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Power

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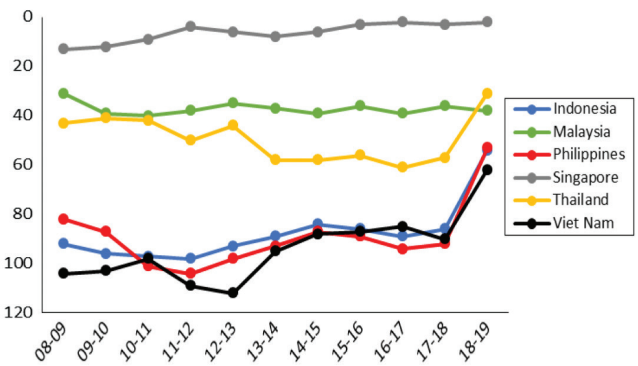
A POLICY BRIEF ON THE PHILIPPINE POWER SECTOR

I. INTRODUCTION

Achieving reliable and affordable electricity has been a constant challenge for the Philippines. While the country no longer experiences the extremely low levels in the power supply that marked the early 90s, much still has to be done in order to address the rising electricity demands of a fast-growing economy. The World Economic Fund's Global Competitiveness Report 2019 shows the rise in the country's ranking in terms of the quality of power supply, overtaking Vietnam and Indonesia (see Figure 1). Despite this, the country experienced yellow and red alerts in the summer of 2019.

Figure 1. Quality of power supply ranking, ASEAN-6, 2008-2019



Source: World Economic Forum, Global Competitiveness Report

According to the Department of Energy (DOE), 47 power plant projects are in different stages of implementation, potentially adding more than 6,000 MW to the country's power grid. While a majority of the projects being built are coal-fired power plants, there is a growing demand for more sustainable alternative sources of energy, i.e. renewable energy. Meanwhile, the National Grid Corporation of the Philippines began construction of the Mindanao-Visayas Interconnection Project in late 2018. Once completed, it will bridge the gap between the Visayas and Mindanao grids for a fully connected Philippine grid.

This policy brief provides a general situationer and analysis of the current state of the Philippine power sector. The discussion is divided into four sections: (1) Generation, (2) Transmission and distribution, (3) Pricing and the Wholesale Electricity Spot Market (WESM), and (4) Regulatory and other issues. The policy brief includes discussion and recommendations made at a roundtable on April 2, 2019 at AmCham, as well as inputs from interviews with industry experts and independent research of the authors.

II. GENERATION

Electricity generation in the Philippines remains low compared to countries like Vietnam, whose power output in 2018 was more than double, as well as Malaysia and Thailand, which were about 1.6 times more.

The same holds true for electricity generation per capita, particularly in the context of rapid development in Asia. Among the ASEAN-6 economies, Philippine electricity generation per capita remains low. Singapore, for example, generates 9.38 TWh per million people, while the Philippines produces only 0.94 TWh per million. Malaysia, which has less than a third of the Philippine population, generates nearly 70% more electricity. Table 1 provides a glimpse of how the country has fallen behind in terms of output expansion over the past two decades from 1998-2018.

Table 1. Electricity generation and installed power capacity, ASEAN-6

Economy	Installed cap., 2016 GW	Electricity generation, TWh		
		1998 (a)	2018 (b)	10-year Growth
Indonesia	61	77	267	3.5x
Malaysia	33	58	168	2.9x
Philippines	**22**	**42**	**100**	**2.4x**
Singapore	13	28	53	1.9x
Thailand	45	90	178	2.0x
Vietnam	41	22	213	9.7x
ASEAN-6	215	317	979	3.1x

Sources: British Petroleum, CIA World Factbook

The countries with the biggest expansion and multiples are Vietnam, with nearly a 10-fold expansion, Indonesia with 3.5 times, and Malaysia with three times multiples. Compared to other countries undergoing a phase of rapid development, the Philippines grew the least in 20 years. Thailand has double Philippine installed capacity and generates 78 TWh more, notwithstanding slower electricity generation growth rates. Effective policies are needed to address low consumption levels in the Philippines.

It has been over a century since the commercialization of electricity, but the exact role of electric generation in economic growth remains unclear. Studies have investigated the nexus between electricity consumption (EC) and economic growth (GDP). In 2016, a literature survey listed some 180 empirical studies that utilize multiple causality test methodologies.[1] The studies found that there are four ways EC relates to GDP: (a) Growth Hypothesis is a unidirectional causality running from energy consumption to economic growth and is a signal that the economy is energy dependent; (b) Conservation Hypothesis is a unidirectional causality running from economic growth to energy consumption and implies that energy conservation has no effect on the economy; (c) Feedback Hypothesis is a bi-directional causality between economic growth and energy consumption, where an increase in either variable leads to an increase in the other; and (d) Neutrality Hypothesis implies that there is no correlation between economic growth and energy consumption.

With rising income levels in the Philippines, socioeconomic progress becomes increasingly dependent on resources geared towards expanding both the demand and supply sides of EC. ***The economic well-being of the Philippines is best served by deploying policies and resources to drive up EC.*** Being more energy dependent affords the government control over factors that can positively affect GDP outcomes. In a low-income country, EC is driven to higher levels only when the economy grows. As the Philippines raises its level of development, policies should focus on incentivizing higher EC such that it leads to GDP growth. But the government must take caution as this relationship works both ways. De-incentivizing customers to drive down consumption and suppliers to such a degree that it hampers production, can drive down GDP.

This is especially important to further drive economic growth: the country needs more up-to-date research on variables that increase power demand and supply. The Philippines needs to identify factors of production that would most effectively bolster EC. More than macro studies like the EC-GDP nexus discussed, the country needs to answer specific queries such as which energy dependent industries exert the most effect on GDP. Indeed, such a study was conducted in Taiwan[2]; economic data was disaggregated into 17 industries. This enabled policy makers to target specific sectors like mining and quarrying with conservation since EC in this industry negatively impacts GDP.

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1 S. Tiba and A. Omri (2016)
2 N. Apergis and J. Payne. Energy

Such a study provides greater specificity with which our decision makers can build on to raise EC. While the Philippines has had comparably strong GDP growth against neighbors over the past decade, targeted policies that drive up EC could conceivably lead to even faster growth.

On the demand side of electricity consumption, national electrification is still an issue. In a report by the Department of Energy (DOE) in 2017, at least 2.1 million households still do not have access to electricity. Moreover, some 12 million households still lack access to reliable 24/7 electricity. Another demand side issue that requires attention is the rise of electric vehicles. A survey conducted shows that many Filipinos are actually interested in transitioning to electric vehicles.[3] New laws for e-vehicles can incentivize car buyers to speed up adoption and drive up EC.

Installed Capacity, Peak Demand, and Reserve Margins

In terms of capacity, the country's installed power generation profile, including reserves, appears challenged to meet increasing peak power demand and increasing unscheduled outages resulting from an ageing fleet.

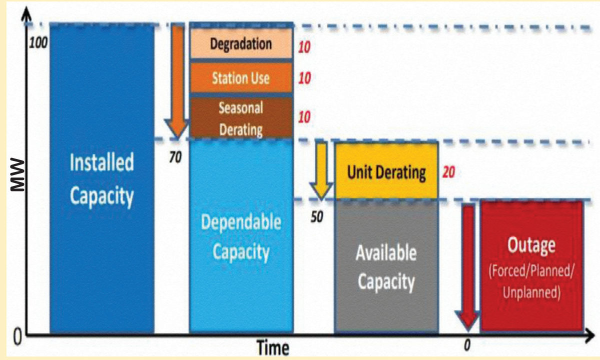
The other side of the challenge in raising EC is that there must be an adequate, reliable supply. Absolute installed capacity is often cited as a measure of a country's ability to meet power demand. However, on its own, installed capacity its not always the most accurate barometer of national power wellness. Installed capacity, in absolute terms, without attention to its relationship to peak demand and available reserves needed to address spikes in demand, does not provide a complete picture of the country's energy well-being. For example, a country with a relatively low installed capacity but adequate reserves to meet increasing annual peak demands should be in better shape compared to a country with a much higher installed capacity but insufficient reserves.

Box 1. Differentiating installed, dependable, and available capacity

Installed capacity is the maximum amount of electricity a powerplant can produce and is the total manufacturer-rated capacity of the equipment.

Dependable capacity is the capacity that can be relied upon (monthly or annually) and is used for medium to long term planning.

Available capacity is the current capacity of an electric power plant. It is the ability of a power plant or a generating unit to produce electricity in a certain time period (hourly or daily) and is used for short term planning.



Source: Department of Energy

Thus, spurring EC growth requires that electricity demand is relevantly anticipated such that power generation satisfies peak loads, while maintaining adequate reserves for plant outages and grid infirmities. On the one hand, excessive reserves can result in more costly electricity, which could cause reduced demand. Singapore and Malaysia have 48% and 32% reserve margins, respectively. Singapore's excessive generation capacity has led to increasing business risk for its Generation Companies (gencos) to the point that all but one has slipped below profitability.

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3 Frost & Sullivan (2018)

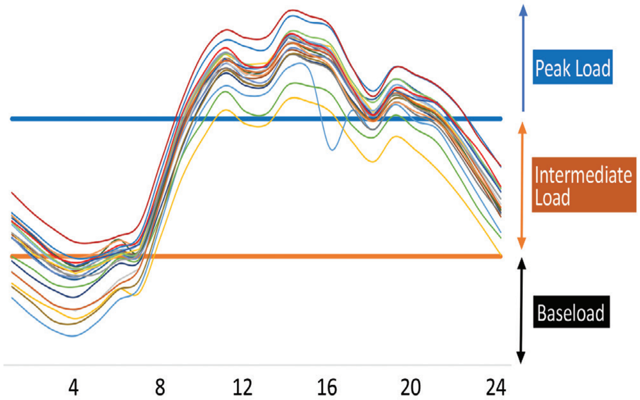
While Malaysia finds its 32% reserve margin to be optimum, it recently had to terminate four Independent Power Producer (IPP) contracts that would have raised reserves to 46%, costing consumers an estimated US$ 300 million. Oversupply is an economic inefficiency that degrades the profitability of gencos and could result in consumers footing the bill to prevent power plant closures.

Indonesia has a reserve margin of 27.5%, while Thailand's is at 55%. At first glance, it would appear that Indonesia has optimum reserves, while Thailand is burdened with over capacity. However, the two economies are facing a similar problem - imbalances in regional power development planning. Indonesia's West Java region, which accounts for the bulk of the country's electricity consumption (60%), has a reserve margin of only 12.5%, while its two other regions average an inefficient 50%. Thailand exhibits the same imbalance: central Thailand, which consumes the bulk of total generation, has a 40% reserve margin, while its southern region has 15%.

On the other hand, underestimating demand results in insufficient installed capacity, and the prospect of power shortages. From 2014 to 2018, Vietnam had been growing electricity demand at an average of 10% annually. As a result, the country estimates it will need US$ 150 billion in local and foreign investments to upgrade a power system now operating on razor thin margins. This situation is made worse as the government is approaching a debt ceiling. In 2019, Vietnam staved off a power shortage by adding 4.6 GW in solar generation and rationing demand. Industry consulting firm IHS Markit forecasts a reserve margin of 0.2% from 2020-22 due to 20 GW in delayed power projects.

Insufficient installed capacity, just like oversupply, is an economic inefficiency that must be avoided. Power shortages mean irretrievably lost productivity. A country's economic fortunes are built up over time. The Philippines would be more developed today if it had not lost billions of pesos in productivity during the rolling blackouts of the early 90s. Indeed, capacity planning for the appropriate amount of additional generation to keep pace with increasing peak demand and baseload growth remains to be a challenge many countries in the region face.

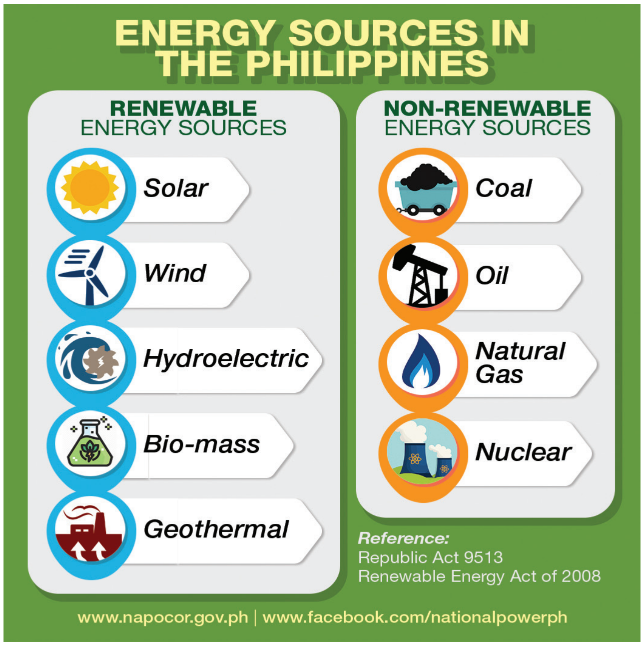
Figure 2. Philippine load profile (March 2019 excluding Saturday and Sunday)



Source: NGCP

Another challenge policy makers face in capacity planning is that the daily load profile is cyclical in nature. The load profile (see Figure 2), which is the amount of electricity required and supplied at a given time, increases and decreases in the course of a day. The trends of consumption and production follow human activity. Electricity demand is generally lowest at 4 am, reflecting that much of the population is inactive. Shortly before 12 noon there is a sharp uptake of demand, presumably as the work force ramps up activity before midday. There is another spike as people return from lunch and launch into the afternoon's work. Activity starts declining as the workforce returns home. There is another rise in demand as people prepare for dinner. From 7pm human activity winds down.

