Chapter 4

Impact of Coal Divestment

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Chapter 4
Impact of Coal Divestment

Assuming the restriction on CFPP construction and renewal is introduced worldwide, we will examine its impacts on the seven countries in this chapter. There are two key implications. The first is that even in the NNC, the future CO_2 emission will increase in these countries. Hence, other measures to achieve the climate change target should be adopted. The second is that this restriction will cause severe energy security challenges in both natural gas–fired substitution and renewables (solar PV and wind power) substitution.

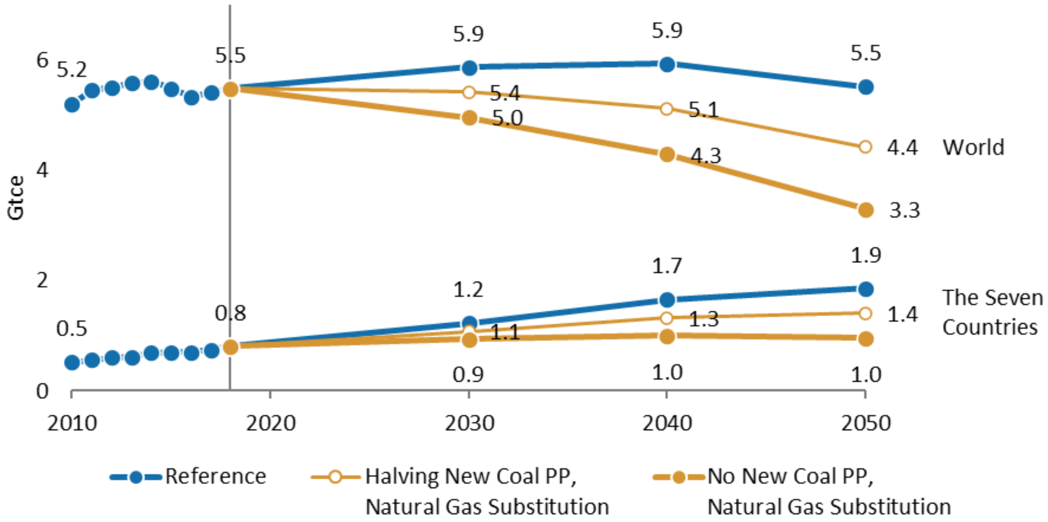
1. CO_2 Emission Reduction

In the NNC and the HNC, coal-fired power generation is capped and replaced by natural gas or solar PV and wind power generation. Therefore, CO_2 emissions in both scenarios are lower than the REF. Nevertheless, in both cases, CO_2 emissions will steadily increase throughout the projection period due to the sheer increase in power demand.

In the NNC or the HNC, coal consumption for power generation is suppressed compared to the REF since coal-fired power generation is relatively suppressed. Due to this effect, for the NNC, where coal-fired power generation is the most reduced amongst all scenarios, the total primary consumption of coal in the seven EAS countries in 2050 will be about 1.0 Gtce, which is nearly half of the REF in the same year (about 1.9 Gtce). With the NNC, increases in coal's primary consumption from 2018 to 2050 can be suppressed to approximately 0.2 Gtce (Figure 4.1).

The trend that coal's primary consumption is suppressed from the REF in the NNC and the HNC is also true globally. In the NNC, the world's primary consumption of coal will be reduced to 3.3 Gtce, equivalent to the level at the beginning of this century. The global primary consumption of coal declines more rapidly than the seven EAS countries because consumption outside Asia has been declining.

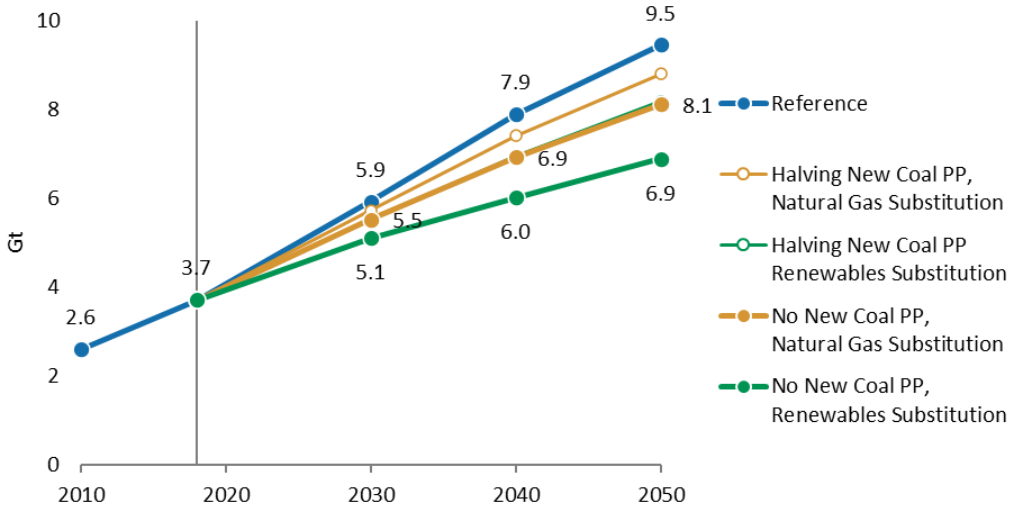
Figure 4.1: Primary Consumption of Coal in the Seven EAS Countries and the World



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

Natural gas has a lower carbon emission factor than coal. Solar PV and wind are CO_2-free power sources. Therefore, replacing coal-fired power generation with natural gas–fired power generation or solar PV and wind power generation contributes to reducing CO_2 emissions. The reduction in coal's primary consumption results in lower CO_2 emissions than the REF for both the NNC and the HNC (Figure 4.2). In the NNC, with renewables substitution, where CO_2 emission reduction effect will be the greatest, CO_2 emissions in 2030 will be reduced by 0.8 Gt (-14%) and in 2050 by 2.6 Gt (-27%) compared with the REF. In natural gas–fired power generation, the CO_2 emission reduction effect of the NNC (natural gas substitution) is about half that of the NNC (renewables substitution). As described above, although the effect varies from case to case, the introduction of this restriction considerably affects CO_2 emission reduction compared to when no restriction is introduced.

