037
Vietnam	Achieve 15–20% of renewable energy share in total primary energy supply by 2030, 25–30% by 2050

Source: ASEAN Center for Energy (2020)

Climate Action Tracker (2021), which provides an independent scientific analysis of government measures, evaluated the mitigation commitments of four Southeast Asian countries. They found that Vietnam's targets are critically insufficient and are inconsistent with holding warming to below 2°C (degrees Celcius). Climate Action Tracker rated the targets set by Indonesia and Singapore to be highly inadequate. Of the four ASEAN countries evaluated, only the Philippines' target was placed as 2°C compatible but is not entirely consistent with the 1.5°C Paris Agreement long-term temperature goal.

Misaligned government priorities have long-term implications. Figure 6 shows that current policies and plans in the region favor fossil fuels, coal, gas, and oil to maintain their role as primary fuels up to 2040. As renewables continue to decline in cost, these fossil fuel-based infrastructure risk becoming stranded assets, and thus impede the ability of ASEAN countries to transition their energy systems in the scale and speed required by climate action

Figure 6: Primary energy demand in Southeast Asia under existing energy policies, in megatonne of oil equivalent (Mtoe)



Source: IEA (2019)

Market structure barriers

The decentralized and distributed characteristics of renewable energy mean that energy generation can no longer be sited in central, huge locations. As generation moves closer to consumption points, traditional business models that rely heavily on grid infrastructure and centralized operations are challenged by more competition, multiple generators, and advances in digitalization.

Figure 7 shows the state of prevailing market structures in Southeast Asia. Most of the countries have a single buyer model, which is usually a publicly owned and vertically integrated power utility that buys power from both public and private generating units and distributes it to consumers. Independent power producers are essential players in Malaysia, the Philippines, Thailand, and Singapore. Vietnam is piloting a wholesale electricity market. Only Singapore and the Philippines have wholesale and retail competition in their electricity markets. A wholesale electricity market involves electricity sales among electric utilities before it is eventually sold to consumers. A retail electricity market involves the sales of electricity to consumers.

Figure 7: Electricity market structures in Southeast Asia

Vertically integrated regulated utilities	Single buyer model with independent power producers	Wholesale market	Retail competition
Brunei	Cambodia Indonesia Laos Malaysia Myanmar Thailand Vietnam	Philippines Singapore Vietnam	Philippines Singapore

With the transition requiring new energy market structures and business models, moving out of central operations towards a decentralized one is most likely necessary. Markets need to be opened to participation by the public.

Funding gaps

Accelerating and scaling energy transition requires investments of capital. There are several estimates about how much the transition could cost. The Stanford study (Jacobson et al., 2019) mentioned earlier suggests USD 7.1 trillion investment requirements.

4. ACCELERATING JUST REGIONAL ENERGY TRANSITION

While energy transition is ongoing in the region, current targets and deployment rates need to scale and speed up. Doing so requires hurdling barriers and uncertainties that stand in the way of the region's renewable energy transition policymaking and planning.

Technical strategies: Addressing the 'variability' of solar and wind

Technologies that address variability already exist, with their cost also rapidly coming down. These technologies include planning tools that assist in balancing energy demand with heterogeneous renewable energy supplied by wind, water, and sunlight energy generators from across different locations. These tools also help maintain and ensure flexibility of the system, ramping it up and down based on actual demand.

In addition, backup loads from storage systems also provide solutions. These include pumped-storage hydro systems and gas turbines using agricultural residues as fuel stock that can come online once the wind and solar energy cannot meet peak demand. Storage of excess renewables is also a technology that is fast evolving in development and reducing in cost. Systems that utilize renewables, demand management, efficiency approaches, load balancing, and storage are already competitive with traditional generating units.

Scaling and speeding up energy transition require not only national but also regional energy transition planning. Regional cooperation on energy transition matters since some Southeast Asian countries cannot transition to renewables at the scale and speed required. An integrated electricity system could enable energy transition since interconnections tap into different supply and demand patterns, thus reducing solar and wind output variability. Aggregating individual solar and wind farms over a larger geographic area, such as the Southeast Asian region, smoothens load profiles. Bilateral and multilateral cooperation for energy transition thus needs to be advocated at the level of ASEAN. Mechanisms around transparent auditing systems and fair tariffs should also be included in these efforts.

