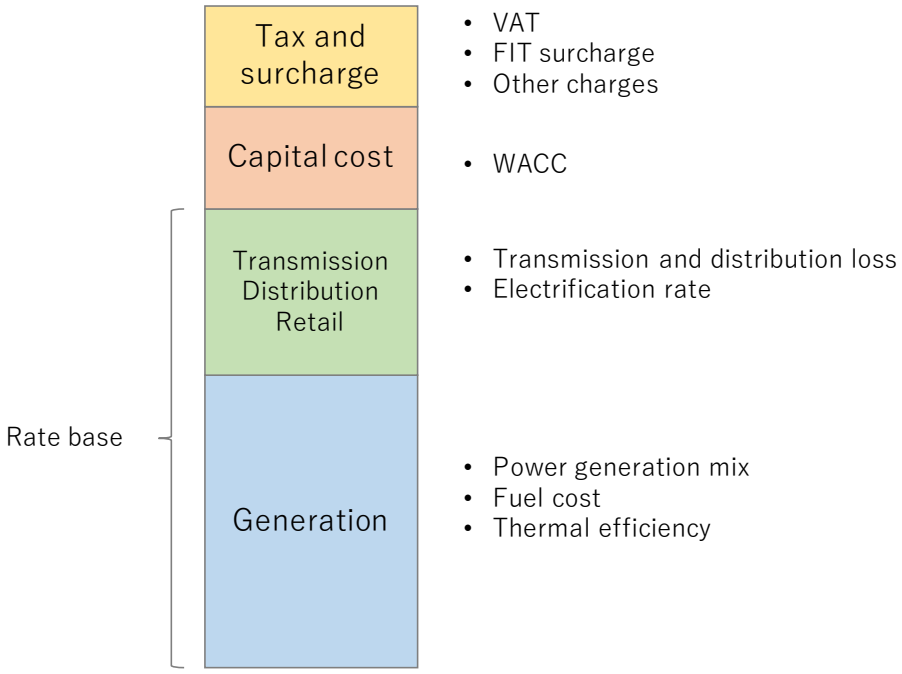
Chapter 3

Comparing Electricity Cost Structures

3.1 Cost Structure and Analysis Items

Figure 3-1 shows the components of the power supply cost. These components are divided into the rate base (i.e. generation, transmission, and distribution and retail), capital cost, and taxes. Factors that affect the magnitude of components are extracted. Finally, results of the analysis for each of this study's countries are compared.

Figure 3-1. Cost Structure of Power Prices



Source: Author.

3.1.1 Generation Cost

In general, fuel cost takes up a large portion of the generation cost. Therefore, reducing fuel cost is likely to bring down the generation cost. This subsection thus presents a comparative analysis on the gross thermal efficiency, which represents the efficiency in fuel use; and the power

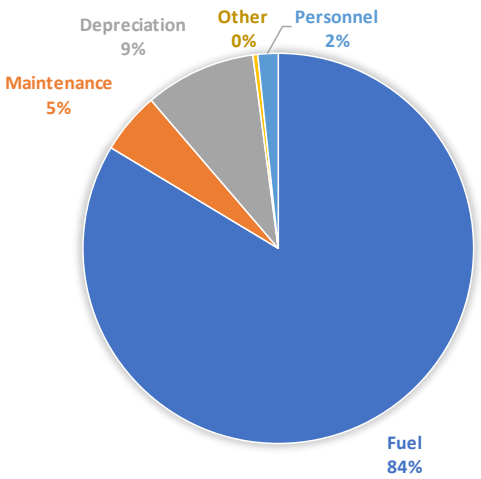
generation mix, which represents a ratio of low- and high-cost fuel used, in addition to the cost of fuel for power generation.

Fuel costs vary depending on whether the fuel is domestically produced or imported, and on each country's fuel policy, including that on pricing. For example, domestically produced coal and natural gas are often cheaper than imported ones. In some cases, the actual fuel prices at which power generation companies procure may be set lower than the market price by government subsidies. For this study's purpose, the actual fuel prices at which power companies procure are compared to the extent possible.

When the gross thermal efficiency is high, the amount of fuel that has to be spent to obtain the same power output will be smaller – hence attaining a lower generation cost. In countries where the gross thermal efficiency is relatively low, the generation cost can be reduced by repairing existing power plants, replacing them with high-performing plants, or improving the operation of power plants to enhance efficiency.

Controlling the power generation mix will also lower the generation cost. Generation costs are lessened when cheaper power sources are used for generation. In general, the most promising sources of power in reducing generation cost are those from hydroelectric and coal-fired thermal plants. In contrast, the generation cost is likely to be high when one relies on small diesel generators or imported natural gas.

Figure 3-2. Generation Cost Structure of PLN in Indonesia (Reference)



Source: PLN, 8 January 2018.

3.1.2 Transmission and Distribution/Retail Cost

For the transmission and distribution sectors, analysis will focus on the T&D loss, demand density, and electrification rates.

If generated electricity can be sent without a loss, cost per electric energy (kWh) can be reduced. Transmission and distribution loss varies depending on the geographical conditions of the country. Simple comparisons can gives insights on the possibility of cutting cost in the T&D sectors.

Demand density (length of distribution power lines per kWh of electric energy sold) represents the efficiency of the power distribution business. If this value is small, it means power is sold by shorter distribution lines – i.e. electricity is sold efficiently at less cost.

Electrification rate is used to measure the degree of need for T&D investment in the future. When the electrification rate is low, a country's investment requirement for T&D in the future will be higher than that of most countries, which indicates that reducing the cost in the T&D sectors would remain relatively difficult.

3.1.3 Capital Cost

For the capital cost, the weighted average cost of capital (WACC) across countries will be compared.

Weighted average cost of capital is a weighted average of loaning cost (interest rate, %) and stock procurement cost (expected rate of return, %) operated with debt-equity ratio. It represents how much cost (%) is needed for financing. In general, the sum of 'business operation cost (rate base)' and 'the amount derived by multiplying rate base by WACC' is regarded as the total cost of a power company. Therefore, WACC is an important factor which affects the electricity cost. Because of this formula, a smaller WACC reduces profits for the business operator; hence, lowers the power supply cost.

3.1.4 Tax

Taxes heavily rely on the policies of the country, and it is inappropriate to simply compare them in numbers. They also have a significant influence on electricity cost.

All the countries in this study impose value-added tax (VAT). Some levy other charges such as the universal services charge and renewable energy charge.

3.2 Data Source

The following data sources are used to analyse electricity costs in different countries.

3.2.1 The Philippines

a) Generation cost

i.	Power generation mix	IEA, World Energy Balance 2017
ii	Fuel cost	Meralco Annual Report 2014, 2016 https://company.meralco.com.ph/investor-relations/annual-reports
iii.	Gross thermal efficiency	IEA, World Energy Balance 2017

b) Transmission and distribution cost

i.	Transmission and distribution loss	PDOE, Power Situation https://www.doe.gov.ph/electric-power/2016-philippine-power-situation-report
ii.	Electrification rate	IEA, Energy Access Database

c) Capital cost

i.	WACC	Meralco and Philippines University Research data, Diliman 2014 https://www.youtube.com/watch?v=7ev1TR4SUg0

d) Tax, etc.

i.	VAT	The Philippine government's website https://www.gov.ph/philippine-government
ii.	Other taxes	Meralco Annual Report 2016 https://company.meralco.com.ph/investor-relations/annual-reports

3.2.2 Indonesia

a) Generation cost

i.	Power generation mix	IEA, World Energy Balance 2017
ii.	Fuel cost	PLN Annual Report 2016 https://ja.scribd.com/document/349077515/PLN-Sustainability-Report-2016
iii.	Gross thermal efficiency	IEA, World Energy Balance 2017

b) Transmission and distribution cost

i.	Transmission and distribution loss	PLN Annual Report 2014, 2016 http://www.academia.edu/33681752/PLN_Annual_Report
ii.	Electrification rate	IEA, Energy Access Database

c) Capital cost

i.	WACC	METI, Action plan for the Philippines' power sector, March 2017

d) Tax, etc.

i.	VAT	Indonesian government website http://www.indonesia.cz/the-government-of-the-republic-of-indonesia/

3.2.3 Malaysia

a) Generation cost

i.	Power generation mix	IEA, World Energy Balance 2017
ii.	Fuel cost	Energy Commission 'Peninsular Malaysia Electricity Supply Industry Outlook 2016'
iii.	Gross thermal efficiency	IEA, World Energy Balance 2017

b) Transmission and distribution cost

i.	Transmission and distribution loss	TNB Annual Report 2016
ii.	Electrification rate	IEA, Energy Access Database

c) Capital cost

i.	WACC	Energy Commission, 'Review on Electricity Tariff in Peninsular Malaysia under the Incentive-based Regulation Mechanism' (FY 2014-FY 2017)

d) Tax, etc.

