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Issue Report on Belt and Road Green Energy and Environment

—Status Quo and Prospect of Southeast Asian Power Infrastructure Development

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In April 2019, Chinese and international partners officially launched the BRI International Green Development Coalition (BRIGC) at the Second Belt and Road Forums for International Cooperation. BRIGC aims to establish a policy dialogue and communication platform, an environmental knowledge and information platform, and a green technology exchange and transfer platform, so as to advance global consensus, understanding, cooperation, and action of a green Belt and Road Initiative (BRI).

Power infrastructure has become an important area of China's overseas investments, playing a crucial role in the " the Belt and Road Initiative "(BRI) infrastructure connectivity. Southeast Asia is one of the key construction areas of BRI. How to channel investment to low-carbon and green renewable energy infrastructure through policy portfolio is not only crucial for promoting the green transformation of energy in Southeast Asia, but also helpful to enhance China's green influence and leading role in international governance.

The issue Report on Belt and Road Green Energy and Environment by the BRIGC first reviews the status quo of power infrastructure development in Southeast Asia and relevant plans and policies for power development. After summarizing China's policies supporting overseas infrastructure development and investment cooperation, the report analyzes China's role in power infrastructure investment in Southeast Asia. On this basis, the opportunities and challenges of low-carbon and clean electricity in Southeast Asia are explored from the perspectives of resource potential, technology, finances, cost, supporting infrastructure, system issues and policies. Finally, the report put forward suggestions for China and Southeast Asian countries to cooperate in promoting low-carbon transformation of electricity infrastructure.

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Executive Summary

As the Belt and Road Initiative continues to expand and deepen, infrastructure interconnectivity has been scaled up, and industrial investment has expanded. Propelled by growing energy and power demands with rapid economic and social development, the Belt and Road countries are building power infrastructure and modernizing their energy markets and industrial chains. From its own experience of promoting domestic energy transition and low-carbon power development, China has accumulated a wealth of know-how in policy formulation, infrastructure investment and construction. Chinese investors and enterprises in the power generation industries actively participate in international cooperation and propose projects in thorough alignment with local policies. Driven by domestic and foreign policies and markets, energy and power infrastructures have become an important area of China's foreign investment and cooperation, and played a vital role in infrastructure interconnectivity in the Belt and Road Initiative.

Southeast Asia benefits from abundant energy resources that allows considerable development potential. With the acceleration of global integration and rapid regional economic and social development, Southeast Asia has become a hotbed for global investment in renewable and fossil power infrastructure. However, due to factors such as easy fossil resource availability, energy security concerns, and priority on energy access, the energy plans of most countries are still dominated by fossil energy in the short to medium term, which is not conducive to the realization of regional and global climate change and sustainable development goals. Therefore, combinations of policy instrument and international cooperation that channel domestic and foreign capital into low-carbon and green renewable energy infrastructure will be instrumental for the green transition of the energy and power sector in Southeast Asia. At the same time, China needs to improve its foreign investment policies to encourage investors to fully consider environmental, climate, and energy risks in their investment activities, to promote high-quality and sustainable development of foreign investment, and to exert its positive green influence and leading role in international energy and climate governance.

This report reviews Southeast Asia's energy and power policies, goals, status quo and trends, as well as China's foreign investment strategic planning and policy system and its role in Southeast Asian power infrastructure development, and on this basis, examines the opportunities and challenges for China's engagement in Southeast Asian power infrastructure. Through case studies based on Indonesia, Malaysia and Thailand, this report provides recommendations for cooperation between the Chinese government and host countries in the field of power infrastructure investment to formulate and improve foreign investment policies, as well as for Chinese investors in power infrastructure in Southeast Asia. The main findings of this report are as follows:

1) **Energy and power infrastructure development in Southeast Asia:** Renewable energy resources are abundant and diverse with significant development potential in the region, but the resource endowments and development conditions vary widely among various countries. High power demand in the region requires improvement of power supply. While coal is still the dominant source of power in the medium and short term, renewable power generation is steadily increasing. Southeast Asia is therefore one of the world's most promising power markets, albeit a large gap in power investment remains. Scaling up investment is a necessity

for the successful implementation of the ASEAN Plan of Action for Energy Cooperation (APAEC), and it is estimated that ASEAN countries needs US$290 billion of financial support by 2025, of which 75% for the power sector, to achieve the APAEC goals.

2) **Southeast Asia's clean and low-carbon development goals, policies and measures:** The basis for environmental standards and related systems have been established, but the implementation and enforcement are less commendable. Southeast Asian countries have signed up to the Paris Agreement and formulated nationally determined contributions, which includes the development of renewable energy as an important part of its response to climate change. Sustainable energy development and climate change mitigation are closely linked, and an effective response to climate change requires a high degree of integration between energy and climate policies.

3) **Southeast Asia's energy and power policies:** The power sector in Southeast Asia, where a vertically integrated management model or single buyer is commonplace, has a low level marketization and lacks incentives for competition. Improving energy supply and electricity access is still highlighted in power development goals of most countries. The countries do attach importance to the development of renewable energy and have set renewable energy targets and incorporated relevant measures in national plans and policies. Efforts are also made to promote regional grid interconnectivity and energy integration. Optimal resource allocation for an interconnected clean power transmission grid based on economic and social development advantages and energy endowments will be a priority of energy and power development in the region.

4) **Foreign investment in the Southeast Asian power market:** Southeast Asia is one of the world's most promising regions for power development, with an insufficient regional infrastructure and huge development potential. Coal power is the dominant area of foreign investment, and renewable energy gradually becomes more attractive to investors. China is a major participant in the Southeast Asian power market. It has invested US$6.6 billions in the Southeast Asian power sector since 2003, accounting for 48% of its global total incoming investment. More information should be made public on the environmental and social impact of foreign investment projects.

5) **Green development has become an important part of China's foreign investment strategy.** China has issued a series of strategic cooperation plans under the Belt and Road Initiative and launched a policy framework for building a green financial system. Host countries generally believe that China's power development policies and investment and construction experiences have a high reference value for Southeast Asia, and more exchanges and cooperation in policy implementation and capacity building are welcome. Both Chinese government and enterprises are expected to strengthen interaction and communication with local stakeholders to enhance mutual trust, jointly promote the green development of power infrastructure, and promptly eliminate misunderstandings or disputes caused by low transparency.

6) **Opportunities and challenges for low-carbon transformation of power infrastructure in Southeast Asia**

Opportunities: First, Southeast Asia is home to diverse renewable energy resources with tremendous development potential as countries are in different stages of renewable energy

development and have varied resource availability and economic development conditions. Second, Southeast Asian countries have set clear and positive targets in renewable energy, and provide some policy support for renewable energy development. The APAEC 2016–2025 sets the goal of working towards a 23% share of renewable energy in total energy supply, and correspondingly, ASEAN member states have respectively defined their national targets and adopted a raft of measures to boost renewable energy development. Third, limited policy risk and growing economic efficiency of renewable power generation has high chance to stimulate the further development of renewable energy. In recent years, in the world and in Southeast Asia, the cost of renewable energy generation has fallen sharply and is expected to continue its decline. For example, the levelized cost of photovoltaic power (LCOE) in Southeast Asia has fallen by 65% in the past five years, and the cost of wind power has dropped enough to be competitive compared to coal. Should the externality costs of carbon emissions be taken into account in the cost of electricity generation when future regulations apply, the cost of coal power would exceed the cost of renewable energy generation. Fourth, the development of green finance is pushing the financial sector to withdraw funds from fossil energy and mobilize funds to renewable energy. Related financial actors have established respective green credit policies and environmental and social risk management systems under the guidance of national regulations and policies, and gradually applied them to overseas investment projects.

Challenges: First, the power market management system in Southeast Asia is dominated by a vertically integrated model without market pricing mechanism. The vertically integrated model is prone to monopoly, leading to poor economic efficiency. In some countries, the government still plays the principal role in power pricing due to the absence of market pricing mechanism. Second, energy and power policies and support mechanisms lack stability and consistency. Southeast Asian countries have established supporting policies to improve the environment for foreign investment. Nevertheless, poor policy implementation and frequent policy changes have gravely dampened the confidence of foreign investors and the investment attraction of local power generation sector. Third, imperfect laws and regulations, restricted safeguard policies, complicated and time-consuming procedures, and inter-department coordination difficulties make the red tape challenging. Fourth, there are shortfalls of R&D investments, financing channels and top-notch professionals, as well as appropriate industrial foundation. Renewable power generation projects that fall into capital-intensive industries in Southeast Asia, where inadequate access to financial support and financing channels will to a large extent undermine the investment attraction. Despite rich labor resources, the lack of skilled workers and mature industrial chains given the weak industrial foundation hinders renewable energy projects. Fifth, grid infrastructure is underdeveloped. Southeast Asia as a whole is hobbled by poor grid structure, few high-voltage lines, inadequate peak-shaving capacity, and deficient cross-border grid interconnectivity, which, in some measure, has impeded the development of renewable energy. Sixth, Although the cost of power generation has declined sharply, renewable energy is still less competitive than fossil fuels in this regard in the short term.

To this end, the following recommendations are offered for the green power infrastructure cooperation between China and the host countries:

1) **Recommendations for ASEAN and its member states to promote the sustainable development of power infrastructure in the region:** ASEAN member states should formulate appropriate renewable energy development plans and specific policies based on scientific research, and give full play to think tanks, platforms and networks to promote experience and knowledge sharing within and outside ASEAN. They also need to work out intergrated solutions suitable for national sustainable energy and power development. Besides, based on experience sharing and overall planning, research and analysis of country-specific conditions should be conducted with regional and international support to promote more reasonable and effective policies and measures, including foreign investment regulations and preferential policies, and renewable energy FiT policies and related supporting measures.

2) **Recommendations for China's engagement in low-carbon transformation of power infrastructure in Southeast Asia. First, the Chinese government should take environment and climate impacts into account as crucial factors in revising overseas investment policies.** Guideline should be provided for effective management of potential environmental and climate risks by public and private capital in foreign cooperation to facilitate the high-quality and sustainable development of China's foreign investment. China should enhance strategic cooperation with Southeast Asian countries to provide technical and funding assistance to the planning and roadmap of local renewable energy development. In-depth cooperation with target countries should be carried out in terms of strategic planning, and policy exchanges with Southeast Asia should be increased in terms of clean energy and power. China should also recognize the importance of foreign aid in promoting local overall planning and mobilizing funds, so as to improve the local strategic planning capacity and industry deployment. Second, Chinese businesses should prioritize environmental and social impact assessment of overseas investment projects and secure sustainability of local economy, society and environment. They should actively establish and implement environmental and social risk management systems under the guidance of national green bonds policies and foreign investment laws and regulations. Third, both Chinese government and businesses should boost conversations and exchanges with investment recipients. It is crucial to reinforce communication and dialogues with Southeast Asian countries at the central and local levels by harnessing bilateral and multilateral platforms, including the Clean Energy Forum of East Asia Summit and the Greater Mekong Sub-regional Energy Cooperation, maximize China's strength in clean power technology, industrial green transformation and expert pool to offer more technical assistance, professional training and project demonstration, etc. Chinese enterprises should carry out more cross-cultural conversations and exchanges with local governments, labor unions, social organizations and media outlets, and better communicate their contributions to the local society and economy in an effort to obtain more understanding and support from local communities. Fourth, China and Southeast Asia should actively carry out cooperation in green finance, and together continue to build the Belt and Road green financing system, to provide financial guarantee and support for green transformation of power infrastructure in host countries, and promote the high-quality development of China' foreign investment that propels China a its transition from a large investor to strong investor.

Foreword

The Belt and Road Initiative launched by China in 2013 provides promising prospects for cooperation between China and countries along the BRI as well as global cooperation in promoting sustainable development. Since its inception, the international community has expressed its support for China to exert leadership in global climate governance by driving low-carbon transformation in BRI economies and jointly developing a broad and inclusive green, low-carbon market with China.

The Belt and Road Initiative has played a positive role in catalyzing China's overseas infrastructure cooperation. China has stressed on many occasions the necessity, importance and urgency of cooperation in building a "Green Belt and Road". The *Vision and Actions on Jointly Building the Silk Road Economic Belt and the 21st Century Maritime Silk Road* jointly issued by the National Development and Reform Commission (NDRC), Ministry of Foreign Affairs (MFA) and Ministry of Commerce (MOFCOM) in 2015 explicitly stated that efforts should be made to promote green and low-carbon infrastructure construction and operational management. The impact on climate change should be fully taken into account for the construction. When conducting investment, attention should be paid to protecting local ecological environment, rationally and effectively exploiting and utilizing local resources and energy, and fostering local social and economic development, with a view to jointly create win-win situation through mutual consultation. The *Guidance on Promoting Green Belt and Road* and the *Belt and Road Ecological and Environmental Cooperation Plan* issued in 2017 sketched out the general idea and roadmap for building a Green Belt and Road, and set forth clear requirements for strengthening environmental and social risk management in overseas investment and boosting the development of the green financial system.

Southeast Asia is the third most populous region, the sixth largest economy, and one of the most economically vibrant regions in the world. Southeast Asia is also a long-term partner of China, as well as a key region for the Belt and Road Initiative. Along with rapid economic and social development, its demand for electricity and coal has been soaring in recent years, but there is a large shortage of power supply and a lack of funds due to backward power infrastructure and development. Most countries in the region are environmentally fragile and highly vulnerable to climate change. However, in order to achieve electricity access and ensure energy and power security, in light of rapid economic development and increasing greenhouse gas (GHG) emissions, Southeast Asian countries still make fossil fuels the main tool for their future power infrastructure development. Amid mounting pressures in the global fight against climate change and local environmental pollution, the fast expanding coal-fired power generation capacity in the region has captured global attention. At the same time, Southeast Asia possess abundant renewable energy resources with huge potential for development, making it a hotbed of global renewable energy investment. In support, Southeast Asian countries have formulated a series of policies to advance the reform of power structure and the development of renewable energy. Nevertheless, there are still considerable risks and challenges in investing in renewable energy due to various reasons, including human resource and capital shortages, backward technical means, and imperfect regulatory systems and development plans. The sustainable development of power generation is vital to economic and social development, environmental and public health protection, and effective response to climate change in the region. Southeast Asian countries should to further improve the investment environment, attract international capital and leverage social capital to

develop renewable energy.

China has led the world in domestic renewable energy investment. In recent years, it has increased its share in international renewable energy market to become one of the world's main suppliers of renewable energy equipment and related advanced technology. Chinese enterprises also take a leading position in the renewable energy value chain. In 2016, Chinese foreign investment in renewable energy projects jumped by 60% to $32 billion. At the start of 2017, China announced that it would invest $360 billion in renewable energy by 2020 and scrap plans to build 85 coal-fired power plants (Source: World Economic Forum). Through decades of rapid domestic investment, Chinese power companies have accumulated a wealth of experiences in infrastructure investment, construction design and equipment manufacturing, and have strong capacity for overseas investment. Southeast Asia is the largest destination of Chinese outward power investment, where Chinese enterprises get involved in the power infrastructure market through engineering construction, equipment export, and mergers & acquisitions. Poor industrial foundation and relatively underdeveloped infrastructure in Southeast Asia create opportunities for Chinese companies to invest in large-scale infrastructure projects. However, many obstacles are facing China's foreign investment in renewable energy, such as high financing cost, limited financing channels and volumes, mismatch between returns and risks of investment, great risks and risk management challenges, unclear planning and goals and inadequate policy support for renewable energy in countries along the Belt and Road, as well as trade and technical barriers, which, to some extent, dampens China's renewable energy investment in Southeast Asia.

In order to gain insight into the status quo and identify the problems of power infrastructure development in the Belt and Road countries in the context of deteriorating climate change, as well as the main challenges for power investment, and provide policy recommendations as a reference for China's outward power investment, this report gives an analysis and summary through literature research and expert interview, with a focus on Southeast Asia, as the key region for China's cooperation and investments under the Belt and Road Initiative.

The report consists of four parts. Chapter 1 examines the characteristics of energy demand changes and the status quo of power infrastructure development in Southeast Asia, including electricity market characteristics, clean and low-carbon power development goals and related policies, and policy incentives for foreign investment in the power market. Chapter 2 reviews China's overseas investment policies and how it engages with opportunities and challenges in Southeast Asian power infrastructure market. Chapter 3 offers recommendations for promoting the green transition and sustainable development of the power sector in the region through cooperation and exchanges between the Chinese government, foreign investors, and host country stakeholders. In order to deeply understand the opportunities and challenges of China's investment in Southeast Asian power infrastructure and enlighten the Chinese government and investors on seizing opportunities while avoiding risks, the appendix presents a brief analysis of three countries (Indonesia, Thailand, and Malaysia) with relatively supporting business environments and promising renewable power generation industries, including domestic energy development situation and trends, existing renewable energy policies, and obstacles facing China's investment.

Chapter 1 Status Quo of Power Infrastructure Development and Foreign Investment in Southeast Asia

1.1 Energy consumption characteristics of Southeast Asia

Energy consumption in Southeast Asia is growing rapidly, predominated by fossil energy. Energy consumption in the region has been soaring. Rising fuel demand has outstripped the region's own production. Energy and electricity demand has been driven up by fast infrastructure and manufacturing development, coupled with accelerated urbanization, population growth, and improvement of residents' living and consumption levels. Primary energy demand in the region has surged by more than 80% since 2000, with an average annual growth of 3.4%, far higher than the global average (2%) (see Figure 1–1).

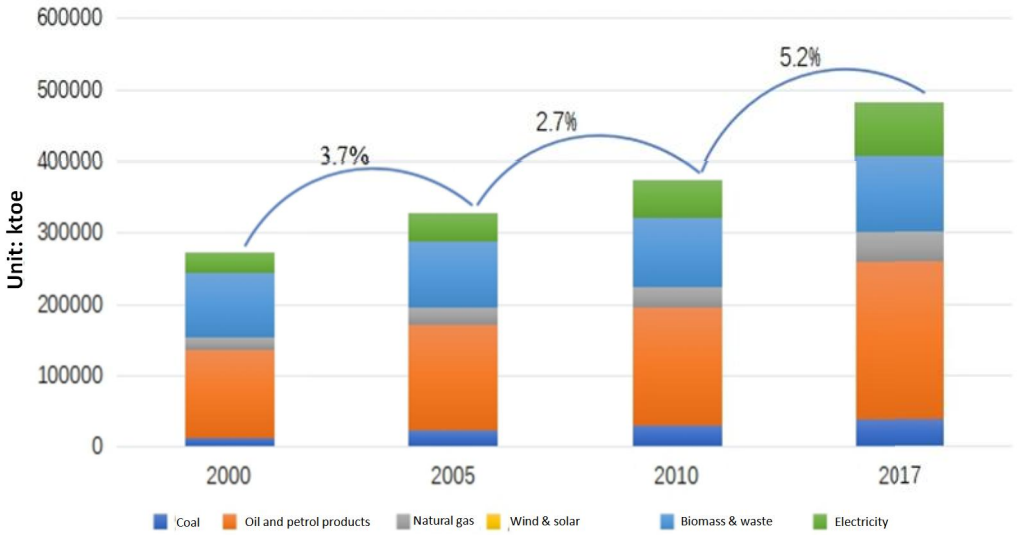

Figure 1–1 Primary energy consumption in Southeast Asian countries

Data source: IEA (Data missing for East Timor and Laos)

Energy demand expansion has propelled the development and production of fossil fuels, especially oil. Southeast Asia as a whole has become a net importer of fossil fuels. With the exception of Indonesia, which is a net coal exporter, Southeast Asian countries are all net coal importers (ACE&CETERI, 2018). The net coal imports of Malaysia exceeded 30 million tons in 2018 and 20 million tons in Thailand, Vietnam and the Philippines, while the volume was less than 10 million tons in other Southeast Asian countries. Financial income is one of the important driving forces for the sustainable development of the coal industry in Southeast Asia.