Figure 4.2: CO_2 Emission in the Seven EAS Countries, by Scenario



PP = power plant.
Source: The Institute of Energy Economics, Japan (2021).

On the other hand, Figure 4.2 also indicates that in all cases, CO_2 emissions will increase steadily towards 2050. Even in the NNC (renewable substitution), where CO_2 emissions from the power generation sector are reduced most, CO_2 emissions in 2050 will be 1.9 times higher than in 2018 (3.7 Gt), reaching 6.9 Gt. This is because fossil fuel consumption in non-power sectors such as industry, buildings, and transportation increases against the backdrop of significant economic growth in the seven EAS countries.

Therefore, based on the results of the analysis described above, we can say that the restriction on financing for the construction and renewal of CFPPs has a considerable CO_2 emission reduction effect compared to the case where no limitation is introduced. Still, the reduction effect through this restriction is not enough to solely reduce GHG emissions.

2. Energy Security

Countries and regions must procure the energy required for their stable development. Regarding energy security, it is not enough to focus only on procurable energy amount. For example, the IEA defines energy security as the uninterrupted availability of energy sources at an affordable price (IEA, 2019b). In other words, for energy security, governments and utilities must promptly procure sufficient energy amounts at a reasonable price without interruption.

Each country or region has different geographical and socio-economic conditions for energy, such as economic standards, demand volume, indigenous production, and distance from producing countries. It means that even if a restriction on energy use introduced as a measure against climate change is globally uniform, its impacts on energy security can vary from country to country. Therefore, the acceptability of such undifferentiated restrictions could also differ by country.

This study examined the impacts of coal divestment on the construction and renewal of CFPPs on energy security in the seven EAS countries. The result implies that the adoption of alternative power sources, both natural gas–fired and renewable energy (solar PV and wind), will cause energy security challenges for the region. The following sections describe such challenges in each case in detail.

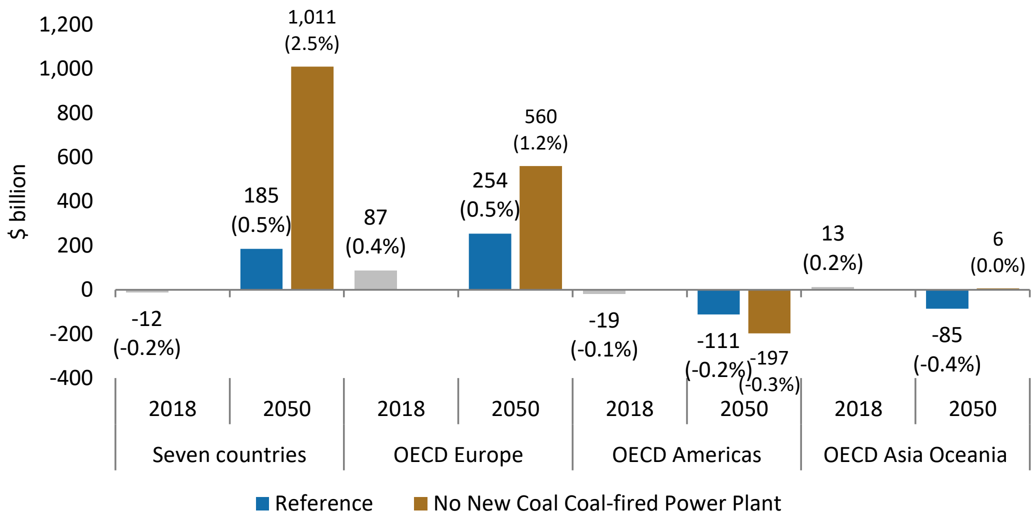
2.1. Natural gas substitution cases

Comparing the natural gas substitution cases of the NNC and the HNC with the REF, there are two issues regarding the seven EAS countries' energy security. The first is that the net import spending on natural gas will increase significantly, putting pressure on the regional economy. The second is that ensuring a stable supply of the requisite natural gas becomes much more difficult. The details of each issue are below.

(i) Substantial increases in total net import spending on natural gas and coal will weigh on the regional economy.

In the NNC, the seven EAS countries' net import spending on natural gas and coal in 2050 totalled US$1,011 billion, 5.5 times larger than that of US$185 billion in the REF (Figure 4.3). The spending in 2050 accounts for 0.5% of the REF's regional nominal GDP, while it accounts for 2.5% in the NNC. It means that net import spending in the NNC will further squeeze the seven EAS countries' economy compared to the REF.

Figure 4.3: Net Import Spending on Natural Gas and Coal



Notes: OECD Americas comprises Canada, Mexico, and the US. Percentages represent the ratios of the net import spending to the nominal GDP of the region.
Source: The Institute of Energy Economics, Japan (2021).

The total net import spending in the NNC increased because the net import volume of natural gas, which has a higher price per unit calorific value than coal, increases from the REF. The coal demand will decrease in the NNC by reduced CFPP capacities. Comparing the net imports of coal in 2050 under the two scenarios, the NNC is about 585 Mtoe lower than the REF. Net import spending of coal in the NNC will be -US$83 billion (negative) with the nominal unit price of $141/t, well below US$40 billion of the REF. On the other hand, in the NNC, the natural gas demand for power generation will soar from the REF. Comparing the net imports of natural gas in 2050 under the two scenarios, the NNC is 496 Mtoe higher than the REF. As seen in Table 3.3, the natural gas unit price in the NNC could skyrocket relative to the REF due to the drastic expansion of the natural gas supply chain. As described in issue (ii) below, it will be necessary to rapidly develop the supply chain to cover enormous natural gas demand in the NNC. Natural gas prices must surge to make such an expanded supply chain economically viable. In total, the increase in natural gas import has much more impact on the net import spending than the decrease in net coal import.