The cyclical nature of electricity demand can be divided into three components. The first is **baseload**, which is the amount of power made available by an energy producer to meet fundamental demand of consumers. This is electricity made available at all times. The second component is **intermediate load** demarcated as the area between the blue and orange horizontal lines on Figure 2. Demand starts rising at around 5 am until noon. This load is usually provided for by intermediate power plants. These plants ensure that there is sufficient power in the grid as human activity builds up. Finally, **peak load**, the maximum power carried during a given period, is the area above the blue horizontal line.

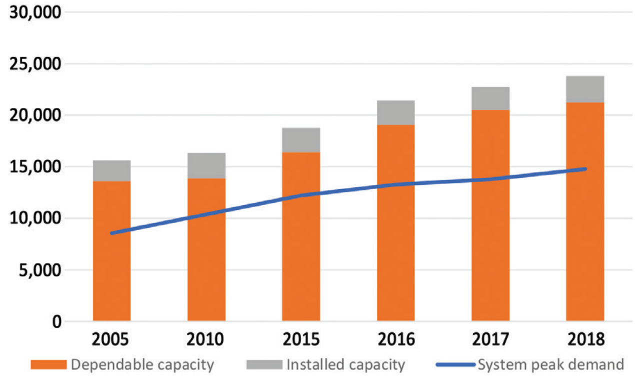


Energy sources in the Philippines • Source: NAPOCOR. Graphic by TAPP.

As the preceding discussion suggests, capacity planning is a balancing act. **The DOE, as the agency chiefly responsible for Philippine power development, constantly faces the challenge of providing sufficient installed capacity to avoid economic inefficiencies. The DOE also needs to ensure that the level of power development adequately provides for the country's baseload and peak demands.**

As part of the DOE's mandate for power development, capacity planning goes beyond nameplate or installed capacity. Dependable capacity is the system capacity after accounting for the load carrying ability of the power plant that it can reliably produce over a month or year given the effects of seasonal conditions and the power used by the station itself. Along with installed capacity, this is what is used for medium and long term capacity planning. In the Philippines, national peak demand increased at an average rate of 6.6% annually from 2016-2018, matching average GDP growth in the same period. For the same 2016-2018 period, installed and dependable capacity grew at 8.3% and 9.1% a year, respectively - showing greater growth momentum than peak demand (see Figure 3). Within this context of apparently sufficient capacity, it is unusual for the country to experience five months of frequent "yellow alert" or thin reserves from March to July 2019.

Figure 3. Philippine peak demand vs. capacity, 2005-2018



Source: DOE

The National Grid Corporation of the Philippines (NGCP) is responsible for monitoring real-time supply and demand conditions in the power system. By June 2019, the NGCP declared 32 yellow alerts and 11 red alerts in the Luzon grid. Under existing regulations, a yellow alert is triggered when available power supply falls below a certain threshold of required reserves, while a red alert occurs when the supply level falls to an even lower level. The NGCP requires that the system maintain the following reserves: (a) regulating reserve equivalent to 4% of peak demand; (b) contingency reserve equal to the capacity of the largest unit in the grid – 647 MW in the case of the Luzon grid – that should be able to run for 30 minutes; and (c) dispatchable reserve which is also equivalent to the largest unit in the grid but must be able to run for eight hours. Thus, if peak demand for the Luzon grid is 10.88 GW as it was in the last week of May 2018, the required regulating reserve is 435 MW, while the contingency and dispatchable reserves are at 647 MW each, combining for a total of 1,694 MW (see Table 2).

Table 2. Peak demand, Philippines, MW

Year	System peak demand (total is non-coincident)				
	Luzon	Visaysas	Mindanao	Total	Inc./Yr.
2005	6,443	967	1,149	8,559	
2010	7,656	1,431	1,288	10,375	363
2015	8,928	1,768	1,517	12,213	368
2016	9,726	1,893	1,653	13,272	1,059
2017	10,054	1,975	1,760	13,789	517
2018	10,876	2,053	1,853	14,782	993
2016-18 (% increase)	6.80%	5.10%	6.90%	6.60%	

Source: DOE

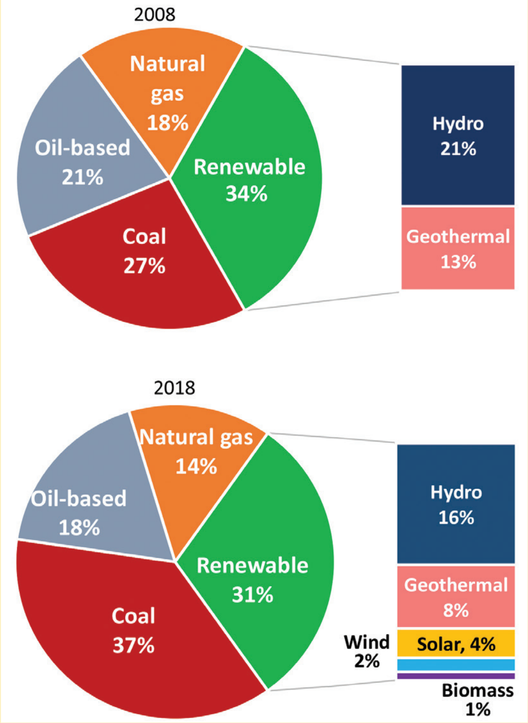
The most recent data shows that Luzon demand peaked on June 6, 2019 at 11,237 MW, only 1.2% shy of the 11,376 MW available capacity on that day. This fact is remarkable in that it highlights just how narrow the available capacity has become. As of December 2018, Luzon had 14.97 GW in dependable capacity, which is what the system can supply under specified conditions for a given time interval without exceeding approved limits of temperature and stress. Available capacity, on the other hand, is defined as the full power output of a system less station service, and is lower than dependable capacity (and generally about 70% of installed capacity). The NGCP reserve profile reports for 2018 and 2019 show that the average available capacity for the summer months (March to June) remained virtually the same i.e. growth in dependable capacity did not translate into system available capacity. System load, on the other hand, rose 6.6% quarter-on-quarter. Also, the data shows available capacity sourced from hydro dropped 15% from the summer of 2018. It seems that underperforming hydro plant assets (whether due to weather or plant performance) and, occasionally, coal plant shutdowns contributed to stagnant available capacity, even as electricity demand rose.

A significant increase in installed capacity in 2018 came from solar, wind, and biomass sources - some 1,547 MW added over 2008 levels. Due to the intermittency of renewable supply sources, however, increases in installed capacity do not necessarily translate to reliable power output needed to address demand surges. It is noteworthy, however, that a more significant increase in installed capacity came from coal, with the three grids seeing significant increases in their coal power capacity. Such increases, however, failed to adequately respond to the increased demand in 2019.

As the Philippines seeks to expand its Renewable Energy (RE) generation portfolio, it is imperative that capacity planning account for the intermittency of RE sources. Recall the load profile of a typical weekday in the Philippines. The curve is characterized by three peaks in demand - shortly before lunch, between 1 and 4 pm, and 7 pm. Solar Photovoltaic (PV) as it currently stands, starts to lose effective generation at 12 pm until the sun sets. Solar PV then, without excess capacity and energy storage, presents a mismatch between the demand and load profiles where it insufficiently satisfies two of the three peaks. Wind resources generally have a capacity factor of 30% which means wind can only be relied upon to the extent of 30% of nameplate capacity. While the country's wind resources provide almost twice as much as power

Box 2. Generation fuel mix, 2008 vs. 2018, Philippines

	2008	2018	Growth
Philippines	15,681	23,815	52%
Coal	4,213	8,844	110%
Oil-based	3,353	4,292	28%
Natural gas	2,831	3,453	22%
Renewable	5,284	7,227	37%
Luzon	11,913	16,549	39%
Coal	3,783	6,264	66%
Oil-based	2,100	2,612	24%
Natural gas	2,831	3,452	22%
Renewable	3,199	4,222	32%
Visayas	1,835	3,450	88%
Coal	198	1,059	435%
Oil-based	659	738	12%
Natural gas	-	1	100%
Renewable	977	1,652	69%
Mindanao	1,933	3,816	97%
Coal	232	1,521	556%
Oil-based	594	942	59%
Natural gas	-	-	-
Renewable	1,107	1,353	22%



Source: DOE

Solar PV per installed capacity rating, it is also reliant on favorable weather conditions. Finally, hydroelectric power generally has lower output levels during summer months, which is the time of year when power demand is greatest. Thus the challenge is that as the country's portfolio of generation assets increasingly relies upon RE sources, capacity planning must suitably account for the current limitations of RE technologies.

Stated another way, the growth in generation which outpaced GDP growth did not necessarily insulate the country from supply issues, as can be seen from the tight supply experienced in the first half of 2019.

While the DOE maintains that the country currently has sufficient electric generation capacity, this is contradicted by NGCP data. If indeed we are to accept the statement, then it behooves stakeholders to understand why the system continues to experience red and yellow alerts. Congress in 2019 launched an investigation into the rising number of alerts over the past three years. A number of reasons, were identified, including: **(1) the possibility that dependable generation capacity is lower than expected; (2) unplanned/forced shutdowns are much higher than expected particularly among ageing installed capacity assets; or (3) the current reserve margin may be too low given the grid load profile.**

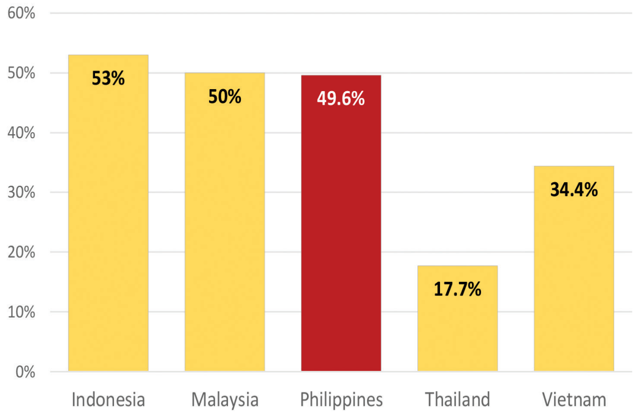
Thus, a critical headwind facing the sector is the seemingly narrowing gap between peak demand and reliable supply and healthy reserve margins. While a grid may seem to have sufficient nameplate reserves to address increased demand, if a significant portion of the supply comes from intermittent sources and an ageing fleet of traditional baseload sources risking a greater number of unplanned outages, the system is hard pressed to address power demand. This could lead to tight supply when critically needed, as well as price swings in the open market.

Robust capacity planning must account for the inherent variability or intermittency of RE sources. Capacity factor is the ratio, expressed as a percentage, of the amount of electricity produced in a given time period to the amount it would have produced if it had operated at full capacity for the period. As the Philippines aims to expand the role of renewables in its energy portfolio, more attention is needed in determining the effects of high temperatures and other relevant ambient conditions on the output levels of power generation assets. That the country had numerous red alerts due to a drop in hydro power output is perhaps a warning against placing too much emphasis on installed and dependable capacity as measures of adequate supply.

Coal

Within Southeast Asia, coal still accounts for a significant share of capacity and generation (see Figure 4). The Philippines is not an exception. In 2018, for example, coal accounted for the largest installed capacity and generation at 37% and 52%, respectively.

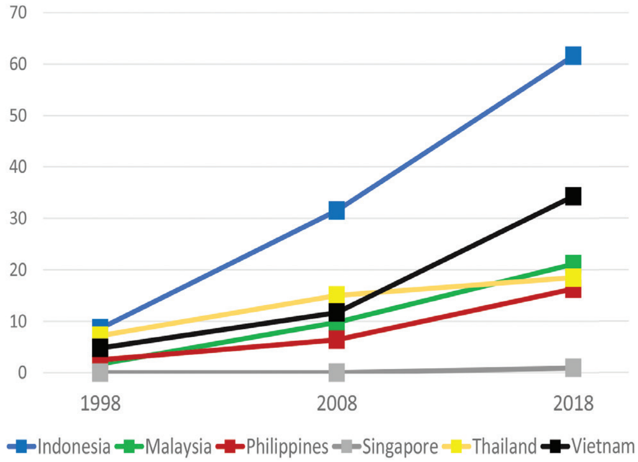
Figure 4. Share of coal in total generation, ASEAN-5, 2017



Sources: DOE, Business Malaysia, US International Trade Administration, World LPG Association+A17, Singapore Energy Market Authority, Thailand Energy Policy and Planning Office

Over the past two decades, Philippine coal consumption expanded 6.5 times from only 2.5 mtoe in 1998 to 16.3 mtoe in 2018 (see Figure 5). From 1998 to 2018, Malaysia's coal use expanded 12 times and that of Vietnam and Indonesia seven times. Today, over 50% of Philippine power generation is sourced from coal. International Energy Agency (IEA) projections on Asia's energy mix predicts that coal plant electricity production will continue to rise until 2025 and steadily lose prominence in the power mix by 2040.