Energy consumption in Southeast Asia has long been dominated by fossil energy, with renewable energy accounting for a small fraction. Fossil fuels took up three-quarters of the region's primary energy consumption in 2018. Oil is the most important component in the region's energy mix, while

coal has been the fastest growing and most available since 2000. Renewable energy[1] currently meets only 15% of the region's energy demand (IEA, 2019). The amount of hydropower has quadrupled since 2000, and the use of modern biomass energy for heating and transportation has also seen tremendous growth. Despite declining costs, the contribution of solar photovoltaic (PV) and wind power to the region's energy consumption remains low. In addition, energy efficiency of vehicles and household appliances is becoming a key variable in energy consumption trends. Fuel consumption of vehicles in Southeast Asia has doubled since 2000 due to approximately tripled vehicle ownership. In the construction sector, electricity used for lighting purpose and by electrical appliances and equipment has increased at an annual average of 6% in the past two decades. Electricity consumption for air conditioning and affiliated usage has almost tripled, which is associated with very strong energy demand of residential space cooling.

Electricity demand in Southeast Asia has rocketed as universal access to electricity remains the basic task of all Southeast Asian countries. Southeast Asia has been dedicated to achieving universal access to electricity by 2030. Electricity demand in the region has increased at an annual average of 6% in recent years, well above the world average, making it one of the world's fastest growing regions (see Figure 1–2). By forecast of the *Southeast Asia Energy Outlook 2019*, electricity consumption in Southeast Asia will double by 2040, growing nearly 4% on an annual basis, twice as fast as the rest of the world.

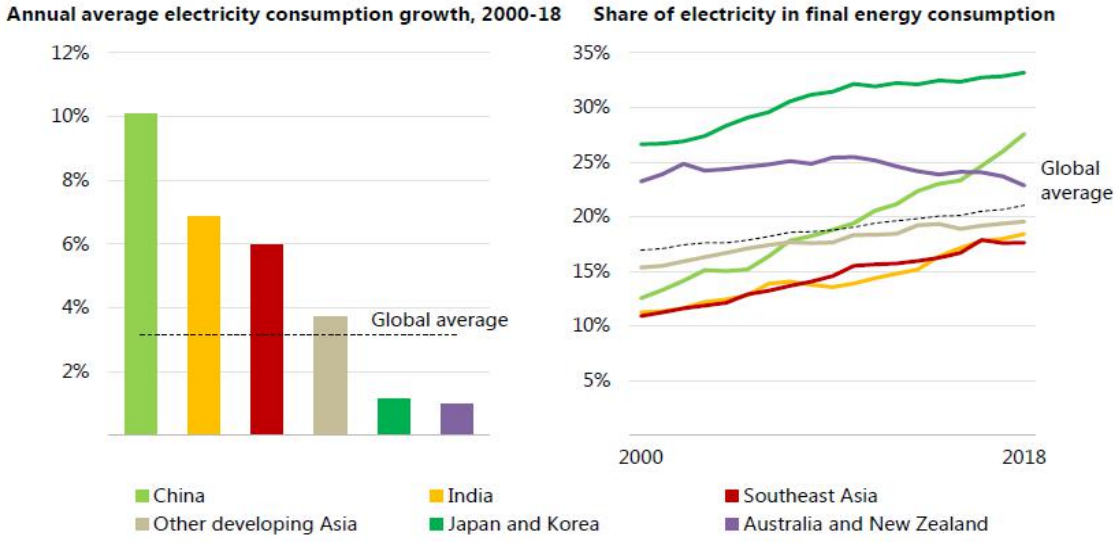

Figure 1–2 Average growth of electricity consumption in Asian economies and share of electricity in final energy consumption, 2000–2018

Data source: Southeast Asia Energy Outlook 2019

[1] Solid biomass utilized for cooking is excluded.

1.2 Power infrastructure characteristics of Southeast Asia

Both the installed capacity and the amount of electricity generation in Southeast Asia have been on the rise, of which the installed capacity of coal power generation has increased rapidly. There has been a continued rise in the region's installed capacity and amount of electricity generation in order to meet the fast growing demand (see Figures 1–3, 1–4 and 1–5). The total installed capacity in the region expanded from 90.598 GW to 206.818 GW between 2004 and 2015, with an annual increase of about 7.75%. Among them, the installed capacity derived from coal increased rapidly, replacing oil as the main source of electricity generation in the region. As of 2017, the total installed capacity stood at 240 GW, with coal and renewable energy accounting for 70% of the added installed capacity that year. The installed capacity of renewable energy has also grown steadily, up from 33 GW in 2000 to 72.3456 GW in 2019, but the share in the total installed capacity remains small. The amount of electricity generated in Southeast Asia has kept rising since 2000 and surpassed 100 TWh in 2017[2]. Among them, 76.6% was derived fossil fuels (to which gas, coal and oil contributed 37.76%, 36.19% and 2.65% respectively), and 23.4% from renewable energy, of which hydropower (including small hydropower) made up 18.25%, geothermal power 2.3%, biomass power 1.78%, wind power 0.63%, and solar power 0.25% (IEA, 2017). Southeast Asia was one of the few regions in 2008 that saw an increase in the share of coal-fired power plants in total electricity generation. Coal will still take a dominant position in the region's power generation according to its current power development plan. Electricity currently represents 18% of final energy consumption in the region, lower than the level of most other regions, but this proportion will surge and reach 26% in 2040, comparable to the global average. The share of renewable energy in electricity generation in the region climbed to about 24% as of 2018, but under the current policy scenario, it is expected to hit 30% by 2040 based on the forecast of regional electricity demand growth trends.

There is a shortfall in funds for power infrastructure construction. The demand for power infrastructure construction and development in Southeast Asia has been enormous in the context of economic and social development coupled with accelerating urbanization, fast population growth, and improvement of living standards. However, there is a significant gap in power infrastructure. Power supply falls short of demand, with shortages of available power and development funds in various countries, due to underdeveloped power infrastructure and backward power development. According to estimates by the International Energy Agency (IEA), Southeast Asia will need US$1.2 trillion in investment during 2018–2040 to modernize its power sector. Taking renewables as an example, as per report released by the International Renewable Energy Agency (IRENA) in 2016, a minimum investment of US$290 billion is needed in order to increase the share of renewables in primary energy mix to 23% in 2025.

[2] East Timor was not taken into account for lack of data and 2015 data is used for Laos.

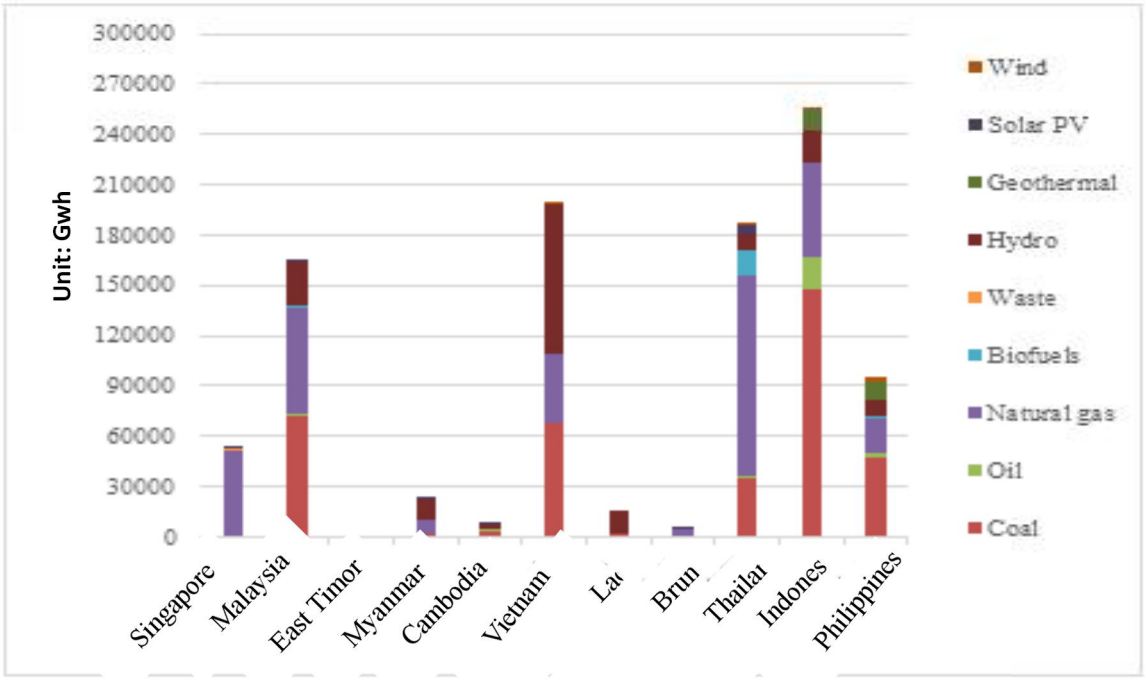

Figure 1–3 Amount and sources of electricity generated in Southeast Asian countries, 2017

Data source: IEA, https://www.iea.org/statistics/

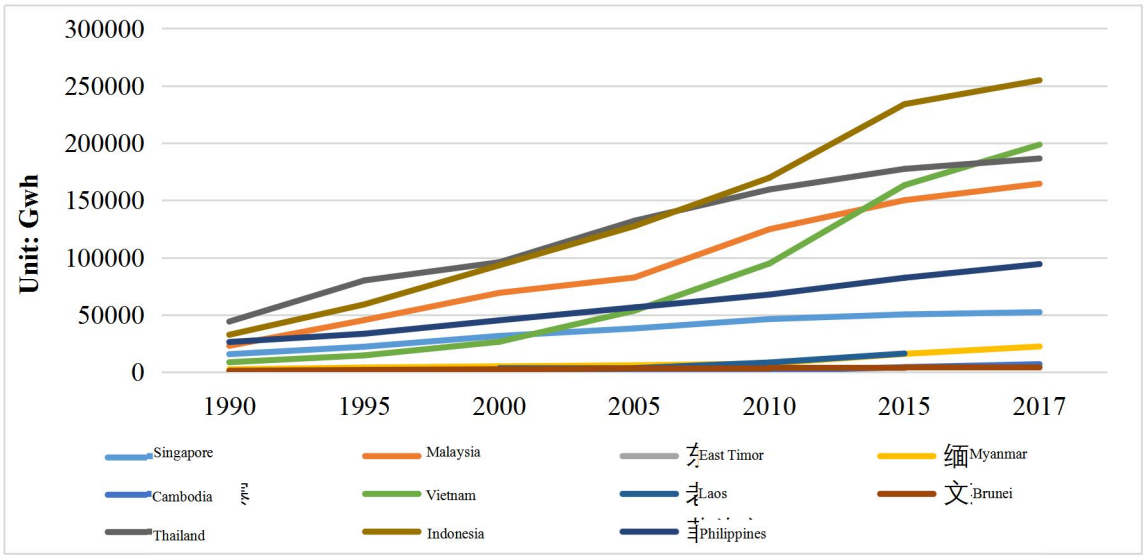

Figure 1–4 Total power generation in Southeast Asian countries, 1990–2017

Data source: IEA, https://www.iea.org/statistics/

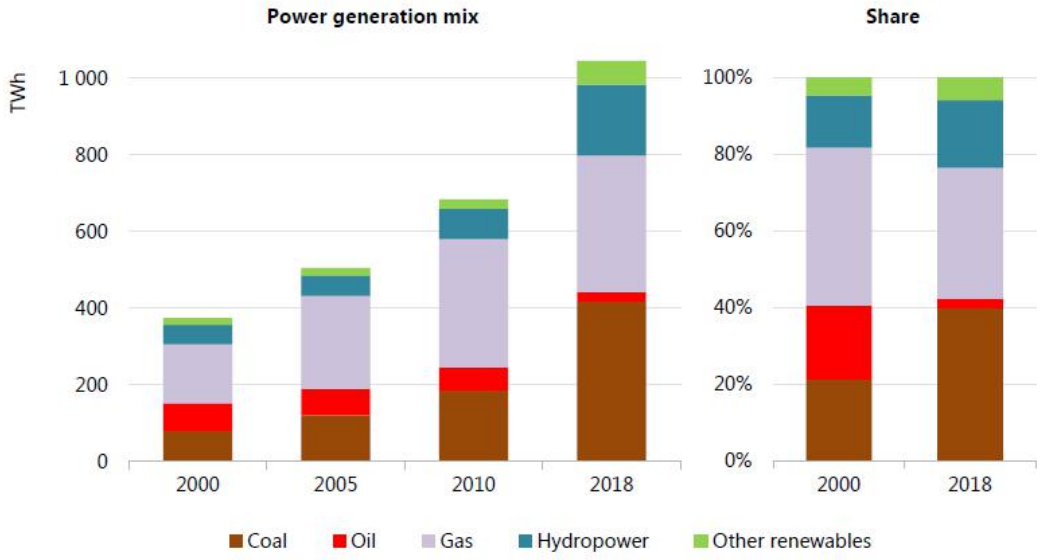

Figure 1–5 Installed power generation mix of Southeast Asia, 2000–2018

Data source: IEA, Southeast Asia Energy Outlook, 2019

Subcritical technology is mainly used for coal-fired power generation, while energy efficient technologies have great potential. Southeast Asia currently relies heavily on coal power to meet its growing electricity demand. As shown in Figure 1–6, as of 2017, coal power contributed to 31.1% of the total installed capacity in the region. Coal consumption of Indonesia, Malaysia, Philippines, Thailand and Vietnam accounted for 98% of the region's total coal consumption. It is expected that coal will still dominate the energy mix of these countries in the next ten years. According to the *Cleaner Coal Utilization Roadmap in ASEAN* released by ASEAN Centre for Energy (ACE) in 2019, these five member states of the Association of South East Asian Nations (ASEAN) are working on plans on the scale of coal demand and the future installed capacity of coal power (see Table 1–1 and Figure 1-7 for details) to further strengthen the dominance of coal in their energy consumption.

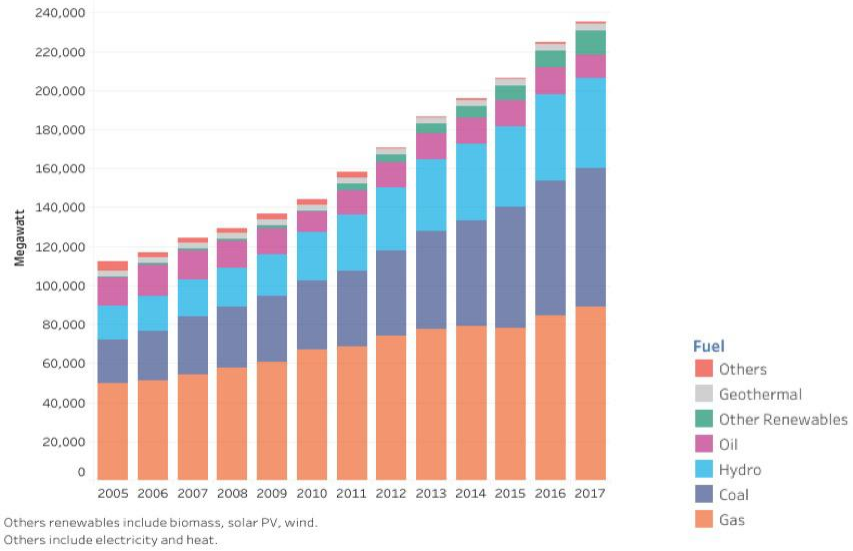

Figure 1–6 Coal usage in the installed power generation mix in Southeast Asia (Data missing for East Timor)

Data source: ACE, 2019

Table 1–1 Coal utilization targets and planning by major ASEAN member states

Country	Coal demand	Installed coal power capacity	Coal-related plans
Indonesia	144 million tons in 2027	57,008 MW or 48.8% of the total in 2027	Indonesia PNL's Electricity Business Plan (RUPTL 2018–2027)
Vietnam	86,694 million tons in 2035	60,530 MW or 35.3% of the total in 2035	Vietnam National Energy Development Plan 2016–2025; Vietnam Energy Outlook 2017
Malaysia	54% of primary energy consumption in 2034	13,146 MW in 2020	Eleventh Malaysia Plan 2016–2020
Thailand	23% of primary energy consumption in 2036	9,606 MW or 13.7% of the total in 2036	Thailand Power Development Plan 2015–2036
Philippines	18.12 millions of tones of oil equivalent (Mtoe) in 2030	19,228 MW in 2030	Philippine Energy Plan 2016–2030; Philippine Power Development Plan 2016–2040

Data source: ACE, 2019

In order to establish the status of coal as the principal energy source and improve energy efficiency in the region, Southeast Asia plans to establish a conditional cash transfer program that encourages the development of clean coal technology (CCT). There are five main goals in clean coal utilization: improve CCT for power generation; raise public awareness on the benefits of coal use; promote intra-regional coal trade and CCT investment; conduct policy research to enhance coal development and utilization and build capacity; and establish a fully functional ASEAN Coal Data and Information System (ACDIS). Cleaner coal utilization will contribute to the fulfillment of global commitments to reducing finance for power generation of coal and other fossil fuels.

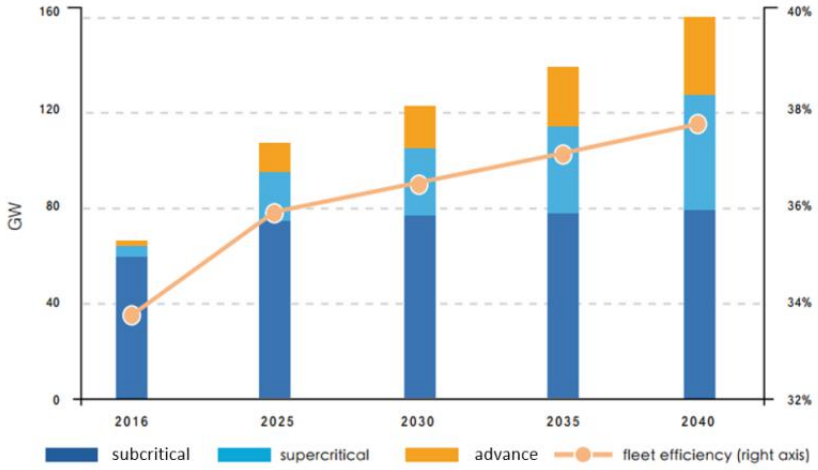

Figure 1–7 Projected installed types of coal-fired power units and and energy efficiency in Southeast Asia

Data source: ACE, 2019

1.3 Policies promoting clean power infrastructure in Southeast Asian countries

It is difficult to change, in the short to medium term, the important position of fossil fuels in the energy development of Southeast Asia. Nevertheless, Southeast Asian countries have been devoted to promoting clean power structure, and have formulated relevant policies that promote clean coal utilization, development of renewable energy and popularization of energy efficient technologies, and strengthen environmental supervision.

1.3.1 Low-carbon development goals, policies and measures

Southeast Asian countries are divided in climate change targets and major energy response measures and policies. Singapore and Malaysia have opted for emission intensity as emission reduction indicator; Myanmar and Laos have proposed policy actions without quantifiable mitigation targets; Brunei, Philippines and Cambodia, on the other hand, have pledged 60–70% absolute emission reduction based on the baseline scenario as the three countries are extremely prone to climate change impact and thus highly motivated for emission reduction. Table 1–2 shows the emission reduction targets and specific initiatives of Southeast Asian countries.