In the NNC, the natural gas prices will globally surge compared to the REF. Nevertheless, its impacts on the net import spending varies from region to region (Figure 4.3). In OECD Americas, high natural gas prices in the NNC will help its net surplus improve. Although OECD Asia Oceania will turn to a net importing region in the NNC, its net import spending will be limited as Australia remains in the LNG export position. In contrast, net import spending in the seven EAS countries and OECD Europe will notably deteriorate in the NNC.

However, the increase in net import spending of OECD Europe in the NNC is much less than the seven EAS countries. One reason for this is the additional natural gas demand in OECD Europe will be well below that of the seven EAS countries as coal-fired power generation capacities are much less. OECD Europe's net import will be 364 Mtoe in 2050 in the NNC, just 51% of the seven EAS countries. The other reason is the import cost difference since Asian import prices are expected to remain higher than Europe's.

(ii) Difficulty of a stable supply of necessary natural gas volume increases

In general, to supply reserved natural gas to consumption areas, supply chains such as exploration, development, production, transportation, and storage should be developed corresponding to the scale and timing of supply and demand. Therefore, in the NNC or the HNC, where the natural gas demand surges for power generation, the supply chain must be expanded accordingly. For such expansion, it is essential to provide many development resources like materials, equipment, experts, and investment funds at each stage of the chain. However, as the demand gets large, it becomes more difficult to secure these resources.

First, it is necessary to explore and develop more gas fields worldwide to produce much more natural gas. In addition to conventional gas resources, producers must actively work on shale and other technically and economically challenging developments, such as in polar regions and deep water. This process will require many development resources like geological data, materials, and equipment for drilling activities and the construction of facilities, specialists from energy, service, and engineering companies, as well as sufficient funds to cover all these operations.

Secondly, it is necessary to ramp up transport capacities to ship the produced natural gas to consuming areas. With coal divestment in place, the LNG demand in the seven countries will increase from 31 MT in 2018 to 300–400 MT in 2040 and 400–600 MT in 2050. Considering the world total LNG demand in 2018 is 314 MT and IEA forecasts the demand to be 847 MT in 2040, it is difficult to assume that the seven countries and the global LNG industry can accommodate the sheer amount of additional LNG demand.

2.2. Renewables substitution cases

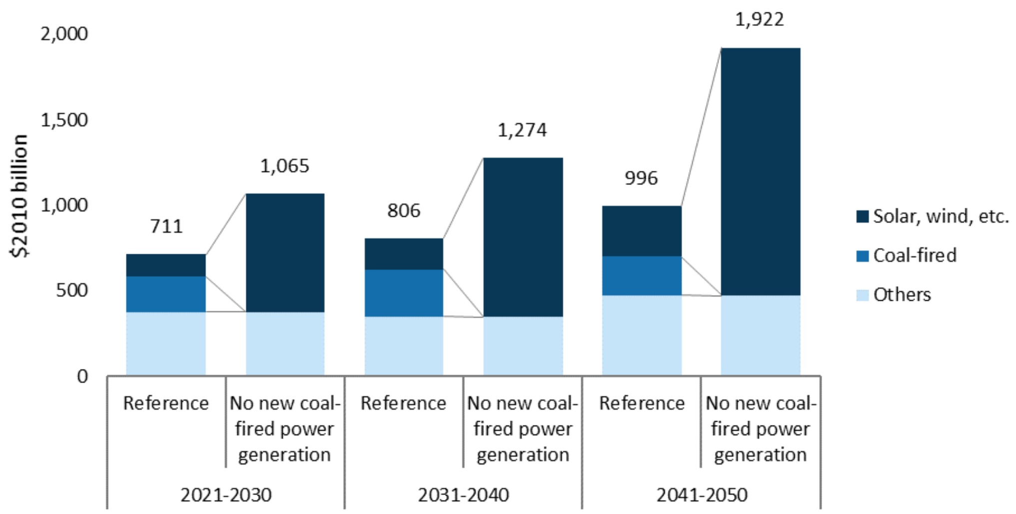
In the renewables substitution cases in the NNC and the HNC, two issues on energy security of the seven EAS countries will arise. The first is higher power costs, and the second is the difficulty of a stable power supply.

(i) Increase in the power cost

Higher electricity costs burden the overall economy and industrial competitiveness via higher electricity prices. Also, higher costs could give rise to a gap in energy accessibility amongst customers, depending on their economic situation. Chapter 3 illustrated that in the case of renewable energy substitutes, the electricity cost would go up in the seven countries for two reasons.

The first reason is the enormous amount of capital investment for new solar PV and wind power generation. In the NNC, the seven countries will see reduced coal-fired power generation capacity in 2050 by 594 GW relative to the REF, requiring the augmentation by renewables to meet electricity demand. Figure 4.4 shows rough estimates of total power generation plant costs (not including transmission and distribution facilities costs) for the REF and the NNC.

Figure 4.4: Capital Expenditures for Power Generation in the Seven EAS Countries



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

The cumulative capital expenditures through 2021 to 2050 in the NNC will increase by about US$1.7 trillion relative to the REF. This increase will put upward pressure on electricity costs in the region.

