Fast Facts on Energy
Philippine Power Outlook

Office of Senator Win Gatchalian

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Power Demand

The energy sector is a unique market as far as the equilibrium is concerned due to the nature of the good. Specifically, there is no temporal arbitrage possible in the electric market as power cannot be stored efficiently under the current technological regime. Thus, market needs to clear in real time. Under this situation, one of the important measures in evaluating the market is the peak demand of the system. The following table shows the peak demand of the various grids in the Philippines.

Table 1: Peak Demand on the different island grids (2016).

Island Group	Demand (MW)	Percentage
Luzon	9,726	73.70 %
Visayas	1,878	14.23 %
Mindanao	1,593	12.07 %
Total	**13,197**	**100.00 %**

Source: NGCP (2016)

As the economy of the Philippines continue to grow, the demand for power is also expected to go up as energy intensive sectors of the production augment the growth in consumption of energy intensive goods and services. The following figures shows the power demand projections of the Department of Energy Philippine Energy Plan at various modalities.

Figure 1. The Luzon Peak Demand Forecast of the Philippine Energy Plan at various modalities.

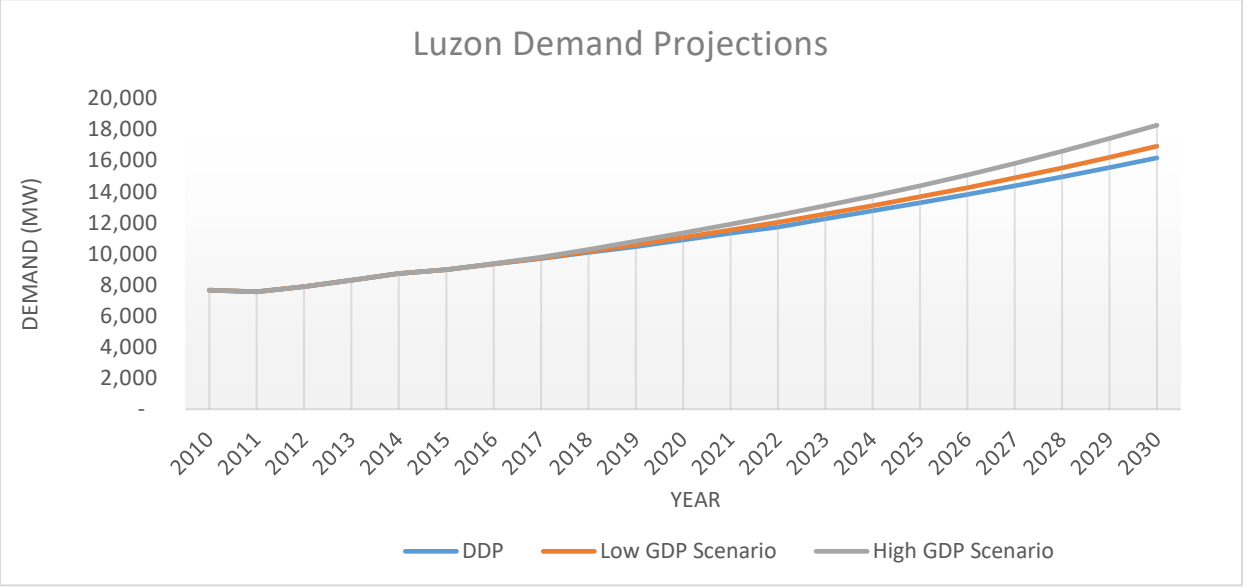


Figure 2. The Visayas Peak Demand Forecast of the Philippine Energy Plan at various modalities.

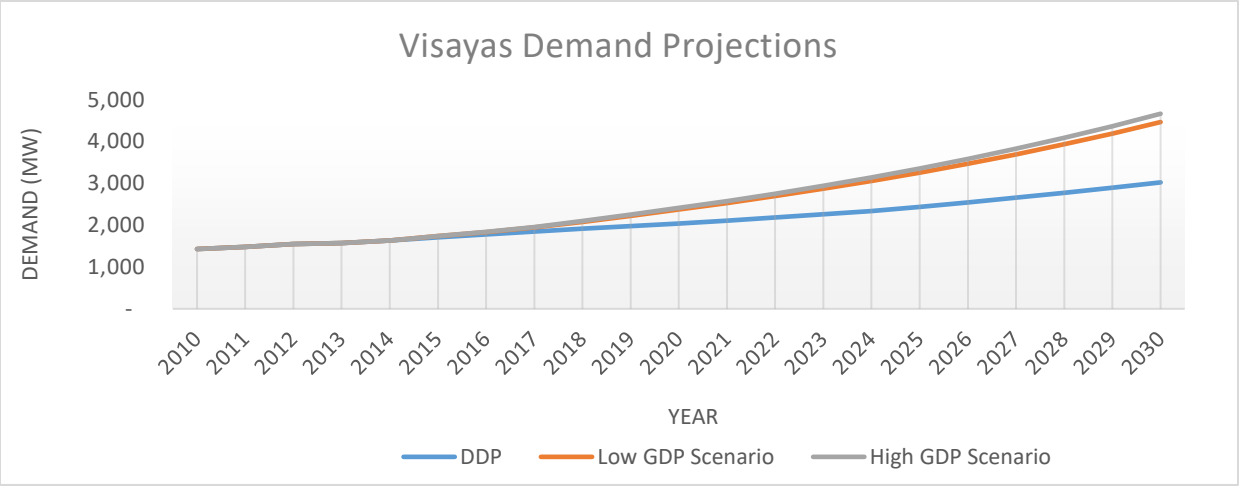


Figure 3. The Mindanao Peak Demand Forecast of the Philippine Energy Plan at various modalities.

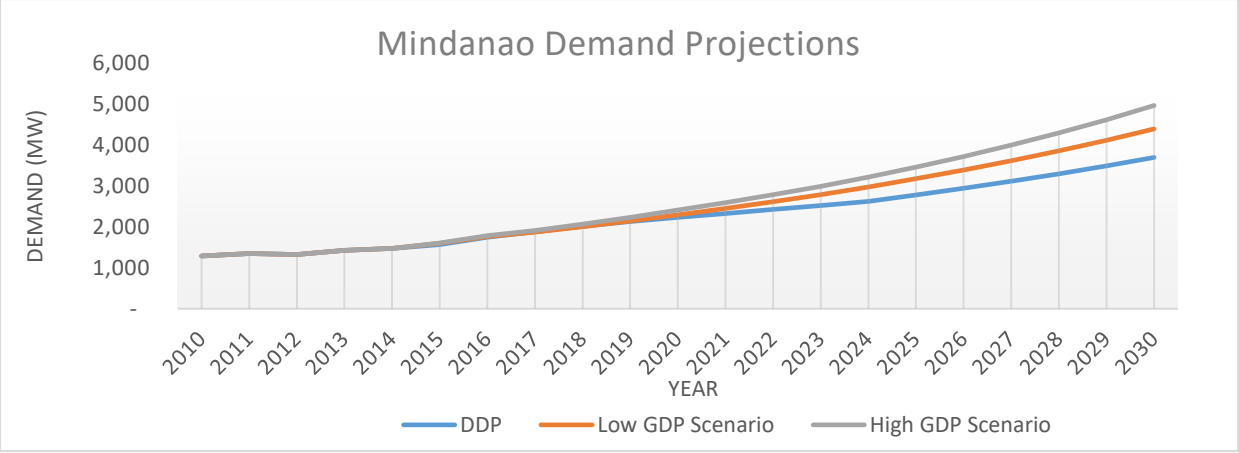


Figure 4. The Philippine Peak Demand Forecast of the Philippine Energy Plan at various modalities.