Table 1–2 Climate targets committed in nationally determined contributions (NDCs)

Country	Climate change mitigation targets: ("Conditional" refers to availability of national aid and technical support)	Main energy policies and measures
Brunei	(Compared with the business-as-usual or BAU scenario, 2015) energy sector: energy consumption reduced by 63% and share of renewable energy in total power generation reaching 10% by 2035; transportation sector: CO_2 emissions from vehicles in the morning rush hour cut by 40%; forest coverage reaching 55% with an increase of 34% .	Development of solar power technologies; use of 10–15MW potential of waste energy resources; energy intensity target of reducing the tons of oil equivalent per unit of GDP by 45% from the 2005 level; formulate energy efficiency and conservation policies and laws; white paper on land transportation
Philippines	GHG emissions slashed by 70% by 2030 compared with the business-as-usual (BAU) scenario.	National Climate Change Action Plan 2011; Ecological Solid Waste Management Act of 2000; Biofuels Act of 2006; Renewable Energy Act of 2008
Malaysia	Unconditional scenario: emission intensity cut by 35% by 2030; conditional scenario: emission intensity cut by 45% by 2030 (base year: 2005)	National Petroleum Policy (1975), National Energy Policy (1979), National Depletion Policy (1980), Four Fuel Diversification Policy (1981), National Forest Policy (revised in 1992), National Biodiversity Policy (1998), Five Fuel Policy (2001), National Policy on the Environment (2002), National Strategic Plan for Solid Waste Management (2005), National Biofuel Policy (2006), National Energy Policy (2008), National Green Technology Policy (2009), National Climate Change Policy (2009), New Economy Model, Government Transformation Programme and Economic Transformation Programme (2010), National Renewable Energy Policy and Action Plan (2010), Low Carbon Cities Framework (2011),

		National Automobile Policy (2014)
Cambodia	Unconditional scenario: emissions reduced 27% during 2020–2030 compared with the BAU scenario, of which the energy sector contributes to 16%, manufacturing sector 7%, transportation sector 3%, and other sectors 1%; conditional scenario: forest coverage reaching 60%, and land use, land-use change and forestry (LULUCF) emissions reduced by 57%	Climate Change Action Plan for Manufacturing, Energy and Transportation Sectors (2014–2018); on-grid and off-grid renewable energy power generation; end-use energy efficiency improvement; renewable energy utilization and energy efficiency improvement in manufacturing; mass public transportation, energy efficiency improvement of transportation through the use of environmentally friendly driving, hybrid electric vehicles, electric vehicles and bicycles; building and stove energy efficiency improvement; waste discharge reduction by using biological fermentation and filters; and solar irrigation
Singapore	Carbon intensity reduced by 36% from the 2005 level by 2030 and emissions peaking around 2030	National Climate Change Strategy 2012; Sustainable Singapore Blueprint 2015; enhancement of solar PV deployment; renewable energy expected to meet 8% of Singapore's peak electricity demand in 2030
Thailand	Unconditional scenario: GHG emissions reduced by 20% in 2030; conditional scenario: GHG emissions reduced by 25% in 2030	Thailand Power Development Plan B.E. 2558-2579 (2015–2036); Thailand Smart Grid Development Master Plan B.E. 2558–2579; Alternative Energy Development Plan, Energy Efficiency Plan, and Environmentally Sustainable Transportation System Plan B.E. 2556–2573 (2013–2030); Climate Change Master Plan B.E. 2558–2593 (2015–2050); National Industrial Development Master Plan B.E. 2555–2574 (2012–2031); Waste Management Roadmap. National energy targets: By 2036, the share of renewable energy in power generation and final energy consumption will be raised to be 20% and 30% respectively; energy intensity will be reduced by 30% from the 2010 level,

Vietnam	Unconditional scenario: GHG emissions reduced by 8% and energy intensity of the energy sector by 20% in 2030 compared to levels of the BAU scenario; conditional scenario: GHG emissions reduced by 25% and energy intensity of the energy sector by 30% in 2030	Law on Energy Economy and Effective Utilization (June 2010); National Climate Change Strategy (December 2011); National Green Growth Strategy (September 2012); Management of Greenhouse Gas Emission; Management of Carbon Credit Trading Activities to the World Market (November 2012); promotion of effective exploitation and share of new energy and renewable energy in energy production and consumption; energy efficiency and effectiveness improvement, and energy consumption reduction; fuel structure adjustment of industrial and transportation sectors
Indonesia	Unconditional scenario: GHG emissions reduced by 29% by 2030; conditional scenario: GHG emissions reduced by 41% by 2030	Share of new energy and renewable energy in primary energy supply reaching at least 23% in 2025 and 31% in 2030; climate mitigation actions compared with the BAU scenario; use of clean coal technologies; renewable energy generation (7.4 GW; 132 TWh); use of biofuels in the transportation sector (90%, 100%); additional natural gas distribution lines; additional compressed natural gas (CNG) fueling stations
Myanmar	By 2030, renewable energy—9.4GW installed hydropower capacity, and at least 30% share of renewables in rural electrification; energy efficiency—20% potential savings in electricity consumption of industrial processes, and about 260,000 stoves distributed during 2016–2031	National energy policies; draft long-term energy master plan; draft national electrification master plan; draft rural electrification plan; national energy efficiency and conservation policies, strategies and roadmaps
Laos	Policy actions, no quantifiable mitigation targets	By 2025, the share of renewables (<15MW) in total energy consumption will be raised to 30%; the share of biofuels in transportation fuel demand will be raised to 10%; by 2020, 90% of rural users will have access to on-grid electricity, and off-grid fuel consumption will be reduced; hydropower plants

		with large installed capacity (>15MW) will be built to provide clean electricity to neighboring countries that will reach up to 5,500 MW in 2020 and 20,000 MW afterwards.

Data source: NDC reports of Southeast Asian countries, ASEAN Plan of Action for Energy Cooperation 2016–2025

The energy sector has an unquestionable role in achieving the goals of the Paris Agreement, and sustainable energy development and climate change mitigation action are closely linked, calling for an effective climate change mitigation framework with high degree of integration between energy and climate policies. An effective coordination framework should be established to facilitate closer exchanges and cooperation between energy and climate policymakers. The *ASEAN Plan of Action for Energy Cooperation (APAEC) 2016–2025*[3] is generally recognized as a joint statement of ASEAN countries on global climate action and a key strategy for climate actions in the region. The accomplishment of the APAEC goals also embodies the contribution of ASEAN member states to international action on climate change. Under the theme of "Enhancing Energy Connectivity and Market Integration in ASEAN to Achieve Energy Security, Accessibility, Affordability and Sustainability for All", the APAEC 2016–2025 pointed out that energy is key to the realization of a systematic, competitive and resilient region in Southeast Asia. ASEAN is now one of the most dynamic and fast growing regions, where member states constantly implement domestic structural reforms to improve their productivity and competitiveness. To fuel this growth, primary energy demand is expected to increase by an average of 4.7% per year from 2013 to reach 1,685 Mtoe in 2035. The APAEC 2016–2025 will be carried out in two phases. Phase I will cover the period 2016–2020 for the implementation of short to medium-term measures to enhance energy security cooperation and take further steps towards connectivity and integration. The key strategies of the program areas in this phase include ASEAN Power Grid, Trans-ASEAN Gas Pipeline, coal & clean coal technology, energy efficiency & conservation, renewable energy, regional energy policy & planning, and civilian nuclear energy. Strategic planning for Phase II (2021–2025) will begin in 2018 based on a stocktake of the Phase I progress.

Besides, Southeast Asian countries has set down other goals and policies concerning green transition and low-carbon development based on country-specific conditions, in order to tackle climate change and achieve respective sustainable development goals (SDGs). For example, Vietnam formulated the *National Green Growth Strategy* in 2012, and approved the *National Action Plan on Green Growth 2014–2020* in 2014, which defined four main directions and clarified funding sources, specific measures and responsible departments. In the meantime, in order to mobilize public funds and private capital to areas such as renewable energy and energy efficiency, Vietnam issued a series of sustainable financial policies and guidelines between 2015 and 2017 to support the implementation of the above-mentioned action plan.

[3] It was formally signed at the 32nd ASEAN Ministers on Energy Meeting (AMEM) held on 23rd September 2014.,

1.3.2 Renewable power development goals and incentive policies

Southeast Asia is one of the most dynamic players in the global energy system. Southeast Asian countries are at different stages of economic development, with varying energy resource endowments and consumption models. Yet they face the shared challenge of satisfying the growing need in a safe, affordable and sustainable manner. In recent years, great efforts have been made in this region to upgrade the policy framework, reform the consumption subsidy for fossil fuels, intensify regional cooperation, and encourage investment in renewable energy. At the 33th ASEAN Ministers on Energy Meeting and a series of related events in October 2015 in Kuala Lumpur, the APAEC 2016–2025 was adopted, with enhanced accessibility of electricity and modern energy being one of the key goals. It is noteworthy that ASEAN countries have long been dedicated to improving the electricity access through renewable energy technologies and enabling rural electrification through distributed PV system and micro-grid. Yet many hurdles still exist for renewable energy development due to technical and financial constraints, lack of fiscal arrangements, and weak political mutual trust, resulting in much delayed action compared to expected targets.

According to ASEAN plans, renewable energy will represent 23% of primary energy mix by 2025. ASEAN member states have begun to set targets for renewable energy in national plans and strategies and implement relevant measures. The specific targets for different countries by 2030 are as listed in Table 1–3 below.

Table 1–3 Renewable energy development targets of tenSoutheast Asian countries

Country	Renewable energy target	Feed-in tariff	Self-consumption plan	Competitive tendering (or auctioning)	Tax incentives	Preferential loans	Capital subsidies	Tradeable renewable certificates
Brunei	√							
Cambodia	√			√	√			
Indonesia	√	√	√	√	√			
Laos	√				√			
Malaysia	√	√	√	√	√			
Myanmar	√				√			
Philippines	√	√	√		√			√
Singapore	√			√	√			
Thailand	√	√	√	√	√	√	√	
Vietnam	√	√	√		√			

(Data source: IEA, *Southeast Asia Energy Outlook 2019*)

Table 1–4 Incentive measures for renewable energy development in Southeast Asian countries

Country	Targets
Brunei	Power from renewable energy accounting for 10% by 2035
Cambodia	Installed capacity of hydropower increasing to 2,241 MW by 2020
Indonesia	Share of new energy and renewable energy increasing to 23% of primary energy supply by 2025 and 31% by 2050
Laos	Renewable energy making up 30% of primary energy supply by 2025
Malaysia	Installed capacity of renewable energy reaching 2,080 MW by 2020 and 4,000 MW by 2030
Philippines	Energy consumption decreasing by 16% annually based on baseline forecast by 2030
Singapore	Installed capacity of solar PV power reaching 350 MW by 2020 and 1 GW afterwards
Thailand	Increased shared of renewable energy in final energy consumption, reading 30% by 2036; installed capacity of renewable energy reaching 36% and power generation from renewables reaching 20% by 2037
Vietnam	Installed capacity of non-hydro renewables reaching 12.5% by 2025 and 21% by 2030

(Data source: ASEAN Report on Feed-in Tariff Mechanism)

To promote renewable energy development, ASEAN member states have rolled out supportive policies and incentives. As seen in Table 1–4, from an industrial perspective, support policies offered include renewable energy targets, feed-in tariff (FiT) policy, self-consumption plan and competitive tendering (auctioning), while policy incentives include tax incentives, preferential loans, capital subsidies, tradable renewable certificates, etc. Among them, the FiT policy has gradually emerged as the centerpiece for boosting renewable power. For instance, FiT has been generally adopted in countries with high growth in installed capacity of renewable energy, such as Indonesia, Malaysia, Philippines, Thailand and Vietnam. Among these countries, Indonesia has identified the price cap of regional and national power cost as the standard, while the rest have opted for the levelized cost of energy (LCOE) plus extra subsidies for investment returns of different technologies as the standard (see Table 1–5). In general, FiT policies in Southeast Asian countries are subject to frequent changes and immature in the design of specific mechanisms, and therefore, need

improvements according to feedback on existing policies.

Malaysia has established a comprehensive and transparent FiT application platform for renewable energy project developers to optimize the FiT application process and simplify the process of signing power purchase agreements for different renewable energy technologies. Thailand's FiT scheme has also achieved considerable success, although it has an electricity market structure different from Malaysia and more sustainable funding source for policy support mechanism. As the best case for promoting renewable energy development in Southeast Asia, the comprehensive electricity prices of both Malaysia and Thailand have taken into account incentives for renewable energy technologies with different installed capacity quotas and extra incentives provided for specific regions. FiTs are designed based on the sum of LCOE and extra subsidies to increase the investment returns of different technologies. For Malaysia, the key to the success of the FiT policy lies in its robust electricity market structure. Thailand, on the other hand, mainly sets certain installed capacity quotas for different renewable energy technologies, and considers appropriate incentives for different technologies, as well as extra subsidies to mobilize specific regions.

Table 1–5 FiT mechanisms in six ASEAN member states

Country	FiT mechanism
Indonesia	FiT is based on energy production cost rather than technical cost, and requires a comparison between local production cost of energy (LPCE) and national production cost of energy (NPCE). For solar, wind, biomass, biogas and tidal energy, FiT shall be 85% of LPCE to the maximum if LPCE is higher than NPCE; while for hydro, solid waste and geothermal power, FiT shall be equal to LPCE if LPCE is higher than NPCE. For all energy types, if LPCE is not higher than NPCE, FiT shall be determined based on agreement by all stakeholders (Perusahaan Listrik Negara and independent power producers, i.e. PLN and IPPs).
Malaysia	FiT of renewable energy companies is determined by annual quota granted by the government.
Philippines	FiT is fixed with differences for various types of renewable energy, and determined by the Philippine Energy Regulatory Commission (ERC) according to the development plan
Thailand	Renewable energy technologies are classified into two types: natural energy (hydropower, wind power, solar PV power) and bioenergy (urban solid waste, biomass, biogas). FiT of natural energy includes two types: fixed FiT and extra subsidies (subsidy premium of three southern provinces). FiT of bioenergy consists of two parts: fixed FiT and variable FiT (the variable depends on inflation rate).
Vietnam	A nationally uniform and fixed FiT is adopted for all types of renewable energy, rather than setting FiT based on specific regions or installed capacity.

(Data source: ASEAN Centre for Energy & Renewable Energy Engineering Institute, 2018, ASEAN Report on Feed-in Tariff Mechanism)

In addition, regional grid interconnection and energy integration are also important renewable energy development targets for Southeast Asia. The interconnection of power grid and infrastructure is a key factor in clean energy development. Therefore, optimized resource allocation for an interconnected clean power transmission grid based on competitive economic and social development and resource endowment shall be a priority for power development in the region.

Currently, most trade in power on the grid of Southeast Asia remains on a bilateral basis. Though cross-border grid exists in most countries, trade in power is largely non-directional (such as power purchase agreements). To fully harness these grids, Southeast Asia is planning to boost multilateral power trade. The cross-border interconnection and multilateral power trade will promote asset utilization and resource sharing, improve the flexibility of the power sector in ASEAN, and ensure greater uptake of renewable energy, especially solar and wind power.

1.3.3 Environmental standards

In recent years, a stringent environmental standard framework has emerged in Southeast Asian countries, but the enforcement has not been vigorous and efficient enough. Taking environmental quality standard as an example, Southeast Asian countries except for Myanmar have all established national ambient air quality standards, which are subject to review and update on a regular basis. Despite the gap in air quality standards with developed economies, some countries have narrowed the gap in conventional pollutants such as SO_2 and NO_2 compared to the United States and the European Union by updating their own standards. To illustrate, the average daily limit is 105 ug/m^3 for SO_2 and 75 ug/m^3 for NO_2 in Malaysia, of which both are higher than Grade II standards of China and the SO_2 standard is lower than that of the European Union (Liu Yi, 2018). The environmental charge as per existing laws in Southeast Asian countries is mainly pollution discharge fee, which is directly levied from polluters according to the type and quantity of pollutants legally ratified by environmental protection authorities. Besides, an environmental protection fee is also charged from enterprises in some countries. Taking Vietnam for instance, such fees apply on manufacturers of petroleum, diesel, lubricant, coal, HCFC solution, nylon bag (taxable), herbicide, formicide, forestry product preservative, solid disinfectant, etc. (Liu Yi, 2018).

However, the implementation and enforcement of environmental laws and standards is less commendable in Southeast Asian countries due to the following reasons: (1) Structural defects exist in the legal system in these countries with inconsistencies in legal authorization, multi-layered structure and forms of existence, as well as overlapping or conflicting authorities which compromised the law execution; (2) The vertical segmentation of the institutional structure makes horizontal coordination difficult among ministries and departments; (3) Many Southeast Asian countries are lacking in public trust for law and judicial system (Fan Chun, 2018). In recent years, heightened penalties for environmental violations, integration of environmental and resource conservation authorities, enhanced efficiency in environmental administration and rigorous law execution in Southeast Asian countries have improved the situation and rectified, to some degree, poor execution and implementation of environmental laws and regulations.

1.4 Electricity market characteristics of Southeast Asia

1.4.1 Power sector in Southeast Asia is not yet well marketized, with lack of incentives for competition

Power plant is not completely separated from the power grid, and a vertically integrated management model is commonplace (see Table 1–6) in Southeast Asia, with the exceptions of only Philippines and Singapore where market forces are more mature. Such vertical integration is prone to market monopoly and superpowers of certain market players. Examples can be found in the Electricity Generating Authority of Thailand (EGAT)—the only power system operator and the biggest power enterprise in Thailand. EGAT manages and controls power supply through national control center and five regional control centers. It also possesses a power transmission network covering the entire country, including transmission lines and high-voltage substations of varying voltage classes. The electricity markets in Singapore and Philippines are characterized by liberal competition between retailers, and independent power producers (IPPs) play a crucial role in the market by contributing to more than half of the national total installed capacity. From 2018 onwards, all power consumers in Singapore have been offered free choices of power suppliers, so that electricity prices are subject to market influence to an extent that is high in the world. At present, electricity prices in Southeast Asian countries generally run high and are heavily subsidized with few incentives. The average sales price of electricity in major Southeast Asian countries is higher than in China with Vietnam as the only exception (see Figure 1–6). The manufacturing sector in Southeast Asia is hampered partially by excessive power cost, impairing economic and social development.

Table 1–6 Power management systems of Southeast Asian countries

Country	Market structure	Power generation	Transmission and distribution	Power consumption
Cambodia	Vertical integration/ single buyer	IPPs National Power Corporation Rural power enterprises	National Power Corporation Rural power enterprises	Phnom Penh, provincial capitals Rural power enterprises
Brunei	Vertical integration / single buyer	Department of Electrical Services Berakas Power Company	Department of Electrical Services (Operation) Berakas Power Company (Maintenance, development)	End users
Indonesia	Vertical integration / single buyer	PT Pembangkitan Jawa-Bali (PTPJB) Indonesia Power IPPs Leasing power producers	Indonesia Power	Residential, industrial, and commercial users, others
Laos	Vertical integration / single buyer	National Power Corporation IPP	National Power Corporation	Key accounts
Malaysia	Vertical integration / single buyer	National Power Corporation IPP	National Power Corporation (in various regions) Tenaga Nasional Berhad (TNB), Sarawak Energy Berhad (SEB)	End users
Myanmar	Vertical integration / single buyer	Myanmar Electric Power Enterprise Hydropower enterprises IPPs (hydropower)	Myanmar Electric Power Enterprise	End users
Thailand	Vertical integration / single buyer	EGAT IPPs Small power producers (SPPs) Micro power producers	EGAT	Direct users Industrial estates

Vietnam	Cost pool	Vietnam Electricity Group IPPs	Vietnam Electricity Group	End users
Singapore	Price pool	Domestic IPPs	Singapore Power Limited	End users
Philippines	Price pool	National Power Corporation—small power companies IPPs	National Transmission Corporation (TransCo)	Power supply market—monopolized Power supply market—non-monopolized

(Data source: ASEAN Centre for Energy, ASEAN Power Cooperation Report 2017)[4]

1.4.2 Southeast Asia is one of the world's most promising regions in electricity market development

Southeast Asia has weak infrastructure with huge potential for development and stays in the forefront of the Belt and Road countries in terms of demand for infrastructure construction. China International Contractors Association and China Export & Credit Insurance Corporation (SINOSURE) have assessed the potential of infrastructure construction, investment and development in the Belt and Road countries, and proposed a comprehensive index for horizontal country comparisons, taking into account the four dimensions of development environment, demand, cost, and popularity. Southeast Asia has secured the top position in the index for three years in a row because of strong demand for infrastructure construction and huge market for investment in energy, transportation and other fields propelled by huge population base, rapid economic development and relatively favorable environment. Among them, Indonesia, Vietnam, and Malaysia are the top three countries in the Southeast Asia infrastructure development index.