All these strategies require planning to ensure a more realistic forecast. Advances in artificial intelligence and data science can assist in these approaches. Southeast Asian countries, thus, should embed plans to prepare their future energy engineers for this new demand, such as through revision of current engineering curricula and tailoring them to the needs of the transition.

Governance strategy: national transition plans and regional cooperation

Governments can drive new investments in renewable energy, mainly through new plans, support policies, targets, and funding to turbocharge the development, deployment, and integration of wind, water, solar, and geothermal energy, and in making public buildings efficient and constructing energy-efficient public housing. The pandemic further reveals the reach of government intervention at times of crisis, portending its crucial role in transition governance (Delina, 2020b). Avoiding social and economic collapse via interventionist approaches is not new – and is bound to continue, especially as surprise events arrive with more frequency due to accelerating climate change.

Post-COVID-19 pandemic stimulus packages must be aligned with the temperature decrease aspirations of the Paris Agreement. Energy transition programs offer opportunities to meet national commitments to emissions reduction and create new jobs, revitalize local economies, and close energy poverty gaps.

Plans currently on the drawing boards of national and local governments should include opportunities for exploiting locally available and market-ready solar, wind, and hydro technologies. Opportunities for increasing energy efficiency in homes, buildings, appliances, and industry should also be built onto recovery plans. The plans should include expanding and deepening existing targets for energy efficiency (see Table 4 for existing targets). These plans should likewise contain provisions on phasing out fossil fuel-based capacities and infrastructures. With renewable energy generated mainly in pockets of locations, instead of one central facility, opportunities for demand-side management, storage, and microgrids should also be part of these plans.

Table 4: Energy efficiency targets in Southeast Asia

Singapore	Improve energy intensity by 35% by 2030 from 2005 levels
Vietnam	Increase commercial electricity savings to more than 10% of total power consumption relative to business as usual (BAU)
Malaysia	Promote energy efficiency in industry, buildings, and residential sectors via standard-setting, labeling, energy audits, and building design
Myanmar	Reduce primary energy demand by 8% by 2030 from 2005 level
Philippines	Reduce energy intensity 40% by 2030 from 2010 level; decrease energy consumption by 1.6% per year by 2030 from baseline forecasts

Policymakers are talking about green recovery and building back better as necessary post-pandemic action. In Malaysia, the government is auctioning a 1 GW new solar project to create local jobs and help with pandemic recovery (Martin, 2020).

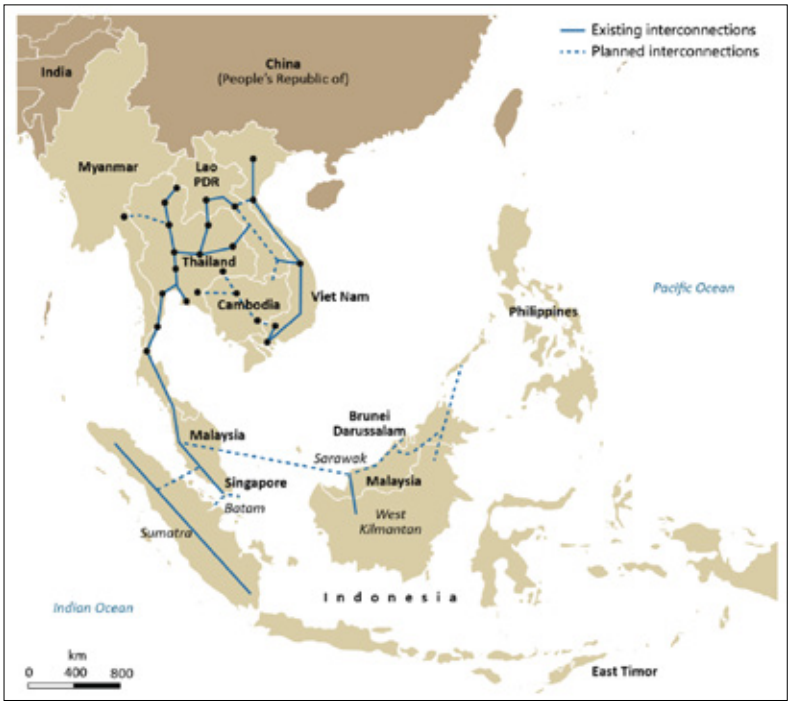
At the same time, programs that allow citizen participation in energy generation and distribution should also be embedded in recovery strategies. Utility-scale energy business models should be revisited. Laws and regulations should be designed towards a more consumer-oriented market by opening the energy sector to prosumer-based models such as cooperative energy, peer-to-peer trading, and fintech-enabled energy market participation.

