CCICED

SPECIAL POLICY STUDY REPORT

Global Climate Governance and China's Role

2020

Policy Studies Release
September, 2020

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Special thanks to Dr.Hugh Outhred (Managing Director) and Dr. Maria Retnanestri (Director) from IPEN Pty Ltd, Dr.Yudiandra Yuwono, Mr. Septia Buntara and Ms. Monika Merdekawati from ASEAN Center for Energy, and Dr.Philip Andrews-Speed from Energy Studies Institute of National University of Singapore to share data of ASEAN power infrastructure development and case studies, as well as insights for this report.

* The co-leaders and members of this SPS serve in their personal capacities. The views and opinions expressed in this SPS report are those of the individual experts participating in the SPS Team and do not represent those of their organizations and CCICED.

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Executive Summary

The Special Policy Study on *Global Climate Governance and China's Role* is one of the research topics set up by the CCICED on Global Governance and Ecological Civilization. The research focus of 2019–2020 is the low-carbon development of infrastructure along the Belt and Road Initiative (BRI).

The BRI provides broad opportunities for China, partner countries, and the world to advance sustainable development. However, most countries along the route have fragile ecological environments, inadequate infrastructures, weak climate mitigation capabilities—and are particularly vulnerable to the impacts of climate change. Due to the scale of investments and the associated long-term lock-in effects, infrastructure has always been a critical issue to tackle climate change, hence the close attention that China's BRI has received from the international community. The world is looking to China to take a leadership role in global climate governance and use the foundation of the BRI to uplift the low-carbon economic transition of the countries along the BRI and build together a broad green low-carbon market.

Southeast Asia is a key region for the BRI. In recent years, Southeast Asia's economy has shown rapid development, making it one of the fastest-growing regions in the world economy. At the same time, demand for electricity and coal has also been soaring. With the increase of industrialization and income per capita, the demand for electricity will continue to grow rapidly in the future. In light of the global action on climate change and the increased pressure to tackle local environmental pollution, the rapid growth of coal-fired power generation in Southeast Asia has attracted global attention. China's support in the development of coal-fired power plants in Southeast Asia, while working with host countries to increase their power supply and improve the energy access of local populations, has been controversial. For the international community, this would increase climate risks and be incompatible with the "Green Belt and Road Initiative."

This report first reviews the BRI and related Chinese policies supporting the development of overseas infrastructure; then, it analyzes the current situation of socioeconomic development, power infrastructure development plans, and electricity infrastructure policies in Southeast Asia. Then, this report focuses on China's role in power infrastructure investments in Southeast Asia. Taking Indonesia as a case study, an in-depth analysis reviews the challenges facing the low-carbon transition of its power infrastructure. On this basis, the opportunities and challenges of clean, low-carbon power generation in Southeast Asia are explored from the perspectives of resource potential, technology, finances, cost, supporting infrastructure, systemic issues, and policies. Finally, we propose recommendations on how China and Southeast Asian countries could cooperate to promote the transition to low-carbon power infrastructure.

There are both challenges and opportunities in the development of low-carbon, clean power generation in Southeast Asia.

Opportunities: First, Southeast Asia has a growing population with rising incomes and a rapid rate of urbanization, leading to an urgent, concrete demand for electricity, creating huge market potentials. Currently, multiple Southeast Asian countries have insufficient power supply. The International Energy Agency (IEA) estimates that, by 2040, Southeast Asia's electricity demand will be twice that of today, reaching 2000 TWh yearly. With a growth rate close to 4%, it is one of the fastest-growing power markets in the world. At the same time, countries are undergoing structural transformations, moving from agriculture to extractive industries, manufacturing, and services at different speeds. Backed by

a strong influx of foreign direct investment, some countries have emerged as hubs for a wide variety of industries and services.

Second, Southeast Asia is rich in renewable energy resources. The conditions for hydropower, photovoltaics, wind power, tidal energy, geothermal, and other **resources are favourable and display great potential for development**. In recent years, globally 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 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.

Renewable energies have been given higher importance by Southeast Asian countries, and **renewable energy targets have been adopted**. The ASEAN Plan of Action for Energy Cooperation 2016-2025, sets an "inspirational" renewable energy target of 23% of the primary energy supply in the Association of Southeast Asian Nations (ASEAN) region by 2025, and countries are encouraged to **formulate policies such as feed-in tariffs and tax incentives to ensure the rapid development of renewable power generation**. Furthermore, more and more international financial institutions have adopted policies restricting the financing of coal power projects, strengthening the proactive signal for the development of renewable energy.

Challenges: First, the coal lobby is strong, and the power ecosystem lacks market competition. Leaving Singapore and the Philippines, where power is more market-based, aside, Southeast Asian countries still have a vertically integrated power system, with coal remaining at the core of the business model. This not only leads to monopolistic behaviours but also lacks the willingness to turn towards renewable energy.

Second, there is a lack of qualified human resources and capacity for independent innovation. Southeast Asia has insufficient research and development (R&D) investment and skilled workers. These contribute to difficulties turning the renewable energy resource into energy supply**.**

Third, there is financial pressure and the lack of an effective market-financing mechanism. Achieving renewable energy deployment targets needs investment, and the GDP per capita of most countries in Southeast Asia remain less than USD 5,000 (excluding Singapore, Brunei, and Thailand). Fiscal revenues are difficult to canalize towards investments in renewable energy, and efficient market financing mechanisms are lacking. Local financial institutions overestimate the risks of renewable energy projects, making them difficult to finance.

Fourth, the grid infrastructure is often not up to the task. The overall power grid structure in Southeast Asia is weak, with only a few high-voltage grade lines. The power interconnection between countries is limited, with limited power grid peaking capability.

Fifth, the cost of renewable energy power generation remains high, and competitiveness remains insufficient, especially when not accounting for negative externalities.

Sixth, the cost of integrating renewable energy into the grid will increase the price of electricity, which is difficult for consumers to bear.

Based on the above analysis, the following recommendations are presented for cooperation between China and Southeast Asia to support the low-carbon development of power infrastructure.

(1) Make environmental and climate impacts a key driver when revising overseas investment policies. The Chinese government should include environmental protection and climate considerations as requirements to the policies on foreign aid and overseas investment. In addition, the government should establish a blacklist mechanism for overseas investment that restricts high-carbon lock-in projects such as coal-fired power plants, encourage investment in low-carbon projects, implement the Green BRI and promote a mutually beneficial strategy based on openness.

(2) Provide technical and financial assistance for local renewable energy development plans and roadmaps. The Chinese government should promote in-depth cooperation with Southeast Asian countries at the strategic planning level based on their extensive experience in a low-carbon energy transition, make full use of the resources of the diverse platforms, and share China's experience in clean energy development and technologies.

(3) Chinese enterprises should be compelled to comply with the impact assessments of overseas investment projects to ensure compatibility with local economic, social, and environmentally sustainable development. For now, electric power infrastructure constructions in Southeast Asia by Chinese companies are still solely based on engineering, procurement, and construction (EPC). Building local capacities such as labour force and industrial chain is still a challenge. When conducting investments overseas, Chinese companies should consider more than returns on investment and act on considerations for the local economic, social, and environmental impacts of the project on sustainable development. A systematic assessment of the impacts of the project from inception through its lifetime to its aftermath should be carried out, including the positive and negative impacts on macroeconomics, the promotion of local employment, the ecological environment, etc. Measures should be implemented to minimize negative impacts, such as the application of ISO14000 standards.

(4) Strengthen communications with the local communities. Communication with central and local governments can be strengthened through bilateral and multilateral platforms such as the East Asia Summit Clean Energy Forum and Greater Mekong Subregion Energy Cooperation. China's advantages in clean electricity technology, green industrial transformation, and experts will be fully exploited, and technical assistance, training for professionals, and project demonstration in Southeast Asian countries will be strengthened. Enterprises should strengthen cross-cultural communication with the local community and enhance publicity. It is necessary to communicate with host countries' governments, trade union organizations and other relevant social groups, and local media to publicize enterprises' contributions to the promotion of local socioeconomic development and to gain the understanding and support of local communities. Pay attention to the prevention and control of public opinion risks, and clarify in a timely manner any untrue or negative reports involving enterprises.

Foreword

The Special Policy Study on *Global Climate Governance and China's Contribution*, under the CCICED umbrella research of the Global Governance and Ecological Civilization Task Force, was launched in July 2018 and will last for three and a half years. The research project has four primary focuses: (1) the impact of Chinese cabinet restructuring on climate change policy and recommendations; (2) China's contribution and leadership in the global climate governance system and its overall mid- and long-term strategy and roadmap for combating climate change; (3) green investment in infrastructure, and climate investment and financing in the context of the Belt and Road Initiative; and (4) key takeaways for improving the effectiveness of carbon pricing policies.

In 2019, while continuing to study China's mid- and long-term strategy for climate change, the team also embarked on research on low-carbon power infrastructure development in Southeast Asia, an issue that draws considerable international attention.

Southeast Asia represents a hotbed of investment and development for the Belt and Road Initiative. As the region's economy took off to become one of the most vibrant globally, its demand for energy and electricity and coal consumption has also soared. 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.

While China has supported Southeast Asian countries in increasing electricity supply and achieving their energy access goals, China has received criticism for its participation in financing and building coal-fired power plants. The international community has voiced its concern that the projects increase the risk of climate change and run counter to the principle of a green Belt and Road.

This report consists of three sections. The first section focuses on Chinese efforts to build low-carbon power infrastructure in Southeast Asia; the second section deals with gender issues in climate change; and the third section contains a comprehensive set of annual policy recommendations.

Section I: China Promotes Power Infrastructure Development in the Belt and Road Region and Tackles Climate Change: Southeast Asia as a case study

1. BELT AND ROAD INITIATIVE AND CHINA'S POLICY SUPPORT TO OVERSEAS INFRASTRUCTURE DEVELOPMENT

1.1. Green Development and Achieving SDGs Are Part and Parcel of the Belt and Road Initiative

When visiting Kazakhstan and Indonesia in September and October of 2013, Chinese President Xi Jinping outlined the notions of building the Silk Road Economic Belt ("Belt") and the 21st Century Maritime Silk Road ("Road"), respectively, and set in motion the Belt and Road Initiative (BRI). BRI seeks to harness existing bilateral and multilateral mechanisms between China and other countries to actively foster economic partnerships with the countries along the route and build "a community of shared interests, future and

responsibility featuring mutual political trust, economic integration and cultural inclusiveness" (Hu Jian et al., 2017). As of the end of January 2020, the Chinese government had signed 200 intergovernmental cooperation agreements with 138 countries and 30 international organizations.[1]The geographical scope of cooperation has expanded beyond the Eurasian continent to include countries from Africa, Latin America, the South Pacific, and Western Europe.

Green development represents the consensus of countries jointly building the Belt and Road. President Xi has called for the building of a green Belt and Road on multiple occasions. The *Vision and Actions on Jointly Building the Silk Road Economic Belt and the 21st Century Maritime Silk Road* issued in March 2015 proposed that efforts should be made to incorporate and integrate the green concept, environmental protection, and the principles of sustainable development into the five areas of connectivity advocated by the BRI.[2] Speaking at the opening ceremony of the Belt and Road Forum for International Cooperation in May 2017, President Xi called on all parties to build the Belt and Road into a road of innovation, pursue green development, and strengthen cooperation in ecological and environmental protection to attain the 2030 Sustainable Development Agenda. At the second Belt and Road Forum for International Cooperation in April 2019, President Xi once again stressed the need for open, green, and clean cooperation in a people-centered approach.

Countries along the BRI now account for 67% of the global population and roughly 34% of the world's GDP. The vast majority of them are developing countries and nations with economies in transition. The per capita GDP of approximately two thirds of countries along the BRI are lower than the global average (Chai Qimin et al., 2019; State Information Center, 2018). A deficit in infrastructure and fragile ecological environment expose these countries to the full brunt of climate change. Losses from climate disasters in the BRI countries are more than double the global average. Seven of the top 10 countries most affected by global climate disasters between 1995 and 2005 belonged to the Belt and Road region (Chai Qimin et al., 2019). In the meantime, due to the potential for economic development and increased energy intensity, countries along the BRI will likely become the largest growing energy consumers and greenhouse gas emitters globally. In the broader context of global low-carbon development and climate-resilient transformation, the green development needs of the BRI region are growing ever more urgent.

In a word, promoting green and sustainable development along the Belt and Road is not only an inherent requirement of the BRI but also an inevitable choice for the countries along the route. Creating a green and low-carbon community of shared future along the Belt and Road is of utmost significance to building a community of shared future for mankind, facilitating the achievement of the 2030 Sustainable Development Goals and the vision of a clean and beautiful world.

1.2. China's Overseas Investment Policy Has Shifted with Surging Investment and Improving Management

Since China's reform and opening-up, the country's policy on outbound direct investment (ODI) has undergone a paradigm shift from restriction to encouragement. Prior to 2000, the Chinese policy was to keep a tight rein on outbound direct investment; after 2000, the country began to adopt a "going global" strategy by gradually removing restrictions on the approval of ODI and actively encouraging investment abroad (Li Feng, 2016). The BRI

[1] Belt and Road Portal: https://www.yidaiyilu.gov.cn/xwzx/roll/77298.htm

[2] Namely policy coordination, facilities connectivity, unimpeded trade, financial integration and people-to-people bonds

provides a strong strategic platform for the implementation of the "going global" strategy and created wider channels for ODI.

China's ODI rank among the top three in the world in terms of its flows and existing stock, and the Association of Southeast Asian Nations (ASEAN) has witnessed the fastest growth in ODI flows from China. The country's ODI stood at USD 143.04 billion in 2018, a year-on-year (YoY) decrease of 9.6% (see Figure 1-1). With a 29% slash in global ODI, which had fallen for three consecutive years, China rose to become the second-largest ODI originator slightly behind Japan (USD 143.16 billion). At the end of 2018, China's existing stock of ODI reached USD 1.98 trillion, 66.3 times the amount at the end of 2002 and trailing only the United States and the Netherlands. An examination of the regional distribution of China's ODI flows (see Table 1-1) reveals that Asia remains the most popular destination for ODI from China and that ASEAN, in particular, is where Chinese FDI has grown most rapidly.

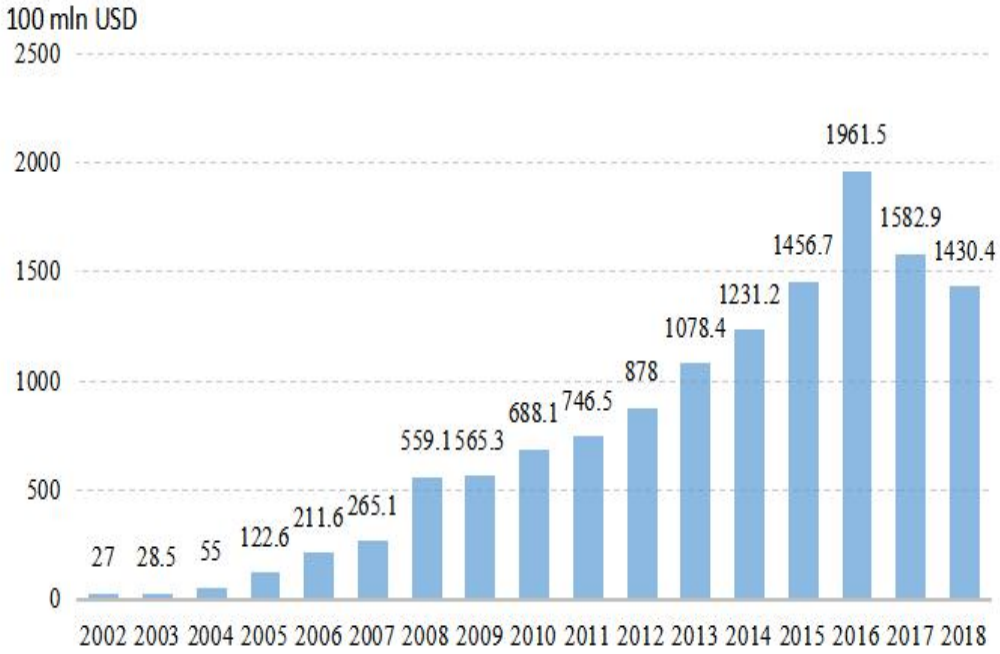

Figure 1-1. China ODI between 2002 and 2018

Data Source: Ministry of Commerce of the People's Republic of China et al.,2019

Table 1-1. China ODI flows to major economies in 2017

Economy	Investment (USD 100 million)	YoY Growth (%)	Weight in Total Investment (%)
Hong Kong SAR	911.5	-20.2	57.6
ASEAN	141.2	37.4	8.9
European Union	102.7	2.7	6.5
United States	64.3	-62.2	4.0
Australia	42.4	1.3	2.7
Russia	15.5	19.7	1.0
Total	1277.5	-18.6	80.7

Data Source: Ministry of Commerce of the People's Republic of China et al., 2018

1.3. China Has yet to Place More Stringent Requirements on Environmental Protection in Outbound Investment Policies

Multiple Chinese government agencies implement and manage the policies on overseas investment. Large foreign investments exceeding USD 2 billion must seek approval from the State Council. Other important government agencies include the People's Bank of China (PBOC), the National Development and Reform Commission (NDRC), the Ministry of Commerce (MOC), the Ministry of Finance (MOF), and the China Banking and Insurance Regulatory Commission. The MOC is tasked with the review and approval of direct investment by Chinese enterprises overseas, and the approval authority for most items is delegated to provincial-level commerce authorities with the exception of special projects. The NDRC is mainly responsible for evaluating overseas resource development projects, projects requiring large-value foreign exchange transactions, overseas acquisitions and bidding projects, and some special projects. The State Administration of Foreign Exchange (forex) supervises and manages foreign exchange receipts and payments and forex registration associated with domestic enterprises' direct overseas investment. The PBOC and the State Administration of Foreign Exchange are in charge of managing the pilot CNY settlement of overseas direct investment. The National Agency for International Development Cooperation (NADICA) is responsible for formulating strategic guidelines, plans, and policies for foreign assistance; coordinating and making recommendations on major issues of foreign assistance; promoting the reform of foreign assistance modalities; preparing foreign assistance programs and plans; determining foreign assistance projects; and supervising and evaluating their implementation.