According to the *ASEAN Investment Report 2018*, foreign direct investment (FDI) flows to ASEAN grew from US$123 billion in 2016 to US$137 billion in 2017, with a rise in investments in eight member states. Combined FDI flows to Cambodia, Laos, Myanmar and Vietnam reached a record level with an increase of 21%, accounting for 17% of the total FDI flows to the region. As per the IEA estimates, ASEAN will require US$1.2 trillion investment between now and 2040 to modernize its power sector, which calls for more foreign investment to meet such demand. Investment is an important factor in the success of the *ASEAN Plan of Action for Energy Cooperation*. In order to achieve the APAEC goals, ASEAN will provide financial support of US$290 billion in total or about US$27 billion each year by 2025, representing about 1% of the region's gross national product (GDP). Among them, 75% or about US$ 217.5 billion will flow to the power sector. All in all, ASEAN is one of the world's most promising regions for energy infrastructure and electricity market development.

1.4.3 Southeast Asian policies concerning foreign investment in the power sector

[4] Note: Cost pool: on-grid order, size and price determined by variable cost of power generation. Price pool: liberal and competitive retail market for power sector. Single buyer: buyer monopoly, minimum power bills for given load.

Southeast Asia has attracted a large amount of foreign investment and become an important region for undertaking world industrial transfer and manufacturing, owning to low investment threshold, huge market potential, cheap labor, convenient transportation and friendly foreign investment policies. Southeast Asian countries have formulated and amended their laws, regulations and preferential policies to improve the investment environment, so as to leverage foreign investment to propel domestic economic and social development. This sub-section sorts out the foreign investment laws of hot investment destinations in Southeast Asia, and especially, sums up the provisions and terms concerning foreign investment in the fields of power and energy, which reveals the overall attitude and environment of these countries with respect to foreign investment in power infrastructure, as shown in Table 1–7.

Table 1-7 Provisions concerning power infrastructure in foreign investment laws of some Southeast Asian countries

Country	Foreign investment law	Related content
Vietnam	Foreign Investment Law, amended on June 9, 2000	The law provides a basic legal basis for FDI in Vietnam by defining the scope and form of foreign investment. It also proposes a list of sectors where foreign investment is encouraged, including the application of high technology, protection of ecological environment and effective utilization of natural resources. It clearly stipulates that the State of Vietnam will not license any foreign investment project in sectors or regions which may have adverse effects on national defense, national security, cultural and historical heritage, fine custom and tradition, or the ecological environment. The Government of Vietnam shall guarantee that foreign investors investing in Vietnam are treated fairly and equitably. The law includes detailed provisions on investment guarantee measures, and specifies the rights and obligations of foreign investors investing in Vietnam. Among them, Article 51 states that foreign-funded institutions investing in Vietnam have the responsibility to comply with the provisions of the law on environmental protection.
Laos	Law on Investment Promotion, updated in 2016	The law stipulates various matters concerning foreign investment, and clarifies the procedures for investment in two types of business: general business and concession business. Electric power is classified into concession business, and investment in it shall seek the approval of planning and investment sector authority in accordance with the procedures. The law also provides that various departments and local governments can determine the list of activities to attract investment, and business or activities

		in the list must have great effect on national economic foundation and potential contribution to natural resource development. Regarding tax incentives, it defines the scope of business promoted by the government, including the manufacture of new products, development of new energy, use of large human resources, investment in environmental protection, and infrastructure construction and development in the industrial sector. Other incentives include tax reductions and exemptions, provision of information and materials, and land use related incentives.
Thailand	Investment Promotion Act, enacted in 1977 and amended in 2001	The competent authority is the Board of Investment. The law stipulates activities eligible for investment promotion, and various preferential policies for such activities, such as incentives related to taxes, land use, management rights, and equipment tariffs. Public utilities, infrastructure, environmental protection, and target activities are all included in investment promotion activities that deserve attention. In addition, activities that may have adverse effects on natural resources and ecological environment are classified into restricted activities, in which foreign investors are allowed to participate only after obtaining the approval of the Minister of Commerce in accordance with the Cabinet's decision and meeting certain conditions. Foreign investment in engineering services and engineering construction shall require special approval.
Malaysia	Investment Promotion Act and foreign investment guide, 1986	Foreign investment policies are mainly embodied in industry-specific foreign investment provisions and foreign investment ratio restrictions. Industries are classified to three categories: encouraged, restricted, and prohibited. Renewable energy falls into encouraged export-oriented production and high-tech fields. Foreign investment in encouraged industries can enjoy preferential policies including emerging industrial status, investment tax subsidies, reinvestment subsidies, and accelerated capital subsidies.

Myanmar	Foreign Investment Law, amended in November 2019	Under the law, Myanmar allows foreign investment in power, oil and gas, mining, manufacturing, transportation, communications, construction, and other service industries. The amendment removed the provisions that the share of foreign investment in joint ventures shall be at least 35%, and such share shall be no more than 50% in some restricted areas. It also provides preferential policies for joint ventures, to encourage foreign investment and joint venture investment. In March 2019, the Myanmar Investment Commission issued a catalog of projects prohibited from foreign investment, including projects that damage farmland and water resources, projects that consume excessive electricity, and power survey projects.
Cambodia	Law on Investment of the Kingdom of Cambodia, enacted in 1994 and amended in 1999; Law on the Amendment to the Law on Investment of the Kingdom of Cambodia, enacted in February 2003	The law gives basically the same treatment to domestic capital and foreign capital. Areas of investment are divided into two categories: encouraged and restricted. Infrastructure and energy, provincial and rural development, environmental protection, and job creation are listed as key areas where investment is encouraged by the government. There are several types of investment methods, i.e. foreign direct investment, merger and acquisition of qualified investment projects by joint ventures and their investment projects, build-operate-transfer (BOT) model.
Indonesia	New Investment Law, enacted in March 2007	The law clarifies several categories of industries, including industries that are close to both domestic and foreign investment, industries that are closed for foreign investors, industries that foreign investors own no more than 95% of the share, and industries that are conditionally open. Power stations, ports, nuclear power and other infrastructure are included in the list of industries that foreign investment is allowed in the form of joint ventures with a share of no more than 95%. Foreign direct investment entering Indonesia must abide by the negative list, which specifies permitted, prohibited and conditionally permitted industries for foreign investment[5].

(Data source: Foreign investment laws of various countries)

[5] The latest negative list was set out by Presidential Regulation No. 44 of 2016 and came into effect on May 18, 2016.

Most countries in Southeast Asia have included the effective utilization of natural resources and infrastructure investment in the list of encouraged industries for foreign investment. Although the specific regulations are different, they have introduced various supporting and preferential measures to encourage and attract foreign investment and improve domestic investment and business environment. In addition, the foreign investment laws of Southeast Asian countries all contain binding clauses related to environmental protection, which set out basic requirements for the environmental performance of foreign investment in these countries.

Chapter 2 Status Quo and Trend of China's Support for Southeast Asian Power Infrastructure Development

2.1 China's foreign investment policies

In order to effectively manage the environmental, social, financial, diplomatic, cultural and other risks faced by "going global" and promote the construction and development of green Belt and Road, China has formulated a series of policies, guidelines and standards (see Table 2–1). Chinese companies are expected to effectively identify, analyze and manage potential risks and assume corporate social responsibilities while "going global" to make financial revenue, so that they can contribute to local sustainable development and response to climate change, as well as the establishment of China's image as a responsible big country.

China's policy system for green foreign investment is gradually taking shape towards completion. In 2017, the *Guidance on Promoting Green Belt and Road*, jointly issued by the Ministry of Environmental Protection (MEP), MFA, NDRC, and MOFCOM, proposed to mainstream ecological civilization in the Belt and Road Initiative, bolster green development, strengthen environmental protection, and jointly build a green silk road. In 2018, suggestions on promoting sustainable finance and, in particular, green finance drafted by the G20 Sustainable Finance Study Group with the People's Bank of China (PBOC) as the lead, were incorporated into the Buenos Aires G20 Leaders' Declaration, driving a global consensus on green finance. China and its partners have launched the Belt and Road International Green Development Coalition and the Belt and Road Sustainable Cities Alliance, worked out the *Belt and Road Green Investment Principles*, kicked off the Belt and Road Initiative Environmental Big Data Platform, and worked with other countries to implement the Belt and Road South-South Cooperation Initiative on Climate Change. In April 2019, a total of 27 international financial institutions signed up to the *Belt and Road Green Investment Principles*, marking the emergence of consensus on green investment under the framework of Belt and Road Initiative.

Under the guidance of green strategy and policy planning, Chinese financial regulatory agencies, banks and enterprises have gradually realized the importance of green finance in guarding against and managing various risks in foreign investment activities, and started to actively formulate policies and take actions. For example, the China Banking and Insurance Regulatory Commission (CBIRC) published the *Green Credit Guidelines* in 2012, requiring investors to pay attention to environmental and social risks when investing abroad. China Development Bank (CDB), Export-Import Bank of China (CEXIM), and Industrial and Commercial Bank of China (ICBC) have also set strategic goals and environmental and social risk management regulations to address climate change, but not yet detailed the specific actions for investment and financing in the energy and power sector.

Though China is yet to be equipped with all-round expertise for building green Belt and Road, the country has gained a wealth of practical experience in green low-carbon transformation, which can be used by other developing nations for their own green transformation, and enhance China's influence in green global governance and thereby raising its global stature in other arenas.

Table 2–1 China's foreign investment policies (partial)

Policy	Time issued	Issuing agency	Main content
Green Credit Guidelines	2012	CBIRC	Article 21 states that banks shall strengthen environmental and social risk management for proposed overseas projects, ensure project sponsors are compliant with local environmental, land, health and safety laws and regulations in the project country or region, and shall publicly commit to adopt relevant international best practices or standards for proposed overseas projects, ensure the proposed projects are consistent with international best practices in essence.
Visions and Actions on Jointly Building the Silk Road Economic Belt and the 21st Century Maritime Silk Road"	2015	NDRC, MFA, MOFCOM	It provides a programmatic framework and program for the specific implementation of the Belt and Road Initiative.
Guiding Opinions on Promoting International Cooperation in Production Capacity and Equipment Manufacturing	2015	State Council	It mentioned "vigorously develop and implement overseas power projects and enhance international market competitiveness" in the main tasks. It stated that (we will) actively explore the thermal power and hydropower markets of relevant countries, encourage participation in cooperation on major power projects in various ways, and expand the scale of domestic thermal power and hydropower equipment and technology exports; and actively participate in the investment and construction of wind and solar PV power projects in relevant countries, and promote international cooperation in wind and PV power generation capacity and equipment

			manufacturing.
Guiding Opinions on Building a Green Financial System	2016	PBOC, MOF, NDRC, Ministry of Ecology and Environment (MEE), China Banking Regulatory Commission (CBRC), China Insurance Regulatory Commission (CIRC), China Securities Regulatory Commission (CSRC)	Article 8 "Promote international cooperation in green finance" proposes to promote regional cooperation on green finance and support green investment of relevant countries through the Belt and Road Initiative and regional cooperation mechanisms such as China-ASEAN Cooperation and South-South Cooperation.
Guidance on Promoting Green Belt and Road	2017	MEE, MFA, NDRC, MOFCOM	It proposed to boost green infrastructure and prioritize environment quality by popularizing energy conservation and environmental protection standards and practice in such sectors as green transport, green building and clean energy.
Belt and Road Ecological and Environmental Cooperation Plan	2017	MEE	It requires respecting laws and regulations to promote international production capacity cooperation and eco-friendly infrastructure construction. In the specific measure of "promoting the green and low-carbon construction, operation and management of infrastructure", it proposed to improve green and low-carbon operation, management and maintenance of facilities by clarifying environmental protection requirements in infrastructure construction standards and enforcing environmental standards and practices in such sectors as green transportation, green building and green energy.
Opinions on Further Guiding and Regulating the Directions of Overseas Investments	2017	NDRC, MOFCOM, PBOC, MFA	"Overseas investments using obsolete production equipment that is not in compliance with the relevant target jurisdiction’s technical standards" and "overseas investments that are not in compliance with the relevant target jurisdiction's environmental

			protection, energy consumption or safety standards" are included in the restricted category.
Environmental Risk Management Initiative for China's Foreign Investment	2017	Green Finance Committee, Investment Association of China, China Banking Association, Asset Management Association of China, China Trustee Association, Foreign Economic Cooperation Office of MEE	It put forward 12 suggestions for strengthening risk management of overseas investment by Chinese-funded financial institutions and enterprises, adopting responsible investment principles, and effectively managing environmental and social risks.
Interim Measures for the Reporting of Outbound Investments Subject to Record-Filing or Approval	2018	MOFCOM, PBOC, State-owned Assets Supervision and Administration Commission, CSRC, CBRC, CIRC, Foreign Exchange Bureau	It set up the mode that manages outbound investments by levels and categories, and introduced the approach of encouraged development combined with negative list to manage the record-filing/approval of outbound investments.
County (Region) Guides for Foreign Investment Cooperation	Updated every year	MOFCOM	They give a systematic introduction to the environmental laws, regulations and competent authorities of major countries and regions along the Belt and Road, as well as basic licensing systems, such as environmental impact assessment.
Framework Agreement on Coordinated Promotion of Belt and Road Energy Cooperation	2018	National Energy Administration (NEA), SINOSURE	The two agencies will further strengthen energy cooperation, and enhance corporate financing facilitation, to jointly push the Belt and Road energy cooperation to a new level. They will pioneer the system design of green channels through which renewable energy business can "go global".
Cooperation Principles and Concrete Actions for the Belt and Road Energy Partnership	2019	NEA (agreed by all partners)	It proposed to promote cooperation in clean energy and energy efficiency to address climate change and secure universal access to affordable, reliable and sustainable modern energy service.
Guiding Opinions on	2020	General Office of the CPC	It encourages enterprises to

Building a Modern Environmental Governance System		Central Committee, General Office of the State Council	participate in green Belt and Road construction, to enable advanced environmental protection technology, equipment and production capacity to go global.

2.2 Year-on-year growth in China's overseas power investment, with an emerging preference to renewable energy

According to the *China's Electric Power Industry Annual Development Report 2020* issued by the China Electricity Council in 2020, by the end of 2019, the cumulative actual overseas investment of China's major power companies stood at US$87.85 billion, and the newly signed contract amount of China's overseas contracted projects hit US$284.85 billion. As per statistics from the China Chamber of Commerce for Import and Export of Machinery and Electronic Products, in 2019, Chinese power companies invested in foreign power projects and signed contracts on 563 projects with a total contract value of US$47.2 billion, an increase of 1.1% year-on-year. PowerChina International Group Limited., China Gezhouba Group International Engineering Co., Ltd., and China Energy Engineering Group Co., Ltd (CEEC) rank the top three in contract amount of direct exports or engineering, procurement & construction (EPC), engineering, design & installation, and civil engineering contracts that exclude subcontracting between Chinese enterprises. The top five companies in contract value of overseas new energy projects[6] are PowerChina International Group Limited., China Gezhouba Group International Engineering Co., Ltd., China Machinery Engineering Corporation, Energy China Group Guangdong Thermal Power Engineering Co., Ltd., and China National Electric Engineering Co., Ltd..

In the context of tackling climate change, energy transition and sustainable development, the world is making active move to withdraw from coal power investment and turning the eye to cleaner, low-carbon renewable energy. Given great opportunities brought by declining renewable energy costs and lower policy risks for global renewable energy investment, Chinese energy and power companies become increasingly involved in overseas renewable energy investment and cooperation. According to *Serial Report on China Power Industry Transformation—Opportunities for Overseas Power Investment* released by PricewaterhouseCoopers in 2018, Chinese companies' investment in overseas power markets has grown rapidly, with an emerging preference to renewable clean energy sources and developed countries. In March 2019, the State Development & Investment Group Co., Ltd. (SDIC) revealed that the company has completely withdrawn from coal-related operations and will mainly invest in new energy in the future. This made SDIC the first centrally state-owned enterprise in China to make a complete exit from coal.

In addition, nearly two-thirds (64%) of foreign energy investment by Chinese private companies have flowed into renewable energy (Zhou L et.al, 2018). For example, Trina Solar has invested in large-scale solar PV equipment manufacturing plants and power plants in Thailand and Vietnam.

[6] They mainly include solar, wind, and waste power generation projects.

2.3 Status quo of China's support for power infrastructure development in Southeast Asia

2.3.1 Southeast Asia has become a hot spot for China's outward foreign investment.

The advancing Belt and Road Initiative pushes forward the rapid development of China's foreign infrastructure investment and cooperation, of which power infrastructure is one of the priorities. As per MOFCOM data, in 2018, China's outward FDI amounted to US$143.04 billion, becoming the world's second largest foreign investor[7]. The FDI flows to the Belt and Road countries were US$17.89 billion and the year-end stock was US$172.77 billion, accounting for 12.5% and 8.7% respectively. China's outward FDI destinations were highly concentrated, with the top 20 countries / regions representing 91.7% of the total. According to Ernst & Young's *Overview of China Overseas Investment 2019*, Asia was the most popular overseas M&A destination for Chinese enterprises driven by the Belt and Road Initiative. China's outward overseas investment in Asia increased against the downward trend in other regions[8]. In the favored power and utilities sectors, China's overseas EPC contracts grew steadily in value, with a year-on-year rise of 7.6% in 2019. According to MOFCOM's *Statistical Bulletin of China's Outward Foreign Direct Investment 2018*, China's outward foreign investment mainly went to Asia in 2017, of which the flows to Southeast Asia, a hot spot in recent years, accounted for 8.9% with a scale of US$14.12 billion (Figure 2-1).

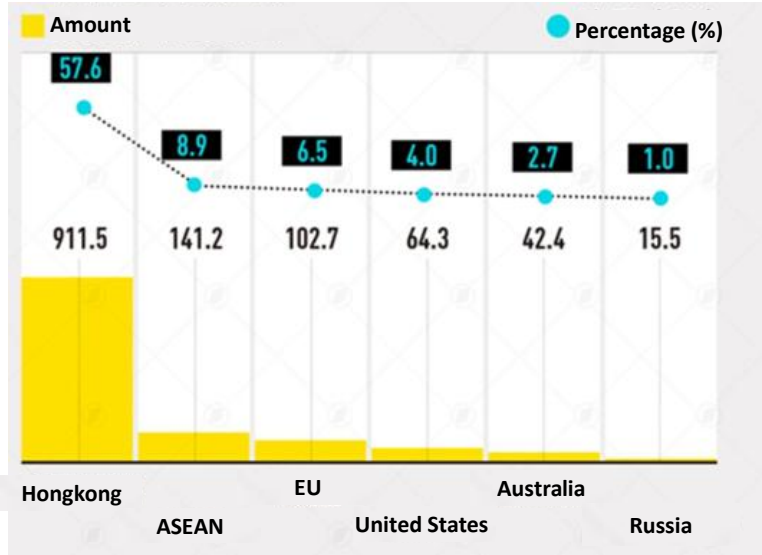

Figure 2–1 Destinations of China's outward foreign investment, 2017

Data source: MOFCOM, Statistical Bulletin of China's Outward Foreign Direct Investment 2018, compiled by China Business Network

[7] Japan was the largest foreign investor, with a total investment of US$143.16 billion in the same year.