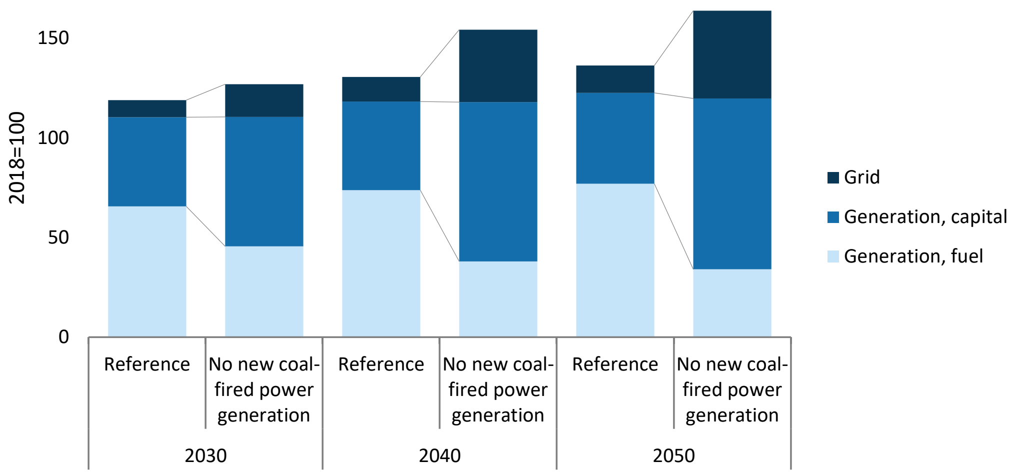
The power transmission and distribution facilities for connecting the new power generators with existing systems should be expanded because each solar PV and wind facility locations are to be geographically dispersed compared with conventional large-scale power plants. Although estimation in Figure 4.4 does not include them, this expansion also requires vast facility costs.

Besides, a large part of total cash out for construction occurs during the construction period, in short, before the income from electricity sales comes in. In terms of the feasibility of the NNC, it is necessary to consider whether utilities can finance such considerable amounts with acceptable conditions.

The second reason is that the operating costs of power grids and other software increase. Concurrent with the construction of facilities, utilities must drastically reform the system operation methodologies because solar PV and wind power generation is intermittent. This reformation and new methods will raise operating costs compared to the REF.

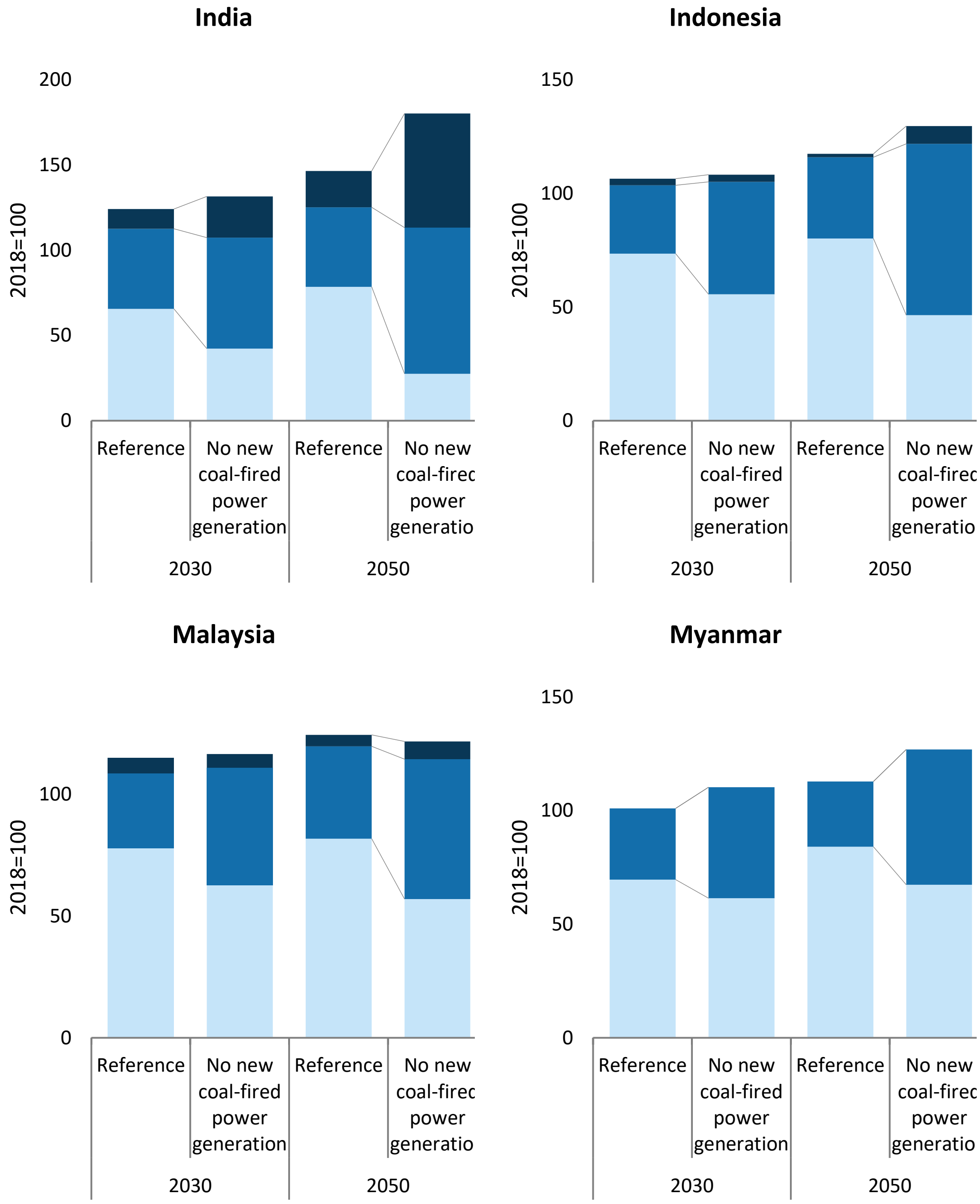
Figures 4.5 and 4.6 show the estimated electricity costs of the seven EAS countries in the REF and the NNC. The difference between the two scenarios widens in later years; finally, the electricity costs in 2050 in the NNC become 20% higher than the REF.

