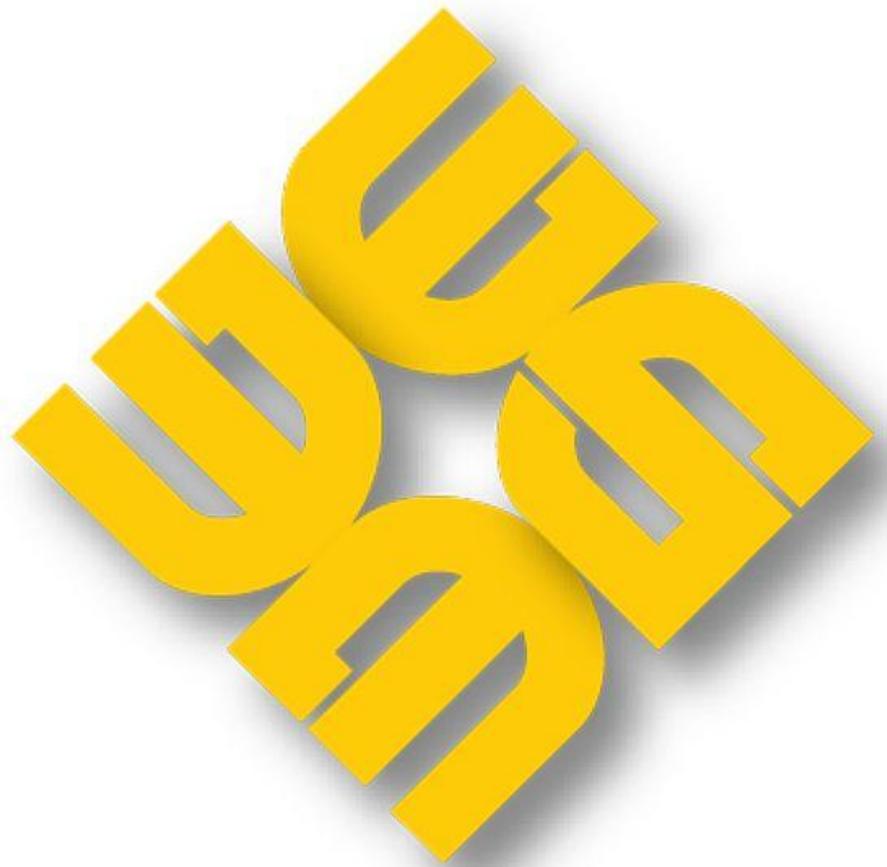


MAG-MMAR-2018-12

MONTHLY MARKET ASSESSMENT REPORT

For the Billing Period 26 November to 25 December 2018



**PHILIPPINE
ELECTRICITY
MARKET
CORPORATION**

**MARKET ASSESSMENT GROUP
(MAG)**

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EXECUTIVE SUMMARY

This monthly report assesses the results of the WESM operation for the December 2018 billing period (26 November to 25 December 2018) and how the market performed compared with the previous month and year. The market prices averaged at PhP3,186/MWh this month, a decrease by 4.1 percent from previous month's PhP3,324/MWh following the 8.8% wider supply margin observed this month. However, this was higher by 31.4 percent compared to PhP2,424/MWh in December 2017 due to narrower supply margin this year.

The WESM registered capacity reached at 18,902 MW by the end of December, higher by 20MW from previous month's 18,882 MW attributable to the entry of biofuel plant of San Carlos Biopower Inc. on 21 December 2018. Of said registered capacity, about 68 percent or an average of 12,803 MW was offered in the market during the month. Outage capacity (10 percent) posted a slightly higher average this month at 1,926 MW from 1,914 MW in the previous month. Meanwhile, 12 percent of the registered capacity was not offered in the market, averaging at 2,353 MW, likewise showing a decrease from last month's 2,378 MW. On the other hand, preferential and non-scheduled capacities averaged 1,504 MW, comprising about 8 percent of the total registered capacity. Lastly, an average of 300 MW or about 1.6 percent of the registered capacity accounted for the capacity designation of Malaya TPP as Must Run Unit (MRU), in cases of supply shortfall and to address system security. Taking into account security limits and ramp rates, effective supply was 0.5 percent higher this month at an average of 13,065 MW from previous month's 13,002 MW.

On the other hand, system demand recorded an average of 9,446 MW this month, 2.2 percent lower than previous month's 9,658 MW due to the cooler temperatures as well as the observance of holidays on 30 November and on 24 and 25 December. The reserve schedule averaged at 1,146 MW. Consequently, the demand plus reserve schedule averaged at 10,591 MW, demonstrating a 1.3 percent decrease from last month's 10,729 MW.

Driven by the decrease in demand, the supply margin widened by 8.8 percent this month at 2,474 MW coming from previous month's 2,273 MW. However, this was lower when compared with last year's supply margin of 2,558 MW.

San Miguel Corporation (SMC), Aboitiz Power (AP), First Gen Corporation (FGC) and Power Sector Asset and Liabilities Management (PSALM) continued to dominate the market with a combined market share of 71.1 percent based on registered capacity during the December billing month. SMC held the top spot at 23.8 percent followed by AP (20.9 percent), FGC (15.2 percent) and PSALM (11.2 percent).

Correspondingly, the Herfindahl-Hirschman Index (HHI) calculated based on offered capacity by major participants' grouping indicated a concentrated market for 370 trading intervals (51 percent) of the time and moderately concentrated market for the remaining 350 trading intervals (49 percent) during the December billing month.

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MONTHLY MARKET ASSESSMENT REPORT

This monthly report assesses the results of the WESM operation for the December 2018 billing period (26 November to 25 December 2018) and how the market performed compared with the previous month and year.

I. Capacity Profile

The WESM registered capacity stood at 18,902 MW by the end of the December billing month, higher by 20 MW from previous month's 18,882 MW attributable to the entry of biofuel plant of San Carlos Biopower Inc. on 21 December 2018. Of the total registered capacity, about 68 percent or an average of 12,803 MW (previous month's 12,790 MW) was offered in the market during the month. Outage capacity (10 percent) posted a slightly higher average this month at 1,926 MW from 1,914 MW in the previous month. Meanwhile, capacity not offered (12 percent) in the market decreased from previous month's average at 2,378 MW to current month's 2,353 MW.

On the other hand, preferential¹ and non-scheduled capacities averaged 1,504 MW, comprising about 8 percent of the total registered capacity. Lastly, an average of 300 MW or about 1.6 percent of the WESM registered capacity was attributed to the capacity designation of Malaya TPP as Must Run Unit (MRU), in cases of supply shortfall and to address system security.

Figure 1. Capacity Profile (Ex-ante), December 2018

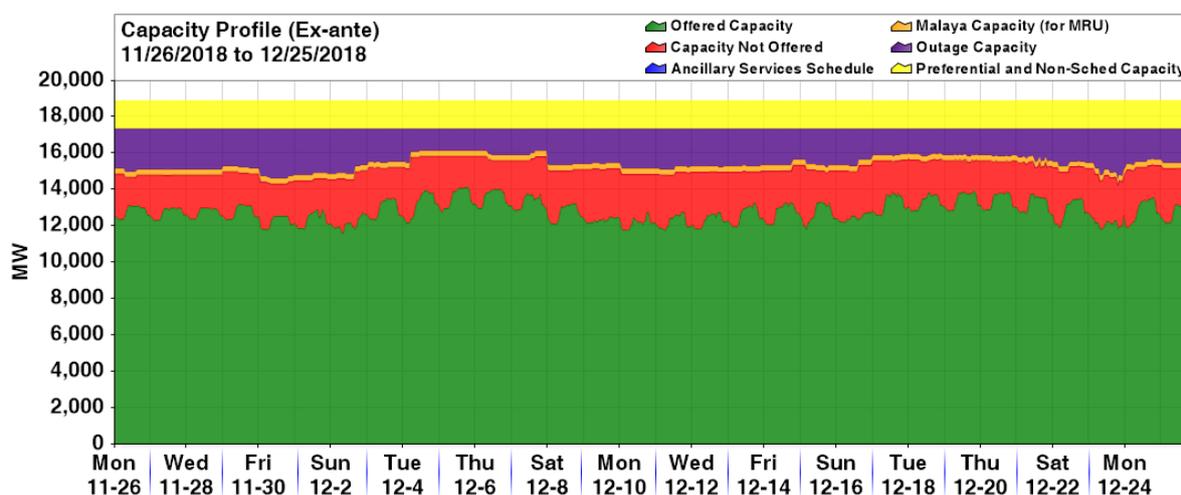


Table 1. Capacity Profile (Ex-ante), December 2018, November 2018 and December 2017

	December 2018 (In MW)		November 2018 (In MW)		December 2017 (In MW)		% M-on-M Change (Nov 2018 - Dec 2018)	% Y-on-Y Change (Dec 2017 - Dec 2018)
	Avg MW	% of RegCap	Avg MW	% of RegCap	Avg MW	% of RegCap		
Registered Capacity (end of month)	18,902		18,882		18,764		0.1	0.7
Offered Capacity	12,803	68	12,790	68	11,986	65	0.1	6.8
Outage Capacity	1,926	10	1,914	10	1,996	0	0.6	(3.5)
Capacity Not Offered	2,353	12	2,378	13	2,443	13	(1.1)	(3.7)
Malaya Capacity for MRU	300	1.6	300	1.6	579	3	0.0	(48.2)
Preferential and Non-Scheduled Capacity	1,504	8	1,500	8	1,431	8	0.2	5.1

¹ Preferential capacity refers to the combined registered capacities of priority dispatch and must dispatch generating units.

II. Power Plant Outages

A. Outage Capacity by Plant Type

System-wide outage capacity averaged at 1,926 MW this month, slightly higher by 0.6 percent from previous month's 1,914 MW. This increase was driven by the higher outage capacity involving coal plants from previous month's 552 MW to 675 MW this month attributable to the maintenance outages of Sual CFTPP unit 2 (647 MW) from 16 November to 4 December 2018 and Calaca CFTPP unit 2 (300 MW) from 8 to 16 December 2018.

Natural gas plants likewise noted an increase in average outage capacity from previous month's 219 MW to current month's 283 MW related to the maintenance outage of San Gabriel NGPP (420 MW) beginning 8 December until the end of the billing month.

On the other hand, hydro plants observed a lower outage capacity averaging at 117 MW compared to 200 MW in November. This decrease was attributable to the resumption of operations of Kalayaan PSPP units 1 and 2 (2x180 MW) from planned outage in November. Meanwhile, this month's outage from hydro plants mainly involved the planned outages of Angat Main HEP unit 3 (50 MW) and Kalayaan PSPP units 3 and 4 (2x180 MW).

Decrease in oil-based plants' average outage capacity was similarly noted from previous month's 545 MW to current month's 470 MW due to the resumption of operations of Limay CCGT units 3 and 7 (2x60 MW). This month's outage from oil-based plants was mainly attributable to the forced outages of Malaya TPP unit 2 (300 MW) and Navotas DPP unit 2 (49 MW).

Geothermal plants likewise recorded a lower outage capacity averaging at 381 MW (previous month's 399 MW) mainly related to the planned outage of Makban GPP B (63 MW) and maintenance outage of Tiwi GPP A (59 MW) on top of the deactivated shutdown of Makban GPP C (55 MW) and Tiwi GPP B (44 MW). The month-on-month decrease was driven by the resumption of operations of one unit of Makban GPP A (63 MW) on 22 November from its forced outage since 30 August.

Year-on-year, this month's outage was 3.5 percent lower compared to previous year's average at 1,996 MW. Coal plants recorded a higher average outage capacity at 1,051 MW in the previous year which mainly involved Sual CFTPP unit 1 (647 MW), SLPGC CFTPP unit 1 (150 MW), and SMC Limay CFTPP unit 1 (150 MW).

Provided in Appendix A is the list of major plant outages.

Figure 2. Plant Outage Capacity (by Plant Type), December 2018

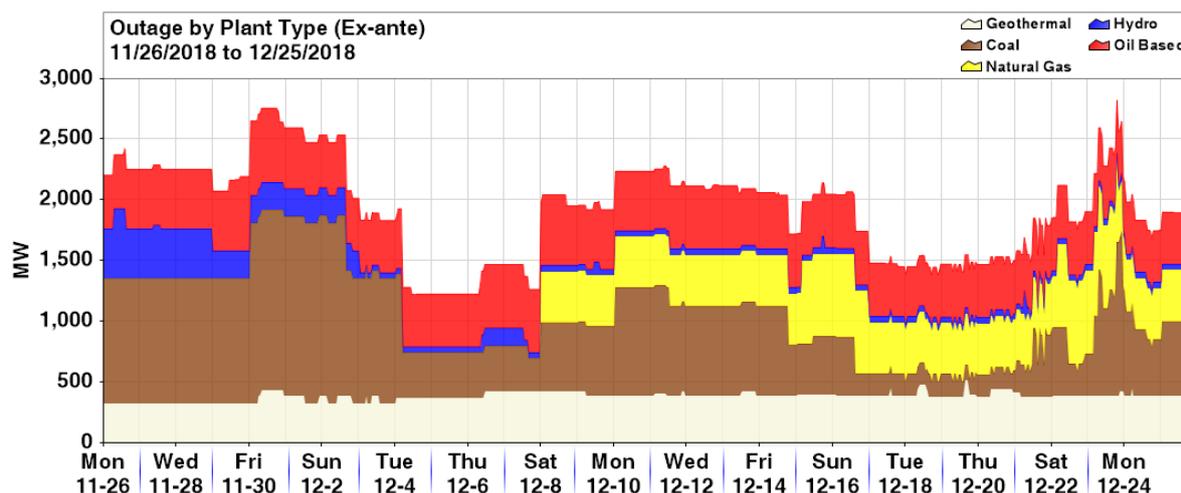


Table 2. Outage Summary (Ex-ante), December 2018, November 2018 and December 2017

Resource Type	December 2018 (In MW)			November 2018 (In MW)			December 2017 (In MW)			% M-on-M Change (Nov 2018 - Dec 2018)			% Y-on-Y Change (Dec 2017 - Dec 2018)		
	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
Coal	1,482	123	675	1,023	123	552	1,894	682	1,051	44.9	0.0	22.3	(21.8)	(82.0)	(35.7)
Natural Gas	685	0	283	974	0	219	775	0	233	(29.7)		29.0	(11.6)		21.5
Geothermal	520	328	381	482	328	399	518	278	388	7.9	0.0	(4.4)	0.3	18.0	(1.6)
Hydro	578	50	117	444	50	200	215	0	53	30.2	0.0	(41.3)	168.8		119.6
Oil Based	613	411	470	661	381	545	577	132	272	(7.3)	8.0	(13.7)	6.1	211.7	73.0
TOTAL	2,822	1,221	1,926	2,657	1,202	1,914	2,927	1,489	1,996	6.2	1.6	0.6	(3.6)	(18.0)	(3.5)

B. Outage Capacity by Category

Majority of the outages this month were due to forced outages, accounting for about 49 percent of the outage capacity at 925 MW. This, however, was only 2.5 percent lower than last month's 949 MW. Major coal plants that were on short-duration forced outages in December were QPPL CFTPP (459 MW), Pagbilao unit 3 (420 MW), GN Power unit 1 (316 MW), Masinloc unit 1 (315 MW) and Calaca unit 2 (300 MW). Oil-based plant Malaya TPP unit 2 (350 MW) was still on its forced outage that started on 19 May 2018.

Planned outage capacity was also lower this month, averaging at 229 MW from the 367 MW in November. This decrease was driven by the lower outage capacity involving hydro plants from 200 MW in November to 117 MW this month attributable to the short-duration outages of Kalayaan units 3 and 4 (2x180 MW) and natural gas plant San Lorenzo unit 1 (265.8 MW). Coal power plant Kepco Salcon unit 1 (with plant capacity of 103 MW) was on outage from 01 November 2018 and resumed its operation on 07 December 2018.

Maintenance outage capacity averaged at 648 MW, likewise recording a 27.0 percent increase from 510 MW in the previous month. This was mainly due to the maintenance outages recorded by coal plant Sual CFTPP unit 2 (with plant capacity of 647 MW), San Lorenzo NGPP unit 2 (261.8 MW), Calaca unit 2 (300 MW), SMC unit 4 (150 MW) and natural gas plant San Gabriel NGPP (420 MW).

Meanwhile, outage capacity related to deactivated shutdown remained at an average of 99 MW, attributable to the long-standing deactivated shutdown involving geothermal plants Makban GPP unit C (55 MW) and Tiwi GPP unit B (43.7 MW).

Figure 3. Plant Outage Capacity (by Outage Category), December 2018

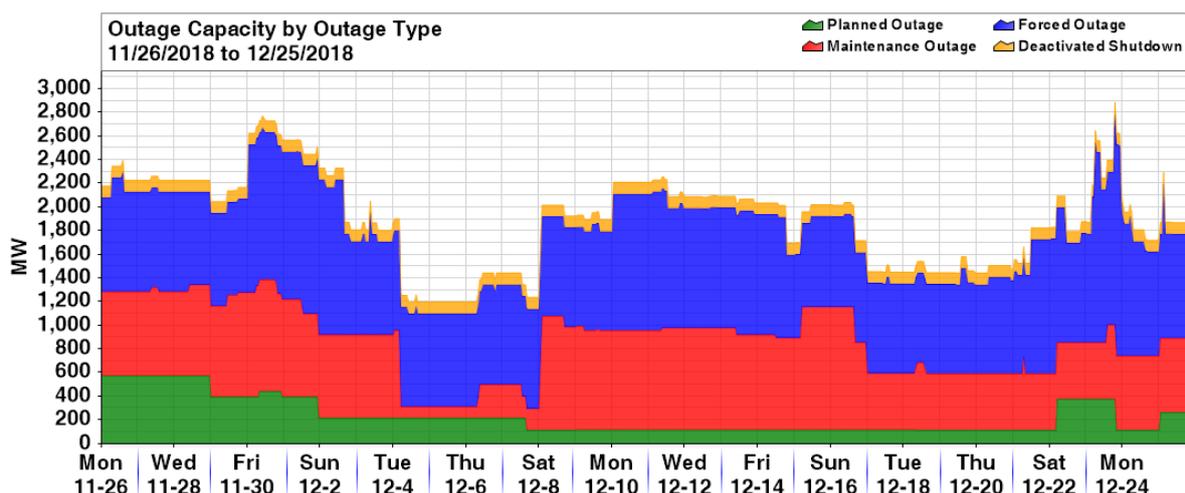


Table 3. Outage Summary, by Outage Category, December 2018 and November 2018

Resource Type	December 2018 (In MW)			November 2018 (In MW)			% M-on-M Change (Nov 2018 - Dec 2018)			% Y-on-Y Change (Dec 2017 - Dec 2018)		
	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
Planned	576	113	229	854	207	367	(32.5)	(45.4)	(37.7)	3.5	86.8	(18.1)
Maintenance	1,041	97	648	768	85	510	35.5	27.0	(20.6)	(29.0)		
Forced	1,789	700	925	1,513	708	949	18.2	(1.1)	(2.5)	6.6	130.5	29.6
Deactivated Shutdown	99	99	99	99	99	99	0.0	0.0	0.0	0.0	0.0	0.0

C. Outage Factor

About 10.2 percent of the total registered capacity went on outage in the December billing month, a slight decrease from last month's 10.3 percent and last year's 10.9 percent. Geothermal plants (21.4 percent), oil-based plants (19.3 percent) and coal plants (9.0 percent) demonstrated the highest outage factors in December, while natural gas plants and biomass plants recorded 8.6 percent and 6.5 percent, respectively.