[8] China's FDI and overseas M&A value decreased by 9.8% and 31% respectively.

2.3.2 EPC is the most traditional approach for China's engagement in overseas power market, but there is a shift towards equity investment.

China's participation in foreign power infrastructure projects is mainly realized through equity investment, financial support, EPC and equipment export, etc. Each power project may involve one or more of the above approaches, and the dominating approach will determine if Chinese enterprises and financial institutions are in a decision-making status and if long-term economic gains would be possible. China has gone through a period from project assistance to EPC and to the current integrated project development for overseas power plant investment, which has allowed Chinese equipment, technology and capital to gradually make their way to foreign markets.

Taking a holistic view of the decade from 2009 to 2018, EPC is still most commonly adopted by China in foreign coal-fired power projects. This makes Chinese enterprises merely constructor or equipment provider rather than a decision-maker, who are only entitled to short and mid term economic gains. But the situation is now changing. 2018 marked the first time that the installed capacity built by Chinese enterprises through equity investment exceeded that of EPC (Greenpeace et al, 2019).

2.3.3 China has been actively involved in renewable energy development in Southeast Asia and South Asia.

China is also actively involved in renewable energy projects in South Asia and Southeast Asia. Between 2014 and 2018, wind power and PV projects involving China via equity investment were mainly in South Asia and Southeast Asia. During this period, in countries including Pakistan, India, Malaysia and Thailand, the total completed installed PV capacity with equity investment from Chinese enterprises reached 1,185 MW, accounting for 93% of total investment in the Belt and Road countries in the same period. Besides, another 996 MW of installed PV capacity is under planning or construction, which will bring the total Chinese contribution to 2,181 MW in these countries. The installed capacity of PV power stations invested or planned for investment by China in Bangladesh, Afghanistan, Vietnam and Pakistan has exceeded 30% of total PV installed capacity in these countries by the end of 2018. Between 2014 and 2018, approximately 80% of wind power projects in the Belt and Road countries involving Chinese enterprises via equity investment were located in South Asia and Southeast Asia, with an installed capacity of 397.5 MW already completed and 1362 MW under construction or planning, adding up to 1,759.5 MW.

Apart from equity investment, between 2014 and 2018, China participated in constructing 8,440 MW of PV power stations in the Belt and Road countries by exporting equipment. Three of the top five destinations of China's PV equipment exports were in South Asia and Southeast Asia, namely India (5,800 MW), Thailand (1,060 MW) and Philippines (250 MW). Furthermore, Southeast Asia is also a hub for overseas PV bases launched by Chinese enterprises. A total of 12 Chinese PV enterprises have participated in building PV component factories in the manufacturing base hubs in Southeast Asia, especially Vietnam and Thailand, with an announced capacity of 7 GW.

2.3.4 China's power investors in Southeast Asia need to further enhance consultation with local organizations, with attention paid to environmental and social issues, while bolstering

local economic and social development.

Local energy planning experts and stakeholders in Southeast Asian countries are divided on China's construction of local power infrastructure. On the one hand, local stakeholders welcome China's investment, believing that China's support has accelerated local power infrastructure construction and thereby contribute to local electrification rate growth and economic development. On the other hand, amid increasing public attention to air quality, water use, environmental pollution and health impact, local communities, non-governmental organizations (NGOs) and the media become more concerned about and dissatisfied with coal power due to its negative environmental impacts. Projects led by other countries try to push forward best international practices in environmental, social and corporate governance and safety. In comparison, Chinese investment projects are deficient in soliciting the opinions of local population, especially local communities, NGO, and citizens, and have triggered some disputes and even worse, backlash from local residents. Besides, Chinese business investors usually give priority to Chinese workers in employment, fueling discontentment of local workers or labor unions.

Local experts said in interviews that Chinese companies do not pay due attention to dissemination and consultation in local project investment or construction. This gives rise to some stereotypes of projects involving China in the mind of many local communities and organizations. In worse cases, projects involving China via EPC and equipment export rather than investment are all deemed as Chinese investment, and the resultant environmental and social problems are then attributed to Chinese-funded banks and corporations and even the Chinese government. In the process of project implementation, large centrally state-owned enterprises and state-owned enterprises usually input resources in local public welfare projects, including education, health care, poverty alleviation, road construction and other fields, which can bring some local social benefits. However, due to the lack of effective local publicity, the impact on local community and the public is very limited.

It is generally believed that China's power development policies and investment and construction experiences have a high reference value for Southeast Asia, according to the author's interview with an official of the Vietnamese investment department and a local NGO engaged in energy and climate activities. They strongly hope that while China increases power infrastructure investment in Southeast Asia, there will be more dialogue and cooperation with host countries in policy implementation and capacity building. At the same time, the Chinese government and enterprises are expected to interact and consult with key local stakeholders more actively in the investment process, especially with regard to project profiles, environmental and social impacts, or some disputes or issues arising therefrom, in order to enhance mutual trust and promptly resolve misunderstandings or disputes caused by low transparency.

2.4 Opportunities and challenges for China's engagement in low-carbon transformation of power infrastructure in Southeast Asia

2.4.1 Increased opportunities for China's involvement in Southeast Asian renewable power investment

Southeast Asia is home to diverse renewable energy resources, with tremendous potential for development in most countries that are in different stages of renewable energy development. Indonesia and Thailand are early runners on the fast track of development in renewable energy. As the world's biggest archipelagic state with a distinctive tropical rainforest climate, Indonesia is naturally blessed with rich geothermal, wind, solar and hydro power and ranks the second in the installed capacity of geothermal power (Courtney Weatherby, 2019). The country also boasts considerable land availability and favorable resource conditions for building power stations. Malaysia, Philippines and Vietnam started early in renewable energy development with a focus on hydropower that is highly market-based and demonstrates an active momentum. Vietnam is rich in wind resources throughout the year with an average wind velocity of 7.3m/s and even 9–10m/s in coastal regions in the south, so it has vast potentials for wind power. Philippines, on the other hand, owns the world's third largest installed capacity of geothermal power and significant untapped reserves (Courtney Weatherby, 2019). Singapore, Brunei, Cambodia, Laos and Myanmar are trailing behind in renewable energy development due to constraints in historical background, geographical conditions, economic development and natural resources. Myanmar is endowed with abundant resources in hydro, wind and geothermal power with significant potentials for development. Progress is on track to feed renewable energy into the power grid, establish a corresponding power market and advance power system reform. Singapore and Brunei are highly developed economies with small population and territory and poor hydro, wind and geothermal power. However, with ample solar power resources, both countries may further explore and develop solar power projects and technologies.

Southeast Asian countries have set clear and positive goals in power development from renewable energy, providing policy support for renewable energy development. The APAEC 2016–2025 sets the goal of working towards a 23% share of renewable energy in total energy supply. Correspondingly, ASEAN member states have respectively defined their national targets (see Table 1–4) —Laos (59%), Philippines (41%), Indonesia (26%), Cambodia (35%), Myanmar (29%) and Thailand (24%) have developed more ambitious targets than ASEAN as a whole. As per information released by IRENA, in order to increase the share of renewable energy in primary energy mix to 23%, ASEAN needs to invest US$27 billion (i.e. 1% of GDP) annually in the next eight years. So strategy and target will be the key drivers of renewable energy development in Southeast Asia. In the current situation, when investing in power infrastructure in Southeast Asia, Chinese enterprises are motivated largely by the development needs and market opportunities of host countries. Hence, the adjustment and refinement of renewable power generation targets and supporting policies in Southeast Asian countries is extremely important for China's energy and power investment in the region.

Small policy risk and growing economic efficiency of renewable power generation will surely stimulate the further development of renewable energy. In light of economic viability, Southeast Asian countries are most likely to opt for fossil fuels with higher economic efficiency in the short run. However, with further depletion of coal resources and inclusion of carbon emissions into cost, both the cost of coal-fired power and the risk of stranded assets may be on the rise. Based on the latest IRENA report, except for solar power, LCOE of most renewable energies have fallen within the cost range of fossil fuels. Nevertheless, in the past five years, LCOE in solar power has declined by

65% in Southeast Asia (Figure 2–3) (IEA, 2019). The lower cost of renewable energy has made cheap electricity access possible, and will prove especially effective for regions highly dependent on diesel power or power grid extension at high cost.

Figure 2–2 LCOE in selected countries and regions, 2013–2018

Data source: IEA, Southeast Asia Energy Outlook 2019

Amid increasing urgency of global response to climate change, carbon constraints, financing gaps, investment environment, and water resource pressure put more and more coal power projects on the edge of early closure or construction shelving. The profit margin of coal power projects is shrinking. 42% of the global coal power capacity is already unprofitable, and with the implementation of carbon pricing, enhancement of environmental regulation and cost reduction of renewable power, more will face investment and economic risks in the future. Studies have shown that 56% of coal-fired power plants in the world will run at a loss by 2030 and over 70% by 2040. In the next two to five years, solar will have higher economic efficiency than coal in Southeast Asia, and wind will be more cost-effective than coal in some Southeast Asian areas (see Figure 2–4). Despite low initial investment, the sustainability and economic competitiveness of coal power in Southeast Asia will continue to fall in the entire life cycle. In comparison, with the decline in operation and maintenance costs, renewables will gain an economic advantage over coal throughout the life cycle.

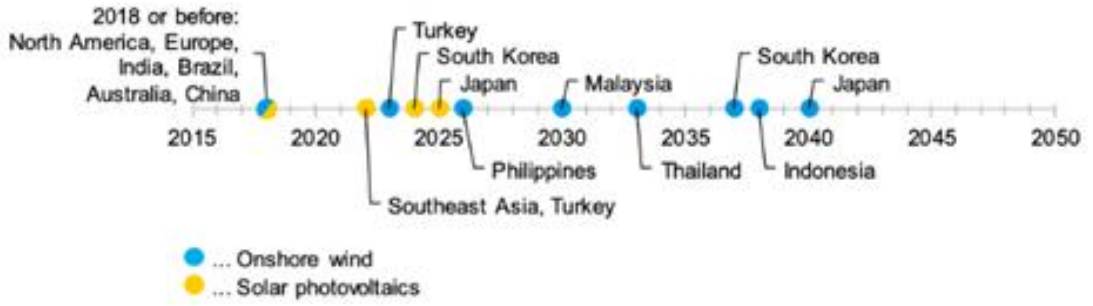

Figure 2–3 Time point when solar and wind power costs less than coal power of new-build generation

Data source: Bloomberg NEF

The development of green finance is pushing banks to withdraw funds from fossil energy and mobilize funds to renewable energy. With the rise and development of green finance around the globe, countries give more consideration to financial policies in promoting green and low-carbon economic and social transformation. In particular, propelled by tackling climate change and achieving SDGs by 2030, international agreements, national governments, multilateral development financial institutions, commercial banks, and industry giants have proposed policies, concrete measures or roadmaps (Greenovation Hub, 2019) to withdraw from coal power and coal-related operations in the energy and power sector, as well as climate finance support policies to stimulate capital flows to lower-carbon, green and climate-resilient industries.

With the further implementation of green development philosophy, the Chinese government and financial institutions are making active efforts to promote the green and inclusive development of the financial sector by building a green financial system. Major financial institutions that provide financial support for Chinese outbound investment, such as CDB, CEXIM, and ICBC, have established respective green credit policies and environmental and social risk management systems under the guidance of national regulations and policies, and gradually applied them to the investment and financing decision-making and supervision of overseas projects. Although public information about these policies is limited due to the lack of transparency, their annual social responsibility reports plus some interviews reveal that to keep pace with international trends, Chinese financial institutions are taking steps to incorporate key international issues such as climate change, energy transition and biodiversity conservation into investment policy and business, and to play a role in channeling capital into lower-carbon and green industries. Besides, CDB, CEXIM, and ICBC have all pledged in their public green credit strategic plans to actively support the development of renewable energy.

2.4.2 Challenges in power development associated with policies, funds, management systems, industrial chains, human resources and technological development

The power market management system in Southeast Asia is dominated by a vertically integrated model in the absence of market pricing mechanism. Other than Singapore and Philippines where market forces are dominant, the rest of Southeast Asia is yet to separate grids from power plants and operates the power sector in a vertically integrated fashion. The vertically integrated model is prone to monopoly, leading to poor economic efficiency. In some countries, the government still plays the principal role in power pricing due to the absence of market pricing mechanism. Besides, as the prospect for investment attraction is dampened by low marketization, the region seems unaffected by the record low price of renewable energy in the rest of the world.

In terms of policy support, energy plans in most Southeast Asian countries were formulated prior to the substantial decline in renewable energy prices, when governments were convinced that subsidies are the only viable solution for low-cost renewable energy. For example, in view of the soaring interest of investors in solar energy, the Cambodian government expressed in the middle of 2017 to include solar energy in the next version of energy plan, which the Master Energy Plan finalized in early 2017 did not. Thailand, Malaysia, Vietnam and Indonesia provide FiT subsidies for solar and wind power generation, but the FiT policy does not play its due role, due to the lack of clear supervision over licenses and terms of power purchase agreements for solar, wind and biomass technologies (Courtney Weatherby, 2019).

Energy and power policies and support mechanisms lack stability and consistency. With the rapid decline in the cost of renewable power generation, Southeast Asia sees the possibility of meeting its specific energy needs in a cost-effective and sustainable manner through policies and actions, which has led regional renewable energy development to a golden period. The latest Southeast Asia Energy Outlook shows that manufacturing industries related to renewable energy has begun to rise in Southeast Asia. For example, Malaysia has become the world's third largest producer of PV modules, and Thailand the main solar PV manufacturing base in the global market. Great energy demand and changing supply and demand relationship poses many challenges for policy formulation and adjustment in various countries. Frequent changes in policies supporting power development in Southeast Asia add financial and policy risks for foreign investors. Poor policy continuity and enforceability undermines to some extent the investment attraction of renewable power generation projects in Southeast Asia.

In recent years, Southeast Asian countries have rolled out supporting policies such as tariff, land, FiT, and green finance, in an active effort to establish and improve the environment for foreign investment and encourage the development of power industries. However, due to inadequate capability of overall planning and insufficient assessment of policy-related market changes, these policies are not yet well implemented and are subject to frequent changes. The lack of policy consistency, continuity and stability has gravely dampened the confidence of foreign investors and the investment attraction of local power industries. For example, in order to encourage investment in solar power projects, the Vietnamese government issued in April 2017 the *Decision on Mechanisms for Encouragement of Solar Power Development*, stipulating the purchase of electricity generated by solar power projects at a guaranteed price of US$0.0935/kWh. This policy resulted in

serious overcapacity as about 4.5 GW installed capacity of solar power projects was put into operation in July 2017, exceeding the 2020 target of 850 MW outlined in the *National Power Development Plan VII*. In November 2019, the Vietnamese government withdrew this policy and changed the FiT policy in favor of auction. Because of such policy adjustments, solar PV project investors that have been mobilized by the previous policy may suffer financial and economic losses, where they fail to sign, in a timely manner, a power purchase agreement with Vietnam Electricity.

In addition, unstable regional energy prices and frequent policy changes make it extremely challenging to establish appropriate policy support mechanisms. In some Southeast Asian nations, the FiT scheme is not well applied, more often than not with design flaws and benchmark policy changes after it is published. Changes in competent government agencies and instabilities of power market structure form the main barriers to the successful operation of policy support mechanisms. Another impediment to smooth policy implementation is the unavailability of guides in English as most Southeast Asian countries have issued policies and support mechanisms in local languages only, despite the significant rise of foreign investment in local energy and power markets. Some new problems and obstacles have emerged in the development of Southeast Asian power infrastructure, arising from the successful implementation of policy supporting mechanisms focusing on LCOE with cost consistency of regional renewable energy power plants in Thailand and Malaysia. The sensitivity analysis of power generation technologies indicates that changes in construction costs noticeably affect LCOE calculations. Factors that influence project construction costs, such as finance and tax, energy, land cost, tariff, other subsidies, or technological improvements, all have impacts on LCOE and internal rate of return, though the degree varies in countries, depending on the level of economic and social development.

In short, the common problems encountered in the FiT policy implementation in Southeast Asian countries include: 1) Certain power generation technologies are not attractive for investment due to frequent policy changes or low initial incentives; 2) Power purchase agreements and approvals are unclear, and procedures for permits are complicated; 3) Installed overcapacity of a few attractive renewable energies results from policy adjustments in response to surging applications; 4) Guidelines for the interconnection of renewable energy power plants are not clear; 5) Power purchase agreements are hardly accessible, with performance risks.

Challenges also arise from inadequate safeguard measures, complicated and time-consuming procedures, difficulties of coordination among government departments, and inadequate public awareness. Foreign investment in renewable power generation projects in Southeast Asia is dampened by imperfect laws and regulations, restricted safeguard policies, complicated and time-consuming procedures, and inter-department coordination difficulties. For example, Brunei and Laos's renewable energy policy frameworks are still very imperfect, and severe bureaucracy has greatly hindered the approval of renewable power generation projects. In Indonesia, PLN monopolizes power transmission, distribution and operation, and secures a dominant position in the local power market, which discourages other potential investors.

In addition, weak public support and public awareness affect to some extent the development of renewable energy in Southeast Asia. In ASEAN member states, the public is not aware of the

environmental and social benefits that can be bought by renewable energy, such as job creation, air pollution mitigation, and response to climate change.

There are shortfalls of R&D investments, financing channels and top-notch professionals, as well as appropriate industrial foundation. Capital acquisition and financing channels are crucial for renewable power generation projects that fall into capital-intensive industries in Southeast Asia. ASEAN member states such as Malaysia, Indonesia, and Vietnam also lack the experience and expertise in risk assessment of renewable energy investments. Inadequate access to financial support and financing channels, including public financial support, will greatly undermine the investment attraction of renewable energy.

Geographical factors and technical conditions are also one of the challenges facing renewable energy development in Southeast Asia. For example, due to geographic factors, Indonesia and Philippines are unable to build a relatively unified large power grid, leading to technical obstacles to the grid integration of renewable energy. At the same time, due to landform and environmental factors, as well as policy deficiencies, investment in large-scale renewable energy projects in the region is likely to trigger many social problems associated with land acquisition and related environmental impacts. In addition, the industrial foundation for renewable power generation is not yet well established, and human resources with relevant knowledge and skills are in short, both restricting the rapid uptake of renewable energy as sources of power generation. Affected by short development history and weak industrial foundation of renewable energy technologies, renewable-energy power plants and equipment manufacturers fall short in Southeast Asia except for a few countries, and so do skilled workers and especially senior production and management talents despite rich labor resources, which hinders the development of renewable energy.

Grid infrastructure is too underdeveloped to meet the impacts and challenges brought by large-scale connection of renewable energy. Except such developed economies as Singapore and Brunei and relatively developed Malaysia, other Southeast Asian countries are hindered by underdeveloped grid infrastructure, especially for the four newcomers of ASEAN, namely Cambodia, Laos, Myanmar and Vietnam whose grid infrastructures are severely compromised. The electricity accessibility is only 61% in Cambodia and 56% in Myanmar.

The intermittence, randomness and instability of wind and solar will result in fluctuations of voltage, current and frequency of the grid after massive connection of wind and PV power plants to the grid, thus affecting the quality of power. In order to mitigate the negative impact, grid operators need to leave some spinning reserve capacity, which would increase the operational cost and place indirect constraints on new energy development. Currently, most Southeast Asian countries are hobbled by poor grid structure, few high-voltage lines and deficient cross-border grid interconnectivity. Besides, the scale of pumped-storage hydropower stations with high adjustability in the region is rather limited with inadequate peak-shaving capacity, which, in some measure, has impeded the development of renewable energy.

