Chapter 3

Power Outlook in the Seven EAS Countries

This chapter analyses the impact of divestment on coal-fired power generation in India, Indonesia, Malaysia, Myanmar, the Philippines, Thailand, and Viet Nam. After the assumptions and model structure in section 3.1, section 3.2 explains the outlook for electricity-generated, coal-fired power generation capacity, and the power mix of the seven countries.

1. Assumptions and Model Structure

1.1. Scenarios

The model sets three scenarios with different degrees of restrictions on financing new CFPP construction and replacement starting 2021. This restriction is assumed to be applied to the seven EAS countries and the entire world.

Reference Scenario ('REF')

We developed the Reference Scenario or REF as an energy outlook according to past trends and the energy and environment policies in place so far. The REF assumes that policies expected through traditional and conventional ways of thinking are incorporated. In contrast, no aggressive energy conservation or low-carbon policies deviating from past trends will be adopted. The REF also assumes no global restrictions on financing new CFPP construction and replacement; nevertheless, the role of coal-fired power generation in some regions will decline even in the REF. The power mix in the REF is developed based on several conditions, such as the past trend of the mix, energy policies, the development policy of CFPPs, and power demand outlook.[38]

No New Coal-Fired Power Plant Scenario ('NNC')

The No New Coal-Fired Power Plant Scenario or NNC assumes that the restriction on the financing of new CFPP construction and replacement will result in no new or replaced CFPPs coming online worldwide starting 2021. In this scenario, existing CFPPs that have been operating for 40 years will be phased out, while no coal-fired power generation capacity will be added starting 2021, leading to a gradual reduction of total coal-fired power generation capacities. Note that we do not assume the early decommissioning of CFPPs operating for less than 40 years.

[38] However, we did not directly incorporate the energy plans of each government into the model as the REF, especially when those plans significantly deviate from reality.

Halving New Coal-Fired Power Plant Scenario ('HNC')

The Halving New Coal-Fired Power Plant Scenario or HNC is an intermediate scenario between the REF and the NNC, assuming that only half of the new or replaced coal-fired power generation capacities in the REF will be built worldwide in 2021 onwards.

In the NNC and the HNC, alternative power sources must compensate for the electricity that CFPPs would have furnished after 2021. In this study, we prepared two cases under both the NNC and the HNC. In the first case, natural gas–fired power generation will substitute for all lost electricity that new or replaced CFPPs would have supplied. In the second case, solar photovoltaic (PV) and wind power generation will do the same.[39]

Table 3.1 summarises key assumptions that branch the REF, HNC, and NNC.

Table 3.1: Key Assumptions of REF, HNC, and NNC

Scenario	Reference Scenario (REF)	Halving New Coal-Fired Power Plant Scenario (HNC)		No New Coal-Fired Power Plant Scenario (NNC)	
New or renewed coal-fired power plants after 2021	No restriction	Half in the REF		None	
Substitution for the above-restricted coal-fired power plants	Not applicable	Natural gas-fired	Solar PV/ wind	Natural gas-fired	Solar PV/ wind

Source: The Institute of Energy Economics, Japan (2021).

Other assumptions, which apply to all scenarios and cases, are as follows.

CO_2 capture and storage

This study assumes that thermal power plants constructed or replaced starting 2021 will not be equipped with carbon capture and storage facilities.

Population

The assumptions on population refer to the UN's World Population Prospects 2019 (UN, 2019).

[39] We did not presume a nuclear power substitution case because (i) nuclear power projects often face severe challenges on the aspects of technology transfer, regulations, and non-proliferation, which are difficult to overcome in a short period, and (ii) coal phase-out discussions rarely suppose the substitution by nuclear.

Macroeconomy

We assumed the economic growth rates (Table 3.2) refer to outlooks by international organisations, such as the International Monetary Fund and ADB, and governments' economic development plans.

Table 3.2: Average Annual Growth Rate in Real GDP (2018–2050), %

World	2.6	Myanmar	5.3
India	5.6	Philippines	4.4
Indonesia	4.5	Thailand	3.1
Malaysia	3.7	Viet Nam	5.3

Source: The Institute of Energy Economics, Japan (2021).

International energy prices

Oil prices are assumed to creep up over the medium to long term with increased demand and higher production cost, though experiencing high volatility over the short term. The real oil price (in 2019 dollars) for the REF is assumed to increase to US$97/bbl in 2030 and US$128/bbl in 2050. Oil prices for the HNC and the NNC are assumed to remain at the REF level.

While natural gas prices in the US will remain lower than in other regions, Japan's real LNG import price is assumed to deviate from the REF oil prices gradually. However, since coal divestment will likely increase gas demand, the HNC and the NNC assume much higher gas prices (in 2019 dollars) at $14.2/Mbtu for the HNC and $18.2/Mbtu for the NNC.

As production has been adjusted to weak demand and demand has been recovering due to a halt in economic deterioration in China, the world's largest coal consumer, coal prices will turn up in the future. While demand for coal for power generation is expected to increase in other Asian countries, stricter environmental regulations are likely to make it challenging to expand coal production capacity. As the supply–demand balance tightens gradually, coal prices for the REF will moderately rise over the medium to long term to reach $128/t in 2050 in 2019 dollars. However, with coal divestment decreasing coal demand, the real price is expected to be significantly lower at $87/t for the HNC and $77/t for the NNC in 2050.

Table 3.3: International Energy Prices

REF			2019 Real Prices			Nominal Prices		
		2019	2030	2040	2050	2030	2040	2050
Oil	$/bbl	64	97	117	128	120	178	236
Natural Gas								
Japan	$/Mbtu	9.9	9.7	9.9	10.1	12.0	15.0	18.6
Europe (UK)	$/Mbtu	4.8	8.3	8.6	9.2	10.3	13.0	17.0
United States	$/Mbtu	2.5	3.8	4.3	5.0	4.8	6.5	9.2
Steam Coal	$/t	109	112	122	128	140	186	236

HNC			Natural gas-fired substitution						Solar PV/Wind substitution					
			2019 Real Prices			Nominal Prices			2019 Real Prices			Nominal Prices		
		2019	2030	2040	2050	2030	2040	2050	2030	2040	2050	2030	2040	2050
Oil	$/bbl	64	97	117	128	120	178	236	97	117	128	120	178	236
Natural Gas														
Japan	$/Mbtu	9.9	12.5	13.6	14.2	15.5	20.7	26.2	9.7	9.9	10.1	12.0	15.0	18.6
Europe (UK)	$/Mbtu	4.8	11.2	12.4	13.9	13.9	18.8	25.6	8.3	8.6	9.2	10.3	13.0	17.0
United States	$/Mbtu	2.5	6.6	7.8	9.7	8.3	11.9	17.9	3.8	4.3	5.0	4.8	6.5	9.2
Steam Coal	$/t	109	98	95	87	122	144	160	98	95	87	122	144	160