Transition planning should also include projections on new job creation and skilling requirements. New jobs in the renewable energy sector could potentially be distributed across the energy value chain and geographies. Unlike centralized operations in fossil fuel-based energy systems, renewable energy systems bring more distributed benefits for people and communities.

Regional cooperation on green recovery

The ASEAN Power Grid (APG) plan already articulates the scope for integrating the region's power systems and ASEAN regional power trading (Silitonga, 2018). Coordination is crucial in optimizing resources across multiple countries. Agreed upon by its member states in 1997, the plan was designed to strengthen energy security, improve power system economics, scale-up electricity access, and integrate renewables to support ASEAN development. Figure 8 shows the existing and planned electricity interconnections in the region. In addition to interconnections in continental Southeast Asia, there are plans or visions to connect archipelagic member states to the continent.

Figure 8: Southeast Asia power grid, existing and planned interconnections



Source: IEA (2019)

Although the plan for energy interconnections enjoyed strong support at the regional level, on-ground development has been primarily bilateral. Table 5 shows current electricity interconnections and trades in the region. Eight of the 10 ASEAN member countries have interconnections of some kind. These energy trade arrangements are limited to unidirectional power trades through long-term power purchase agreements or bidirectional electricity trading without financial compensation (e.g., Singapore–Malaysia). These bilateral trades enabled not only increased energy security but also the development of clean energy, mainly hydropower, as shown, for instance, in the case of the Laos–Thailand energy trade agreement.

Table 5: Current bilateral electricity connections in Southeast Asia

Cambodia	Exports to Thailand Imports from Laos, Thailand, Vietnam
Indonesia	Exports to Malaysia
Laos	Exports to Cambodia, Malaysia (through Thailand), Thailand, Vietnam
Malaysia	Imports from Laos (through Thailand), Thailand
Thailand	Imports from Cambodia and Laos
Singapore	Bidirectional, non-financial exchange with Malaysia
Vietnam	Exports to Cambodia Imports from Laos

A multilateral energy trade could ensure more efficient use of energy resources while maintaining decision-making in the hands of sovereign countries. Regional energy trade could also lower operating costs for the system since the grids will be used and maintained more effectively. Operational costs could also be lowered as low-cost wind, and solar generation displaces fossil combustion systems. However, the regional energy trade vision for ASEAN is presented with barriers, including absent or weak capacity for both institutional arrangements and actors to lead and coordinate this system and market. Differing national-level opinions on the possible implications of electricity integration, however, hampers multilateral progress. Persistent barriers in this regard include harmonizing tariffs and grid codes and reducing fossil fuel subsidies.

Nevertheless, some ASEAN member states have pushed to implement a regional interconnection, including the following:

- The *Lao PDR-Thailand-Malaysia-Singapore Power Integration Project* is a pilot multilateral energy trade project between four ASEAN countries. Phase 1 of the project began in 2018 and involved exporting power from Laos to Malaysia using Thailand's grid. The project's Phase 2 is planned to increase energy trade volume by including Singapore. When completed, the project may also allow for multidirectional energy trading among these countries.

- The *Greater Mekong Subregion Initiative* promotes the integration of Laos, Thailand, Vietnam, Myanmar, Cambodia, and China. This initiative has, thus far, produced some technical work on harmonizing grid codes of the countries involved, but with little progress in other areas.