Although the cost of power generation has declined sharply, renewable energy is still less competitive than fossil fuels in this regard in the short term. In the past five years, LCOE has declined to varying degrees in renewable energy in Southeast Asia. In particular, LCOE of PV power

slid enormously, down by 42% to 52% in Indonesia, Thailand and Vietnam where LCOE of onshore wind power also decreased by 16% to 43% during the same period (Figures 2–6 and 2–7).

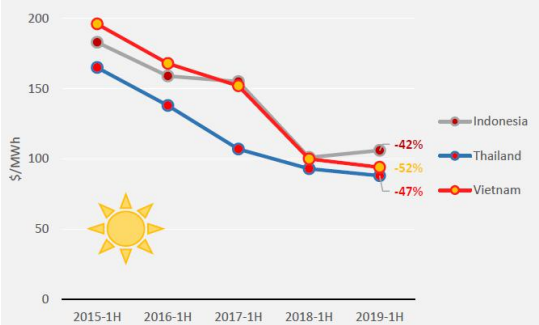

Figure 2–6 LCOE changes in PV power in Indonesia, Thailand and Vietnam (H1 2015—H2 2019)

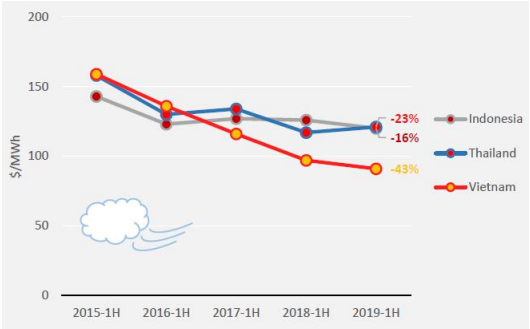

Figure 2–7 LCOE changes in onshore wind power in Indonesia, Thailand and Vietnam (H1 2015—H2 2019)

Data source: Romain Zissler. Renewable Energy to Replace Coal Power in Southeast Asia

Despite lowered cost, power derived from renewable energy is still more expensive than coal power. LCOE analysis was conducted on coal power and renewable energy in the five countries of Indonesia, Malaysia, Philippines, Thailand and Vietnam. Apparently, the LCOE of PV, onshore wind, geothermal, biomass, small hydro power, and CCGT is generally higher than that of coal power, as shown in Figure 2–8. At the project level, most competitive projects of five renewable energy sources (PV, onshore wind, geothermal, biomass and small hydro power) were selected from several Southeast Asian countries (Indonesia, Malaysia, Philippines, Thailand and Vietnam) to compare with the most competitive coal power projects. Results showed that the cost advantage of power from renewable energy is only reflected in small hydro power projects (in Thailand and Vietnam) with LCOE significantly lower than that of coal power (US$25–35/MWh) and some geothermal power projects (in Thailand and Indonesia) with LCOE slightly lower than that of coal power. LCOE of biomass, onshore wind and PV power remain generally higher than that of coal power. Economic viability and profitability are important factors of investment presence and preference in Southeast Asia. The vision of safe, accessible, affordable and sustainable energy system with low-cost renewable energy is hardly achievable before the cost of power from renewable energy is reduced to a range absolutely competitive with that of coal power.

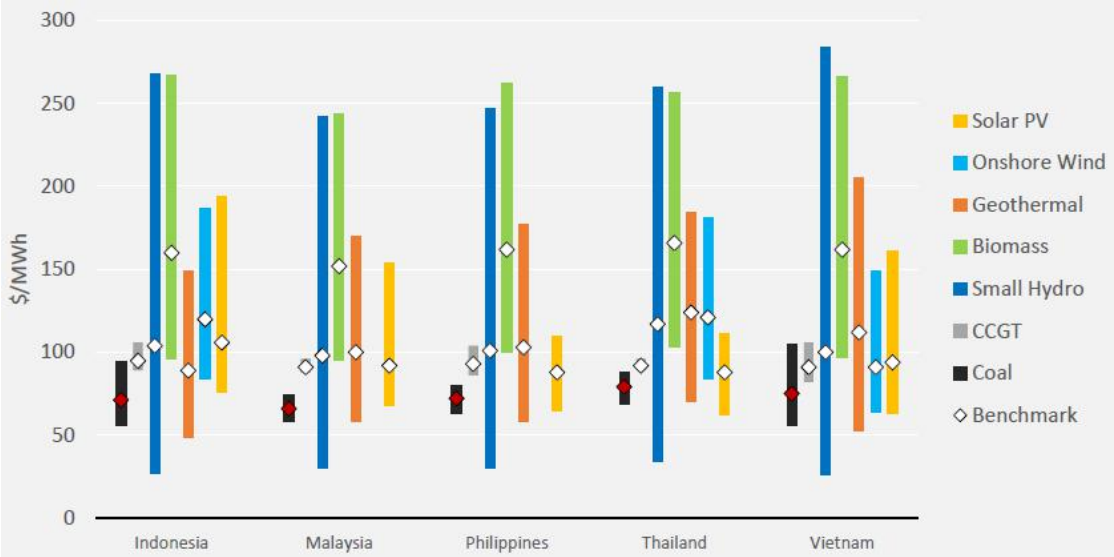

Figure 2–8 LCOE of power technologies in some Southeast Asian countries (H1 2019)

Data source: Romain Zissler, Renewable Energy to Replace Coal Power in Southeast Asia

2.5 Broad prospects for green energy cooperation between China and Southeast Asia

China-ASEAN cooperation mechanism has played an important role in cooperation between the two sides since established in 1997. With the economic and social development of both sides, environmental protection has become an important dimension of the mechanism. Important documents on China-ASEAN environmental cooperation include *China-ASEAN Environmental Cooperation Strategy (2016–2020)* adopted in February 2017, *China-ASEAN Environmental Cooperation Action Plan (2011–2013)* and *China-ASEAN Environmental Cooperation Strategy (2009–2015)* adopted in December 2011, and *China-ASEAN Strategic Partnership Vision 2030* adopted in November 2018. Among them, the Vision proposes to deepen financial cooperation, including through active involvement of financial institutions to support infrastructure development in the region; recognizes the importance of measures to boost clean energy development under the new ASEAN-China Clean Energy Capacity Building Program and the Study on Clean Coal Utilization Roadmap in ASEAN; and emphasizes the need to strengthen cooperation in environmental protection, water resources management, sustainable development, and climate change.

Facing common environmental and development challenges, China and ASEAN have carried out green infrastructure, environmental and climate cooperation under various bilateral and multilateral mechanisms. China and Southeast Asia have experienced similar development processes and face many common environmental and development challenges. For example, in the context of globalization, regional industrial structure is prone to environmental risks; urbanization and industrialization intensify environmental pressure; regional production and consumption patterns need improvements; and global environmental issues aggravate regional environmental, climate and energy risks. In view of the *ASEAN Economic Community Blueprint*, combined with the common areas with China-ASEAN environmental cooperation, the key areas of future cooperation will be biodiversity conservation, environmental management capacity building, global

environmental issues, and environmental products and services. With the continuous development of China's trade cooperation with Southeast Asia, cooperation between China's provinces and cities and Southeast Asian countries and sub-regional economic cooperation in various forms have also advanced continuously. China, together with Cambodia, Laos, Myanmar, Thailand and Vietnam, launched the Lancang-Mekong cooperation mechanism in 2016 to expand cooperation in five areas: connectivity, production capacity, cross-border economy, water resources, agriculture, and poverty reduction. China has also maintained good bilateral relations with the Eastern ASEAN Growth Area composed of parts of Brunei, Malaysia, Indonesia, and Philippine, as well as close cooperation in the fields of agriculture, energy and fishery infrastructure construction. The China-ASEAN Investment Cooperation Fund (CAF)[9] with a scale of US$10 billion was created and put into operation in April 2010, which through rational operations and policy guidance, can mobilize more social capital into China-ASEAN green power infrastructure cooperation to fill the funding gap for greening Southeast Asian power infrastructure.

China and ASEAN have obvious complementary advantages in energy and power cooperation. As per the *Joint Statement Commemorating the 10th Anniversary of the China-ASEAN Strategic Partnership*, announced by the leaders of China and ASEAN member states in 2019, the two sides would strengthen cooperation in the energy field and formulate an action plan for China-ASEAN cooperation on new energy and renewable energy. China and ASEAN have aligned green energy and power strategic planning and policy through various multilateral and bilateral cooperation mechanisms. At the same time, the two sides have extremely obvious complementary advantages in renewable energy and energy efficiency. Driven by the market and business opportunities, Chinese-funded enterprises have made various attempts of investments in Southeast Asian power infrastructure ahead of policy planning, and acquired considerable market share and investment and operation experience. Huge space remains for cooperation between the two sides in related fields, created by rich resources of new energy and renewable energy in Southeast Asian countries and high demands on foreign investment to make up for financial shortfall. The cooperation in policy and market can be carried out in stages through regional master plan and specific country cooperation, and on the basis of exchanges and dialogues, regular adjustments and updates will be made to adapt to different policies and market environments.

[9] Initiated by CEXIM, CAF is committed to promoting economic cooperation and development between China and Southeast Asian countries through investment in target industries in the fields of infrastructure, energy and natural resources. It has so far completed nine investments in Cambodia, Laos, Malaysia, Philippines, Singapore, Thailand and Indonesia, covering transportation, electricity, renewable energy, public utilities, telecommunications, pipeline and storage & transportation, public welfare facilities, minerals, oil, natural gas, and forests.

Chapter 3 Recommendations

3.1 Recommendations for promoting the sustainable development of power infrastructure in Southeast Asia

The connection between economic growth and energy demand has been a complex issue for both policymakers and investors. In light of the influx of foreign investment, Southeast Asian governments need to carefully consider creating a favorable investment environment to leverage foreign investment to boost economic and social development without compromising their goals of climate change and green energy transition.

Regional top-level planning under the APAEC framework is one of the effective options for sustainable power development in Southeast Asia. Effectively addressing the obstacles and challenges currently faced by renewable power generation in the region is of critical importance in advancing policies and creating supporting mechanisms for renewable energy in ASEAN member states. It directly determines the mid- and long-term investment attraction of renewable power infrastructure, and the progress towards the goal of meeting the growing demand for energy and electricity in a safe, affordable and sustainable manner. Therefore, ASEAN member states should formulate appropriate and systematic renewable energy development plans and specific measures with incentives based on scientific evaluation. Top-level regional planning can serve as an effective solution, especially to addressing weak and relatively underdeveloped grid.

If APAEC, as a top-level planning instrument for Southeast Asia, could include corresponding measures in its second phase to resolve the main obstacles currently faced, ASEAN member states would be more likely to achieve sustainable energy development and electricity access targets. The success of green energy and power reform will depend in large parts on the willingness of government departments of ASEAN member states. As long as that they still use coal subsidies, tax exemptions, preferential guarantees and other policies to lower the costs of coal power, governments of ASEAN member states will continue to play a key role.

Think tanks, platforms and networks should be brought into full play to promote experience and knowledge sharing within and outside Southeast Asia, and specific solutions suitable for national sustainable energy and power development should be formulated based on regional planning. As a regional energy think tank, the ASEAN Centre for Energy (ACE) has conducted research on the status quo and future impacts of regional sustainable energy development. Entrusted by member states, ACE mainly acts as a catalyst, think tank and policy advisor, and directly proposes solutions for current regional energy development. The varied domestic power systems of member states make it impossible to directly convert energy and power plans among these countries. Problems alike can be solved through ACE by studying and formulating regional renewable energy development plan. Exchanges and dialogues, technology transfer, and experience sharing on the ACE platform can also create more opportunities for member states to work out solutions for their own energy development. These could not only help member states formulate implementable policies and supporting mechanisms, but also promote the stable development of their policies. Besides, the associated increased information disclosure of energy development will enhance foreign investors' understanding of regional energy and power development plans and trends and

the public awareness of regional energy security vulnerability

In order to leverage and broaden green financing funds and channels, ASEAN and its member states can use platforms such as the Central Banks and Supervisors Network for Greening the Financial System to exchange policies and experiences on green finance with domestic and foreign financial regulators and banks. This will help them improve domestic green and low-carbon policies and green financial support, mobilize domestic and foreign capital to support lower-carbon, green and renewable power infrastructure, and make investment in renewable power generation more attractive, effective and marketized.

ASEAN Member States should further improve the domestic investment environment and adopt more effective policies that support renewable power generation. For the purpose of attracting foreign investors that solve domestic funding gaps in energy and power development, Southeast Asian countries are working hard to advance the formulation and implementation of foreign investment policies, renewable energy FiT policies and other preferential policies. However, problems such as unpredictability and instability of policies have arisen due to insufficient policy impact assessments, which undermines the investment attraction of local power infrastructure. Based on experience sharing and overall planning, research and analysis of country-specific conditions should be conducted with regional and international support to promote more reasonable and effective policies and measures, including foreign investment regulations and preferential policies, and renewable energy FiT policies and related supporting measures.

Apart from Member State governments, ACE and other regional stakeholders, international support is also very important for Southeast Asia for its sustainable energy development. With the rapid development of renewable energy, international investors have gradually realized that they should enrich their investment portfolios and channel more funds to renewable energy with less financial and policy risks, instead of focusing on fossil energy such as coal, in order to avoid stranded assets and resultant financial losses. Hence, ASEAN member states should step up extensive exchanges and cooperation with international investors, strengthen information disclosure and transparency, and establish an integrated network and service platform that help international investors better understand the local situation, including power infrastructure investment, investment approval procedures, financing services, environmental regulation and supervision, green development strategies, and green finance.

3.2 Recommendations for China's engagement in low-carbon transformation of power infrastructure in Southeast Asia

The Chinese government should ponder environment and climate impact as crucial factors in revising overseas investment policies. In environment management of foreign investment projects, China, by and large, adopts the standards of target countries, and recommends Chinese standards or international practices only when host countries lack relevant laws and regulations. Most host countries lack full-fledged environment management frameworks with sufficient environmental protection standards. This has prompted a string of low carbon projects in developing countries, giving rise to massive GHG emissions and environmental pollution and triggering the risk of locking developing countries in high-carbon development trajectory. Therefore, the Chinese government

should make environmental protection and climate factor mandatory requirements for foreign aid in overseas investment policies. It should draw up a negative list for overseas investment, and restrict high carbon lock-in projects such as coal power, encourage low-carbon investment, implement green Belt and Road, and advance the win-win strategy of opening up. At the same time, China should incorporate environmental and social issues of global concern such as environment, climate, and sustainable development into its foreign investment policies and with concrete measures. Public and private capital will be thus guided to actively identify and manage various risks in the process of foreign cooperation and avoid financial, economic and reputation losses that may be caused thereby. In turn, this will be conducive to establishing China's image as a responsible large country and driving the high-quality and sustainable development of China's foreign investment.

China should enhance its strategic cooperation with Southeast Asian countries to provide technical and funding support to the roadmap of local renewable energy development. Most of Southeast Asian Countries are in the relative early stages of industrialization with a fairly high demand for rapid increase in electricity supply to serve social and economic development. Before renewable energy can fully compete with fossil fuels in costs, Southeast Asian Countries might be inclined to deploy low-cost fossil fuel power generation projects with readily accessible resources to pursue their electricity access targets. Some countries have recognized the benefits of clean power, but their limitations in planning, funding and technical capacities render it unlikely to drive the transformation of energy systems in a systematic and efficient manner. As the world's largest producer of renewable energy equipment, China boasts extensive expertise in low-carbon transformation of energy system, while Southeast Asian countries, as developing countries, face similar challenges arising. China should carry out in-depth cooperation with host countries in strategic planning, leverage multi-level governmental dialogues in energy and electricity macro-level planning, and foster policy exchanges and cooperation with Southeast Asian countries in terms of clean energy and power. Research on cooperation should be strengthened to jointly promote technological advancement and reduce the cost of clean energy development. The varied existing platforms should be fully harnessed to share China’s experience in clean energy development, deploy appropriate technologies, and help Southeast Asian countries navigate the path toward clean power.

In addition, China should recognize the importance of foreign aid in promoting local overall planning and mobilizing funds in its strategic cooperation with host countries. When selecting and determining the top-level design, organizational structure and system construction, as well as specific cooperation directions of foreign aid, the specific development needs and existing problems of different regions and host countries should be taken into account; technical assistance should be provided to help regions and host countries improve their capabilities of strategic planning and sectoral deployment; and domestic and foreign public funds and private capital should be leveraged to provide financial support for local green low-carbon transition and sustainable development.

Chinese businesses should prioritize environmental and social impact assessment of overseas investment projects and secure sustainability of local economy, society and environment.

Financial institutions and enterprises serve as the mainstay of China's foreign investment. Enterprises should actively establish and implement environmental and social risk management systems under the guidance of Chinese national green bonds policies and foreign investment laws and regulations, in order to effectively manage potential policy, environmental, social, financial, reputational and stranded asset risks in foreign investments. In particular, financial institutions that provide financial support to enterprises should actively improve green credits and environmental risk management policies, and identify and evaluate potential risks after studying and analyzing the specific conditions of investment destinations. In line with international and local policies and regulations, environmental, climate and sustainability issues and problems of concern to the international community and host countries should be reflected in the specific investment strategies. While avoiding their own risks, they should supervise the environmental and social behavior and performance of their whole value chain, including clients and projects and make sure they support the realization of host countries' SDGs.

Chinese enterprises primarily adopt the EPC model for power infrastructure projects in Southeast Asia, and are therefore unlikely to empower local capacities relative to labor force and sectoral value chains, etc. Apart from investment income, Chinese investors should be more conscious of the impact on the sustainability of local economy, society and environment, operate locally with more local headcounts, and actively participate in public welfare activities. It is important to conduct systematic assessment prior to, during and after projects, examine the pros and cons for the macro economy, job creation and the ecological environment, and make efforts to minimize negative impacts and fulfill social responsibilities.

Both Chinese government and businesses should appreciate and boost conversations and exchanges with investment recipients. It is crucial to reinforce communication and dialogue with Southeast Asian countries at the central and local levels by harnessing bilateral and multilateral platforms, including Clean Energy Forum of East Asia Summit and the Greater Mekong Sub-regional Energy Cooperation, maximize China's strength in clean power technology, industrial green transformation and expert pool to offer more technical assistance, professional training and project demonstration, etc.

Chinese financial institutions and businesses need to establish communication and coordination mechanisms and channels, and step up cross-cultural exchanges with local communities. Communication should be conducted in a way that can be understood and accepted by and with the local public, communities, social organizations, and media outlets. Especially when there are potential or negative impacts on the local environment and society, open channels should be available for stakeholders to complain, and solutions should be jointly discussed to avoid greater social disputes that may lead to project suspension or shelving. Enterprises should better explain their contributions to local social and economic development, in an effort to gain understanding and support from all actors. It is also necessary to stay alert to public opinion risks and make prompt media announcements and clarifications on any misunderstandings regarding the enterprises.

China and Southeast Asia should actively carry out cooperation in green finance to provide

financial guarantee and support for green transformation of power infrastructure in host countries. As noted by the report jointly released by the Economist Corporate Network and Baker McKenzie in March 2020, sustainability has become the core issue of the Belt and Road Initiative. When sustainability is put high on the agenda of the initiative, the scale of available funds will be expanded. Research concluded that under the Belt and Road Initiative, transportation, telecommunications, utilities, digital infrastructure, renewable and clean energy represent the areas with the largest development potential and the highest engagement of private enterprises. These five areas are able to attract more and more sustainable funds, with sustainability most clearly reflected in renewable and clean energy. Green finance, which focuses on mobilization of public and private capital towards more inclusive, sustainable and green industries, has emerged as an increasingly important breakthrough point for green Belt and Road Initiative. Last year, China, in partnership with the City of London Corporation's Green Finance Initiative, formulated the *Green Investment Principles for the Belt and Road Initiative*, calling on lenders, investors and companies involved to ensure their projects meet the requirements of environmental sustainability and the Paris Agreement under the United Nations.