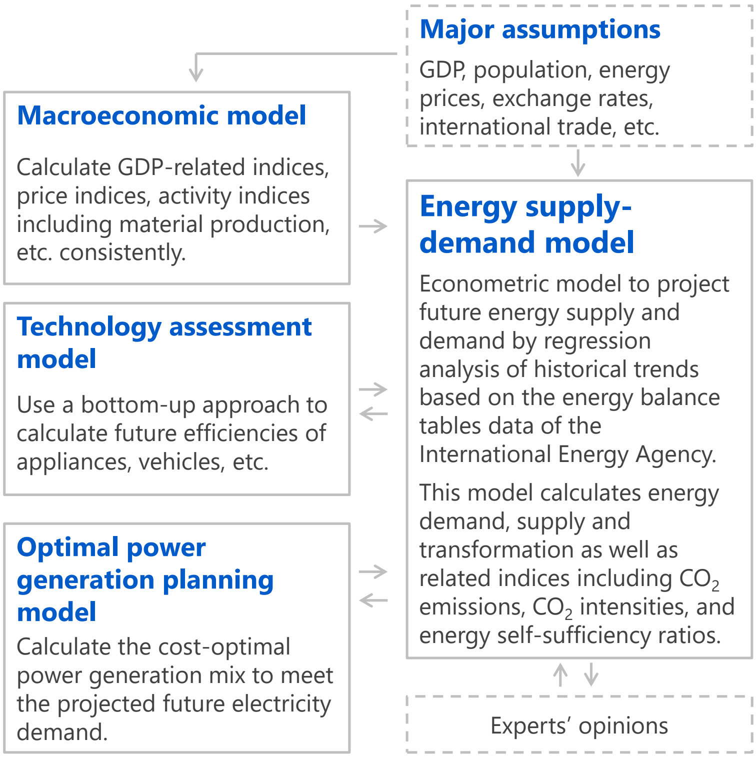
NNC			Natural gas-fired substitution						Solar PV/Wind substitution					
			2019 Real Prices			Nominal Prices			2019 Real Prices			Nominal Prices		
		2019	2030	2040	2050	2030	2040	2050	2030	2040	2050	2030	2040	2050
Oil	$/bbl	64	97	117	128	120	178	236	97	117	128	120	178	236
Natural Gas														
Japan	$/Mbtu	9.9	15.3	17.4	18.2	19.0	26.3	33.7	9.7	9.9	10.1	12.0	15.0	18.6
Europe (UK)	$/Mbtu	4.8	14.1	16.3	18.6	17.5	24.6	34.3	8.3	8.6	9.2	10.3	13.0	17.0
United States	$/Mbtu	2.5	9.4	11.4	14.4	11.7	17.3	26.6	3.8	4.3	5.0	4.8	6.5	9.2
Steam Coal	$/t	109	83	81	77	103	122	141	83	81	77	103	122	141

Source: The Institute of Energy Economics, Japan (2021).

1.2. Model structure

We used a quantitative analysis model to develop an energy outlook and assess energy supply and demand in the world through 2050 (Figure 3.1). Based on IEA's energy balance tables, the model covers various economic indicators and population, vehicle ownership, basic materials production, and other energy-related data collected for modelling. We divided the world into 42 regions and international bunkers (Figure 3.2) and built a detailed supply and demand analysis model for each.

Figure 3.1: Modelling Framework



Source: The Institute of Energy Economics, Japan (2021).

Figure 3.2: Geographical Coverage

Source: www.craftmap.box-i.net.

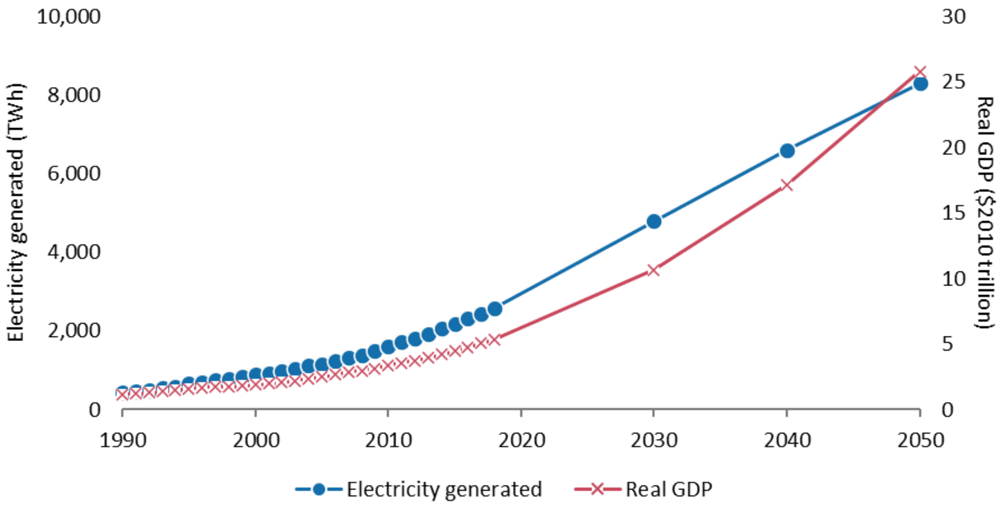
2. Reference and Divestment Scenarios

We quantitatively analysed global energy supply and demand using the assumptions and models described in section 3.1. In the REF case, the seven EAS countries' total power generation in 2050 will reach 8,308 TWh, 3.2 times greater than in 2018. Also, the cumulative coal-fired power generation throughout the projection period in the NNC will be 53% less than in the REF. Section 3.2 shows the collective and individual outlook of electricity generated, CFPP capacities, and the seven EAS countries' power mix.

2.1. Total of the seven EAS countries

Although there are differences between the countries, the robust growth of the economy and population will generally drive electricity demand in the seven EAS countries towards 2050. In response to this rapid demand growth, total electricity generation in the region will increase from 2,584 TWh in 2018 to 8,308 TWh in 2050 (Figure 3.3).

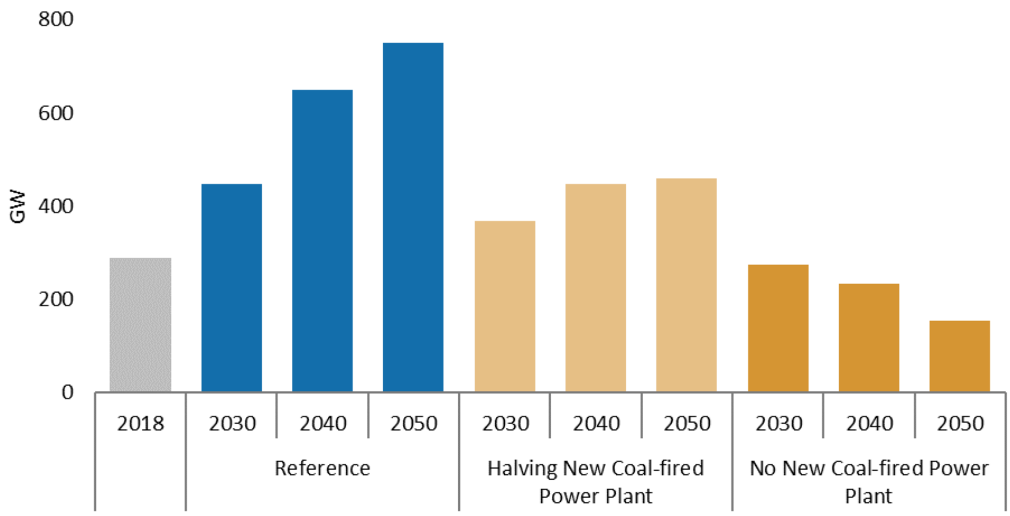
Figure 3.3: Electricity Generated and Real GDP in the Seven EAS Countries (1990–2050, REF)



Source: The Institute of Energy Economics, Japan (2021).

In the REF, coal-fired power generation capacities in the seven countries will increase from 289 GW in 2018 to 749 GW in 2050. As a result, coal-fired power generation will continue to be the region's primary power source (Figure 3.4). In contrast, the capacities in the NNC will continue to decline after 2021, reaching 155 GW in 2050. In the HNC, the capacities will plateau after a modest increase until the late 2040s, and reach 459 GW in 2050.

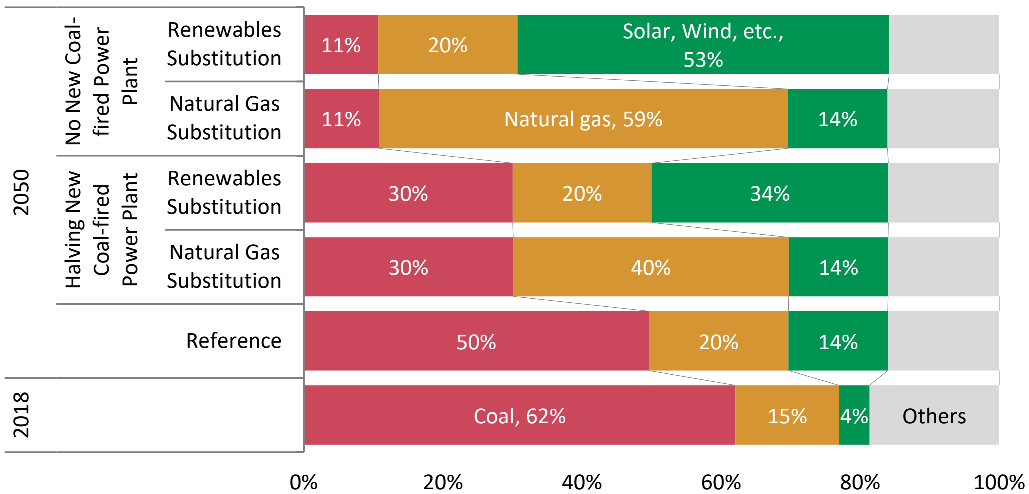
Figure 3.4: Coal-Fired Power Generation Capacity in the Seven EAS Countries (2018–2050)



Source: The Institute of Energy Economics, Japan (2021).