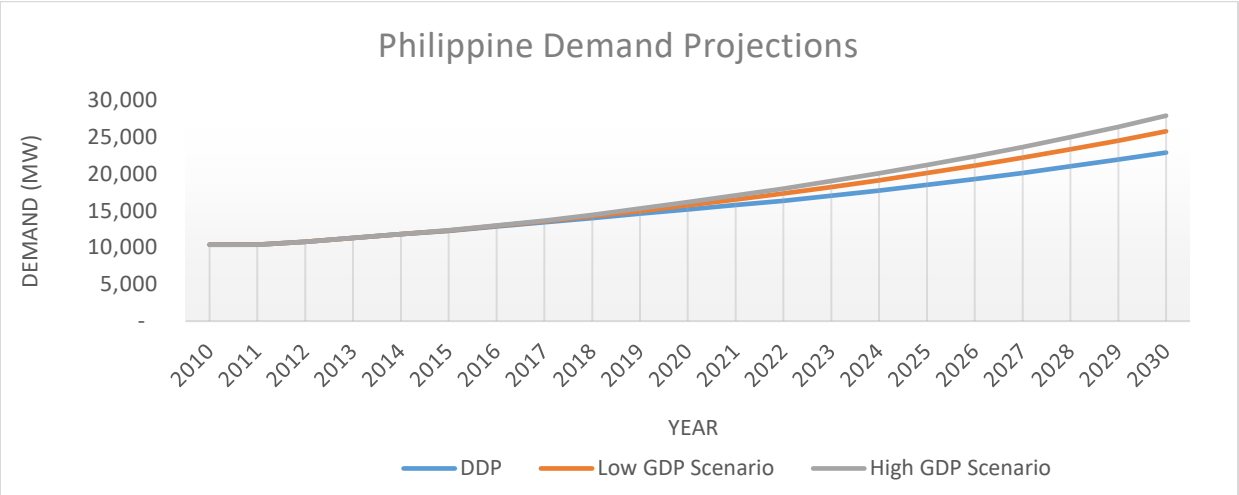


Table 2. Growth Rate of Philippine Peak Demand Forecast at Selected Years

Philippine Demand	2016	2018	2020	2022	2024	2026	2028	2030	AAGR*
DDP Growth Rate	5.02%	4.27%	4.00%	3.64%	4.02%	4.35%	4.36%	4.37%	4.04%
Low GDP Growth Rate	5.05%	5.11%	5.17%	4.99%	5.03%	5.07%	5.12%	5.15%	4.66%
High GDP Growth Rate	5.46%	5.78%	5.85%	5.53%	5.46%	5.62%	5.66%	5.70%	5.08%

Source: PEP 2016

*2010-2030

Power Supply

Now that we have shown the demand side of the equation, it is now time to focus on the supply side. The installed capacity refers to the nameplate capacity of each plant on the system. However, not all of this power is available at the system at any given time due to various constraints like the availability of inputs and the need for maintenance. The dependable capacity takes those factors into account.

Table 3. Capacity Measures of the Luzon Grid (2016)

	Luzon			
	Capacity (MW)		Percent Share (%)	
Technology	Installed	Dependable	Installed	Dependable
Coal	5,294	4,970	35.30 %	36.50 %
Oil Based	2,133	1,655	14.20 %	12.20 %
Diesel	*763*	*645*	*5.10 %*	*4.70 %*
Oil Thermal	*650*	*470*	*4.30 %*	*3.50 %*
Gas Turbine	*720*	*540*	*4.80 %*	*4.00 %*
Natural Gas	3,430	3,291	22.90 %	24.20 %
Renewable Energy	4,120	3,684	27.50 %	27.10 %
Geothermal	*843*	*777*	*5.60 %*	*5.70 %*
Hydro	*2,537*	*2,323*	*16.90 %*	*17.10 %*
Wind	*337*	*293*	*2.20 %*	*2.20 %*
Biomass	*95*	*71*	*0.60 %*	*0.50 %*
Solar	*307*	*220*	*2.10 %*	*1.60 %*
Total	**14,977**	**13,600**	**100.00 %**	**100.00 %**

Source: DOE (2016)

Table 4: Capacity Measures of the Visayas Grid (2016)

Technology	Visayas			
	Capacity (MW)		Percent Share (%)	
	Installed	Dependable	Installed	Dependable
Coal	1,054	1,050	32.10 %	37.30 %
Oil Based	655	434	19.90 %	15.40 %
Diesel	*600*	*434*	*18.30 %*	*15.40 %*
Oil Thermal	-	-	-	-
Gas Turbine	*55*	-	*1.70 %*	-
Natural Gas	1	-	-	-
Renewable Energy	1,574	1,329	47.90 %	47.20 %
Geothermal	*965*	*813*	*29.40 %*	*28.90 %*
Hydro	*20*	*18*	*0.60 %*	*0.60 %*
Wind	*90*	*90*	*2.70 %*	*3.20 %*
Biomass	*101*	*77*	*3.10 %*	*2.70 %*
Solar	*399*	*331*	*12.10 %*	*11.80 %*
Total	**3,284**	**2,813**	**100.00**	**100.00**

Source: DOE (2016)

Table 5. Capacity Measures of the Mindanao Grid (2016)

Technology	Mindanao			
	Capacity (MW)		Percent Share (%)	
	Installed	Dependable	Installed	Dependable
Coal	1,070	959	33.80 %	35.70 %
Oil Based	828	733	26.20 %	27.30 %
Diesel	*828*	*733*	*26.20 %*	*27.30 %*
Oil Thermal	-	-	-	-
Gas Turbine	-	-	-	-
Natural Gas	-	-	-	-
Renewable Energy	1,264	993	40.00 %	37.00 %
Geothermal	*108*	*100*	*3.40 %*	*3.70 %*
Hydro	*1,061*	*840*	*33.50 %*	*31.30 %*
Wind	-	-	-	-
Biomass	*36*	*10*	*1.10 %*	*0.40 %*
Solar	*59*	*43*	*1.90 %*	*1.60 %*
Total	**3,162**	**2,684**	**100.00 %**	**100.00 %**