There are few provisions in China's foreign investment policies that lay particular emphasis on environmental protection. The Guidelines for Environmental Protection in Foreign Investment and Cooperation promulgated by the MOC and Ministry of Environmental Protection in 2013 remains the only policy document that seeks to reduce the environmental impact of Chinese companies' overseas operations. It aims to guide the companies to promptly identify and prevent environmental risks. However, it is not legally enforceable and relies on voluntary compliance. The Opinions on Further Guiding and Regulating the Direction of Overseas Investment, issued jointly by the MOC, the PBOC, and the Ministry of Foreign Affairs in August 2017, classifies foreign investment projects into encouraged, restricted, and prohibited categories. The Administrative Measures for Overseas Investment by Enterprises, unveiled by the NDRC in November 2017, stipulates that overseas investments by Chinese enterprises in projects deemed sensitive would be subject to prior recordation and approval, as well as close monitoring and scrutiny afterwards. Subsequently, in January 2018, the NDRC released the Catalogue of Sensitive Industries for Overseas Investment (2018 Edition), listing cross-border water resources development and utilization as a sensitive industry. The Interim Measures for the Reporting of Outbound Investments Subject to Record-filing or Approval, published by seven ministries and commissions including the MOC, the PBOC, and SASAC in January 2018, provides that outbound investments by Chinese investors will be guided and regulated based on the principle of "encouraging development and a negative list" and that an outbound "blacklist" will be researched and established.

Compared with domestic investment policies (see Annex 1), the policies on foreign investment do not explicitly forbid projects with high pollution and carbon emissions, high resource consumption, and outdated and polluting technology but, instead, place a greater priority on safeguarding national economic and security interests. The environmental considerations only occur for projects that fail to meet the technological, environmental, and energy consumption standards of the investment destinations. However, target countries have varying standards. Developed countries, such as members of the European Union (EU) and a number of developing countries have stricter emission control protocols and higher environmental performance than China. Meanwhile, environmental governance in many countries along the Belt and Road is much weaker than that in China, and Chinese companies are subject to fewer environmental regulations and constraints in these countries.

1.4. Chinese Financial Institutions Are Still Rendering Financing Services for Overseas Coal Power and Related Industries

To achieve the Paris Agreement emission reduction targets, multilateral development agencies and many foreign financial institutes have halted financial support to coal power projects, while Chinese financial institutions are still playing a pivotal role in endorsing coal power projects both at home and abroad. China's four largest commercial banks (Agricultural Bank of China, Bank of China, China Construction Bank, and Industrial and Commercial Bank of China) have invested far more in coal-related assets than their international competitors. According to the *Banking on Climate Change 2019* report, in 2018, 71% of the global coal mining financing and 55% of the financing for coal-fired power generation came from China's four largest commercial banks. The four banks also topped the global list of banks that funded coal projects between 2016 and 2018, as shown in Table 1-2. By examining their financing policies, one could discern the important factor for their strong backing of coal power: the four banks are yet to draw up restrictive or prohibitive provisions against coal power financing, which falls short of their mainstream international peers. Apart from the increased environmental risks of funding these projects, the banks are subject to potentially exorbitant financial risks as a result of the future tightening of climate and environmental protection policies.

Table 1-2. Ranking of coal power financing by Chinese commercial banks

Unit: USD 100 million

Ranking	Bank	2016	2017	2018
1	Bank of China	47.44	49.88	63.69
2	Industrial and Commercial Bank of China	51.96	55.79	53.21
3	China Construction Bank	56.36	31.88	28.72
4	Agricultural Bank of China	43.40	26.15	26.33

Data Source: Bank Track et al., 2019

Data from Boston University's Global Development Policy Center reveals that China's two major policy banks (China Development Bank and China Export-Import Bank) provided approximately USD 3.2 billion to foreign countries in financing energy projects in 2019, bringing the total since 2000 to USD 250 billion. Between 2007 and 2014, China Development Bank and the Export-Import Bank of China invested more in the energy sector overseas than the World Bank, Asian Development Bank, African Development Bank and Inter-American Development Bank combined. Between 2013 and 2017, 41% of the loans to the power industry were invested in coal power, 57% in large hydropower, and 2% in non-hydro renewable energy projects.

1.5. China Is Promoting Green Foreign Investment Policies

China has crafted a path toward green overseas investment through an enhanced policy framework. In September 2015, the Central Committee of the Communist Party of China and the State Council distributed the *Master Plan for Reforming the System of Ecological Civilization*, which called on the country to "strive for faster progress in eco-civilization, ensure that resources are used more efficiently, and step up efforts to promote the new pattern of modernization in which man develops in harmony with nature"(CPC Central Committee and State Council, 2015). In 2017, the *Guidance on Promoting Green Belt and Road*, jointly published by the Ministry of Environmental Protection, the Ministry of Foreign Affairs, the National Development and Reform Commission, and the Ministry of Commerce, proposed to "mainstream ecological civilization in the Belt and Road Initiative, bolster green development, strengthen eco-environment protection, and jointly build a green silk road"(Ministry of Environmental Protection of the People's Republic of China et al., 2017). In 2018,

suggestions on promoting sustainable finance and green finance, drafted by the G20 Sustainable Finance Study Group with the People's Bank of China as the lead, were incorporated into the Buenos Aires G20 Leaders' Declaration, driving a global consensus on green finance. The Network of Central Banks and Supervisors for Greening the Financial System (NGFS), of which China is one of eight founding members, has seen its membership and influence grow steadily.

Through building a green Belt and Road, China will put into practice the green development philosophy, adopt green as a way of life, build an ecological civilization, and achieve the 2030 SDGs. At the two Belt and Road Forums, China and its partners have launched the Belt and Road Sustainable Cities Alliance and the BRI International Green Development Coalition, formulated the Green Investment Principles for the Belt and Road Development, kicked off the joint establishment of the BRI Environmental Big Data Platform, and worked with other countries to implement the Belt and Road South-South Cooperation Initiative on Climate Change. On 25 April 2019, the Green Investment Principles for Belt and Road Development was put into the List of Deliverables of the Second Belt and Road Forum for International Cooperation. Twenty-seven large international financial institutions participated in the ceremony, which marks an emerging consensus on green investment under the BRI framework.

Chinese financial institutions and companies are beginning to realize the risks associated with coal investments and have started to act accordingly and divert from coal. In March 2019, Wang Huisheng, chairman of the State Development & Investment Corporation (SDIC), announced that the company had completely withdrawn from coal-related operations and will focus future investments in new energies. This makes the SDIC the first Chinese state-owned enterprise to completely divest from coal.

Though China is yet to be equipped with all-round expertise for building a 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. China's influence in green global governance will be enhanced, thereby raising its global stature in other arenas.

2. SOCIOECONOMIC DEVELOPMENT AND POWER INFRASTRUCTURE IN ASEAN

2.1. Positive Economic Growth but Uneven Development in ASEAN

Southeast Asia is one of the most economically vibrant regions in the world. The average annual growth of the regional GDP has amounted to 5.4% over the past decade, much higher than the global average of 3.3%. In 2018, the total GDP of the 11 Southeast Asian countries accounted for 3.65% of the world, making the region a key driver of world economic growth (see Figure 2-1). According to the e-Conomy SEA report jointly produced by Google and Temasek, "Southeast Asia's Internet economy continues to grow at an unprecedented pace, and it has soared to USD 100 billion for the first time in 2019." This momentum will continue in 2020. The report predicts that, by 2025, the region's Internet economy will triple in size to USD 300 billion (Google et al., 2019).

In 2018, the per capita GDP of Southeast Asian countries stood at roughly USD 4,783.8 (World Bank, 2020). According to the World Bank's classification of countries by income levels, the vast majority of countries in Southeast Asia, with the exception of Singapore,

Brunei, and Malaysia, are lower-middle-income countries. Singapore's per capita GDP of over USD 60,000 places the country comfortably at the top of the standings in the region. Brunei, which boasts the second-highest per capita GDP in the region, has a comparable per capita GDP to that of the developed world. However, the per capita GDP of most countries in Southeast Asia are still below USD 4,000, with the lowest being Myanmar'S USD 1,330. There are still notable disparities in development among the various countries in the region. Figure 2-2 shows the per capita GDP by country (World Bank, 2020).

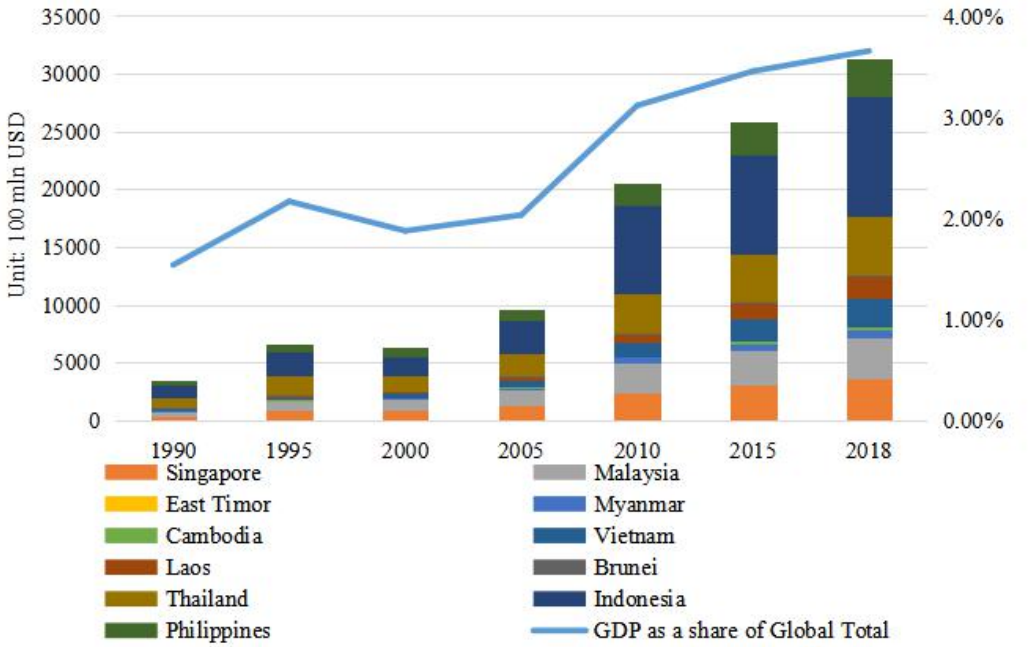

Figure 2-1. GDP of Southeast Asian countries and their global share, 1990-2018.
Data Source: World Bank, 2020

2.2. Rich in Energy Resources but Uneven in Energy Distribution Across Countries

Fossil-based energy remains the most important energy resource in Southeast Asia, but its geographic distribution is uneven. The technically recoverable natural gas, crude oil, hard coal, and lignite resources in Southeast Asia stand at 6.46 trillion cubic metres, 1.82 billion tonnes, 37.53 billion tonnes, and 10.23 billion tonnes, respectively, accounting for 39%, 29%, 38%, and 3% of their total reserves. **The distribution of fossil-based energy resources in ASEAN countries is extremely uneven** and primarily concentrated in four countries: Indonesia, Malaysia, Vietnam, and Thailand. Among them, Indonesia is the fifth-largest producer and second-largest exporter of coal in the world (ASEAN Center for Energy, 2017).

The region boasts a wide variety of renewable energy resources with considerable potential for development. There are abundant and diverse resources of renewable energy, including geothermal, hydro, biomass, solar, wind, and ocean energy. Resource endowments and conditions for development vary greatly from country to country. Hydropower is the primary source of renewable energy in Southeast Asia. Except for Singapore, where there are no large rivers, ASEAN countries have rich hydropower resources. Wind is mainly concentrated in Vietnam, Laos, Thailand, the northern Philippines, and parts of the coasts of other countries. In the region, the Philippines, Thailand, and Malaysia in particular receive a considerable amount of solar radiation, with an annual average of 5 kWh per square metre per day. Indonesia and the Philippines are also rich in geothermal resources. Indonesia is estimated to contain the world's largest geothermal energy reserves, accounting for

approximately 40% of the global total. The Philippines and Indonesia are endowed with abundant wave and tidal energy resources due to the large number of islands. Indonesia is the richest among its peers in Southeast Asia in biomass energy. The distribution of renewable energy in the region is shown in Table 2-1 below.

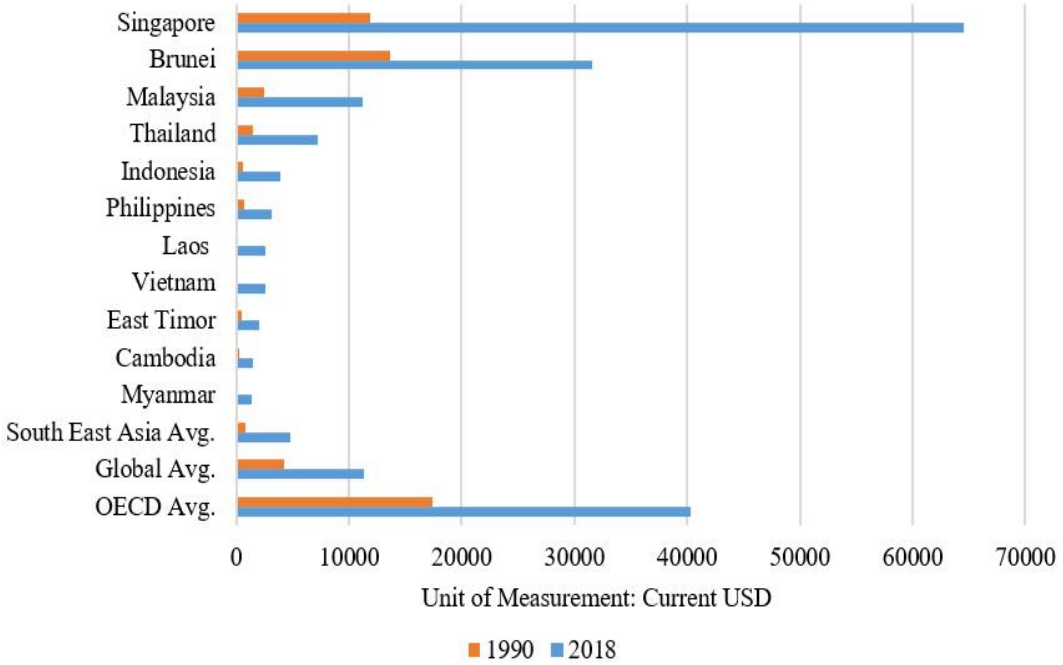

Figure 2-2. Per capita GDP of Southeast Asian countries
(Note: 1990 data of East Timor, Myanmar and Cambodia were missing and replaced by those from 2000)
Data Source: World Bank, 2020

2.3. Consumption of Primary Energy and Power Increasing Rapidly, Predominated by Fossil Fuels

The region has witnessed a rapid growth in energy use and has become a net importer of fossil fuels. The development of infrastructure and industrial bases in the region, coupled with higher incomes and the emergence and rise of the consumer class, have pushed up the demand for coal and natural gas, especially for the purpose of power generation. Consequently, primary energy consumption in Southeast Asia has grown substantially. Primary energy demand in the region has surged by more than 80% since 2000, with average annual growth of 3.4%, far exceeding the global average of 2% (see Figure 2-3). Rising fuel demand, especially for oil, has far outstripped the region's own production. For the first time, Southeast Asia as a whole will become a net importer of fossil fuels in the next few years.

Table 2-1. Distribution of renewable energy in Southeast Asia.

Country	Biomass (GW)	Geothermal (GW)	Hydro (GW)	Wind (GW)	Tidal (GW)	Solar ($kWh/m^2/day$)
Brunei			0.07			9.6–12
Cambodia			10			5
Indonesia	32.6	28.9	75		49	4.8
Laos	1.2	0.05	26			3.6–5.3
Malaysia	0.6		29			4.5
Myanmar			40.4	4		5
Philippines	0.24	4	10.5	76	170	5

Singapore					0.03-0.07	3.15
Thailand	2.5		15			5–5.6
Vietnam	0.56	0.34	35	7	0.1-0.2	4.5

Data Source: ASEAN Center for Energy, 2017

The energy consumption in Southeast Asia has long been dominated by fossil fuels, with renewable energy accounting for a small fraction. Fossil fuel consumption 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 source since 2000. Renewable energy (excluding solid biomass utilized for cooking) currently meets only 15% of the region's energy needs (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 to the total energy consumption remains low.

Electricity use has registered high growth, but consumption per capita remains low at approximately half of the global average. Electricity demand in the region has been climbing at an average of 6% per year, which far exceeds the global average, making it one of the world's fastest-growing electricity consumers. In addition, population growth and economic development will continue to spur power consumption in the region. In 2017, total power consumption in the region stood at roughly 937 billion kWh/year (data is missing for East Timor and Laos), and the per capita amount was 1,445 kWh/year. **Power consumption per capita varies greatly among countries. The average power consumption per capita in the region made up only half of the global average** (roughly 3,200 kWh/year) (see Figure 2-4).

The construction sector will overtake the industrial sector as the largest electricity consumer in the future. In the *Southeast Asia Energy Outlook 2019,* the International Energy Agency (IEA) forecasts that electricity consumption in the region will double by 2040, growing nearly 4% on an annual basis, twice as fast as the rest of the world. Electricity currently represents just 18% of total final energy use in Southeast Asia, lower than in most other regions. However, that proportion is expected to hit 26% in 2040, comparable to the global average. The construction sector (residential facilities and services) will experience the fastest increase in power use and jump by 250% by 2040 to reach over 1,200 TWh, making it the largest final consumer of electricity ahead of the industrial sector.