Consequently, coal share in the seven countries' power mix, which was 62% in 2018, will be 50%, 30%, and 11% in the REF, HNC, and NNC, respectively (Figure 3.5).

Figure 3.5: Power Mix in the Seven EAS Countries (2018, 2050)

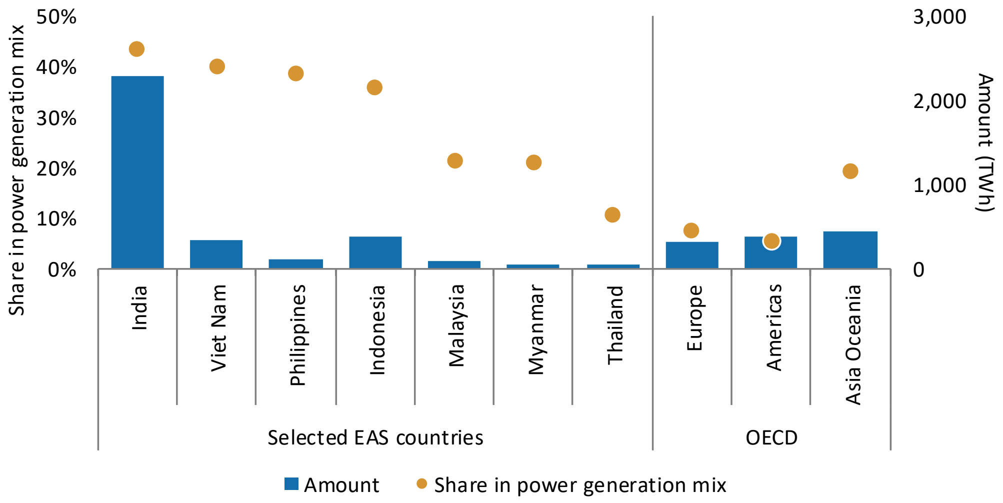


Source: The Institute of Energy Economics, Japan (2021).

The cumulative coal-fired power generations from 2018 to 2050 in the region will be 96 PWh in the REF, 45 PWh in the NNC (53% less than the REF), and 71 PWh in the HNC (27% less than the REF). Therefore, some alternative power sources must compensate for the differences of 51 PWh or 26 PWh in the cumulative power generation between the REF and the other two scenarios. The difference of 51 PWh between the REF and the NNC is so huge that it is equivalent to the sum of cumulative power generation in Japan and Korea in the same period.

Besides, in 2050, the seven countries will require 3,265 TWh of substitute power, approximately three times as needed in the total OECD (Figure 3.6). Figure 3.6 also shows that most of the share of coal-fired power generation in each country will be higher than that of each OECD region. Given the above, if these EAS countries' governments enforce the restriction, the region will face significant challenges than in the OECD. We are to see such challenges in more detail in Chapter 4.

Figure 3.6: Electricity Generated by New and Replaced Coal-Fired Power Plants in the Seven EAS Countries (2050, REF)

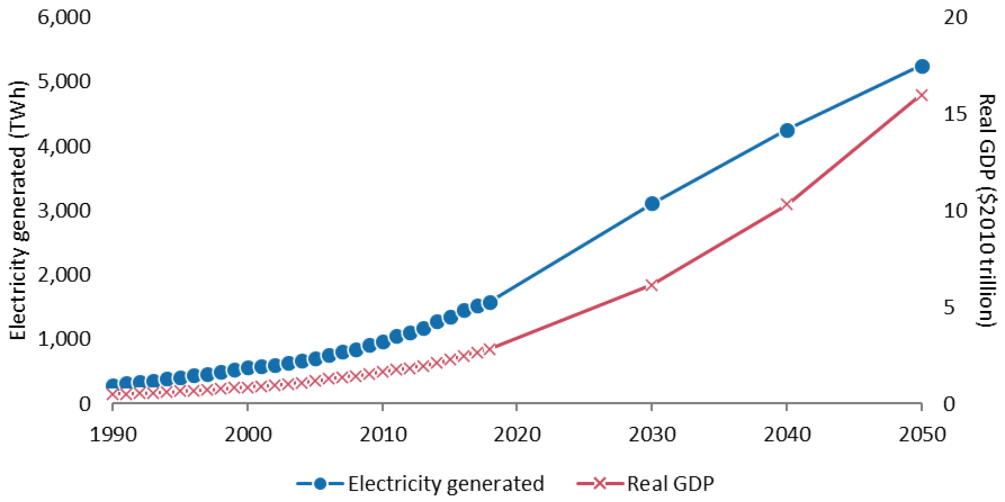


EAS = East Asia Summit, OECD = Organisation for Economic Co-operation and Development.
Note: OECD Americas consists of Canada, Mexico, and the US.
Source: The Institute of Energy Economics, Japan (2021).

2.2. India

The model presumes that India's population and economy will drastically grow throughout the projection period. As a result, its population and real GDP in 2050 will rank first and third in the world, respectively. However, GDP per capita in 2050 will be less than US$10,000, and there is much room for further economic development. Based on this growth, this country's electricity will surge from 1,583 TWh in 2018 to 5,255 TWh in 2050, corresponding to the increased demand (Figure 3.7). In 2050, India will have the third-largest volume of electricity generation in the world, following China and the US. The final consumption of electricity per person in 2050 will be 2.7 MWh, which is equivalent to the current level in Thailand and is far from saturated.

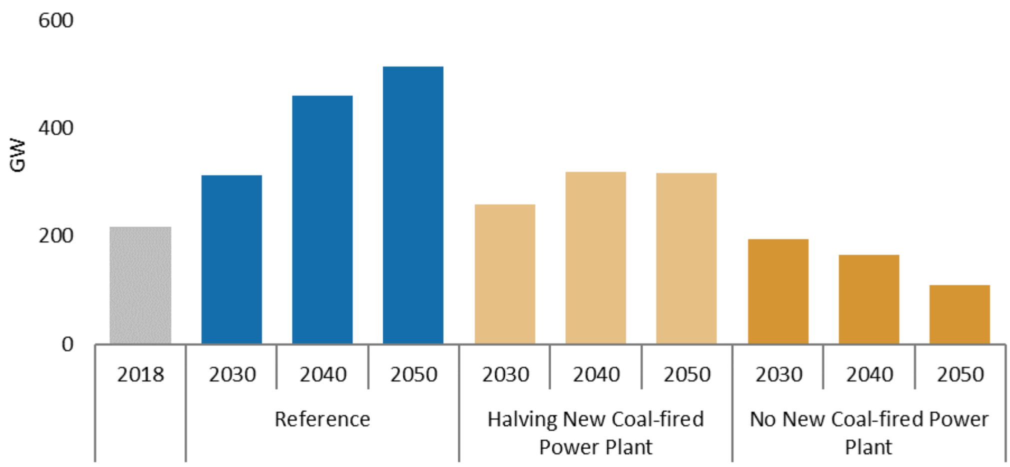
Figure 3.7: Electricity Generated and Real GDP in India (1990–2050, REF)



Source: The Institute of Energy Economics, Japan (2021).

Figure 3.8 shows coal-fired power generation capacities in India by scenario.