Source: DOE (2016)

Table 6: Capacity Measures of the Philippine System

Technology	Philippines			
	Capacity (MW)		Percent Share (%)	
	Installed	Dependable	Installed	Dependable
Coal	7,419	6,979	34.60 %	36.50 %
Oil Based	3,616	2822	16.90 %	14.80 %
Diesel	*2191*	*1812*	*10.23 %*	*9.49 %*
Oil Thermal	*650*	*470*	*3.03 %*	*2.46 %*
Gas Turbine	*775*	*540*	*3.62 %*	*2.83 %*
Natural Gas	3,431	3,291	16.00 %	17.20 %
Renewable Energy	6,958	6,005	32.50 %	31.40 %
Geothermal	*1,916*	*1,689*	*8.90 %*	*8.80 %*
Hydro	*3,618*	*3,181*	*16.90 %*	*16.70 %*
Wind	*427*	*383*	*2.00 %*	*2.00 %*
Biomass	*233*	*157*	*1.10 %*	*0.80 %*
Solar	*765*	*594*	*3.60 %*	*3.10 %*
Total	**21,423**	**19,097**	**100.00 %**	**100.00 %**

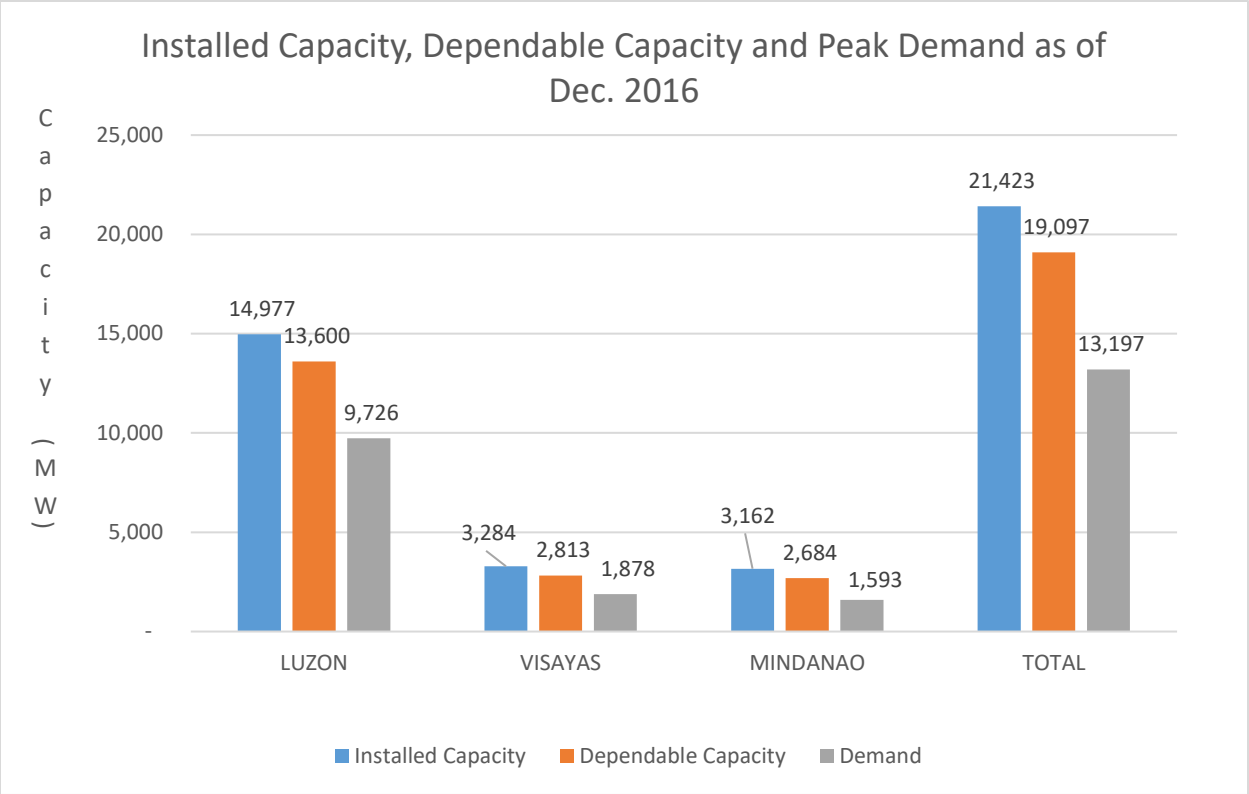
Source: DOE (2016)

Table 7: Summary Statistics of the Philippine Grid

Grid	Capacity (MW)		Percent Share (%)	
	Installed	Dependable	Installed	Dependable
Luzon	14,977	13,600	69.91%	71.22%
Visayas	3,284	2,813	15.33%	14.73%
Mindanao	3,162	2,684	14.76%	14.05%
Total	**21,423**	**19,097**	**100.00%**	**100.00%**

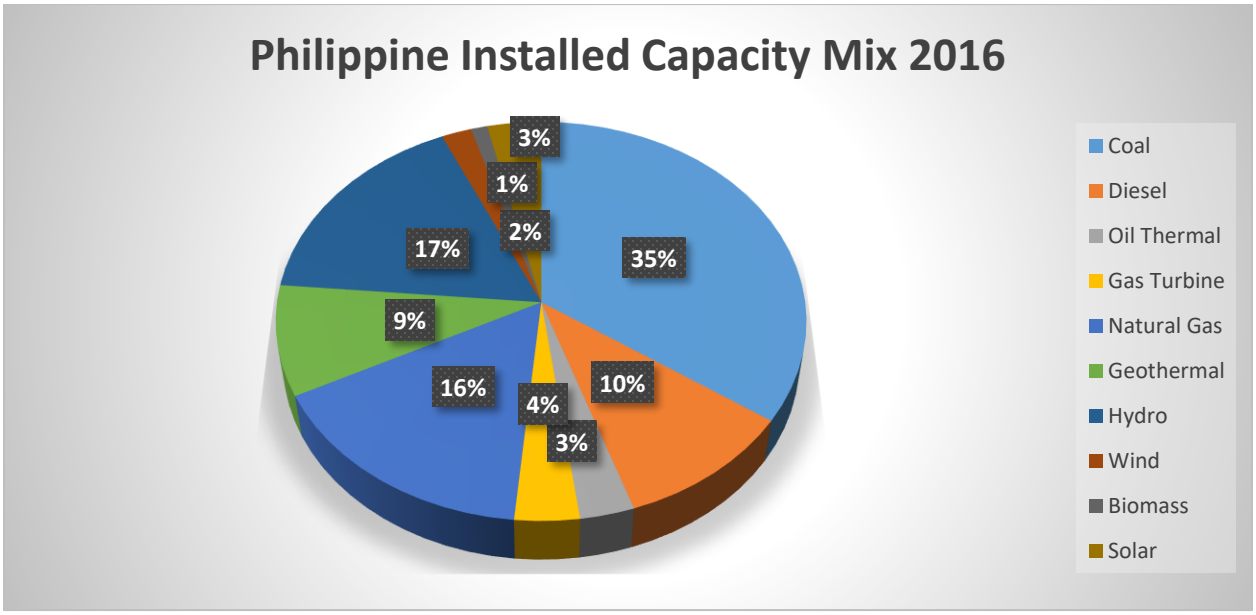
Source: DOE (2016)