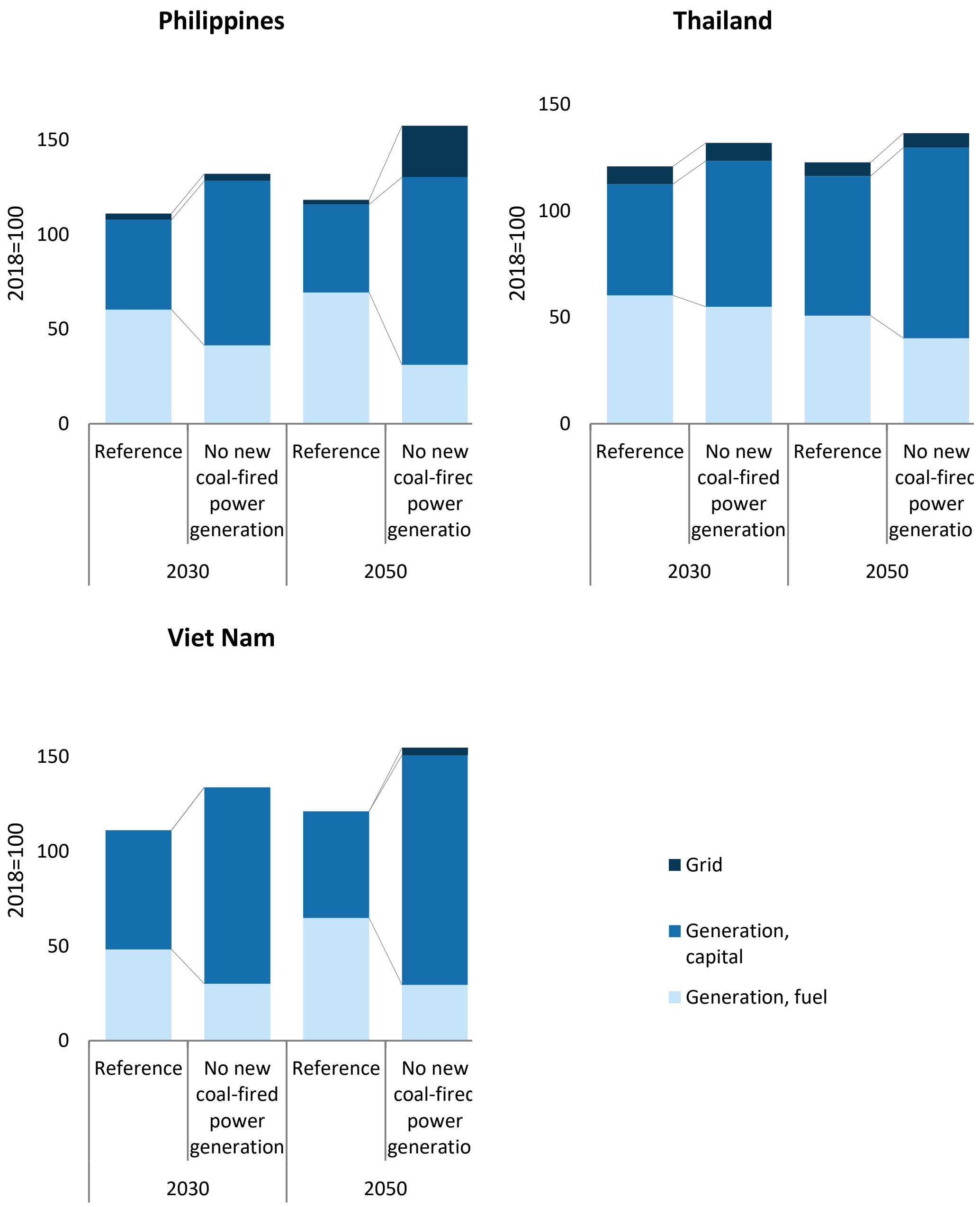
Figure 4.5: Indicative Electricity Costs in the Seven EAS Countries (Combined)



Note: Electricity prices are also affected by other costs, such as labour costs, taxes, subsidies, price regulation, power companies' profit, etc.
Source: The Institute of Energy Economics, Japan (2021)

Figure 4.6: Indicative Electricity Costs in the Seven EAS Countries





Note: Electricity prices are also affected by other costs, such as labour costs, taxes, subsidies, price regulation, power companies' profit, etc.
Source: The Institute of Energy Economics, Japan (2021).

Capital and operating costs of renewables can also vary from the region based on technical and commercial situations. For example, in OECD Europe, continuous innovations in renewables technologies have contributed to lower capital and operating costs. Moreover, the developed wholesale trading system in the region helps renewable energy to replace thermal power generation. Furthermore, the well-interconnected power grids play a role in alleviating costs to deal with supply intermittency caused by renewables. On the other hand, in the seven EAS countries, technology innovations, market developments, and grid connectivity are relatively less developed than those in OECD Europe. These differences will lead to significant differences in expenses to introduce a vast amount of renewables amongst regions, even under similar restrictions.

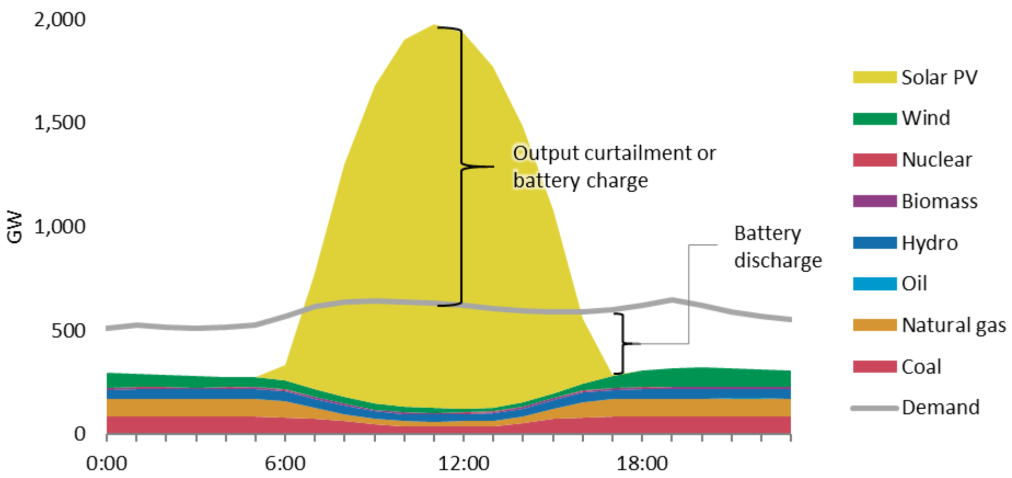
(ii) Stable supply of electric power becomes difficult.