Figure 5. Coal and gas consumption, ASEAN-6, mtoe



Source: British Petroleum

Groups opposed to coal-fired generation argue that the country needs to cease construction of new coal plants in favor of cleaner RE resources and natural gas-fired plants. While the position addresses environmental concerns, there is much to be said about the role that coal plays in the grid. With a capacity factor of over 60%, coal has traditionally been ideal for baseload supply and in the Philippines has seen its role expanding to mid-merit to even peaking duties in the grid, especially when intermittent sources are unavailable. The popularity of coal for developing countries is that it has the lowest levelized cost of electricity (LCOE). Installing carbon capture technology, however, raises coal to be among the most expensive (see Table 3).

Table 3. Estimated levelized cost of electricity (unweighted average) for new generation resources entering service in 2023 (2018$/MWh)

Plant type	Capacity Factor (%)	Total System LCOE
Dispatchable technologies		
Coal with 30% CCS*	85	104.3
Coal with 90% CCS*	85	98.6
Conventional CC**	87	46.3
Advanced CC**	87	41.2
Advanced CC** with CCS*	87	67.5
Conventional CT***	30	89.3
Advanced CT***	30	77.5
Advanced Nuclear	90	77.5
Geothermal	90	41.0
Biomass	83	92.2
Non-dispatchable technologies		
Wind, onshore	41	55.9
Wind, offshore	45	130.4
Solar PV	29	60.0
Solar thermal	25	157.1
Hydroelectric	75	39.1

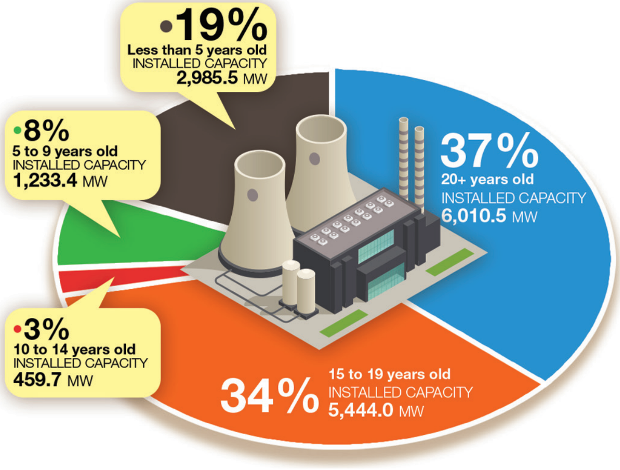
Source: U.S. Energy Information Administration
* carbon capture and sequestration
** combined-cycle
*** combustion turbines

Generation companies have committed to providing some 3.7 GW of new coal capacity in Luzon (see Table 4). This capacity is expected to come online over the next five years (2019-2024), augmenting the current fleet of ageing plants. San Buenaventura with 500 MW opened in October 2019. An additional 300 MW of new capacity from Masinloc Unit 3 (Zambales) is expected by late 2019, and then subsequently another 1,336 MW should come into operation by 2020 from Dinginin Units 1 and 2 in Mariveles Quezon. The addition of these plants to the grid should lead to more robust available generating capacity.

500 MW San Buenventura coal-fired power plant, opened October 2019. • Source: SBPL

During the summer months of 2019, the Luzon grid experienced almost daily yellow alert warnings. During the week of April 5-11, 2019, NGCP data shows that Ancillary Services[4] were practically unfilled. Available capacity was reduced by 2,489 MW due to planned maintenance, unplanned outages, and derated capacity. What is confusing about this incident is that the capacity of unplanned outages (1,602 MW) was double the planned maintenance (827 MW). Moreover, new plants accounted for over half of the capacity taken off-system.

Figure 6. Aging and installed capacity of existing power plants, Luzon, 2018



Source: BP (2019)

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4 Ancillary services are the services necessary to support the transmission of electric power from seller to purchaser given the obligations of control areas and transmitting utilities within those control areas to maintain reliable operations of the interconnected transmission system.

Table 4. Upcoming major coal projects, Luzon, MW[5]

Project	Proponent	Location	Capacity	Start of Construction	Target Operation
Atimonan U1	A-One Energy	Atimonan, Quezon	600	Q4 2023	Q2 2024
Atimonan U2	A-One Energy	Atimonan, Quezon	600	TBA	TBA
Dinginin U1	GNPower Dinginin	Mariveles, Bataan	668	September 2016	June 2020
Dinginin U2	GNPower Dinginin	Mariveles, Bataan	668	TBA	Sept. 2020
Masinloc U3	SMC Global Power	Masinloc, Zambales	300	2016	Q4 2019
Masinloc U4	SMC Global Power	Masinloc, Zambales	300	TBA	TBA
Redondo U1	Redondo Peninsula Energy	Cawag, Subic Bay Freeport Zone	300	2020	2021
Redondo U2	Redondo Peninsula Energy	Cawag, Subic Bay Freeport Zone	300	2021	2021
	TOTAL		**3,736**		

Source: DOE

While this could raise an issue of collusion, it is better to focus on the vulnerability it highlights. Old conventional plants require frequent or longer scheduled maintenance shutdowns, especially as they near the end of their contract lives. The Energy Regulatory Commission (ERC) found that over 70% of Philippine power plants are 16 years old and above, and these accounted for 62% of outages. Indeed, a study on power plant life extension finds that Forced Outage Rates (FOR) follow a roller coaster pattern of intensive repair requirements every 20 years. The chronic depletion of Ancillary Services for the Luzon grid in 2019 was foreshadowed by seven yellow alerts during the prior year. The DOE reported that in Luzon all seven of the yellow alert events in 2018 were caused by forced and unplanned outages. In 2018, the Visayas grid fared worse than the Luzon grid, experiencing 15 red alerts that year. NGCP data shows the problem continued into 2019 as available capacity dipped below Required Dispatch Reserves in 10 of 26 weeks.

For context, we compare the FOR of the Luzon grid to the North American Electric Reliability Corp. (NERC) (see Table 5). The data shows favorable numbers for natural gas and hydro in the Philippines, but also shows that nearly 60% of the country's capacity mix (oil, thermal, coal, geothermal) is comparatively unreliable.

In a statement presented at the Senate, the National Transmission Corporation (Transco) said that *"despite available capacity reserve of Luzon Grid, the grid is deemed unreliable. Forced outage rate (FOR) of dominant power plants are high… Larger Capacity Reserve is required to maintain Luzon Grid reliability to 1 day/year if FOR of power plants will not improve."*

Table 5. Forced outage rates, Luzon, %

Technology	Luzon 2016-18	NERC 2013-17	2018 Luzon cap. mix
Oil thermal	18.39	12.54	16
Coal	8.92	6.91	38
Geothermal	8.31	2.11	5
Oil CCGT	6.02	12.54	-
Oil Diesel	1.58	12.54	-
Natural Gas	2.10	17.02	21
Hydro	0.97	8.63	15

Source: DOE and NERC

This supports the contention that, even if on paper the reserve margin seems to be relatively at par with industry comparables, this margin rapidly deteriorates if the reliability of the plants likewise falls. ***The assessment and planning for reserves in the grid therefore should carefully scrutinize not only the specific load profile to be serviced but also the quality and reliability of the plants in***

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5 More updates on power projects can be found at the *Arangkada* Philippines Infrastructure Tracker at *www.arangkadaphilippines.com*

the system and the transmission grid itself. It is critical to focus on how best to address the deteriorating reliability of these older plants. A more thoughtful and thorough management of outage anticipation and execution is called for. Likewise, it would serve the ERC well to closely coordinate power supply-demand forecasts with the DOE and other stakeholders to ensure a more relevant program of addressing capacity needs.

Gas

It is noteworthy that coal consumption is much greater than natural gas for the three lowest income nations among the ASEAN-6 (see Table 6). In 2018, for instance, Philippine coal use was 4.7 times that of natural gas; for Vietnam it was four times. This trend between national income and natural gas consumption is apparent beyond even the ASEAN-6 context. As can be seen in Table 6, with the exception of Germany, which is focused on RE, higher income countries consume much greater quantities of natural gas and have been building capacity over the past two decades. The Philippines, on the other hand, has lagged behind in exploring and developing indigenous oil and gas fields since the discovery and subsequent operation of the Malampaya gas field in the 1990s.

Malampaya natural gas accounted for 30% of the Luzon generation mix and 21% of the country total in 2018. This is testament to its importance in serving as a lower emission alternative to coal and contributing to a diversified energy mix. Unfortunately, the field is not inexhaustible and has begun to decline. The gas field currently supplies 2.7 GW of near baseload generation, but there are concerns that this level of output is unsustainable. Estimates differ. Some in the industry are anticipating a 66% output decline by 2024. The Malampaya Consortium (Consortium) operates under Service Contract (SC) 38. It is currently seeking an extension past SC 38's 2024 expiration, but government approval is pending. In addition, the various Gas Sales and Purchase Agreements are set to expire in 2024.On the other side, the Santa Rita (1,000 MW) and San Lorenzo (500 MW) PPAs with Meralco, the sole offtaker, are due to expire in August 2025 and September 2027, respectively. The Ilijan power plant (1,200 MW) also has a PPA with Meralco set to expire in 2019, which can be extended only until the end of the IPPA Agreement in 2022. Supply contracts for the power plants are expiring in 2024.

Table 6. Coal and natural gas consumption, selected countries, 2018, mtoe

Country/ Economy	Coal Consumption 2018	Natural Gas Consumption 2018
US	317.0	702.6
Germany	66.4	75.9
China	1,906.7	243.3
India	452.2	49.9
Japan	117.5	99.5
South Korea	88.2	48.1
Indonesia	61.6	33.5
Australia	44.3	35.6
Taiwan	39.3	20.3
Vietnam	34.3	8.3
Malaysia	21.1	35.5
Thailand	18.5	42.9
Philippines	**16.3**	**3.5**
Hong Kong	6.3	2.6
Singapore	0.9	10.6
Total World	**3,772.1**	**3,309.4**

Source: DOE and Business World. Graphic by TAPP

This means that, if proper actions are not taken, there will potentially be 2.7 GW of stranded capacity caused by the geology of the field (i.e. the uncertainty as to how much longer gas can actually support the generation) and/ or structural challenges (expiring contracts). Moreover, Meralco is committed to pay for the capacity and energy generated by San Lorenzo and Santa Rita under the terms of their respective PPAs.

Photo and location of the Malampaya off-shore gas field
Source: Business World and Oil & Gas Journal.

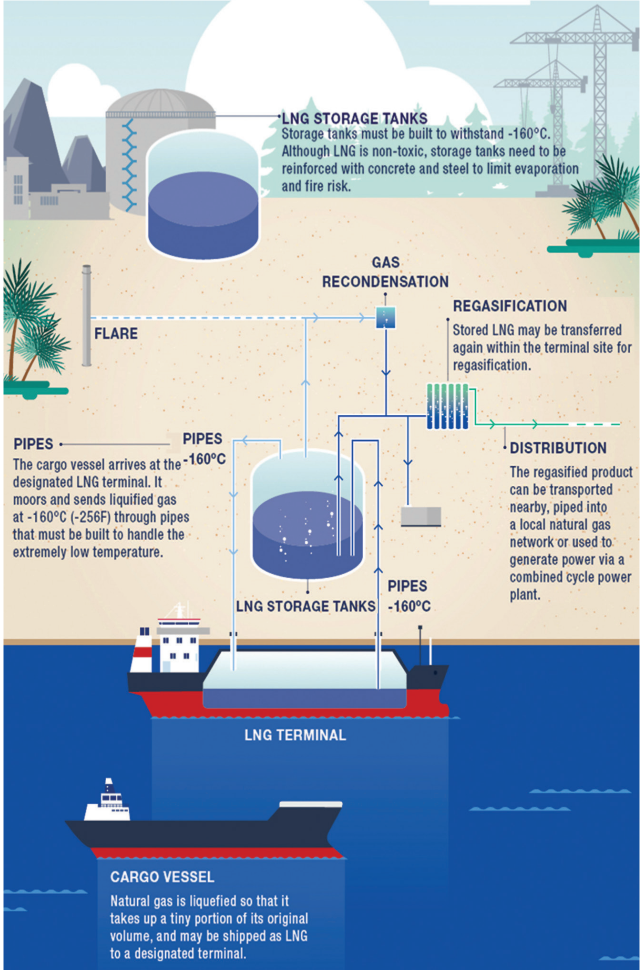
LNG Terminals

There are at least four liquefied natural gas (LNG) receiving terminal projects proposed to process imported LNG to feed into the current gas plants when the contracts expire and/or Malampaya gas runs out. The **first** approved is the **Tanglawan** LNG project partnership between Phoenix Petroleum, Chinese CNOOC Gas and Power Corporation, and PNOC. The 2.2 mtpa (metric tons per annum) Tanglawan plant is expected to begin commercial operation in 2023. The **second** LNG processing facility is the **Batangas** LNG terminal proposed by First Gen and Tokyo Gas. The Batangas LNG terminal has concluded the tendering phase and selected Japan's JGC Corporation for engineering, procurement, and construction. The **third** is by Australian firm Energy World Group, which intends to build a facility at **Pagbilao Grande Island** in Quezon province and is reported to be nearing completion. The **fourth** is by Texan firm Excelerate, which proposes to build a floating LNG import terminal in **Batangas Bay** and expects to complete the project by 2021. There are other proponents who may also apply to the DOE and receive notices to proceed.