Figure 5. Installed Capacity, Dependable Capacity and Peak Demand as of Dec. 2016



Source: DOE (2016)

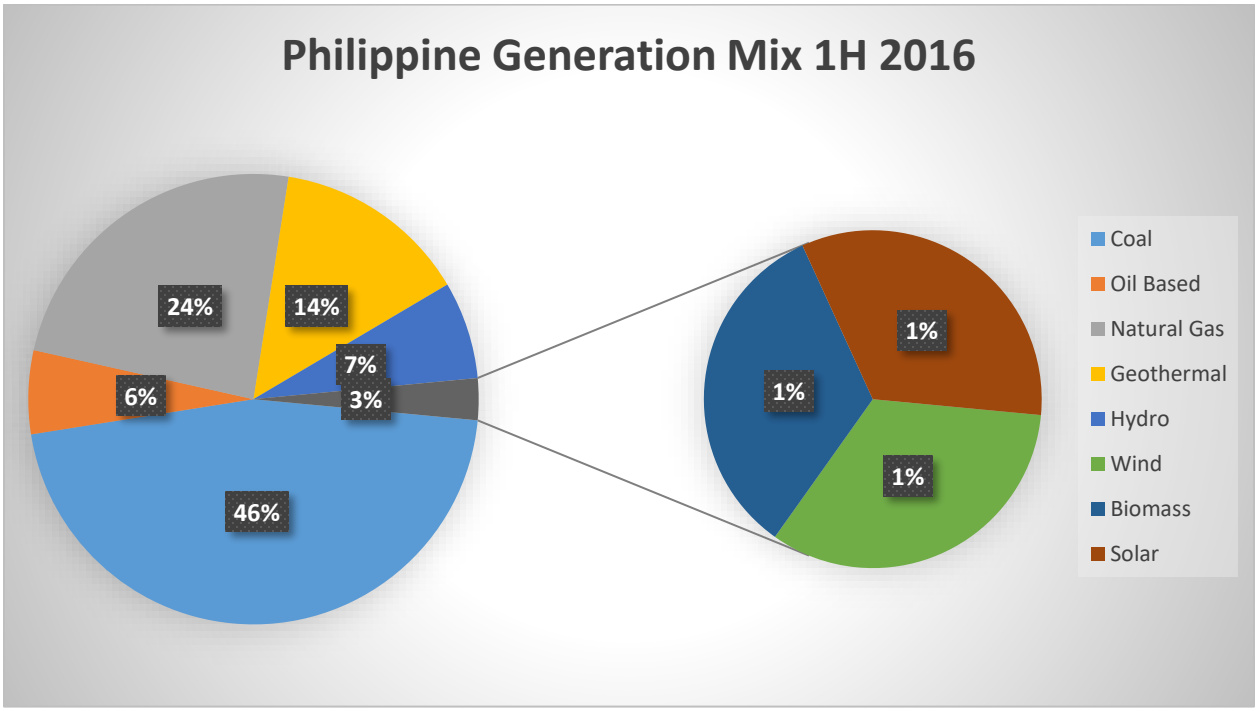
Figure 6. Breakdown of the Installed Capacity in the Philippines



Source: DOE (2016)

For the **first half of 2016**, the country has generated **42,700.63 GWh** of power. The breakdown of the generation mix is as follows:

Figure 7: Generation Mix for First Half 2016



Source: DOE (2016)

The system is still expecting additional power plants to enter into operation in the coming years. The following tables show the expected amount of power entering in the system.

Table 8: Committed Power Plants for 2017

Island Group	Coal	Oil	Nat Gas	Geo	Hydro	Biomass	Solar	Battery	Total
Luzon	720		650	12		22.9	29.5	10	**1,444.4**
Visayas		16		50			65.7		**131.7**
Mindanao	450	29.5			96.2	14.2			**589.9**
Total	**1,170.0**	**45.5**	**650.0**	**62.0**	**96.2**	**37.1**	**95.2**	**10.0**	**2,166.0**

Source: DOE (2016)

Table 9. Breakdown of 2017 Committed Power Plants

Island Group	Renewable Capacity (MW)	Fossil Capacity (MW)	% Renewable	% Fossil
Luzon	74.4	1370	**5.15%**	**94.85%**
Visayas	115.7	16	**87.85%**	**12.15%**
Mindanao	110.4	479.5	**18.72%**	**81.28%**
Total	**300.5**	**1865.5**	**13.87%**	**86.13%**

Source: DOE (2016)

Table 10: Committed Power Plants for 2018

Island Group	Coal	Oil	Nat Gas	Geo	Hydro	Biomass	Solar	Battery	Total
Luzon				31					**31.0**
Visayas	135				13.1				**148.1**
Mindanao	640				30				**670.0**
Total	**775.0**			**31.0**	**43.1**				**849.1**

Source: DOE (2016)

Table 11. Breakdown of 2018 Committed Power Plants

Island Group	Renewable Capacity (MW)	Fossil Capacity (MW)	% Renewable	% Fossil
Luzon	31	0	100.00%	0.00%
Visayas	13.1	135	8.85%	91.15%
Mindanao	30	640	4.48%	95.52%
Total	74.1	775	8.73%	91.27%

Source: DOE (2016)

Table 12: Committed Power Plants for 2019

Island Group	Coal	Oil	Nat Gas	Geo	Hydro	Biomass	Solar	Battery	Total
Luzon	800				61				**861**
Visayas									
Mindanao					8				**8**
Total	**800**				**69**				**869**

Source: DOE (2016)

Table 13. Breakdown of 2019 Committed Power Plants

Island Group	Renewable Capacity (MW)	Fossil Capacity (MW)	% Renewable	% Fossil
Luzon	61	800	7.08%	92.92%
Visayas				
Mindanao	8		100.00%	0.00%
Total	69	800	7.94%	92.06%

Source: DOE (2016)

Table 14: Committed Power Plants for 2020

Island Group	Coal	Oil	Nat Gas	Geo	Hydro	Biomass	Solar	Battery	Total
Luzon	1,200				1.5				**1,201.5**
Visayas									
Mindanao									
Total	**1,200.0**				**1.5**				**1,201.5**

Source: DOE (2016)