i.	VAT	Ministry of Finance Malaysia website http://www.treasury.gov.my/?lang=en

3.2.4 Thailand

a) Generation cost

i.	Power generation mix	IEA, World Energy Balance 2017
ii.	Fuel cost	MEA Annual Report 2016 http://www.mea.or.th/en/e-magazine/detail/82/86/294
iii.	Gross thermal efficiency	IEA, World Energy Balance 2017

b) Transmission and distribution cost

i.	Transmission and distribution loss	EGAT Annual Report 2016 https://www.egat.co.th/en/information/annual-report MEA Annual Report 2016 http://www.mea.or.th/en/e-magazine/detail/82/86/294
ii.	Electrification rate	IEA, Energy Access Database

c) Capital cost

i.	WACC	Darryl S. Jarvis (2011). EGAT, Infrastructure Regulation

d) Tax, etc.

i.	VAT	Thailand government website http://www.thaigov.go.th/

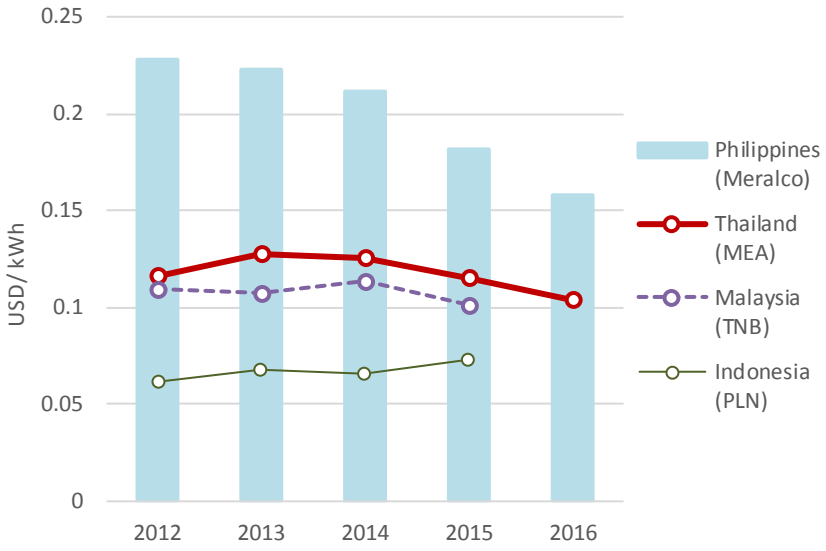
3.3 Comparison of Overall Structure

The Philippines responded to the power shortage since the latter half of 1980s and the financial difficulty facing the NPC by permitting IPPs to enter the power generation sector – a first amongst the countries in the Asian region. However, as the national government hurried to secure its power supply capacity and allowed high off-take prices from IPP as well as implied take or pay condition to NPC, the power supply cost increased, and the financial condition of NPC deteriorated.

Therefore, the government instituted the EPIRA Act (Republic Act No. 9136), which aimed to sell the assets of NPC so as to repay debts and introduce the principle of competition in the electricity market.

In spite of such efforts to lower electricity rates, the electricity rate in the Philippines remains high.[8] It is still about 1.5-fold than that of Thailand.

Figure 3-3. Comparison of Average Power Price

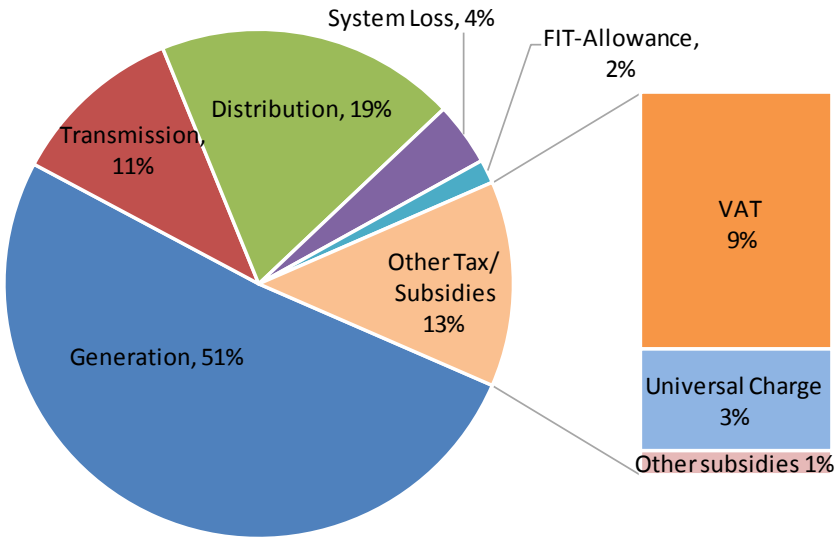


Source: Meralco Annual Report, PLN Annual Report, MEA Annual Report, Energy Commission, 'Electricity Supply Industry in Malaysia'

[8] It should be noted that electricity rates in Indonesia and Malaysia include subsidies.

The cost structure of the country's power distribution/retail companies shows that the power generation cost comprises the largest proportion at 51%. If the nation were to improve its standard of living and strengthen its industrial competitiveness, further cost reduction particularly in the power generation sector need to happen.

Figure 3-4. Structure of Annual Meralco Rate in 2016



Source: Meralco Annual Report 2016.

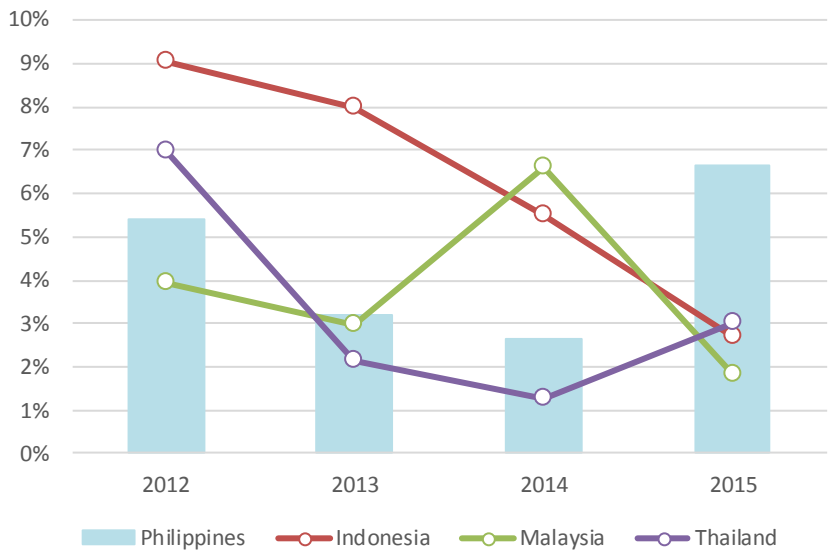
This section analyses the power supply cost structure in the Philippines in comparison with that of Indonesia, Malaysia, and Thailand. This comparative analysis aims to grasp the characteristics of the power supply cost in the Philippines and explores how to reduce costs.

3.4 Power Generation Cost

3.4.1 Increase in power demand

From 2012 to 2016, power consumption in the Philippines, Thailand, Malaysia, and Indonesia had increased. In 2015, in particular, the Philippines garnered the highest growth rate amongst these countries.

Figure 3-5. Year-on-Year Change in Power Demand

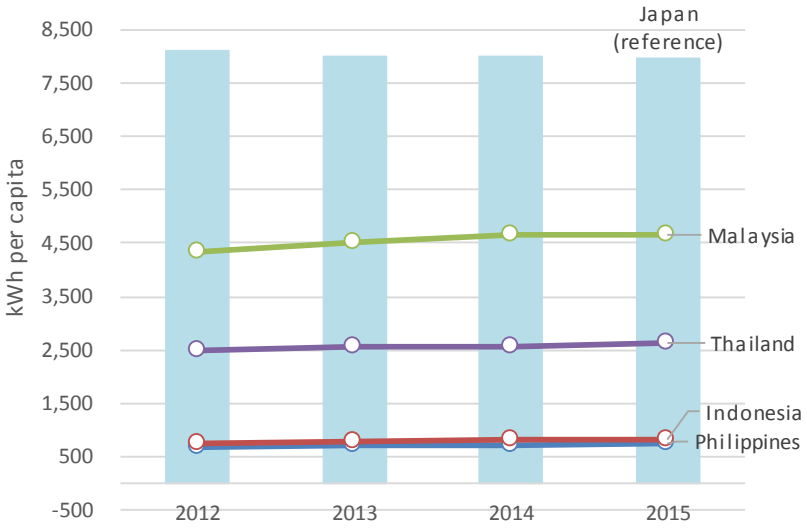


Source: IEA, World Energy Balance, 2017.

Per-capita power consumption rates in the Philippines as well as in Indonesia, however, are smaller than in Malaysia and Thailand (Figure 3-6). Although not the sole reason, the lower electrification rates in the Philippines and Indonesia partly explain this difference. In Thailand, the national electrification rate has reached 100%. In Malaysia, the rate is almost 100%. In contrast, while the electrification rate has reached almost 100% in the metropolitan areas of the Philippines and Indonesia, their national averages (which include their remote islands) are at a low 90%.