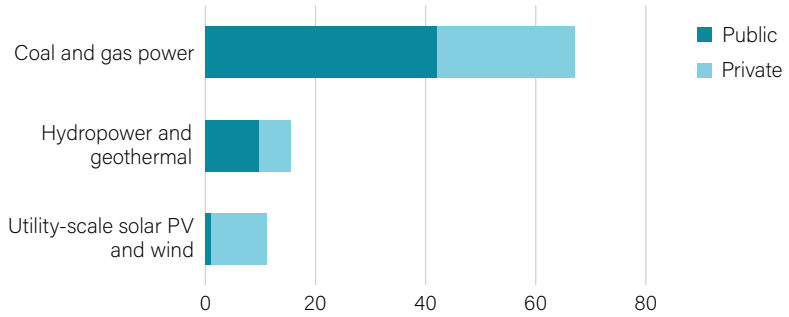
- The *Brunei Darussalam-Indonesia-Malaysia- Philippines East Asian Growth Area*, established in 1994, fosters electricity integration by building the physical infrastructure for cross-border trade.

Changing energy business models

While success could never be guaranteed, the presence of enabling policies can make the transition go faster. Governments have a crucial role in supporting investments, mitigating the risks to the private sector, setting ambitious targets, and undertaking planning in the face of uncertainty. The government is primarily responsible for ensuring a level playing field for new renewable energy investors, players, and new energy markets. This can happen through expansive rules that open energy markets to renewable energy players.

Energy transition requires shifts in existing energy business models. Some countries in the region are already moving out of that business model. In the Philippines and Singapore, for example, competition has opened. This structure means that consumers would eventually choose where they buy their power from and what kind of power that is. Since renewable energy generation is primarily distributed, rather than centralized, as in traditional power plants, utilities need to start thinking about their business models.

Figure 9: Sources of finance for power generation in Southeast Asia in USD $ billion, 2014–2018

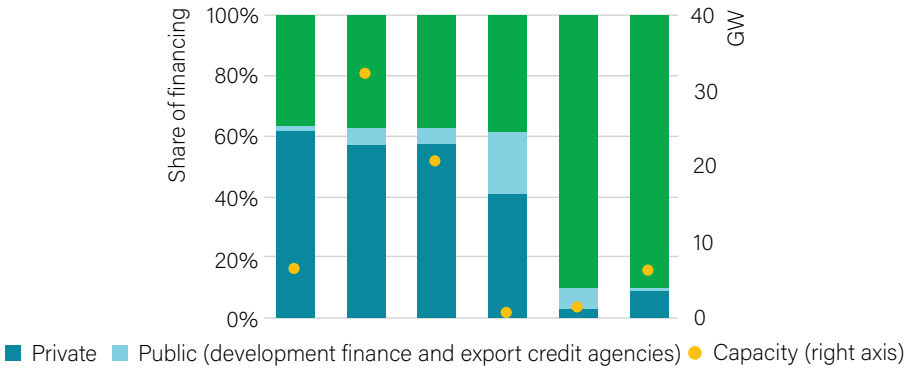


Source: IEA (2019)

Public finance

Governments also have a pivotal role to play in enabling greater access to energy transition finance. Figures 9 and 10 shows the relative importance of public and private funding for the power sector. Over the last five years, the bulk of public energy sector funding so far had mostly gone into coal and fossil energy investments. The region's state-owned utilities have driven most of these investments, including in Indonesia, Vietnam, and Myanmar, where most generation has been built, owned, and operated directly by public utilities. A small amount went into large-scale hydropower and geothermal projects requiring significant upfront capital. Very little went into renewable energy. As shown in Figure 10, private money – not public support – has gone into renewable wind and solar energy projects.

Figure 10: Sources of finance for power generation investment in Southeast Asia by types of capital provider, 2014–2018



Source: IEA (2019)

Moving public support from the fossil side over to renewables is crucial to scale up the transition since solar and wind energy technologies still face investment risks. State support has already proven effective in encouraging private sector support of renewable energy projects, as shown in the recent surge in Vietnam's solar and wind energy projects (Vu, 2021). However, enabling environments and investment frameworks are still needed to make large-scale financing of renewables and energy efficiency conducive in Southeast Asia. To make renewable energy projects more bankable, governments also need to design transparent procurement frameworks and contracts.