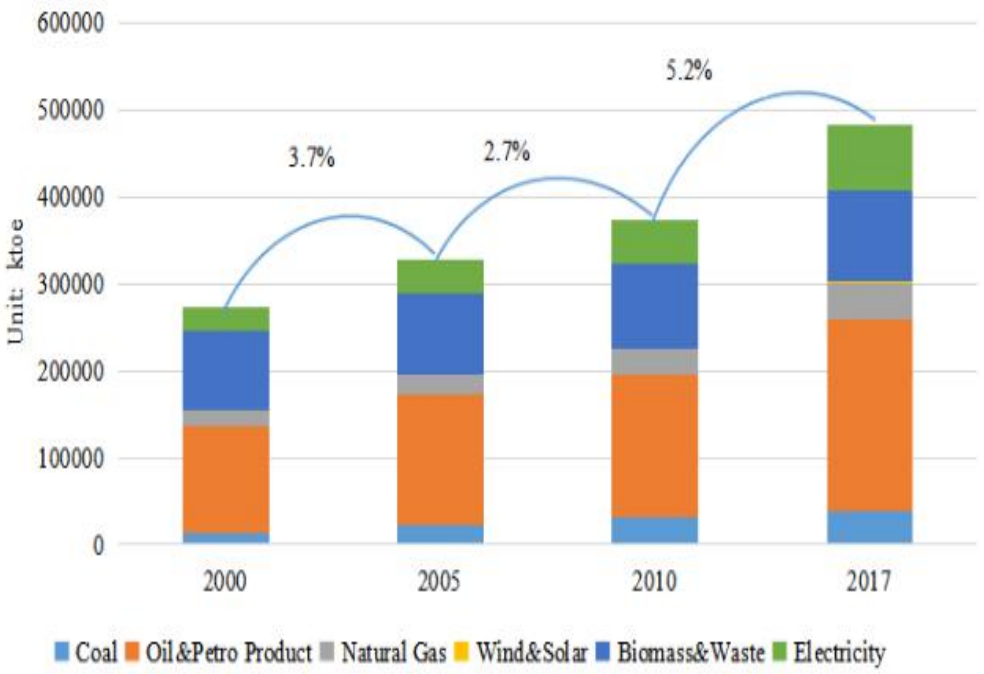

Figure 2-3. Primary energy consumption in Southeast Asian countries
Data Source: IEA, 2020 (data missing for East Timor and Laos)

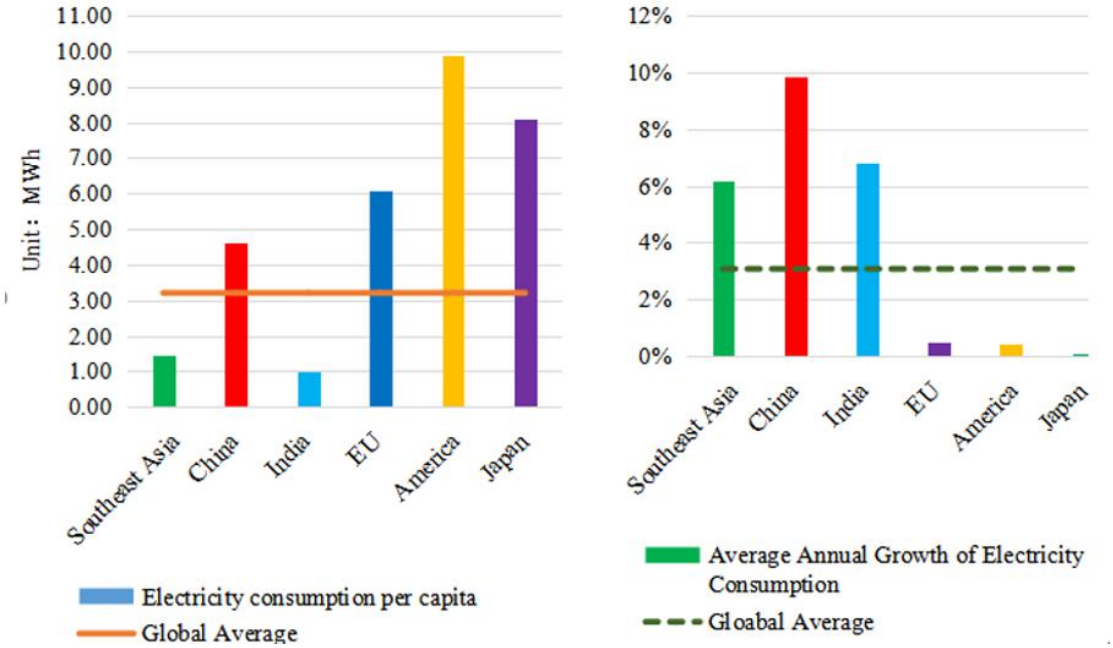

Figure 2-4. Average annual growth of electricity consumption and per capita electricity consumption, 2000-2017
Data Source: IEA, 2020 (data missing for East Timor and Laos)

2.4. There is a Significant Gap in Power Infrastructure, and Thermal and Hydropower Plants Provide the Majority of the Installed Power Generation Capacity

The installed electricity generation capacity of Southeast Asian countries has risen steadily in recent years. The region has experienced a major shift in the source of electric power from oil-fired to coal-fired power generation. In the meantime, the installed renewable power generation capacity is also growing continuously. In 2018, the installed capacity of coal, gas, and oil-fired power plants stood at 95 GW, 75 GW, and 25 GW, respectively (IEA, 2019). **The installed capacity of renewable energy reached 64.31 million kW**, of which hydropower (including small hydropower) accounted for 72.49%, followed by biomass at 11.78%, geothermal at 6.05%, solar at 6.95%, and wind at 2.73% (see Figure 2-5) (IRENA, 2020).

Total electricity generation in Southeast Asia registered at 1001.213 billion kWh in 2017 (Note: East Timor not taken into account for lack of data and 2015 data is used for Laos). **Of the total power production, 76.6% was derived from fossil fuel**, of which natural gas and coal contributed 37.76% and 36.19%, respectively, and oil merely 2.65%. The amount of **power produced from renewable sources** stood at 234.247 billion kWh **or 23.4% in the region. Within the category of renewable energy, hydropower (including small hydropower) made up 18.25%**, geothermal 2.3%, biomass 1.78%, wind 0.63%, and solar 0.25% (IEA, 2019). The gross production of electricity by Southeast Asian countries between 1990 and 2017 is shown in Figure 2-6 below; the power generation mix between 2000 and 2018 is presented in Figure 2-7; and the amount and sources of power generated in 2017 can be found in Figure 2-8.

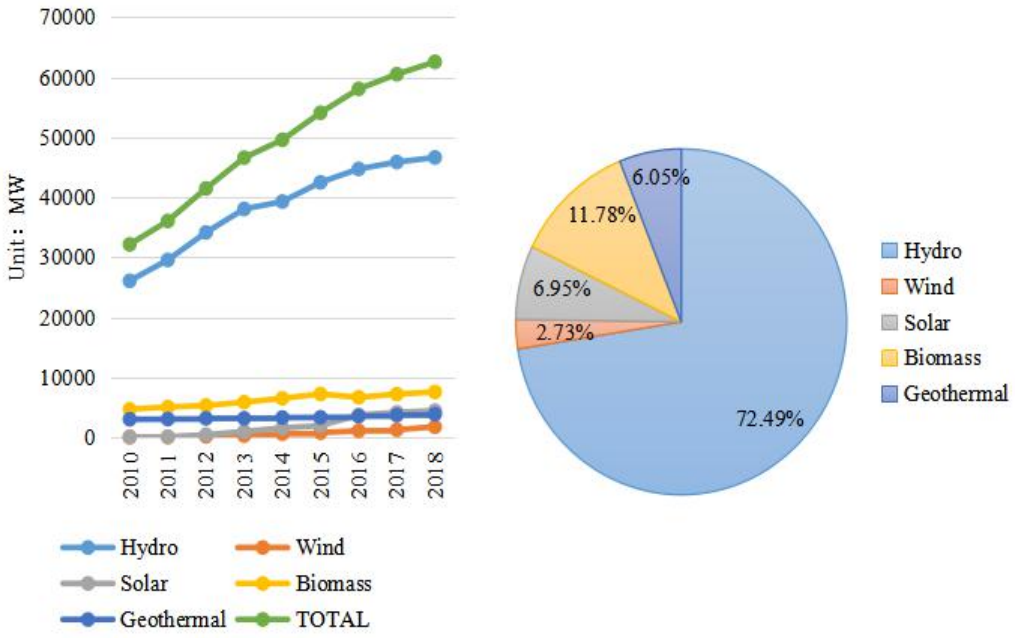

Figure 2-5. Development of Installed Renewable Power Capacity in Southeast Asia
Data Source：IRENA, 2020

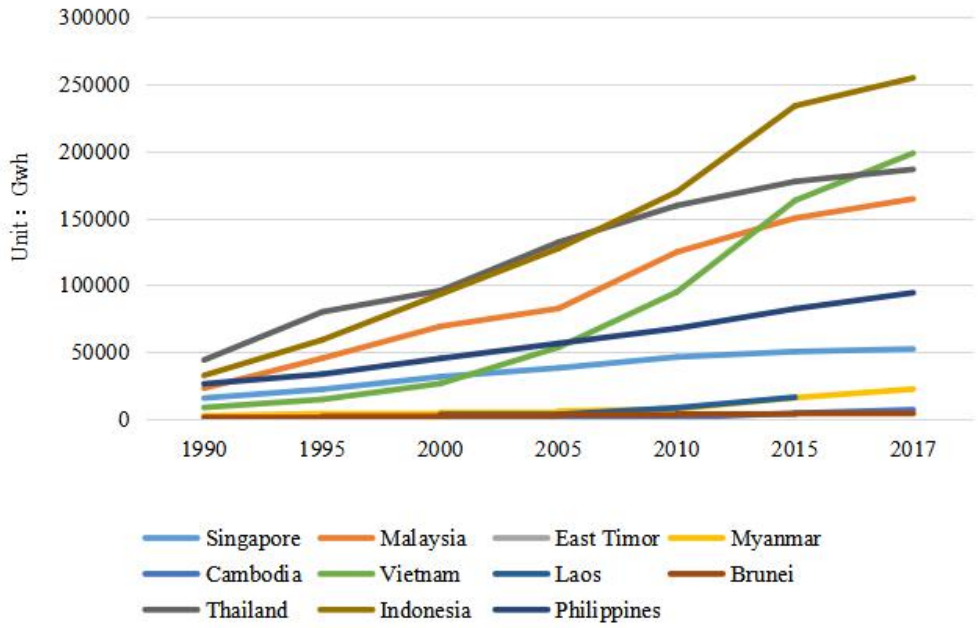

Figure 2-6. Total power generation in Southeast Asian countries from 1990 to 2017
Data Source: IEA, 2020

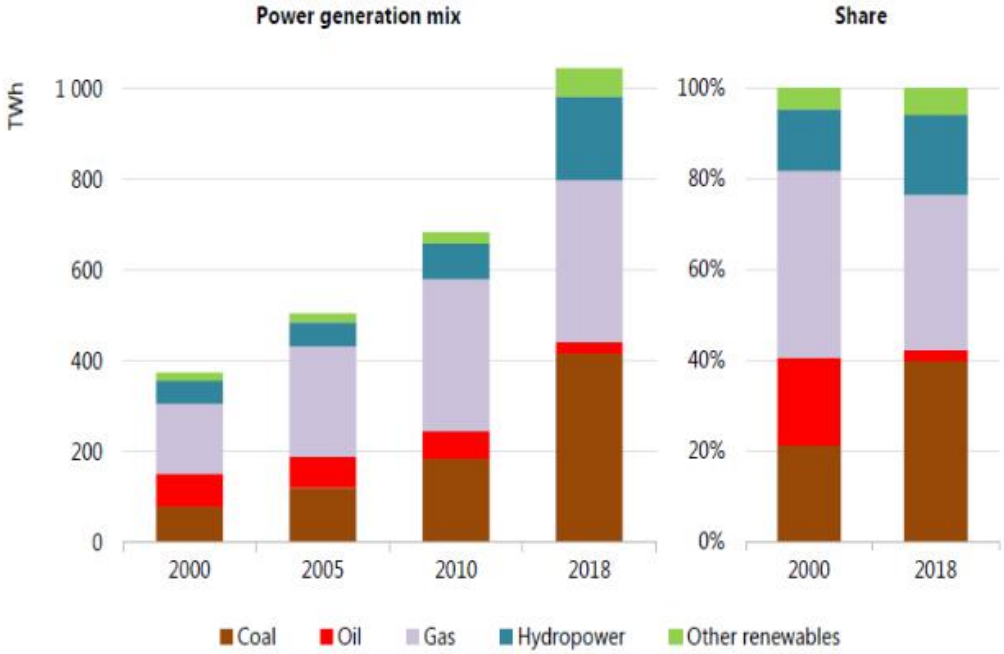

Figure 2-7. 2000-2018 installed power generation mix of Southeast Asia
Data Source： IEA, 2019

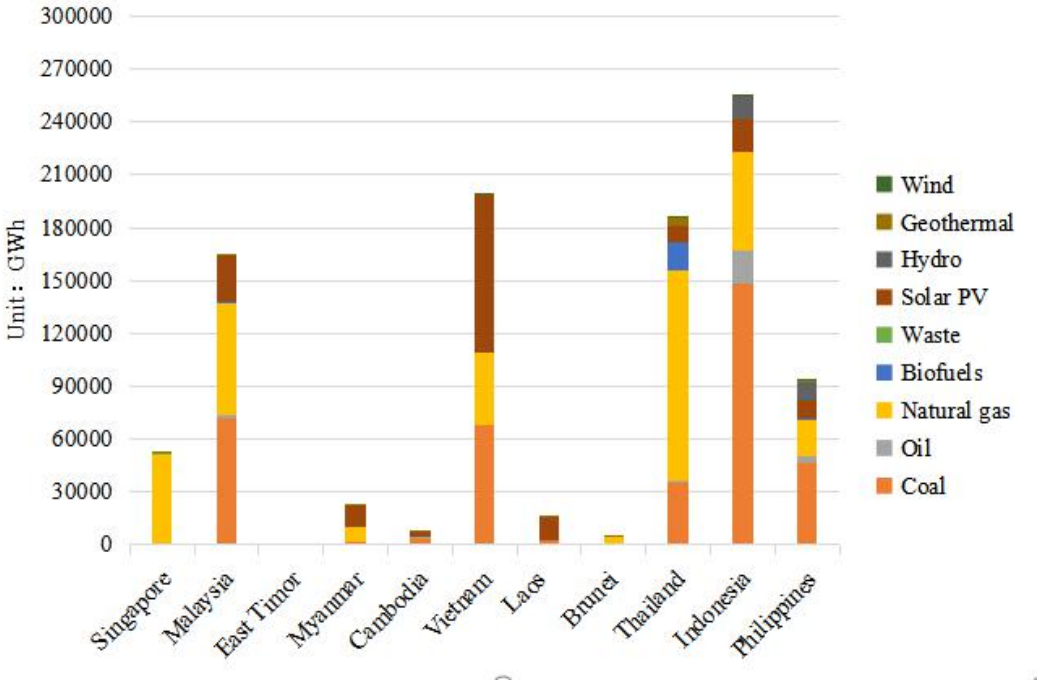

Figure 2-8. The amount and sources of electric power generated in 2017
Data Source: IEA, 2020

3. POWER MANAGEMENT POLICIES AND CLEAN AND LOW-CARBON DEVELOPMENT GOALS IN SOUTHEAST ASIA

3.1. The Power Sectors in Most Southeast Asian Countries Are Not Market-Based and Lack Incentives for Competition

The vertical integration/single buyer model is the most common form of power market of Southeast Asia, where power plants are not completely separated from the grid and a vertically integrated management model is commonplace (see Table 3-1). The only exceptions are the Philippines and Singapore, where market forces are more mature. The vertical integration is prone to market monopoly and the superpowers of certain market players.

Examples can be found in EGAT—the only power system operator and the biggest power enterprise in Thailand. It manages and controls the power supply through a 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 power markets in Singapore and the Philippines are characterized by liberal competition between retailers, and independent power producers play a crucial role in the market with total installed capacity making up over 50% of the national total.

Table 3-1. Power management mechanisms in Southeast Asian countries

Country	Market Structure	Power Generation	Power Transmission and Distribution	Power Consumption
Cambodia	Vertical integration/single	Independent power plant (IPP)	National power company	Phnom Penh, provincial capitals,

	buyer	National power company Rural power enterprises	Rural power enterprises	rural power enterprises
Brunei	Vertical integration/single buyer	Department of Electrical Services Berakas Power Company	Department of Electrical Services (operation) Berakas Power Company (maintenance and development)	End users
Indonesia	Vertical integration/single buyer	PT Pembangkitan Jawa-Bali (PTPJB) Indonesia Power IPP Leasing power plants	Indonesia Power	Residential Industry Commerce Others
Laos	Vertical integration/single buyer	National power company IPP	National power company	Key accounts End users
Malaysia	Vertical integration/single buyer	National power company IPP	National power company (in various regions) Sabah Energy Sarawak Energy	End users
Myanmar	Vertical integration/single buyer	Myanmar Electric Power Enterprise Hydropower enterprises IPP (hydropower)	Myanmar Electric Power Enterprise	End users
Thailand	Vertical integration/single buyer	Thai Power Authority IPP Small power plants Micro power plants	Thai Power Authority	Direct users End users Industrial zones
Vietnam	Cost pool	Vietnam Electricity IPP	Vietnam Electricity	End users
Singapore	Price pool	Domestic IPPs	Singapore Power Ltd.	End users
Philippines	Price pool	National power corporations—small power companies Independent power plants	National Transmission Corporation (TransCo)	Power supply market—monopolized Power supply market—non-monopolized

Note: Cost pool: on-grid order, size and price determined by the variable cost of power generation
Price pool: liberal and competitive retail market for power sector
Single buyer: buyer monopoly, minimum power bills for a given load
Data Source: ASEAN Center for Energy, 2017

The power price in Southeast Asia is heavily subsidized. The average sales price of electricity in major Southeast Asian countries is higher than in China, with Vietnam as the only exception (see Figure 3-1). The manufacturing sector in Southeast Asia is hampered by excessive power costs. For instance, based on the progressive tariff system in Myanmar's industrial and commercial sectors, the unit price is USD 0.1608 for power consumption between 10,000 and 50,000 kWh, USD 0.1281 between 50,000 and 200,000 kWh, USD

0.1067 between 200,000 and 300,000 kWh, and USD 0.0855 for consumption over 300,000 kWh. In Laos, three different power prices are defined for the industrial and commercial sectors, with a maximum of USD 0.1484 for the entertainment industry, a minimum of USD 0.07675 for high-voltage industries, and USD 0.1005 for other services.

The Philippines ranks the highest in power prices among all Southeast Asian countries due to its lack of power supply and has among the world's highest electricity bills for both residential and industrial purposes. The Philippines has adopted a categorized power pricing system with approximate rates of USD 0.2067 per kWh for residential consumption and USD 0.1144 per kWh for industrial use (Energy Observer, 2016). Thailand mainly relies on natural gas for its power plants, which represents roughly 60%–70% of its generated power. This has led to its high electricity pricing, at USD 0.1111 on average in 2016.

Vietnam enjoys the lowest power price in Southeast Asia at USD 0.0685 per kWh in 2016. Yet it is noteworthy that the affordability is accompanied by the instability of its power supply, with blackouts occurring now and then.

3.2. Increasing Energy Supply and Electrification Remains the Strategic Priority of Power Development in Most Southeast Asian Countries

Southeast Asia is one of the most dynamic players in the global energy system. Its members are in different economic development phases 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.

