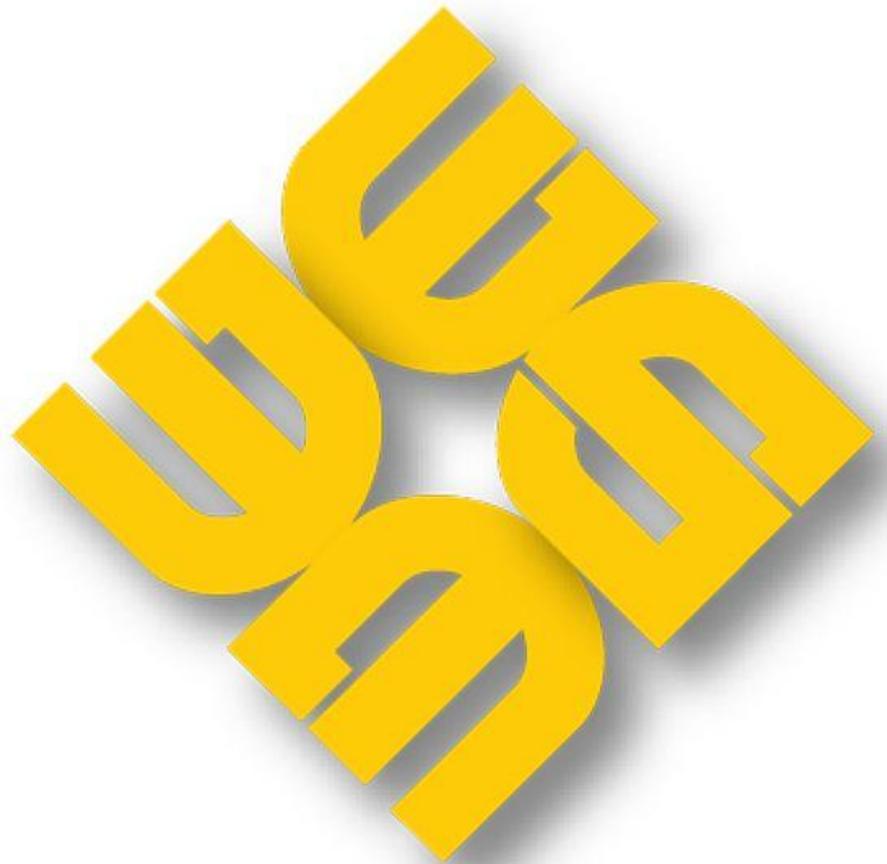


MAG-MMAR-2018-09

# MONTHLY MARKET ASSESSMENT HIGHLIGHTS

For the Billing Period 26 August to 25 September 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 September 2018 billing period (26 August to 25 September 2018) and how the market performed compared with the previous month. No yearly comparison was conducted as results of the market monitoring indices for the September 2018 billing month are not comparable with that of the same period last year. To recall, the Luzon-Leyte HVDC Interconnection was unavailable from 6 July to 7 September 2017 at 2200H due to the intensity scale 5 earthquake in Visayas resulting in the physical separation of the market into two pricing regions – Luzon and Visayas.

The WESM registered capacity stood at 18,888 MW by the end of the September billing month, posting a 150 MW increase from previous month's 18,738 with the entry of the fourth unit of the coal-fired facility of SMC Consolidated Power Corporation. Unavailable capacities namely capacity on outage (13 percent) averaged at 2,513 MW and capacity not offered (11 percent) averaged at 2,116 MW. Preferential and non-scheduled capacities (8 percent) averaged 1,500 MW while the capacity designation of Malaya TPP as Must Run Unit (0.4 percent) averaged at 300 MW. Only 67 percent of the total WESM registered capacity or an average of 12,593 MW was offered in the market.

Taking into account security limits and ramp rates, the effective supply recorded an average of 12,570 MW this month. This posted a 2.5 percent decrease from previous month's 12,894 MW due to higher level of outage capacity which averaged at 2,513 MW from 1,861 MW in August.

System demand decreased to an average of 9,559 MW, which was 0.4 percent lower than previous month's 9,593 MW while system-wide reserve schedule averaged at 885 MW this month from 893 MW in August. Accordingly, the demand plus reserve schedule averaged at 10,444 MW, posting a decrease of 0.4 percent from last month's 10,486 MW.

Driven by the decrease in effective supply, tighter average supply margin was observed this month at 2,126 MW from previous month's 2,408 MW. Consequently, market prices increased to an average of PhP2,966/MWh coming from PhP2,713/MWh in the previous month.