The DOE established the rules and regulations governing the Philippine downstream natural gas industry in Circular DC2017-11-0012. The IRR establishes some important aspects for the LNG terminals that are expected to come online. First, operators of LNG terminals are expected to accommodate both indigenous natural gas and imported LNG. Second, the operation of LNG terminals will require a congressional franchise in order to operate. Third, the DOE, in coordination with the ERC, will be responsible for setting and regulating rates for transmission and distribution pipelines. Lastly, the IRR specifies that Third Party Access (TPA) only applies to available and uncommitted excess capacity for each terminal.

TPA, however, is modified by Rule 8 section 3 which exempts operators during a determined Infrastructure Development Period. Moreover, Rule 8 section 3(b) appears to extend this incentive for as long as operators undertake significant increase in or modifications on existing facilities:

> *"To encourage initial capital investment in new infrastructure... an Infrastructure Development Period shall be considered and determined, during which the Operator shall be exempted from Third Party Access."*



How does an LNG Terminal Work? • Source: SamsungC&T

Section 3(b) goes on to read:

> *"This provision shall also apply to significant increases of capacity in existing Natural Gas Facilities and to any modification of such facilities..."*

The forgoing provisions appear to condition the encouragement of capital investment on restrictions on TPA. Firstly, it may be construed that placing TPA restrictions infringes Rule 8 section 1(a): "Encourage competition which drives efficiencies and lowers costs and price to consumer." Secondly, introducing such restrictive elements may not be in agreement with ideals envisioned in the EPIRA law, which should carry greater import than an implementing rule. Lastly, requiring a congressional franchise means there is an interpretation that LNG terminals are a public service, and that undue limitations should not be imposed on its ability to service legitimate customers.

Indigenous Sources

Given the time constraints, the Philippines is leaning towards importing fuel, rather than face the prospect of debilitating 15% of domestic dependable capacity. It is in this context that one appreciates the benefits of indigenous gas. Since gas first started flowing from Malampaya in 2001, the government has received US$ 10 billion in royalties. To put this number in perspective, by 2004 enough royalties were remitted to the government to self-fund 20 onshore or at least 1 offshore exploration campaign (a study published in that year estimated unsuccessful exploration costs US$ 5 to 20 million.)[6] Today, the U.S. Energy Information Administration estimates oil and gas onshore exploration at US$ 5-8 million while deepwater campaigns range at around US$ 100-200 million.

The success rate of finding commercially viable oil and gas wells is 30% to 40%. That the risk of failure is much greater is the chief concern of any Exploration & Production (E&P) company. E&P companies operate under the premise that failure means costs associated with exploration are unrecoverable. These companies also know that the only sure way of finding commercially viable wells is to undertake known risks while avoiding unknown risks that threaten their ventures. This is a numbers game where E&P companies risk capital hoping to find oil and gas reserves.

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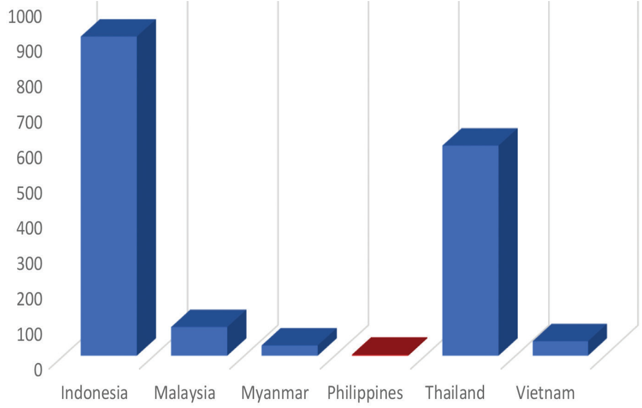
6 Oil and Gas Exploration and production: Reserves, Costs, Contracts. Paris Center for Economic Management, Institut Francais Du Petrole (2004)

For the company, it is a source of income, and for nations fortunate enough to find reserves within their borders, it means industry, commerce, and energy security.

Figure 7. Wells drilled per year, ASEAN-6, 2007-2017, average



DOE and Business Mirror

In the Philippines, there has been a scarcity of oil and gas exploration (see Figure 7). For the past five years, there has been an average of only three explorations a year. In contrast, Myanmar, Vietnam, and Indonesia are each doing at least 10 times as many explorations annually. Indonesia and Thailand dwarf exploratory drilling done in other ASEAN nations. The Philippines needs to actively promote exploration and production activities in order to catch up to its neighbors on indigenous energy.

Regulatory Risk on Exploration and Production

A contributing factor for limited activity in exploration is regulatory risk. As E&P companies seek to limit their risk profile to known variables, they remain averse to regulatory pressures that can undermine their bottomline performance.

The dearth of exploration can be traced as far back as 1949 when the Petroleum Act was passed into law to promote seismic exploration and deep drilling. When the Petroleum Act failed to encourage E&P activities, Presidential Decree 87 (PD 87) was signed into law in 1972. PD 87 sought to "promote the discovery and production of indigenous petroleum." Under the same administration and in the same vein, PD 1459 and PD 1857 were signed. These decrees, despite originally being intended to be a boon for E&P companies, have become a regulatory risk that needs to be addressed.

The Commission on Audit (COA) is the government institution responsible for reviewing national revenues, expenditures, and use of funds. On April 6, 2015, COA ruled that the government effectively shouldered the tax burden of the Consortium in contravention of law. The conflict between COA, on one side, and the DOE, Office of the President, and Department of Finance, on the other, stems from their respective interpretations of the law.

The DOE maintains that the government's 60% share should already include all taxes, as straightforwardly worded in the law. The COA, however, asserts that PD 87 (Section 8) subjects the contractors to income tax and is further reinforced by Section 12 which grants an exemption from all taxes except for income tax. As such, the COA ruled that the DOE undercollected US$1.2 billion in royalties, as it found the current arrangement further violates provisions of SC 38 (Sections 6.1 (j) and 6.3), which obligate the contractors to pay corporate income tax. The DOE and the Office of the Solicitor General appealed to let the Consortium keep the alleged underpayments. However, on January 24, 2018, the COA sustained its ruling.

The result is tantamount to double taxation from the perspective of the DOE. The legal battle, then, is about whether the Consortium keeps its 40% interest in net proceeds or if this interest is reduced to 14%.p

In response to the alleged underpayment, Shell Philippines Exploration B.V. (SPEX), as operator of the Consortium, filed a case with the Singapore International Arbitration Center. In July 2016, SPEX filed another case in the International Centre for the Settlement of Investment Disputes Arbitration (ICSID) in Washington. In 2019, the Singapore Arbitration Center ruled in favor of SPEX. While this ruling is non-binding, there is hope that the victory "would go a long way in giving exploration and development activities in the country a much needed and long overdue boost." The relief brought about by the conclusion of the arbitration in Singapore may, however, be short lived as there is yet another challenge to E&P companies.

This is the kind of regulatory risk that gives E&P companies pause. The government's consternation over this matter is understandable as it affects the calculus on exploration and the country's energy prospects. The Consortium is facing the possibility of losing 65% of proceeds from the project. Some might think this is still a winning outcome. But it must be recalled that energy exploration is an inherently risky venture. To put things into perspective, the oil and gas sector of Indonesia spent nearly US$ 4 billion between 2002 and 2016 in the exploration stage without finding commercially viable wells.

For E&P companies to invest dollars in very risky ventures, returns should be commensurate to risks taken. In order to lower the risk profiles of E&P activities, the DOE established the Philippine Energy Contracting Round (PECR) - a transparent competitive system of awarding service contracts for petroleum prospective areas. The PECR system aims to fast-track exploration and development by predefining areas more likely to yield hydrocarbons. Qualified E&P companies then bid for the chance and right to explore awarded blocks.

One such bidder was deemed qualified for Area 5 in East Palawan and Area 7 in Recto Bank. The two sites have a combined estimated oil reserve of over two billion barrels. What is more is that each site is estimated to have more gas reserves than the Malampaya gas field (2.8 and 3.5 TCF vs 2.7 TCF). However, because of the uncertainty stemming from the interpretation of PD 87 and PD 1459, the bidder is not keen to explore the areas. ***Unless some company undertakes the risk of exploration, estimates will be no more than estimates. Economic benefits to the country do not accrue on mere projections.***

House Bill 4157 (HB 4157) known as the Corporate Income Tax and Incentives Rationalization Act (CITIRA Bill) is a part of the Comprehensive Tax Reform Program of the Duterte administration. One of the most salient features of HB 4157 is to align the Philippine corporate income tax rate to other Asian nations. For example, Singapore has a 17% tax rate while Cambodia, Vietnam, and Thailand each has a tax rate of 20%, and Indonesia is at 25%, while the Philippines is at 30%. The bill proposes to reduce tax rates to 20% over a period of 10 years. This, however, comes at a cost that may profoundly affect E&P company interest in the country.

HB 4157 will remove fiscal incentives introduced in PD 87 Section 12 such as the tax-free importation of equipment and supplies, exemption from all taxes except income tax, accelerated depreciation, and the tax-assumption (that income tax is imputed in the government's share of an energy resource). Lowering the income tax to 20% may not be enough to incentivize actual exploration rather than mere declared interest.

Ilocos Norte's Bangui windmills - a source of energy and a tourist destination for the region. Source:WikiCommons.

Given the current risk environment and the imminent loss of fiscal incentives, the power industry needs to prepare. ***There is a need for concerted effort among key players in the industry to formulate fiscal incentives that can give stability needed by E&P companies.*** These incentives need to sufficiently address the return considerations of an inherently risky venture, ranting incentives is justifiable if the recipients generate good jobs, invest in less developed areas, and when incentives are given for a reasonable amount of time." This, too, must be done in the interest of territorial integrity. A significant portion of the country's estimated reserves lie in the sea to the west, which is disputed. More importantly, given the current Malampaya situation, the DOE needs to establish firm contingencies in the event that 2.7 GW of power becomes stranded in the next few years.

Renewable Energy

With the exception of Germany and Australia (see Table 7) other economies, both rich and emerging, have wind and solar share of below 9% of total power generation. Germany, however, has subsidized these renewables since the late 90's. After two decades, they supply less than a fourth (24%) of total consumption. Likely due to weather, solar has a capacity factor of about 20% of total RE generation in Germany. In contrast to Germany, countries like South Korea, Taiwan, and Singapore have small landmass considerations. Consequently, they hardly rely on wind and solar PV, which can require up to 50 times more land area than coal and 100 times more than gas power plants.

Table 7. Wind and solar generation, selected countries, TWh

Economy	Solar (1)	Wind (2)	Others* (3)	Total Generation (4)	% of Solar and Wind of Total Generation (1+2) / (4)	% RE of Total Generation (1+2+3) / (4)
US	97.1	277.7	83.7	4,460.8	8.4%	10.3%
Germany	46.2	111.6	51.4	648.7	24.3%	32.2%
Australia	12.1	16.3	3.5	261.4	10.9%	12.2%
China	177.5	366.0	90.7	7,111.8	7.6%	8.9%
India	30.7	60.3	30.5	1,561.1	5.8%	7.8%
Indonesia	^	0.2	14.5	267.3	0.1%	5.5%
Japan	71.7	6.8	33.7	1,051.6	7.5%	10.7%
Malaysia	0.5	-	1.0	168.4	0.3%	0.9%
Philippines	**1.2**	**1.2**	**11.5**	**99.8**	**2.4%**	**13.9%**
Singapore	0.3	-	0.9	52.9	0.6%	2.3%
South Korea	9.3	2.4	10.2	594.3	2.0%	3.7%
Taiwan	2.7	1.7	2.0	273.6	1.6%	2.3%
Thailand	4.7	0.8	12.3	177.6	3.1%	10.0%
Vietnam	0.1	0.3	0.1	212.9	0.2%	0.2%
Total World	**584.6**	**1270.0**	**625.8**	**26,614.8**	**7.0%**	**9.3%**

** Geothermal, biomass, other renewables • ^ Less than 0.1 • Source: BP*

Agus-Pulangi hydroelectric power complex in Mindanao
Source: NAPOCOR/BusinessWorld

Wind and solar PV play an important role as the country diversifies its power generation assets and drives toward reducing greenhouse gas emissions but must be carefully weighed with land use plans. The Paris Agreement on Climate Change Article 5 states:

> *"Parties should take action to conserve and enhance, as appropriate, sinks and reservoirs of greenhouse gases as referred to in Article 4, paragraph 1(d), of the Convention, including forests."*

Thus, solar PV and wind deployment should consider implications on carbon sequestration and food production (when farmland is used for energy). As the world becomes more developed, the Intergovernmental Panel on Climate Change finds that about a quarter of the ice-free land in the world is subject to human-induced degradation. In the Philippines, only a quarter of landmass remains forested. Further, as a signatory nation, it is incumbent for the Philippines to reduce its dependence on fossil fuels as the country plans its future energy landscape.