Electricity supply and demand must always balance in a grid to avoid a blackout. Hence, utilities continuously control the power supply in networks to deal with fluctuating demand. However, unlike thermal power generators, it is almost impossible to artificially manage the inflow from solar PV and wind generation without large-scale battery technologies as sunlight and wind conditions are beyond control.

Solar PV and wind power generation capacities in 2050 in the NNC will hit 3,244 GW, 48 times the level in 2018. This dramatic capacity increase could urge utilities to close some of their thermal power plants. Thermal power generation balances supply and demand by covering the intermittency of renewables. Therefore, the expansion of solar PV and wind power could hinder the stable power supply.

Figure 4.6 shows an indicative example of electricity supply and demand in a day in January 2050 in India, which assumes the largest renewable capacities amongst the seven EAS countries in the NNC.

Figure 4.7: Indian Electricity Supply and Demand (January 2050, Indicative)



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

In Figure 4.7, the power supply overshoots the demand during the daytime due to solar PV, while there is a shortage after sunset. This figure implies that it is essential to develop large-scale batteries and output control technologies to balance supply and demand adequately before introducing a vast amount of renewables.

3. Natural Gas Market

Natural gas would be one of the main alternatives to coal in power generation in the economies discussed in this study. Demand for natural gas in Asian countries is expected to grow faster than the total energy in the region in the REF. In parallel with the expansion of renewables, the share of natural gas in the seven countries' energy mix is expected to expand from 12% in 2018 to 16% in 2050.

In the alternative scenarios (the NNC and the HNC), more specifically in the natural gas substitution cases, natural gas demand in the seven countries and the rest of the world is forecasted to be unrealistically higher than the REF. This will lead to undesirable impacts on the healthy growth of the natural gas market in the region.

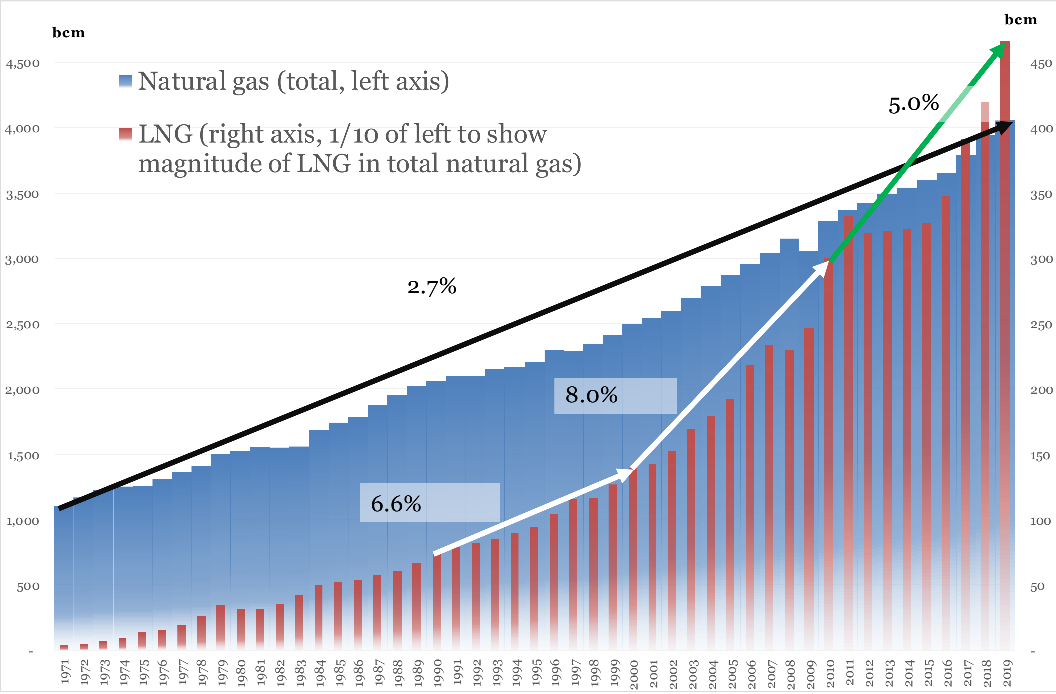
With modest domestic production growth in ASEAN and India, the region's import dependency could rise significantly from the current level of around 30% to nearly 50% by 2050 in the REF and even a higher dependency in the NNC and the HNC. Therefore, ASEAN and India need a stable investment in the infrastructure of natural gas and LNG-receiving terminals and pipelines, gas-fired power generation facilities, and securing natural gas and LNG supply sources from within and outside the region.

Globally, new LNG liquefaction plants with significant capacity have started operation in recent years. The world is expected to see a further considerable expansion of LNG production in the next decade. However, considering that the sheer increase of natural demand would have to be met by imported LNG, the LNG market would be severely constrained in natural gas substitution cases of the NNC and the HNC.

3.1. LNG development in the seven countries

Global natural gas demand grew at 3% per year from 2009 to 2019 to 4 trillion cubic metres. The Asia-Pacific region was the largest contributor to this, annually increasing 5.3%. Most other regions saw growth, with North America and the Middle East contributing about one-third to the increase. The LNG market continued expanding in 2019, with the absolute volume growth in 2019 second only to 2010.