The market shares when calculated based on registered capacity remained to be dominated by four (4) major participant groups, namely San Miguel Corporation (SMC), Aboitiz Power (AP), First Gen Corporation (FGC), and Power Sector Asset and Liabilities Management (PSALM).

Correspondingly, the Herfindahl-Hirschman Index (HHI) calculated by major participant grouping indicated a moderately concentrated market based on registered capacity throughout the September billing month.

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## MONTHLY MARKET ASSESSMENT REPORT

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

No yearly comparison was conducted as results of the market monitoring indices for the September 2018 billing month are not comparable with that of the same period last year. To recall, the Luzon-Leyte HVDC Interconnection was unavailable from 6 July to 7 September 2017 at 2200H due to the intensity scale 5 earthquake in Visayas resulting in the physical separation of the market into two pricing regions – Luzon and Visayas.

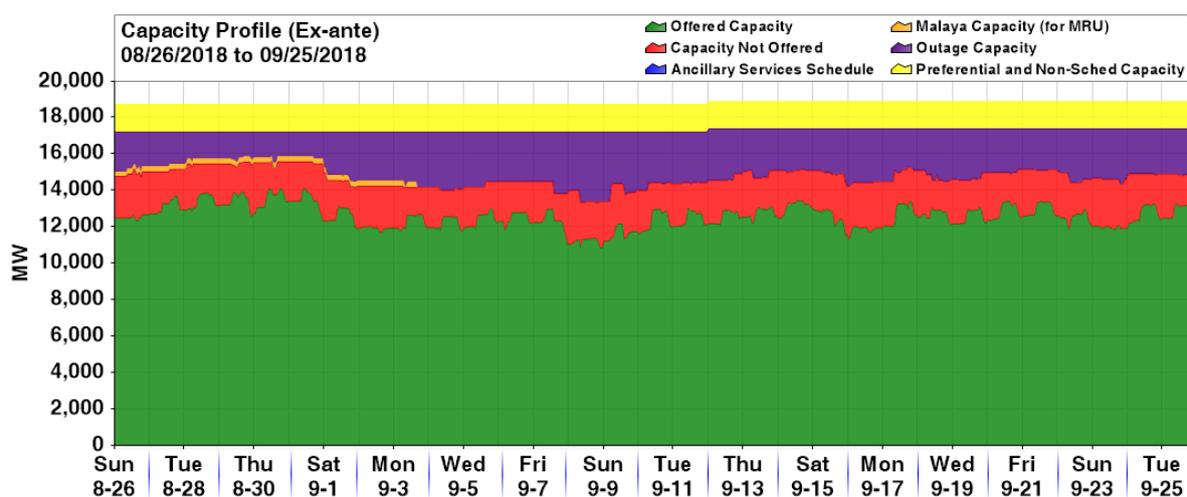
### I. Capacity Profile

The WESM registered capacity stood at 18,888 MW by the end of the September billing month, posting a 150 MW increase from previous month’s 18,738 with the entry of the fourth coal-fired facility of SMC Consolidated Power Corporation.

Of the said registered capacity, about 67 percent (previous month’s 70 percent) or an average of 12,593 MW was offered in the market during the month. Outage capacity (13 percent) posted a higher average this month at 2,513 MW coming from 1,861 MW in the previous month. Meanwhile, 11 percent was attributable to capacity not offered in the market which averaged at 2,116 MW.

On the other hand, preferential<sup>1</sup> and non-scheduled capacities averaged 1,500 MW, comprising about 8 percent of the total registered capacity. Lastly, an average of 300 MW or about 0.4 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), September 2018**



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

**Table 1. Capacity Profile (Ex-ante), September 2018 and August 2018**

	September 2018 (In MW)		August 2018 (In MW)		% M-on-M Change (Aug 2018 - Sep 2018)
	Avg MW	% of RegCap	Avg MW	% of RegCap	
<b>Registered Capacity (end of month)</b>	18,888		18,738		0.8
<b>Offered Capacity</b>	12,593	67	13,087	70	(3.8)
<b>Outage Capacity</b>	2,513	13	1,861	10	35.1
<b>Capacity Not Offered</b>	2,116	11	1,990	11	6.3
<b>Malaya Capacity for MRU</b>	300	0.4	300	2	0.0
<b>Preferential and Non-Scheduled Capacity</b>	1,500	8	1,500	8	0.0

## II. Power Plant Outages

System-wide outage capacity observed a higher average at 2,513 MW this month from 1,861 MW in August. This increase was driven by higher outage capacity involving coal plants averaging at 1,201 MW from previous month's 689 MW. It was also noted that coal plants accounted for 48 percent of total outage capacity which was mainly contributed by the planned outage of Sual CFTPP unit 1 beginning 31 August and maintenance outage of Pagbilao CFTPP unit 3 (420 MW) on top of the existing outages of SLTEC CFTPP unit 2 (123 MW) beginning 18 June until the end of the billing month, SLPGC CFTPP unit 1 (150 MW) from 6 March to 17 September, and Palm CFTPP (135 MW) from 17 August to 13 September.