Southeast Asian countries have spared no effort in expanding access to electricity and securing rural electrification. At the 33rd ASEAN Ministers on Energy Meeting and a series of related events in October 2015 in Kuala Lumpur, the *ASEAN Plan of Action for Energy Cooperation (APAEC)* was adopted, with enhanced accessibility to electricity and modern energy being one of the key goals. It is noteworthy that ASEAN countries have long been dedicated to improving electricity access through renewable energy technologies and enabling rural electrification through distributive solar PV and micro-grids. **Yet many hurdles remain 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. In the end, results remain uneven between countries. The most challenging bottlenecks seem to be the lack of awareness, financial tools, and the lobbying power of incumbent companies.**

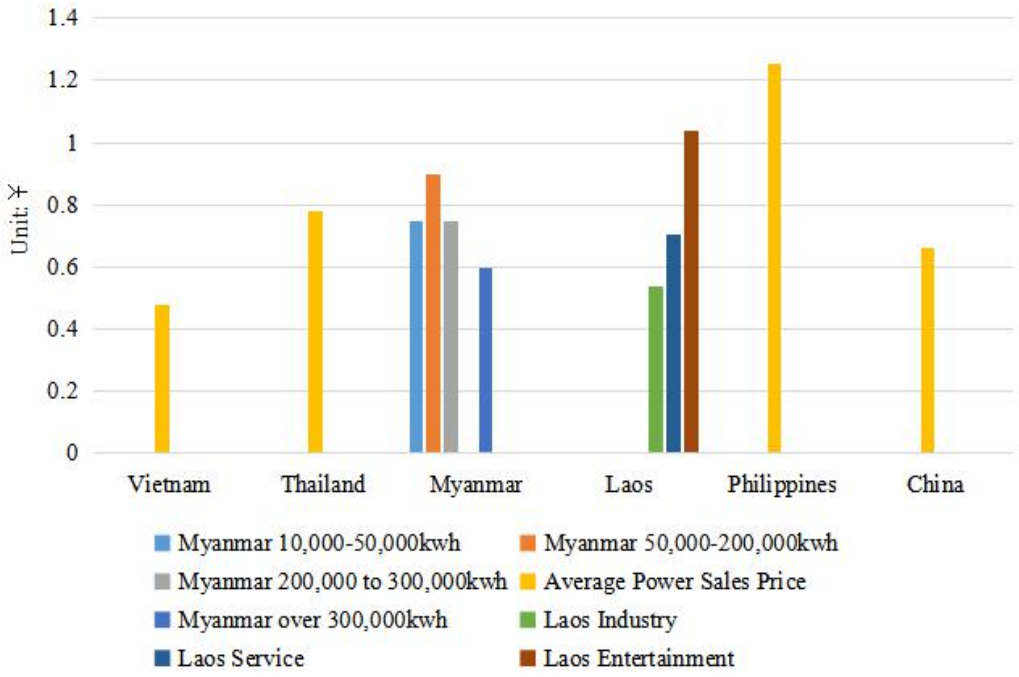

Figure 3-1. Power sales prices in Southeast Asian countries and China
Data Source: Energy Observer, 2016

Facilitate regional grid interconnection and energy integration. The interconnection of the power grid and infrastructure is a key factor in clean energy development. Therefore, a clean energy power transmission grid shall be a priority for energy and power development. Currently, most trade in power on the grid of Southeast Asia remains on a bilateral basis. Though cross-border grids exist in most countries, trade in power is largely non-directional (such as purchase agreements). To fully harness these grids, the region 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.

China has launched trials in power grid interconnection with Southeast Asian countries and is especially active in power project cooperation and development in the Greater Mekong Subregion (GMS). Power interconnection in GMS will eventually enable large-scale, long-distance stable power transmission and reception, large-scale power exchange between multiple countries and minor power exchange in border regions between neighbouring countries, with total exchange expected to reach approximately 50 million kW. The EU's experience with electricity market integration could be applied in ASEAN. Directive 90/377/EEC of the European Union regulating electricity market reform imposes transparency in the prices of electricity and natural gas for all industrial users, and Directive 90/547/EEC on electricity transmission aims to remove barriers between member states and establish a single EU electricity market.

3.3. Renewable Energy Gets Attention with a Multi-Pronged Approach to Boost Renewable Sources of Electricity

In recent years, Southeast Asian countries have turned their eyes to renewable energy and set corresponding targets in national plans and strategies. According to ASEAN plans, renewable energy shall represent 23% of the primary energy mix by 2025. Specific 2030 targets of different countries are listed in Table 3-2.

Table 3-2. Renewable energy development targets of Some Southeast Asian countries

Country	Target

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
the Philippines	Energy consumption decreasing by 16% annually based on the baseline forecast by 2030
Singapore	Installed capacity of solar PV reaching 350 MW by 2020 and 1 GW afterwards
Thailand	Increased shared of renewable energy in end consumption, reaching 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: IEA, 2019

As for Nationally Determined Contributions (NDCs), despite these countries' varying emission reduction targets, renewable energy constitutes an important component (see Table 3-3). Singapore and Malaysia have opted for emission intensity as their emission reduction indicator; Myanmar and Laos have proposed policy actions without quantifiable mitigation targets. Brunei, the 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, thus highly motivated to reduce emissions.

Table 3-3. Climate change mitigation targets pledged in country NDC

Country	Climate Change Mitigation Targets	Target Year	Description ("Conditional" refers to availability of national aid and technical support)
Brunei	Absolute emissions reduction under the relative baseline scenario	2035	(1) Energy sector: energy consumption reduction by 63% (from business as usual [BAU]), share of renewable energy reaching 10% in total energy; (2) Land transport sector: carbon dioxide emissions cut by 40% (BAU); (3) Forest coverage reaching 55% with 34% increase (based on current figure, 2015).
the Philippines	Absolute emissions reduction under the relative baseline scenario	2030	By 2030, greenhouse gas emissions will be reduced by about 70% compared with the baseline scenario.
Malaysia	Carbon intensity	2030	Unconditional carbon emissions intensity reduction by 35% + conditional emission cut by 10% (2005 as baseline year).
Cambodia	Absolute emissions reduction under the relative baseline scenario	2030	Unconditional: except for land use, land-use change, and forestry (LULUCF), the total emissions decreased by 27% compared with the baseline scenario. Conditional: forest coverage reaching 60%, LULUCF emission cut by 57%.
Singapore	Carbon intensity	2030	Carbon emissions intensity reduction by 36% in 2030 from 2005.
Thailand	Absolute emissions reduction under the relative baseline scenario	2030	Unconditional: 20% reduction by 2030 compared to baseline scenario. Conditional: increase to 25%.
Vietnam	Absolute emissions reduction under the relative baseline scenario	2030	Unconditional: 8% reduction by 2030 compared to baseline scenario. Conditional: increase to 25%.
Indonesia	Absolute emissions reduction under the relative baseline	2030	Unconditional: 29% reduction by 2030 compared to baseline scenario.

	scenario		Conditional: increase to 41%.
Myanmar	Policy action, no quantifiable mitigation target	-	-
Laos	Policy action, no quantifiable mitigation target	-	-

Data Source:UNFCCC, 2020

To facilitate renewable energy development, ASEAN members have rolled out supportive policies and incentives. As is seen in Table 3-4, from the industrial perspective, support policies offered by ASEAN members include: setting renewable energy targets, introducing a feed-in tariff (FIT) policy, self-consumption plan and competitive tendering (auctioning). Policy incentives include tax incentives, preferential loans, capital subsidy, tradable renewable energy certificates, etc. **Among many incentives, the FIT has gradually emerged as the centerpiece for boosting renewable power.** The FIT has been generally adopted in countries with high growth in the installed capacity of renewable energy, such as Indonesia, Malaysia, the Philippines, Thailand, and Vietnam. Among these countries, Indonesia has identified the price cap of regional and national power costs as the standard while the rest of the countries have opted for the levelled power cost plus extra subsidy for investment returns of different technologies as the standard (see Table 3-5). In general, FIT policies in Southeast Asian countries are subject to frequent changes with immature design in the specific mechanism, hence the need for improvement according to feedback on existing policies.

Table 3-4. Incentive measures of renewable energy development in ASEAN countries

ASEAN Countries	Renewable Energy Target	FIT	Self-Consump. Plan	Competitive Tendering (auctioning)	Tax Incentives	Preferential Loans	Capital Subsidies	Tradable Renewable Energy Credit
Brunei	√							
Cambodia	√			√	√			
Indonesia	√	√	√	√	√			
Laos	√				√			
Malaysia	√	√	√	√	√			
Myanmar	√				√			
the Philippines	√	√	√		√			√
Singapore	√			√	√			
Thailand	√	√	√	√	√	√	√	
Vietnam	√	√	√		√			

Data Source: ASEAN Center for Energy and China Renewable Energy Engineering Institute, 2018

3.4. Environmental Standards and Institutional Regulations Are Taking Shape with Growing Public Awareness for Environmental Protection

In recent years, a stringent environmental standard framework has emerged in Southeast Asian countries. Taking the environmental quality standard as an example, Southeast Asian countries have all promulgated their national standards for air quality, which are regularly reviewed and updated, with Myanmar as the only exception. Despite the gap in air quality standards, some countries have narrowed the gap in conventional pollutants such as sulphur dioxide (SO_2) and nitrogen dioxide (NO_2), compared to the United States and the EU, by updating their own standards. The average daily limit is 105 ug/m^3 for SO_2 and 75 ug/m^3 for NO_2 in Malaysia, both of which are higher than Grade II standards of China; however, Malaysia's SO_2 standard remains lower than Western standards, such as that of the EU (Liu Yi, 2018).

Table 3-5. FIT mechanisms by country

Country	FIT mechanism
Indonesia	The FIT is based on energy production cost rather than technical cost and requires a comparison between the local production cost of energy (LPCE) and the national production cost of energy (NPCE). For solar, wind, biomass, biogas, and tidal, maximum FIT shall be 85% of LPCE if LPCE is higher than NPCE. 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 (state-owned PLN and IPPs).
Malaysia	The FIT of renewable energy companies is determined by an annual quota granted by the government.
Philippines	The FIT is fixed rather than determined by the type of renewable energy, specific regions, or scope of capacity.
Thailand	Renewable energy technologies are classified into two types: natural energy (hydropower, wind power, solar PV) and bioenergy (urban solid waste, biomass, biogas). There are two types of natural energy FITs: fixed FITs and extra subsidy (subsidy premium of three southern provinces). The FIT of bioenergy consists of two parts: fixed FIT and variable FIT (the variable depends on the inflation rate).
Vietnam	A nationally uniform and fixed FIT is adopted for all types of renewable energy rather than setting an FIT based on specific regions or installed capacity.

Data Source: ASEAN Center for Energy and China Renewable Energy Engineering Institute, 2018

The environmental charge, as per existing laws in Southeast Asian, countries is mainly a pollution discharge fee, which is directly levied from polluters according to the type and quantity of pollutants legally ratified by environmental protection authorities. In addition, an environmental protection fee is also charged from enterprises in some countries. Vietnam, for instance, applies such fees on manufacturers of petroleum, diesel, lubricant, coal, HCFC solution, nylon bag (taxable), herbicide, formicide, forestry product preservative, solid disinfectant, etc. Environmental protection fees levied on oil extraction, gas exploitation, and nylon bag production are 4.306 USD/tonne, 8.611 USD/tonne, and 1.292–2.153 USD/kg, respectively (Liu Yi, 2018).

However, the implementation and enforcement of environmental laws is less commendable in Southeast Asian countries due to the following reasons: (1) structural defects exist in the legal system with inconsistencies in legal authorization, multi-layered structure and forms of existence, as well as overlapping or conflicting authorities that compromise the execution of the law; (2) the vertical segmentation of the institutional structure makes horizontal coordination difficult among ministries and departments; (3) the lack of public trust for law and the judicial system (Fan Chun, 2008). In recent years, strengthened penalties for environmental violations, integration of environmental and resource conservation authorities, enhanced efficiency in environmental administration, and rigorous law execution have improved the situation.

The voices of residents and environmental protection organizations are seldomly heard. Investments such as coal-fired and hydropower plants have triggered a backlash from the local community due to severe social and environmental impacts, potential damage to people's quality of life, and the possibility of violating the national pledge for carbon emission reduction. In Indonesia, residents of Bengkulu Province in Sumatra reacted against the Bengkulu 2*100 MW PLTU steam coal-fired power plant for lacking local community involvement during the environmental impact evaluation and analysis prior to project kick-off

and the negative impacts on marine life and mangroves. Civil societies were also critical of the coal-fired power plant constructed by China on the grounds of potential air and water pollution in Java-Bali and impairment to tourism in Bali. However, the outcry of residents and environmental NGOs were not taken seriously or examined. In most cases, only a small portion of the local communities are solicited for their opinions. The information transparency concerning environmental and social impacts is undermined by too few opinion solicitations from local communities or meaningful engagement of residents in project decision-making.

4. THERE EXISTS ENORMOUS DEMAND FOR POWER INFRASTRUCTURE INVESTMENT IN SOUTHEAST ASIAN COUNTRIES

4.1. Power Infrastructure Investments in Southeast Asia Promises May Hit the Trillion Threshold While Renewable Power May Be the Investment Focus

Southeast Asia is an important destination for the relocation of Chinese industries. With its per capita power consumption around half of the world average, the region is expected to maintain steady growth in installed capacity in the next 10 years, supported by the growing population and industrial development. According to a forecast under the existing policy framework, the installed power capacity in the region will see a net increase of 90 GW for coal-fired energy and over 180 GW for renewable energy (IEA, 2019). Taking transport, labour, and construction experience into consideration, the investment costs will be higher than those of China. At a unit construction cost of 5,000 CNY/kW, the market size of energy (power plant project) investment in the region will reach CNY 1 trillion in the next two decades.

Air pollution is Southeast Asia has become a major environmental issue during the expansion of power infrastructures. At present, most Southeast Asian countries have developed their goals for renewable energy and come up with supporting policies. From the perspectives of technological cost, energy security, environmental constraints, and international trends, further development of renewable energy is indispensable for the region.

4.2. China's Involvement in Power Infrastructure Development in Southeast Asia

4.2.1. Apart From Coal-Fired Power Plants, China Is Actively Engaged in Renewable Energy Projects in Southeast Asia

South Asia and Southeast Asia are the main destinations of China's investment in coal-fired power plants. A statistical analysis by Greenpeace based on disclosed information shows that, by the end of 2018, Chinese enterprises had built 10.8 GW of coal-fired power plants overseas through equity investment, nearly 94% of which are in South Asia and Southeast Asia; another 23.1 GW is in the planning or construction phase. Based on the estimated construction cost of coal-fired plants in China recently (unit construction cost of thermal power stations launched in 2016–2017 was 3,593 CNY/kW), the total investment in these uncompleted projects is close to CNY 83 billion (Greenpeace, 2019).

While investing in coal-fired projects, China is also actively involved in renewable energy projects in South Asia and Southeast Asia. According to statistics and analysis by Greenpeace, from 2014 to 2018, wind power and solar PV projects involving China via equity investment are mainly in South Asia and Southeast Asia. During this period, in countries including Pakistan, India, Malaysia, and Thailand, the total completed installed solar PV capacity with an equity investment from Chinese enterprises reached 1,185 MW, accounting for 93% of total investment in countries along the Belt and Road in the same period. In addition, another 996 MW of installed solar PV capacity is in the planning or construction

phase, which will bring the total Chinese contribution to 2,181 MW in these countries. The installed capacity of solar PV power stations invested in or planned for investment by China in Bangladesh, Afghanistan, Vietnam, and Pakistan had exceeded 30% of total solar PV installed capacity in these countries by the end of 2018. Apart from equity investment, from 2014 to 2018, China participated in constructing 8,440 MV of solar PV power stations in countries along the Belt and Road by exporting equipment. During this period, three of the top five destinations of China's solar PV equipment export were in South Asia and Southeast Asia, namely India (5,800 MW), Thailand (1,060 MW), and the Philippines (250 MW). In the same period, approximately 80% of wind power projects in 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 1,362 MW under construction or planning, adding up to 1,759.5 MW (Greenpeace, 2020).

Furthermore, Southeast Asia is also a hub for overseas solar PV bases launched by Chinese enterprises. A total of 12 Chinese solar PV enterprises have participated in building solar PV component factories in the manufacturing base hub in Southeast Asia, especially in Vietnam and Thailand, with an announced capacity of 7 GW.

4.2.2. Engineering, Procurement, and Construction (EPC) Are the Most Common Chinese Involvement in Overseas Power Infrastructure Projects, yet China Is now Migrating from EPC to Equity Investment

China's participation in foreign power infrastructure projects is mainly through equity investment, financial support, EPC, and equipment export, etc. Each coal-fired 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 periods from project assistance to EPC to the current integrated project development for overseas coal-fired power plant investment, which has allowed Chinese equipment, technologies, and capital to gradually make their way to foreign markets.

From 2009 to 2018, China participated in building 74.3 GW of overseas coal-fired projects via EPC and 10.8 GW via equity investment, meaning that EPC is the most common for China in foreign coal-fired power projects. This makes Chinese enterprises merely "constructors" or "equipment providers," who are only entitled to short- and mid-term economic gains, rather than decision-makers. In this case, Chinese businesses are primarily driven by market forces, the demand of the host countries for energy development, and enterprises' pursuit of profit. The relationship between China and the host country and the policies of the Chinese government are only secondary factors.

But the situation is now changing. The first batch of overseas coal-fired power plants with Chinese enterprises as equity investors was put into operation in 2012. According to Greenpeace, overseas coal-fired power projects with China as an equity investor added to an installed capacity of only 0.4 GW before 2013, but the figure soared to 10.4 GW from 2014 to 2018, 26 times that of the previous 5 years. The year **2018 marked the first time that the installed capacity built by Chinese enterprises through equity investment exceeded that of EPC, reaching 3.5 GW, and the role of Chinese investors in foreign coal-fired power projects is gradually shifting from EPC to equity holder.** In the 5 years from 2019 to 2023, the capacity of coal-fired power projects with Chinese enterprises as an equity investor, whether built, under construction or in planning, is on track to reach 39.8 GW. Another 24.1 GW will be added through EPC. **Equity investment will overtake EPC in terms of installed capacity of coal-fired power projects in the future as China's mainstream foreign coal-fired power investment (Greenpeace, 2019).**

4.2.3. Chinese State-Owned Banks and Major State-Owned Enterprises Are Strong Backings for Overseas Coal-Fired Power Investments, While Most Private Enterprises Favour Renewable Energy Projects

Most Chinese investors and developers in the coal-fired power sector are state-owned enterprises. Policy banks such as China Development Bank and China Import-Export Bank are the leading players among financial institutions, followed by commercial banks such as Bank of China and Industrial and Commercial Bank of China. Major state-owned enterprises—including State Grid, which monopolizes China's public utilities market, Sinomec in infrastructure, State Power Investment Corporation and China Huadian Co., Ltd.—are the giants in the power sector and take the biggest share among all competitors in the field. **In contrast, about two thirds (64%) of outbound energy investment by private enterprises goes to renewables** (Zhou Lihuan et al., 2018).