Figure 4.8: Historical Natural Gas and LNG Market Development in the World



Note: The bars for LNG use 1/10 scale of total natural gas, meaning that when natural gas and LNG bars have the same length, LNG represents 10% of the total natural gas.
Source: Compiled by the author based on data of IEA and Cedigaz.

Natural gas and LNG in the seven countries vary in their development stages. India, Indonesia, Malaysia, Singapore, and Thailand are in the advanced stages of development of integrating LNG into their energy needs. Myanmar, the Philippines, and Viet Nam use LNG in its initial stage or is under consideration. While ASEAN is forecasted to continue to be a net natural gas exporter until 2030, the region's LNG imports are expected to grow.

As one of the fastest-growing economies globally, India is a relatively newcomer in the LNG market, starting imports in 2004. The country's primary LNG buyers have been the entities set up by national companies or the national companies themselves. But with government policies supporting a shift to a natural gas–based economy, private companies have set up additional LNG receiving infrastructure in recent years.

ASEAN is also expected to be a key market for small-scale LNG projects. In archipelagic countries, such as Indonesia and the Philippines, many islands have been using oil products to generate power; thus, replacing old and inefficient oil-fired power plants with more efficient natural gas systems is desired. The largest barrier to extending small-scale LNG to smaller islands is cost. Therefore, sufficient demand should be aggregated and generated, and logistic operation is optimised. The companies that have already developed LNG-receiving infrastructure in the region can provide physical hubs to redistribute LNG in smaller parcels; some have already expressed a willingness to do so. Some have already initiated LNG-bunkering operations in the region, too.

3.2. International market

(i) Recent market trend

Looking at ASEAN and India’s situation, it is essential to note the region’s significance in the global LNG market and LNG’s importance in the regional natural gas supply. As ASEAN and India include three exporting, six active, and two prospective importing countries of LNG, and major markets and production centres are not necessarily interconnected with pipelines, LNG is the focus in discussions over the prospect of natural gas in the region.

The four markets in Northeast Asia, historically important LNG markets from Southeast Asia, represent 55% of global LNG imports. LNG represents about 55% of the region's natural gas supply. The two regions are still firmly interconnected through LNG trade, once as the supplier and consumer and now as market development partners.

The world’s LNG market grew substantially over the past decade as more countries see LNG to diversify energy sources; switch from coal to gas in power generation; and industrial, residential, and commercial sectors to reduce GHG emissions. The LNG trade grew by 13% between 2018 and 2019 to 355 million tonnes, mainly driven by production growth in Australia, Russia, and the US.

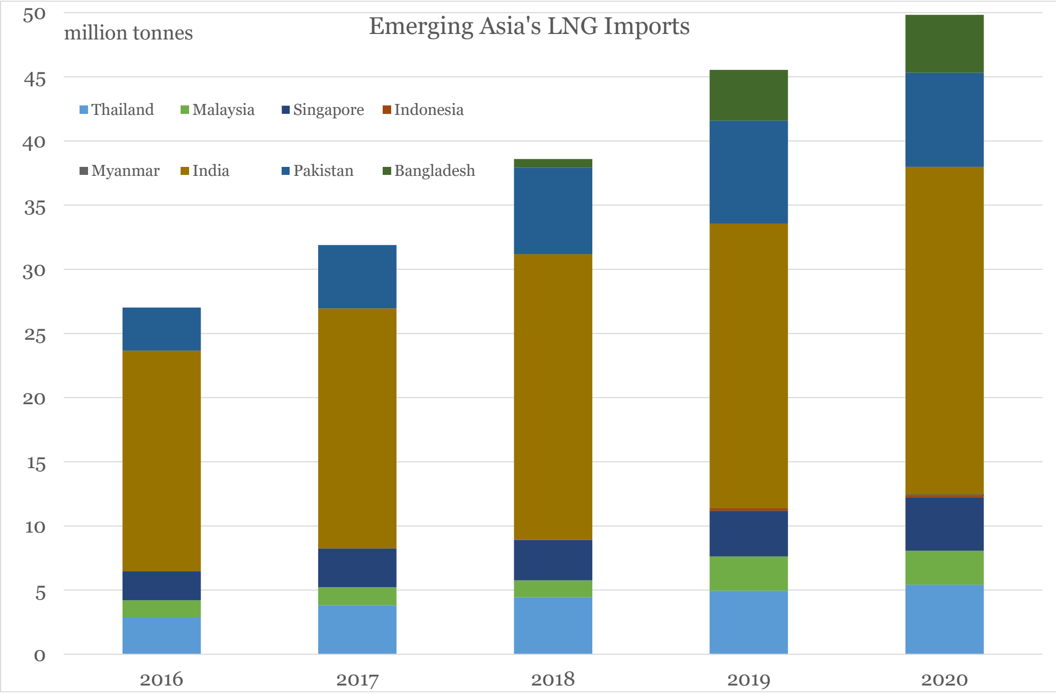
In addition to supply expansion, the rapid increase of LNG demand in Asia also contributed to the market’s robust trade.

The booming supply and demand for LNG, especially better volume flexibility required by new LNG importers, brought the industry into a new phase of flexibility. New trading patterns such as spot trading, short-term contracts, arbitrage, equity lifting, and portfolio trading are spreading widely in the global LNG trade scenes. Furthermore, the LNG from the US has added another layer of flexibility and liquidity into the market as its supply is free from destination restrictions.

Japan has been the largest importer of LNG in the world for more than 3 decades. China is the third-largest consumer of natural gas (including imports of LNG and pipeline gas, as well as its rapidly growing domestic gas production) globally, following the US and Russia, after taking over Japan as the largest consumer of natural gas in the region as recently as in 2011. Northeast Asia's four big importers represented 55% of the global LNG imports in 2019.