It is highly likely that electricity demand will increase steadily in the Philippines in the future. For example, the *IEEJ Outlook 2018* (Suehiro et al., 2017) forecasts that the average growth in electricity demand in the Philippines from 2015 to 2030 will be 5.7%. This exceeds the forecasted increase in demand in Indonesia, Malaysia, and Thailand for the same period (5.5%, 3.5%, and 3.0%, respectively).

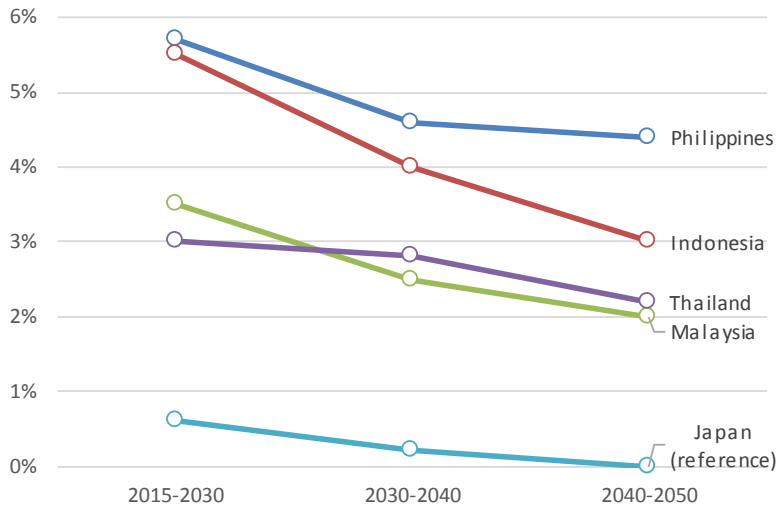
Figure 3-6. Comparison of Electricity Consumption Per Capita



Source: IEA, World Energy Balance (2017).

From a mid- to long-term perspective, the above forecasts indicate that a comparatively larger amount of investment will be required to increase the Philippines' power supply capacity and to expand or construct power transmission/distribution networks. From the viewpoint of power supply cost, the challenge to the country will come down to how it will control the cost through efficient investing.

Figure 3-7. Projected Electricity Consumption Growth Rate

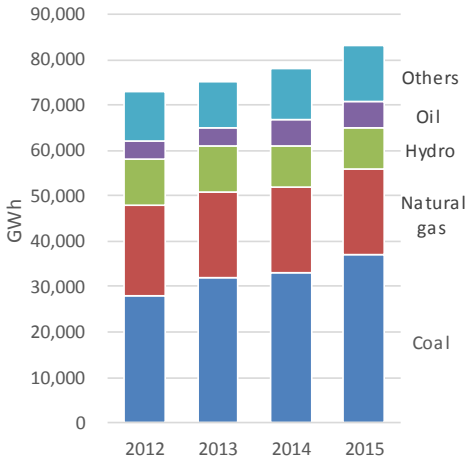


Source: IEEJ Outlook 2018 (2017).

3.4.2 Power Generation Mix

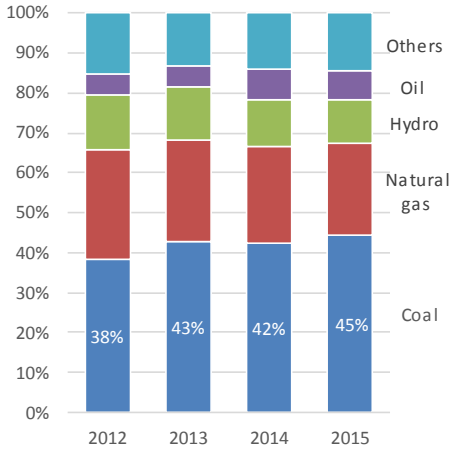
Among the fuel types used, low-priced coal accounts for the largest proportion, followed by natural gas, in the Philippines, Indonesia, and Malaysia. On the other hand, due to heavy opposition to coal (thermal) power, about 70% of Thailand's electricity is generated from natural gas.

Figure 3-8. Fuel Mix in the Philippines



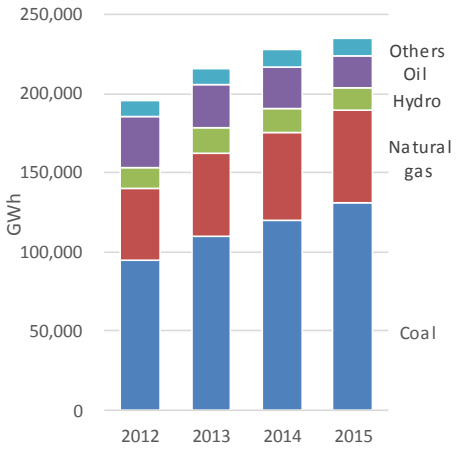
Source: IEA, World Energy Balance (2017).

Figure 3-9. Share of Fuel Types in the Philippines



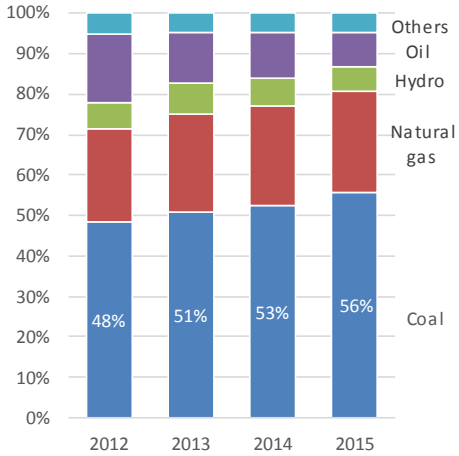
Source: IEA, World Energy Balance (2017).

Figure 3-10. Fuel Mix in Indonesia



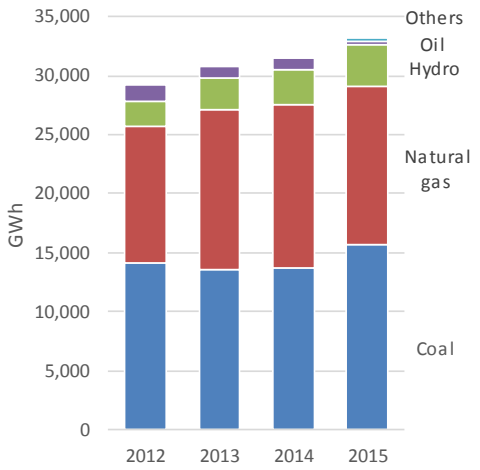
Source: IEA, World Energy Balance (2017).

Figure 3-11. Share of Fuel Types in Indonesia



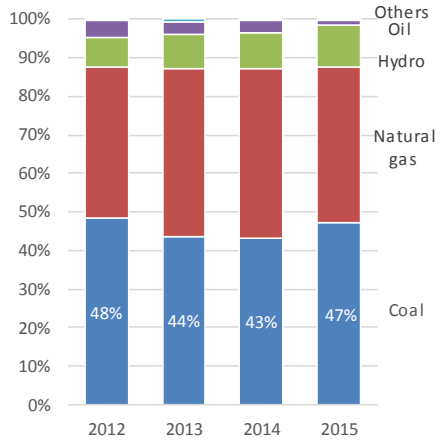
Source: IEA, World Energy Balance (2017).

Figure 3-12. Fuel Mix in Malaysia



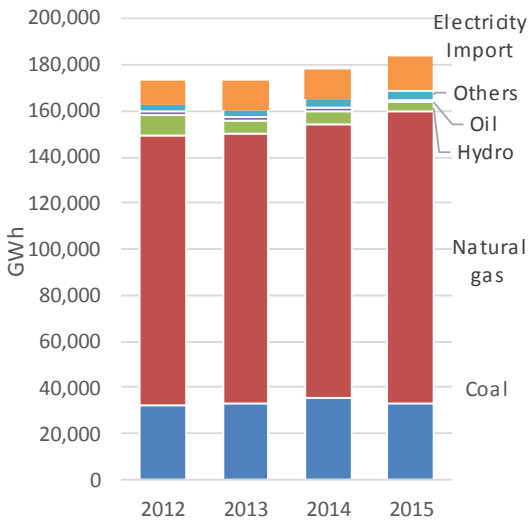
Source: IEA, World Energy Balance (2017).