Compared to Indonesia, Vietnam, and Myanmar, the pressure of building and operating energy generation plants in the Philippines, Malaysia, Singapore, and Thailand, have been shared with independent power producers (IPPs). Many IPP investments in these countries, however, were developed via direct negotiation with the utility. Often, this approach is cumbersome and conducted without much transparency.

With energy transition, new purchasing approaches have emerged. Incentive schemes, such as feed-in tariffs, were introduced to drive most solar, wind, and geothermal investments. However, the success of these mechanisms to attract new investments has been varied. The Indonesian feed-in tariffs, for instance, did not make any recognizable dent in renewable energy penetration since the tariffs were set at levels capped by the local price of coal power (Guild, 2019). There is also a lack of local capacity to supply and operate renewable energy systems, which hampered renewable energy deployment. Other persistent challenges include red tape and licensing and land acquisition issues.

Auctions and public-private partnerships

Bringing down the cost of procurement or the price for renewable energy in the region is critical. In Southeast Asia, the prices are still high compared to other regions, even after accounting for changes in resource quality because governments in the region had traditionally engaged in negotiated bilateral deals with the private sector instead of using competitive tenders and auctions to solicit private sector participation. India opened its renewable energy market to competition hence the rapid decline in cost in that country.

In Southeast Asia, competitive tenders and auctions remain small but are growing for renewables, especially for solar power in Malaysia and Thailand and geothermal energy in Indonesia. Prospects for geothermal energy project auctions in the Philippines also exist following government announcement, but procedures are still to be laid out. Cambodia's recent solar power procurement experience, nevertheless, is illustrative.

Much of Cambodia's demand for power is found around Phnom Penh, where there is also a high potential for solar power. With support from the Asian Development Bank, the government set up a 100 MW National Solar Park project structured as a public-private partnership to exploit this resource and transition Cambodia's energy profile to more renewables (ADB, 2019). In this arrangement, the government will take the lead. The publicly owned national utility, the Electricite du Cambodge (EDC), was to procure the land and set up a solar park facility, which included the substation to pick up the power and transmit to the grid. ADB funded this public infrastructure through a loan to the government.

With the right enabling conditions set, Cambodia sought to include the private sector by tendering generation to the private sector, both from within and abroad. The public-private partnership approach allocated the risks to parties best suited to manage a particular risk. The private company was responsible for project-specific risks, including financial closure risk, design risk, and construction project costs. In this case, the government, represented by EDC, took responsibility for any change in political risks, access to the grid, and provision of land. It would be difficult for the private sector if they are asked to shoulder these risks, especially the latter two.

With competition in place, private actors are expected to bid the lowest possible price. Japanese, Chinese, Indian, European, Malaysian, and Cambodian firms bid for this project. The lowest bid submitted was USD 0.045 per kWh (kilowatt-hour), which, in 2019, was the lowest for any ASEAN country in 2019. The final winning offer tariff was at USD 0.03877 per kWh.

Third-party contracting: Energy services companies

The future of the energy business is also no longer oriented towards entities that sell electricity as a commodity but rather to those that sell electricity as a service. A utility, for instance, may sell energy efficiency services or community-level models. In Thailand, Malaysia, and the Philippines, energy services companies (ESCOs) have offered various energy services, including delivering efficiency projects financed from energy savings, distributed renewable energy supply, and supply-demand management.

ESCOs address energy efficiency investment challenges by providing performance-based contracting. These contracts guarantee savings to reduce financing risks and bundle small projects to make them bankable. Thailand offers one example (Streitferdt et al., 2017). Financing energy efficiency investments in small and medium enterprises (SMEs) can be challenging since these businesses tend to be undercapitalized to introduce efficiency changes. Yet, there are several of them operating in any economy. ESCOs fill in this gap. ESCOs can approach SMEs, invest in retrofitting or replacing their appliances

and equipment and deliver energy efficiency savings. ESCOs can then be paid from that savings. Since ESCOs are also often undercapitalized, they are also constrained from making the investments.