Meanwhile, consistent with the discussions above, outage factor by category showed that forced outage capacity continued to be the main driver for most of the outages in the current month, recording an outage factor of 5.0 percent. This is attributable to the high forced outage factor of oil-based plants at 17.7 percent and geothermal plants at 8.6 percent. Maintenance outage factor came next at 3.4 percent, with natural gas plants recording the highest maintenance outage factor at 8.1 percent. Planned outage factor was posted at 1.2 percent this month, while outage factor related to deactivated shutdown remained at 0.5 percent.

Figure 4. Outage Factor (by Plant Type), December 2018, November 2018, December 2017

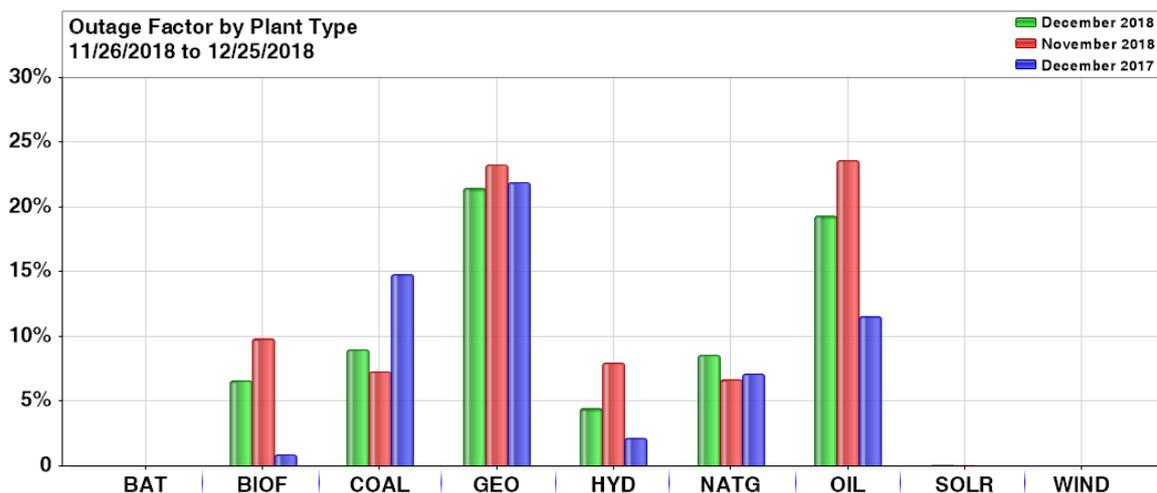


Figure 5. Outage Factor (by Outage Type), December 2018, November 2018, December 2017

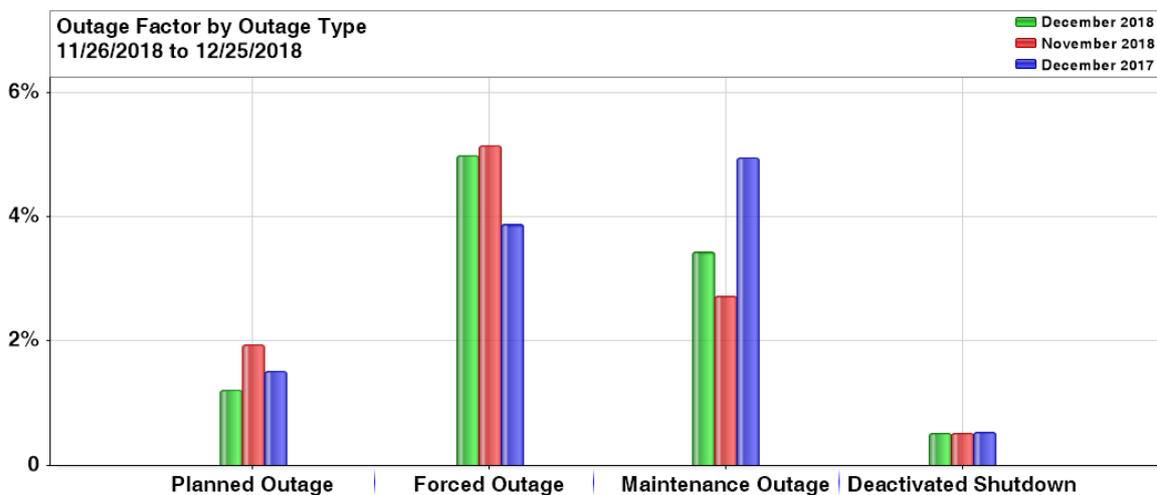


Table 4. Outage Factor, December 2018, November 2018, December 2017

Plant Type	Total Outage Factor			Forced Outage Factor			Maintenance Outage Factor			Planned Outage Factor			D/S Outage Factor		
	Dec 2018	Nov 2018	Dec 2017	Dec 2018	Nov 2018	Dec 2017	Dec 2018	Nov 2018	Dec 2017	Dec 2018	Nov 2018	Dec 2017	Dec 2018	Nov 2018	Dec 2017
BAT															
BIOF	6.5	9.8	0.8	5.9	8.4	0.3	0.7	1.4	0.4	0.0	0.0	0.1			
COAL	9.0	7.3	14.8	4.8	3.7	5.3	3.6	2.5	7.9	0.6	1.1	1.7			
GEO	21.4	23.3	21.9	8.6	15.5	14.1	3.6	0.8	0.8	3.7	1.4	1.5	5.5	5.5	5.5
HYD	4.4	7.9	2.1	0.1	0.6	0.9	0.2	0.1	0.1	4.1	7.2	1.2			
NATG	8.6	6.6	7.1		0.4	0.8	8.1	6.2	4.3	0.4	0.0	2.0			
OIL	19.3	23.6	11.5	17.7	15.9	1.7	1.6	4.5	8.2		3.2	1.6			
SOLR	0.1	0.1	0.0	0.1	0.1	0.0									
WIND															
Total	10.2	10.3	10.9	5.0	5.1	3.9	3.4	2.7	4.9	1.2	1.9	1.5	0.5	0.5	0.5

III. Demand and Supply Situation

System demand² continued to decrease during the December billing month recording an average of 9,446 MW, lower by 2.2 percent from previous month's 9,658 MW, as cooler temperatures prevailed as well as the observance of holidays on 30 November and on 24 and 25 December. Weekly average system demand ranged from a low 7,179 MW (from 24 to 25 December) up to 9,857 MW (from 3 to 9 December). Year-on-year, this year's average demand was 7.3 percent higher than previous year's 8,802 MW.

For this period, the reserve schedule averaged at 1,146 MW. Consequently, the demand plus reserve schedule averaged at 10,591 MW, posting a 1.3 percent decrease from last month's 10,729 MW and 8.7 percent increase from last year's 9,739 MW.

On the other hand, average effective supply³ demonstrated a 0.5 percent increase at 13,065 MW this month from previous month's 13,002 MW. Weekly average effective supply ranged from 11,976 MW (24 to 25 December) up to 13,473 MW (3 to 9 December). Similar with the year-on-year comparison of average demand, this year's average effective supply was higher than previous year's 12,298 MW.

Driven by the decrease in demand, supply margin⁴ widened by 8.8 percent this month at 2,474 MW coming from previous month's 2,273 MW. On the contrary, this month's average supply margin was lower when compared to previous year's 2,558 MW.

Figure 6. Demand and Effective Supply (Ex-ante), December 2018

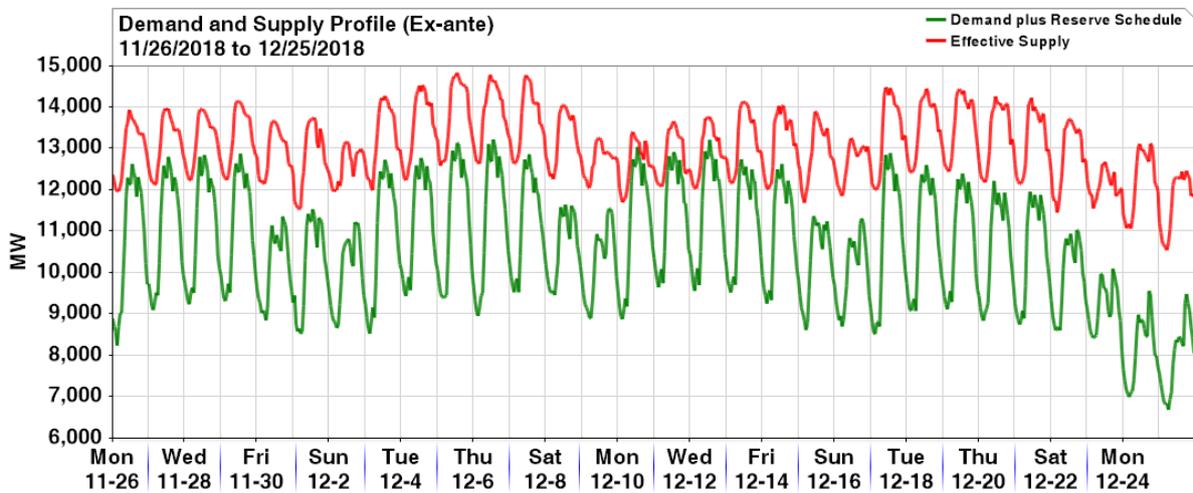


Table 5. Demand and Supply Summary (Ex-ante), December 2018, November 2018 and December 2017

	December 2018 (In MW)			November 2018 (In MW)			December 2017 (In MW)			% M-on-M Change (Nov 2018 - Dec 2018)			% Y-on-Y Change (Dec 2017 - Dec 2018)		
	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
Demand	11,851	5,856	9,446	11,957	6,851	9,658	11,101	6,067	8,802	(0.9)	(14.5)	(2.2)	6.8	(3.5)	7.3
Reserve Schedule	1,608	671	1,146	1,498	592	1,071	1,077	487	938	7.4	13.2	7.0	49.3	37.6	22.2
Demand plus R/S	13,226	6,692	10,591	13,152	7,443	10,729	12,131	6,875	9,739	0.6	(10.1)	(1.3)	9.0	(2.7)	8.7
Effective Supply	14,839	10,551	13,065	14,510	11,776	13,002	13,819	10,968	12,298	2.3	(10.4)	0.5	7.4	(3.8)	6.2
Supply Margin	4,437	89	2,474	4,655	176	2,273	4,800	732	2,558	(4.7)	(49.1)	8.8	(7.5)	(87.8)	(3.3)

Note: The derived values were non-coincident.

² Demand is equal to the total scheduled MW of all load resources in Luzon and Visayas plus losses.

³The system effective supply is equal to the offered capacity of all scheduled generator resources, nominated loading level of non-scheduled generating units and projected output of preferential dispatch generating units adjusted for any security limit and ramp rates. Scheduled output of plants on testing and commissioning, through the imposition of security limit by SO, are accounted for in the effected supply. Likewise included is the scheduled output of Malaya plant when it is called to run as Must Run Unit (MRU).

⁴The supply margin is equal to the effective supply less system demand requirement plus reserve schedule.

Table 6. Weekly Demand and Supply Summary (Ex-ante), December 2018

	26 Nov to 2 Dec 2018 (in MW)			3 to 9 Dec 2018 (in MW)			10 to 16 Dec 2018 (in MW)			17 to 23 Dec 2018 (in MW)			24 to 25 Dec 2018 (in MW)		
	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
Demand	11,586	7,403	9,519	11,734	7,650	9,857	11,851	7,568	9,768	11,309	7,225	9,286	8,451	5,856	7,179
Reserve Schedule	1,360	797	1,139	1,500	879	1,156	1,608	904	1,217	1,586	808	1,144	1,176	671	890
Demand plus R/S	12,885	8,245	10,658	13,226	8,529	11,013	13,216	8,619	10,984	12,895	8,126	10,430	9,562	6,692	8,069
Effective Supply	14,149	11,546	13,009	14,839	12,002	13,473	14,142	11,697	12,930	14,487	11,459	13,159	13,126	10,551	11,976
Supply Margin	3,737	1,054	2,351	4,128	1,311	2,459	3,379	89	1,945	3,910	1,573	2,729	4,437	2,978	3,907

IV. Market Price Outcome⁵

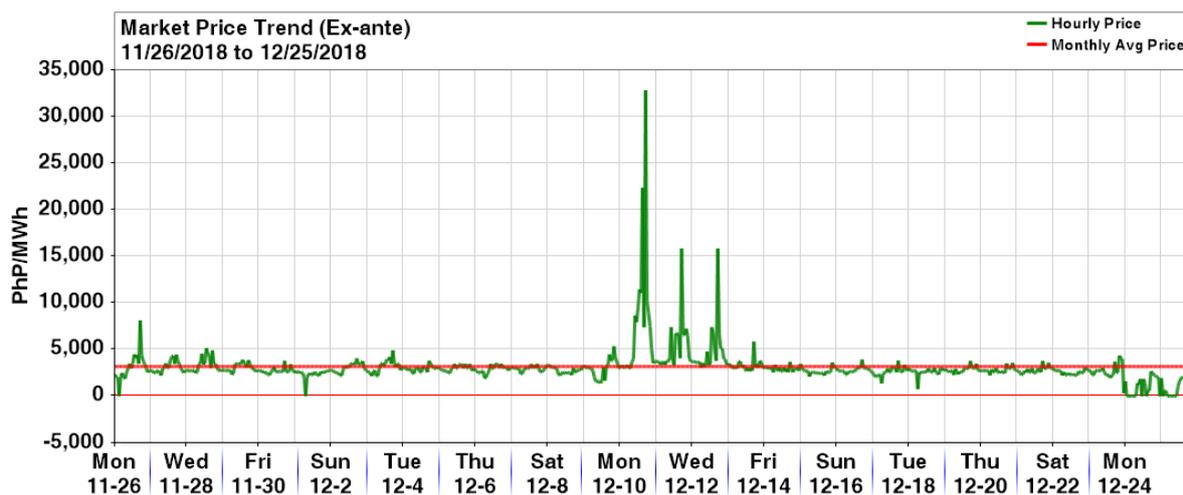
A. Market Prices

Market prices recorded a lower average at PhP3,186/MWh from previous month's PhP3,324/MWh following the wider supply margin observed this month. This was, however, higher by 31.4 percent compared to PhP2,424/MWh in December 2017 attributable to the better supply and demand conditions in the previous year.

Price spikes reaching as high as PhP32,827/MWh were noted from 10 to 12 December attributable to the relatively tight supply margin recorded during the period. High level of outage capacity involving coal plants Mariveles CFTPP unit 1 (316 MW), Calaca CFTPP unit 2 (300 MW), SMC Limay CFTPP unit 1 (150 MW), SLTEC CFTPP unit 2 (123 MW) and natural gas plant San Gabriel NGPP (420 MW) was observed during the period.

Prices were generally below PhP9,000/MWh for the rest of the billing month. The weekly average prices went as low as PhP1,396/MWh from 24 to 25 December driven by the low demand during the holidays.

Figure 7. Market Price Trend, December 2018



⁵The market prices were represented by the following: (i) ex-ante load weighted average price (LWAP) for trading intervals without pricing error during ex-ante, (ii) ex-post LWAP for trading intervals with pricing error during ex-ante but without pricing error during ex-post, (iii) LWAP based on the market re-run result for trading intervals with pricing error both during ex-ante and ex-post, and (iv) estimated load reference price (ELRP) for trading intervals where the ERC-approved Price Substitution Mechanism (PSM) was applied.

Table 7. Market Price Summary, December 2018, November 2018 and December 2017

	December 2018 (In PhP/MWh)			November 2018 (In PhP/MWh)			December 2017 (In PhP/MWh)			% M-on-M Change (Nov 2018 - Dec 2018)			% Y-on-Y Change (Dec 2017 - Dec 2018)		
	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
Luz-Vis	32,827	0	3,186	32,077	0	3,324	6,824	0	2,424	2.3		(4.1)	381.1		31.4
Luzon	32,828	0	3,191	32,493	0	3,322	6,824	0	2,431	1.0		(3.9)	381.1		31.3
Visayas	32,827	-10,951	3,164	31,664	0	3,336	6,824	-515	2,390	3.7		(5.2)	381.0	(2,024.8)	32.4

Table 8. Weekly Market Price Summary, December 2018

	26 Nov to 2 Dec 2018 (in PhP/MWh)			3 to 9 Dec 2018 (in PhP/MWh)			10 to 16 Dec 2018 (in PhP/MWh)			17 to 23 Dec 2018 (in PhP/MWh)			24 to 25 Dec 2018 (in PhP/MWh)		
	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
Luz-Vis	8,140	0	3,039	5,346	1,406	2,977	32,827	2,099	4,372	4,350	301	2,711	4,176	0	1,396

The market prices in Luzon averaged at PhP3,191/MWh, higher by 0.9 percent than the PhP3,164/MWh recorded in the Visayas region. Price separation was noted on 9 December following the planned outage of the HVDC link due to the scheduled shutdown of Naga Converter Station. During this period, Visayas region also recorded negative market prices.