Table 15. Breakdown of 2020 Committed Power Plants

Island Group	Renewable Capacity (MW)	Fossil Capacity (MW)	% Renewable	% Fossil
Luzon	1.5	1200	0.12%	99.88%
Visayas				
Mindanao				
Total	1.5	1200	0.12%	99.88%

Source: DOE (2016)

Table 16. Total Committed Power Plants up to 2020

Island Group	Coal	Oil	Nat Gas	Geo	Hydro	Biomass	Solar	Battery	Total	%
Luzon	2,720	0	650	43	62.5	22.9	29.5	10	**3,537.9**	**70%**
Visayas	135	16	0	50	13.1	0	65.7	0	**279.8**	**6%**
Mindanao	1,090	29.5	0	0	134.2	14.2	0	0	**1,267.9**	**25%**
Total	**3,945**	**45.5**	**650**	**93**	**209.8**	**37.1**	**95.2**	**10**	**5,085.6**	**100%**
%	**78%**	**1%**	**13%**	**2%**	**4%**	**1%**	**2%**	**0%**	**100%**	

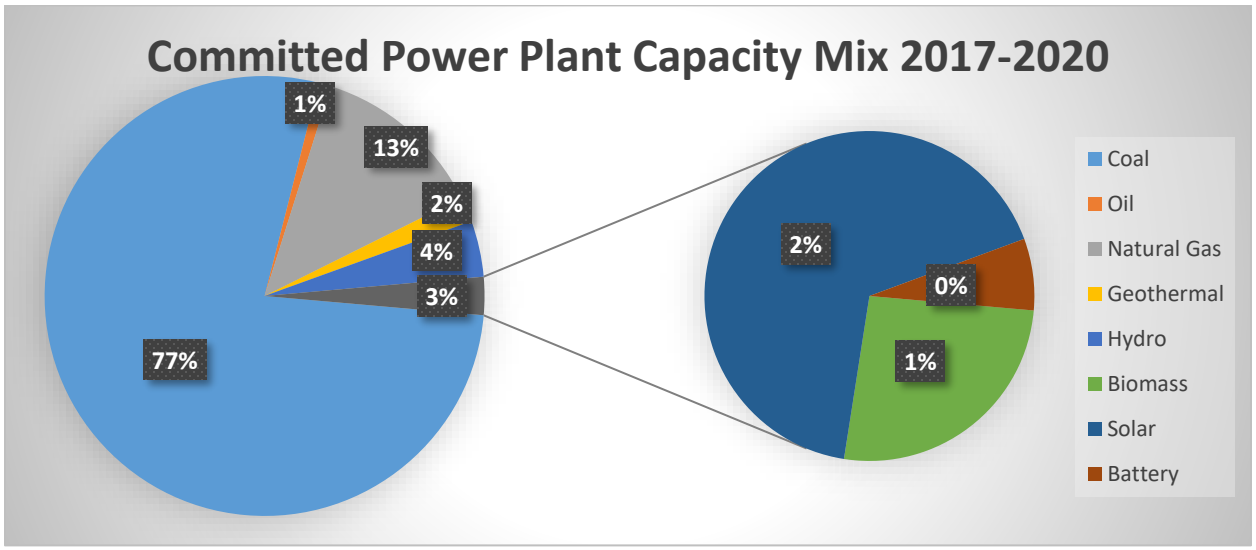
Source: DOE (2016)

Table 17. Breakdown of Total Committed Power Plants up to 2020

Island Group	Renewable Capacity (MW)	Fossil Capacity (MW)	% Renewable	% Fossil
Luzon	167.9	3370	4.75%	95.25%
Visayas	128.8	151	46.03%	53.97%
Mindanao	148.4	1119.5	11.70%	88.30%
Total	445.1	4640.5	8.75%	91.25%

Source: DOE (2016)

Figure 8. Committed Power Plant Capacity Mix

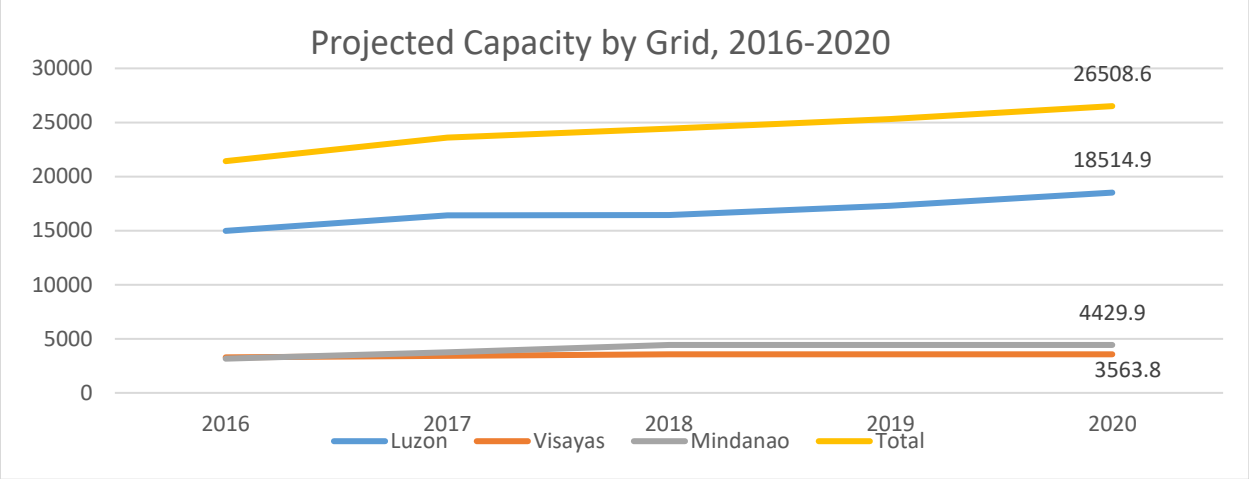


Source: DOE 2016

From the data shown above, it can be seen that the system can expect an infusion of 5,000 MW of capacity in the next 4 years. The bulk of that amount (3,500 MW) will be added to the Luzon grid. The Mindanao grid which is already experiencing surplus in electricity is expected to see 1,200 MW more of power, which makes the rehabilitation of Agus-Pulangi feasible, as there is enough supply to counter the loss of output associated with rehabilitating the plant.

The following figure shows the evolution of the capacity of the different grids.