To address this gap, Thailand's large utility, the Provincial Electricity Administration (PEA), rolled out an onboard repayment program by establishing an ESCO fund while looking at harvesting efficiency gains. PEA has the data on all its consumers and knows how much energy SMEs are consuming. To increase the efficiency of energy use in SMEs, the PEA entered into an agreement with SMEs. It provided them with an estimate of the savings they can generate from adopting efficiency measures such as retrofits and the cost of delivering those savings. PEA would then contract the ESCOs to provide those retrofits and other energy efficiency services, including, when necessary, replacing inefficient equipment with efficient ones. ESCOs access this funding via the ESCO Fund. The SMEs would pay back this cost through their utility bill over time. PEA collects these funds to pay back the ESCOs. This approach to credit enhances PEA's entire business model.

The ESCO model is promising, but barriers must be addressed to be fully exploited in the region. In the Philippines, regulations restrict which entities can undertake energy efficiency investments. In Indonesia, ESCO projects have required higher-cost equity to proceed. Even in Thailand, ESCOs are limited to participate in solar development because of energy performance contracting requirements.

Funding strategy: Green finance

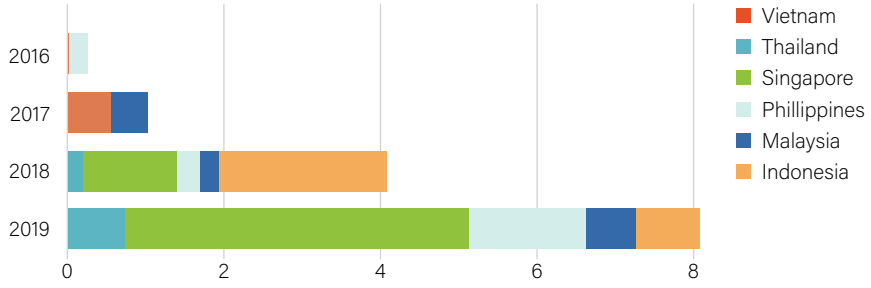
Green finance offers an opportunity to address transition funding gaps. Green finance mixes carbon finance to deliver emissions reductions, social and environmental finance to build resilience, and sustainable finance to improve governance and social outcomes. Green finance includes financial instruments that can be applied in the public and private sector. Public sector green finance can be mobilized through tax revenues, bond issuances, and development loans. Private sector green finance can be mobilized through debt, equity, or corporate and project bonds.

Green bonds are of particular interest, given the surge in their subscriptions in recent years, including Southeast Asia. Green bonds are specialty or fixed-income securities to finance green, social, and sustainable projects. In 2019, the volume of green bond issuance rose to USD 258 billion, more than 50% compared to 2018. In Southeast Asia, issuance almost doubled from 2018 volume (see Figure 11), reaching USD 8.1 billion in 2019 (Climate Bonds Initiative, 2020). ASEAN issuance represents 3% of the global total.

Two-thirds of the 2019 green bond issuances in the region went to the building and energy sectors. As of the end of 2019, the cumulative issuance in 2013 was at USD 13.4 billion. Green buildings topped the use of proceeds (34%) followed by renewable energy (33%), transport (12%), water (8%), waste (5%), with the rest (8%) on land use and other sectors.

Some examples of green bond transactions for energy transition in 2019 is the Philippines' Ayala Group issuance to support solar, wind, and geothermal projects, and Malaysia's Telekosang Hydro One's mini-hydro project. In ASEAN, the number of issuances rose from five to 57. In terms of volume, it has gone up from about USD 500 million to about USD 3.8 billion (Climate Bonds Initiative, 2020).

Figure 11: ASEAN green bond issuance in USD $ billion, 2016–2019



Source: Climate Bonds Initiative (2020)

Achieving green finance goals requires guidelines and standards to enlist people's trust in these instruments. In Southeast Asia, regulators are setting up principles and procedures through, for instance, the International Capital Market Association (ICMA) and the ASEAN Capital Markets Forum (ACMF). Verification also matters. This means requiring assurance providers to confirm that the bond issuance fits global standards, including UN Sustainable Development Goals alignment. Green bond issuances also require a large amount of demand. This volume requirement means that green bond issuances must be attractive enough to bring in a diverse pool of domestic and international investors, such as banks, insurance companies, institutional investors, and large pension funds.