Figure 8. Market Price Trend - Luzon, December 2018

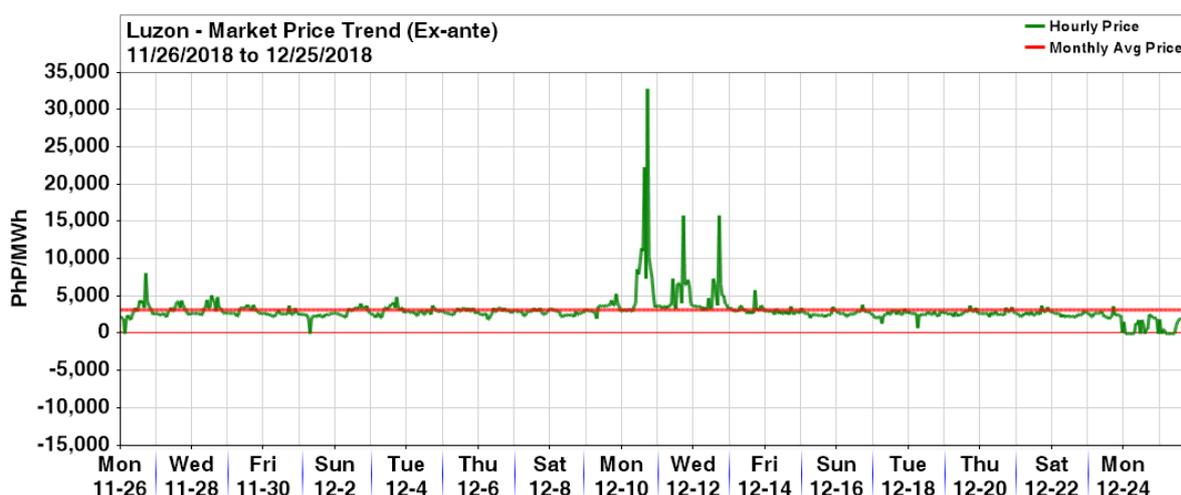


Figure 9. Market Price Trend - Visayas, December 2018

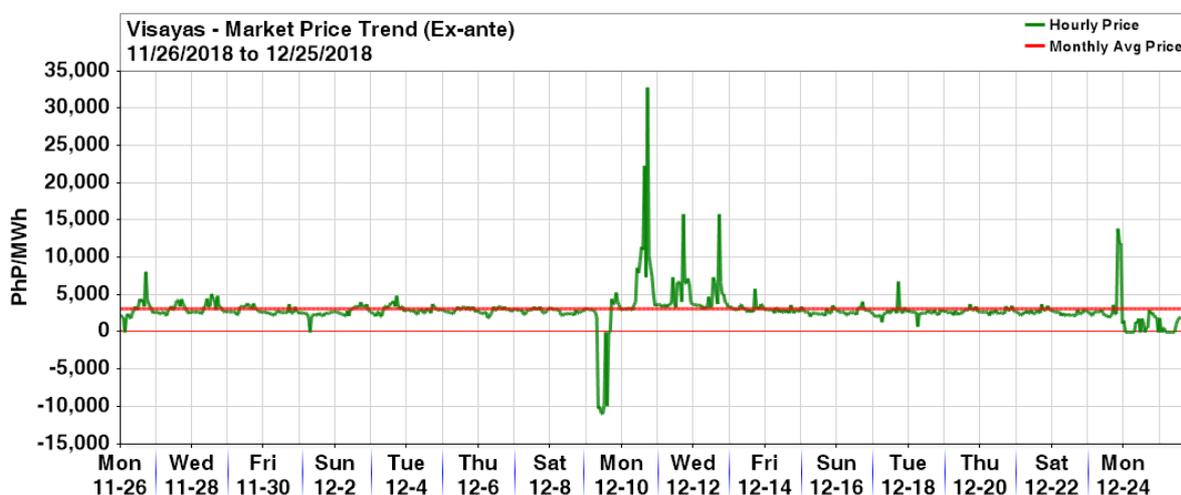


Table 9. Regional Price Summary – December 2018, November 2018 and December 2017

	Luzon (In PhP/MWh)			Visayas (In PhP/MWh)			% Difference		
	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
December 2018	32,828	0	3,191	32,827	-10,951	3,164	0.0	(100.0)	0.9
November 2018	32,493	0	3,322	31,664	0	3,336	2.6		(0.4)
December 2017	6,824	0	2,431	6,824	-515	2,390	0.0	(100.0)	1.7

B. Price Distribution

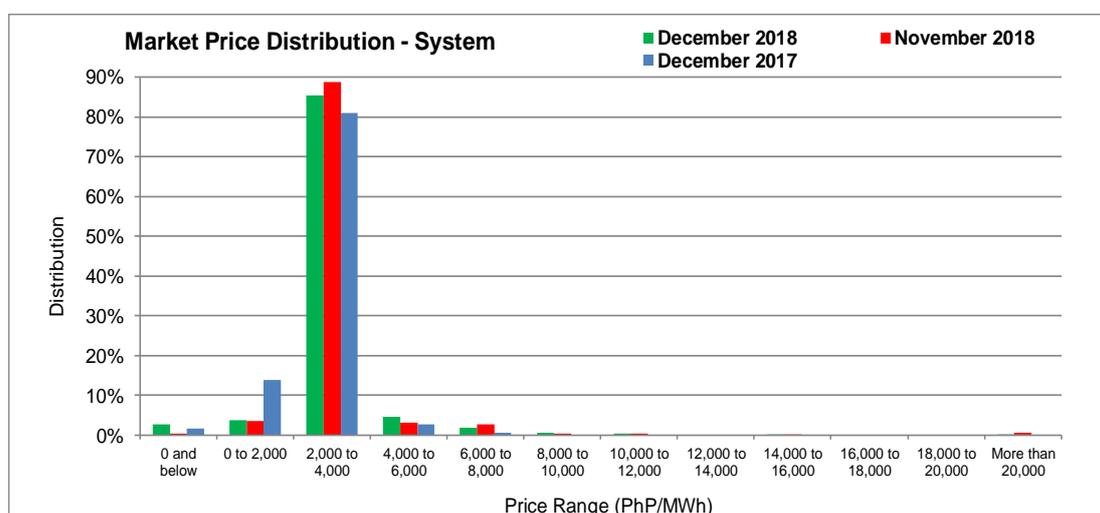
Consistent with the decrease in month-on-month average prices, higher frequency of prices below PhP2,000/MWh was noted this month at 6.5 percent from 3.9 percent in the previous month. Also, lower frequency was recorded at above PhP20,000/MWh at 0.3 percent this month from 0.5 percent in November.

In addition, lower frequency of prices at PhP6,000/MWh up to PhP16,000/MWh from previous month's 3.6 percent to current month's 3.2 percent.

Figure 10. Price Distribution, December 2018, November 2018 and December 2017

Price Range (PhP/MWh)	% Distribution		
	December 2018	November 2018	December 2017
0 and below	2.8	0.4	1.7
0 to 2,000	3.8	3.5	13.9
2,000 to 4,000	85.4	88.7	81.0
4,000 to 6,000	4.6	3.2	2.8
6,000 to 8,000	1.9	2.7	0.7
8,000 to 10,000	0.6	0.4	0.0
10,000 to 12,000	0.4	0.4	0.0
12,000 to 14,000	0.0	0.0	0.0
14,000 to 16,000	0.3	0.1	0.0
16,000 to 18,000	0.0	0.0	0.0
18,000 to 20,000	0.0	0.0	0.0
More than 20,000	0.3	0.5	0.0

Table 10. Price Distribution – December 2018, November 2018 and December 2017



C. Price Duration Curve

The price duration curves for both the off-peak⁶ and peak⁷ hours demonstrate that market prices during the peak hours were higher when compared with off-peak hours.

Majority of the prices during off-peak hours (85 percent) were between PhP2,000/MWh to PhP4,000/MWh. On the other hand, the remaining market prices were between PhP6,000/MWh to PhP21,000/MWh (4.6 percent). As shown in Figure 12, 85 percent of the prices during peak hours ranged between PhP2,000/MWh to PhP4,000/MWh. Meanwhile, another 4.6 percent were between PhP6,000/MWh to PhP8,000/MWh, 3.75 percent were above PhP0/MWh to PhP2,000/MWh while 2.8 percent was below PhP2,000/MWh. The remaining 2.3 percent were above PhP10,000/MWh.

Figure 11. Price Duration Curve (Off-Peak Period), December 2018

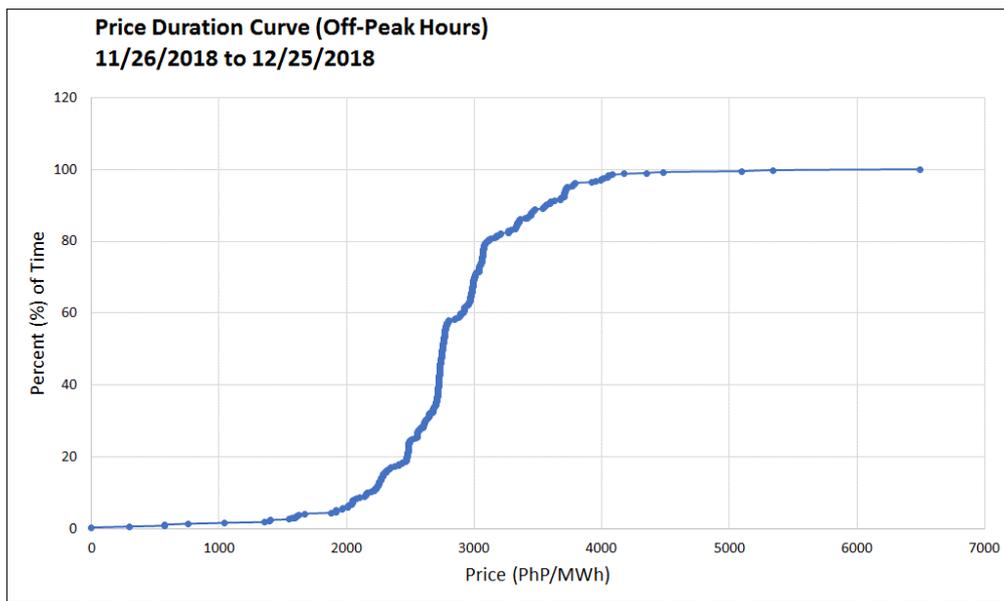
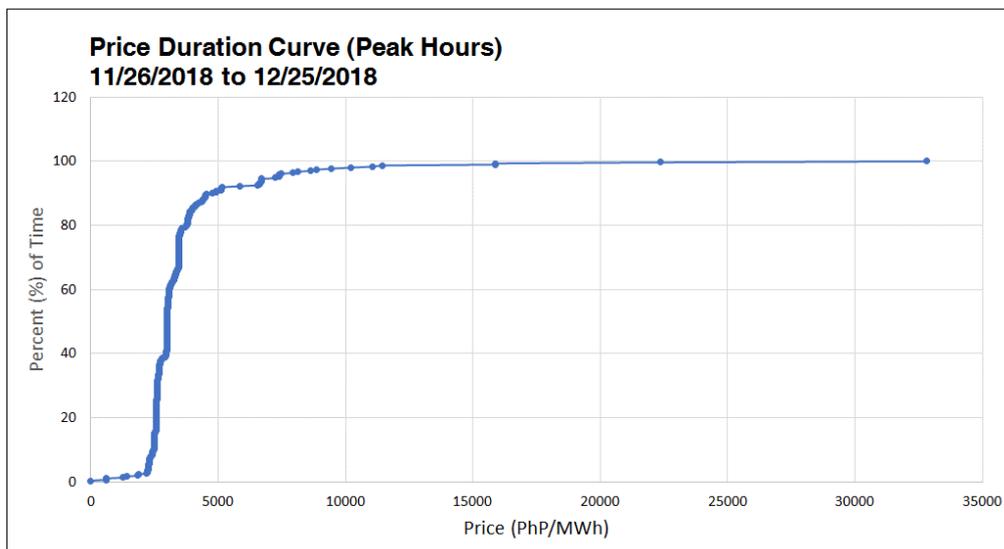


Figure 12. Price Duration Curve (Peak Period), December 2018



⁶Off-peak hours include 0100H to 0900H and 2200H to 2400H from Mondays to Sundays and 0100H to 1800H and 2100H to 2400H on Sundays and Holidays

⁷Peak hours include 1000H-2100H from Mondays to Sundays and 1900H-2000H on Sundays and Holidays

D. Interesting Pricing Event

Interesting pricing events refer to intervals determined to have price outliers based on the relationship of market price and supply margin. Prices within the upper and lower reference price thresholds are considered as “normal prices”, while prices outside or beyond the thresholds are tagged as “interesting pricing events”. Annex A provides details on the MSC-approved methodology in determining interesting pricing events.

Out of the 720 trading intervals, two (2) intervals have market prices above the upper reference price thresholds, and are therefore tagged as interesting pricing events. On the other hand, no interval has a price below the lower price threshold. Moreover, the secondary price cap was not imposed during the billing period. The market prices on 10 December at 1600H and 1800H were interesting pricing events.

Figure 13. Supply Margin and Market Price, December 2018

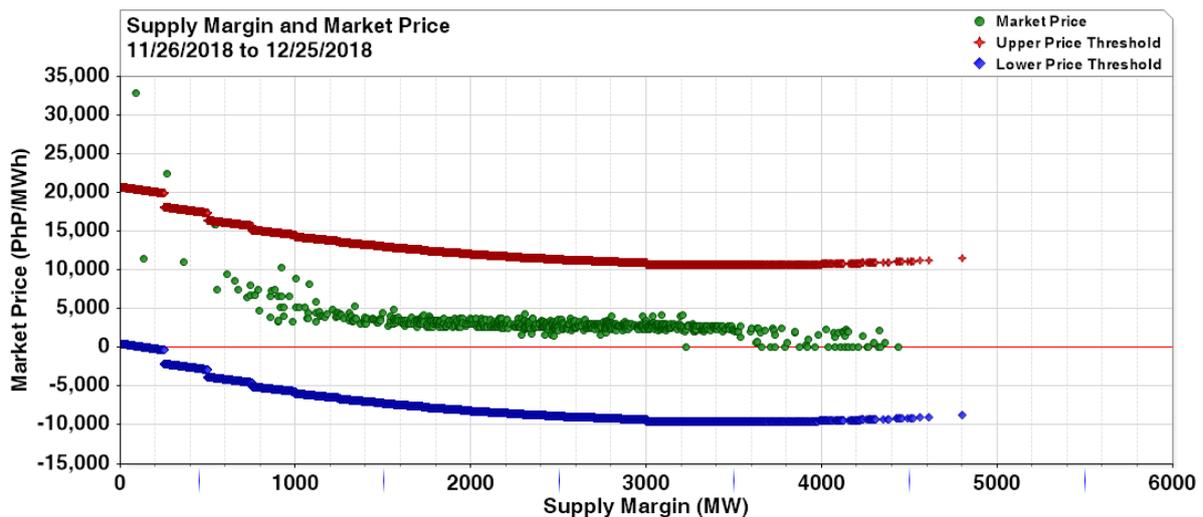


Table 11. Interesting Pricing Events – December 2018

Date	Hour	Market Price (PhP/MWh)	Supply Margin (MW)	Reference Price Threshold (PhP/MWh)
12/10/2018	18	32,827	89	20,436
12/10/2018	16	22,342	269	18,088

V. Pricing Errors and Market Intervention

System-wide non-congestion pricing errors affected 4 trading intervals or 0.6 percent of the time in the ex-ante and 3 trading intervals or 0.4 percent of the time in the ex-post during the December billing month, related to inappropriate input data. This posted a decrease from previous month’s non-congestion pricing error occurrences that affected 7 trading intervals or 0.9 percent of the time during the ex-ante and ex-post.

In Visayas, non-congestion pricing errors affected seven (7) trading intervals or 1.0 percent of the time, higher than last month’s 3 trading intervals or 0.4 percent of the time in the ex-ante and four (4) trading intervals or 0.6 percent of the time were affected in the ex-post, lower than last month’s five (5) trading intervals or 0.7 percent of the time.

Meanwhile, a decrease in the system-wide application of Price Substitution Methodology (PSM) was observed this month, affecting a total of 84 trading intervals or 11.7 percent of the time (previous month's 111 trading intervals or 14.9 percent of the time) in the ex-ante and 84 trading intervals or 11.7 percent of the time (previous month's 117 trading intervals or 15.7 percent of the time) in the ex-post. PSM application this month was mainly due to the constraint on Samboan-Amlan Line 1 (Cebu-Negros submarine cable).

Table 12. PEN, PSM and MI Summary, December 2018

	Luz-Vis		Luzon		Visayas		Total	
	Freq.	% of Time	Freq.	% of Time	Freq.	% of Time	Freq.	% of Time
PEN (RTD)	4	0.6	-	-	7	1.0	11	1.5
PEN (RTX)	3	0.4	1	0.1	4	0.6	8	1.1
PSM (RTD)	84	11.7	-	-	-	-	84	11.7
PSM (RTX)	84	11.7	-	-	4	0.6	88	12.2

Note: The column "Total" refers to the total number of trading intervals with PEN, PSM or MI (system-wide or regional)

Shown in Table 13 below are the non-congestion pricing errors by type during the month. The system-wide non-congestion pricing errors, affecting a total of 5 trading intervals in the ex-ante were related to base case as well as inappropriate input data while 3 trading intervals in the ex-post were all related to inappropriate input data.

In Luzon, pricing errors due to base case constraint affected only one (1) trading interval in the ex-post.

On the other hand, pricing errors due to over-generation affected three (3) trading intervals and four (4) trading intervals due to load shedding in the Visayas during the ex-ante and pricing errors due to over-generation affected four (4) trading intervals during the ex-post.

Table 13. PEN Type Summary, December 2018

	Luz-Vis		Luzon		Visayas		Total	
	Freq.	% of Time	Freq.	% of Time	Freq.	% of Time	Freq.	% of Time
PEN (RTD)	5	0.7	-	-	7	1.0	12	1.7
Contingency		-		-		-	-	-
Base Case	1	0.1		-		-	1	0.1
Over-generation		-		-	3	0.4	3	0.4
VoLL		-		-	4	0.6	4	0.6
Inappropriate Input Data	4	0.6		-		-	4	0.6
PEN (RTX)	3	0.4	1	0.1	4	0.6	8	1.1
Contingency		-		-		-	-	-
Base Case		-	1	0.1		-	1	0.1
Over-generation		-		-	4	0.6	4	0.6
VoLL		-		-		-	-	-
Inappropriate Input Data	3	0.4		-		-	3	0.4

VI. HVDC Scheduling

Power flow through the HVDC Interconnection was generally directed towards the Luzon region for 554 trading intervals in the ex-ante during the billing month.