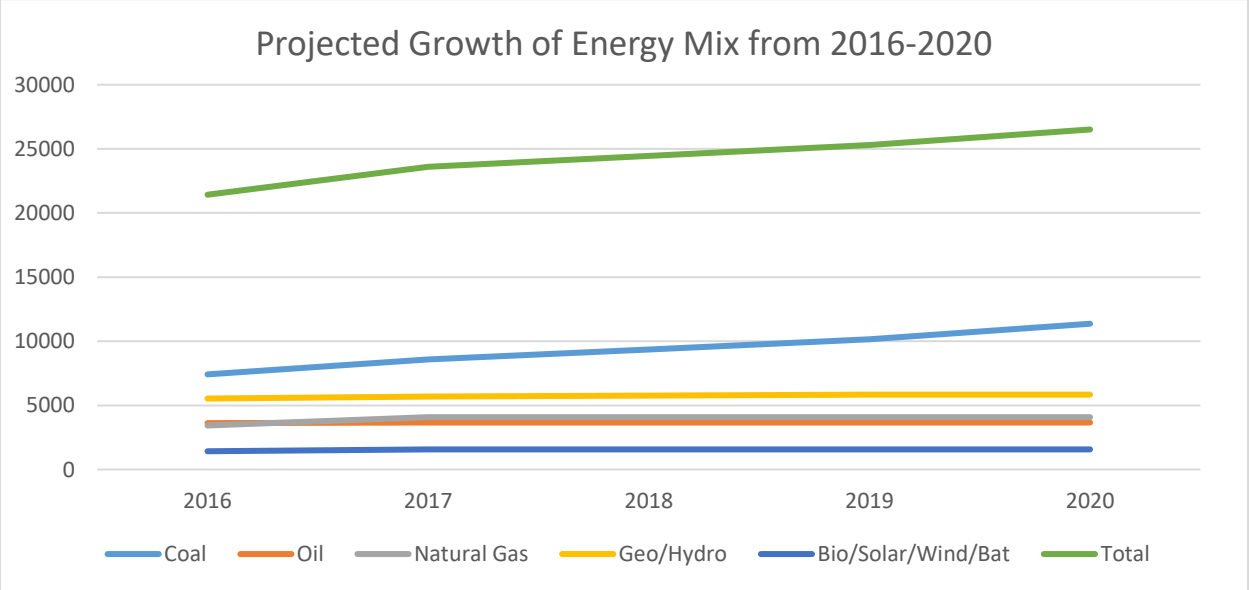
Figure 9. Projected Capacity by Grid from 2016 to 2020.



Source: DOE (2016), *personal calculations

The following figure shows the growth of the energy mix from 2016 to 2020. The figure shows that coal will be driving the increase in capacity that will be observed in the selected time period.

Figure 10. Projected Growth of Energy Mix from 2016-2020



Source: DOE 2016

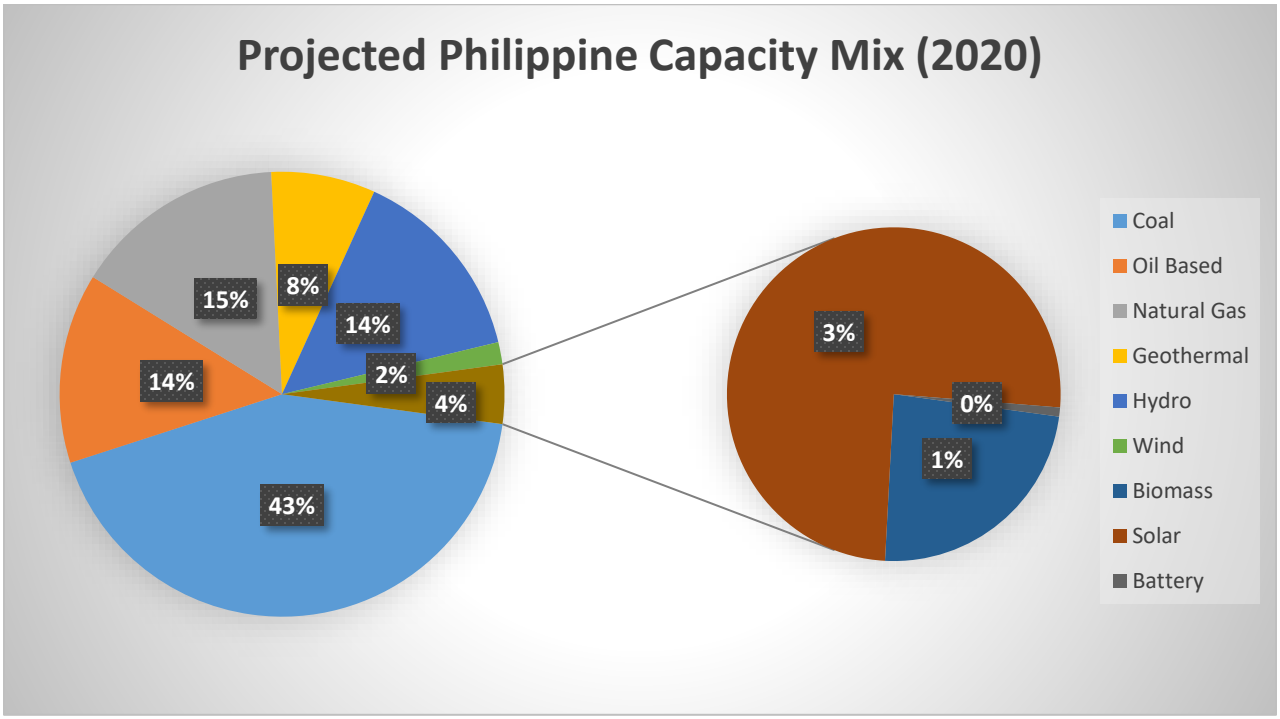
The following table and graph will show the projected energy mix at year 2020.

Table 18. Energy Mix 2020* for different grids.

Island Group	Coal	Oil	Nat Gas	Geo	Hydro	Wind	Biomass	Solar	Battery	Total
Luzon	8,014	2,133	4,080	886	2,599.5	337	117.9	336.5	10	**18,514.9**
Visayas	1,189	671	1	1,015	33.1	90	101	464.7	0	**3,563.8**
Mindanao	2,160	858	0	108	1,195.2	0	50.2	59	0	**4,429.9**
Total	**11,363**	**3,662**	**4,081**	**2,009**	**3,827.8**	**427**	**269.1**	**860.2**	**10**	**26,508.6**