Thailand provides one example of recent green bond issuance for low-carbon infrastructure. In 2020, the Thai government issued its first sovereign sustainability bond to finance Bangkok's public mass rapid transit (Reuters, 2020). The issuance was tied with COVID-19 recovery measures, such as support measures for SMEs.

Participation strategy: Opening the energy sector to citizen participation

The full impacts of the pandemic are yet to emerge. To many, it is not difficult to imagine what could arise in a region where creating jobs and securing livelihoods and people's rights remain vital challenges. In the energy sector, large-scale development using renewable energy remains an untested area. However, the lack of empirical evidence from any part of the world that industrialization can proceed with renewable energy does not mean that the transition should not be pursued at the national and regional levels.

Meanwhile, small-scale, community-oriented, and local development is possible with solar, wind, and hydropower (e.g., Delina, 2020; Delina et al., 2020). Decentralized renewable energy solutions are critical for closing energy poverty and building resilience in islands, especially in the typhoon belt. Community energy also opens opportunities for citizen participation and public engagement in closing energy access gaps and the energy transition.

The community energy model is not new in Southeast Asia. In the Philippines, for example, rural electrification had been primarily met through a cooperative approach. However, one may argue that this institutional arrangement is more private sector-led than a truly citizen-mobilized organization. Closing energy poverty in off-grid islands in the Philippines has also been a province of rural electric cooperatives.

In the Romblon archipelago, for example, in the Philippine typhoon belt, the Romblon Electric Cooperative (ROMELCO), with support from Korean funders and the Asian Development Bank, put up a hybrid solar and diesel generation system that closed energy access gaps in the fishing island of Cobrador (Delina et al., 2020). The project delivered a reliable and affordable energy source to fisherfolks, who use this service for illumination at night and for powering small appliances at home and in the island elementary school. In addition, the fishing community also used the new energy for productive purposes such as refrigeration and ice-making, essential in commanding premium prices for their catch.

In Thailand, a Kaeng Krachan National Park community adopted a communal approach to energy access and energy transition. With policy prohibiting grid extension to the park, the community created a self-sufficiency group that provides low-cost credit to its members to install a solar home system, a biogas digester, or a solar-powered irrigation system (Delina, 2020). These technologies addressed energy poverty and benefited the local carbon sink as cutting trees for firewood and charcoal was reduced in favor of biogas digesters fueled by abundant cow manure. These energy services also opened new opportunities for household-scale businesses, especially among women entrepreneurs who freed some of their time previously spent in fuel gathering (Delina, 2020).

Activism and mobilizations: towards a just energy transition

A just energy transition demands a systemic and accelerated transformation of the energy system to enable people to choose and decide on energy systems that work for them and their communities. While energy transition has been occurring in Southeast Asia, there is still scope for governments to quickly remove all barriers to achieving 100% renewable energy for all. This also includes bans for new fossil fuel development, especially coal and natural gas, and accelerating the retirement of existing fossil fuel capacities and replacing them with wind, water, and sunlight-based systems. This also includes addressing the social and environmental problems that fossil fuel extraction and combustion have created. A just energy transition also requires people-centered solutions, requiring energy decisions to be referred to and decided by all affected actors.

A just energy transition in Southeast Asia thus requires continuing advocacy work, especially given fossil fuel lock-in in many ASEAN countries. Civil society and non-government organizations must strengthen their mobilization efforts, essentially on two fronts: mobilization for accelerating energy transition and mobilization for fossil fuel phase-out. Civil society organizations in the region, working across scales and levels from grassroots to regional, have already adopted this two-pronged approach.

The Kaeng Krachan case in Thailand illustrates that citizens can chart their energy futures in their communities, showing at the same time, that these futures can be powered 100% by renewable energy. Local governments in the Philippines have also developed plans supporting renewable energy in their jurisdictions, suggesting that local mobilizations matter for energy transition.

Mobilizations to keep fossil fuels out of energy systems are also expanding. The province of South Cotabato in southern Philippines, for example, denied a coal mining application (Delina, 2021), while the province of Bohol in central Philippines issued a policy banning coal-fired power plants on their island (Conde, 2018).