On the other hand, the HVDC power flow was directed towards the Visayas for 157 trading intervals in the ex-ante during the billing month, with schedules ranging from 1 MW to 250 MW. It was noted that the 420-MW limit was maximized for nine (9) trading intervals during the billing month.

Figure 14. Summary of HVDC Limits Imposed by NGCP-SO, December 2018

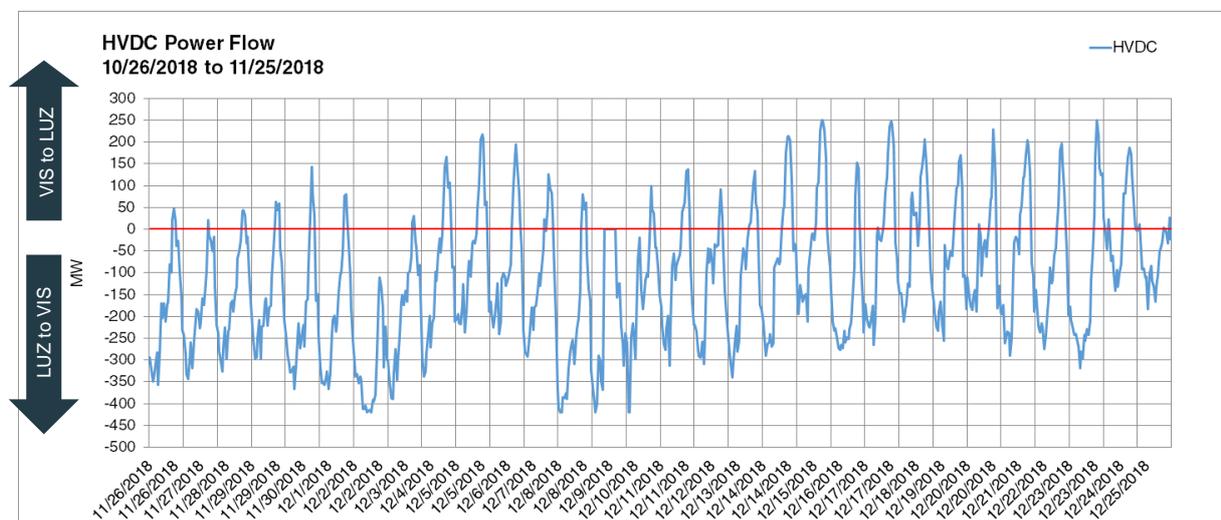


Table 14. Summary of HVDC Limits Imposed by NGCP-SO and Results of HVDC Schedules (Ex-ante and Ex-post), December 2018

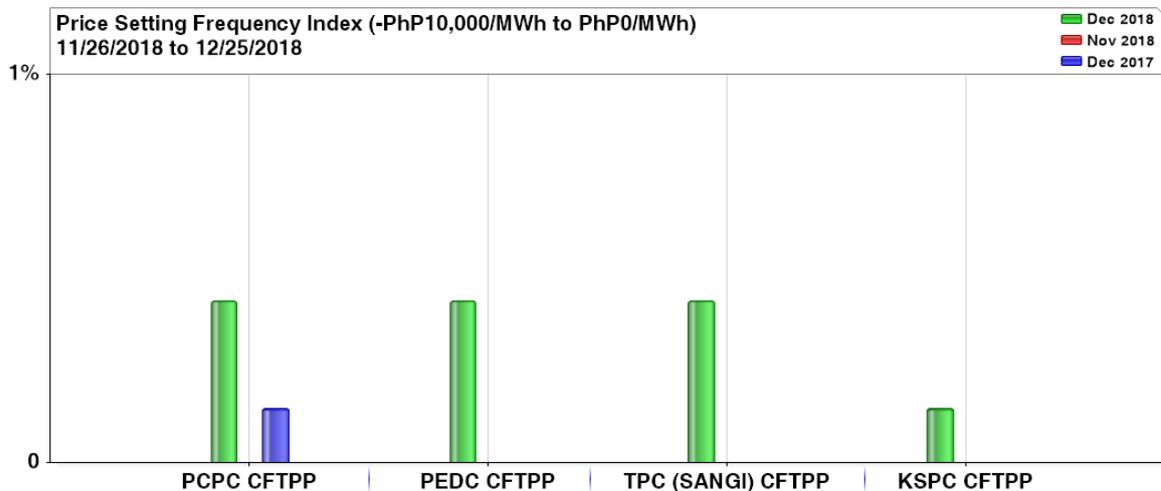
Results of HVDC Scheduling	HVDC Limit during Ex-ante (Visayas/Luzon)			HVDC Limit during Ex-post (Visayas/Luzon)		
	(No. of Trading Intervals)			(No. of Trading Intervals)		
	0/0	250/420	Total	0/0	250/420	Total
Visayas to Luzon	-	554	554	-	561	561
Limit Not Maximized		548	548		551	551
Limit Maximized ¹¹		6	6		10	10
Luzon to Visayas	-	157	157	-	-	150
Limit Not Maximized		154	154		147	147
Limit Maximized ¹¹		3	3		3	3
No Flow ¹¹	9		9	9		9
TOTAL	9	711	720	9	561	570

VII. Price Setting Plants⁸

⁸ A generator trading node is considered as a price setter when its last accepted offer price is between 95% to 100% of its nodal price. A generating plant is considered as price setter if at least one of its trading nodes was price setter in a given trading hour.

Market prices at -PhP10,000/MWh were noted at 0.42 percent of the time during the billing month. The frequent price-setters are coal plants, topped by PCPC CFTPP, PEDC CFTPP and TPC (Sangi) CFTPP which set the price at this level at 0.4 percent each, followed by KSPC CFTPP at 0.1 percent.

Figure 15. Price Setting Frequency Index (-PhP10,000/MWh) - December 2018, November 2018 and December 2017



About 96.3 percent of the market prices in December were below PhP5,000/MWh. Coal and natural gas plants figured as the top frequent price-setters in Luzon, with Masinloc CFTPP setting the price in 44.0 percent of the time during the month, followed by Pagbilao CFTPP at 26.3 percent, Sual CFTPP at 24.7 percent, SLTEC CFTPP at 19.3 percent, QPPL CFTPP at 17.2 percent, Pabilao unit 3 at 16.1 percent and Ilijan NGPP at 15.0 percent.

In the Visayas, coal plants CEDC CFTPP, PCPC CFTPP, TPC (Sangi) CFTPP, and PEDC CFTPP were the most frequent price-setters at below PhP5,000/MWh, setting the price at 20.8 percent, 16.8 percent, 12.9 percent and 12.4 percent of the time, respectively, during the month.

The determination of the price setter/s in a trading interval factors in the prevailing pricing condition for the same. The price setters are determined from: (i) ex-ante for trading intervals without pricing error during ex-ante, (ii) ex-post with pricing error during ex-ante but without pricing error during ex-post, (iii) market re-run results for trading intervals with pricing error both in ex-ante and ex-post, and (iv) trading intervals where the price substitution methodology (PSM) was applied. For trading intervals affected by PSM, the unconstrained marginal plants are considered price setters. Further, in instances of regional price separation, price setters are determined separately for each region.

Figure 16. Price Setting Frequency Index (PhP5,000/MWh and Below) - Luzon, December 2018, November 2018 and December 2017

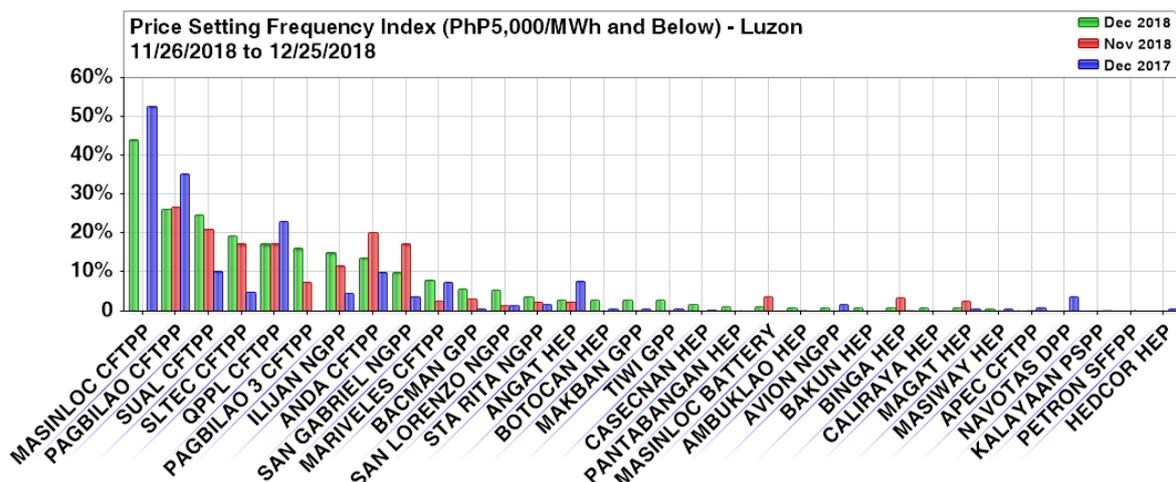
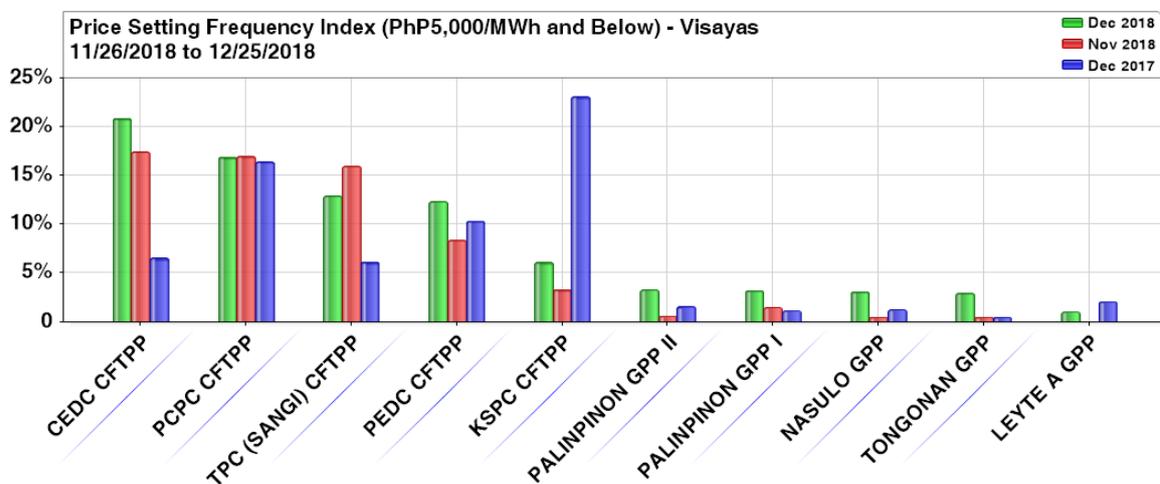
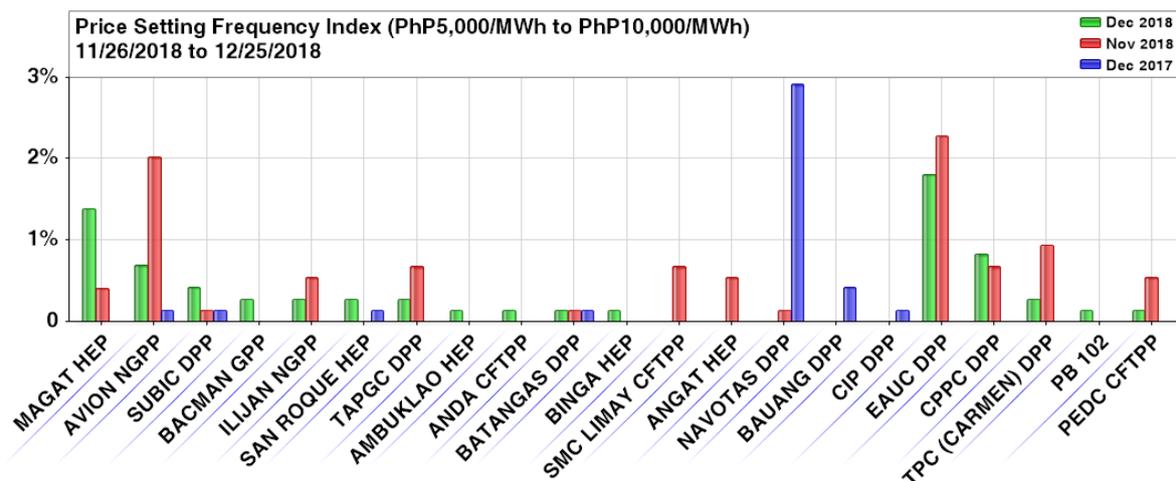


Figure 17. Price Setting Frequency Index (PhP5,000/MWh and Below) - Visayas, December 2018, November 2018 and December 2017



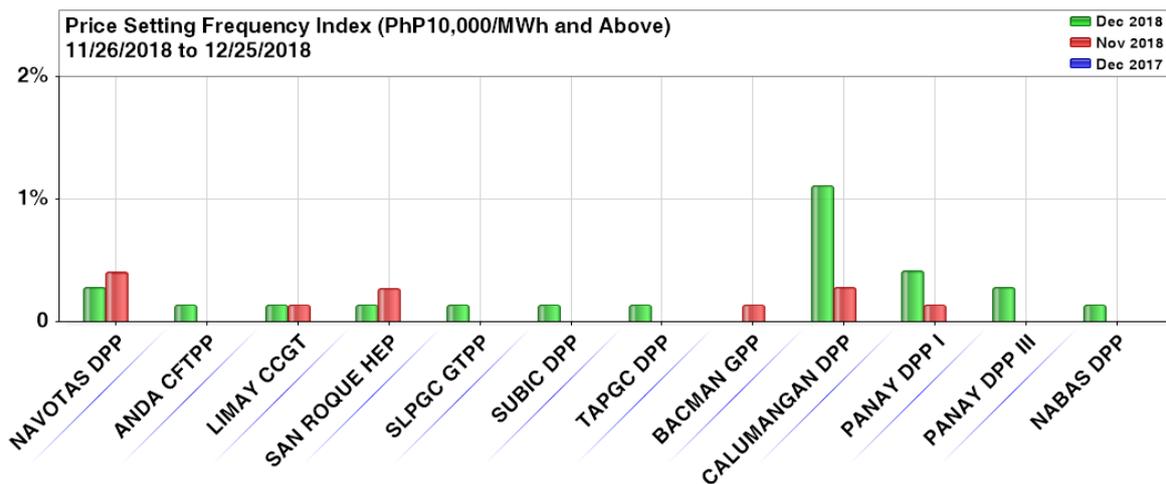
Market prices ranged above PhP5,000/MWh to PhP10,000/MWh at 2.26 percent of the time during the month, a marked decrease from last month's 4.03 percent. Oil-based, hydro and natural gas plants obtained the highest frequencies in setting the prices at this level, topped by EAUC DPP at 1.8 percent, Magat HEP at 1.4 percent, CPCC DPP at 0.8 percent, Avion NGPP at 0.7 percent and Subic DPP at 0.4 percent.

Figure 18. Price Setting Frequency Index (Above PhP5,000/MWh to PhP10,000/MWh), December 2018, November 2018 and December 2017



Market prices above PhP10,000/MWh were noted at 0.94 percent of the time during the billing month. The most frequent price-setters are mostly oil-based plants, topped by Calumangan DPP, which set the price at this level at 1.11 percent. Panay DPP I was next on the list at 0.4 percent, followed by Navotas DPP, and Panay DPP III at 0.2 percent each.

Figure 19. Price Setting Frequency Index (Above PhP10,000/MWh), December 2018, November 2018 and December 2017

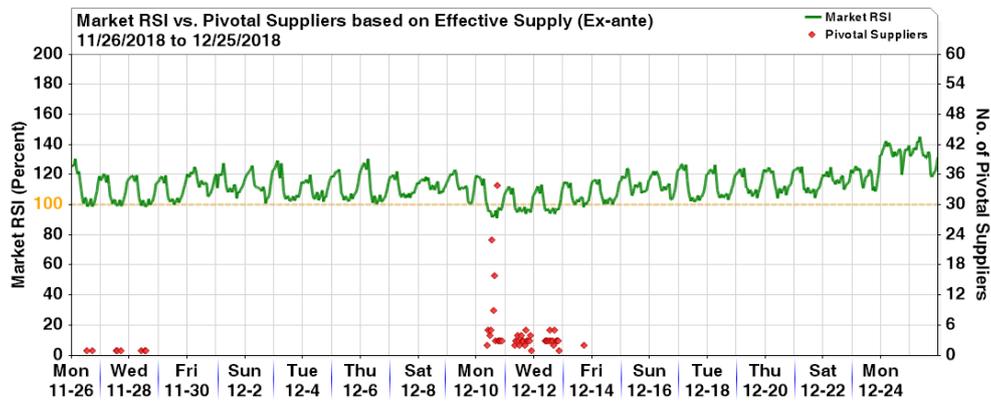


VIII. Residual Supply

The succeeding figure below show the hourly trend of the Market Residual Supply Index (Market RSI)⁹ plotted against the number of pivotal supplier/s.

The hourly market RSI exceeded the 100 percent mark for 93 percent of the time or in 673 trading intervals, an increase from previous month’s 90 percent. This indicated that fewer trading intervals had pivotal suppliers.