4.3. Evaluation of China's Participation in Power Infrastructure Construction by Southeast Asian Countries

Chinese bids for power plants are cheaper and respond to local demand for cheap solutions. According to a local expert interviewed for this report, local actors are divided on the Chinese construction of local power infrastructure, and some local actors are satisfied with the Chinese companies bringing additional power generation capacity to support the local economy's growth.

However, Chinese plants are sometimes subject to quality issues and might affect the effectiveness of the plant and the cost-effectiveness. In general, according to local experts, the global reputation of Chinese manufacturing in infrastructure is not very high.

Local populations are increasingly sensitive to air quality, water usage, and environmental pollution issues, and the impacts on health. According to a local expert, air pollution, both from traffic and new coal power plants, is increasingly becoming a public issue. Air pollution is already reaching levels previously seen in China, given the same pathway of growing industry and unabated coal power, although the use of ultra-supercritical technologies might lead to lower levels of air pollution. Air pollution is becoming an issue of public concern in the already high-density industrial and road traffic areas where the new plants are installed. These new investments are unlikely to be modified in the short term, given the limited available cash, and therefore the health impacts are highly likely to last for the next decades.

Chinese companies often bring their own workforce, which brings limited development opportunities, capacity building, and independence for the local community.

The involvement of the local population—notably, through consultations with the local community, NGOs and civil society—is lacking when Chinese actors implement power projects. In comparison, according to local experts, projects led by BP, for instance, used to inform and consult local NGOs on a weekly basis when conducting infrastructure projects. The foreign-led projects would push forward best international practices in terms of environmental, social, and corporate governance (ESG), safety, and environment to ensure a sustainable local economy.

A local bribery case[3] in 2019 involving a power purchase agreement between PLN, Indonesia's local energy producer and distributor; Blackgold, an Indonesia-focused coal mining company; and China Huadian Engineering Co. Ltd. led to the arrest of nine officials,

[3] https://www.chinadialogue.net/article/show/single/en/11375-Corruption-and-coal-dug-up-in-Indonesia

including the chief executive of PLN and a former Social Affairs Minister. Experts in local power investments estimate that the risk of corruption is higher in relation to high-growth infrastructure projects. These kinds of cases risk eroding public trust in the coal sector. In 2016, the Corruption Eradication Commission (KPK) found that 40% of 10,992 coal sector licences issued in four Indonesian provinces had failed to meet all legal requirements, including the payment of taxes, land rents, and other royalties. As a consequence, over 2,000 of these permits have been revoked or allowed to expire.

5. CASE STUDY OF LOW-CARBON TRANSFORMATION OF POWER INFRASTRUCTURE IN SOUTHEAST ASIA: INDONESIA[4]

5.1. Despite the Sustained Rapid Increase in Power Supply in Indonesia, the Per Capita Power Usage is Fairly Low

Indonesia is a vast archipelago comprising more than 17,000 islands. The five major islands are Papua, Kalimantan, Sumatra, Sulawesi, and Java. Indonesian territory covers 1.9 million km^2, comparable to one fifth of China or the United States. It is administratively divided into 34 provinces, from Aceh on the western tip of Sumatra to Papua in the east. At 264 million in 2018, the Indonesian population ranks fourth after China, India, and the United States, and it is the most populous nation in Southeast Asia. The population is spread unevenly among the 6,000 inhabited islands, with 57% residing in Java and Bali and 43% spread across the remaining islands.

Recent years have witnessed a 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% YOY. **With expanding power supply, electrification in Indonesia has continuously improved,** up from 78% in 2013 to 97% in 2018, connecting 12.8 million people per year on average and reducing the number without electricity supply from 54 million in 2013 to 8 million in 2018. But the country's power access is unevenly distributed, with nearly 100% in the western region（DKI Jakarta, Ba，Banten， West Jave，DI Yogyakarta) and only 59.85% in southeastern region（ Nusa Tenggara Timur [NTT]) (PWC, 2018).

Between 2013 and 2018, total electricity consumption grew from 187.5 TWh to 234.6 TWh, up 5.1% YOY. The household sector consumes the largest share of electricity, followed by industry, business, and public service, with shares averaging 42%, 33%, 18%, and 6%, respectively (Annex 2). But the per capita power use is relatively low at only 888 kWh per person in 2018, which was way below the world average and even a far cry from the average in Southeast Asia (1507 kWh per person in 2015).

5.2. Renewable Energy Has Potential, but Fossile Fuels Predominate the Generation Mix

Between 2010 and 2017, power produced from fossil fuels accounted for 85%–90%. In that period, oil declined from 22% to 5.81%, gas remained stable, and **coal climbed from 38% to 57.22%** (PWC, 2018) (Figure 5-1). This data suggests that 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 (Annex 3), **though subcritical technology is still in use, large and new power plants (mainly on Java Island) primarily use super critical or ultra-super critical technologies.**

[4] This section is mainly contributed by Dr. Maria Retnanestri, Director of IPEN Pty. Ltd and an Indonesian energy specialist.

From 2010 to 2017, the share of hydropower in the generation mix dropped from 12% to 7.06%, while other renewable energy except hydropower grew from 3% to 5.09%. As a whole, the share of renewables fell from 15% to 12.5%. This data shows the relatively low percentage of renewable energy in the generation mix (PWC, 2018).

The plan for additional electricity generation capacity from 2020 to 2028 (Annex 4) indicates that fossil fuel will decline in its percentage of additional power generation capacity to 70%, but coal will remain high at 48%. This points to the irreversible importance of coal in the short term. The share of renewables will increase to 30%.

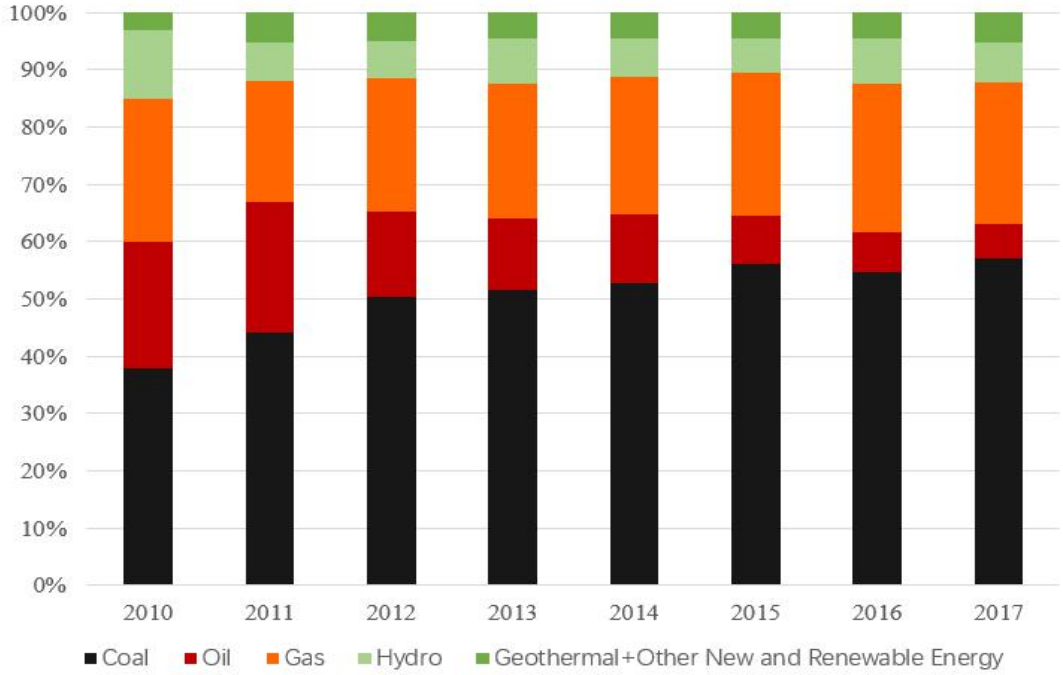

Figure 5-1. Share of electricity generation capacity by energy type
Data Source: PWC, 2018.

Indonesia's electricity supply systems are not integrated into one interconnected system due to its archipelagic nature. To attain the 100% power supply goal, a distributed renewable energy power system provides one of the viable solutions.

5.3. Indonesia Has Set Targets for Renewable Energy Development, but Coal Is Still Deemed as an Indispensable Tool for Achieving the 100% Electrification Goal

5.3.1. The Goal of Power Development

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, the power generated by renewables should reach 23% of total electricity generation in the country. According to the planned investment of renewable energy in 2025, it is estimated that the investment in solar PV generation will be USD 17.45 billion; hydropower and micro hydropower will be USD 14.58 billion; wind power generation will be USD 1.69 billion; waste treatment power generation will be USD 1.67 billion; biomass power generation will be

USD 1.37 billion; and hybrid power generation will be USD 260 million (Wang Yingbin,2019).

5.3.2. Policies for Promoting Renewable Energy Development

The Indonesian government has rolled out a range of policies to spur the development of renewable energy.

- 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, replacing Ministerial Regulation 12/2017, on mechanism and pricing of renewable electricity purchase by PLN:

    - Mechanism: Build, Own, Operate and Transfer (BOOT).

    - Electicity purchase price: Solar PV power, wind power, biomass power, biogas power, and ocean power should be no more than 85% of local average generation cost (BPP) and hydropower, waste power, and geothermal power can be up to 100%.

- Presidential Regulation 35/2018, replacing Presidential Regulation 18/2016, on the acceleration of waste power development for electricity in 12 major cities in Indonesia.

- Ministerial Regulation 41/2018, replacing Ministerial Regulation 26/16, on biodiesel financing for palm oil businesses.

- Ministerial Regulation 49/2018 on rooftop PV.

In 2018, the Indonesian Parliament called for speeding up the legislative process of renewable energy power generation and actively invited stakeholders and academic representatives to participate in legislative discussions.

5.4. Challenges for Low-Carbon Transformation of the Power Sector in Indonesia

5.4.1. Lack of a Full-fledged and Robust Renewable Energy System and Policy

First, the policy lacks consistency and adequacy. Frequent policy changes undermine investor confidence and increase project development risks, and the inadequate policy makes it difficult to grow the percentage of renewables in power generation, a case being the Ministerial Regulation 13/2019 on Rooftop PV. While the government argued that the policy would allow solar PV owners to save 30% on their energy bills, other voices said the 65% scaling of energy outflow to the grid is deemed to discourage public willingness to invest in solar PV. **Second, it takes complicated procedures to acquire a land-use permit.** For example, geothermal resources are often located in a protected forest or conservation forest, making it complicated to obtain a development permit. **Third, certain systems and policies are absent.** There are currently no incentives and investment attraction regulations to boost the uptake of renewable power generation.

5.4.2. Renewable Energy Is Not Attractive for Investment

First, renewable energy pricing is not competitive. The power purchase price by PLN at 85% of BPP is considered unattractive, as developers may be unable to recover their investments and make a reasonable profit. Such pricing is seen as placing renewables at the unfavourable position of being unsubsidized while competing with subsidized coal electricity.

Second, renewable energy subsidies are unclear. Appropriate subsidies make investment more appealing in renewable energy power generation, but Indonesia currently lacks clarity on renewable subsidies for the buyer.

5.4.3. Fossil Fuels Are Easily Available

The abundant reserves and lower prices of fossil fuels make it hard to move Indonesia toward renewables for power generation in the short term. Coal resources are available in Indonesia with a reserve-to-production ratio of 61 years. Annual coal power station installation is planned to peak in 2020–2023 and slow down to 2028. The 2019–2028 total additional installation of 27,064 MW remains the largest in proportion at 48%. **Gas resources are available in Indonesia with a reserve-to-production ratio of 49 years.** Additional gas generating capacity installation is scheduled to peak by 2022, and, in 2019–2028, the additional 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.

5.4.4. Renewable Energy Has Great Potential but High Cost for Power Generation

Despite its tremendous potential (Table 5-1), the 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, are very site specific, thus only possible to be developed in certain provinces. Otherwise, the higher cost of renewables compared to fossil fuel is the main reason (Annex 5-6). **The construction/investment of renewable energy power generation is generally more expensive than fossil fuels.** The construction/investment cost of hydro, thermal, and solar PV power stations is 1,500 USD/kW, 1,750 USD/kW, and 1,200 USD/kW, respectively; for coal, diesel, cogeneration and gas it is only 1,250 USD/kW, 900 USD/kW, 680 USD/kW, and 400 USD/kW. **From the operation cost point of view, renewable energy doesn't stand out either.** The unit operation cost of hydro, thermal, and solar PV power stations is 18 USD/MWh, 106 USD/MWh, and 411 USD/MWh, respectively, while coal, diesel, cogeneration, and gas is 51 USD/MWh, 179 USD/MWh, 86 USD/MWh, and 344 USD/MWh.

5.4.5. Renewable Energy Development Is Set to Hurt Vested Interest

In the power market, the producers are limited in number and face high entry barriers. Diverse producers in the power generation industry offer the same product. Coal and other conventional fossil fuel generators have long been established in the market, and their interests would be impaired if renewables got a big boost. In Indonesia, the state firm PLN has a market monopoly, and, given the high uptake of coal power in its electricity portfolio, the company would spare no effort to avoid stranded coal assets. Furthermore, it would prioritize grid stability and curb the size of renewables connected to the grid.

Table 5-1. National Energy Master Plan of Indonesia

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

5.5 International Cooperation of Coal Power Development in Indonesia

5.5.1. Overview of Power Cooperation

To fill the funding gap in power investment, Indonesia strongly encourages international cooperation on coal power. Between 2015 and 2019, the government could only secure 41% of the infrastructure funding needed; the rest was expected to be financed by the private sector, along with knowledge and experience sharing in the development, operation, and management of infrastructure services. Collaboration models include IPP or Kerjasama Pemerintah Swasta (KPS) (known as public-private partnerships [PPP] in English).

China, Japan, Indonesia, and Malaysia are the biggest investors in the country's coal power sector. Incomplete statistics suggest that China participated, in various forms, in 32 coal power projects in Indonesia, involving 20,169 MW of installation, among which 12,197 MW are in-service units and 7,972 MW are planned and signed. Annex 7 introduces some of the coal-fired power plants under international cooperation.

The decision-making process for procuring a coal-fired power project with foreign investment includes four scenarios: direct assignment, direct selection between competing proposals, open tender, and PPP.

The limit on foreign investment share: For projects with power generation of less than 1 MW, only domestic investment is allowed; for 1–10 MW, the foreign share is up to 49%; for above 10 MW, the maximum foreign investment is 95%, although it might be greater under certain conditions.

5.5.2. Differences Between International and Local Investment in Terms of Project Selection

The future 10-year power station projects (2019–2028) indicate that larger power installed capacity, greater capital intensity, and more state-of-the-art technology will lead to greater private (local and/or foreign) investments, whether in coal or renewables. Annex 8 illustrates the percentage of PLN and private investors in power generation projects between 2019 and 2028. **First, over half are joint projects.** Of the allocated projects (49.9 GW), 16.2 GW (32.5%) is designated to be fully owned by PLN, while 33.67 GW (67.5%) is joint projects of various kinds. **Second, joint projects and those assigned to PLN have their own distinctive features.** The greater allocation for joint projects involves coal, mine-mouth coal, geothermal, mini hydro, hydro, and other renewable power projects. PLN features more

combined-cycle/cogeneration and gas power, while diesel generation and pumped storage power generation are reserved for PLN only.

5.5.3. The Positive Impact of International Cooperation on Coal Power Development in Indonesia

First, international cooperation will introduce advanced technologies. Both the 2 x 1,000 MW PLTU Jawa 7 in Serang Regency, West Java, and the 2 x 1,000 MW PLTU Jawa Tengah in Batang Regency, Central Java, use ultra-supercritical (USC) technology, facilitating technology transfer and creating thousands of local jobs during project construction. **Second, it will bring in top-notch management expertise.** In the PLTU 2x15 MW project in Deli Serdang (North Sumatera) and the PLTU 2x20MW in Gorontalo (Sulawesi Island) undertaken by Shanghai Electric Power Construction (SEPC), Shanghai University of Electric Power Engineering (SUEP) has provided training for the local employees. **Third, it will make up the shortfall in funding.** Domestic funding sources are inadequate to finance coal power station development in the next 10 years, and international cooperation fills the gap. **Fourth, it strengthens research and development (R&D) cooperation on coal power technology.** Shenhua Guohua Electric Power Company has collaborated with universities in China and is exploring R&D collaboration with universities in Indonesia.

6. OPPORTUNITIES AND CHALLENGES FOR LOW-CARBON AND CLEAN POWER IN SOUTHEAST ASIAN COUNTRIES

6.1. Opportunity 1: Pressing Demand and Vast Market Potentials for Power in Southeast Asia

Southeast Asia reported average annual growth of over 5% in power demand between 2010 and 2018, twice that of the world's average. Under the scenario of IEA's predetermined policy, power demand in the region would double by 2040, reaching 2,000 TWh, with an annual increase of nearly 4% or twice of that in the rest of the world (IEA, 2019). Currently, power accounts for 18% in end energy consumption, which is lower than most other regions; yet this percentage is expected to hike and hit the world average in 2040, reaching 26%. The pressing need for power is real in Southeast Asia, where coal-fired power is considerably losing its appeal under the pressure of global climate change, carbon emissions, and air pollution, while renewable energy is gaining popularity with the governments and the public.

6.2. Opportunity 2: Diverse Renewable Energy Resources with Tremendous Potential for 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 hydropower and ranks second in installed capacity of geothermal (Courtney Weatherby, 2019). The country also boasts considerable land availability and favourable resource conditions for building power stations.

Malaysia, the Philippines, and Vietnam started early in renewable energy development, with a focus on hydropower that is highly market-based and demonstrating active momentum. A narrow piece of land higher in the west and lower in the east, Vietnam features a tropical monsoon climate with 3,260 km of coastline (excluding islands) and is rich in wind resources throughout the year, with an average wind velocity of 7.3 m/s and 9-10 m/s in coastal regions

in the south. The 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 potential for development. Progress is on track to feed renewable energy into the grid, establish a corresponding power market, and advance power system reform. Singapore and Brunei are highly developed economies with small populations and territories and poor hydro, wind, and geothermal power potential. However, with ample solar power resources, these countries may learn from Japan's experience in solar power development.