Figure 3-13. Share of Fuel Types in Malaysia



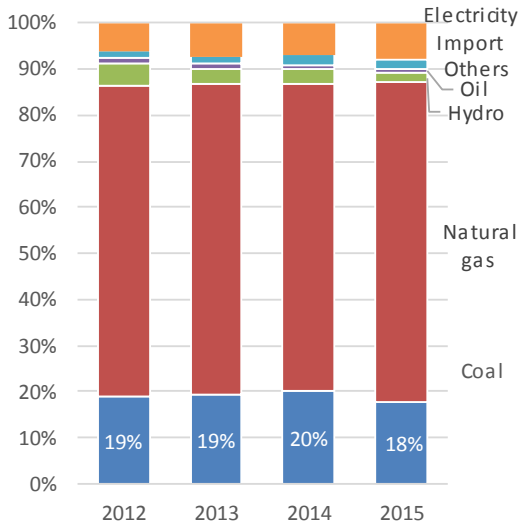
Source: IEA, World Energy Balance (2017).

Figure 3-14. Fuel Mix in Thailand



Source: IEA, World Energy Balance (2017).

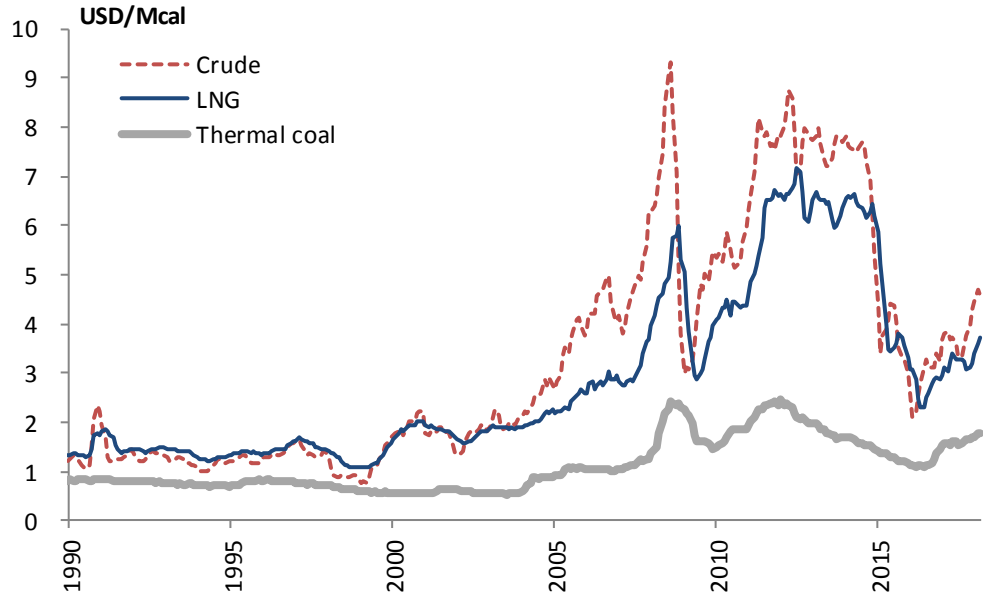
Figure 3-15. Share of Fuel Types in Thailand



Source: IEA, World Energy Balance (2017).

What are the differences in natural gas and coal prices in international markets? Taking the trend in Japan's import prices as an example, one notes that coal has consistently been priced lower than natural gas in the past. Since the price of liquefied natural gas (LNG) is often linked to the price of crude oil under current commercial practices, the gap in the prices of natural gas and coal widens whenever the crude oil price soars. While the capital investments in coal (thermal) power is larger than in gas thermal power, the power generation unit price is generally lower for thermal coal because of its lower fuel cost.

Figure 3-16. Japan's Fossil Fuel Import Price (Price per Unit Heat Content)



Mcal = Mega calorie.

Source: IEEJ, EDMC data bank.

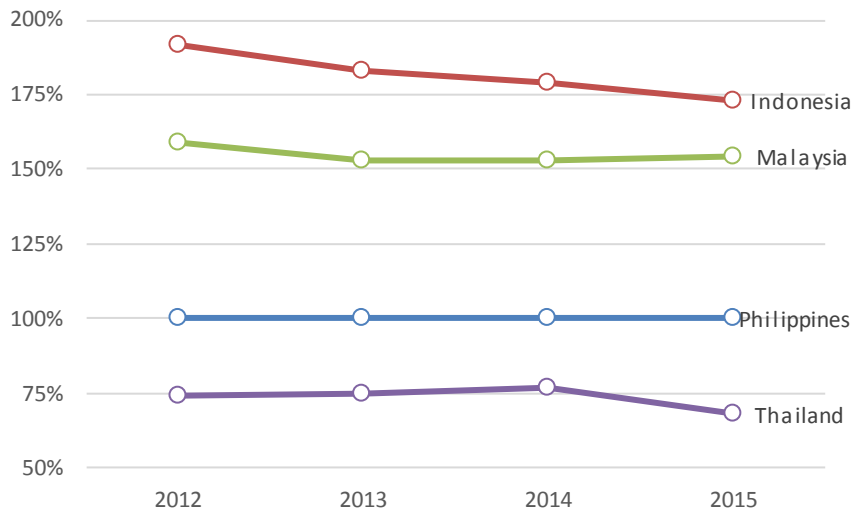
As shown in Figure 3-16, thermal coal is generally one of the lowest-cost power sources but is already used in the Philippines at a rate comparable with other countries. In 2015, the share of coal (thermal) power in the total power supply within each country is as follows: 45% in the Philippines, 56% in Indonesia, 47% in Malaysia, and 18% in Thailand. Should coal plants' operation increase and that of natural gas plants decrease, the power generation cost could drop. It has been noted, however, that excessive use of coal-fired power plants will place a burden on the environment.

3.4.3 Fuel Cost

As shown in the previous section, the share of natural gas and coal in the four ASEAN countries surveyed accounts for about 80% of the total power supply, and the prices of natural gas and coal have a considerable impact on the fuel cost. This section now analyses the trends in natural gas price and coal price across these four nations.

First, in terms of their source for natural gas, Indonesia, Malaysia, and the Philippines – where the self-sufficiency rate exceeds 100% – use domestically produced gas. On the other hand, Thailand's self-sufficiency rate for natural gas is about 70%. The remaining 30% relies on imports, mostly via pipelines from Myanmar.

Figure 3-17. Self-sufficiency on Natural gas



Source: IEA, *World Energy Balance* (2017).

The fall in natural gas prices in recent years had been experienced by all the countries in this study. While prices have improved in recent years, that of the Philippines is still at its highest level. As of 2015, the differences between the Philippines' price and that of Indonesia, Malaysia, and Thailand were US$1.1/MMBtu, US$3.9/MMBtu, and US$0.7/MMBtu, respectively. Compared with the 2015 gas price for power generation in the Philippines was US$9.06/MMBtu, prices in Indonesia, Malaysia, and Thailand were lower by 12%, 43%, and 8%, respectively.

Note that the largest price difference was between the Philippines and Malaysia's. The higher

gas price in the Philippines can be partly due to the large investment requirements and the high risk in developing the Malampaya deep water gas field, which includes 500 km of subsea pipelines. Meanwhile, the gas price for power generation in Malaysia is subsidised by its government.

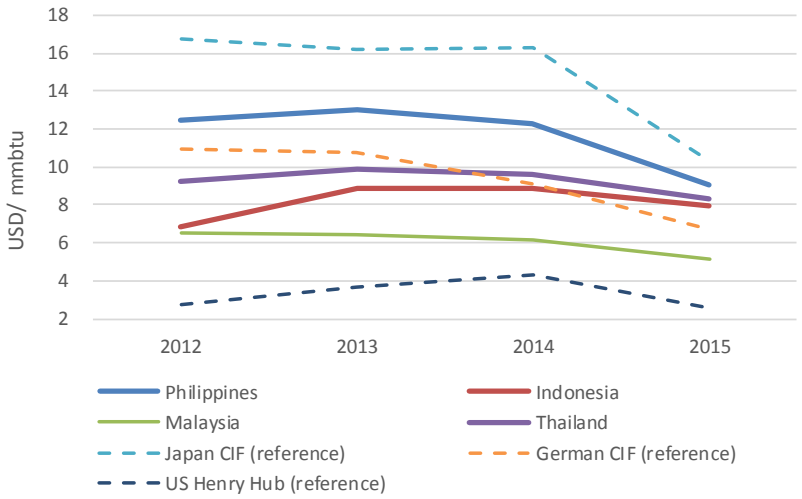
As its domestically produced natural gas resources tend to be running dry, the Philippines would have to rely on imported natural gas to secure its supply in the future. Should the Philippines import natural gas, it will inevitably use LNG.

Figure 3-18 below shows Japan's price for imported LNG as a reference case for the four other Asian countries. Note that its imported price has always been higher than the price of domestic natural gas in the Philippines. Although actual prices will depend on contracts, a nation that starts to use imported LNG will generally experience a rise in the price of natural gas for power generation. Therefore, any future dependence on LNG could possibly widen the difference between the Philippines' power generation cost and that of the three other countries.

Liquefied natural gas prices in international markets vary depending on various factors such as the change in demand-supply balance and the emergence of risk factors. Furthermore, any change in these prices can occur quickly and in a larger scale than that of domestically produced natural gas. Recently, for example, the spot price soared when China imported a huge amount of LNG during the winter peak season. The generation cost of gas thermal power stations in the Philippines will become vulnerable to such changes in international LNG prices in the future.