Figure 20. Market RSI vs. Pivotal Suppliers (Ex-Ante), December 2018

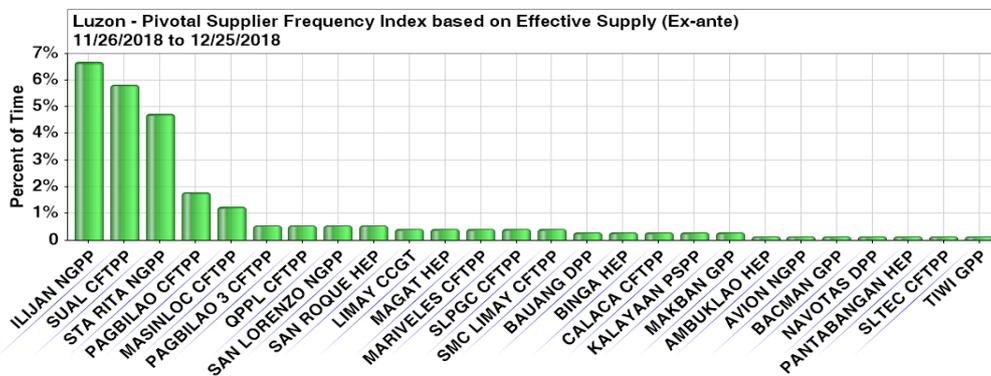


IX. Pivotal Suppliers¹⁰

A total of 26 Luzon plants emerged as pivotal suppliers during the December billing month led by Ilijan NGPP for having been pivotal for 96.7 percent of the time and Sual CFTPP for 5.8 percent. Other Luzon plants namely Sta. Rita NGPP, Pagbilao CFTPP, and Masinloc CFTPP.

Eight (8) Visayas plants were considered as pivotal suppliers this month led by Leyte A GPP and PEDC CFTPP at 0.4 percent of the time each. CEDC CFTPP and KSPC CFTPP likewise emerged as pivotal supplier this billing month at 0.3 percent of the time each.

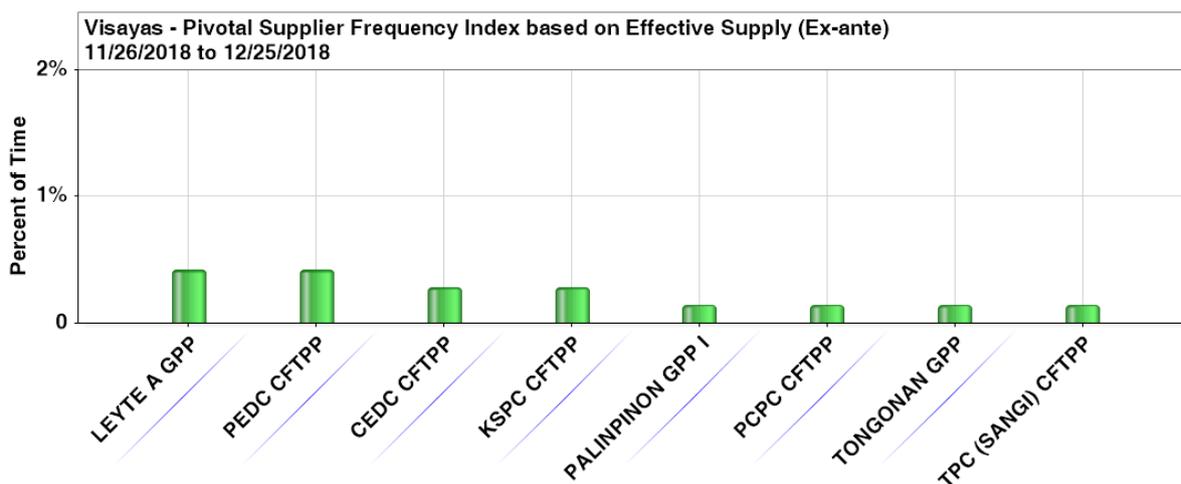
Figure 21. Pivotal Supplier Frequency Index - Luzon, December 2018



⁹ For a generator, the Residual Supply Index (RSI) is a dynamic continuous index measured as ratio of the available generation without that generator to the total generation required to supply the demand. The Market RSI is measured as the lowest RSI among all generators in the market. A Market RSI less 100% indicates the presence of pivotal generator/s or supplier/s.

¹⁰ The Pivotal Supply Index (PSI) measures how critical a particular generator is in meeting the total demand at a particular time. It is a binary variable (1 for pivotal and 0 for not pivotal) which measures the frequency that a generating is pivotal for a particular period.

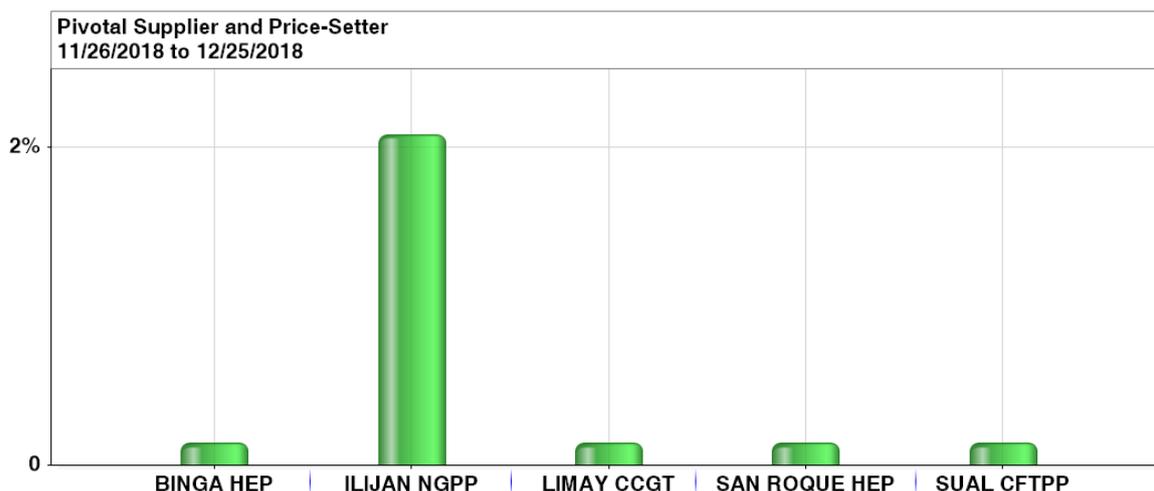
Figure 22. Pivotal Supplier Frequency Index - Visayas, December 2018



X. Price-Setters and Pivotal Plants

Natural gas plants Ilijan NGPP became the top price setters while it was pivotal at 2.08 percent followed by hydro plants Binga HEP, San Roque HEP, coal plant Sual CFTPP and Limay CCGT at 0.13 percent of the time respectively during the December billing month.

Figure 23. PSI vs. PSFI, December 2018

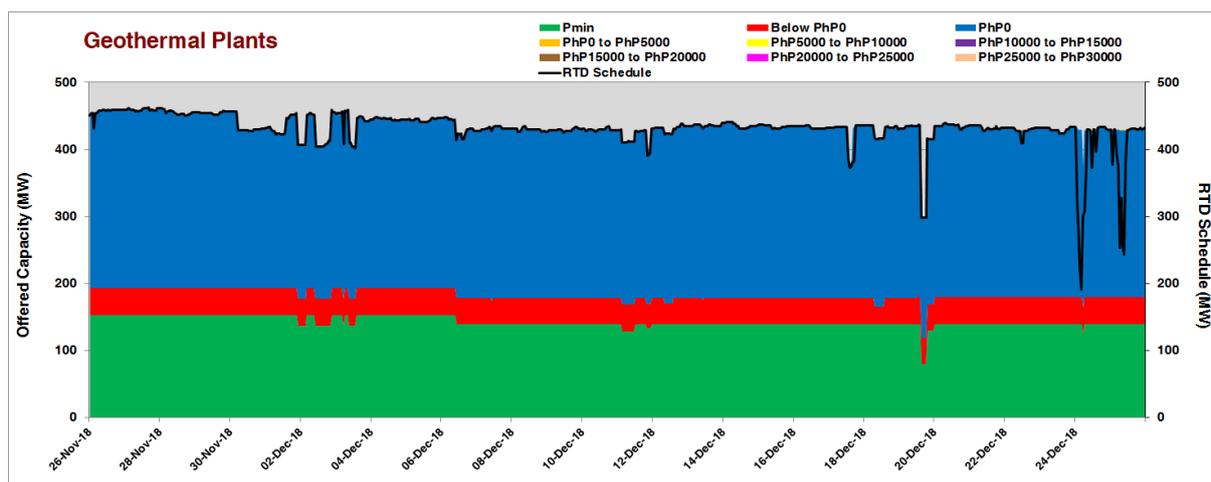


XI. Generator Offer Pattern

Geothermal plants in Luzon submitted almost its entire capacity (99.9 percent) at PhP0/MWh and below. About 58.0 percent of the offer prices were at exactly PhP0/MWh, while the remaining 41.9 percent were at below PhP0/MWh. The remaining 0.1 percent of the offers were at prices above PhP0/MWh to PhP5,000/MWh.

Considering the low offer prices of Luzon geothermal plants, almost all of its submitted capacity offers, at 99.3 percent, were scheduled for dispatch in the market during the billing month.

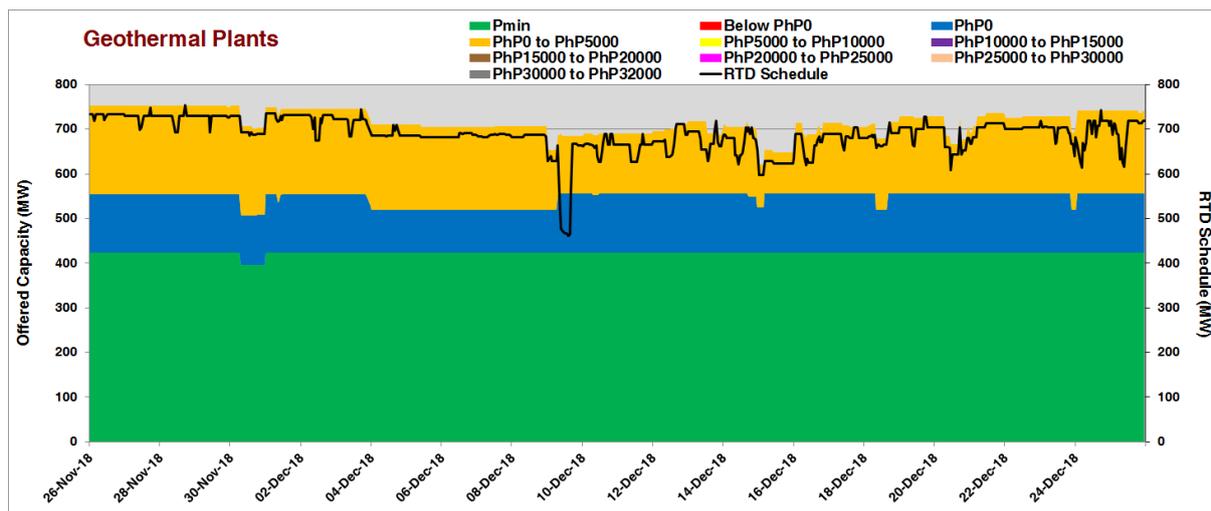
Figure 24. Geothermal Plants Offer Pattern, Luzon – December 2018



Geothermal plants in the Visayas demonstrated slightly higher-priced offers compared with the geothermal plants in Luzon. While about 76.3 percent of its capacity offers were priced at PhP0/MWh and below, the remaining 23.7 percent were priced higher at above PhP0/MWh to PhP5,000/MWh.

Accordingly, 96.1 percent of the offers submitted by the Visayas geothermal plants were scheduled for dispatch during the month.

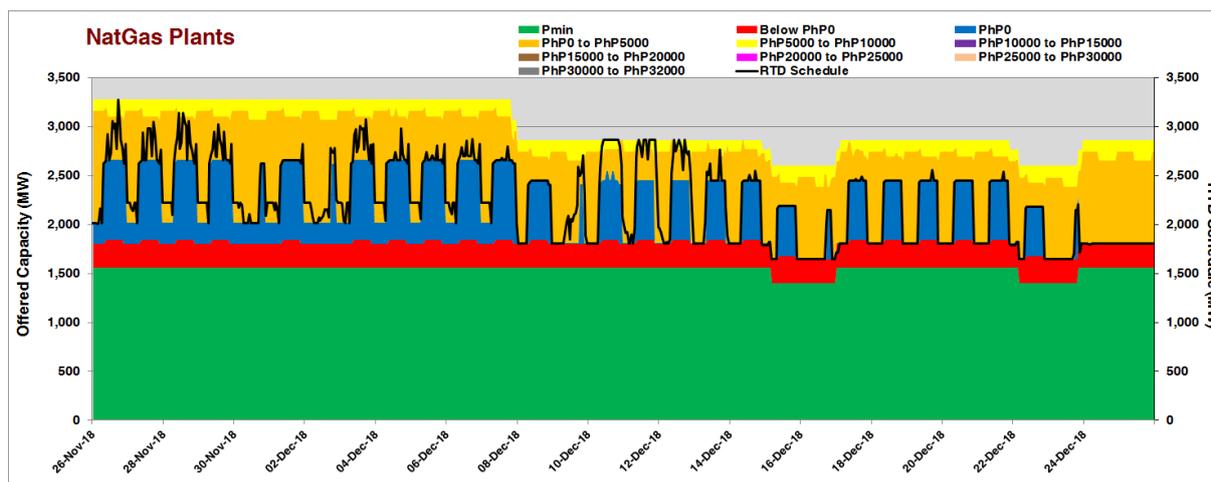
Figure 25. Geothermal Plants Offer Pattern, Visayas – December 2018



Natural gas plants offered 72.7 percent of its capacity at PhP0/MWh and below. The remaining 22.6 percent comprised of higher offer prices ranging above PhP0/MWh to PhP5,000/MWh, while another 4.7 percent were offers priced above PhP5,000/MWh to PhP10,000/MWh.

Correspondingly, 75.3 percent of the offers submitted by natural gas plants were scheduled for dispatch during the month.

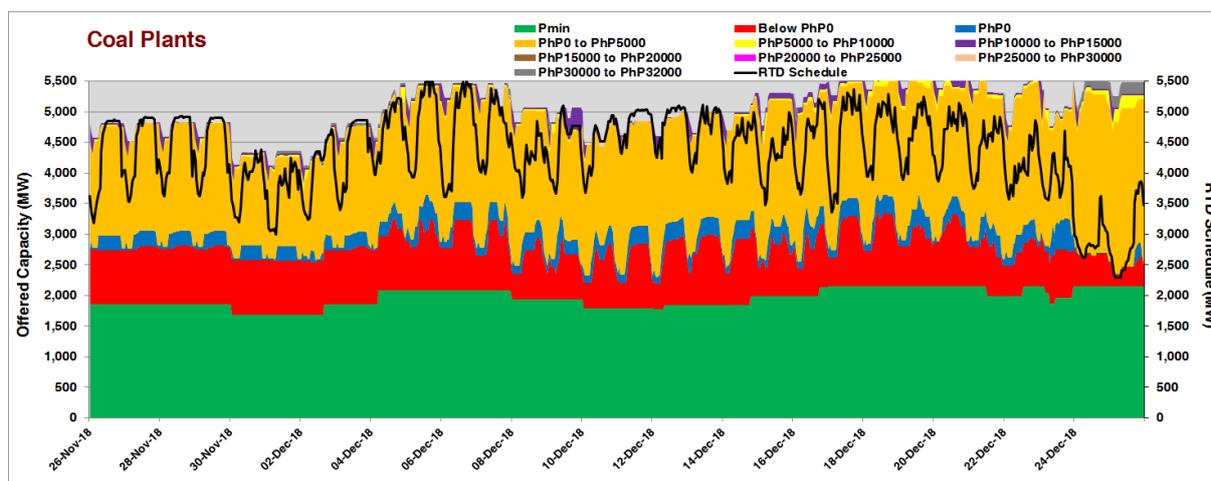
Figure 26. Natural Gas Plants Offer Pattern, Luzon – December 2018



Luzon coal plants offered 59.2 percent of its capacity at PhP0/MWh and below, and a considerable portion (38.1 percent) at prices ranging above PhP0/MWh to PhP5,000/MWh which indicates a higher month-on-month comparison, having offered only 35.6 percent of its capacity at this price range in November. The remaining capacity was offered at higher prices. 2.3 percent were distributed to prices above PhP5,000/MWh to PhP15,000/MWh, while another 0.4 percent of the offers were priced above PhP30,000/MWh to PhP32,000/MWh.

Respectively, 86.1 percent of the offered capacity of Luzon coal plants was scheduled for dispatch during the month.

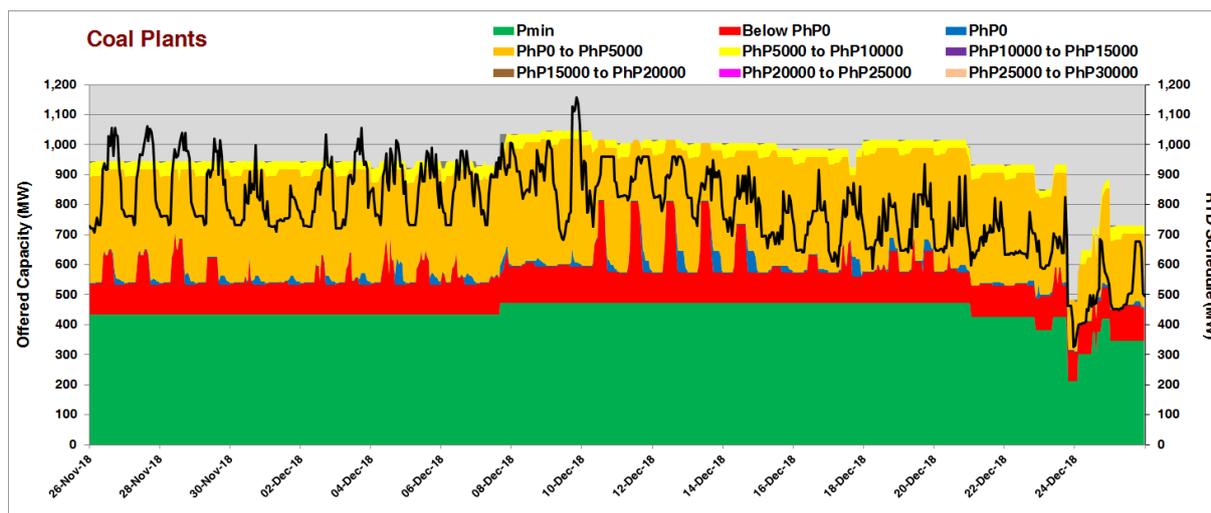
Figure 27. Coal Plants Offer Pattern – Luzon, December 2018



On the other hand, Visayas coal plants submitted 61.1 percent of its capacity offers at PhP0/MWh and below. Another 35.4 percent comprised of offers priced above PhP0/MWh to PhP5,000/MWh. Similar with the offer pattern exhibited by Luzon coal plants, the Visayas coal plants likewise offered at higher prices during the month. It is observed that 3.4 percent of its offers were priced above PhP5,000/MWh to PhP10,000/MWh (from last month's 3.7 percent). Only 0.1 percent of its offers were priced above PhP30,000/MWh to PhP32,000/MWh.