Similarly, oil-based plants recorded an increase in its average outage capacity from 478 MW to 676 MW this month attributable to the forced outage of Malaya TPP unit 1 (300 MW) from 3 September until the end of the billing month and the existing forced outage of Malaya TPP unit 2 (350 MW) since 19 May.

Geothermal plants likewise recorded a higher outage capacity averaging at 428 MW (previous month's 301 MW) related to the forced outages of units of Tiwi GPP unit A (59 MW) and Makban GPP unit A (63 MW) on top of the prevailing outages of Makban GPP unit C (2 x 55 MW) and Tiwi GPP unit B (44 MW).

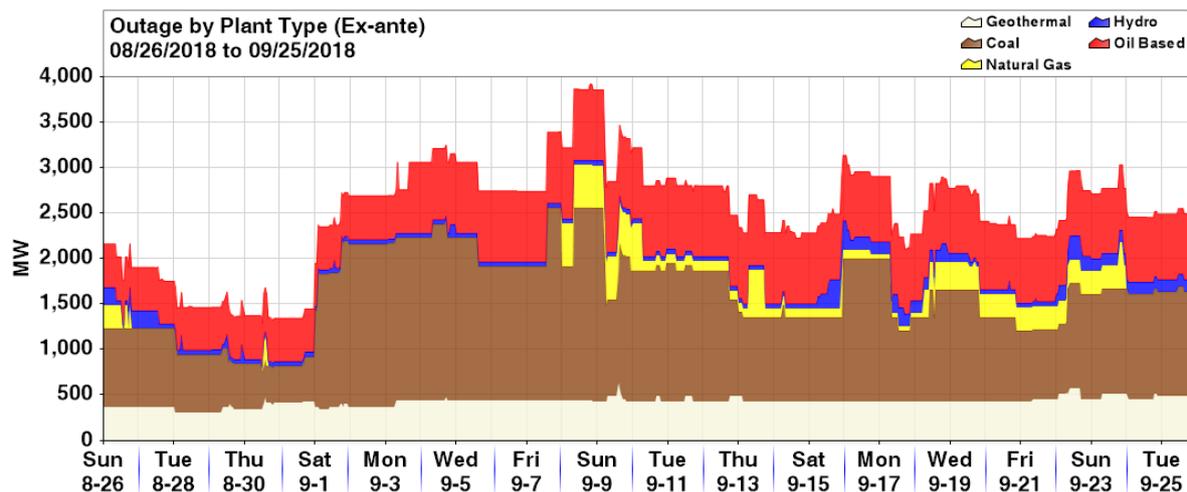
On the other hand, hydro plants' outage capacity decreased to 86 MW from 248 MW in the previous month related to the resumption of operations of San Roque 3 (145 MW) on 27 August from planned outage that began on 12 March. This month's outage from hydro plants mainly involved Angat Main HEP unit 3 (50 MW).

Natural gas plants also observed a lower average outage capacity this month at 123 MW (previous month's 145 MW) attributed to the resumption of operations of Sta. Rita NGPP unit 2 (256 MW) on 26 August. However, Sta. Rita NGPP unit 2 underwent another maintenance outage from 18 to 23 September. In addition, San Gabriel NGPP (420 MW) went on forced outage from 7 to 10 September.

Outage capacity reached a high of 3,920 MW on 8 September from 2000H to 2100H following the maintenance outage of Sta. Rita unit 2 on top of the existing outages of coal plants – namely Sual CFTPP unit 1 (647 MW), Sual CFTPP unit 2 (647 MW), Pagbilao CFTPP unit 3 (420 MW), SLPGC CFTPP unit 1 (150 MW), Palm CFTPP (135 MW), and SLTEC CFTPP unit 2 (123 MW), oil-based plants – namely Malaya TPP unit 2 (350 MW) and Malaya TPP unit 1 (300 MW), and natural gas plant San Gabriel NGPP (420 MW).