To reduce the procurement cost of natural gas, two measures can be considered. One is to make the most of domestically produced natural gas to the extent of economic rationality. The other one is to reduce price fluctuation risks by diversifying the LNG procurement portfolio. This LNG procurement portfolio should not only include the import partner countries for LNG but the period of procurement contracts and price formulas as well.

Figure 3-18. Comparison of Natural Gas Price for Power Generation



mmbtu = million British thermal unit

Source: Annual report of each company; BP, Statistical review of world energy (2017).

In terms of coal supply, imports account for more than half of the total supply in Malaysia, the Philippines, and Thailand. Meanwhile, Indonesia has a self-sufficiency rate as high as 600%.

Although the Philippines produces coal, a large portion is exported. As a result, the nation's actual self-sufficiency ratio for coal dropped to around 10%[9] compare to 30% of apparent self-sufficiency. In addition, it has been observed that the Philippines' dependence on imports has been growing significantly in recent years.

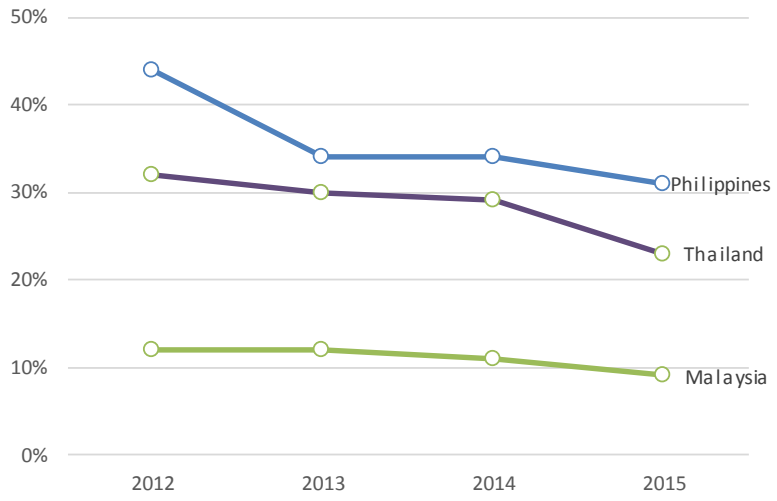
Coal prices dropped from 2012 to 2015. This may have been in response to the decline in the global price of thermal coal.

As of 2015, Indonesia, Malaysia and Thailand's coal prices for power generation were lower than the Philippines' price of US$68/ton by US$16/ton (23%), US$4/ton (6%), and US$11/ton (16%), respectively. Here, the price difference with Indonesia was the widest.

It is highly likely that the coal supply in the Philippines, where the actual self-sufficiency rate is no more than 10%, will continue to depend on imports in the future; thus, it will be influenced by price changes in the global market. The measures to mitigate such impact is the same as that suggested above for natural gas, including diversifying the coal procurement portfolio.

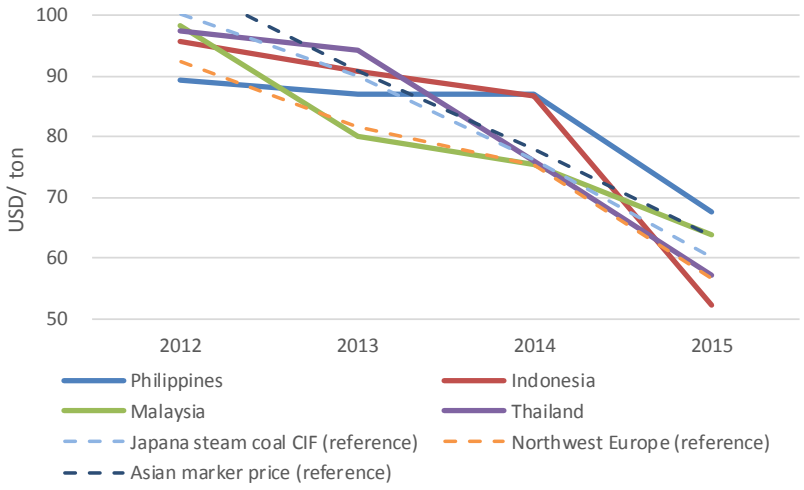
[9] Interview with the Department of Energy, Government of the Philippines.

Figure 3-19. Self-sufficiency in Coal



Source: IEA, World Energy Balance (2017)

Figure 3-20. Comparison of Coal Price for Power Generation

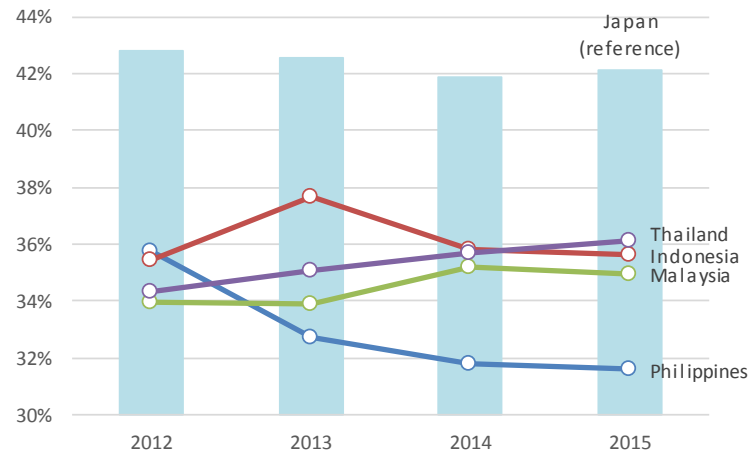


Source: Annual report of each company; BP Statistical Review of World Energy (2017).

3.4.4 Thermal Efficiency

The thermal efficiency (generating-end) of coal in Indonesia, Malaysia, and Thailand has either improved or remained around the same level. In the Philippines, however, the thermal efficiency of coal has gone down year after year. By 2015, the Philippines and the Indonesia have a difference of 4 percentage points in their thermal efficiency numbers.

Figure 3-21. Thermal Efficiency of Coal



Source: IEA, World Energy Balance, 2017.

Generating-end thermal efficiency is an important factor directly connected with the amount of fuel consumption, and thus, the power generation cost. If the generating-end thermal efficiency of coal in the Philippines had been 42% (i.e. not just 32% in 2015), a 10% reduction in coal consumption could have resulted in a US$235 million savings in Meralco's power generation cost.

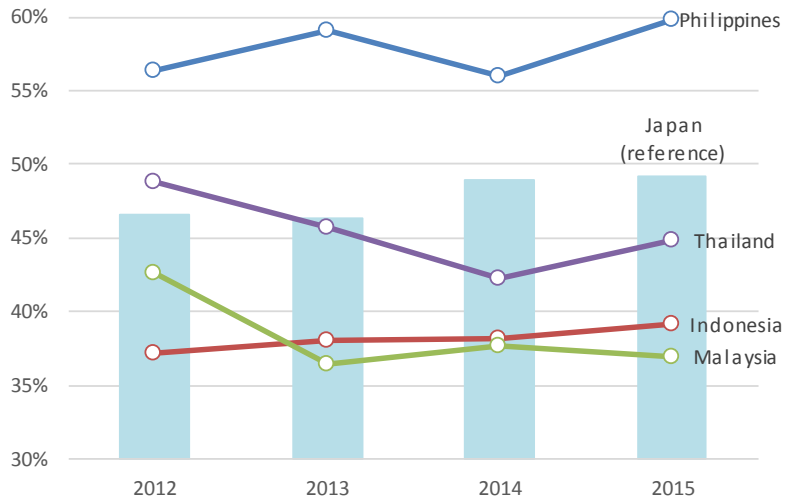
Table 3-1. Estimated Cost Reduction Effect of Thermal Efficiency Improvements

Electricity generated from coal (Meralco in 2015)	29,680 GWh
Assumed thermal efficiency improvement	10% points
Reduced fuel consumption	22,083 GWh
Heat content of coal	5,500 kcal/kg (23.0GJ/ton)
Saved amount of coal consumption	3.46 Mton
Average coal price in 2015	US$68/ton
Saved value of coal consumption	US$235 million

Source: Author.

In terms of the thermal efficiency of gas, on the other hand, it is the Philippines that had marked improvements amongst the four countries year after year. In 2015, the Philippines' score was 22.8 percentage points better than Malaysia's, which had the worst efficiency rating for gas power amongst the four nations analysed for this study.

Figure 3-22. Thermal Efficiency of Natural Gas



Source: IEA, World Energy Balance (2017).

In the Philippines, two factors could explain why the efficiency of gas (thermal) power is relatively high, while that of coal (thermal) power is relatively low. First, high-efficiency gas thermal power has been introduced to IPPs in the Philippines since 2000. Today, a greater part of its gas power generation capacity comes from high-efficiency plants.