Consequent to the Renewable Energy Act of 2008 (RA 9513), the DOE published the National Renewable Energy Plan 2011-2030 (NREP), which sets the laudable goal of tripling the country's installed capacity in RE to 15.3 GW by 2030. The share of solar and wind in the country is only 2.4% generation of the total, 11 years after the passage of RA 9513 due to the preponderance of geothermal. According to the Renewable Energy Management Bureau of the DOE, wind and biomass installations are currently on track. Solar, on the other hand, went beyond the NREP to almost triple its projected installed capacity.

Power Project Delays

Among some of the issues currently being faced by RE developers are: (1) the difficulty in securing RE service contracts. While such contracts are required to be released within 25 days, the award takes up to six months or longer; and (2) the difficulty in securing land conversion permits for solar and wind farms. The Department of Agrarian Reform (DAR) is not issuing permits for new conversions. Before a developer applies to the DAR, it needs to approach the Department of Agriculture, which also has delay challenges. Even though the construction period for renewable energy plants is short – six months for a solar farm, 18 months for a wind farm, and 24 months for a biomass installation – projects are delayed by red tape needed to secure required permits.

The 132.5 MW Cadiz Solar Power Plant is one of the largest in Southeast Asia located in Cadiz City, Negros Occidental.
Source: Rappler.

Local governments can be unpredictable. Companies need reliability and predictability. Large power projects are long-term propositions and do not coincide with political election cycles. Apart from challenges faced with securing DOE service contracts, agriculture and land conversion, and LGU permits, there are particular agencies that hamper the swift development of renewable projects. For example, the National Commission for Indigenous People is challenged in securing endorsements from indigenous peoples, mainly for hydropower projects.

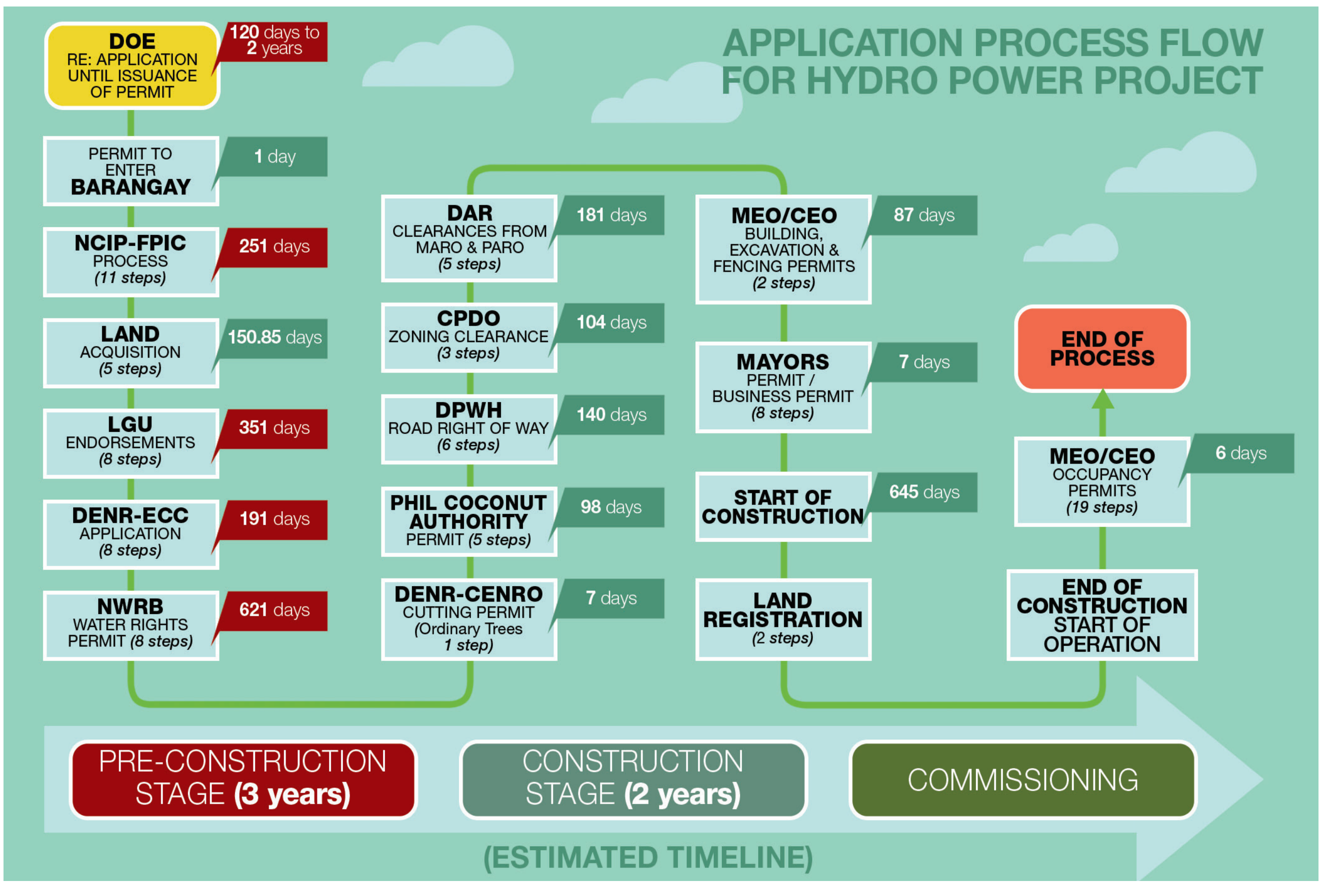
Senator Sherwin Gatchalian, chairman of the Senate Energy Committee, counted a total of 359 government signatures, involving 74 different agencies and bureaus, covering 43 different licenses and contracts, needed to build a hydropower plant (see Figure 8).

Conventional Renewable Energy

Much of the attention from 2010-2019 was been on variable RE. As a result, the seeming inattention resulted in negligible growth in both geothermal and hydro generation. One reason for this is that almost all the most productive geothermal and hydro resources are already being utilized. The NREP, however, aims to add 1,495 MW in geothermal and 5,394 MW in hydro by 2030.

In aggregate, this is a substantial amount. In 2018, geothermal and hydro accounted for 24% (5,645 MW) of installed generating capacity and 20% of total generation. Keeping pace with NREP targets would mean generation from these sources would more than double by 2030. Since 2011, however, very little of the planned capacity additions has come to fruition.

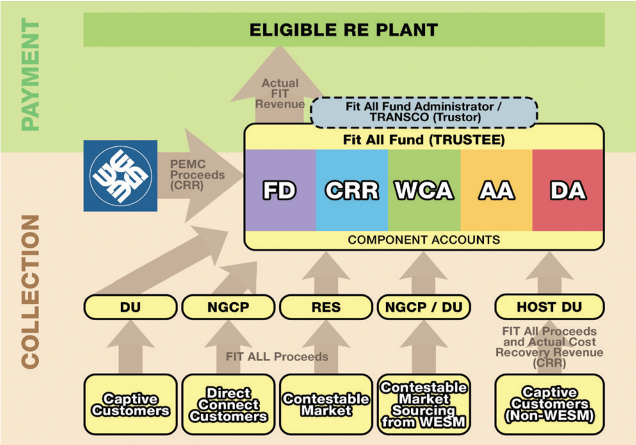
Figure 8. Permits to build a hydropower plant



Source: Presentation of Sen. Sherwin Gatchalian during the Energy Outlook Forum by Stratbase-ADRI, September 27, 2018. Graphic by TAPP.

RA 9513 was passed to increase energy self-reliance and reduce harmful emissions associated with traditional methods of energy production through the development of RE sources. To achieve this core objective of accelerating the development of emerging RE sources, Section 7 of the law mandates the establishment of a Feed-in-Tariff (FIT) system. ERC's Resolution 16 (Series of 2010) incentivizes investments in eligible RE generation such as solar, wind, run-of-river hydro, and biomass. Under FIT implementing rules, generation proponents are granted fixed tariffs for a period of 20 years. To account for the declining cost to construct RE generation and to encourage earlier participation, degression rates were imposed to reduce tariffs over time.

Figure 9. FIT-ALL fund flow



Source: ERC

In 2013, the ERC issued guidelines that defined the FIT Allowance (FIT-ALL) as a separate uniform charge calculated annually for each kWh billed to all on-grid customers. The resolution also establishes the process through which FIT-ALL is collected, administered, and disbursed to eligible RE plants. The National Transmission Corporation (TransCo) is responsible for collecting from companies that distribute to or interface with end users. TransCo collects the component accounts that comprise the FIT-ALL Fund which is then held by a trustee until disbursement (see Figure 9).

Criticisms were made against the FIT by consumer groups. Two cases were docketed before the ERC where the main complaint is that the FIT-ALL scheme locked in consumers to pay high tariffs for 20 years.

Despite the criticism, the framework of the FIT system successfully spurred investments in emerging RE technologies. From the end of 2013 to 2018, solar, wind, and biomass installed capacity saw a 10-fold increase (from 153 MW to 1,581 MW). Solar and wind deployments made significant headway in meeting Philippine NREP goals for these two RE sources. Solar was so successful that as of 2018 installed capacity (896 MW) is more than triple the NREP target of 285 MW by 2030. The FIT regime also benefited wind and biomass as these are also on target to meet the current NREP goal by 2030.

The FIT regime has ended for wind and solar and will end for biomass and run-of-river hydro by 2020. Subsequently, FIT-ALL rates charged to customers should taper off. The denominator utilized in computing FIT-ALL rates is Forecast National Sales, which is the total estimated electricity billed to on-grid customers. As time goes by and generation increases, customers will see FIT-ALL rates go down.

FIT met its core objective to get RE generation started when generation costs were not as low as coal and natural gas. But emerging RE is reaching maturity and prices continue to decline. Between 2011 and 2016, solar and wind project costs dropped by 80% and 50%, respectively. As the FIT regime draws to a close, the Renewable Portfolio Standards (RPS) is expected to take on the challenge of attracting investment in RE generation.

The National Renewable Energy Board of the DOE is currently drafting the Rules and

Guidelines Governing the Establishment of the Renewable Portfolio Standards (RPS Rules). The current draft RPS Rules contribute to the growth of the RE industry by mandating that a certain percentage of electricity sold to customers be sourced from eligible RE generation. Mandated participants are required to increase the amount of electricity sourced from RE up to 35% at a minimum by 2030.

Comments submitted by power industry players, however, suggest there will be a likely increase in generation costs that consumers will have to shoulder. One commentator cited a numerical exercise conducted in 2016 which showed that increasing variable RE in the country's fuel mix could result in a 13% increase in price per kWh by 2040 (4.32 PhP/kWh vs 4.88 PhP/kWh). ***The simulation, however, assumes static generation tariffs. Continuous technology innovation in RE should lower Long Run Marginal Costs mainly through reduction in equipment costs. Moreover, innovations lead to better performance and higher capacity factors. Onshore wind was less than 20% efficient in 1983, but technological advances are pushing wind capacity factors to 30%. The same advances are pushing offshore wind capacity factors to over 40%.***

Decreasing costs in RE generation could mean that implementing RPS can result in societal gains such as reducing carbon emissions and increasing energy independence without necessarily burdening consumers with higher electricity prices. ***As a commentator on the draft RPS Rules suggested, there is a need for an in-depth technical and economic study to support RPS. The study should account for technological advances.*** Assumptions made in 2016 may be rendered out-of-date given the maturation rate of emerging RE technologies.

Nuclear

The Bataan Nuclear Power Plant (BNPP), the country's sole nuclear generation facility, began construction in 1976 by the National Power Corporation (NPC) and reached its current state of near completion in 1984. Controversies regarding installation cost, construction flaws, and concerns brought about by the Chernobyl disaster, plus corruption allegations, led the new Philippine government in mid-1986 to mothball the facility. The Westinghouse-built plant was fully paid for at a total cost of US$ 2 billion.

Facade of the Bataan Nuclear Power Plant Source: Philstar

Though the transmission lines to the plant were stolen, maintenance on the idle nuclear generation facility continues. From 2007 to 2018, it was reported that the government spent PhP 50 million annually. A number of ideas have been raised on what can be done with the facility. In 1993, for example, the government formed a committee to determine whether it should be converted to a non-nuclear facility and at least one private firm proposed converting the plant to gas. Still, 33 years after reaching near completion, the BNPP remains unused, and its fuel rods sold and shipped abroad.

In 2008, an eight-person team from the International Atomic Energy Agency (IAEA) inspected the BNPP. The team made two primary recommendations: (1) a thorough technical and economic evaluation should be made and (2) that the Philippine government attend to general requirements for restarting its nuclear program. Two years after the recommendations were made, Korea Electric Power Corporation (KEPCO) evaluated the feasibility of rehabilitation and found the plant can be rehabilitated at a cost of US$ 1 billion.

After satisfying the recommendation for a thorough evaluation through KEPCO's study, the IAEA again sent a team of experts in 2018. The eight-day mission reviewed the status of the Philippines in meeting 19 nuclear power program infrastructure issues along with the Philippine self-evaluation report. The Philippine Senate notes that the Integrated Nuclear Infrastructure Review (INIR) Mission Report has not been made public. This report contains specific recommendations for legislators and regulators to undertake necessary foundational groundwork. In the meantime, the following IAEA general recommendations are actionable:

- Involve a broader range of stakeholders in completing the work required to enable a national commitment to introduce nuclear power.
- Develop a legal and regulatory framework that ensures and demonstrates a commitment to safety, security, and non-proliferation.
- Further enhance human resource and leadership development, nuclear fuel cycle options, and electrical grid impacts.
- Adapt the existing national frameworks for emergency preparedness and response and nuclear security in light of a future nuclear power project.