Figure 3.8: Coal-Fired Power Generation Capacity in India (2018–2050)

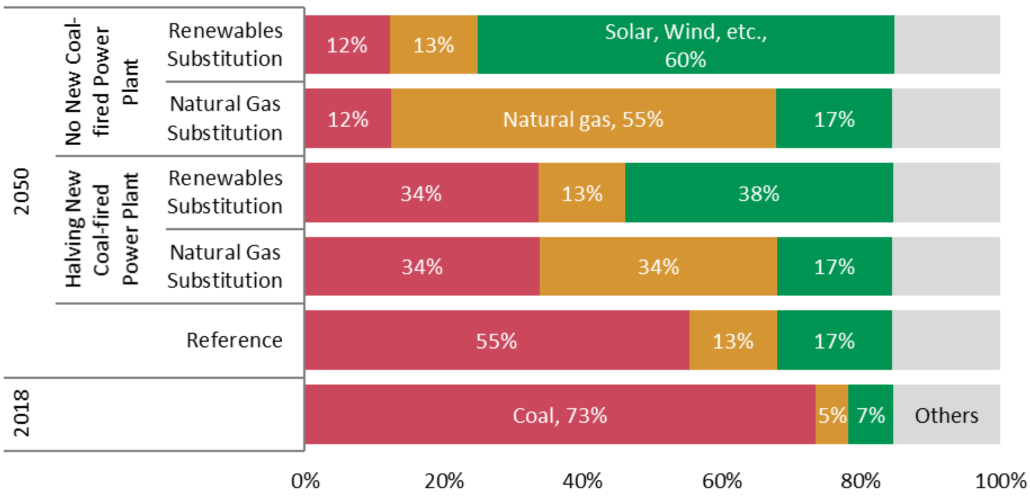


Source: The Institute of Energy Economics, Japan (2021).

The capacities in the REF will reach 515 GW in 2050, 2.4 times as 218 GW in 2018. By contrast, in the NNC, no new or renewed plants and the gradual phase-out of ageing plants will lead coal-fired power generation capacities to decline to 108 GW in 2050. The capacities in the HNC will increase at a modest pace until the mid-2040s, then level off and remain at 318 GW in 2050.

Figure 3.9 shows how coal share in the power mix, 73% in 2018, will branch by scenario. The NNC and the HNC will see shares of 12% and 34% in 2050, respectively, significantly lower than 55% in the REF backed by steady growth in the capacity.

Figure 3.9: Power Mix in India (2018, 2050)

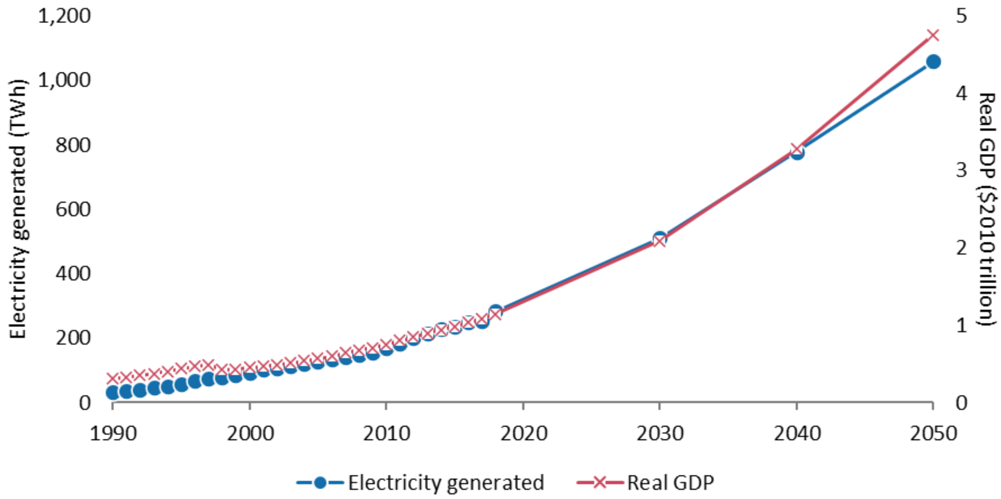


Source: The Institute of Energy Economics, Japan (2021).

2.3. Indonesia

In Indonesia, population and economic growth will drive electricity demand and supply throughout the projection period. The total power generation in 2050 will hit 1,059 TWh, 3.7 times as in 2018 (Figure 3.10). In 2050, however, the final electricity consumption per capita will remain at 2.9 MWh, only 70% of the global average for that year. Hence, this country's power demand could go up further if a power-intensive lifestyle prevails as the economic level rises.

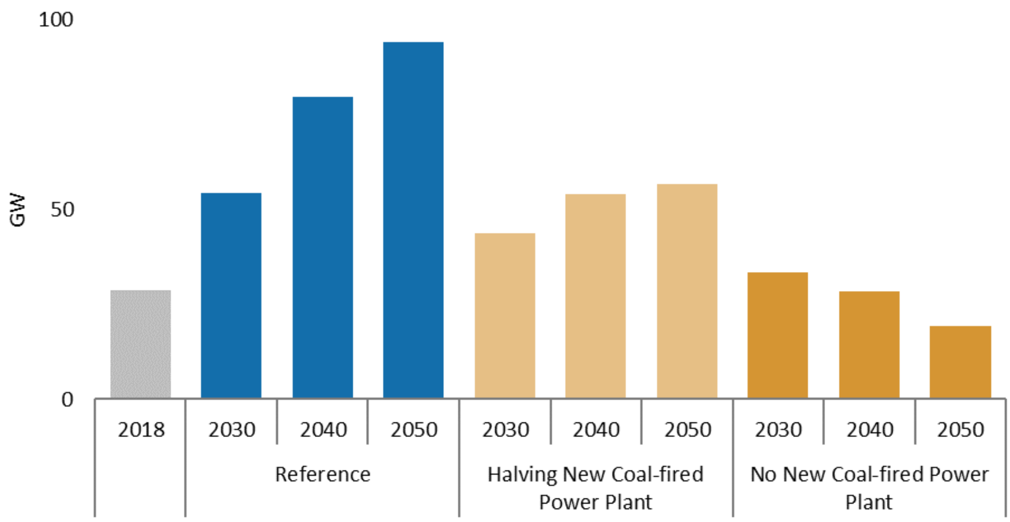
Figure 3.10: Electricity Generated and Real GDP in Indonesia (1990–2050, REF)



Source: The Institute of Energy Economics, Japan (2021).

Figure 3.11 presents coal-fired power generation capacities by scenario.

Figure 3.11: Coal-Fired Power Generation Capacity in Indonesia (2018–2050)

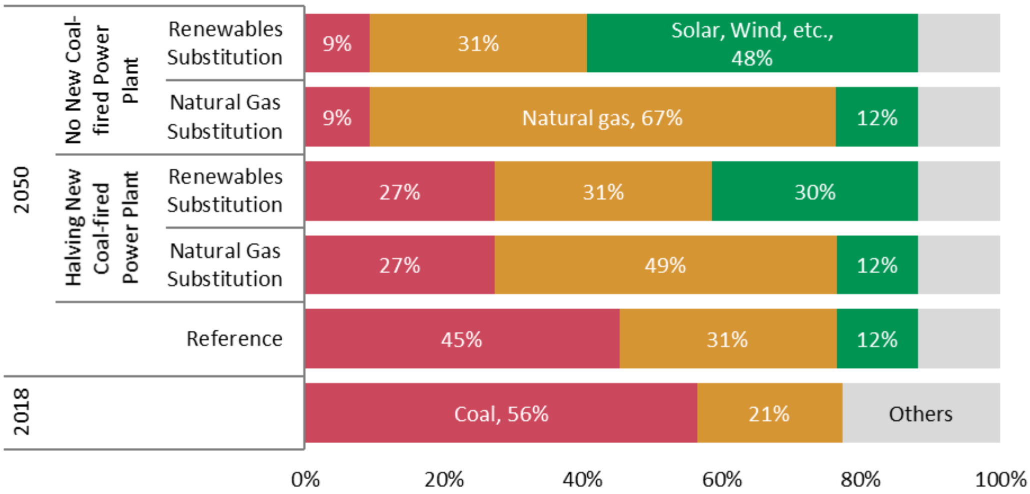


Source: The Institute of Energy Economics, Japan (2021).

At the workshop, it was mentioned that although Indonesia plans to utilise CFPPs for the following years, the country is trying to reduce dependency on them and introduce low-emission technologies such as critical integrated gasification combined cycle (IGCC) and CCS. Dependence on coal-fired power generation will decrease in the REF as well. However, as power demand increases, the capacities in the REF will robustly surge to 94 GW in 2050, more than three times than in 2018 (29 GW). On the other hand, the capacities in the NNC will drop to 19 GW by 2050, reflecting the retirement of ageing plants. In the HNC, the capacities will remain at 57 GW in 2050, after almost flattening in the mid-2040s.