6.3. Opportunity 3: Active Renewable Power Development Goals are Set in Southeast Asia Countries with Supports to Clean Power

Strategy and target setting will be the key drivers of renewable energy in Southeast Asia. Major Southeast Asian countries have mapped out their goals in power generation from renewable energy (Table 3-2). ASEAN has set its target in the *ASEAN Plan of Action for Energy Cooperation 2016-2025*, working toward a 23% share of renewables in total energy supply. Correspondingly, ASEAN countries have respectively defined their national targets: Laos (59%), Philippines (41%), Indonesia (26%), Cambodia (35%), Myanmar (29%), and Thailand (24%) have developed more ambitious goals than ASEAN as a whole. As per information released by the International Renewable Energy Agency (IRENA), in order to increase the share of renewables to 23%, ASEAN needs to invest USD 27 billion (i.e., 1% of GDP) annually in the next 8 years.

Governments of Southeast Asian countries have changed their tune by announcing policies in support of clean power development. With mounting pressure from environmental pollution and backlash from the public, the capacity of newly launched coal-fired power projects in the region has slumped from a whopping 12.92 GW at its peak in 2016 to a mere 1.5 GW in the first half of 2019. Governments have also adopted multiple synergized policies, such as FIT and tax incentives, to endorse renewable energy. Malaysia has implemented a Green Investment Tax Allowance (GITA), with a maximum of 100% tax exemption for investment in green assets.

6.4. Opportunity 4: Significant and Hopefully Continuous Reduction in the Cost 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 the inclusion of carbon emissions into cost, the cost of coal-fired power may be on the rise. Based on the latest IRENA report (2017), except for solar power, the global levelized cost of energy (LCOE) of most renewables has fallen within the range of fossil fuel cost. With the exception of hydropower and geothermal power, the LCOE of renewable energy projects (biomass power, geothermal power, hydropower, onshore wind power, offshore wind power, solar power, and ground solar PV) launched since 2017 has been reduced since 2010. The LCOE of solar PV alone fell by over 70% (IRENA, 2017) (see Figure 6-1).

The past 5 years have seen the LCOE decline in renewable energy in Southeast Asia, though the degree of reduction may vary. In particular, the LCOE of solar PV slid enormously, down by 42% to 52% in Indonesia. In Thailand and Vietnam, the LCOE of onshore wind power

also decreased by 16% to 43% during the same period (Zissler, 2019) (Figures 6-2 and 6-3). The lower cost of renewable energy has made cheap power access possible and will prove especially effective for regions highly dependent on diesel power or power grid extension at a high cost, thereby boosting the uptake of renewable energy.

6.5. Challenge 1: A Powerful Coal-Fired Power Lobby and Lack of Market Competition in Power Sectors in Most Countries

Other than Singapore and the 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. Furthermore, most power plants are coal-fired, and, with a monopoly in the market, there is a lack of incentives to move toward renewable energy. 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 a 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.

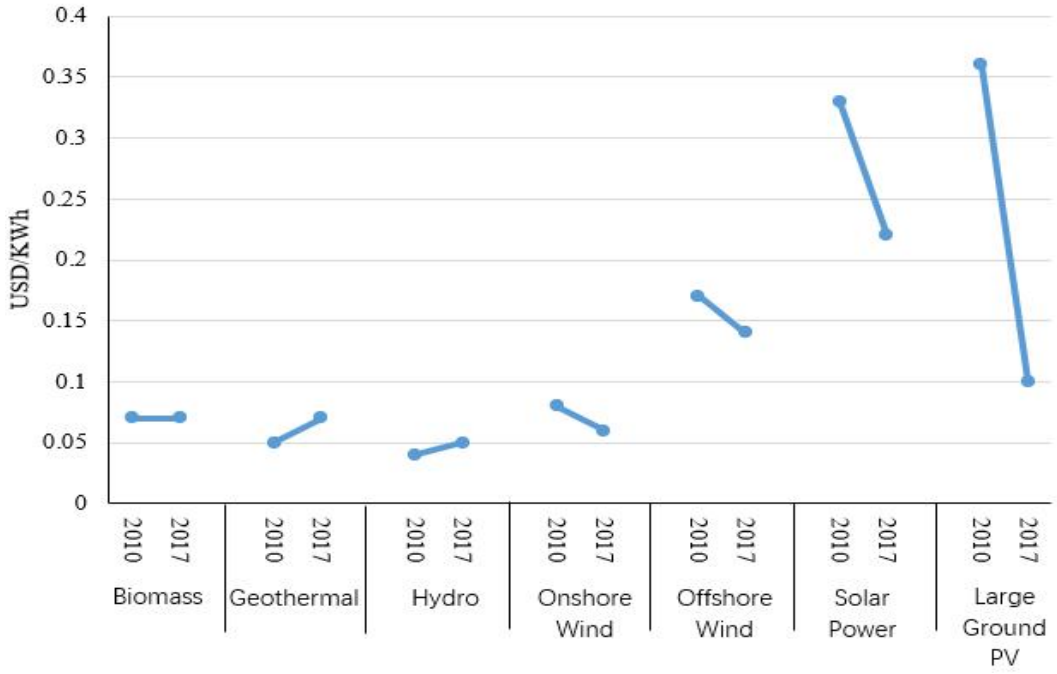

Figure 6-1. LCOE changes in the world's renewable energy

Data Source：IRENA, 2017.

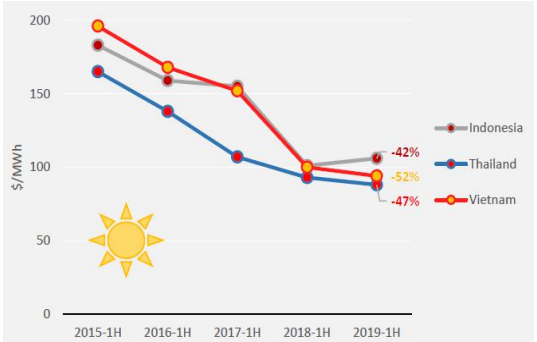

Figure 6-2. Tendency of LCOE changes in

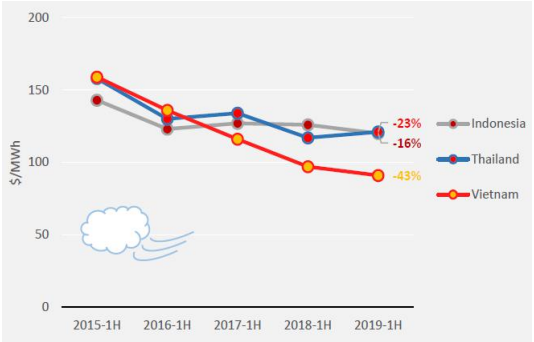

Figure 6-3. Tendency of LCOE changes in

PV in Indonesia, Thailand and Vietnam (First Half of 2015—First Half of 2019).

On-shore Wind Power in Indonesia, Thailand and Vietnam (First Half of 2015—First Half of 2019).

Data Source: Zissler, 2019.

6.6. Challenge 2: Human Resources and Indigenous Innovation Fall Short

For all its rich labour resources, Southeast Asia has long been troubled by a lack of R&D investment and top-notch professionals in the field of renewable energy. R&D places high demands on financial investment and the competence of skilled talents. The situation is worsened by the tightly controlled key technology transfer from developed countries that make the region unlikely to acquire core technologies even at high prices. Countries are unable to translate their resource advantages into energy advantages. At present, the region still needs to step up international cooperation in renewable energy in terms of technical standards and protocols, pilot projects of advanced technologies, science and technology cooperation bases, and joint professional training, etc. This is not only a viable approach for obtaining renewable energy technologies but also a major avenue for filling the funding gap.

6.7. Challenge 3: Governments Are Under Huge Financial Strain and Lack Effective Market Financing Channels

To attain the target of renewable energy development and boost economic and environmental sustainability, ASEAN members are expected to invest USD 2.36 trillion into the energy sector from 2016 to 2040. Yet, most ASEAN members are developing countries with per capita GDP below USD 5,000, the exceptions being Singapore, Brunei, Malaysia, and Thailand. Countries such as Cambodia, Vietnam, Laos, and Myanmar are unable to raise sufficient funds to fuel the energy sector due to their underdeveloped national economy and strapped public purse.

Management and operation of financial institutions in Southeast Asian countries are far from mature. Many ASEAN countries are not familiar with the business model of renewable energy and tend to overestimate the risks, which makes financing a major challenge for renewable energy projects. More often than not, these financial institutions show more preference for well-understood new energy projects. For instance, banks in Malaysia are generally more interested in solar PV projects with little enthusiasm for biogas or biomass. This has further aggravated the financing pressure for non-PV projects (Esther Lew Swee Yoong, 2019).

Moreover, **some Southeast Asian countries are haunted by the problem of debt sustainability**. At present, renewable energy development in Southeast Asia is mainly financed through lending from multilateral banks such as the World Bank and Asia Development Bank. Many debt-ridden countries tend to be more conservative and discreet in borrowing to fund clean energy.

6.8. Challenge 4: Underdeveloped Grid Infrastructure Hampers Connection of Renewable Energy

Aside from developed economies such as Singapore and Brunei and the relatively developed Malaysia, Southeast Asian countries are hindered by underdeveloped grid infrastructure, especially for the four newcomers of ASEAN—Cambodia, Laos, Myanmar, and Vietnam, whose grid infrastructures are severely unsufficient. Electricity accessibility is only 61% in Cambodia and 56% in Myanmar.

With the massive connection of wind and solar PV power plants to the grid, the intermittence, randomness, and instability of wind and solar will result in fluctuations of voltage, current, and frequency of the grid, thus affecting the quality of power. In order to mitigate the negative impacts, 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. In addition, 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 (Natural Resources Defense Council (NRDC), 2019).

6.9. Challenge 5: Power Generation from Renewables Is Less Competitive Than Fossil Fuels in Terms of Cost

Despite the lowered cost of power generation from renewable energy, it is still more expensive than coal power. Zissler Romain (2019) argues that economic viability is the key impediment for renewables in Southeast Asia. **At the national level**, LCOE analysis was conducted on coal-fired power and renewable energy in Indonesia, Malaysia, Philippines, Thailand, and Vietnam. Apparently, the LCOE of solar PV, onshore wind, geothermal, biomass, small hydro, and combined cycle is generally higher than that of coal power (Figure 6-4). **At the project level**, most competitive projects of five renewable energy sources (solar PV, onshore wind, geothermal, biomass, and small hydro) were selected from several Southeast Asian countries (Indonesia, Malaysia, Philippines, Thailand, and Vietnam) to compare with the most competitive coal-fired power projects. Results show that the cost advantage of power from renewable energy is only reflected in small hydro projects (in Thailand and Vietnam) with LCOE *significantly* lower than that of coal power (25–35 USD/MWh) and some geothermal projects (in Thailand and Indonesia) with LCOE *slightly* lower than that of coal power. LCOE of biomass, onshore wind, and solar PV remain generally higher than that of coal power (Figure 6-5).

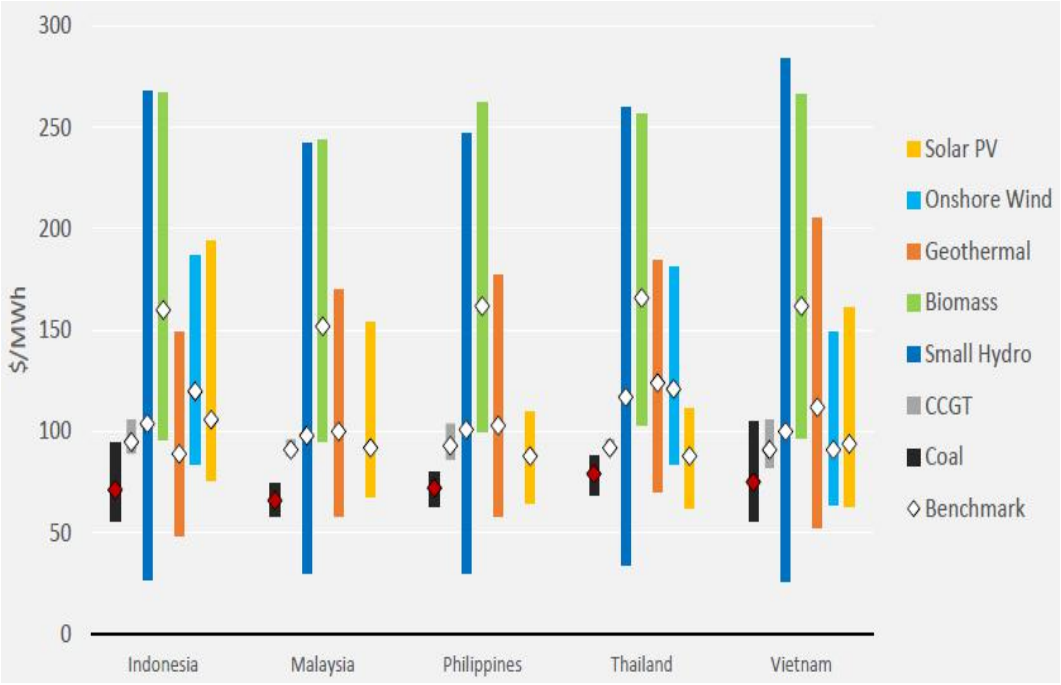

Figure 6-4. LCOE of power technologies in Some Southeast Asian countries (First Half of 2019)

Data Source: Zissler Romain, 2019.

6.10. Challenge 6: Grid Connection of Power from Renewables Will Boost Electricity Bills and Compromise Affordability

The grid connection of more expensive renewable power would drive up electricity prices. Considering the large population living under the poverty line, the affordability for end users cannot be neglected—and renewable energy should not be developed at the expense of users. Annex 9 suggests that the electricity bill for 100 kWh accounts for over 5% of minimum monthly wages in many Southeast Asian countries, running as high as 8.5% and 7.8% in the Philippines and Cambodia, respectively. Connecting renewable power means a higher economic burden for consumers, which, to some degree, puts a brake on the development of renewables (Esther Lew Swee Yoong, 2019). In view of the geographical characteristics of Southeast Asia, smart microgrid layout can expand the function of renewable energy and provide power solutions for remote and island areas.

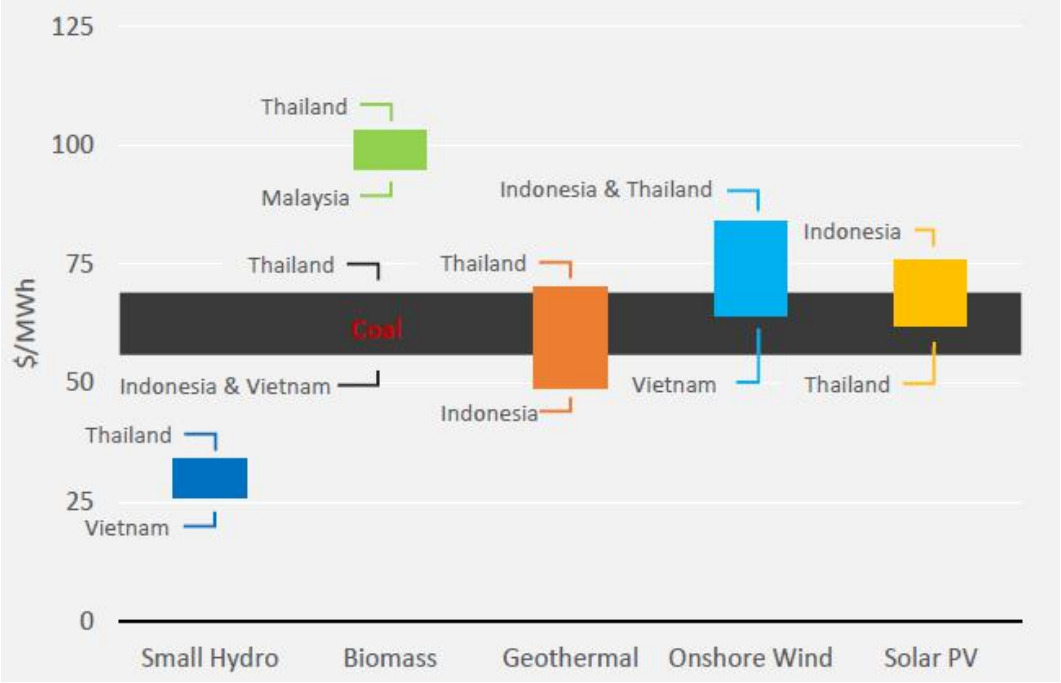

Figure 6-5. LCOE of most competitive renewable energy projects and coal-fired power projects in Southeast Asia (First Half of 2019)
Data Source: Zissler Romain, 2019.

7. RECOMMENDATIONS FOR CHINA'S ENGAGEMENT IN LOW-CARBON TRANSFORMATION OF POWER INFRASTRUCTURE IN SOUTHEAST ASIA

7.1. Revise Overseas Investment Policies, Taking Into Account the Environmental and Climate Impacts as Crucial Factors

In the environmental management of foreign investment projects, China often adopts the standards of target countries, most of which lack a full-fledged environmental management framework and environmental protection standards. This has prompted a series of high-carbon projects in developing countries, giving rise to massive greenhouse gas emissions and environmental pollution. Therefore, the Chinese government should make

environmental protection and climate change mitigation factors mandatory requirements for foreign aid policies and the overseas investment policies of financial institutions. They should also draw up a negative list, restrict high-carbon lock-in projects (e.g., coal power), encourage low-carbon investment, implement the green BRI, and advance the win-win strategy of opening up.

7.2. Enhance Strategic Cooperation with Southeast Asian Countries to Provide Technical and Funding Assistance to the Planning and Roadmap of Local Renewable Energy Development

Most Southeast Asian countries are in the infant stage of industrialization with a fairly high demand for electricity supply. They are inclined to deploy low-cost coal power projects with readily accessible resources. Some countries have recognized the superiority of clean power, but their limitations in planning, funding, and technical expertise 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, China boasts extensive expertise in the low-carbon transformation of the energy system and should carry out in-depth cooperation with target countries in strategic planning. It should also leverage multi-level governmental dialogues in energy and electricity macro planning and bolster policy exchanges with Southeast Asia 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 platforms should be fully harnessed for the aforementioned purpose.