The global demand shock in 2020 also significantly affected natural gas demand in the seven countries, but in different ways by country. While India imported 26 million tonnes of LNG in 2020, 15% more than in 2019, its gas consumption as a whole is estimated to decline by 2%. The ASEAN countries imported 9% more LNG in 2020 than a year earlier. Ample supply and relatively palatable prices are expected to stimulate demand there.

Figure 4.9: LNG Imports in ASEAN and South Asia

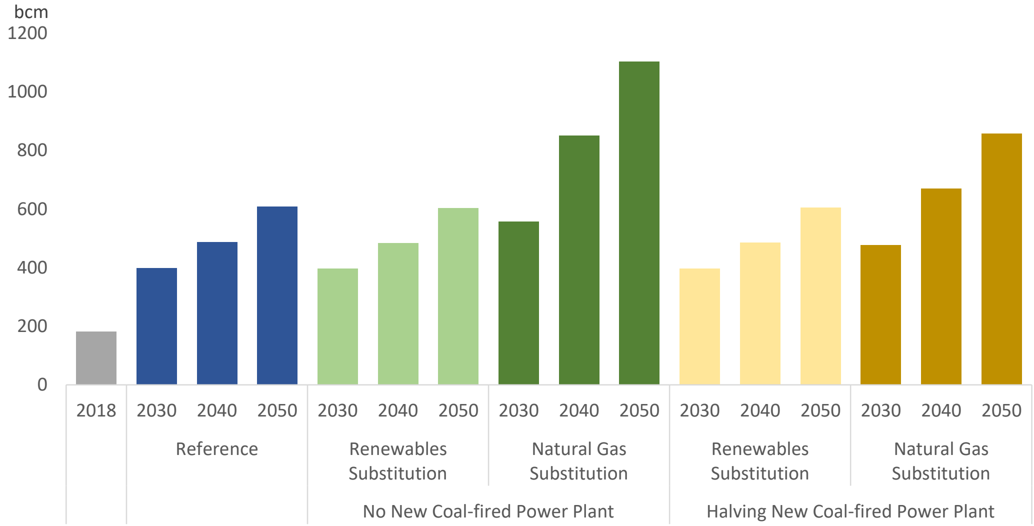


Source: Based on data from Cedigaz LNG Service.

(ii) Coal divestment and additional LNG needs

Based on the analysis in Chapter 3, coal divestment would substantially increase natural gas demand. In the REF, demand in the seven countries will grow by 4% per year to reach 707 bcm in 2050, which is already robust. Meanwhile, the growth rate of natural gas substitution case of Halving New Coal-fired Power Plant (NGHNC) and No New Coal-fired Power Plant (NGNNC) would be 5%–6% per year, and the demand would reach as much as 997 bcm (NGHNC) and 1,284 bcm (NGNNC) in 2050.

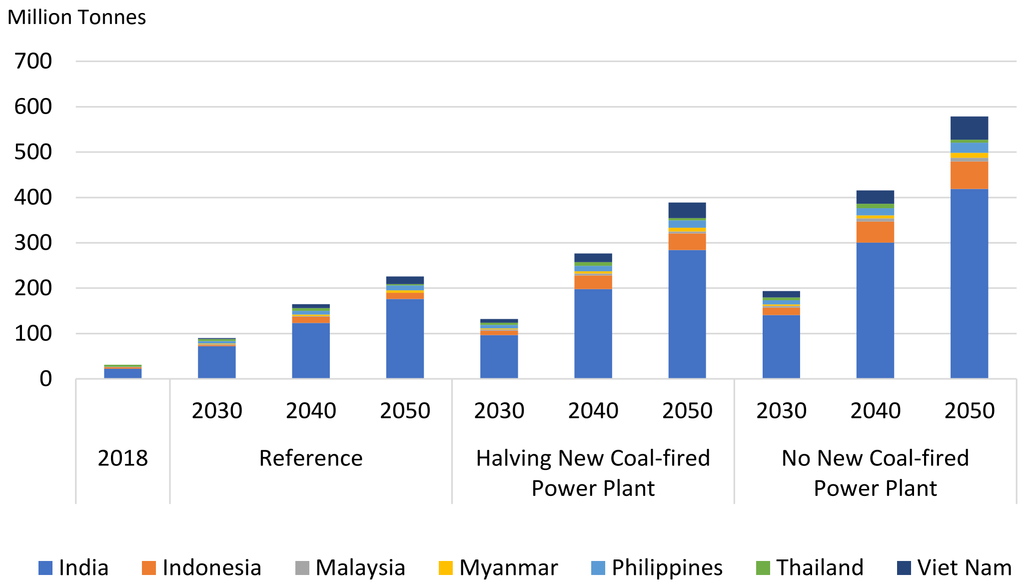
Figure 4.10: Natural Gas Demand Outlook, by Scenario



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

Natural gas production in ASEAN and India is expected to grow only 1% per year towards 2050. Considering the limited potential of pipeline gas imports, imported LNG should meet most gas demand increases. Therefore, additional demand for imported LNG would be huge. The seven countries imported 31 MT of LNG in 2018, 10% of the world total. In the REF, LNG demand in the seven countries will grow by 6% per year, much faster than the natural gas demand, to reach 240 MT in 2050, expanding the market share to 30% of the world total. The growth rate of the natural gas substitution case of NGHNC and NGNNC would be 8%–10% per year, and the demand would reach as much as 389 MT (NGHNC) and 579 MT (NGNNC) in 2050. World LNG demand in the REF, which considers feed gas production availability and liquefaction plant additions, is about 800 MT in 2050. Thus, 389–579 MT demand size of the seven countries in 2050 seems almost unrealistic. Substituting natural gas for coal for power generation in the seven countries would cause severe stress on the LNG supply system, resulting in supply shortages and higher LNG prices.

Figure 4.11: Demand for Imported LNG in the Seven Countries, by Natural Gas Substitution Scenario



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