Figure 3.12 shows that coal's share in the power mix of the NNC will plummet from 56% in 2018 to 9%. This shrinking is compared to 45% in the REF, provided that the capacity in 2050 in the NNC will only be 30% less than in 2018. In the HNC, the share will drop to 27%.

Figure 3.12: Power Mix in Indonesia (2018, 2050)

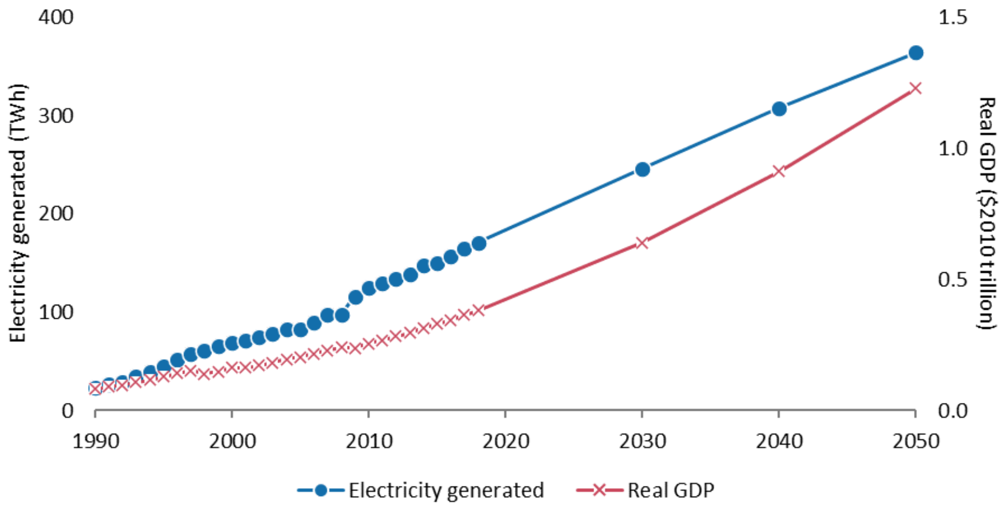


Source: The Institute of Energy Economics, Japan (2021).

2.4. Malaysia

Malaysia has the highest GDP per capita amongst the seven countries. The average annual GDP growth of this country is the second-slowest after Thailand. However, in 2050, the GDP per capita of about US$30,000 will be three times the average of the seven countries. Power demand will increase at a modest pace than in other countries. Nevertheless, the power generation in 2050 will be at 364 TWh, 2.1 times as in 2018 (Figure 3.13). The final consumption of electricity per capita will exceed 8 MWh, comparable to the average of current OECD countries.

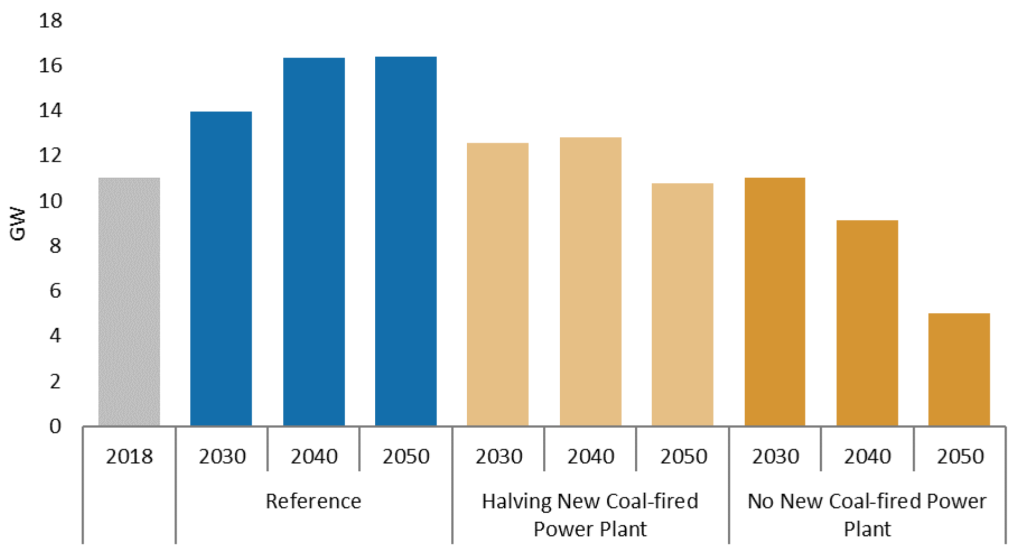
Figure 3.13: Electricity Generated and Real GDP in Malaysia (1990–2050, REF)



Source: The Institute of Energy Economics, Japan (2021).

Figure 3.14 shows Malaysia's coal-fired power generation capacity by scenario.

Figure 3.14: Coal-Fired Power Generation Capacity in Malaysia (2018–2050)

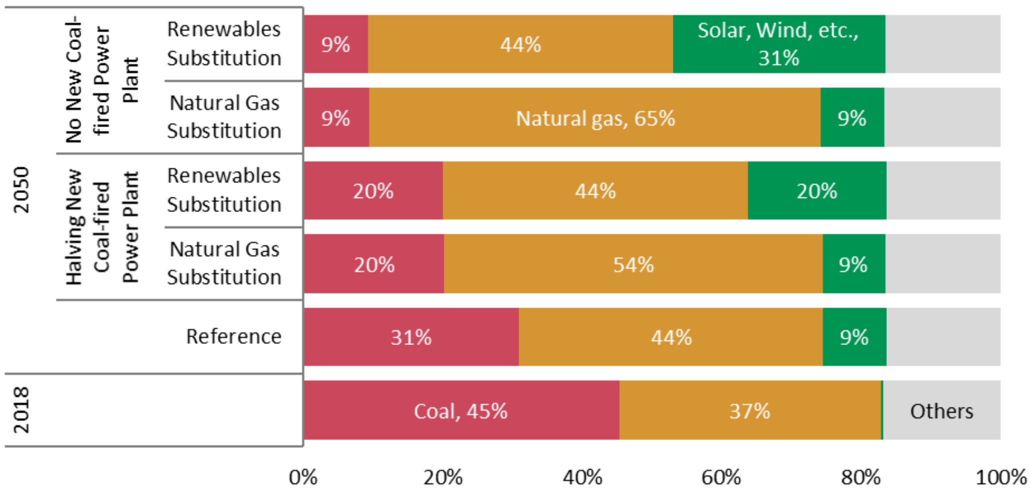


Source: The Institute of Energy Economics, Japan (2021).

At the workshop, it was mentioned that Tenaga Nasional Berhad, the largest power generator, pledged not to invest any more in greenfield CFPPs. Therefore, the increase in coal-fired power generation capacity in the REF will be restrained. The REF capacities will plateau in the mid-2040s and reach 16 GW in 2050, 1.5 times as in 2018 (11 GW). In contrast, the capacities in the NNC will drop to 5 GW in 2050. In the HNC, the capacities will slightly increase until the mid-2030s. After that, they will decrease to 11 GW in 2050, almost the same as in 2018.

As a result, coal share in the power mix will vary from the current level of 45% (Figure 3.15). In the REF, renewables' expansion will erode the share of coal power to 31% by 2050, lower than in 2018. On the other hand, coal share in the NNC and the HNC in 2050 will decline to 9% and 20%, respectively.