82.8 percent of its total offered capacity was scheduled for dispatch in the market during the December billing month, lower than last month's 84.9 percent.

Figure 28. Coal Plants Offer Pattern, Visayas – December 2018

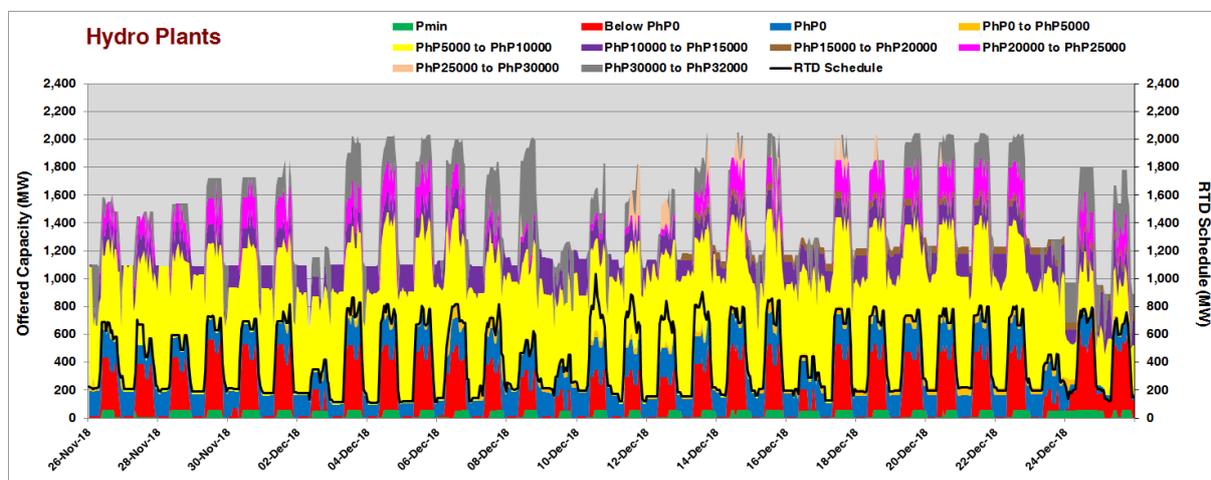


Luzon hydro plans submitted 26.7 percent of its offers at PhP0/MWh and below, 2.1 percent at above PhP0/MWh to PhP5,000/MWh, and a considerable portion (45.7 percent) at higher prices ranging above PhP5,000/MWh to PhP10,000/MWh.

25.6 percent were priced even higher at above PhP10,000/MWh. Of which, 8.8 percent comprised of offer prices distributed above PhP10,000/MWh to PhP15,000/MWh, 1.5 percent of prices above PhP15,000/MWh to PhP20,000/MWh, 5.3 percent of prices above PhP20,000/MWh to PhP25,000/MWh, and 0.6 percent above PhP25,000/MWh to PhP30,000/MWh. The remaining 9.4 percent were offer prices ranging above PhP30,000/MWh to PhP32,000/MWh. It is noted that Luzon hydro plants submitted a slightly higher offer prices this month when compared with the previous billing month which recorded only 23.12 percent of its offer prices at above PhP10,000/MWh.

Accordingly, 29.8 percent of the offered capacity of Luzon hydro plants was scheduled for dispatch.

Figure 29. Hydro Plants Offer Pattern, Luzon – December 2018

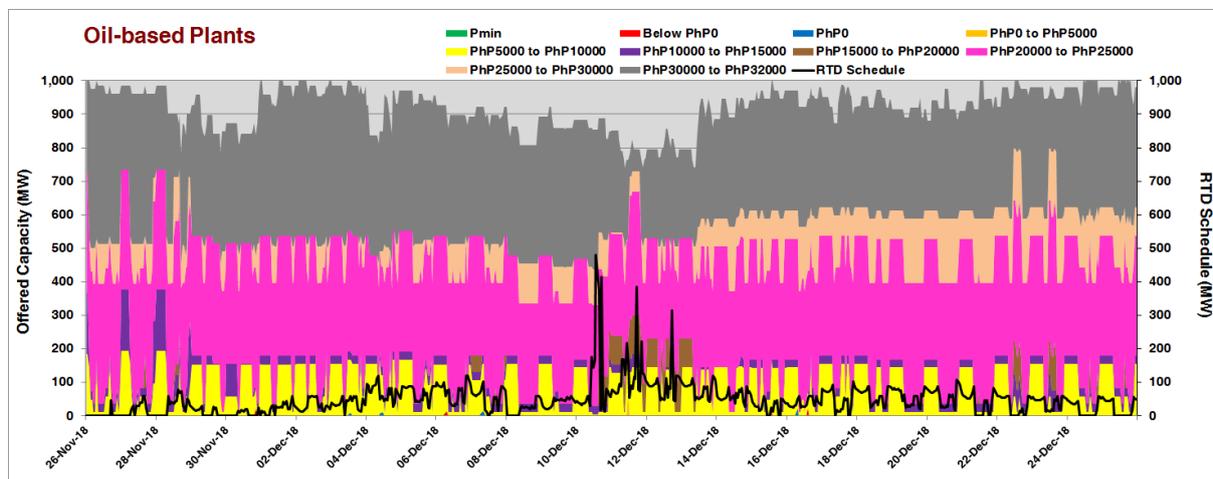


Luzon oil-based plants submitted the highest offer prices this month with bulk of their offers, at 38.8 percent, priced above PhP30,000/MWh to PhP32,000/MWh and 38 percent of prices above PhP20,000/MWh to PhP25,000/MWh. Meanwhile, 9.7 percent were priced above

PhP5,000/MWh to PhP10,000/MWh, 4.3 percent of the offered prices were ranging from PhP10,000/MWh to PhP20,000/MWh and only 9.0 percent were offered above PhP25,000/MWh to PhP30,000/MWh.

Correspondingly, 5.1 percent of the offers were scheduled for dispatch in the market, a decrease from 2.1 percent posted in the previous month.

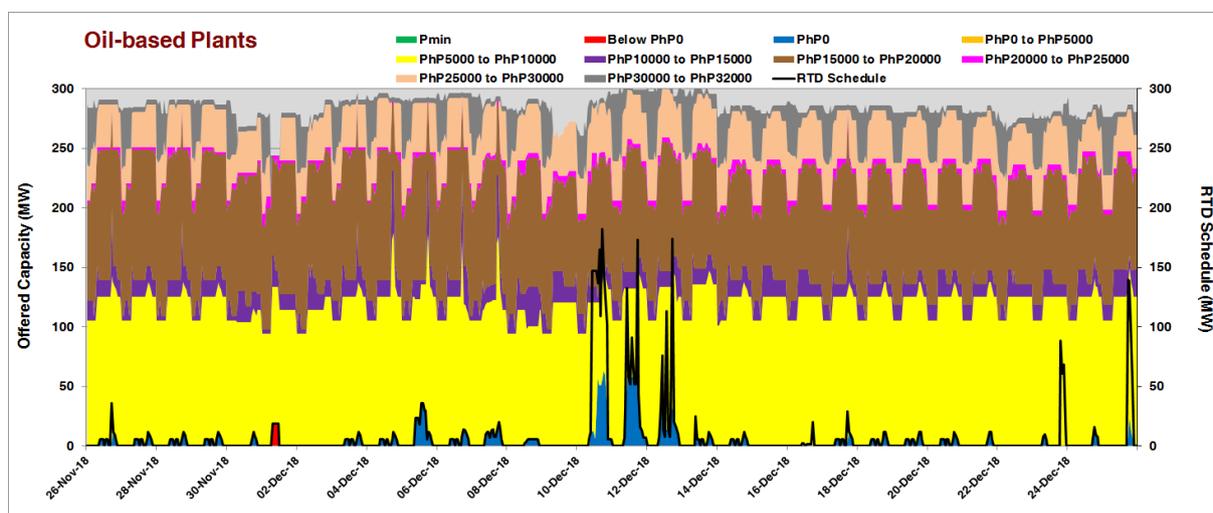
Figure 30. Oil-based Plants Offer Pattern, Luzon – December 2018



When compared with other plant types, Visayas oil-based plants offered their capacities at relatively higher prices. Majority of its offers were submitted at prices ranging from PhP5,000/MWh to PhP10,000/MWh (40.5 percent) and the 32.7 percent were prices above PhP15,000/MWh to PhP20,000/MWh. 5.3 percent of the prices were offered from PhP10,000/MWh to PhP15,000/MWh and the remaining 20.1 percent were prices above PhP20,000/MWh to PhP32,000/MWh. A small portion, at 1.4 percent, were offer prices at PhP0/MWh.

2.6 percent of the capacity offered by Visayas oil-based plants were scheduled for dispatch during the billing month. This was slight higher than last month's 2.3 percent.

Figure 31. Oil-based Plants Offer Pattern, Visayas – December 2018



XII. Capacity Factor

Luzon

In terms of registered capacity, natural gas plants recorded the highest capacity factor among the Luzon resource types at 68.3 percent, followed by coal plants at 65.9 percent, geothermal plants at 44.7 percent, hydro plants at 19.5 percent and oil-based plants at 3.1 percent.

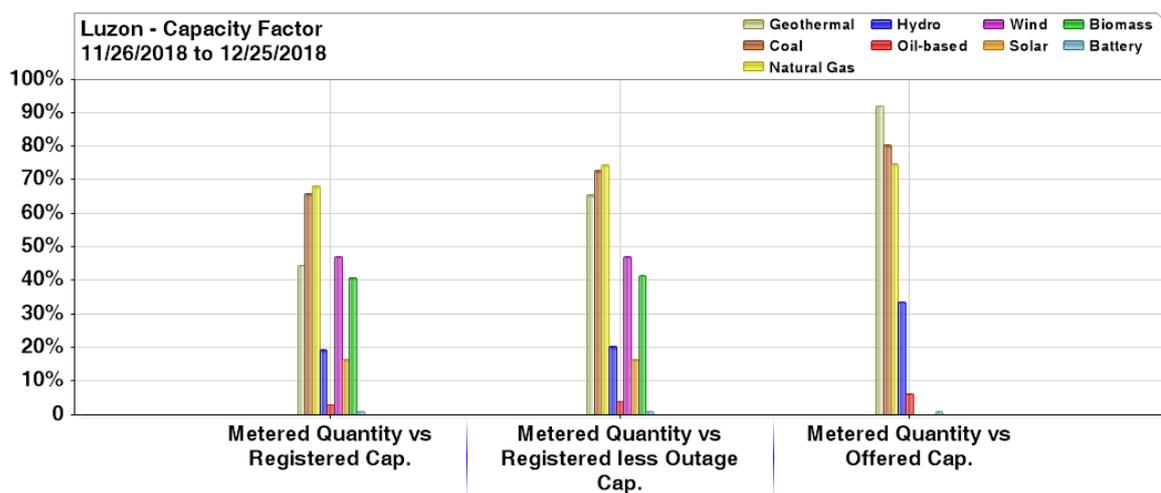
Natural gas plants likewise obtained the highest utilization when measured in terms of registered capacity net of outage, at 74.7 percent. Coal plants came next at 72.9 percent, geothermal plants at 65.6 percent, hydro plants at 20.4 percent, and oil-based plants at 4.1 percent.

Utilization among lower-priced plants was highest when measured based on offered capacity. This demonstrates that offered capacities of lower-priced plants are generally scheduled for dispatch in the market. Geothermal plants posted the highest capacity factor at 92.1 percent. Coal and natural gas plants followed with 80.6 percent and 75.0 percent, respectively. Lower utilization levels were recorded by hydro plants at 33.6 percent and by oil-based plants at only 6.2 percent.

Meanwhile, the capacity factors of preferential dispatch plants, measured in terms of registered capacity, are posted at 47.3 percent for wind, and 16.6 percent for solar while biomass recorded a capacity factor of 40.8 percent in terms of registered capacity.

The sole battery energy storage facility in the WESM – Masinloc Battery, posted a capacity factor of 1.0 percent each when measured in terms of registered capacity, registered capacity net of outage, and offered capacity.

Figure 32. Capacity Factor – Luzon Plants, December 2018



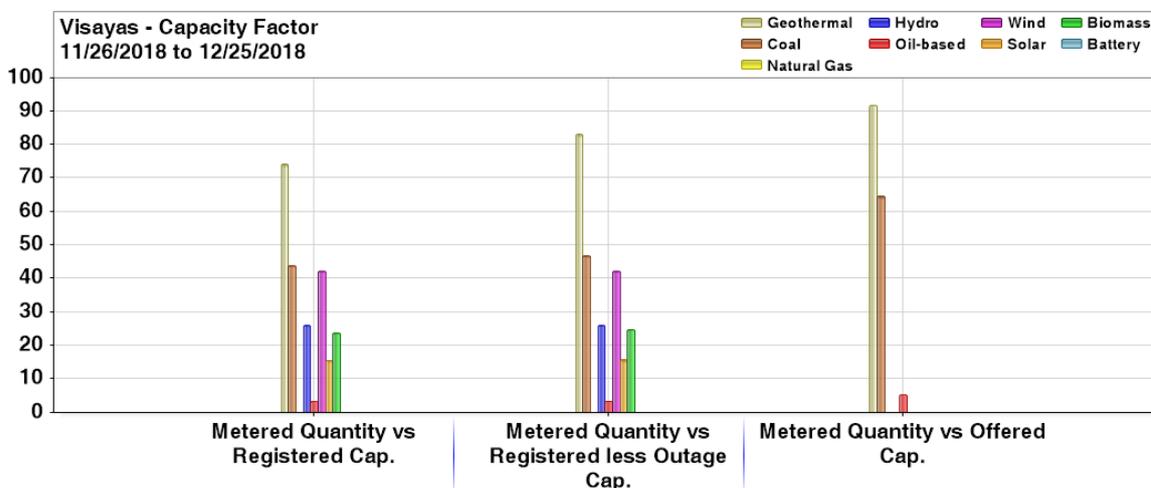
Geothermal plants posted the highest utilization among the resource types in the Visayas. In terms of registered capacity, the Visayas geothermal plants were utilized at 74.2 percent, followed by coal plants at 43.9 percent, hydro plants at 26.0 percent and oil-based plants at 3.3 percent.

Similarly, it was the Visayas geothermal plants which topped the list in terms of utilization based on registered less outage capacity at 83.3 percent, followed by coal plants at 46.8 percent, hydro at 26.0 percent and oil-based plants at 3.3 percent.

Higher utilization levels were obtained based on offered capacity, with geothermal plants recording 91.8 percent, coal plants at 64.6 percent and oil-based plants at 5.4 percent.

Wind plants' capacity factors based on registered capacity and based on registered capacity net of outage were posted at 42.2 percent while solar plants recorded the same at 15.7 percent, respectively. Biomass plant recorded a capacity factor of 23.6 percent when measured in terms of registered capacity and 24.7 percent when measured in terms of registered capacity net of outage.

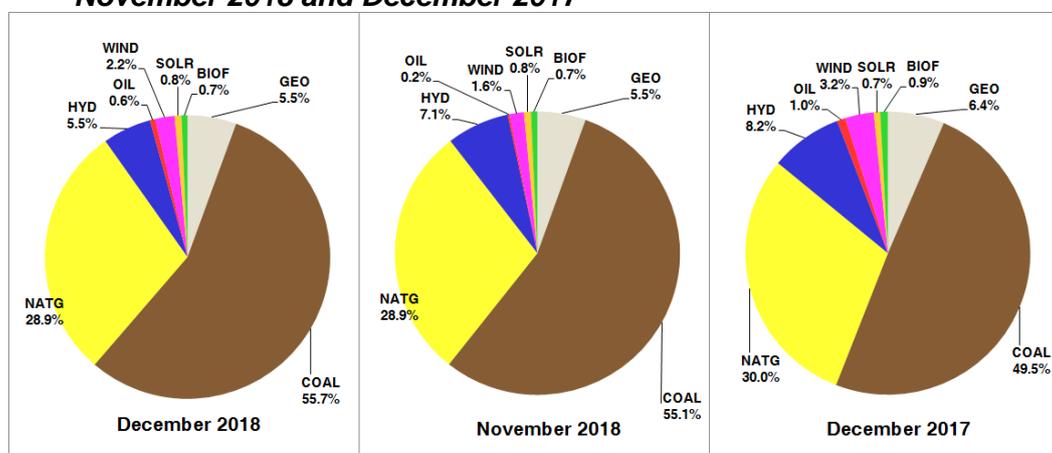
Figure 33. Capacity Factor, Visayas Plants – December 2018



XIII. Generation Mix

Coal plants held the largest portion of the total metered quantity in Luzon at 55.7 percent (from previous month's 55.1 percent), followed by natural gas plants at 28.9 percent (previous month's 28.9 percent), hydro plants at 5.5 percent, geothermal plants at 5.5 percent and oil-based plants at 0.6 percent. Meanwhile, the contribution of preferential and must-dispatch generating units was recorded at 3.7 percent.