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

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



**Table 2. Outage Summary (Ex-ante), September 2018 and August 2018**

Resource Type	September 2018 (In MW)			August 2018 (In MW)			% M-on-M Change (Aug 2018 - Sep 2018)		
	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
Coal	2,122	408	1,201	1,454	273	689	45.9	49.5	74.3
Natural Gas	521	0	123	521	0	145	(0.1)		(15.3)
Geothermal	641	305	428	439	273	301	46.0	11.7	42.1
Hydro	316	50	86	580	50	248	(45.5)	0.0	(65.3)
Oil Based	854	470	676	520	470	478	64.3	0.0	41.3
<b>TOTAL</b>	<b>3,920</b>	<b>1,295</b>	<b>2,513</b>	<b>2,829</b>	<b>1,293</b>	<b>1,861</b>	<b>38.6</b>	<b>0.2</b>	<b>35.1</b>

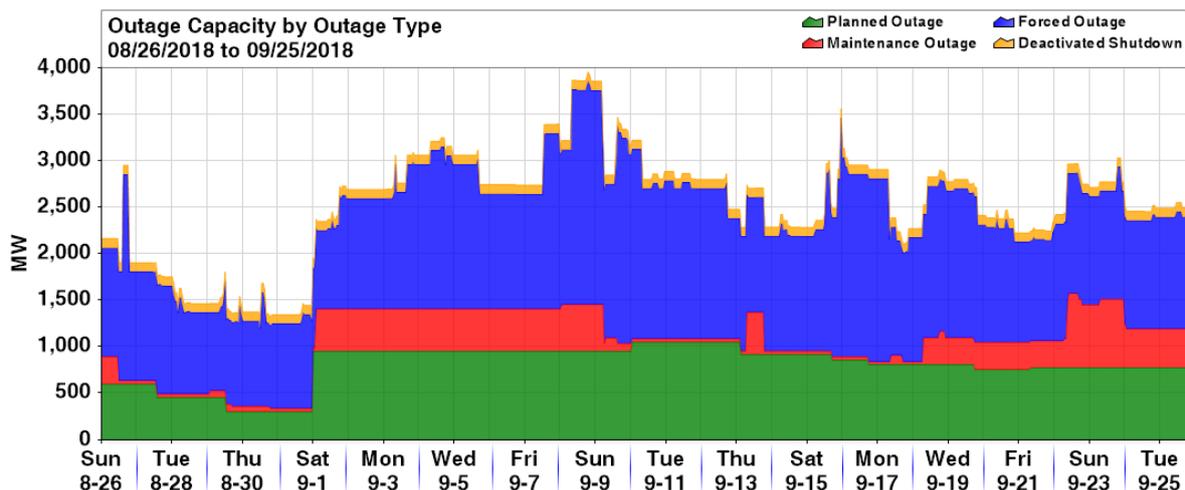
**a. Outage Capacity by Outage Category**

About 54 percent of this month’s system-wide outage capacity were related to forced outages. An average capacity of 1,367 MW went on forced outages, recording an increase from previous month’s 1,173 MW (Table 3). This month’s forced outage capacity mainly involved Malaya TPP unit 2 (350 MW), Malaya TPP unit 1 (300 MW), SLTEC CFTPP unit 2 (122.9 MW) and SLPGC CFTPP unit 1 (150 MW).

Similarly, higher average planned outage capacity was noted this month at 805 MW (from previous month’s 484 MW), attributable to Sual CFTPP unit 1 (647 MW) and PCPC CFTPP (135 MW) as well as higher average maintenance outage capacity at 258 MW (from previous month’s 110 MW) attributable to Pagbilao CFTPP unit 1 (420 MW).

Meanwhile, deactivated shutdown outage capacity remained at an average of 99 MW which involved units of Makban GPP unit C and Tiwi GPP unit B.