Figure 3.15: Power Mix in Malaysia (2018, 2050)



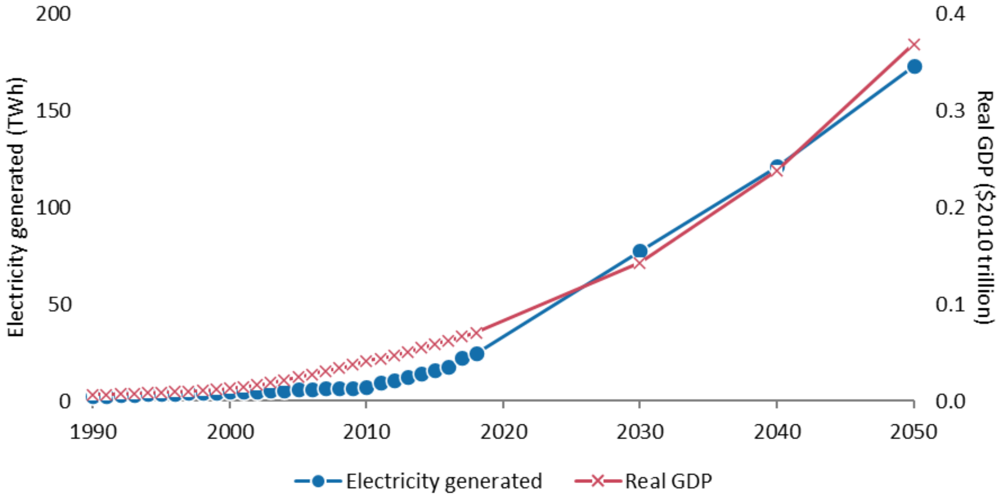
Source: The Institute of Energy Economics, Japan (2021).

2.5. Myanmar

Out of the seven countries, Myanmar is the least developed, but its GDP per capita in 2050 will approach US$6,000. In a few years, it will reach the current level of Thailand. In Myanmar, electricity demand will increase rapidly as its population and economy grow. In 2050, the country will generate seven times more electricity than in 2018, 173 TWh (Figure 3.16). This growth rate is the fastest amongst the seven EAS countries. The final consumption of electricity per capita in 2050 will be 1.8 MWh, which is lower than the current level in Viet Nam. Electricity demand is expected to continue to expand rapidly after the projection period.

Figure 3.16: Electricity Generated and Real GDP in Myanmar

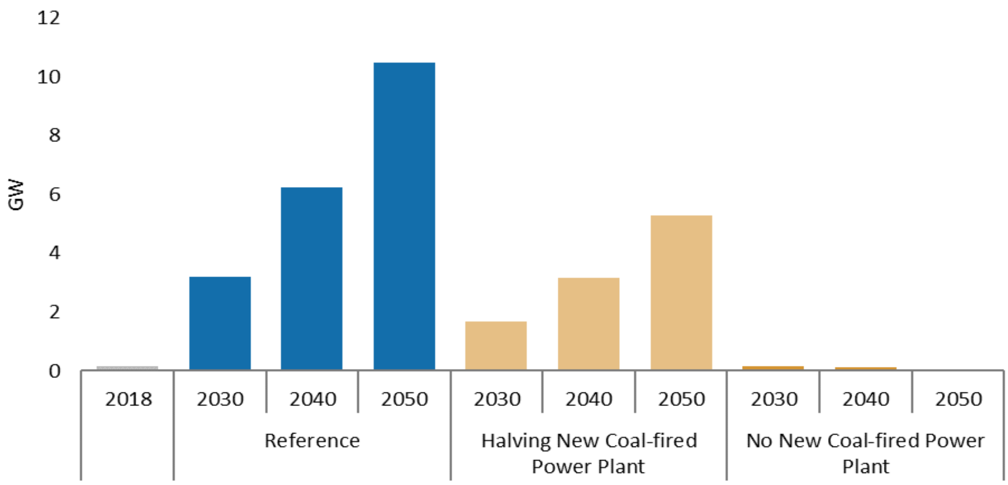
(1990–2050, REF)



Source: The Institute of Energy Economics, Japan (2021).

Figure 3.17 shows the coal-fired power generation capacities in Myanmar by scenario.

Figure 3.17: Coal-Fired Power Generation Capacity in Myanmar (2018–2050)

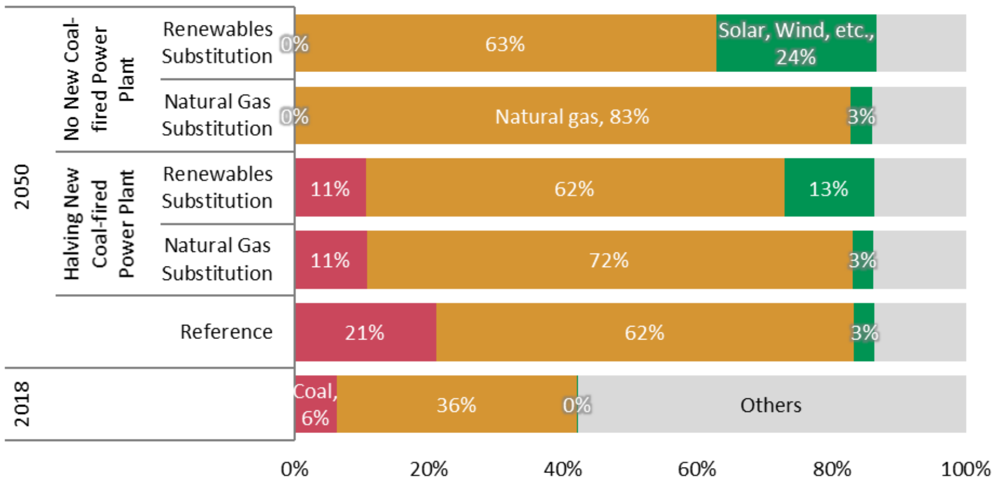


Source: The Institute of Energy Economics, Japan (2021).

The REF will see a steady increase in coal-fired power generation capacity, reaching 10 GW in 2050. As opposed to the REF, the NNC capacity will remain at almost 0 GW in 2050. In the HNC, the capacity will slowly increase than in the REF, resulting in 5 GW in 2050.

As a result of the above, the coal share in the power mix will change (Figure 3.18). In the REF and the HNC, the share in 2050 will rise to 21% and 11% from 6% in 2018, respectively. In the NNC, on the other hand, the share as of 2050 will be almost 0%.

Figure 3.18: Power Mix in Myanmar (2018, 2050)

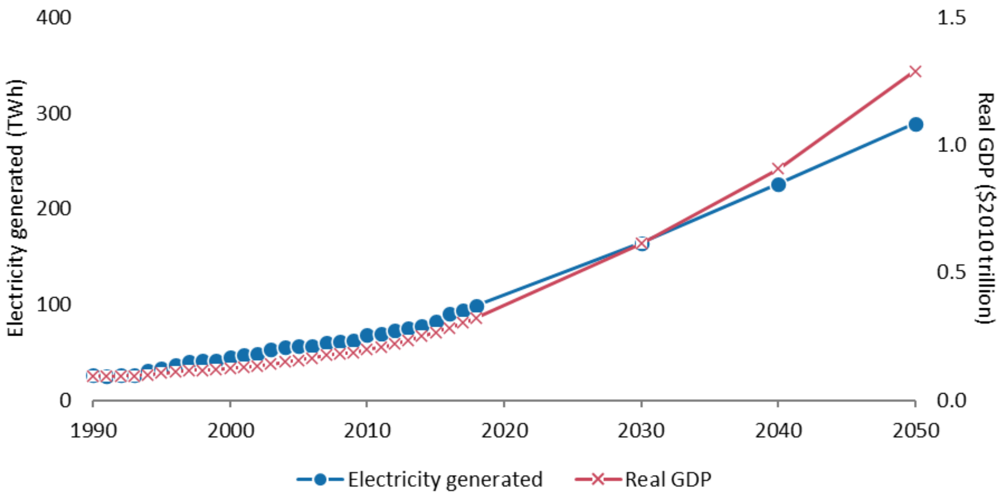


Source: The Institute of Energy Economics, Japan (2021).

2.6. Philippines

The Philippines has the fastest population growth rate amongst the seven EAS countries. This growth will robustly support its power demand increase throughout the projection period along with economic growth. The electricity generated in 2050 will hit 289 TWh, 2.9 times as in 2018 (Figure 3.19).