China should work with host country governments to continuously and actively build the Belt and Road green financing system. Relevant policies should take into account the unique role of foreign aid funds (in forms such as grants, interest-free loans, preferential loans), and facilitate the organic integration of aids into high-quality infrastructure financing, so as to give play to its mobilizing role in the construction of climate-resilient, low-carbon and environmentally-friendly infrastructure in the Belt and Road. CEXIM, CDB, and commercial banks should actively play an intermediary role, formulate clear green credit investment strategies, use their financial leverage to spur the improvement of environmental performance of their corporate clients, establish environmental and social risk response mechanisms, and strengthen environmental and climate information disclosure and transparency.

Appendix 1 Case Study-Indonesia

Indonesia is an archipelago comprising more than 17,000 islands, with its territory covering an area of 1.9 million square kilometers, comparable to one fifth of China or the U.S. At 267 million in 2018, the Indonesian population ranks 4th worldwide, and it is the most populous nation in Southeast Asia. Its Gross National Product (GNP) hit 1.04 trillion US dollars in 2018, the highest in Southeast Asia, with an annual growth rate of 5.8%.

- **Despite the sustained rapid increase in power supply in Indonesia, the per capita power usage is still fairly low.**

Recent years have witnessed dramatic improvement in electricity access in Indonesia. The total installed electricity capacity has grown from 46,613 MW in 2013 to 56,510 MW in 2018, with an average growth of 4.1% per year. Electricity generation climbed from 216,189 GWh in 2013 to 267,085 GWh in 2018, up 4.93% year-on-year. With expanding power supply, electrification in Indonesia has been continuously improved, up from 78% in 2013 to 97% in 2018, reducing the number of people without electricity supply from 54 million in 2013 to 8 million in 2018. But it's noteworthy that the country's electricity access is unevenly distributed, with nearly 100% in the western region and only 59.85% in the southeastern region (PWC,2018).

Between 2013 and 2018, total electricity consumption grew from 187.5 TWh to 234.6 TWh, up 5.1% year-on-year. The household sector consumed the largest share of electricity, followed by industry, business and public service with shares at 42%, 33%, 18% and 6% respectively. But the per capita power use was relatively low, at only 888 kWh per person in 2018, which was way below world average, and even a far cry from the average in Southeast Asia (1,507 kWh per person in 2015).

- **Renewable energy-based power generation has increased, but fossil fuels predominate the generation mix and will continue to be so in the medium and long term.**

Between 2010 and 2017, power produced from fossil fuels accounted for 85%-90%, in which oil saw a steady decline from 22% to 5.81%, gas remained stable and coal climbed from 38% to 57.22% (PWC, 2018) (Figure 1-1). Fossil fuels, especially coal, are of vital importance in the power industry in Indonesia, which boasts rich coal resources with a reserve-to-production ratio of 61 years. In terms of coal-fired power generation technologies (Table 1-1), though subcritical technology is still in use, large and new power plants primarily use super critical or ultra-super critical technologies that are more efficient.

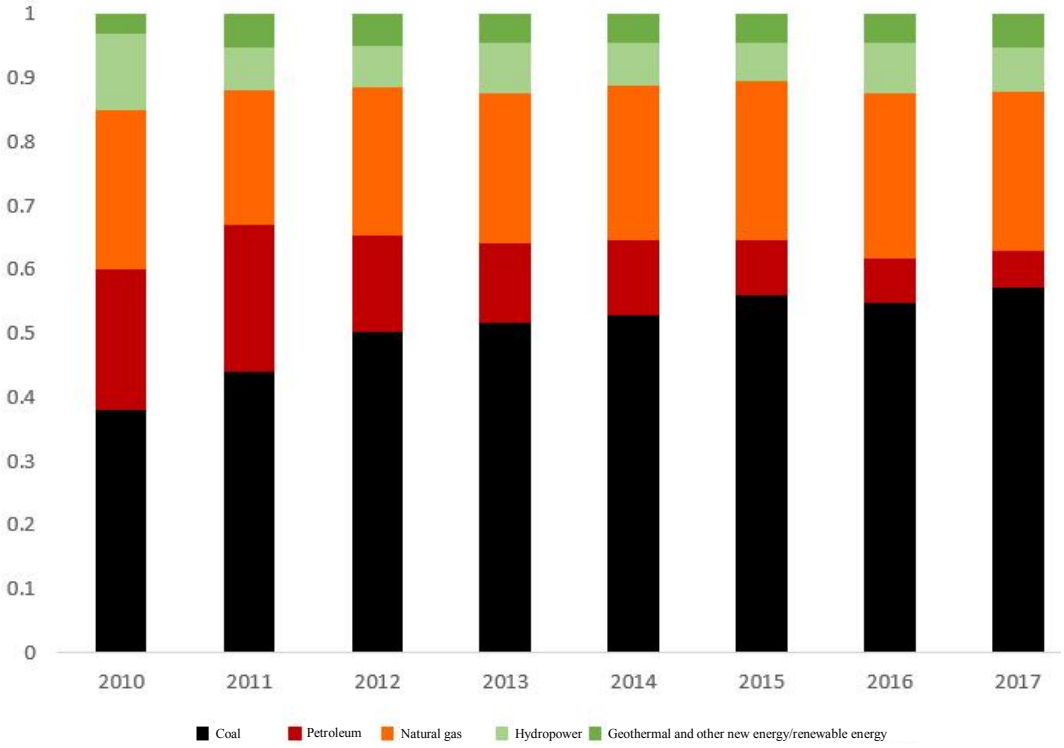

Figure 1-1. Share of Electricity Generation by Energy Technology

Data Source: PWC, Power in Indonesia: Investment and Taxation Guide

From 2010 to 2017, the share of hydropower in generation mix dropped from 12% to 7.06%, while other renewable energy except hydropower saw their proportion grow from 3% to 5.09%. As a whole, the share of renewable energy power generation fell from 15% to 12.5%. This shows the low share of renewables in generation mix, with an increase rate lower than that of fossil fuels.

Table 1-1. Main Technologies of Coal Power Plants in Indonesia

	Coal Power Plants	Province	Installed Capacity	Date of Business Operation
	Subcritical Technology			
1.	PLTU* Paiton, Unit 1	East Java	815 MW	2012
2.	PLTU Tanjung Kasam, Units 1-2	Riau Archipelago	2 x 55 MW	2012
3.	PLTU Sumsel 5, Units 1-2	South Sumatra	2 x 150 MW	2015
4.	PLTU Kalteng 1, Units 1-2	Central Kalimantan	2 x 100 MW	2019
5.	PLTU Tanjung Power, Tabalong	South Kalimantan	2 x 100 MW	2019
	Super Critical Technology			
1.	PLTU Cirebon, Unit 1	West Java	660 MW	2012
2.	PLTU Banten Serang, Unit 1	Banten	660 MW	2017

3.	PLTU Cilacap Sumber, Unit 3	Central Java	660 MW	2019
4.	PLTU Bangko Tengah/Sumsel 8, Units 1-2	South Sumatra	2 x 620 MW	2021
5.	PLTU Indramayu, Units 4-5， PLN[10]	West Java	2 x 1000 MW	2021
	Ultra-Super Critical Technology			
1.	PLTU Celukan Bawang, Units 1, 2 and 3	Bali	3x142 MW	2015
2.	PLTU Lontar, Unit 4	Banten	315 MW	2019
3.	PLTU Jawa 7, Units 1-2	Banten	2 x 1000 MW	2019
4.	PLTU Batang Jawa Tengah, Units 1-2	Central Java	2 x 1000 MW	2020
5.	PLTU Tanjung Jati B2, Units 5-6	Central Java	2x1000 MW	2021

[Note: * PLTU= Pusat Listrik Tenaga Uap (steam coal-fired power plant)]

Indonesia's plan for new electricity generation capacity from 2020 to 2028 (Table 1-2) indicates that fossil fuel will decline in its share of new power generation capacity to 70%, but coal will remain high at 48%. The share of renewables will increase to 30%. This points to the irreversible importance of coal in the short term in the country, but renewables also enjoy big potential. Indonesia's electricity supply systems are not integrated into one interconnected system due to its archipelagic nature. To attain the 100% power supply goal, promoting distributed renewable energy power system and storage technology is one of the viable solutions.

Table 1-2. New Power Generation Capacity Planned for 2020-2028 (MW/Year)

Power Generation	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	Total	%
Coal	1,569	6,047	3,641	2,780	4,590	3,090	1,184	1,695	1,375	1,093	27,064	48
Natural gas	1,592	3,073	1,011	3,155	1,535	845	40	280	400	485	12,416	22
Diesel	138	8	2	3	47	3	-	-	-	-	201	0.36
Fossil fuel	3,299	9,128	4,654	5,938	6,172	3,938	1,224	1,975	1,775	1,578	39,681	70.36
Renewables	559	932	1,697	1,501	1,065	2,287	6,252	199	648	1,574	16,714	29.64
Total	3,858	10,060	6,351	7,439	7,237	6,225	7,476	2,174	2,423	3,152	56,395	100

To promote electricity access and renewable energy development, the Indonesian government has formulated a power plan and rolled out a range of policies. Government Regulation 79/2014

regarding National Energy Policy stipulates the following electricity targets: Close to 100% electrification ratio by 2020； per capita electricity consumption of 2,500 kWh by 2025 and 7,000 kWh by 2050； installed capacity of 115 GW by 2025 and 430 GW by 2050. In 2019, the Indonesian government unveiled the target of renewable energy development: by 2025, power generated by renewables should reach 24.074 million kW, or 23% of total generation in the country. The government has a plan to increase the generation from renewables to 10.335 million kW by the end of 2019, 11.256 million kW by 2020 and 17.421 million kW by 2024. It's estimated that the 2025 target will entail an investment of 36.95 billion US dollars (Wang Yingbin, 2019).

- Government Regulation 79/2014, replacing Presidential Regulation 5/2006, on National Energy Policy, setting renewable energy target of 23% by 2025 and 31% by 2050.
- Ministerial Regulation 50/2017 stipulates the mechanism and pricing of renewable electricity purchase by PLN. Mechanism: Build, Own, Operate and Transfer (BOOT). Pricing: 85% of local average generation cost (BPP) for PV power, wind power, biomass power, biogas power, ocean power, and 100% of the local BPP for hydro power, waste-based power and geothermal power.
- Presidential Regulation 35/2018 on the acceleration of waste-based power development in 12 major cities in Indonesia.
- Ministerial Regulation 41/2018 on biodiesel financing for palm oil businesses.
- Ministerial Regulation 49/2018 on Rooftop PV.

Challenges for low-carbon transformation of power sector in Indonesia

The abundant reserves and lower prices of fossil fuels make it hard for Indonesia to free itself from fossil fuels for power generation in the short term. Coal resources are available in Indonesia with a high reserve. Annual new coal power station installation is expected to peak in 2020-2023 and then slow down to 2028, though the new installed capacity of coal power in 2019-2028 will still be the largest in proportion, at 48%. Gas resources are available in Indonesia with a reserve to production ratio of 49 years. New gas-based installed capacity is scheduled to peak by 2022, and in 2019-2028, the new capacity is projected to reach 12,416 MW, accounting for 22%. Since turning into a net oil importer in 2003, Indonesia has reduced the use of oil in power generation. Diesel generation is reserved for areas where other options are not available or only for stand-by operation to brace for emergencies.

Renewable energy-based generation has great potential, but the cost is high and it is not attractive enough to investors. According to the National Energy Master Plan of Indonesia, despite the tremendous potential for investment in renewables-based generation in the country (Table 1-3), utilization of renewables for power generation is still low, at less than 1% of its potential. Renewable resources with relatively high capacity such as geothermal and hydro energy are very site specific, thus only possible to be developed in certain provinces. But other than that, the higher cost of renewables compared to fossil fuel is the main reason. The construction/investment cost of

renewable energy power generation is generally higher than that of fossil fuels, and renewables-based generation shows no obvious advantage in operation cost either.

Table 1-3 National Energy Master Plan of Indonesia

Renewable Power	Potential (GW)
Geothermal energy	29.5
2. Hydro	75.1
3. Mini & micro hydro	19.4
4. Bioenergy	32.7
5. Solar energy	207.9
6. Wind energy	60.6
7. Ocean energy	18.0
Total	**443.2**

Besides a higher investment cost compared to fossil fuel, renewables are not appealing to investors for some other reasons. 1) Renewable energy pricing is not competitive. The power purchase price by PLN at 85% of BPP is considered not attractive as developers may be unable to recover their investments and make a reasonable profit. Such pricing is seen as placing renewables at an unfavorable position of being unsubsidized while competing with subsidized coal electricity; 2) Renewable energy subsidy is unclear. Appropriate subsidy makes investment more appealing in renewable energy power generation. But now Indonesia lacks clarity on renewable subsidy for the buyer.

Systems and policies on renewables are incomplete and defective, and the development of renewables would hurt invested interest. First, the policy lacks consistency and adequacy. Frequent policy changes undermine investor confidence and increase project development risk, and the inadequate policy makes it difficult to increase the proportion of renewables in power generation, a case in point being the Ministerial Regulation 13/2019 on Rooftop PV. While the Government argued that the policy will allow PV owners to save 30% of energy bill, other voices said the 65% scaling of energy outflow to the grid is deemed to discourage public willingness to invest in PV. Second, it takes complicated procedures to acquire land use permit. Take geothermal power development for example. Geothermal resources are often located in a protected forest or conservation forest, making it complicated to obtain development permit. Third, certain system and policy are absent.

Also, in the power market, the producer is the power generator that is limited in number with high industry entry barrier. Generators based on coal and other conventional fossil fuels have long been established in the market, and their interests would be impaired if renewables get a big boost. In Indonesia, the state firm PLN is deemed as having monopoly. Given its high uptake of coal power in

electricity portfolio, the company would spare no effort to maintain the status quo and avoid stranded assets of coal. Furthermore, it would prioritize grid stability and curb the size of renewables connected to the grid.

Indonesia is seeing a large funding gap for its power infrastructure and needs to attract foreign investors as soon as possible, which are, however, mainly investing in coal power in Indonesia. To attract foreign investment, Indonesia has made efforts to increase its attractiveness by introducing policies and regulations and by improving its investment environment in recent years. The regulations related to foreign investment issued by the Government are as follows:

- Law 25/2007 on Investment states the importance of both domestic and foreign investments to support national development. It regulates the type of businesses that are open to foreign investment, employment, rights and responsibilities, facilities (tax and fiscal incentives, import license, immigration), etc.
- Ministerial Regulation 35/2014 on the delegation of authority to produce electricity business permit from ESDM to the BKPM, to simplify the process of acquiring electricity business license under the BKPM integrated one-stop service.
- Presidential Regulation 38/2015 (Collaboration Between the Government and Business Enterprise in Infrastructure Development) includes foreign holding companies in the development of infrastructure projects, replacing previous regulations.
- Presidential Regulation 5/2019 or Government Regulation 24/2018 on Investment Guidelines and Facilities.

Indonesia imposes limits on foreign investment share based on relevant regulations. For projects with installed capacity of less than 1 MW, only domestic investment is allowed; for 1-10 MW, the foreign share may be up to 49%; for projects above 10 MW, the maximum foreign investment is 95%, although it might be greater under certain conditions.

To fill the funding gap of power investment, Indonesia strongly encourages energy investment and international cooperation. China, Japan and Malaysia are the biggest investors in the country's coal power sector. Foreign investments in coal power has filled the funding gap for Indonesia to develop its power sector, promoted the development of clean coal power technology, and introduced advanced management experience to the country, which, to some extent, improved the levels of the power sector personnel in management capability and professional competence. China also has extensive cooperation with Indonesia in terms of renewable energy, in particular, hydro and thermal power, with the former being mostly large and medium-sized projects, such as Asahan I Hydropower Station, Batu Hydropower Station, Kayan River Cascade Hydropower Station, and Jatigede Hydropower Station. Geothermal power mainly includes SMGP project.

Nonetheless, those investing in clean energy and renewable energy in Indonesia are currently facing multiple obstacles:

- It is difficult to coordinate the connection of renewable power to the grid. Power grids in

Indonesia are very scattered, with many small ones in remote areas. Problems with grid operation and maintenance and constraints of transmission and transformation systems have made it more difficult for renewable energy to enter the grid.

- The feed-in tariff (FiT) of renewable energy is usually higher than the price charged by PLN from consumers, it is therefore difficult to recover the cost in the short term, which indicates low cost effectiveness.

- Local financial institutions provide a low level of funding support for renewable energy projects, and international ones have stringent terms for loaning to these projects. Therefore, financing opportunities for renewable energy projects in Indonesia are currently limited.

- Land acquisition is not easy. Land ownership in many places in Indonesia is unclear, and land acquisition is both time-consuming and costly, which more or less limits the investment and development of renewable energy projects.

- Administration and approval procedures are complicated. The complicated and time-consuming approval procedures make it difficult to obtain the permit for investment and project development. The quick policy change in recent years and the lengthy administrative approval process have cost Indonesia investment opportunities, making it more difficult to invest in renewable energy projects and affecting the rate of return on investment.

On the whole, due to the growth of domestic power demand, the abundance of coal and renewable resources, and the shortage of domestic fiscal funds and social capital, Indonesia needs funding, technology and management support through international cooperation and foreign investment so as to bolster its power infrastructure construction and development. However, the new coal-fired power generation has obviously pushed up greenhouse gas emissions and polluted air and water, drawing opposition in the country. At the same time, due to inadequate support policies and limited economic returns, foreign investors are also facing many risks and challenges while capturing the opportunities for renewable energy investment.

Appendix 2 Case Study-Thailand

Thailand is not only the largest economy in the northern region of Southeast Asia plus Laos, Myanmar, Cambodia and Vietnam, with its GDP accounting for about 57% of the region's total, it also has the biggest installed grid capacity in this region, accounting for 45% of the region's total (ACE, 2020). These data show that Thailand not only has an important influence in the northern subregion, but can also influence the entire Southeast Asia. Since 2005, oil and natural gas have become main fuels in Thailand's primary energy supply, and the share of renewable energy has also increased. The transportation and industrial sectors currently dominate Thailand's energy consumption. With the further development of renewable energy and its growing importance in power grids of Southeast Asia, Thailand intends to reduce its installed capacity or decommission more oil-fired power plants by 2040 despite its increasing energy consumption. As the largest electricity importer in Southeast Asia, Thailand has a cross-border interconnected network with other neighboring member countries except Myanmar, which makes Thailand unique in planning its energy development.

According to statistics from the Energy Policy and Planning Office (EPPO) under the Ministry of Energy of Thailand, the country's total installed power generation capacity was 42,433 MW in 2017, and the annual power generation was 201,165.5 GWh (including imported power at 24,427.42 GWh), in which thermal power accounted for 78.2%, natural gas-based power was 121,044 GWh, coal and lignite power was 35,732.5 GWh, oil-fired power generation was 133 GWh, and diesel power was 198 GWh. Throughout 2017, hydropower generation accounted for 2.3% of the total and non-hydropower renewable energy power accounted for 7.4%, indicating the country is mainly based on thermal power and highly dependent on gas for power supply (Figure2- 1).