Second, no sufficient measures seem to reverse the declining generating-end thermal efficiency of aging coal-fired power plants. If IPP operators aim to maximise their profits, their best strategy is to continue the operation of coal-fired power plants at a minimum cost. Unless there is some incentive or some promotion that aims to increase thermal efficiency, it will be difficult to hope for significant improvements to happen soon.

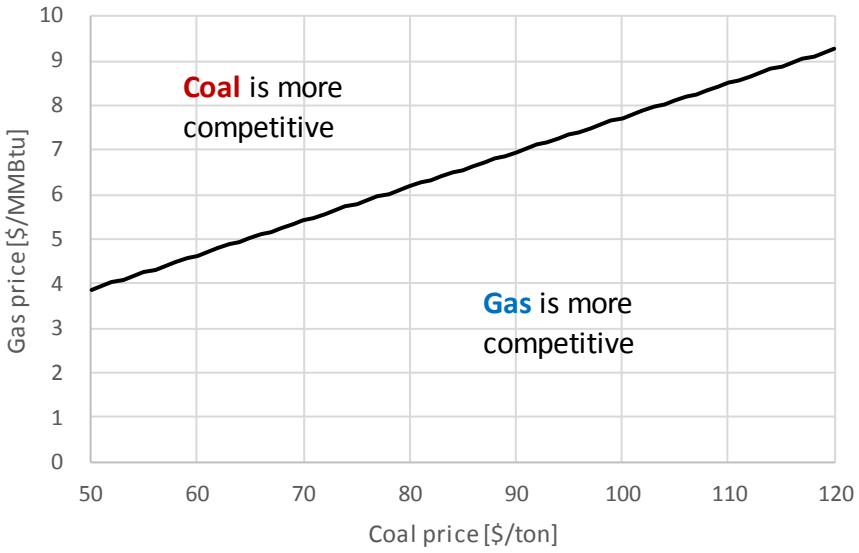
Table 3-2 compares the thermal efficiency-adjusted fuel costs of coal and gas. Coal has lower fuel cost but bears lower efficiency. Conversely, gas has higher fuel cost but offers higher efficiency. Therefore, it is possible for actual fuel cost to be reversed, depending on the difference in fuel cost and thermal efficiency.

Table 3-2. Thermal Efficiency-Adjusted Cost of Coal and Natural Gas

	Coal 2015	**Coal [Breakeven with Gas 2015]**	**Gas 2015**	**Gas [Breakeven with Coal 2015]**
Fuel cost	US$68/ton	US$105/ton	US$9.06/MMBtu	US$5.85/MMBtu
Conversion factor	5,500 kcal/kg (23.0GJ/ton)	5,500 kcal/kg (23.0GJ/ton)	1.055 GJ/MMBtu	1.055 GJ/MMBtu
Fuel cost per unit heat content	US$2.96/GJ	US$4.57/GJ	US$8.59/GJ	US$5.55/GJ
Thermal efficiency	32%	32%	60%	60%
Thermal efficiency-adjusted fuel cost	US$9.25/GJ	US$14.3/GJ	US$14.3/GJ	US$9.25/GJ

Source: Author.

Figure 3-23. Breakeven Price Curve of Coal and Gas in the Philippines (Thermal Efficiency Adjusted)



Heat content of coal = 5500 kcal/ton, Thermal efficiency: coal = 32%, gas = 60%.

Source: Author.

Two important points can be seen from the study's results. First, at 2015 prices, coal (thermal) power is far less expensive even if the difference in efficiency is considered. While the thermal efficiency-adjusted cost per amount of heat produced by coal is US$9.25/GJ, the cost for gas is about 1.54-fold higher at US$14.3/GJ. Thus, while the initial investment and operating cost (excluding fuel cost) for thermal coal stations are higher than those for thermal gas, this is outweighed by the savings on fuel cost.

Second, it is possible that the thermal efficiency-adjusted fuel cost of gas can be lower than coal's. The efficiency-adjusted coal price derived from US$105/ton and the thermal efficiency-adjusted gas price obtained from the US$9.06/MMbtu price becomes equal at US$14.3/GJ. Also, the efficiency-adjusted gas price derived from US$5.85/MMBtu and the efficiency-adjusted coal price from US$68/ton become equal at US$9.25/GJ. If the thermal efficiency-adjusted cost is the same, the total cost will be lower for gas thermal power due to its lower initial investment and operating cost.

According to the BP statistical Review of World Energy (2017), the annual average coal price in Asia went beyond US$105/ton four times (i.e. in 2008, 2010, 2011, and 2012) in the past. Meanwhile, after 2011, the Asian LNG spot price went below US$5.85/MMBtu during off-peak season, spring of 2016 and 2017.[10] Thus, it is possible that the respective competitive edge of coal and gas could be reversed once the Asian coal price rises or gas price goes down.

3.5 Transmission, Distribution, and Retail

3.5.1 Transmission and Distribution Losses

Power T&D losses in the Philippines were high at about 12% in 2012, but the losses had been reduced to 8%, thanks to various nationwide efforts. By 2016, the T&D losses in the Philippines were sufficiently comparable with those of the three other ASEAN countries. However, when compared with Thailand, which has the least loss amongst the comparator-countries, there remains a T&D loss difference of 2.61 percentage points.

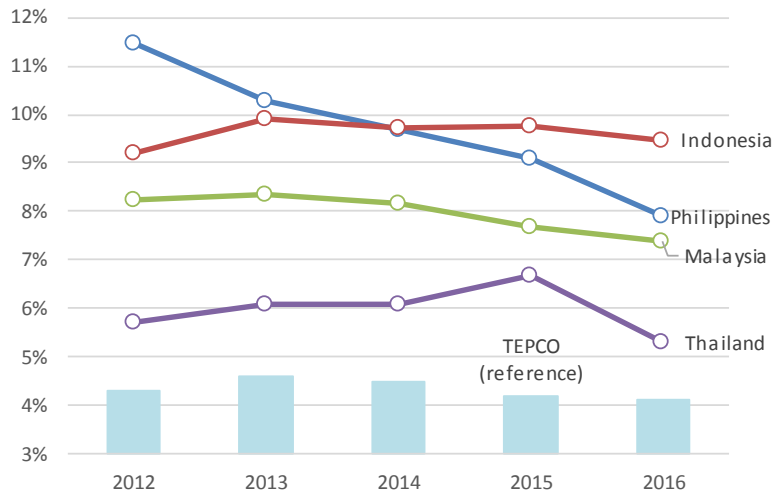
As transmission and distribution is a regulated sector, policies play a significant role in mitigating the T&D losses and providing incentives to players in the energy industry.

[10] World Gas Intelligence.

For instance, an act to reduce T&D losses was enforced in the Philippines under the EPIRA Act in January 2010. Currently, an upper limit of 8.5%/13% is set for DUs and electric cooperatives, respectively. In February 2018, the ERC submitted a resolution[11] setting an upper limit to distribution losses for electric cooperatives of 8.25% to 12.00% in 2022, depending on the category of the electric cooperatives.

On the other hand, as shown in Figure 3-25, the T&D loss of Tokyo Electric Power in Japan is considerably lower at about 4% each year (which was recently reduced further). Although the Philippines have different geographic features from Japan's, the Philippines can likely mitigate its T&D losses as well. Given its T&D losses of 8% (2016 data), its unit power supply cost [₱/kWh] could be reduced by 4% by increasing its power supply.

Figure 3-24. Comparison of T&D Losses



Source: Annual report of each company.

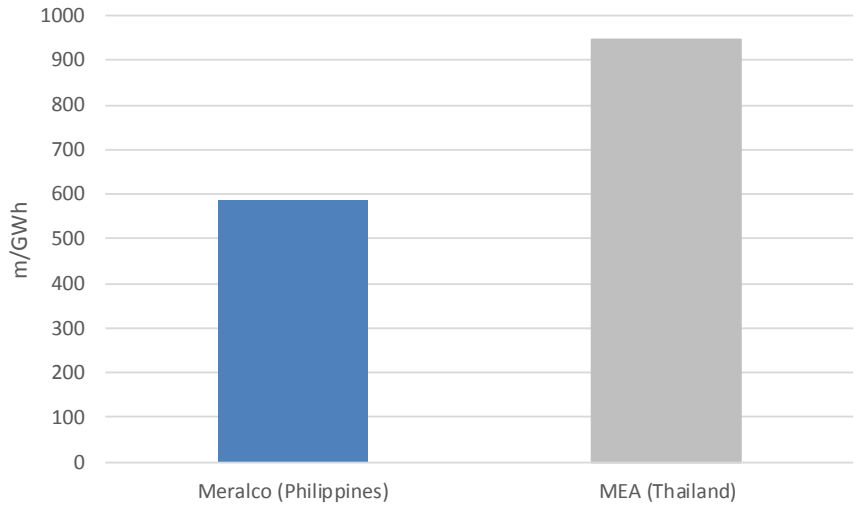
3.5.2 Demand Density

This study reviewed the length of power distribution lines per kWh supplied, of the Philippines' Meralco and Thailand's MEA (based on comparable data available). Results show that Meralco's power distribution line per kWh is shorter than that of MEA by about 40%. This means that the same amount of electricity is supplied through a shorter power distribution line. That is,

[11] Resolution No. 20, Series of 2017, 'A Resolution Adopting the ERC Rules for Setting the Distribution System Loss Cap and Establishing Performance Incentive Scheme for Distribution Efficiency'.