The Nuclear Energy Program Implementing Organization is already addressing these recommendations by communicating to the Office of the President the need for a National Position to Embark on a Nuclear Power Program, and the issuance of an executive order to expedite crucial elements for a nuclear regulatory and legal framework. The IAEA has three milestones: (1) ready to make a knowledgeable commitment to a nuclear power program; (2) ready to invite bids/negotiate a contract for the first nuclear power plant; and (3) ready to commission and operate the first nuclear power plant.

Based on the general recommendations, there is still much to be done to get past the first milestone. Fulfillment of Milestone 1 requirements will afford the Philippines a new option to diversify its portfolio of generation assets. Subsequently, Milestone 2 would come at a time when nuclear technology will see the debut of significant advances.

Emerging Nuclear Technology

Small Modular Reactors (SMR) are an emerging technology with the potential to meet the fast-growing energy needs of developing countries. There are currently 20 SMR designs under development with some eventually to be made commercially available. Interestingly, the construction process already offers some insight with respect to its economic viability. A single SMR unit generally has a lower generating capacity, typically 300 MW or less.

A study[7] on an SMR power plant in Utah shows that the technology can be cost competitive contingent on the implementation of CCS systems. Given the most recent efficiency improvements in SMR, its LCOE currently stands at US$70.5/MWh. This means that, based on the LCOE data in Table 3 (page 12), SMRs have a lower cost than coal CCS ($70.5 vs $98.6 to $104.3 per MWh), and comparable

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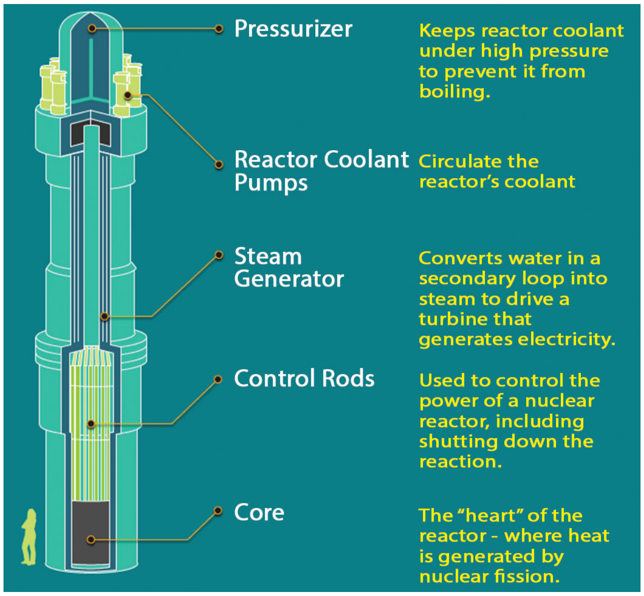
7 Data is only available on NuScale, a US company that will likely be the first to commercially deploy in Utah by 2026.

to advanced combined-cycle natural gas plants CCS ($70.5 vs $67.5 per MWh).



Components of a Small Modular Reactor • Source: U.S. Energy information Association.

In comparison to other traditional electricity generation, SMR is modular in both manufacturing and deployment. The relatively small generating capacity, scalability, and high capacity factor means that it could be ideal for deployment in high-growth regions in the Philippines. SMR modules can be progressively integrated into an existing SMR facility as regional electricity demand grows. Advances in this emerging nuclear technology merit further study and consideration.

III. TRANSMISSION AND DISTRIBUTION

NGCP

The National Grid Corporation of the Philippines (NGCP) is responsible for the management and operation of the national transmission system. Its mandate is to link power plants to distribution utilities (DUs). One key challenge facing the transmission sector is that the DOE projects that Philippine system peak demand will reach 49.8 GW by 2040, which is more than double the installed capacity in 2018. As of 2018, NGCP had a total transmission line length of 20,849 circuit-kilometers (ckm), and a total substation capacity of 34,177 megavolt-amperes (MVA). To meet the country's projected peak demand in 2040, NGCP estimates it will need to build an additional 14,464 ckm of transmission lines and 53,859 MVA in substation capacity.

NGCP will need to expand transmission assets to meet the country's projected transmission line and substation capacity requirements. From 2011 to 2018, transmission line length was extended by only 1,145 km, a yearly growth rate of below 1%. In order to meet projected demand, transmission line length would need to grow 2.54% annually from 2019. The NGCP managed to grow substation assets 4% annually from 2011 to 2018, but this also requires more effort as substation capacity would need to expand by 4.6% over the next 21 years.

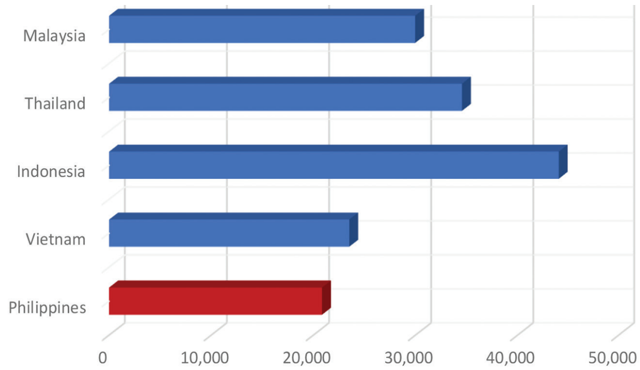
The importance of these metrics is that they provide a general idea of the state of a country's ability to deliver power to where it is needed. One of NGCP's functions as the national grid operator is to link gencos with DUs. The grid operator lays down high voltage lines to traverse a geographic expanse and builds substations to reduce voltages or send power down multiple directions in an effort to serve the needs of power producers and distributors.

As population centers grow, so too do their energy requirements. In 2009, the ERC had approved 1,567 ckm worth of transmission line projects for implementation by 2015. Nearly a third (480 ckm) of this, however, are upgrades on existing lines. Moreover, a significant portion of those planned projects were undertaken in order to comply with the Grid Code which requires redundancies. With upgrades in mind, a low historical growth rate in transmission circuit kilometers is hardly surprising. Moving forward, given the projected growth in peak demand, the NGCP will have to increase its efforts.

Transmission Grid in ASEAN-5

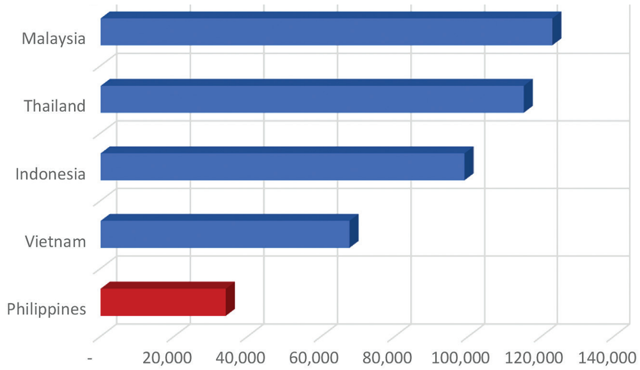
Compared to other ASEAN-5 nations, the Philippines has a smaller length of transmission capacity (see Figure 10). These figures are more likely reflective of historically low electricity consumption in the Philippines relative to other nations. As prospects of strong economic growth propels the economy forward, Figure 11 shows how much more the transmission sector needs to contribute.

Figure 10. Transmission length, ASEAN-5, 2018, ckm



Source: NGCP, Vietnam Electricity, Electricity Generating Authority of Thailand, PWC, Malaysia Energy Information Hub

Figure 11. Substation capacity, ASEAN-5, 2018, MVA

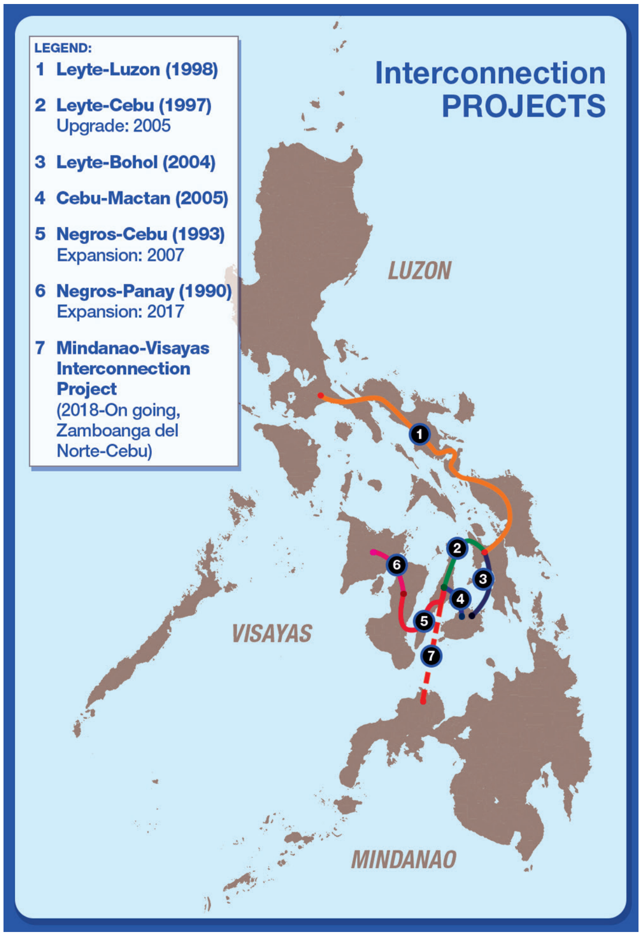


Source: NGCP, Vietnam Electricity, Electricity Generating Authority of Thailand, PWC, Malaysia Energy Information Hub

An adequate transmission network is more than just circuit km and substation capacity. Indonesia is very similar to the Philippines in that its insular and mountainous geography presents infrastructure challenges. As a nation with 17,508 islands (vs. 7,641 in the Philippines), ASEAN's biggest nation finds it difficult to achieve national electrification while maintaining supply reliability. Indonesia has a transmission network twice as long as the Philippines, while substation capacity is three times as much. Jakarta, Indonesia's capital, nevertheless experiences frequent blackouts, unpredictable power outages, and unstable connections. Installed capacity depends on a reliable transmission network to deliver power to end-users. In this regard, there must be oversight to ensure that, as the Philippine transmission network expands, sufficient emphasis is placed on resilience and redundancy.

Island Interconnection

Island interconnections also deserve greater attention. It has been more than 13 years since the last new interconnection was completed between Panay and Boracay in 2006. The intervening years saw only upgrades of existing interconnections. These interconnections serve an important socioeconomic function. The Panay-Boracay Interconnection Project (PBIP), for example, allows Boracay to import electricity from Panay. When PBIP was completed in February 2006, it was vital for the burgeoning tourism industry on the island. Tourism receipts were at Php 10 billion in 2006; by 2017, receipts topped PhP 56 billion. The tourism industry on the island resulted in a move from 4th to 1st grade income levels. Having such interconnections provides island LGUs a key resource supportive of industry and commerce.



Source:NGCP

Interconnection of more Philippine islands will continue to be a challenge. Currently, one of the most important is the Batangas-Mindoro Interconnection Project. NGCP is aiming to install the undersea connection by 2021. Also, NGCP is seeking ERC approval on a PhP 6.4 billion Palawan-Mindoro Interconnection Project. These two interconnection projects will help meet relatively high electricity demand and projected robust growth over the next 20 years of the two island provinces.

The Mindanao-Visayas Interconnection Project (MVIP) is another important undertaking for the NGCP. Stage 1 of MVIP will have a transmission capacity of 450 MW and enable power sharing between both regions. This project is slated to be completed by December 2020. One of its benefits will be the curtailment of regional power imbalances that is, excess generating capacity in one region can be redirected should the other region experience shortages.

In 2018, Mindanao was described as having the enviable problem of power oversupply. The Visayas region, on the other hand, is experiencing power shortages. The MVIP project is being completed so that excess reserves can be shared to help the Visayas.

According to NGCP's Transmission Development Plan, the following are some tangible benefits of island interconnection:

a) Island interconnections can provide additional power supply similar to a generator having the ability to import power when required;
b) The most efficient generator across both power systems is brought on to meet demand resulting in a more efficient dispatch;
c) Interconnections reduce power curtailment as they provide a means of exporting power when there is surplus from other island; and
d) Renewable and indigenous energy potential sites suitable for energy generation may also be taken into consideration. These are sources of energy that may become attractive for development by generation proponents as a result of a wider market due to interconnection.

These interconnections, however, can only go so far in helping capacity planning. If all three regions were to experience shortages, there would be no electricity to import. In fact, the benefits are contingent on having surplus power in at least one region. ***Falling short on investments to maintain adequate reserves diminishes the benefits of grid interconnectedness.***

Congestion

The capacity of a transmission system is limited. Transmission lines and substations have rated capacities that specify how much electricity can be safely conducted. Transmission congestion is defined as "a condition that arises when one or more restrictions prevent the economic dispatch of electric energy from serving loads." The transmission grid operator needs to manage power generated in the system so that the lowest cost electricity is delivered for distribution within the limitations of its systems. Take, for example, two power plants each producing 100 MW and a DU that requires only 150 MW. The grid operator would maintain transmission lines and substations that can handle the 150 MW required. On top of this, the operator would need to source 100 MW from the least cost generator and no more than 50 MW from the other.