7.3. Chinese Businesses Should Prioritize Impact Assessment of Overseas Investment Projects and Secure the Sustainability of the Local Economy, Society, and Environment

Chinese enterprises primarily adopt the EPC model for power infrastructure projects in Southeast Asia and are unlikely to empower the local labour force and industrial chains, etc. Apart from investment income, Chinese investors should be more conscious of the impact on the sustainability of the local economy, society, and the environment; pursue both economic and social benefits; operate with more local headcounts; and actively participate in public welfare activities. It is important to conduct a systematic assessment prior to, during, and after projects; examine the pros and cons for the macroeconomy, job creation, and eco-environment; make an effort to minimize negativity; and make the most of the benefits.

7.4. Boost Conversations Between Chinese Government and Businesses and Investment Recipients

The Chinese government should reinforce communication 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 Subregional Energy Cooperation. China could maximize its strength in clean power technology to offer more technical assistance and project demonstration, etc. Chinese enterprises should carry out more cross-cultural conversations with local governments, labour unions, social organizations, and media outlets, and better communicate their contributions to local society and the economy to obtain more understanding. They should stay alert to public opinion risks and make prompt media announcements and clarifications about misinformation regarding enterprises.

Section II: Gender issue

Achieving SDG 5, gender equality and empowering all women and girls, will have positive cascading effects on the achievement of the other SDGs, notably energy access and climate action. Some key synergies between SDG5, SDG7 and SDG13 and corresponding policy recommendations are presented below.

1. Implement systematic information and consultation of local communities and improve involvement of women to unlock life quality-improving choices for clean energy access

Women are often more involved in household decision making and have the knowledge of what is needed to adapt to changing environmental circumstances in order to determine practical solutions for all, notably the children and elderly. But they remain a largely untapped knowledge resource and have limited access to decision making at the local or political level.

When preparing investments in host countries, investors should implement systematic consultation of local communities, including civil society and populations with a conscientious effort towards gender equality. In regions where women are household leads, women are key decision-makers and drivers of behavior regarding pollution and health conditions of the household. Their concern for a more integrated consideration of negative externalities of pollution should be relayed to the regional and national level.

In recent years, leading women figures have often appeared as bringers of change in Asia. One such pioneer is Ms. Wandee Khunchornyakon[5], founder and chief executive of Solar Power Company Group, which is the first company to develop a solar farm for commercial purposes in Thailand. Despite heavy difficulties for accessing traditional credits, her company now operates 19 solar farms in Thailand with a total generation capacity of 96.98 MW, reducing an equivalent of 200,000 tons of CO2 and generating 20,000 new permanent and local jobs.

2. Create innovative financing schemes that involve local communities and women in particular from assessment, planning, revenues benefits and management of distributed renewable energy and energy storage, creating income complements

Distributed renewable energies are better for the planet, but difficult to deploy in part due to the lack of training of local population on operating and maintaining equipment, whereas higher polluting concentrated fossil fuel-based energies appear easier to deploy, notably on isolated islands. However, distributed renewables could bring more energy and financial independence for local vulnerable communities.

Engaging women as active actors of clean energy and improved energy access can improve the efficiency by rooting implementation in local communities as well as contribute to their economic independence. A gender lens should be applied to the inclusion of local communities in the planning, economic assessment, financial revenues sharing, maintenance and management of distributed renewable energies such as small-medium scale PV and energy storage units.

[5] Roots for the future, The Landscape and Way Forward on Gender and Climate Change, UICN, GGCA

With financing mechanisms that could be supported by foreign aid and micro-credits, such locally planned and managed projects will bring revenue complements to the community, creating self-reinforcing practical and financial incentives, ensuring the sustainable deployment of renewables. At the same time, by involving women and the local communities, these projects would provide better livelihood prospects through access of electricity, improving their education opportunities, shielding them from harmful health effects of indoor pollution (through burning of biomass) while making them active vocal ambassadors of climate change mitigation.

Successful examples of such projects include the Grameen[6] technology centers' actions in Bangladesh, the Barefoot College in Rajasthan in India, and the Solar Sister's in Africa conducting trainings for women as technicians and engineers, teaching them to build, install and maintain solar energy sources. In these cases, it had multiple impacts on women's health, role in the community, education and overall wellbeing.

3. Raise awareness on impacts of climate change on women

We are already seeing some of the devastating effects of climate change, with increasing floods, hurricanes and other natural disasters. Women are the most vulnerable in these situations, facing the maximum risk due to their socio-economic status. With 70% living in poverty, women are disproportionately affected by extreme weather events, loss of agricultural productivity, destruction of life and property and so on, all of which stem from the climate crisis. In its efforts to support the development of countries along South-East Asia, China should raise awareness of the impacts of climate change, notably on vulnerable populations and women.

[6] Applying a gender lens to science-based development, GenderInSite, 2017

Section III: Annual Policy Recommendations

Given the multi-dimensional pressure from the novel coronavirus outbreak, the economic downturn, the global climate security challenges and a fragile domestic ecological environment, China is in dire need of new economic growth engines and innovative drivers for its economic transition to secure the green and low-carbon transformation of its economy by 2030.

The 14th Five-Year Plan period marks a pivotal time for China's high-quality development, which should embody and support the vision to achieve a Beautiful China by 2035 and the global long-term strategy for tackling climate change as outlined in the Paris Agreement. The country needs to make the fight against climate change the new driver of its economic transformation, stay committed to clean and low-carbon development, enhance its confidence to accelerate the economic and energy transformation. This Special Policy Study makes the following recommendations:

1. China should innovate its development pathway through green and low-carbon transformation. This transformation is the inevitable requirement to achieve the grand goal of its modernization, the upgrading of its economic pathway of growth and the new driving force of long-term economic prosperity and will catalyze supply side structural reform, and mitigate the current downward pressure of the economy.

1.1 China should further integrate the green and low-carbon transformation into the top-level strategic planning of China's social and economic development as well as the specific strategies of various departments and specialized fields, as an important measure to improve total factor productivity, hence contributing to maintain China's medium to high economic growth rate in the long-term;

1.2 China's entrance into an aging and high-income society must be fully recognized and taken into account. This societal change will bring about huge changes in the structure, nature and volume of socio-economic demands regarding energy consumption, air quality demands, and overall higher quality of life. The stability of the strategic determination should be kept for a long time so that the supply side structural reform can continuously adapt to the demand side changes, promoting the upgrading of industrial structure and product structure and technological advancement. The total energy and resource use should be continuous curbed, by improving energy and resource efficiency per unit output value, gradually decoupling the growth of income per capita (GDP) from the emission of pollutants and greenhouse gases;

1.3 Continuously reducing coal consumption is a critical part of China's energy revolution. It will support the long-term decarbonization of the energy structure and reduce the emission of greenhouse gases and conventional pollutants per unit of energy. Therefore, China's strategic and institutional objectives of deep economic reform should recognize and integrate more clearly the relevance and pertinence of addressing energy, environment and climate change. To this end China should set clear goals and paths for controlling and reducing coal consumption, developing non fossil energies and improving energy efficiency;

1.4 In the new form and stage of socio-economic development, comprehensive policy and management dimensions such as price signal, tax revenues, public finance, financial mechanisms, industry, market economy, investment, employment, social security, environment, and energy should be integrated in the efforts for the aforementioned strategies by deploying policy tools such as regulatory measures, emissions trading or taxation, and public communication and education. To be more specific, first, benefitting from the tailwinds of the country's fast-tracked implementation of its innovation and development strategy, China should intensify the investments in emission reduction technologies (such as

energy storage, low-carbon cooling, carbon capture and storage, blockchain, etc.) that will drive the development of new industries, achieving the double dividend of pulling economic growth and reducing GHG emissions; second, China should actively promote and improve the green investment and green finance ecosystem, in coordination with the credit reporting system of financial institutions to establish a low carbon technology or low-carbon project library.

2. The critical time window of 2020 must not be missed. Despite the downward pressure on the economy, China must avoid relaxing targets and efforts for environmental protection and climate change during the 14th Five-Year Plan period. On the contrary, China should formulate more aggressive targets for carbon emission reduction, enhance China's Nationally Determined Contribution, formulate mid-century low-carbon development strategies, and implement China's green economic transformation and high-quality development.

2.1 Formulate and implement a total carbon dioxide emission cap, using a combination of three approaches: total carbon emissions, emission intensity and energy structure adjustment. China should strive to not reduce the level of climate ambition for the 14th Five-Year-Plan and improve upon and exceed the current 2015 NDC, making a greater contribution to address climate change;

2.2 Propose the strategic deployment of "Leading the emission peaking" by publishing guidelines of the State Council to promote emission peaking in key industries and key regions (such as the relatively more developed areas of Eastern China, and the energy and material intensive industry sectors) to promote industrial transformative upgrading and high-quality economic development;

2.3 Swiftly improve the carbon emission trading system and the associated market mechanism. Not only should carbon pricing be made the core instrument promote the development of green, low-carbon, circular economy and trigger the energy revolution, but also make it possible for renewable energies to be included in the national carbon market (applied to power generation). Through the carbon market, low-carbon power supply infrastructures would be incentivized to avoid the future carbon-intensive infrastructure and mitigate stranded asset costs. In case of limited legislative resources, the necessary legislative basis for the national carbon market should be included in the amendment agenda for the Environmental Protection Law.

3. Accelerate the pace of energy transformation and upgrading, especially in the coal-reliant economy, speed up the research and establishment of a new generation of policy environment to support a high share of renewable energy, promote technological innovation and industrial modernization, peak the total coal consumption as soon as possible, and ensure a zero growth rule for coal power plants.

3.1 Promote alternative actions to reduce coal consumption, expand the scope of pilot projects focused on switching to natural gas and clean and renewable energy sources, such as geothermal and solar energy, according to local conditions. By encouraging innovation in local system and mechanism, guide social capital to increase investment in "coal to electricity" or "coal to gas". Comprehensively adopt and improve on peak-valley price mechanism and resident tiered pricing policy, expand dispatch-based transactions, reduce the cost of cleaner solutions such as heating gas and electricity, attract market interest and support clean heating;

3.2 Set up the next generation of renewable energy policies and management system, including policies to further reduce the financing cost of renewable energy enterprises, encourage the development of new distributed renewable energy technologies by creating favorable market conditions, especially in terms of land allocation, IPO fast-tracking, easing

the access to preferential loans, etc. Accelerate the reform of electric power system, implement the renewable energy quota system, overcome the existing policy barriers, and improve the flexibility of renewable energy grid connection;
3.3 Formulate a national strategy of socio-economic transition for the coal economy in support of economic growth. Transform China's engine of growth by renewing its industry. In the coal-dependent regions and cities, economic diversification should be faster developed and coal-free industries taking benefits in regional advantages should be promoted, giving priority to the development of strategic emerging industries such as by new materials, Internet plus (e-commerce and data centers) and tourism. Optimize the market environment, provide favorable fiscal and tax policies for new industries and technologies, and boost the decisive role played by the market. Public finance and private funds should jointly set up a just transformation fund. The fund should invest in green finance and emerging green industries such as cultural tourism, part of the proceeds should be redistributed to support the economic transformation of coal dependent regions, mainly focusing on social issues such as resettlement compensation and employment transition, and developing skill formation related to emerging industries;

3.4 strengthen experience exchange with economies which have successfully implement the transition of their economy out of coal, such as the United Kingdom, Germany, Spain, the United States, etc.

4. Comprehensively improve the coordinated management of economic transformation, energy revolution, environmental governance, climate change and public health.

4.1 During the 14th Five-Year Plan, it is necessary to break sector boundaries, achieve synergies between economic development goals, climate and environmental goals, and strengthen the coordination of energy and industrial goals;

4.2 Learning from the experience of the novel Coronavirus outbreak in early 2020 , and attach greater importance to the tremendous social and economic risks associated with the system public environmental risk of climate change. Capacity building on environmental quality, climate risk assessment and risk management research should be carried out relentlessly to accumulate data and case studies. First, we need continuous and long-term institutional arrangements in order to address climate change. Second, we need to accurately disclose climate change related information and achieve high quality MRV. Third, we need to further strengthen the public dissemination of climate change-related scientific research, with its certain results and uncertainty levels;

4.3 Starting from the 14th Five-Year Plan, China should attach greater importance to the relationship between environment, climate, and long-term economic development and public health. Both symptoms and root causes should be addressed, starting from health and economic risk assessment, environmental quality standards and governance targets, and near-term, mid-term and long-term planning for environmental and climate governance measures. Systematical review of strategies and plans for comprehensive prevention and control of environmental, climate and health risks should be implemented;

4.4 By integrating greenhouse gases into the existing environmental monitoring and control system, explore the links between the emission trading scheme and the administrative emission permits system, and accelerate the establishment and improvement of greenhouse gas performance emission standards in key industries. Gradually update the ultra-low emission strategy of the power and metallurgical industries by integrating the greenhouse gases emissions and conventional pollutants into the comprehensive emission reduction target. Improve the carbon pricing mechanism, strengthen the incentive of carbon price to deliver effective emission reduction and low-carbon technology R&D innovation, and drive

low-carbon investment from carbon market. Promote policy study on China's carbon tax policy, and incorporate a carbon tax into the environmental tax system;

4.5 Establish a social and environmental impact assessment system of the policy, and provide recommendations according to the long-term social and environmental impacts to policy makers;

4.6 Encourage and support cross-border exchanges, joint research and data sharing among think tanks, professional associations and non-governmental organizations, and provide technical support for cross-sector cooperation and collaboration.

5. Global climate governance is facing a new geopolitical situation. The expectation of major actors for China's leadership role in the global climate governance is expected to grow in the long-term. Against the background of complex Sino-US relations and the challenge posed by the US withdrawal from the Paris Agreement, the Chinese government should proactively work with European and major developing country governments to build a new global climate political leadership based on multilateralism and promote the implementation of the Paris Agreement. In cooperation with non-Party actors supporting climate change (such as some US state governments, businesses, NGOs, etc.), through track 1.5 or track 2 dialogues explore opportunities to expand leadership areas of global governance (such as the green "Belt and Road" Initiative).

5.1 The Chinese government should actively respond to the EU's "Green New Deal", strengthen cooperation initiatives on the 15th Conference of the Parties to the Convention on Biological Diversity, and consider reaching an agreement to cooperate with the EU at the 2020 China-EU Summit. "Third-party market cooperation" related to Belt and Road countries will effectively combine the experience and expertise of China and the support of developed countries (such as funding, technology, and capacity building) to respond to the mitigation and adaptation needs of developing countries, jointly promoting a global low-carbon transition and broadening action and support to tackle climate change. The European Union's "Green Deal" is the first to propose ambitious long-term goals of "climate neutrality" and a more aggressive mid-term NDC by 2030. It calls for a green low-carbon pathway for the economy achieving by 2050 net zero greenhouse gases emissions. It clearly decouples economic growth and resource consumption. The European Union is looking forward to an alliance with China and in-depth climate cooperation, and highly regards the alignment between the objectives of its "Green Deal" and China's strategic plan to promote low-carbon high-quality economic development, the construction of a beautiful China. Climate change cooperation is likely to become the shining beacon that will enrich the strategic partnership between China and Europe. Where the withdrawal of the U.S. Republican federal government has adversely affected the global climate governance environment, accelerating the establishment of a China-Europe joint leadership in global climate momentum is conducive to maintaining China's advantageous strategic position in the governance of global issues such as climate change since the Paris Agreement. China's proactive position will also reveal advantageous in hedging potential future pressures to reduce emissions from a Democratic US government.

5.2 In the future, the overall relationship between China and the United States will pursue to be of strategic competition in nature. The Chinese government should recognize that climate change has been and will increasingly be an important topic for China-US relations. There remain large political, economic, and technological forces in the US politics, business, and think tanks that actively advocate for climate change. If America's efforts to combat climate change prevail in different ways and on different occasions, climate change, which was the highlight of Sino-US relations, would turn into a new friction and adversarial point in Sino-US relations. In effect, China and the United States would form a larger multi-dimensional gap in their trajectories in the fields of economic structure, energy,

technological research and development. By then China's active, one-step-ahead position in global climate governance would have turned into a passive, reactive position. The Chinese government should proactively promote a low-carbon transition strategy and engage in dialogue and exchange with relevant US entities (provincial and state governments, non-party actors such as enterprises).

5.3Actively make use of the CCICED platform in combination with the 2020 international agenda (e.g., the China-EU Summit in June, the annual meeting of the CCICED in 2021, the China-EU Summit in Leipzig in late 2020, the Kunming Biodiversity Conference in May 2021, and the COP in Glasgow in November 2021, etc.) to organize outstanding think tanks and experts from China and Europe and other regions to discuss topic-oriented, pragmatic issues such as the European "Green Deal" and its international cooperation, the promotion of climate goals, the rationale behind new economic growth, the pathway towards a low-carbon economic transition, the rapid and low-carbon transition of the energy system, the transformation for the coal economy, transport electrification, the coordination between dealing with climate change and the protection of biodiversity. Multi-level China-EU track 2 dialogues should be launched, to deepen mutual understanding between China and Europe, and promote the comprehensive and effective implementation of the Paris Agreement.

5.4China should strengthen the top-level design of the "Belt and Road" climate cooperation, actively support the "Belt and Road" partner countries to formulate low-carbon development plans and action roadmaps, and change from a mere commercial project deployment model to that of strategic cooperation to work with "Belt and Road" partner countries on climate change, supporting the "Belt and Road" countries to update their NDC and formulate and implement mid-century low-greenhouse gas emission development strategies, therefore attracting broader support from the international community. First, China should support the development of the "Belt and Road" developing countries, especially the least developed countries, landlocked developing countries, and small island States, in formulating low-carbon development plans, roadmaps, and action plans. Second, "Belt and Road" countries can share China's best practices in tackling climate change, focusing on areas such as renewable energy and energy, air quality and greenhouse gas co-management, climate investment and financing, agriculture, and nature-based solutions. Third, domestic banks and financial institutions should improve their risk assessment system, formulate relevant policies, and align with the relevant standards of international financial institutions as soon as possible, and gradually stop providing funding for carbon-intensive projects such as overseas coal-fired power generation.