5. CONCLUSION

The transition to renewable energy systems is underway in Southeast Asia, but it needs to be quicker and more ambitious. The pandemic has caused a momentary slowdown in energy demand growth in the region. Still, energy use can quickly bounce back to pre-COVID-19 pandemic demand levels, without efforts to change the structures of present energy systems. The pandemic has also accelerated the growth of renewables in Southeast Asia, but more could have been deployed if countries had supportive policies and energy markets and structures in place earlier. The rapid deployments of solar and wind energy capacity in Vietnam are key energy transition milestones in the region, and so are the many efforts to increase renewable energy penetration, particularly solar energy, in Cambodia and Myanmar. The pandemic recovery plans advanced by Malaysia also bring sustainability efforts front-and-center in the ways stimulus packages should be drawn and designed. These remarkable cases show that governments will play a key role in creating the right conditions to support the transition. With the right policy, opportunity, and support, the private sector and the public also stand to win.

This report shows how targets and supporting policies to advance the energy transition in Southeast Asia remain weak. The future of energy in the region is still fossil-fuel-dominated, contravening efforts to meet the temperature goals of the Paris Agreement. As the climate changes and its impacts are felt, more energy will be required to address space cooling. At the same time, plans should be made to ensure that energy systems are made resilient, especially in areas already experiencing frequent and stronger storms. Nonetheless, financing renewable energy projects has advanced considerably in Southeast Asia, especially with the introduction and popularity of green bonds. However, funding is still required to scale and speed up the transition and close persistent energy poverty gaps in a region where 47 million people remain off-grid or without access to modern electricity.

The pandemic revealed that addressing crises is not only a province of the economy but also, if not most importantly, of the social conditions for human interactions and the constraints imposed by the natural environment. Energy transition, thus, can be a vehicle for Southeast Asia's road to recovery. The transition to cleaner, renewable, and sustainable energy systems addresses energy poverty by using locally available energy resources. At the same time, these efforts could also deliver co-benefits in terms of women's empowerment through energy entrepreneurship. The transition offers the public an opportunity to participate in energy generation and distribution – sectors traditionally held by large businesses. The distributed nature of solar energy, for instance, allows everyone to be prosumers of energy. The variety of ways wind, solar, and hydropower can be generated and sold across vast Southeast Asian geography offers a new opportunity for participating in energy markets. The energy transition therefore levels the opportunity for everyone. It is democratizing.

Yet, energy transition requires hurdling several barriers. The policy and market barriers to deployment remain. Targets and plans are still aligned with coal, oil, and gas. Energy markets and institutions remain closed for participation. However, strategies to address these challenges are available: from focused renewable energy targeting, sustainability-oriented post-pandemic stimulus plans, green finance, and energy market restructuring. All these approaches require a whole-of-system approach, but political commitment from governments remains crucial. Also critical: until Southeast Asia is powered 100% with renewable energy from wind, water, and solar energy, and until participation is open for all, the need for citizen activism, advocacy, and social mobilization remains strong.

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Author: Dr. Laurence L. Delina is assistant professor at the Division of Environment and Sustainability at the Hong Kong University of Science and Technology. His research interests are on the rapid mitigation of climate change, accelerating sustainable and just energy transitions, and climate mobilization. He is the author of Strategies for Rapid Climate Mitigation: Wartime mobilisation as a model for action? (Routledge, 2016), Accelerating Sustainable Energy Transition(s) in Developing Countries: The challenges of climate change and sustainable development (Routledge, 2017), and Climate Actions: Transformative mechanisms for social mobilisation (Palgrave Macmillan, 2018). Dr. Delina has worked with Land Bank of the Philippines, Japan's Institute for Global Environmental Strategies, Oxfam, and the United Nations. He was a Balik Scientist at the Philippines' Department of Science and Technology, a Rachel Carson Fellow, and a Visiting Fellow at Harvard Kennedy School. He received his degrees from universities in the Philippines, New Zealand, and Australia. His PhD is from the University of New South Wales (Sydney).

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