Meralco's distribution line has a higher power density – thus, higher power distribution efficiency. Meralco seems to be comparatively better off as a business as it is capable of operating at lower cost.

Figure 3-25. Length of Distribution Line per kWh Sales in 2015



Source: Meralco Annual report (2016); MEA Annual Report (2016).

3.5.3 Electrification Rate

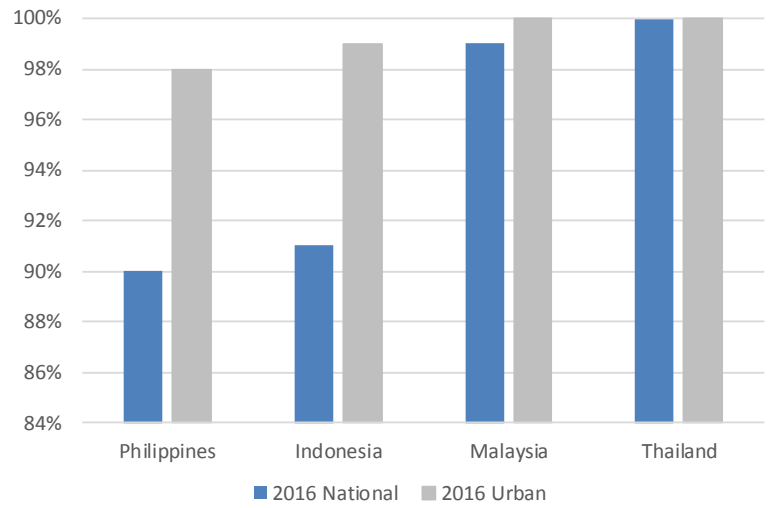
Except for Thailand, the electrification rates of the countries in this study failed to reach 100% in 2016. Even large cities in the Philippines and Indonesia were not 100% electrified.

As the construction of power grids in the Philippines started first in its metropolitan areas, particularly Luzon (where Metro Manila is located), there is a disparity between the electrification rates of Luzon and other areas such as Mindanao. Construction of infrastructure in small villages in mountainous areas may prove difficult, but such could be remedied by, for instance, installing small-scale solar PV power stations. The NPC has classified areas in the Philippines that need electricity into 21 districts, and announced its plan to construct small-scale facilities that combine renewable energy such as solar PV and wind power generation with diesel power generator sequentially by 2020.[12]

[12] Opinyon, 17 November 2015.

These efforts naturally have cost implications. In the Philippines, where the electrification rate is relatively low, investments on electrification will have to be on a larger scale when compared with those in Thailand and Malaysia. A higher spend on electrification because of the infrastructure requirements means that any reduction in T&D cost will be difficult to achieve in the short term.

Figure 3-26. Electrification Rate



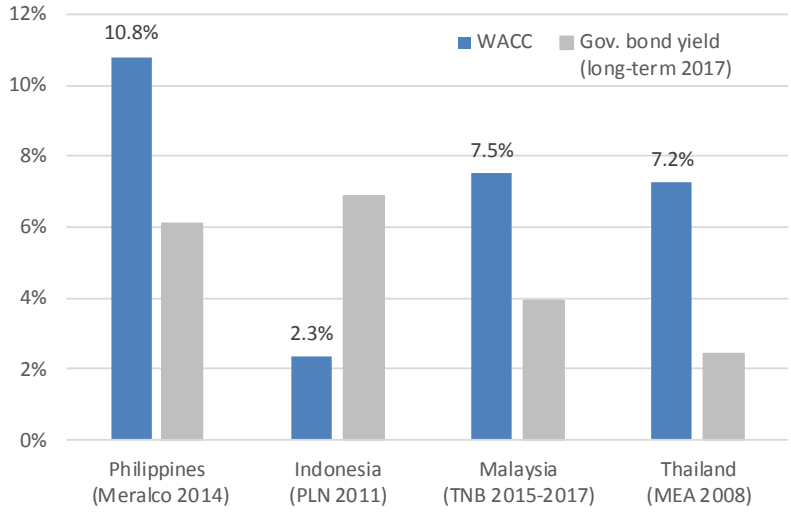
Source: IEA, Energy Access Database (2017).

3.6 Cost of Capital

The WACC of the Philippines is higher than that of the three other ASEAN countries. Its long-term national bonds have relatively high sovereign risk as expressed by the yield; the bonds' premium is also higher than other countries. For example, the WACCs of the Philippines and Malaysia/Thailand have a difference of at least 3 percentage points. If the rate bases are the same for three countries, the difference in WACC is calculated to raise the electricity cost of the Philippines by 3% more than Malaysia's and Thailand's.

When compared with that of Malaysia and Thailand, the difference with the Philippines' WACC is smaller – around 3 percentage points to 4 percentage points – but still significant enough. Such differences may be partly explained by the fact that Meralco, the distribution company in the Philippines, is a private company that requires higher financing than national companies in other countries. The difference in debt-to-equity ratios of these countries is also another factor.

Figure 3-27. Comparison of WACC



WACC = Weighted average cost of capital.

Source: Annual report of the companies, Trading Economics.

Various risk factors affect a nation's WACC. The Organization for Economic Co-operation and Development and credit rating agencies gave Malaysia the highest credit rating amongst the four countries, followed by Thailand. The evaluations on Indonesia and the Philippines are almost similar. Higher ratings mean smaller risks for a country. Therefore, the interest rate, bond yield, and the return on shares will be lower when financing is requested.

Table 3-3. Example of Country Risk Rating

	Indonesia	Malaysia	Philippines	Thailand	best	worst
OECD, Country risk classification	3	2	3	3	0	7
S&P, credit rating	BBB-	A-	BBB	BBB+	AAA	D
Moody's credit rating	Baa2	A3	Baa2	Baa1	Aaa	-

Source: OECD, country risk classification (January 2018), Trading Economics (S&P and Moody's credit ratings).

In terms of risks in business operations, the World Bank ranks the Philippines 113rd amongst 190 countries. This places the Philippines in the last place amongst the four countries in this study. Accumulation of such risks can lead to higher WACC. For this reason, it is a must to establish a favourable business environment.

Table 3-4. Risk Rating in Doing Business

	Indonesia	Malaysia	Philippines	Thailand
Overall	72	24	113	26
Starting a business	144	111	173	36
Dealing with construction permits	108	11	101	43
Getting electricity	38	8	31	13
Registering property	106	42	114	68
Getting credit	55	20	142	42
Protecting minority investors	43	4	146	16
Paying taxes	114	73	105	67
Trading across borders	112	61	99	57
Enforcing contracts	145	44	149	34
Resolving insolvency	38	46	59	26

Note: Assessment amongst 190 countries; the smaller the number, the better.

Source: World Bank, *Doing Business 2018*.

Natural disasters can also affect the risk evaluation. In countries where the risk of natural disasters is high, the risk on business continuity would also be high. According to an analysis done by United Nations University, the Philippines ranks third in 'Vulnerability' against natural disaster. Furthermore, its 'Exposure' to natural disasters is at 52.46%. Although Japan's 'Exposure' rating of 45.91% is almost as high as that of the Philippines, the former has significantly better ratings for 'Vulnerability', 'Susceptibility', 'Lack of coping capacities' and 'Lack of adaptive capacities' (Table 3-5).

Table 3-5. Natural Disaster Risk Rate

Rank	Country	World Risk Index	Exposure	Vulnerability	Susceptibility	Lack of coping capacities	Lack of adaptive capacities
3	Philippines	26.70%	52.46%	50.90%	31.83%	80.92%	39.96%
36	Indonesia	10.24%	19.36%	52.87%	30.09%	79.46%	49.04%
86	Malaysia	6.39%	14.60%	43.76%	19.02%	67.52%	44.73%
89	Thailand	6.19%	13.70%	45.22%	19.34%	75.53%	40.79%
17	Japan (reference)	12.99%	45.91%	28.29%	17.82%	38.04%	29.00%

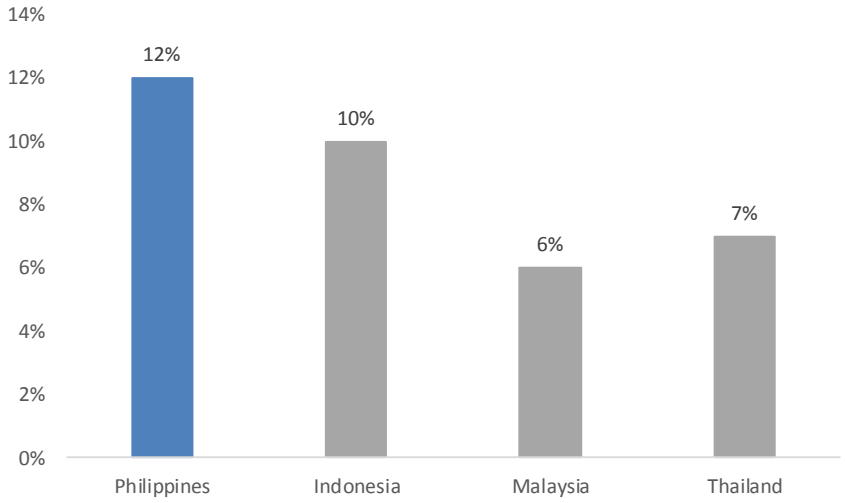
Source: United Nations University, *World Risk Report 2016*.