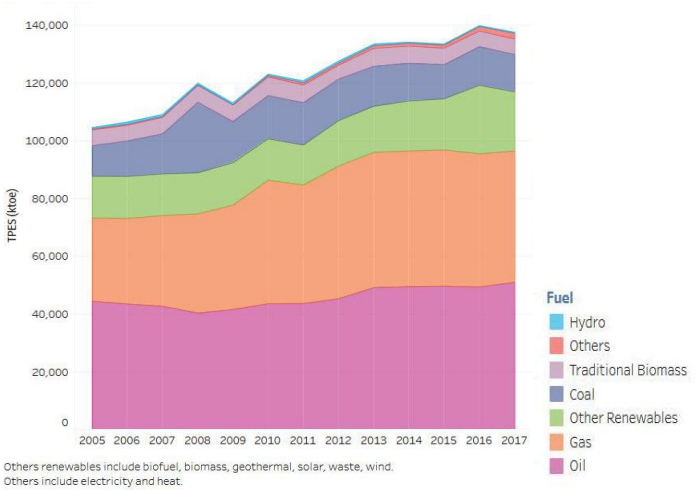

Figure 2-1. Primary Energy Supply in Thailand

Data Source: ACE, 2020

In 2015, EPPO issued the Thailand Power Development Plan 2015-2036 (PDP2015), clarifying the focus of power development in the next two decades, including: 1) Ensuring the stability of the power system; 2) Promoting a diversified energy structure and reducing dependence on a single

energy source by reducing natural gas power generation, increasing clean coal power, limiting purchase of power from foreign countries to 20% of the total, and encouraging renewable energy and nuclear power; 3) Ensuring a reasonable level of reserved power at no less than 15% of the peak demand; 4) Ensuring the fulfillment of power purchase agreements signed with IPPs and SPPs. Renewable energy has seen rapid development in the country since the release of PDP2015. In 2018, Thailand updated its power development plan and issued the National Power Development Plan 2018-2037 (PDP2018), proposing to adapt to domestic power demand, increase the proportion of renewable energy and work to achieve emission reduction targets as soon as possible, and promote low-carbon sustainable development of the sector. PDP2018 requires Thailand to significantly increase the proportion of natural gas and renewable energy in its energy mix. By 2037, non-fossil fuel-based power will increase to 35%, natural gas power will increase from the current 40% to 53%, renewable energy power will increase from the current 10% to 30%, and coal power will drop from the current 37% to 25%. According to the Alternative Energy Development Plan approved by the National Energy Policy Committee, by 2036, the total installed capacity of renewable energy in Thailand can reach 19,634.4 MW. Details are shown in the table below.

Table 2-1 Thailand renewable energy power generation capacity

Power Generation Technology	Power Plant Factor (%)	Target (MW)
Solar: Ground installation Rooftop	 16 15	6,000
Wind power	18	3,002
Hydropower 10 MW and below Above 10 MW	44	3,282.4 376 2,906.4
Solid waste	70	500
Biomass	70	5,570
Biogas (wastewater/solid waste)	70	600
Biogas (energy crops)	78	680
Total		19,634.4

In addition, in A Guide to the Board of Investment 2017 released by the Board of Investment (BOI) of Thailand, item 7.1.1.2 under “Section 7: Service and Public Utilities” states that production of electricity or electricity and steam from renewable energy, such as solar energy, wind energy, biomass or biogas, except from garbage or refuse derived fuel will enjoy incentives for businesses engaged in A2 activities, which are infrastructure activities for the country’s development, and activities using advanced technology to create value-added, with no or very few existing investments in Thailand. A2 activities are eligible for exemption of import duty for machinery, exemption of import duty on raw materials imported, used in production for export, non-tax

incentives and additional incentives, and exemption of 8 years of corporate income tax. It can be seen that the Thai government encourages the entry of foreign investment into renewable energy, and that investors can enjoy policy support for investing in Thailand. The Thai government attaches great importance to waste-to-energy generation and has prioritized its connection to the grid compared to other clean power. Because of the attention and policy guarantee given by the Thai government to waste-based power, Sino-Thai projects on waste-to-energy generation have significantly outnumbered such projects between China and other Southeast Asian countries.

- **Renewable energy support policy**

FiT is the most common policy support for renewable energy development. Southeast Asia has been promoting FiT policies since 2007, and Thailand was the first Southeast Asian country to introduce FiT in the form of a superimposed plan. FiT in Thailand is divided into two categories based on renewable energy technology, one is natural energy, such as hydropower, wind energy and solar energy, and the other is biomass energy, such as solid waste, biomass and biogas. The two categories may be further subdivided to meet different needs. For example, the FiT of natural energy in Thailand is determined by two methods: fixed FiT-fixed ratio of remuneration and FiT subsidy in three southern provinces. The FiT subsidy is an allowance or incentive in addition to the benchmark FiT to encourage the development of renewable energy in rural or remote areas. The allowance is calculated based on the type of renewable energy and its installed capacity. The 2018 FiT plan for solar energy has been terminated, and relevant regulations are being revised. The figure below shows the natural energy FiT in Thailand in 2014-2017.

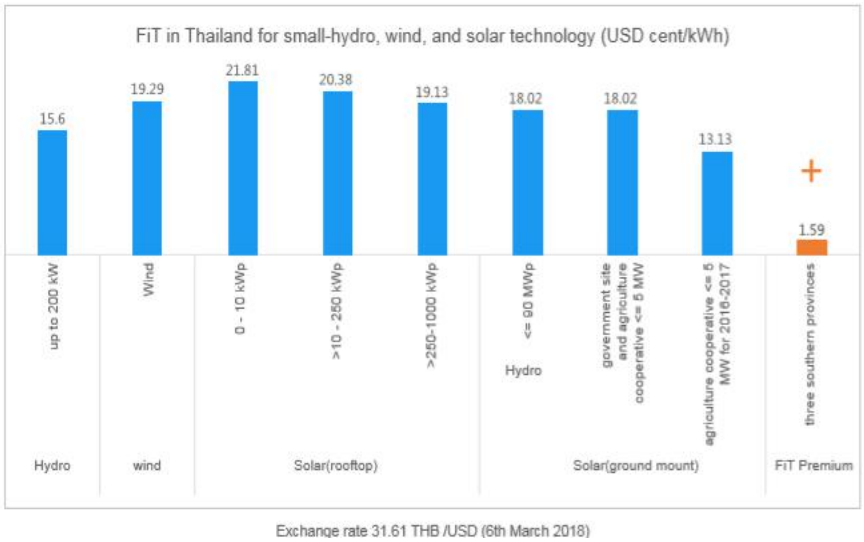

Figure 2-3. Natural Energy FiT in Thailand

Data Source: ACE, 2018

In 2017, the Energy Authority of Thailand formulated a Small Power Plant (SPP) Hybrid Farm (Hybrid Farm) tendering policy for FiT to improve the feasibility of hybrid generation projects from multiple sources of renewable energy. In applying for SPP Hybrid Farm, project developers are allowed to

integrate different renewable energy sources to generate electricity, and shall specify the types of renewable energy used by power plants. There are, however, no requirements on the types of renewable energy and the minimum amount of each type of energy used by power plants. The Energy Authority has allocated 300 MW of power generation capacity for renewables, and SPP Hybrid Farm has the largest allocations in the southern, northern and northeastern regions, at about 10 MW-50 MW.

FiT funds in Thailand mainly come from electricity taxpayers, and state-owned enterprises or the Government will not feel huge burden arising from the rapid increase in renewable energy installations when fulfilling power purchase contracts. Another source of funding is to transfer the cost by setting fuel adjustment costs in the tariff structure and charging all electricity consumers a certain amount of fees. Thailand's appropriate and competitive FiT policy has successfully boosted the development of renewable energy in the country, leading in Southeast Asia in renewable energy and clean energy investment, setting a good example in devising and implementing policy support mechanism based on a strong power market structure, and providing other member countries with an optimal model of FiT structure.

- **Power market structure**

The Thai power system is the so-called "Enhanced Single Buyer" model (ESB), and is regulated by the independent Electricity Generating Authority of Thailand (EGAT). EGAT owns and operates a certain percentage of power plants, but it mainly controls the transmission system. Thailand's power market also has a certain number of Independent Power Producers (IPPs). Electricity distribution includes two parts, with Metropolitan Electricity Authority (MEA) responsible for the area around the capital Bangkok, and Provincial Electricity Authority (PEA) responsible for the other areas of Thailand.

Appendix 3 Case Study-Malaysia

Malaysia has a land area of approximately 330,000 square kilometers. Its domestic population totaled 31.5 million in 2018, with a GNP of 358.6 billion US dollars. It is the third largest economy in Southeast Asia following Indonesia and Thailand. Electrification rate in Malaysia has reached 100%, per capita electricity consumption is about 4,636 kWh, and residential electricity purchase price is 0.069 US dollars/kWh. Malaysia ranks 4th in Southeast Asia in terms of installed power capacity (ACE, 2018) and plays an important role in regional energy development. Since 2005, natural gas has become one of the country's main energy sources, second only to oil and coal. At the same time, the share of coal in Malaysia's total primary energy supply is showing a steady upward trend, and details are shown in the figure below.

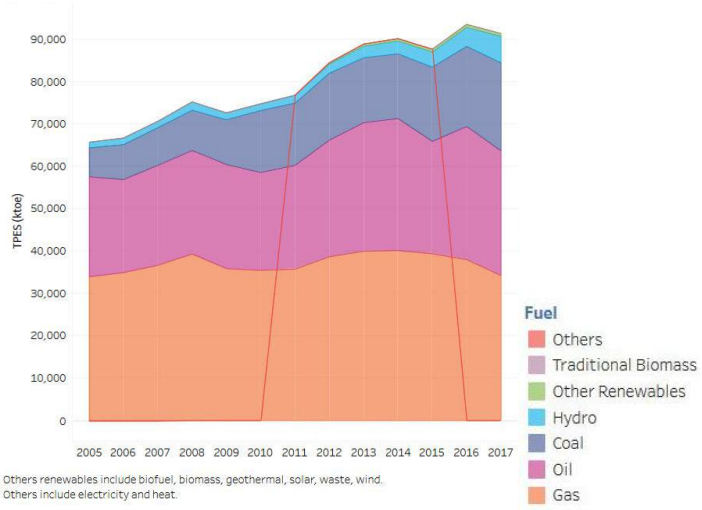

Figure 3-1. Total Supply of Primary Energy in Malaysia (Share by Fuel Type)

Data Source: ACE, 2018

As residential and commercial demand for energy continues to grow in the country, Malaysia is facing the challenge of maximizing its potential income from energy export. Energy production should consider the most cost-effective way to promote high-quality power supply to improve national energy security. Currently, Malaysia's primary energy supply still relies heavily on oil and natural gas. At the same time, as the cheapest fossil energy source, coal plays a vital role in the country's energy structure. It is estimated that Malaysia's coal resources stand at about 1,050 megatons. Due to its abundance and low price, coal has taken up a significantly higher proportion in the country's power energy structure, up from 6.7% in 2000 to 35% in 2009 (Rahim & Liwan, 2012). As shown by the Figure 3-2, transport and industry are currently the main energy consuming sectors.

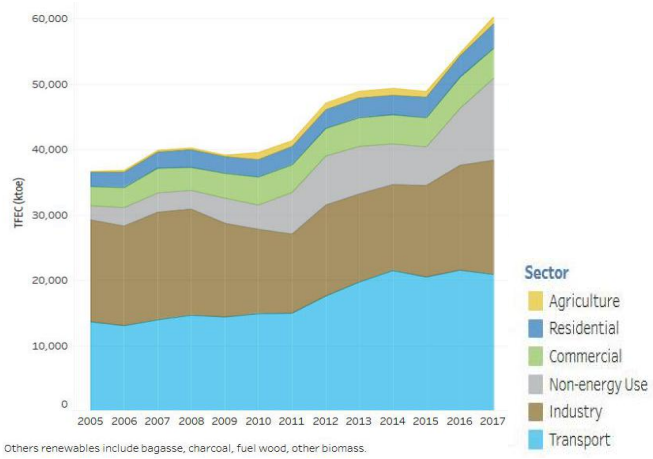

Figure 3- 2. Primary Energy Supply in Malaysia by Sector

- **Power development goals and policy**

Malaysia's energy policy is formulated and supervised by the Energy Department of the Economic Planning Unit (EPU), which is under the direct jurisdiction of the Prime Minister's Office. Its main responsibilities include: formulating policies and strategies for sustainable development of the energy sector, promoting the development of oil and gas industries, ensuring appropriate, safe, high-quality and cost-effective energy supply, improving the sustainable use and development of renewable energy and energy efficiency, and providing funds for energy development planning and evaluating its effectiveness.

To realize stable energy supply, ensure energy security and achieve sustainable development, Malaysia set three basic goals in its national energy policy, which are goal for supply, goal for utilization, and goal for environment. The supply goal is mainly about ensuring an appropriate, safe and cost-effective energy supply by developing alternative energy sources (renewable and non-renewable energy) and promoting a diversified supply of energy in the country. The utilization goal is mainly to improve the effective use of energy. The environmental goal is to minimize the negative environmental impact of the energy supply chain, such as energy production, transportation, conversion and consumption. For policies on climate change, the Malaysian government has decided to increase the installed capacity of renewable energy from 243 MW in 2014 to 2,080 MW in 2020 to meet the demands of economic and social development and to achieve greenhouse gas emission reduction targets.

According to the National Renewable Energy Policy and Action Plan (NREPAP) released in 2011, it is expected that by 2025, share of renewable energy installations in the power structure will increase to 20%, which was only 5% in 2017. Malaysia is the second largest palm oil producer in the world, and many types of bio-waste are produced in the palm oil production process, hence huge potential for biomass power generation. Malaysia is located near the equator, and enjoys very abundant solar energy resources (average daily insolation is about 4.21~5.56 kWh/m^2). Based on evaluations of the development potential of various types of renewable energy, Malaysia has formulated quantifiable development targets for renewable energy technology. Details are shown in Table 3-1 and Table 3-2.

Table 3-1. Development Targets for Renewable Energy in Malaysia (NREPAP, 2011)

Year	Total Installed Capacity of Renewables/MW	Share of Installed Capacity of Renewables	Yearly Power Generation from Renewables/GWh	Share of Renewables	Yearly CO_2 Emission Reduction/Ton
2011	217	1%	1228	1%	773,325
2015	975	6%	5374	5%	3,385,406
2020	2065	10%	11227	9%	7,073,199
2030	3484	13%	16512	10%	10,402,484
2050	11544	34%	25579	13%	16,114,871

Table 3-2. Development Targets for Renewable Power Technology in Malaysia

Total Installed Capacity/MW Year	Biomass	Biogas	Small Hydro	Solar Energy	Solid Waste	Total Installed Capacity of Renewables
2020	800	240	490	175	360	2065
2025	1190	350	490	399	380	2809
2030	1340	410	490	854	390	3484
2035	1340	410	490	1677	400	4317
2040	1340	410	490	3079	410	5729
2045	1340	410	490	5374	420	8034
2050	1340	410	490	8874	430	11544

- **Renewable energy support policy**

Similar to other member countries, Malaysia has a limited fossil energy capacity. The country is committed to tapping the development potential of renewable energy to meet domestic development needs and a green and low-carbon transition. To achieve the target of 20% of power generation from renewable energy by 2025, Malaysia is actively formulating and implementing a number of supporting policies, among which FiT for geothermal, biomass, hydropower, and solar power technologies is the most important policy issued by the Malaysian government. This policy is valid for 16 years for biomass, and 21 years for biogas, small hydropower and solar power technologies. The FiT policy was officially promulgated in 2011, and the FiT of small hydropower was adjusted in 2016, while that of solar PV has been adjusted annually since 2012 with the decline in the cost of solar PV generation technology. Malaysia designs its FiT system based on the sum of LCOE and the return on investment. FiT falls accordingly with the sharp drop in the cost of solar technology and the acceleration of its growth rate in the market. According to the annual decline rate of different renewable energy technologies, except for small hydropower, all renewable energy

FiT will gradually decrease. Therefore, the later the renewable energy equipment is put into operation, the lower the FiT. The price will stay unchanged once the power plant FiT comes into effect. The theoretical basis of the decline rate policy is mainly based on the expectation that the cost of renewable energy technologies will decline as they mature. Therefore, the decline rate reflects the maturity of all renewable energy technologies and the current cost decline trend.

Malaysia's FiT policy is considered to be the main factor driving the 500 MW annual growth of renewable energy installed capacity from 2011 to 2015. According to the Report on Feed-in Tariff Mechanism in Southeast Asia (2018), Malaysia is a hotspot with significant development of renewable energy (especially solar energy), up from 3.4 MW in 2011 to 270 MW in 2016. The solar PV target set by the Sustainable Energy Development Authority Malaysia (SEDA Malaysia) was officially completed in 2016, and the applied solar energy FiT quota was also terminated. Following that, the Government introduced net energy metering (NEM) and large-scale solar energy (LSS) self-consumption plan. NEM and self-consumption plan will further encourage solar PV users to sell surplus electricity to the grid at a competitive price.

Another key supporting policy in Malaysia is the Renewable Energy Special Fund, which is established in accordance with Article 23 of the National Renewable Energy Regulations and is managed and supervised by SEDA Malaysia. The Fund has two funding sources: one is the 300 million ringgit start-up fund from the Government, and the other is the 1% surcharge on consumer electricity bills. The surcharge does not apply to domestic consumers whose monthly electricity consumption is less than 300 kWh or consumers with a monthly electricity bill of less than 77 ringgit. It is charged by the national power corporation Tenaga Nasional Berhad (TNB) on behalf of SEDA Malaysia through electricity bills. The surcharge was increased to 1.6% in January 2014, and was extended to Sabah. 44% of the fund comes from public institutions.

- **Power market structure**

As a single-buyer electricity market regulated by the independent Energy Commission (EC), Malaysia has developed a strong national cooperation mechanism that plays a key role in the Southeast Asian power interconnection plan. The power supply industry in Peninsular Malaysia is operated and managed by a single vertically integrated public institution, which is TNB. TNB is supervised by Suruhanjaya Tenaga (ST) or the Energy Commission (EC). IPPs account for approximately 50% of power generation in the Malaysian electricity market. TNB is the main electricity distributor in Peninsular Malaysia, but the Government also issues permits for local distributors in designated areas (such as mountain tourist attractions, complex shopping malls and industrial parks, etc.) (Figure 3).

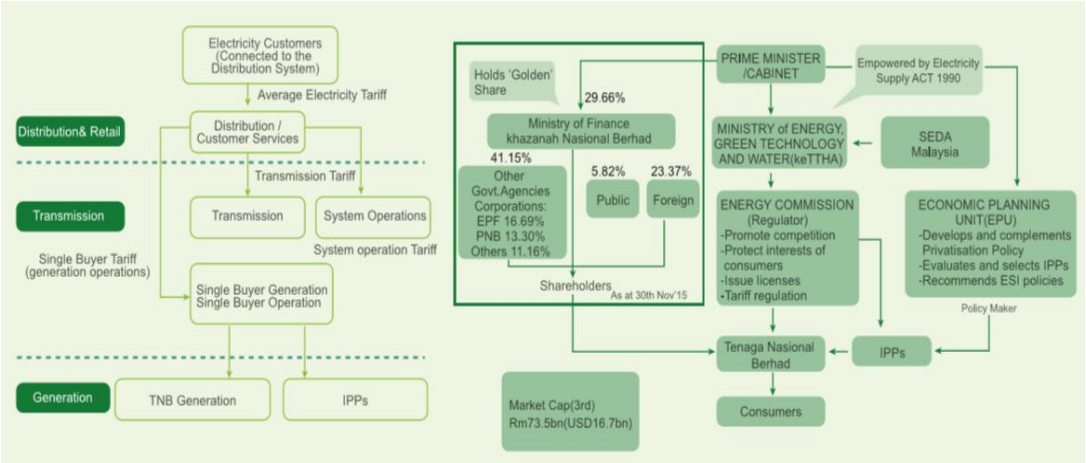

Figure 3- 3. Power Market Structure in Malaysia

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