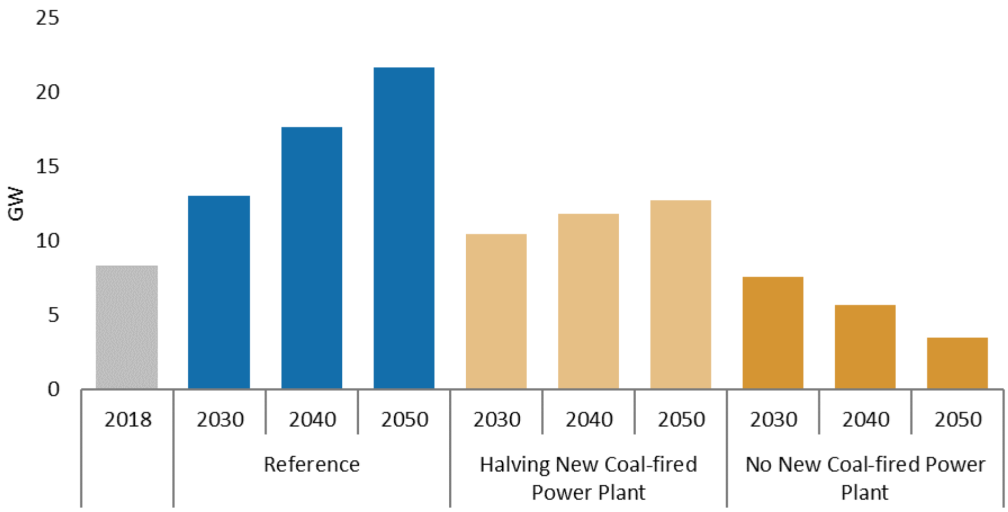
Figure 3.19: Electricity Generated and Real GDP in the Philippines (1990–2050, REF)



Source: The Institute of Energy Economics, Japan (2021).

Figure 3.20 shows the coal-fired power generation capacities in the Philippines by scenario.

Figure 3.20: Coal-Fired Power Generation Capacity in the Philippines (2018–2050)

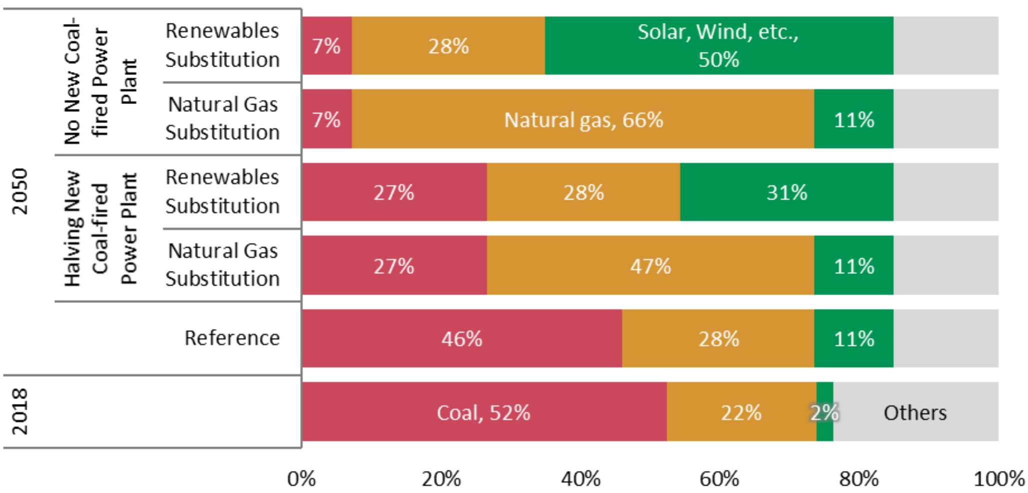


Source: The Institute of Energy Economics, Japan (2021).

The coal-fired power generation capacities in the REF will steadily increase, reaching 22 GW by 2050. In contrast, the NNC capacities will gradually decrease with ageing plants' retirement, reaching 3 GW in 2050. In the HNC, the capacities will increase but slower than the REF and hit 13 GW in 2050.

Figure 3.21 shows how coal share in the power mix will diverge from 52% in 2018. In the REF, the share in 2050 will slightly drop to 46% due to the expansion of natural gas and renewables. The coal share in the NNC and the HNC in 2050 will drastically decrease to 7% and 27%, respectively.

Figure 3.21: Power Mix in the Philippines (2018, 2050)

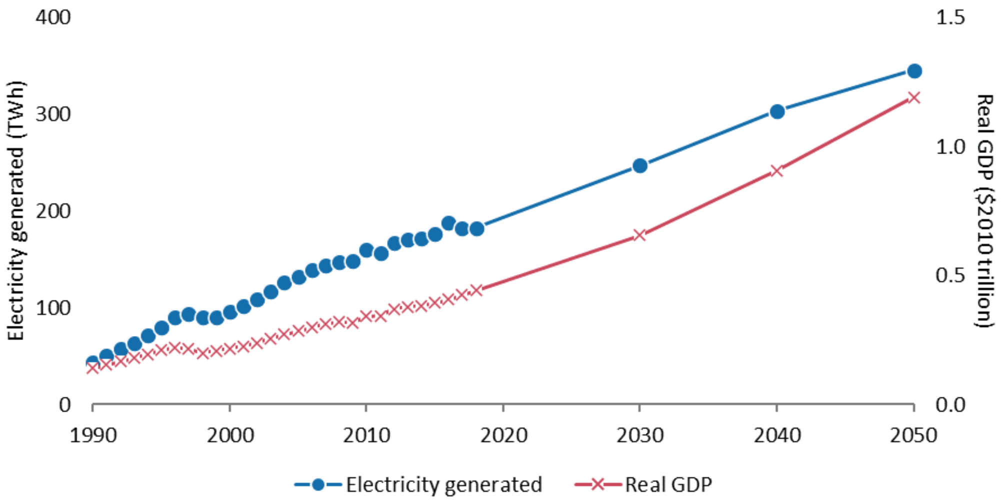


Source: The Institute of Energy Economics, Japan (2021).

2.7. Thailand

Thailand is the only country amongst the seven whose population is expected to peak off by 2050. However, its economic growth will drive power demand. The projected power generation of 345 TWh in 2050 is 1.9 times greater than in 2018 (Figure 3.22).

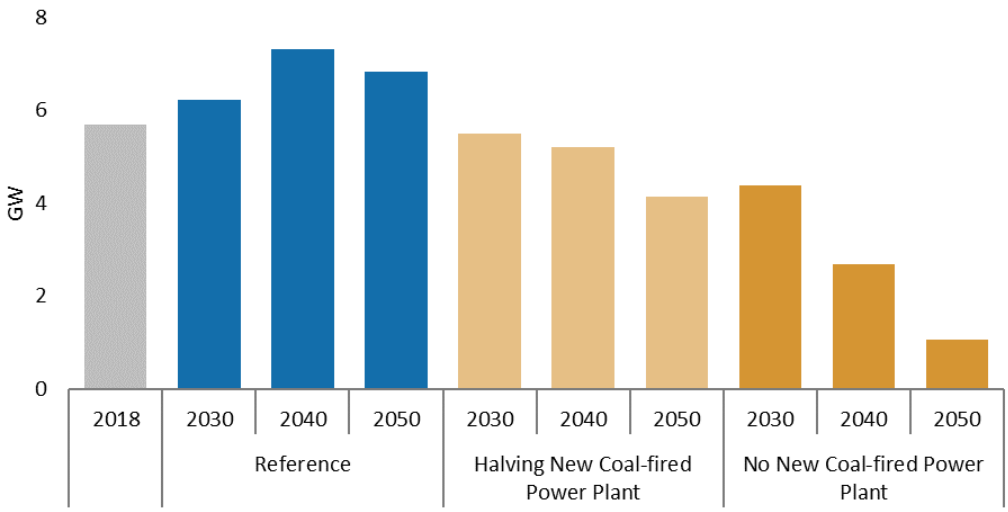
Figure 3.22: Electricity Generated and Real GDP in Thailand (1990–2050, REF)



Source: The Institute of Energy Economics, Japan (2021).

At the workshop, it was mentioned that although existing coal and lignite plants will remain in the power mix at least until 2037, the power development plan does not include new CFPPs. On the other hand, there is information on new CFPPs of 1 GW each in the eastern region and the southern region (see section 2.6.2 on coal-fired power development). The REF of this study incorporates them and assumes that coal-fired power generation capacities in this country will tend to continue to increase until the 2030s. After that, however, the capacities will gradually decrease because of the active penetration of renewables, mainly solar PV. Figure 3.23 shows coal-fired power generation capacity in Thailand by scenario.