Source: DOE (2016), *personal calculations

Figure 11. Projected Capacity Mix for 2020.*



Source: DOE (2016), *personal calculations

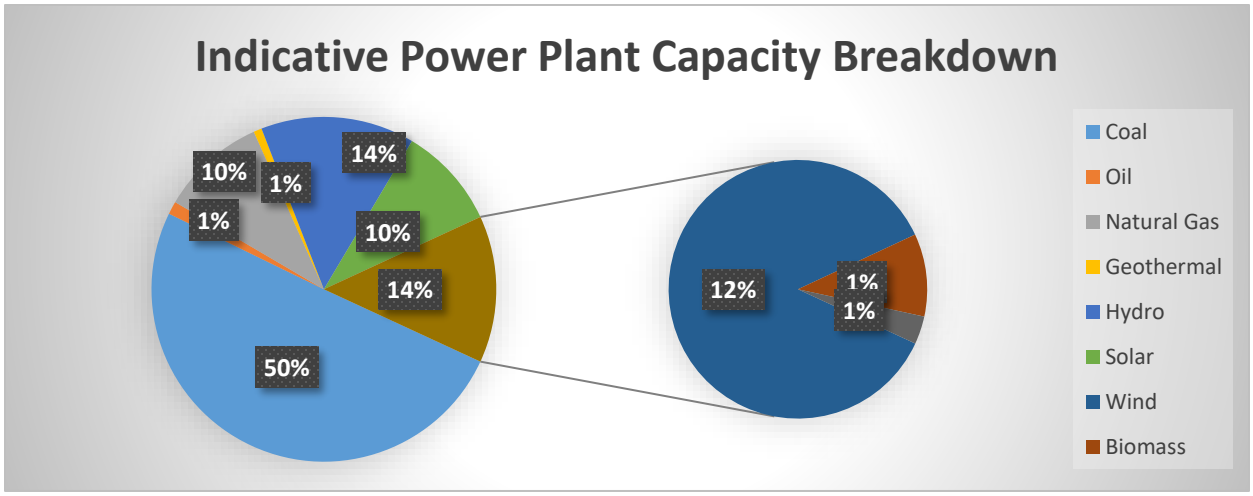
In addition to the committed projects, there is also 20,000 MW of indicative projects in the pipeline. If some of the projects push through, the added power is expected to provide a bigger buffer for an increase in demand for energy.

Table 19. Breakdown of Indicative Projects

Indicative Capacity	Coal	Oil	Nat Gas	Geo	Hydro	Solar	Wind	Biomass	Batt	Total
Luzon	8,280	196	2,050	80	1,591.65	1,178.68	1,267	58.18	0	14,701.51
Visayas	900	10.00	0	40	723.34	465	1,193	152	100	3,583.34
Mindanao	1,243	45.22	0	40	673.44	338	0	85.20	0	2,424.86
Total	**10,423.00**	**251.22**	**2,050.00**	**160.00**	**2,988.43**	**1,981.68**	**2,460.00**	**295.38**	**100.00**	**20,709.70**

Source: DOE (2016), personal computations

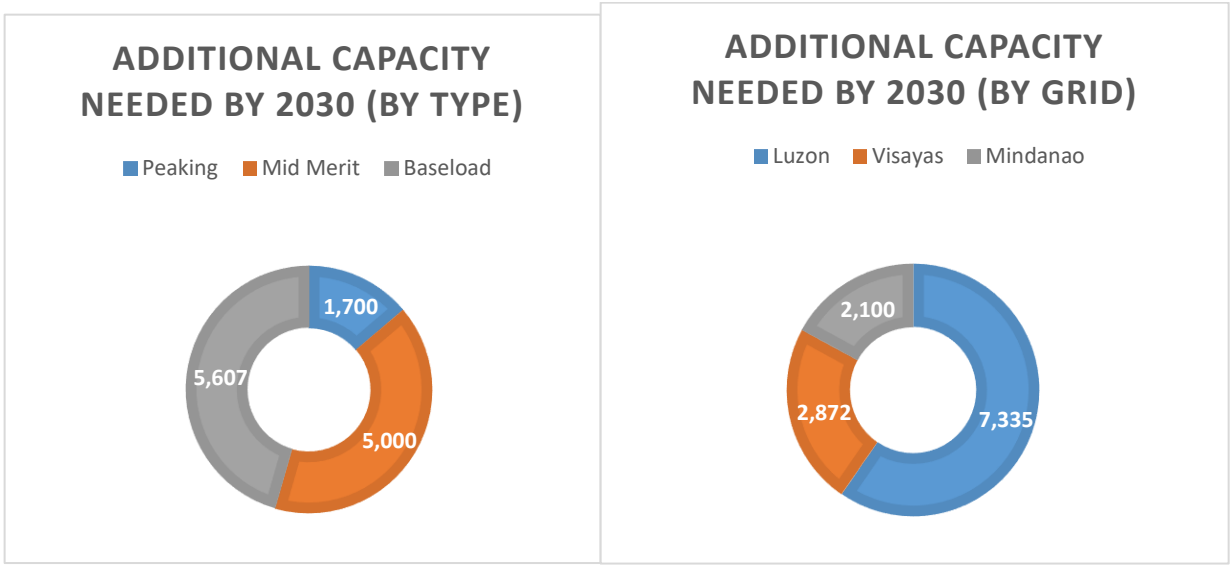
Figure 12. Committed Power Plant Capacity Mix



Source: DOE 2016

The infusion of all this power generating capacity will help the country meet its need for additional generation capacity as the economy expands. In addition, the addition of power will in itself help the economy expand especially if the increase in supply comes with a lowering of rates associated with excess power. The Ateneo School of Government expects the country to need an additional **12,307 MW** of excess power by 2030, broken down in the figures below.

Figure 13. Projected Additional Capacity Needed by 2030.



Source: Ateneo School of Government-SSG Advisors (2016)

Possible Disruptions

Futures

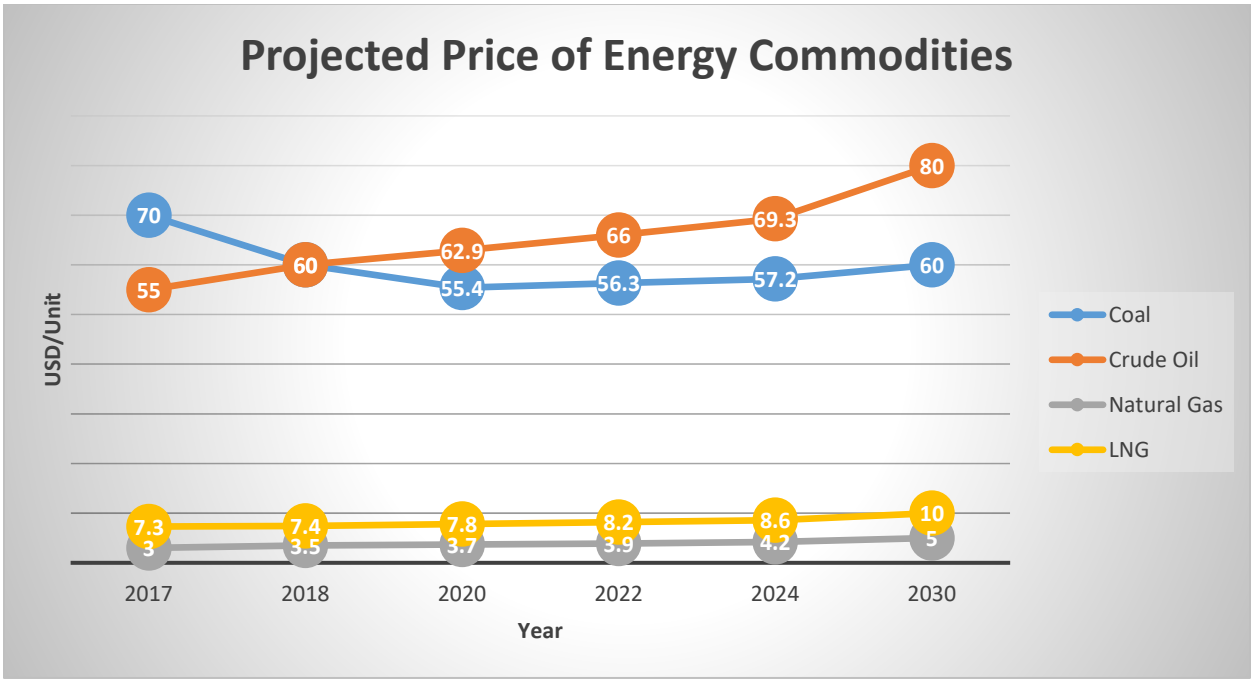
The ff. table shows the World Bank projection of the prices of future energy commodities.