The example given above, however, is extreme. In reality the grid operator needs to manage the dispatch of over 100 power plants over a wide geographic expanse to many DUs. ***One concern in the transmission grid is that forthcoming large capacity coal and natural gas power plants are concentrated in Batangas, Quezon, Bataan, and Zambales.*** If transmission assets are unable to accommodate the generation capacity of these large capacity power producers, limited available generating capacity will result. What impact could these power plants have on network congestion and electricity prices?

Congestion can be minimized but increasing electricity consumption will inevitably push against the physical limits of transmission systems. Metro Manila represents the load center of Luzon, comprising 53% of the total demand for electricity. NGCP's backbone will need to be capable of conducting bulk power generation as Metro Manila continues to develop. Currently, there only two Extra High-Voltage (EHV) drawdown facilities that cater to Metro Manila demand: the San Jose del Monte, Bulacan and Dasmarinas, Cavite substations. The San Jose del Monte EHV substation, in particular, is congested with bulk electricity generation from coal-fired power plants in Masinloc (Zambales) and Sual (Pangasinan), as well as plants in Quezon.

NGCP Transmission Towers. Source: NGCP

The NGCP forecasts that Metro Manila's growing electricity demand necessitates a new EHV substation. The ERC approved in 2019 the construction of a new Taguig EHV. However, progress of the project is slow-going. NGCP first proposed and sought approval for the substation in 2012 and 2014, respectively. At the time, it was pointed out then that the Quezon - Doña Imelda Paco - Muntinlupa transmission corridor was already heavily loaded and the two EHV stations (Bulacan and Cavite) were at risk of overloading. In addition to the time taken to approve the project, the preparation of bid documents, the actual bidding, and the project construction is expected to take as long as 60 months, until 2024.

As the Philippines continues to grow, transmission development will need to be more dynamic. The time between planning and implementation needs to be cut down drastically in order to keep pace with economic demands. As illustrated by the Taguig EHV substation, 12 years (from 2012) is a long

Box 3. Electric Vehicles

Electric charging station built in 2017 by Mitsubishi Motors Philippines and Meralco located inside the Department of Environment and Natural Resources Central Office.

Rising concerns for the dangerous health and environmental effects due to increased carbon emissions caused by transportation to health and the environment has resulted in a surge in global demand for Electric Vehicles (EVs), with worldwide sales growing from just 100 units in 2007 to over 2 million in 2018.* European countries are at the forefront of the shift to EVs, with countries such as Norway and Amsterdam aiming to achieve 100% EV adoption by 2025.

In Southeast Asia, it is estimated that EVs will make up 20% of all vehicles on the road by 2025.** Thailand is one of the first among the ASEAN economy to promote EV use in the Thailand Alternative Energy Development Plan 2012-2021. In a regional survey of ASEAN-6 by Frost & Sullivan, the Philippines exhibited the highest level of consumer interest to purchase an EV.***

The current infrastructure for all-electric EVs is in its nascent stage in the country. Hybrid EVs – which use both fuel and battery – are slowly appearing in the Philippine market. They are taxed at 50% of a comparable gasoline powered model, while purely electric vehicles are tax exempt.

A stronger policy push to improve infrastructure for EVs is essential to encourage the shift to EV use. One priority is to pass S.B. 174 or the Electric Vehicles and Charging Stations Act, which intends to develop nationwide electric charging stations and provide dedicated parking spaces for EVs. It was filed in the 18th Congress by Senator Sherwin Gatchalian.

Aside from benefits to health and the environment, EVs are also more fuel-efficient than the internal combustion engine. EVs use the power grid, potentially decreasing the country's reliance on petroleum for fuel, while increasing demand for electricity generation.

Photo from Mitsubishi
**Frost & Sullivan, Global Electric Outlook 2019*
***International Renewable Energy Association (2016), Renewable Energy Outlook for ASEAN*
****Frost & Sullivan and Nissan (2018), The Future of Electric Vehicles in Southeast Asia*

time to cater to one of the most important electricity demand centers in the Philippines. Faster transmission development will also be critical in other parts of the country. By the DOE's own estimates, the Northern Luzon, Visayas, and Mindanao regions are projected to at least quadruple peak demand by 2040.

Variable Renewable Energy Integration

The Philippine transmission grid will need reinforcement to address the growing role of variable RE (VRE) sources such as solar and wind. As the grid operator, NGCP will need to adapt to the variability and uncertainty these sources introduce to the grid. Variability refers to "output changes over the key time and geographic scales for power system operation." This means that even if the grid operator knows that the wind is blowing and the sun is shining, the amount of power these sources supply oscillates. The wind can stop or weaken or a passing cloud limits generation. Uncertainty relates to the fact that generation from these sources cannot be forecast with absolute certainty.

In contrast to VRE, traditional generation such as fossil fuel-sourced generation or RE sources such as geothermal, dam-type hydro, and biomass offer significantly more predictability and less variability. While traditional turbine-based generation offers these advantages, they are also less flexible. If VRE generation, for example, suddenly drops, the non-variable generation assets cannot cover the gap at a moment's notice. Conversely, if VRE generation produces too much, non-variable generation assets cannot simply be made to drop output levels quickly, compelling the grid operator to curtail excesses. Both reserves and curtailment, however are mismatches in generation and dispatch that are essentially economic costs to the power ecosystem. ***Introducing variable generation into the energy mix of a power network could mean having to increase reserve margins to account for potential shortages and curtailing generation when there is a surplus.***

There are two key issues associated with VRE generation as RE gains prominence in the Philippine portfolio of generation assets. First, VRE site selection will increasingly depend on transmission thermal, voltage, and stability limit considerations. As more VRE assets are added to installed capacity, curtailed electricity becomes a larger issue. The transmission grid operator will find greater amounts of surplus that gets stuck in the grid, leading to heat production, which can pose a (thermal) risk to transmission assets. One solution is spreading installed VRE capacity across the grid. Project proponents may need to be guided towards sites that can already accommodate the capacity or require less transmission infrastructure investment. ***Given the scalability of VRE generation, this can be an opportunity for policy makers to encourage power producers to site in key areas with low energy security. This distribution of power generation addresses not only the VRE question but also the challenging configuration of the existing grid.***

The second issue related to VRE generation is that developing Energy Storage Solutions (ESS) in the Philippine grid will become increasingly important. Utility scale ESS can improve both the utilization and flexibility of the electricity system. Such solutions, for example, have superior ramping characteristics that can quickly cover generation shortages or store electricity that would otherwise be curtailed.

ESS have many applications and can be deployed in multiple points - from generation to grid and even for individual consumers. For VRE generation, ESS can be deployed to firm or smooth generation by siphoning off curtailments and redeploying during shortages. It will be increasingly important in frequency regulation, whole-sale energy arbitrage, providing local capacity and deferring investments in transmission and distribution. ESS deployment is integral to modern power grids as global installations are projected to more than septuple by 2025 (from 8.5 GW in 2018 to 64 GW in 2025). Prices of Li-ion energy storage stabilized in 2018 after falling 70% over five years. This is an opportune time to map out grid deployments and the regulatory framework.

IV. PRICES AND WESM

Price Comparison

Philippine electricity prices remain among the highest in Asia. Meralco, the DU responsible for Metro Manila, charged endpoint customers an average of US¢14.07 per kWh in 2018. The rates exclude VAT but include all other nonrecoverable taxes and charges. Electricity rates for Metro Manila, the largest single-DU market in the Philippines, went down between 2012 and 2018. What can be observed from Table 8 is that the average electricity tariff for Metro Manila is competitive among unsubsidized markets, with the exception of the US.

Table 8. Average retail electricity tariff for all customers, selected countries, US cents/kWh

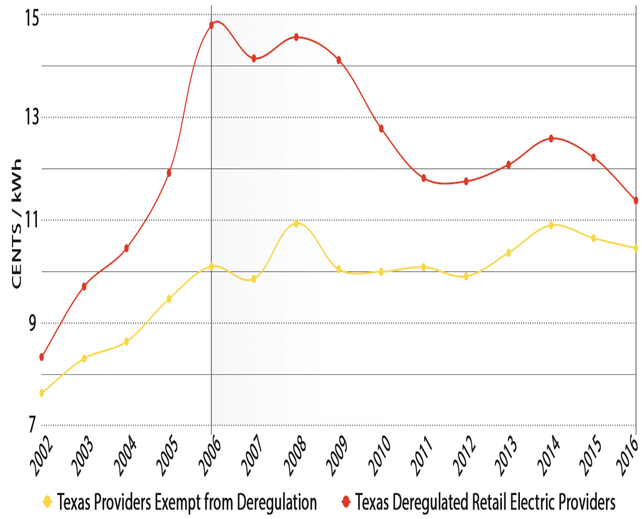
Country/ Economy	2012	2016	2018
Australia (WA)	19.93	16.14	21.38
Japan (Kansai)	24.48	23.32	18.52
Hong Kong	12.88	15.10	15.05
PH-Meralco	**20.26**	**14.65**	**14.07**
S. Korea *	8.91	9.47	10.47
Singapore	20.06	10.89	10.25
Thailand *	10.45	9.93	10.17
US (average)	9.67	9.31	10.09
Malaysia *	8.83	8.83	9.43
Taiwan *	8.71	8.73	8.86
Indonesia *	8.51	7.03	8.06

Source: International Energy Consultants (IEC), "Regional/Global Comparison of Retail Electricity Tariffs", May 2016 and August 2018.
** are subsidized markets*

One aspect of electricity prices in the Philippines is there are no subsidies to pull prices down. The other is that deregulation tends to push prices up. It must be noted that much of the US electricity market remains regulated while the Philippines deregulated when EPIRA was passed into law in 2001. The US state of Texas was deregulated at roughly the same time as the Philippines (2002 for Texas). Texas is used as an example because its deregulated electricity tariffs can be easily compared to regulated states, and it comes closest to being fully deregulated at 86%.

The Philippines experienced a very similar price pattern to Texas (see Figure 12). In 1990, the Philippine electricity tariff was PhP 1.83 per kWh and grew at a compound rate of 9.65% to PhP 7.29 per kWh in 2005. This high compound growth may be attributed to generation costs exceeding electricity prices (as much as PhP 1 loss per kWh consumed in 2003). Deregulation pulled up prices but only because electricity was being sold below cost. But greater competition is working to drive down prices. In 2005, the Philippine Senate Economic Planning Office reported a residential rate of US¢14.43 per kWh and IEC reports an average rate of US¢14.07 per kWh in 2018. From a single debt-ridden entity prior to EPIRA, the deregulation of the market has resulted in the emergence of 108 gencos in the Luzon-Visayas Grid.

Figure 12. Electricity Rates-Texas



Source: Texas Coalition for Affordable Power

Regulated and Subsidized

The DOE data shows that within ASEAN (Brunei and Laos excluded), the Philippines has the highest residential rate (see Table 9). With relatively competitive industrial rates, the average electricity price is lower than Cambodia as of mid-2018, while higher than the other six economies.

Table 9. Electricity prices in ASEAN, July 2018, P/kWh

Country	Resid'l	Comm'l	Ind'l	Average
Cambodia	9.79	9.36	9.36	9.50
Philippines	**10.82**	**9.20**	**6.38**	**8.80**
Singapore	8.64	7.63	7.19	7.82
Myanmar	6.74	6.65	5.76	6.39
Thailand	7.09	5.03	5.03	5.70
Vietnam	5.97	3.27	5.14	4.79
Indonesia	5.38	3.80	3.80	4.32
Malaysia	1.82	1.73	1.73	1.76

Source: DOE Director Mario Marasigan, Energy Outlook forum by Stratbase-ADRi, September 27, 2018, Joy-Nostalg Hotel, Ortigas

For deregulated markets, prices tend to be higher than regulated markets. The gap in prices can be due to differences in subsidies and incentives granted (or withheld) and, most importantly, the profit maximizing behavior of a deregulated utility. But as can be seen in Vietnam's electricity market, profit maximizing behavior can be beneficial to the market.

Among the ASEAN-6, Vietnam offers electricity rates significantly lower than the Philippines (45% less) while offering subsidies only for low income families. As a state-owned enterprise, Electricity Vietnam (EVN) generates 55% of the power in Vietnam and owns all transmission and distribution assets. As such, EVN is also responsible for the purchase of all electricity generation. The current policy of Vietnam's Ministry of Finance effectively curtails any return on equity (and more so return on assets) for EVN. This artificially lowers prices to the point that the power industry, as a whole, finds it difficult to eke out meaningful returns.

The effect is that investors are reluctant to finance new ventures in the power industry. Vietnam's Ministry of Industry and Trade stated "current electricity prices in Vietnam are barely enough for the developers to make a profit." What exacerbates the situation is that the Vietnamese government is up against a budget ceiling but requires US$ 6.7 billion in power generation investments annually (from 2016) to 2030 to prevent a looming shortage. In the Philippines, enforcing caps on returns and unduly restricting profit maximizing behavior can hamper the inflow of investments needed to keep pace with the growth in power demand.