3.7 Tax and Surcharge

3.7.1 Value-added Tax

Value-added tax is now 12% in the Philippines, the highest of the four countries in this study. The Philippines' rate is 6 percentage points higher than Malaysia's, which has the lowest rate in this study. In Malaysia, the Goods and Services Tax was introduced in April 2015. In Thailand, the VAT was scheduled to be increased from 7% to 10% on 1 October 2016, but did not push through. Indonesia applies a 10% VAT.

Figure 3-28. Comparison of VAT



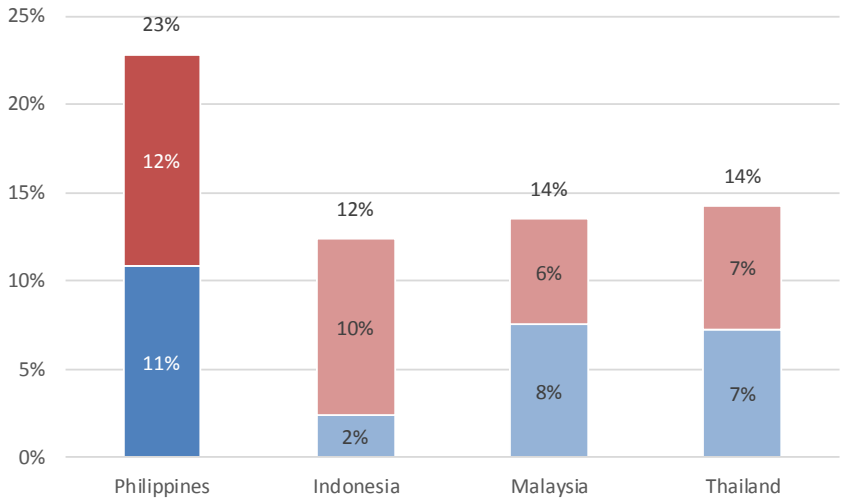
VAT = value-added tax.

Source: Website of each country.

Like WACC, value-added tax is added to all costs. In this section's review of the total values of WACC and value-added tax, care had to be taken because of the difference in the year(s) when relevant data were applicable.

In the Philippines, both WACC and VAT are high; thus, the fixed-rate multiplier is considerably higher than those of the other three countries. In the calculation in Figure 3-31, for example, as much as around 23% of the rate base is always added in the Philippines. In contrast, in the other three countries, the total rates are from 12% to 14% only.

Figure 3- 29. Sum of WACC and VAT



WACC = Weighted average cost of capital; VAT = value-added tax.

WACC: Indonesia = Perusahaan Listrik Negara in 2011; Malaysia = Tenaga Nasional Bethad 2015-2017; Philippines = Meralco in 2014; Thailand = Metropolitan Electricity Authority 2008

Source: Annual reports of companies.

3.7.2 Other Surcharges

To promote renewable energy, the Philippines has introduced the Feed-in-Tariff (FIT) system. In 2010, the ERC announced that a part of renewable energy cost be added to the electricity bill for over 20 years.[13] Feed-in-Tariff surcharges started to be added in 2015, comprising about 2% of the electricity bill by 2016. Should the FIT system be applied widely in the future, the surcharge

[13] Japan Electric Power Information Center, Inc., 'Electricity Projects in Countries Overseas', volume 1, addendum version 2.

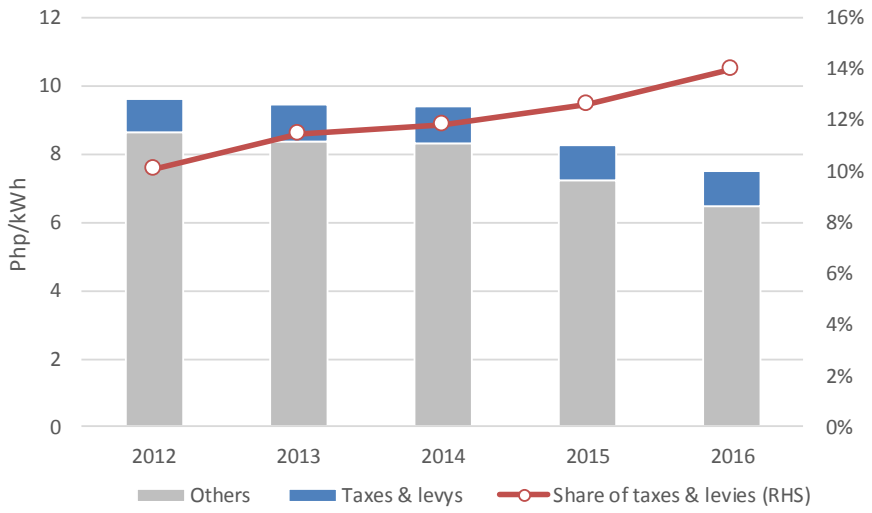
amount will naturally be larger and account for a part of the higher power cost in the future. In fact, in June 2018, the ERC approved the FIT-ALL increase from ₱0.1830 to ₱0.2563 to compensate for the deficit of FIT payment for renewable businesses.

Taxes peculiar to the Philippines, aside from the VAT and FIT, are also added to the electricity rate.

About 10% of the electricity rate is accounted for by the universal charge imposed on all final consumers. The universal charge is composed of stranded debts of NPC, electrification cost of localities, and environmental measures as well as subsidies for low-income groups. For example, the share of the universal charge and that of other subsidies in the entire electricity rate in 2016 were 3% and 1%, respectively. Such sorts of surcharges are peculiar to the Philippines, and cannot be found in the other three ASEAN countries.

In the example on Meralco, as the total electricity bill declines, the ratio of these taxes and surcharges rises.

Figure 3-30. Tax and Levy Portion in Electricity Rate (Meralco)



Source: Meralco Annual Report 2016.

3.8 Summary

Table 3-6 summarises the potential cost reduction from various points in the power supply chain.

Table 3-6. Summary of Analysis

Electricity demand increase		• Compared with other countries, the Philippines has a large room to expand its power demand; thus, this may require larger investments and could make cost reduction relatively difficult to achieve.
Power generation	Power generation mix	• Use of coal (thermal) power is already high. • Power generation cost can be reduced by relying more on coal (thermal) power, but there should be careful consideration on its environmental burden. • Renewable energy could be a cheaper option in a remote area where most are using diesel generators.
	Fuel cost	• Prices of coal and natural gas for power generation are relatively high. Coal and gas are respectively 6%-23% and 8%-43% higher than comparator-countries. • There is room to drive fuel costs down.
	Thermal efficiency	• The efficiency of gas thermal power is extremely high, but that of coal (thermal) power is very low. • If one assumes 10% points higher thermal efficiency for coal, Meralco could have reduced its coal consumption by US$235 million (in 2015). • A 60% efficient gas power plant with US$9.06/MMBtu gas can compete with a 32% efficient coal power plant with US$105/ton coal.
Transmission and distribution	T&D loss	• The Philippines' T&D loss is 2.61% points larger than Thailand's. • If T&D loss were 4% points lower, per-unit electricity

		supply cost could be 4% less.
	Demand density	• Compared with Thailand's MEA, Meralco's demand density is 40% higher, which presents a good environment for the company to operate efficiently.
	Electrification rate	• The electrification rate is lower in the Philippines. • Larger investment requirements for electrification projects would make cost reduction more difficult in the Philippines.
Cost of capital	WACC	• WACC in the Philippines is 3 percentage points–8 percentage points higher than the other comparator-countries in the study. • Cost reduction is possible by lowering WACC.
Tax and levy	VAT	• Fixed-rate multiplier (sum of WACC and VAT) to electricity cost is 9 percentage points–11 percentage points larger than that of the other countries.
	Others	• Specific surcharges not observed in other countries. (3% of universal charge, 1% of other subsidies in 2016) • As the total electricity rate goes down, the proportion of surcharges becomes bigger.

T&D = transmission and distribution; VAT = value-added tax; WACC = weighted average cost of capital.