Table 20. Price projections of chosen energy commodities.

Commodity	Unit	2017	2018	2020	2022	2024	2030
Coal	$/mt	70.0	60.0	55.4	56.3	57.2	60.0
Crude oil	$/bbl	55.0	60.0	62.9	66.0	69.3	80.0
Natural gas (US)	$/mmbtu	3.0	3.5	3.7	3.9	4.2	5.0
LNG	$/mmbtu	7.3	7.4	7.8	8.2	8.6	10.0

Source: World Bank 2016

Figure 14. Price Projection of Energy Commodities



Source: World Bank

The long term price outlook suggests that the price of coal may be falling in the near and intermediate future, which bodes well for the Philippines as the share of coal in both the capacity and generation mix is relatively high. In addition to this, contracts which are pegged in the price of coal power can also expect to see a decrease in price, as can be seen in some of the country's geothermal power plant contracts.

On the other hand, the long term price outlook for crude oil suggests that the price of petroleum products can be expected to rise. Much of the effect will be felt in the transportation sector, which is the primary user of petroleum fuels in the country. This can help make investments in renewable liquid fuels (bioethanol and biodiesel) more attractive, although the price competitiveness of both options remain questionable. However, the Biofuels Act of 2007 coupled with additional investment and support to the sugarcane and coconut industry can help develop bioethanol and biodiesel.

The long term price outlook for natural gas suggests an expected increase in the price of natural gas. However, the most important development in the natural gas sector is expected to happen in year 2024, when the Malampaya stops producing natural gas. The price difference between pipe transported

natural gas and liquefied natural gas (LNG) is very substantial. As such, the country needs to rethink its usage of natural gas in the capacity and generation mix.

Malampaya

The Malampaya Oil and Gas Field is a 3.7 trillion cubic feet gas field supplying natural gas to power plants capable of producing 2,871 MW of power. The development of the plant is a 1.58 billion USD project. The power plants connected to the project are worth 2.7 billion USD. The Malampaya gas field is responsible for generating 23% of the electricity produced in the national grid and close to 30% of the electricity in the Luzon Grid. The Malampaya service contract is scheduled to expire in 2024. However, Shell Philippines Exploration announced a plan that can extend the life of the Malampaya Gas Field by 15 years to 2039 for a cost of 1 billion USD.

The project, however, is facing issues regarding the sharing of revenues. The law mandate a 60-40 sharing of the net proceeds between the government and the private contractor. The Department of Energy (DOE) interpretation of the law says that the 60% government share includes the taxes to be paid by the private contractor. On the other hand, the Commission on Audit (COA) does not support this interpretation, saying that the taxes should be paid from the 40% private contractor share. Until this issue is clarified, the future of gas contracts in the Philippines will remain cloudy.

Another issue affecting further exploration is the issue between China and the Philippines regarding ownership of territory in the West Philippine Sea. Until this issue is resolved, no exploration is possible in the area.

Renewable Energy

There is a worldwide initiative to reduce carbon emissions and promote sustainability by promoting renewable energy resources. With that in mind, it is important to know what renewable energy resources are available for the Philippines to consider and the capacity of each resource to supply power to the grid.

Table 21: Theoretical Capacity of Renewable Energy Sources in the Philippines.

Technology	Capacity (MW)
Hydro	10,000
Geothermal	4,000
Solar	5 kwh/sqm./day
Wind	76,600
Biomass	500
Ocean	170,000

Source: Renewable Energy Management Bureau of DOE (2013)

It should be noted, however, that the share of renewable energy in the generation mix appears to be falling through time. Most of the renewable capacity of the country is in the form of hydropower and geothermal energy. Lack of investment in both industries resulted in a stagnation in installed capacity over the years, resulting in a decrease in their share in the generation mix.

The share of new renewables (solar and wind) is increasing as time passes due to the effect of national programs promoting these technologies. However, their share in the generation mix is still relatively low, due to relatively low penetration and the intermittence of the technologies.

It should be noted, however, that the price of solar is falling. In Abu Dhabi, solar contracts as low as **2.42 US cents per kWh** have been signed. In the Philippines, the 150 MW solar plant in Concepcion, Tarlac is expected to sell power at the **4 Php-5 Php range.**

WESM Mindanao

The advent of excess power in Mindanao has made the possibility of operating a spot market for electricity in Mindanao a reality. However, several issues have been raised against this:

- **The Agus-Pulangi Hydropower Plant.** The cheapest source of power in Mindanao is still the Agus-Pulangi Hydropower plant, which sells power at less than 3 Php. As long as this power plant remains as a the biggest power producer in Mindanao and as long as it sells power at such a cheap price, a true merchant system will have a hard time lifting off in Mindanao, particularly since the Agus-Pulangi is still a government operated plant.
- **The management of the WESM.** Currently, the WESM is operated by the Philippine Electric Market Corporation. However, several groups have raised the issue of a Mindanao spot market being separate from the Philippine spot market. The primary argument for this lies in the fact that there is no interconnection between the Mindanao grid and the other grids.

Leyte-Mindanao Interconnection

Another possible disruption is the development of the Leyte-Mindanao interconnection. Previously, there is little reason to connect both grids, as Mindanao is suffering from a power crisis and Visayas grid is not in shape to supply excess power to Mindanao due to intra-grid problems. However, the influx of power in Mindanao makes an interconnection attractive, as there is now excess power to be moved from Mindanao to the Visayas. An interconnection will stabilize the system by allowing arbitrage of power from both regions, particularly since the two grids have different load profiles with non-coincident peaks. In addition, the dependence of Mindanao to cheap hydropower also makes an interconnection even more attractive, as in times of good rainfall, Mindanao will be able to share its cheap electricity. In times of drought, reserves from Luzon and Visayas can be shared to Mindanao.