According to International Energy Consultants (IEC), Thailand, Indonesia, and Malaysia (among the ASEAN-6) also have artificially low electricity prices owing to subsidies. IEC further reports that, including South Korea and Taiwan, about 41% of tariffs in these countries are subsidized to about US$ 800 billion. These fuel subsidies, cash grants, and deferred expenditures cost governments resources that can be deployed in other key areas.

Market Efficiency

When the Philippine market was deregulated, the policy goal was to introduce competition in the power sector to create downward pressure on prices. The ideal market is one with a sufficient number of participants to create a truly competitive environment while profit seeking behavior ensures sufficient returns. This market efficiency is illustrated in the Norwegian energy sector. There are 1,600 hydropower plants in Norway competitively vying for customers which has driven prices down to US¢4 per kWh. ***Encouraging more investments and participants in generation can go a long way in lowering the price of electricity. This is the most sustainable path for both consumers and the power industry.***

V. REGULATORY AND OTHER ISSUES

Competitive Selection Process

Energy security will require that steps be taken so that DUs can aptly handle diversification. A key driver for diversification is a liberalized Competitive Selection Process (CSP). In 2015, the DOE set forth policy guidelines that require DUs to undergo a CSP in implementing their Power Supply Agreements (PSA). In its circular, the DOE states that among the objectives of the CSP are to:

b. Promote and instill competition in the procurement and supply of electric power to all electricity end-users; and

c. Ascertain least-cost outcomes that are *unlikely to be challenged in the future as the political and institutional scenarios should change*

A controversial issue is that long term PSAs can lock consumers with unduly high prices. The market may benefit from a regulatory measure that enables gencos to challenge PSAs that drive up rates for end users. Long term PSAs reduce risk for gencos and lower financing costs, which are ideally passed on to consumers as lower electricity prices. But the current rate setting methodology essentially replicates generation costs and passes them to customers.

One possible solution is to limit the duration of PSAs. This, however, could drive up financing costs and result in higher electricity prices. ***To address this issue, a challenge mechanism may be added to ensure that the rates charged in long term PSAs are the best that gencos can offer.*** The challenges would have to follow certain rules such as: (1) only the highest rate at any given time may be challenged, (2) that the benefit derived from lower rates must meet a certain threshold, and (3) the challenger must be able to meet the technical load requirements. Applying such a measure may help pave the way to greater competition and lower electricity prices.

Retail Competition

Retail Competition and Open Access (RCOA) is a scheme promulgated by the DOE in 2013 to ultimately create the Competitive Retail Electricity Market (CREM). Customers consuming a threshold amount each month on average can be considered contestable. This affords contestable customers a choice to negotiate and, subsequently, source electricity from registered Retail Electricity Suppliers (RES). The RCOA rules, however, stipulated mandatory contestability based on a diminishing threshold consumption:

Threshold Consumption	Mandatory Contestability
1 MW and above	February 26, 2017
750 kW and above	June 26, 2017
500 kW and above	June 26, 2018

Some industry players sought a Supreme Court Temporary Restraining Order (TRO) which was issued in February 2017. The TRO hinges on two issues: (1) the mandatory migration of customers and (2) the eligibility of DUs to participate as suppliers. The mandatory migration of contestable customers meant that should the customer fail to negotiate with a RES, it would be forced to source costlier electricity from a supplier of last resort.

Prior to the TRO, 1,551 customers were contestable. Many customers that entered the CREM benefited from lower electricity tariffs. One study found that increased competition in this market segment could generate savings of up to 26%. The TRO prevents the ERC from renewing licenses to RES and approving agreements to supply contestable customers. As can be seen in Table 10, this has led to an unfortunate decline in participants in CREM.

Table 10. RCOA and RES by numbers, Philippines

Contestable Customers type	December 2016	April 2018	June 2018
(a) 1MW and above (b) 750-999 kW Total	1,157 394 1,551	910 133 1,043	932 172 1,104
Number of Retail Electricity Suppliers (RES)	54 (30 local, 24 national)	42 (13 local, 29 national)	43 (13 local, 30 national)
Share in electricity demand: (a) RES (b) DUs and bulk users	36% 64%	23% 77%	22% 78%

Source: WESM, IEMOP

The implementation of EPIRA remains incomplete unless RCOA is fully implemented. Issues that led to the TRO should be quickly resolved and may be done so expeditiously by reformulating policies.

VI. RECOMMENDATIONS

The most expensive electricity is no electricity. Better to have excess than deficit. The repeated yellow and red alerts in 2018 and 2019 in the Luzon and Visayas regions signal supply side issues. Capacity planning must be robust, taking a probabilistic approach that accounts for Forced Outage Rates (FOR) and the effects of increasingly adverse summer conditions. Monitoring the Loss of Load Probability (LOLP) and the use of nomenclature such as Summer Capacity, as is often done in more developed countries such as the US, will be key strategic measures to ensure that Ancillary Services and proper reserve margins are maintained.

Transmission development will require a level of dynamism that can match the expected momentum of expansion in generation capacity. The Philippines seeks to more than double installed capacity by 2040 and the transmission grid needs enough capacity to minimize congestion. The rising role of Variable Renewable Energy (VRE) will also require grid reinforcements to mitigate the effects of electricity curtailment. Utility scale Energy Storage Systems also need to be integrated into the grid as it will serve a vital role in frequency regulation, generation smoothing through arbitrage, and potentially reduce or defer investments in transmission and distribution.

Finally, many players in the power industry lament the slow rate of development in the industry. Some have pointed out that other markets that deregulated later than the Philippines are quicker to adopt measures that increase competition. The Retail Competition and Open Access (RCOA) for one, has been delayed for a number of years, while Singapore has already implemented open access to household consumers. The main thrust behind the following recommendations is to encourage new generation proponents and promote competition.

1. Conduct economic studies to determine the sectoral components of total power demand that can most benefit from targeted policies in order to intensify electricity consumption. Capitalize on the positive relationship between growing electricity consumption with economic development.
2. Initiate a well-studied capacity and reserve planning program to account for the loss of load probability brought about by an ageing fleet.
3. Reduce the country's Forced Outage Rates through effective and responsive outage management. This would ensure acceptable levels of available capacity and reduce yellow and red alerts.
4. Promote the Exploration and Production (E&P) of indigenous sources of energy by eliminating regulatory risk. There is a need for legislation to provide time-bound incentives that address the risk-return considerations of E&P companies.
5. Government should consider the implications of placing restrictive terms on Third Party Access for LNG terminals. The legal aspects should be studied within the context of a competitive market as espoused by EPIRA and the principles of a Congressional franchise granted to a public service.
6. Minimize bureaucratic red tape at the national and local government levels for independent power producers in general and Renewable Energy applicants in particular. Implement EVOSS and ARTA.

7. The DOE, LGUs, and NCIP should work together to handhold investors interested in developing geothermal and hydro projects. The collaborative effort may help in the development of Renewable Energy generation in areas with the greatest need for energy security and achieve goals set forth by the National Renewable Energy Plan.
8. Work with power industry leaders to draft a regulatory framework that recognizes the many roles Energy Storage Systems can take in grid deployment.
9. Utilize the Energy Investment Coordinating Council (EICC) created under Executive Order 30 as a forum to regularly engage private sector experts to advise different agencies of government. This ensures all relevant stakeholders can share their expertise towards energy development.
10. A regulatory framework for nuclear power generation is needed to consider its use. A solid framework serves as a decision point on whether or not to utilize nuclear technology.
11. The ERC should work with the private sector to draft a bankable, reasonable, logical PPA template. A template will greatly contribute to an efficient approval process.
12. The implementing agencies of RCOA should reformulate policies and rules in order to resolve issues that brought about the temporary restraining order. RCOA will be instrumental in promoting market efficiency through competition.
13. Introduce a challenge mechanism in Power Supply Agreements to prevent the possibility of long term agreements that burden consumers with unduly high rates.
14. Stimulate the adoption of e-vehicles (cars and motorcycles) in the Philippines as a more environment-friendly and energy efficient alternative to conventional gas vehicles through the passage of S.B. 174 or the Electric Vehicles and Charging Stations Act as well as suitable supportive projects and incentives.

VII. CONCLUSION

A regular and more affordable supply of electric power has long been the goal of Philippine policy makers. Power consumption should grow significantly if the country is to realize its *Ambisyon Natin 2040* aspirations. While water is essential to life, power is vital to modern socioeconomic prosperity. The recommendations above can be implemented over the next few years and put the country's power sector on a much firmer foundation

Market deregulation in 2001 bared inefficiencies in the power industry that regular consumers never truly felt with NAPOCOR effectively subsidizing through debt. Increasing competition in generation is working to lower electricity rates but rates need to go down further. While the lack of general subsidies mostly explain the reason the Philippines has expensive electricity compared to other ASEAN-6 countries, high tariffs nevertheless disincentivizes investment. More players are needed in the industry to drive down rates, and this must be done expeditiously to remain competitive with our ASEAN neighbors.

Source: www.powerphilippines.com

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Vietnam
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List of abbreviations and acronyms:

CCS	carbon capture and sequestration
CSP	competitive selection process
E&P	Exploration & Production
EC	Electricity Consumption
EPIRA	Electric Power Industry Reform Act
ESS	Energy Storage Systems
EVH	Extra High Voltage
FOR	Forced Outage Rates
GDP	Gross Domestic Product
Genco	generation companies, entities authorized by the ERC to operate facilities used in the generation of electricity
IPP	Independent Power Producer
IPPA	Independent Power Producers Association
LNG	Liquefied Natural Gas
NREP	National Renewable Energy Plan
PPA	Power Purchase Agreement
PV	Photovoltaic or the conversion of light into electricity using semiconducting materials
RE	Renewable Energy,
WESM	Wholesale Electricity Spot Market

Units of measurement:

Watts	the International System of Units measure of power
kW	kilowatts = 1,000 watts
kWh	kilowatt-hour: one hour of using electricity at a rate of 1 kW
MW	megawatts = 1 million watts
MWh	megawatt-hour: one hour of using electricity at a rate of 1 MW
GW	gigawatts = 1,000 MW = 1 billion watts
GWh	gigawatt-hour: one hour of using electricity at a rate of 1 GW
TW	terrawatts = 1,000 GW = 1 trillion watts
TWh	Terrawatt-hour: one hour of using electricity at a rate of 1 TW
mtoe	mega tonnes of oil equivalent, or the amount of energy releaed when burning one mega tonne of crude oil
mtpa	million tonnes per annum, measurement unit for LNG
lcoe	levelized cost of electricity, measure of a power source that allows comparison between different methods of electricity generation
ckm	circuit kilometer, used to measure the network
MVA	mega-volt ampere, used to measure apparent power in an electric circuit
TCF	trillion cubic feet, a volume measurement used by the oil and gas industry

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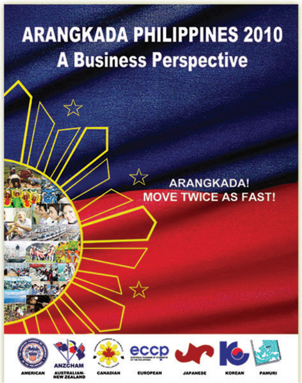

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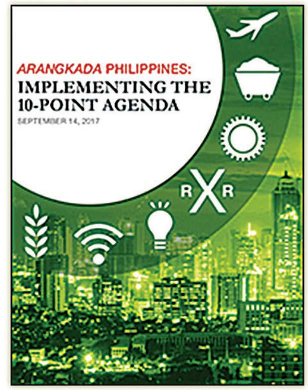

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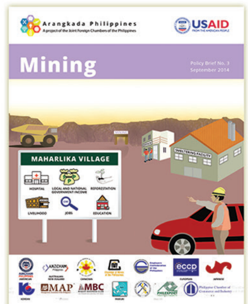

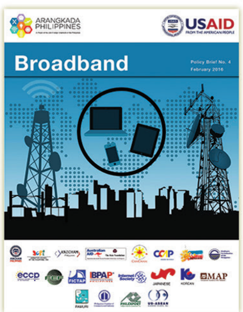

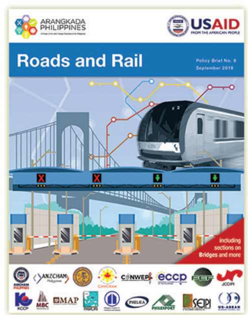

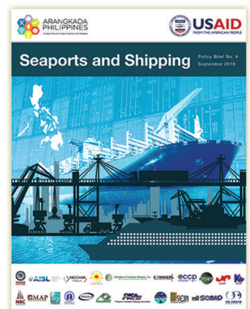

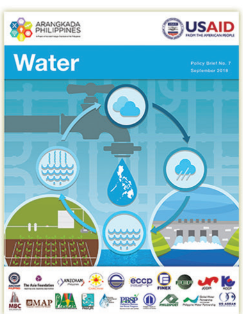

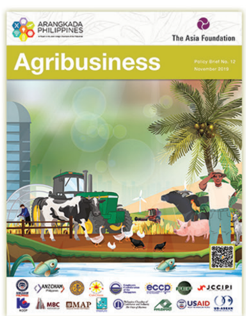

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