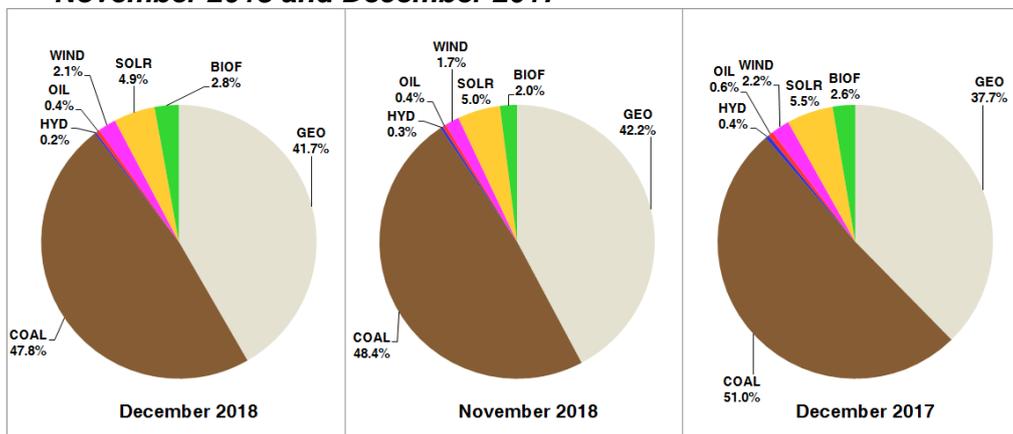
Figure 34. Generation Mix (Based on Metered Quantity) – Luzon, December 2018, November 2018 and December 2017



Coal plants had the highest contribution to the Visayas generation mix at 47.8 percent (from previous month's 48.4 percent) followed by geothermal plants at 41.7 percent (previous month's 42.2 percent). Oil-based and hydro plants came next with 0.4 percent and 0.2 percent,

respectively. Meanwhile, solar plants' contribution was at 4.9 percent, wind plants at 2.1 percent and biomass at 2.8 percent.

Figure 35. Generation Mix (Based on Metered Quantity), Visayas – December 2018, November 2018 and December 2017



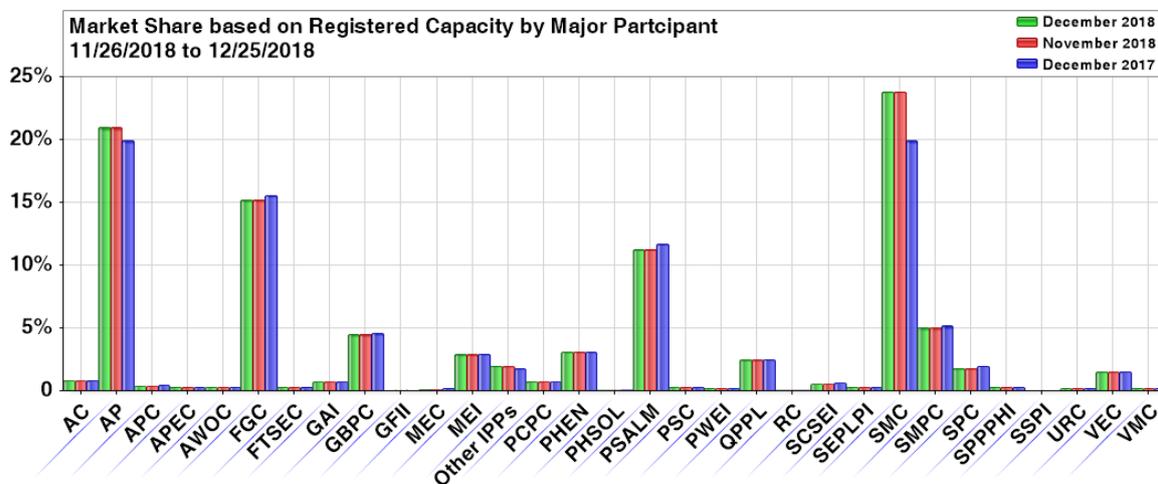
XIV. Market Concentration

a. Market Share

San Miguel Corporation (SMC), Aboitiz Power (AP), First Gen Corporation (FGC) and Power Sector Asset and Liabilities Management (PSALM) continued to dominate the market with a combined market share of 71.1 percent based on registered capacity during the November billing month. SMC held the top spot at 23.8 percent followed by AP (20.9 percent), FGC (15.2 percent) and PSALM (11.2 percent).

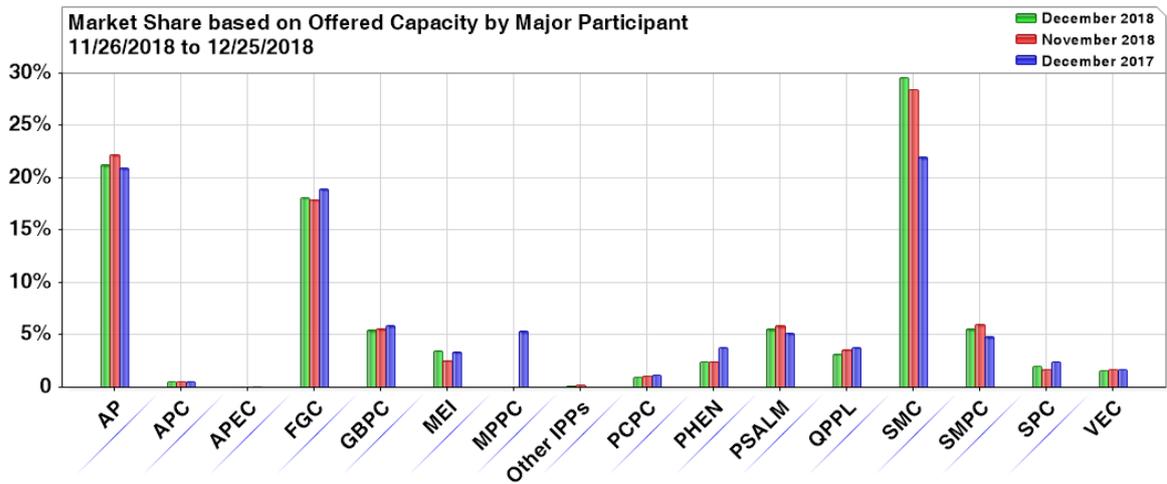
Semirara Mining Power Corporation (SMPC) and Global Business Power Corporation (GBPC) distantly followed at 5 percent and 4.5 percent, respectively.

Figure 36. Market Share by Major Participant Group based on Registered Capacity December 2018, November 2018, and December 2017



SMC likewise held the largest share of the market at 28.6 percent based on offered capacity. AP held the second largest share at 21.2 percent followed by FGC at 18.1 percent. In distant fourth is SMPC at 5.6 percent followed by PSALM at 5.2 percent and GBPC at 5.4 percent.

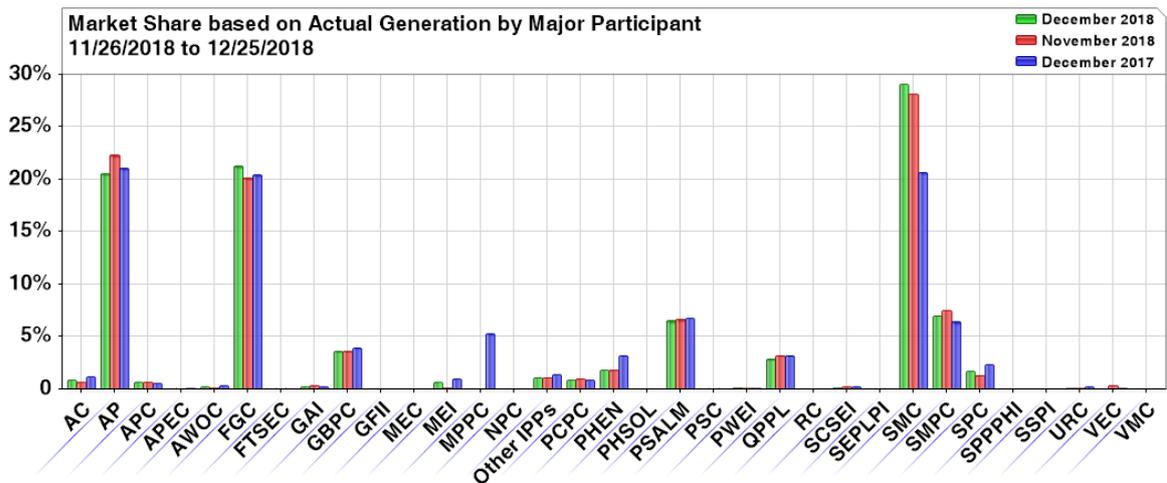
Figure 37. Market Share by Major Participant Group based on Offered Capacity, December 2018, November 2018, December 2017



Market share calculated based on actual generation also showed the SMC group with the largest market share at 29.1 percent. FGC and AP then followed at 21.2 percent and 20.5 percent, respectively.

SMPC and PSALM were also among the highest market shareholders 7.0 percent and 6.5 percent of the actual generation, respectively.

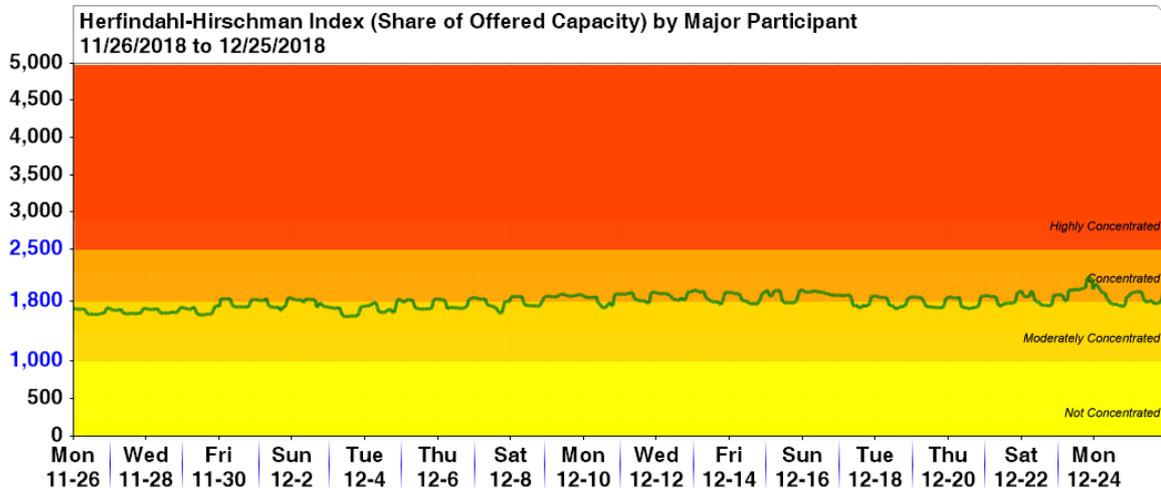
Figure 38. Market Share by Major Participant Group based on Actual Generation, December 2018, November 2018 and December 2017



b. Herfindahl-Hirschman Index (HHI)

The Herfindahl-Hirschman Index (HHI)¹¹ calculated based on offered capacity by major participants' grouping indicated a concentrated market for 370 trading intervals (51 percent) of the time and moderately concentrated market for the remaining 350 trading intervals (49 percent) during the December billing month.

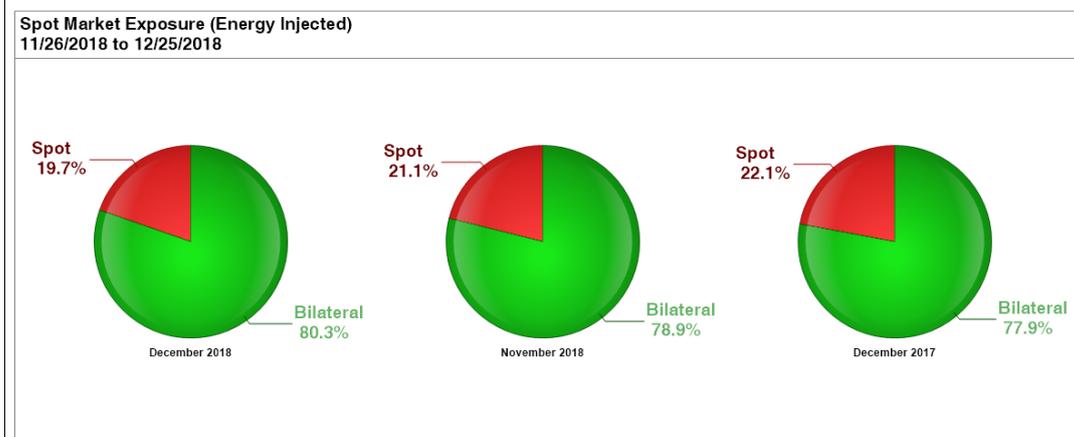
Figure 39. Hourly HHI based by Major Participant Grouping, December 2018



XV. Spot Exposure

The spot market exposure of generator-trading participants comprised about 19.7 percent of the total energy transaction in the WESM. This was lower than previous month's 21.1 percent and previous year's 22.1 percent. Still, majority of the total energy injected into the grid was covered by bilateral contracts.

Figure 40. Spot Market Exposure, December 2018, November 2018, and December 2017



¹¹ The HHI measures the degree of market concentration, taking into account the relative size and distribution of participants in the monitored market. It is calculated as the sum of squares of the participant's market share. The following are the widely-used HHI screening numbers: the HHI approaches zero when the market has very large number of participants with each having a relatively small market share. In contrary, the HHI increases as the number of participants in the market decreases, and the disparity in the market shares among the participants increases. The following are the widely-used HHI screening numbers: (1) when HHI is less than 1,000 the market is not concentrated; (2) in the range of 1,000 to 1,800 the market is moderately concentrated; (3) greater than 1,800 to 2,500 the market is concentrated; and (4) greater than 2,500 the market is highly concentrated and signals lack of competition in the market.