Acknowledgement

Firstly, we express our sincere gratitude to CCICED for setting up and supporting this SPS-"Global Climate Governance and China's Role", which provides a platform for Chinese and international experts to have a full discussion and exchange. Secondly, we highly appreciate Mr. Xie Zhenhua, CCICED's Vice Chair, who provided instructive guidance to our research. Thirdly, we also are grateful of Mr. Liu Shijin, Chinese Chief Advisor of CCICED, Mr. Scott Vaughan, International Chief Advisor of CCICED, Dr. Arthur Hanson, CCICED's Former International Chief Advisor, Dr. Knut Alfsen, Member of Chief Advisors' Group under CCICED, Mr. Guo Jing, Director General of International Cooperation Department, MEE, Mr. Li Gao, Director General of the Department of Climate, MEE, Mr. Li Yonghong, Assistant Secretary General of CCICED, Deputy Director General of Foreign Environmental Cooperation Center, MEE, who gave us detailed suggestions and consultation during research. Finally, we would also like to thank Mr. Zhang Huiyong, Director of CCICED Secretariat, Ms. Liu Kan, Deputy Director of the CCICED Secretariat, Ms. Li Ying, and the International Support Office (SISO) of CCICED to provide coordination.

When our SPS "Global Climate Governance and China's Role" conducted research on the low-carbon transformation of infrastructure along "Belt and Road" regions and climate change objectives, pathways as well as policies, we received strong support from relevant departments, institutions and experts at home and abroad. Special thanks to Dr. Hugh Outhred (Managing Director) and Dr. Maria Retnanestri (Director) from IPEN Pty Ltd, Dr. Yudiandra Yuwono, Mr. Septia Buntara and Ms. Monika Merdekawati from ASEAN Center for Energy, and Dr. Philip Andrews-Speed from Energy Studies Institute of National University of Singapore to share data of ASEAN power infrastructure development and case studies, as well as insights for this report. We would like to express our sincere thanks to them.

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Appendix

Annex 1. Comparison between China's Domestic and Outbound Investment.

Catalog of Restricted Industries in China	The catalog of restricted industries mainly include production capacity, techniques, technologies, equipment and products which are obsolete, incompliant with industrial criteria of entry or relevant regulations, and are prohibited from launching or expansion, or requiring renovation. For example: coal mines below 300,000 tons/year, wet cooling generator unit of coal consumption above 300g standard coal/kwh, ethylene production by naphtha cracking below 800,000 tons/year, soda ash, caustic soda, yellow phosphorus, nitrogen fertilizer produced from oil or gas, coking projects of steel plant without coke dry quenching, coal filling and coke pushing/dedusting equipment, sintering machine of less than 180 sqm, electrolysis of aluminum project, clinker production line of new dry method below (excl.) 2,000s ton/day, general filament lamp, etc.[7]
Restricted Outbound Investment	1. Investment in sensitive countries and regions with which China has not established diplomatic ties, experiencing wars or are restricted for investment by bilateral or multilateral treaties signed by China; 2. Real estate, hotels, the entertainment industry, movie studios and sports clubs; 3. Overseas equity investment funds or platforms with no real industrial project; 4. Investment involving obsolete equipment that does not comply with the technical standards of the target country; 5. Investment that violates the target country's environmental, energy or safety standards. Whereas the first three categories require approval from authorities of outbound investment.[8]
Catalog of Eliminated Industries in China	Eliminated category mainly includes obsolete techniques, technologies, equipment and products that do not comply with appropriate laws and regulations or safety production requirements, cause severe waste of resources or environmental pollution, thus should be eliminated. For example, small coal mines overlapping with planar projection of major coal mines, coal mines below 300,000 tons/year in Shanxi, Inner Mongolia, Shaanxi and Ningxia, regular coal-fired power units with capacity of 300,000kw or below that fail to comply with standards, atmospheric and vacuum petrochemical units of 2,000,000 tons/year or below, diaphragm caustic soda production units, HCFCs, coking by indigenous method, coke oven of steel plants without coke dry quenching installation, self-baked aluminum electrolysis cell and pre-baking cell under 160kA, dry method hollow kiln, shaft kiln for cement, Lepol kiln, wet method kiln, etc[9].
Prohibited Outbound Investment	Domestic enterprises are prohibited from involving in outbound investments that harm or may harm China's interests or national security, including: 1. Projects involving the export of China's core military technology and products; 2. Investments with techniques or products that are prohibited from export; 3. Gambling and sex industry;

[7] Guiding Catalog for Industrial Restructuring (2019)

[8] Notice of the General Office of the State Council on Forwarding the Guiding Opinions of the National Development and Reform Commission, the Ministry of Commerce, the People's Bank of China and the Ministry of Foreign Affairs on Further Directing and Regulating the Direction of Overseas Investments [2017] No.74

[9] Guiding Catalog for Industrial Restructuring

	4. Investment banned by the international treaties signed or joined by China; 5. Other outbound investment that harm or may harm China's interests or national security.
Strategic Emerging Industries (Encouraged in China)	1. New generation of IT industry 2. High-end equipment and new materials 3. Bio industry 4. New energy vehicles, new energy, energy conservation and environmental protection industries 5. Digital creative industry 6. Cutting-edge technology R&D and industrialization, with the focus on core areas such as aerospace, ocean, information network, life science, nuclear technology, etc[10].
Encouraged Outbound Investment	1. Infrastructure projects that facilitate the Belt and Road Initiative and peripheral infrastructure interconnectivity; 2. Projects promoting the export of China's advanced production capacity, equipments and technical standards; 3. Strengthen investment cooperation with overseas enterprises of high and new technologies or advanced manufacturing, encourage establishment of overseas R&D centers; 4. Prudently participate in overseas energy resources exploration and development such as oil, gas and mining with thorough analysis of economic viability; 5. Expand international cooperation of agriculture, encourage mutually beneficial and win-win cooperation in agricultural, forestry, livestock husbandry, side-line production and fishery; 6. Promote outbound investment in trade and commerce, culture, logistics and other sectors in the service industry in an orderly manner, support competent financial institutions to establish overseas branches and service networks to run business abiding by law and compliance requirements.

Annex 2. Electricity Consumption (GWh) and Share of Consumption(%) by Sector and Year 2013-2018.

Sector & average share		2013	2014	2015	2016	2017	2018	Avg Gr %
Household, Ave. 42%	GWh	77,211	84,086	88,682	93,635	94,457	97,823	5.24
Industry, Ave. 33%	GWh	64,381	65,909	64,079	68,145	72,238	76,947	4.24
Business, Ave. 18%	GWh	34,498	36,282	36,978	40,074	41,695	44,027	6.07
Public, Ave. 6%	GWh	11,451	12,3246	13,106	14,150	14,743	15,812	6.74
Total (GWh)		187,541	198,602	202,846	216,004	223,134	234,609	5.13

Data source：Perusahaan Listrik Negara in Indonesia, 2019

[10] Notice of Publishing the Development Plan for National Strategic Emerging Industries during the 13th 5-year Period. [2016] No.67

Annex 3. Generation Technologies of Existing Coal Power Stations

Coal Power Station	Province	Capacity	COD
Subcritical Technology			
1. PLTU* Paiton 3 Unit 1[34]	East Java	815 MW	2012
2. PLTU Tanjung Kasam Unit 1-2[35]	Riau Islands	2 x 55 MW	2012
3. PLTU Sumsel 5 Unit 1-2[36]	South Sumatera	2 x 150 MW	2015
4. PLTU Kalteng 1 Unit 1 - 2[37]	Central Kalimantan	2 x 100 MW	2019
5. PLTU Tanjung Power, Tabalong[38]	South Kalimantan	2 x 100 MW	2019
Supercritical			
1. PLTU Cirebon Unit 1[39]	West Java	660 MW	2012
2. PLTU Banten Serang Unit 1[40]	Banten	660 MW	2017
3. PLTU Cilacap Sumber Unit 3[41]	Central Java	660 MW	2019
4. PLTU Bangko Tengah/Sumsel 8 Unit 1-2[42]	South Sumatera	2 x 620 MW	2021
5. PLTU Indramayu Unit 4-5 PLN[43]	West Java	2 x 1000 MW	2021
Ultra-supercritical			
1. PLTU Celukan Bawang Unit 1,2,3[44]	Bali	3x142 MW	2015
2. PLTU Lontar Unit 4[45]	Banten	315 MW	2019
3. PLTU Jawa 7 Unit 1-2[46]	Banten	2 x 1000 MW	2019
4. PLTU Batang Jawa Tengah Unit 1-2[47]	Central Java	2 x 1000 MW	2020
5. PLTU Tanjung Jati B2 Unit 5-6[48]	Central Java	2x1000 MW	2021

Note: * PLTU = Pusat Listrik Tenaga Uap (Steam Coal-Fired Power Plant).

Annex 4. Plan for Additional Electricity Generation Capacity,2020-2028, MW/year.

Gen	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**
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**
RE	559	932	1,697	1,501	1,065	2,287	6,252	199	648	1,574	**16,714**	**30**
Total	**3,858**	**10,060**	**6,351**	**7,439**	**7,237**	**6,225**	**7,476**	**2,174**	**2,423**	**3,152**	**56,395**	**100**

Annex 5. Construction Cost of Power Stations by Type of Generation, USD/kW.

Generation	Construction/Investment Cost
Renewables	**USD/kW**
Hydro	1,500
Geothermal	1,750
PV	1,200
Thermal Power Station	**USD/kW**
Coal	1,250
Diesel	900
Cogeneration	680
Gas	400

Annex 6. Operating Cost of Power Stations by Type of Generation, USD/MWh.

Generation	Operating Cost
Renewables	**USD/MWh**
Hydro	18
Geothermal	106
PV	411
Thermal Power Station	**USD/MWh**
Coal	51
Diesel	179
Cogeneration	86
Gas	344

Annex 7. Existing investment in Coal Power Station.

Coal Power Station, Capacity, Location, Year of Financial Close	Country of Investment	Investment USD Million	Bank
Subcritical Technology			
1. PLTU Paiton 3 Unit 1, 815 MW, East Java, 2010	Japan	1,215	Japan Bank for International Corporation, Bank of Tokyo-Mitsubishi UFJ, Sumitomo Mitsui Banking Corporation, Mizuho Financial Group, Credit Agricole Group, ING Group, BNP Paribas, Sumitomo Mitsui Trust Holdings
2. PLTU Tanjung Kasam Unit 1-2, 2x55MW, Riau Islands, 2011	China	150	Export-Impot Bank of China

3. PLTU Sumsel 5 Unit 1-2, 2x150MW, South Sumatera, 2012	China	318	China Development Bank
4. PLTU Kalteng 1 Unit 1 – 2, 2x100MW, Central Kalimantan, 2016	Indonesia	316	Bank Mandiri (Indonesia)
5. PLTU Tanjung Power, Tabalong, 2x100MW, South Kalimantan, 2017	Japan	430	Bank of Tokyo-Mitsubishi UFJ, DBS Bank, HSBC, Mizuho Financial Group, Sumitomo Mitsui Corporation, Korea Development Bank
Supercritical Technology			
1. PLTU Cirebon Unit 1, 660MW, West Java, 2010	Japan	595	Japan Bank for International Corporation, Export-Import Bank of Korea, Bank of Tokyo-Mitsubishi UFJ, ING Group, Mizuho Financial Group, Sumitomo Mitsui Banking Corporation, Bank of Tokyo-Mitsubishi UFJ
2. PLTU Banten Serang Unit 1, 660MW, Banten, 2013	Malaysia	730	Maybank, Export-Import Bank of Malaysia, CIMB Group, RHB Group, Citigroup
3. PLTU Cilacap Sumber Unit 3, 660MW, Central Java, 2013	China	700	China Development Bank
4. PLTU Bangko Tengah/Sumsel 8 Unit 1-2, 2x620MW, South Sumatera, 2015	China	1,200	Export-Impot Bank of China
5. PLTU Indramayu Unit 4-5 PLN, 2x1000MW, West Java, 2017	Japan	2,000	Japan International Cooperation Agency
Ultra-supercritical Technology			
1. PLTU Celukan Bawang Unit 1,2,3, 3x142 MW (426MW), Bali, 2013	China	571	China Development Bank
2. PLTU Lontar Unit 4, 315 MW, Banten, 2016	Japan	323	Japan Bank for International Corporation, Sumitomo Mitsui Banking Corporation
3. PLTU Jawa 7 Unit 1-2, 2x1000 MW, Banten, 2016	China	1,839	China Development Bank, Bank of China, ICBC, China Construction Bank
4. PLTU Batang Jawa Tengah Unit 1-2, 2x1000MW, Central Java, 2012	Japan	3,421	Sumitomo Mitsui Trust Holdings, Bank of Tokyo-Mitsubishi UFJ, DBS Bank, Mizuho Financial Group, OCB Bank, Sumitomo Mitsui Banking Corporation, Mitsubishi Trust, Shinsei, Norinchukin.
5. PLTU Tanjung Jati B2 Unit 5-6, 2x1000MW, Central Java, 2017	Japan	3,355	Bank of Tokyo Mitsubishi UFJ, Mizuho Financial Group, Mitsubishi UFJ Financial Group, OCBC Bank, Sumitomo Mitsui Banking Corporation, Sumitomo Mistui Trust Holdings, Norinchukin Bank, Japan Bank for International Cooperation

Annex 8. Planned Additional Power Project Installation 2019-2028.

	PLN	IPP	Partnership	Unallocated	Total
1. PLTU (Coal)	4,704	14,929		1,740	**21,373**
2. PLTU MT (Mine Mouth Coal)		5,660	300		**5,690**
3. PLTP (Geothermal)	617	3,060		930	**4,607**
4. PLTGU (Combined Cycle)	4,603	4,220		310	**9,133**
5. PLTG MG (Gas Power)	3,260	20		3	**3,283**
6. PLTD (Diesel Power)	201				**201**
7. PLTM (Minihydro)	69	1,422		43	**1,534**
8. PLTA (Large Hydro)	1,200	3,139		187	**4,526**
9. PS (Pumped Storage Hydro)	1,540			1,943	**3,483**
10. Other Renewable Power	49	1,186		1,330	**2,565**
Total	**16,243**	**33,366**	**300**	**6,486**	**56,395**

Annex 9. Electricity Bill of 100kwh as a Percentage of the Monthly Income of a Recipient of Minimum Wages (10 ASEAN Countries)

Country	Percentage of electricity bill of 100kwh in monthly income of a recipient of minimum wages	Standards
Vietnam	6.2%	Based on minimum wages of 2,760,000 Vietnamese dong in Category IV (lowest wages) region in Vietnam
Thailand	3.2%	Based on minimum daily wages of 308 baht in Thailand in 2018
Laos	3.7%	Based on minimum wages of 1,100,000 Laotian kip in 2018
Indonesia	4.4%	Based on minimum monthly wages of 3,350,000 Indonesian rupiah in industrial zone adjacent to Jakarta in 2017
Myanmar	6.2%	Based on the national uniform minimum daily wages of 4,800 Myanmar kyat
Malaysia	2.1%	Based on the minimum wages of 1,000 Malaysia riggit in 2017
Cambodia	7.8%	Based on the minimum monthly wages of 690,000 Cambodian riel for apparel and shoe-making industries in 2017
Philippines	8.5%	Based on the average daily wages of 408 pesos for average worker in the Philippines in 2017
Singapore	2%	Based on the minimum wages of 1,100 Singapore dollars in 2017
Brunei	0.16%	Based on monthly wages of 600 Brunei dollars for primary-level laborers

Data Source: Long Yunlu, 2019

Annex 10. Electricity Industry Authority and their Roles and Responsibilities.

No.	Institution	Roles and Responsibilities
1.	**Dewan Perwakilan Rakyat** (**DPR**, House of Representatives)	Commission VII of the DPR is responsible for the approval of energy-related legislation (including electricity) and the supervision of energy-related Government policy. http://www.dpr.go.id/akd/index/id/Tentang-Komisi-VII
2.	**Kementerian Energi & Sumber Daya Mineral** (**ESDM**, Ministry of Mines and Energy/MoEMR)	**Direktorat Jendral Ketenagalistrikan** (Ditjen Gatrik, DG of Electricity), as discussed above http://gatrik.esdm.go.id
3.	**Perusahaan Listrik Negara** (PLN, State-owned Electricity Enterprise)	▪ PLN is responsible for the majority of Indonesia's power generation and has an exclusive role in the transmission, distribution and supply of electricity to the public. ▪ PLN produces Rencana Umum Penyediaan Tenaga Listrik Nasional (RUPTL, a ten year planning for electricity generation, transmission and distribution). The current RUPTL is for the 2019-2028 period. www.pln.co.id
4.	**Kementerian Perencanaan Pembanguan Nasional** (**Bappenas**, Ministry of National Development and Planning)	Direktorat Kerjasama Pemerintah-Swasta dan Rancang Bangun (Directorate for Public Private Partnership) is tasked with facilitating cooperation on infrastructure projects between the Government and private investors. www.bappenas.go.id
5.	**Badan Koordinasi Penanaman Modal** (**BKPM**, Investment Coordinating Board)	BKPM provides a one-stop integrated service for business start-up, licensing procedures, and information for existing and potential investors. https://www9.bkpm.go.id
6.	**Kementerian Keuangan Republik Indonesia** (Kemenkeu, Ministry of Finance/MoF)	MoF provides recommendation for electricity subsidy to PLN and approval of tax incentives for a power project. https://www.kemenkeu.go.id

Annex 11. Policies for Attracting International Cooperation in Indonesia.

Year	Policies
2007	The Law 25/2007 on Investment states the importance of both domestic and foreign investment 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.
2014	The 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.
2015	The 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.
2019	The Presidential Regulation 5/2019 or Government Regulation 24/2018 on Investment Guidelines and Facilities

Annex 12. Ditjen Gatrik (DG of Electricity).

Roles[11]	**National Electricity Master Plan (Rencana Umum Ketenagalistrikan Nasional) 2018-2037**
(1) Formulation of electricity policy (planning, regulation, investment, interconnection, energy supply and security, tariff, etc).	(1) National electricity policy regarding supply, generation energy mix, investment, permit, tariff, subsidy, cross-border electricity, village electrification, consumer protection, legal aspects, safety and environmental protection.
(2) Implementation of electricity policy.	(2) Electricity development plan regarding electrification ratio improvement, generation, transmission and distribution, sales and village electrification.
(3) Formulate norms, standard, procedures and criteria for electricity undertakings.	(3) Current electricity situation by province regarding supply, consumption, installed capacity, generation, transmission, distribution, village electrification.
(4) Provision of electrical technical assistance/coaching and evaluation.	(4) Projection of electricity demand by province.
	(5) Electricity investment.

NOTE:The current National Electricity Master Plan (Rencana Umum Ketenagalistrikan Nasional) 2018-2037 was prepared by Ditjen Gatrik.

[11] Dirjen Gatrik ESDM, Tugas dan Fungsi, http://gatrik.esdm.go.id/frontend/tugas_fungsi, accessed 19 January 2020