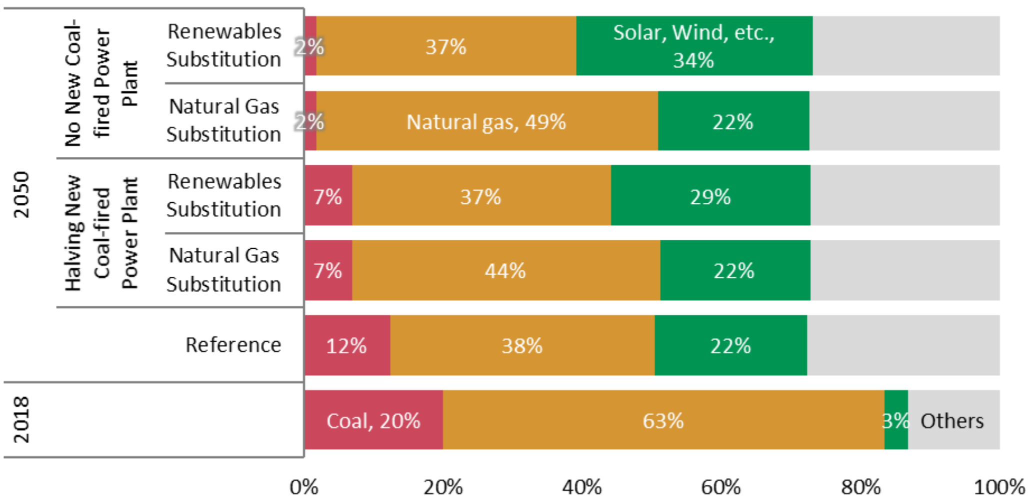
Figure 3.23: Coal-Fired Power Generation Capacity in Thailand (2018–2050)



Source: The Institute of Energy Economics, Japan (2021).

The coal share in the power mix, which was 20% in 2018, will also change (Figure 3.24). In the REF, the share will decrease to 12% due to the expansion of renewables. The share in the NNC and the HNC will see further drops to 2% and 7%, respectively.

Figure 3.24: Power Mix in Thailand (2018, 2050)

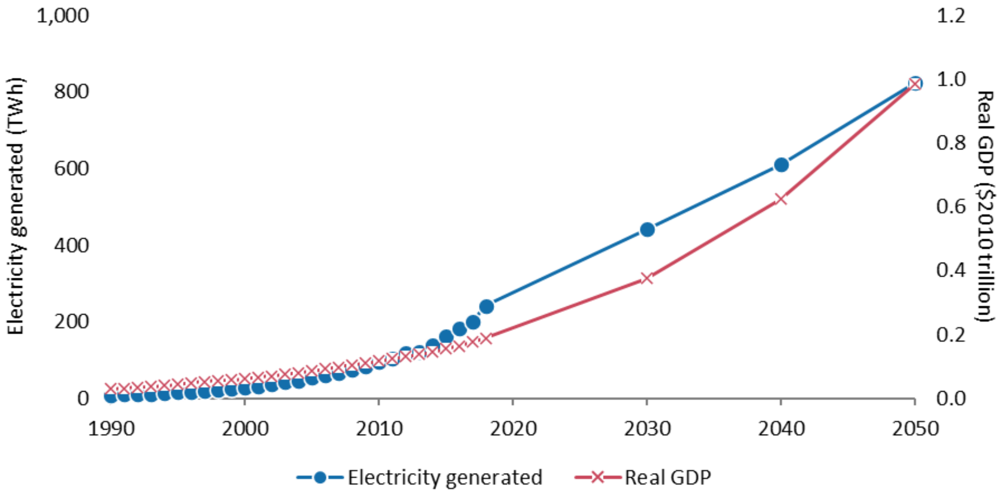


Source: The Institute of Energy Economics, Japan (2021).

2.8. Viet Nam

The power supply in Viet Nam will increase as population and economic growth robustly surge power demand (Figure 3.25). The electricity output of 823 TWh in 2050 will be 3.4 times greater than that in 2018.

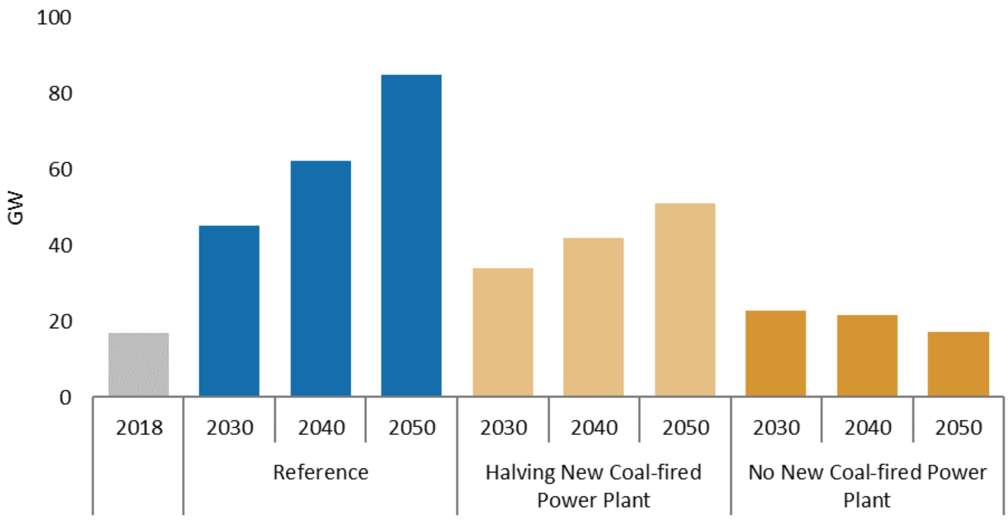
Figure 3.25: Electricity Generated and Real GDP in Viet Nam (1990–2050, REF)



Source: The Institute of Energy Economics, Japan (2021).

Figure 3.26 shows the transition of coal-fired power generation capacity in Viet Nam. The capacities in the REF will reach 85 GW in 2050, five times as in 2018. The capacity in the NNC will slightly increase. After that, it will decrease to 17 GW, which is the same level as of today. In the HNC, the capacity will grow slowly and remain at 51 GW in 2050.

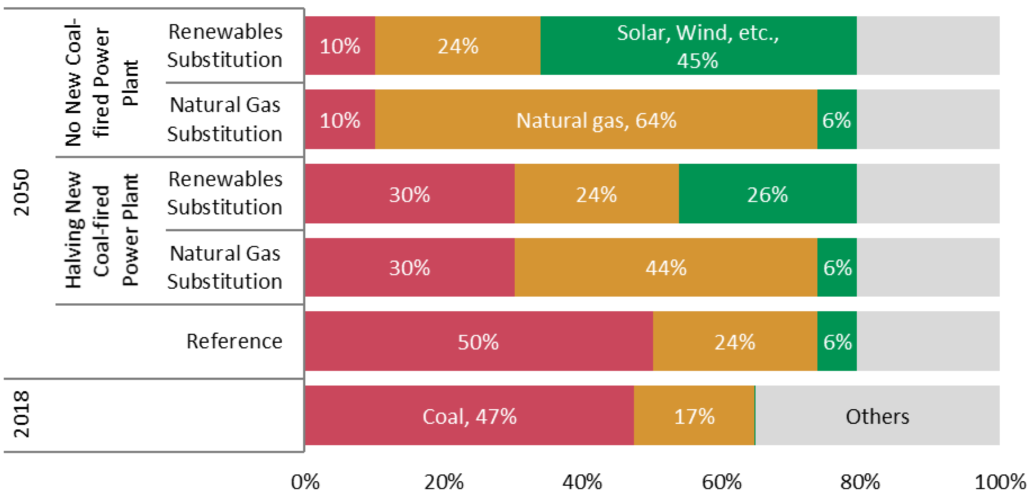
Figure 3.26: Coal-Fired Power Generation Capacity in Viet Nam (2018–2050)



Source: The Institute of Energy Economics, Japan (2021).

At the workshop, it was mentioned that finance for new thermal power plants is a big problem. Coal share in the power mix will change (Figure 3.27). In the REF, the share will rise to 50% from 47% in 2018. On the other hand, the shares in the NNC and the HNC will drop to 10% and 30%, respectively.

Figure 3.27: Power Mix in Viet Nam (2018, 2050)



Source: The Institute of Energy Economics, Japan (2021).