Appendix A. Major Plant Outages

Region	Plant Type	Plant / Unit Name	Capacity (MW)	Date Out	Date In	Duration	Outage Type	Remarks
LUZON	GEO	Twi 3	43.7	10/23/2005 13:26		30.00	Deactivated Shutdown	Twi 3 decommissioned since May 26 2009
LUZON	GEO	Makban 6	55	04/11/2013 22:44		30.00	Deactivated Shutdown	Conducted gas compressor test
VISAYAS	GEO	PGPP2 Unit 4	20	06/27/2014 6:07		30.00	Forced Outage	Steam being utilized by Nasulo plant
LUZON	HYD	Angat M 3	50	01/29/2018 0:01		30.00	Planned Outage	Annual overhauling until 29 July 2018
LUZON	OIL	Malays 2	350	05/19/2018 13:01		30.00	Forced Outage	Burn air heater 2A
LUZON	COAL	SLTEC 2	122.9	06/18/2018 6:14		30.00	Forced Outage	Isolated due to tripping Calaca-Salong Line
LUZON	GEO	Twi 1	59	08/12/2018 11:11	11/28/2018 9:45	2.41	Forced Outage	Low steam supply
LUZON	GEO	Makban 9	20	08/30/2018 19:19		30.00	Forced Outage	On reserve shutdown pending availability of steam supply
VISAYAS	GEO	Upper Mahiao 1	32	09/03/2018 6:01		30.00	Forced Outage	Tripped
VISAYAS	GEO	Upper Mahiao 2	32	09/03/2018 6:01		30.00	Forced Outage	Tripped
LUZON	GEO	Makban Dimat 1	3	09/30/2018 3:30	12/19/2018 10:22	23.43	Forced Outage	Loss of power supply of PGPC injection pump
VISAYAS	COAL	Keppo Salcon 1	103	11/01/2018 0:43	12/07/2018 15:31	11.65	Planned Outage	APMS
VISAYAS	OIL	PB102 Unit 3	6	11/03/2018 17:53		30.00	Forced Outage	Internal trouble
LUZON	COAL	Sual 2	647	11/16/2018 23:28	12/04/2018 4:20	8.18	Maintenance Outage	Maintenance outage until 16 Dec 2018
LUZON	COAL	SMC 1	150	11/18/2018 13:20	12/11/2018 12:42	15.53	Forced Outage	High furnace pressure
LUZON	GEO	Makban 4	63	11/19/2018 21:35		30.00	Planned Outage	Maintenance Outage until 13 December 2018
LUZON	HYD	Kalayaan 3	180	11/21/2018 0:01	12/01/2018 22:56	5.96	Planned Outage	Maintenance Outage until 25 November 2018
LUZON	HYD	Kalayaan 4	180	11/24/2018 0:01	11/28/2018 23:17	2.97	Planned Outage	Planned Outage until 28 November 2018. GOMP
LUZON	OIL	TMD Unit 1	63.8	11/25/2018 0:01	12/01/2018 11:01	5.46	Maintenance Outage	PMS of Switchyard
LUZON	HYD	Angat A 1	6	11/26/2018 6:45	11/26/2018 14:49	0.34	Forced Outage	Affected by tripping of San Jose 300MVA T01
LUZON	HYD	Angat A 2	6	11/26/2018 6:45	11/26/2018 14:49	0.34	Forced Outage	Affected by tripping of San Jose 300MVA T01
LUZON	HYD	Angat A 3	6	11/26/2018 6:45	11/26/2018 14:49	0.34	Forced Outage	Affected by tripping of San Jose 300MVA T01
LUZON	HYD	Angat M 1	50	11/26/2018 6:45	11/26/2018 14:40	0.33	Forced Outage	Affected by tripping of San Jose 300MVA T01
LUZON	HYD	Angat M 2	50	11/26/2018 6:45	11/26/2018 14:40	0.33	Forced Outage	Affected by tripping of San Jose 300MVA T01
LUZON	HYD	Angat M 4	50	11/26/2018 6:45	11/26/2018 14:38	0.33	Forced Outage	Affected by tripping of San Jose 300MVA T01
LUZON	OIL	TMD Unit 2	49	11/26/2018 13:01		29.46	Forced Outage	Unavailable due to cooling tower trouble
LUZON	HYD	Ambuklao 2	35	11/27/2018 8:08	11/27/2018 13:14	0.21	Maintenance Outage	Replacement of thermostatic valve inspection of orifice and cleaning of governor oil cooler
LUZON	GEO	Twi 2	59	11/28/2018 9:47	11/29/2018 13:23	1.15	Maintenance Outage	Maintenance Outage
VISAYAS	SOLR	Silay 20	11/28/2018 14:18	11/28/2018 16:25	0.09	Forced Outage	Affected by the tripping of 69kV Bacolod-Silay Sub TL	
LUZON	OIL	Limay 4	90	11/29/2018 10:03	11/30/2018 19:20	1.38	Maintenance Outage	Limay 4 Main transformer on shutdown to provide safe working clearance for testing of 8-01CB24BCC
VISAYAS	SOLR	Isasol 3	40.5	11/29/2018 11:30	11/29/2018 15:43	0.18	Forced Outage	Affected by shutdown of 69kV Cadiz-VMC Sub TL per TLD5 V CEB-2018-11-0021
LUZON	GEO	Twi 1	59	11/29/2018 13:31		26.44	Maintenance Outage	Maintenance Outage
VISAYAS	OIL	Bohol 2	4	11/29/2018 14:34	12/03/2018 9:18	3.78	Forced Outage	Tripped due to Main Lub oil pump tripped
LUZON	OIL	SLPGC 3	25	11/29/2018 17:14	11/30/2018 18:29	1.05	Maintenance Outage	Maintenance of 69-kV line
LUZON	COAL	QPPL	453	11/30/2018 0:38	12/02/2018 15:10	2.61	Forced Outage	Boiler Tube Leak
LUZON	GEO	Twi 5	57	11/30/2018 5:43	12/01/2018 12:23	1.28	Maintenance Outage	Maintenance outage of Unit Transformer 5 until 2100H
VISAYAS	GEO	Nasulo	48.3	11/30/2018 7:16	11/30/2018 22:27	0.63	Planned Outage	Scheduled maintenance activities
VISAYAS	GEO	PGPP2 Unit 1	20	11/30/2018 9:41	11/30/2018 10:23	0.03	Forced Outage	Auto-tripped, under investigation
VISAYAS	GEO	PGPP2 Unit 2	20	11/30/2018 9:41	11/30/2018 11:20	0.07	Forced Outage	Auto-tripped, under investigation
VISAYAS	OIL	CENPRI 2	4.2	12/01/2018 8:29	12/01/2018 9:17	0.03	Forced Outage	Auto tripped due to high winding temperature
LUZON	GEO	Makban 3	63	12/01/2018 21:32	12/02/2018 3:29	0.25	Forced Outage	Tripped at 47 MW
LUZON	GEO	Makban 3	63	12/02/2018 9:22	12/02/2018 19:47	0.43	Forced Outage	Generator lock-out protection. Tripped at 47MW load
LUZON	GEO	Makban 3	63	12/03/2018 3:56	12/03/2018 5:18	0.06	Forced Outage	Turbine trip actuation
LUZON	GEO	Makban 3	63	12/03/2018 8:01	12/03/2018 13:05	0.21	Forced Outage	Turbine trip actuation
LUZON	HYD	Kalayaan 3	180	12/03/2018 8:47	12/03/2018 9:20	0.02	Forced Outage	Tripped at 135 MW load
LUZON	OIL	Limay 6	60	12/03/2018 23:52	12/04/2018 9:58	0.42	Forced Outage	Multiple flame offs
VISAYAS	GEO	PGPPT Unit 3	37.5	12/04/2018 0:04	12/09/2018 5:03	5.21	Maintenance Outage	Offline due to scheduled maintenance activities
VISAYAS	OIL	Bohol 1	4	12/04/2018 11:47	12/04/2018 12:01	0.01	Forced Outage	Affected by the tripping of Tagbilaran-Loboc 13.8 kV line
VISAYAS	OIL	Bohol 3	4.2	12/04/2018 13:26	12/07/2018 10:56	2.90	Forced Outage	Forced out due to abnormal sound of engine
LUZON	OIL	Limay 1	60	12/04/2018 14:42	12/04/2018 15:26	0.03	Forced Outage	Fuel system trouble
VISAYAS	SOLR	San Carlos 1	19.8	12/05/2018 10:42	12/05/2018 14:15	0.15	Forced Outage	Offline due to internal problem
LUZON	OIL	Limay 4	90	12/06/2018 7:00	12/08/2018 16:19	2.39	Maintenance Outage	Not available due to unit 4 main transformer maintenance
LUZON	HYD	Angat M 1	50	12/06/2018 8:08	12/07/2018 12:21	1.18	Maintenance Outage	Not available due to main transformer inspection and correction of oil leaks
LUZON	HYD	Angat M 2	50	12/06/2018 8:08	12/07/2018 12:21	1.18	Maintenance Outage	Not available due to main transformer inspection and correction of oil leaks
LUZON	GEO	Makban 5	55	12/06/2018 10:13		19.57	Forced Outage	Manually shutdown to facilitate correction of turbine bearing vibration
LUZON	GEO	Makban 5	55	12/06/2018 19:04		19.21	Forced Outage	Turbine vibration
VISAYAS	OIL	Bohol 1	4	12/07/2018 10:46	12/07/2018 16:06	0.22	Forced Outage	Force cut-out due to leak injector
VISAYAS	SOLR	San Carlos 1	19.8	12/07/2018 10:54	12/07/2018 11:51	0.04	Forced Outage	Auto-tripped due to switchgear trouble
LUZON	OIL	Limay 6	60	12/08/2018 0:01	12/13/2018 9:10	5.38	Maintenance Outage	Maintenance outage until 14 December 2018
LUZON	NATG	San Gabriel	420	12/08/2018 0:36		17.97	Maintenance Outage	Maintenance outage until 22 December 2018
LUZON	COAL	Calaca 2	300	12/08/2018 1:06	12/16/2018 15:35	8.60	Maintenance Outage	Maintenance outage until 15 December 2018
VISAYAS	GEO	Mahanagdong A2	5	12/09/2018 0:29	12/18/2018 7:24	9.29	Planned Outage	Scheduled Preventive Maintenance. Capability reduced to 364 MW
VISAYAS	SOLR	Isasol 2	27.2	12/09/2018 8:12	12/09/2018 15:06	0.29	Forced Outage	Affected by maintenance along 69kV Bacolod-San Enrique Sub TL
LUZON	HYD	Pantabangan 1	60	12/09/2018 10:01	12/09/2018 15:02	0.21	Forced Outage	Unavailable due to repair of accumulator shut-off valve
VISAYAS	OIL	Bohol 1	4	12/09/2018 13:37	12/09/2018 15:49	0.09	Maintenance Outage	Affected tripping of Ubay-Garcia-Tagbilaran line
VISAYAS	OIL	Bohol 2	4	12/09/2018 13:37	12/09/2018 15:51	0.09	Maintenance Outage	Affected tripping of Ubay-Garcia-Tagbilaran line
LUZON	COAL	GN Power 1	316	12/10/2018 0:29	12/14/2018 18:13	4.74	Forced Outage	Drum level transmitter problem
VISAYAS	SOLR	San Carlos 1	19.8	12/10/2018 12:57	12/10/2018 15:05	0.09	Forced Outage	Isolated due to emergency opening of 69 kV Escalante-San Carlos line section
VISAYAS	SOLR	San Carlos 2	19.8	12/10/2018 12:57	12/10/2018 15:12	0.09	Forced Outage	Isolated due to emergency opening of 69 kV Escalante-San Carlos line section
VISAYAS	SOLR	San Carlos Sun	46.8	12/10/2018 13:13	12/10/2018 15:08	0.08	Forced Outage	Isolated due to emergency opening of 69 kV Escalante-San Carlos line section
LUZON	GEO	Bacman 3	20	12/11/2018 2:02	12/11/2018 10:45	0.36	Forced Outage	Vacuum pump trip
LUZON	OIL	SLPGC 3	25	12/11/2018 8:01	12/14/2018 11:18	3.14	Maintenance Outage	Fuel Nozzle Replacement
VISAYAS	OIL	Bohol 4	4	12/11/2018 12:25	12/12/2018 11:03	0.94	Forced Outage	High exhaust gas temperature on cylinder 4 5 and 9
LUZON	GEO	Makban 7	20	12/11/2018 20:23	12/11/2018 22:53	0.10	Forced Outage	Affected by the emergency shutdown of Tie-Line C-D. Repair of Line DS at Plant C
LUZON	GEO	Makban 8	20	12/11/2018 20:23	12/11/2018 23:40	0.14	Forced Outage	Affected by the emergency shutdown of Tie-Line C-D. Repair of Line US at Plant C. RECLASSIFIED FROM FORCE_OMC OUTAGE
VISAYAS	OIL	Bohol 3	4.2	12/12/2018 14:06	12/12/2018 21:08	0.29	Forced Outage	Tripped. Turbo charger problem
VISAYAS	OIL	Bohol 4	4	12/12/2018 16:53	12/12/2018 20:10	0.14	Forced Outage	Tripped, defective engine governor
VISAYAS	OIL	CENPRI 4	6.4	12/12/2018 17:43	12/23/2018 21:15	11.14	Forced Outage	Emergency offline due to governor problem
VISAYAS	OIL	Bohol 2	4	12/13/2018 11:06	12/17/2018 10:44	3.98	Forced Outage	Fuel leak at cylinder 12
VISAYAS	GEO	Upper Mahiao 4	32	12/13/2018 11:15	12/13/2018 21:21	0.42	Forced Outage	Emergency shutdown to facilitate rectification of thermal anomaly
VISAYAS	SOLR	Silay	20	12/13/2018 14:54	12/13/2018 17:10	0.09	Forced Outage	Affected by tripping of 69kV Bacolod-Silay sub TL
LUZON	OIL	SLPGC 3	25	12/14/2018 11:19	12/14/2018 13:10	0.08	Forced Outage	Flame detector failure
VISAYAS	OIL	Bohol 3	4.2	12/14/2018 13:16	12/14/2018 18:17	0.21	Forced Outage	Tripped fuel leak at cylinder 6
VISAYAS	GEO	Mahanagdong A1	5	12/15/2018 0:25	12/16/2018 1:57	1.06	Forced Outage	To facilitate steam blowing of newly installed steam scrubber of Maha A Unit 2. Capacity 56MW
LUZON	NATG	San Lorenzo 2	261.8	12/15/2018 4:30	12/16/2018 23:18	1.78	Maintenance Outage	Off line compressor washing

Appendix A. Major Plant Outages

VISAYAS	COAL	TPC Sangi 1	60	12/15/2018 10:19		10.57	Forced Outage	Boiler tube leak
LUZON	OIL	SLPGC 3	25	12/16/2018 8:01	12/16/2018 14:00	0.25	Forced Outage	Not available due to compressor water washing
LUZON	GEO	Bacman 2	60	12/17/2018 12:07	12/17/2018 14:47	0.11	Forced Outage	Tripped with 53MW load
LUZON	GEO	Twi 6	57	12/18/2018 7:09	12/18/2018 13:41	0.27	Maintenance Outage	Maintenance Outage
VISAYAS	GEO	PGPP1 Unit 3	37.5	12/18/2018 8:37	12/18/2018 14:49	0.28	Maintenance Outage	Offline due to scheduled maintenance
VISAYAS	GEO	Mahanagdong A2	5	12/18/2018 10:18	12/18/2018 11:16	0.04	Planned Outage	Cut out from the system. Under test and commissioning
LUZON	GEO	Bacman 1	60	12/19/2018 13:44	12/19/2018 17:52	0.17	Forced Outage	Tripped due to unit 3 trouble
LUZON	GEO	Bacman 2	60	12/19/2018 13:44	12/19/2018 17:18	0.15	Forced Outage	Tripped due to unit 3 trouble
LUZON	GEO	Bacman 3	20	12/19/2018 13:44	12/19/2018 22:01	0.35	Forced Outage	Tripped
VISAYAS	GEO	Upper Mahiao 4	32	12/20/2018 7:06	12/21/2018 2:56	0.83	Forced Outage	To facilitate hotspot correction on Tie Breaker
VISAYAS	GEO	Upper Mahiao 3	32	12/20/2018 7:08	12/20/2018 22:41	0.65	Forced Outage	To facilitate hotspot correction on Tie Breaker
VISAYAS	COAL	CEDC 3	82	12/21/2018 0:37	12/24/2018 14:05	3.56	Forced Outage	DUE TO BOILER PROBLEM
LUZON	HYD	Binga 3	35	12/21/2018 6:07	12/21/2018 7:51	0.07	Maintenance Outage	Reservoir water level data collection freeze
LUZON	HYD	Binga 4	35	12/21/2018 6:07	12/21/2018 7:51	0.07	Maintenance Outage	Reservoir water level data collection freeze
LUZON	HYD	Binga 1	35	12/21/2018 6:13	12/21/2018 7:50	0.07	Maintenance Outage	Reservoir water level data collection freeze
LUZON	HYD	Binga 2	35	12/21/2018 6:13	12/21/2018 7:51	0.07	Maintenance Outage	Reservoir water level data collection freeze
LUZON	COAL	Calaca 2	300	12/21/2018 11:42	12/22/2018 1:02	0.56	Forced Outage	Intercept valve failure. sudden closing
VISAYAS	GEO	Mahanagdong B1	5	12/22/2018 0:08		3.99	Forced Outage	To facilitate turbine rotor replacement
LUZON	COAL	Calaca 2	300	12/22/2018 1:33	12/22/2018 10:38	0.38	Forced Outage	Main turbine temperature drop trip.
LUZON	NATG	San Lorenzo 1	264.8	12/22/2018 4:19	12/23/2018 19:25	1.63	Planned Outage	Offline compressor washing
VISAYAS	COAL	PEDC 2	83.7	12/22/2018 20:10	12/23/2018 6:17	0.42	Forced Outage	Emergency shutdown due to coal feeder B leak on bellows
LUZON	COAL	Masinloc 1	315	12/23/2018 3:46	12/23/2018 9:38	0.24	Forced Outage	Problem at auto-plant control system
LUZON	COAL	QPP1	459	12/23/2018 5:52	12/23/2018 22:47	0.70	Forced Outage	Tripped with 165MW load
LUZON	COAL	SMC 4	150	12/23/2018 13:40		2.43	Maintenance Outage	Correction of punchlist in preparation for commercial operation
VISAYAS	COAL	PALM 1	135	12/23/2018 18:19		2.24	Forced Outage	Affected by the tripping
VISAYAS	COAL	PEDC 1	83.7	12/23/2018 18:19	12/23/2018 23:57	0.23	Forced Outage	Affected by tripping of PEDC U3
VISAYAS	COAL	PEDC 2	83.7	12/23/2018 18:19	12/24/2018 0:07	0.24	Forced Outage	Affected by tripping of PEDC U3
VISAYAS	COAL	PEDC 3	150	12/23/2018 18:19	12/24/2018 6:38	0.51	Forced Outage	Auto tripped due to coal feeder problem
VISAYAS	GEO	PGPP1 Unit 2	37.5	12/23/2018 18:19	12/23/2018 23:22	0.21	Forced Outage	Auto-tripped. affected by the disturbance in Panay area.
VISAYAS	OIL	CENPRI 1	4.2	12/23/2018 19:45	12/23/2018 20:39	0.04	Forced Outage	Emergency offline due to unusual sound monitored
VISAYAS	OIL	PB102 Unit 3	6	12/23/2018 20:43	12/24/2018 16:44	0.83	Forced Outage	Auto trip
LUZON	GEO	Malban 3	63	12/24/2018 4:09	12/24/2018 5:24	0.05	Forced Outage	Turbine tripped actuation
VISAYAS	OIL	Bohol 3	4.2	12/24/2018 22:15	12/25/2018 8:08	0.41	Forced Outage	Excessive exhaust gas leak on cylinder no 10
VISAYAS	COAL	PEDC 3	150	12/25/2018 0:39		0.97	Planned Outage	For annual preventive maintenance schedule
LUZON	COAL	Pagbilao 3	420	12/25/2018 2:07	12/25/2018 3:56	0.08	Forced Outage	High drum level

Methodology in Determining Interesting Pricing Events

Supply margin is defined as the MW difference between the system effective supply¹ and demand requirement plus reserve schedules².

The market price is represented by the load weighted average of the final prices (LWAP) used for settlements which could either be of the following: (i) ex-ante prices for trading intervals without pricing error during ex-ante, (ii) ex-post prices for trading intervals with pricing error during ex-ante but without pricing error during ex-post, (iii) market re-run prices for trading intervals with pricing error both during ex-ante and ex-post, and (iv) estimated load reference prices (ELRP) for trading intervals where the ERC-approved Price Substitution Mechanism (PSM) was applied.

To determine the interesting pricing events, a combination of statistical methods namely, bandwidth method, ordinary least squares (OLS) method and non-parametric method was used to create the upper and lower reference price thresholds³. Further, the following criteria were considered in the determination of thresholds:

1. Market prices and supply margin from 26 December 2013 to 25 December 2017 to only include the periods when the PhP32,000/MWh offer price cap was adopted;
2. Upper and lower reference price thresholds were computed using ± 3 percent standard deviations to provide a reasonable tolerance price levels;
3. Exclusion of intervals with market intervention and/or suspension and secondary price cap imposition; and
4. Exclusion of intervals with negative supply margin to ensure normal market conditions (e.g. no under-generation).

The resulting reference price thresholds corresponding to the supply margin range are provided in the Table 1.

Table 1: Fixed Reference Price Thresholds

Supply Margin Range (in MW)	Reference Price Threshold	
	Upper (PhP/MWh)	Lower (PhP/MWh)
0 to 250	20,733	515
250 to 500	18,146	(2,072)
500 to 750	16,424	(3,794)
750 to 1000	15,201	(5,017)
1,000 to 1,250	14,305	(5,913)
1,250 to 1,500	13,609	(6,609)
1,500 to 1,750	13,023	(7,195)
1,750 to 2,000	12,501	(7,717)
2,000 to 2,250	12,050	(8,167)
2,250 to 2,500	11,680	(8,538)
2,500 to 2,750	11,374	(8,720)
2,750 to 3,000	11,127	(8,844)
3,000 and above	11,504	(9,091)

Prices within the upper and lower reference price thresholds are considered as “normal prices”, while prices outside or beyond the thresholds are tagged as “interesting pricing events”.

¹ The system effective supply is equal to the offered capacity of all scheduled generator resources, nominated loading level of non-scheduled generating units and projected output of preferential dispatch generating units. Scheduled output of plants on testing and commissioning, through the imposition of security limit by SO, are accounted for in the effective supply. Likewise included is the scheduled output of Malaya plant when it is called to run as Must Run Unit (MRU).

² With the implementation of the central scheduling and dispatch of energy and contracted reserves in Luzon beginning 22 December 2015, and in Visayas beginning 07 October 2017, the level that the supply has to fill up is higher as it also has to sufficiently meet the hourly reserve schedule.

³ The methodology adopted in this report is closely similar to the methodology discussed by the Market Surveillance Administrator of the Alberta Electricity System Operator in their report entitled “Supply Cushion Methodology and Detection of Events of Interest” published at www.albertamsa.ca.