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



**Table 3. Outage Summary, by Outage Category, September 2018 and August 2018**

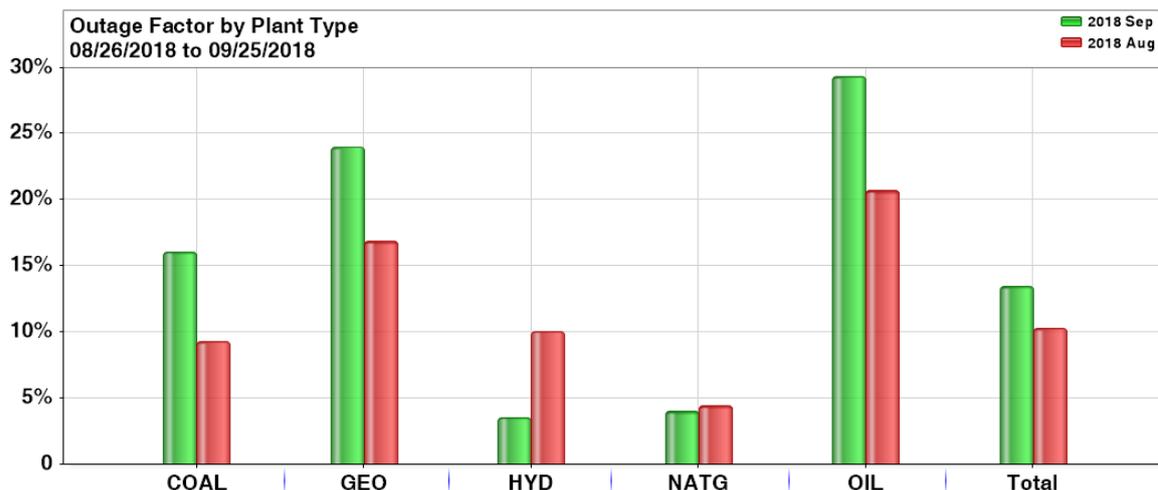
Resource Type	September 2018 (In MW)			August 2018 (In MW)			% M-on-M Change (Aug 2018 - Sep 2018)		
	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
Planned	1,053	305	805	866	315	484	21.6	(3.2)	66.3
Maintenance	799	35	258	346	0	110	130.8		135.4
Forced	2,565	836	1,367	1,834	849	1,173	39.8	(1.5)	16.5
Deactivated Shutdown	99	99	99	99	99	99	0.0	0.0	0.0

**b. Outage Capacity by Outage Category**

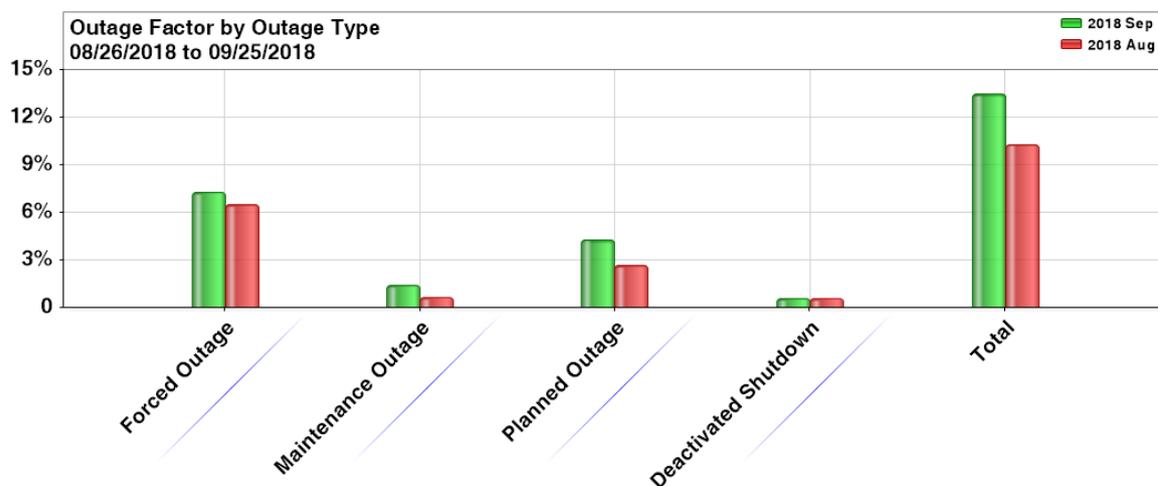
Consistent with the discussion on outage capacity in the preceding sections, the system-wide total outage factor was higher this month at 14 percent when compared to previous month’s 10.5 percent driven by the increases in planned outage factor (from previous month’s 2.6 percent to 4.3 percent), maintenance outage factor (from previous month’s 0.6 percent to 1.6 percent), and forced outage factor (from previous month’s 6.8 percent to current month’s 7.6 percent).

Meanwhile, deactivated shutdown outage factor remained at 0.5 percent.

**Figure 4. Outage Factor (by Plant Type), September 2018 and August 2018**



**Figure 5. Outage Factor (by Outage Type), September 2018 and August 2018**



**Table 4. Outage Factor, September 2018 and August 2018**

Plant Type	Total Outage Factor		Forced Outage Factor		Maintenance Outage Factor		Planned Outage Factor		D/S Outage Factor	
	Sep 2018	Aug 2018	Sep 2018	Aug 2018	Sep 2018	Aug 2018	Sep 2018	Aug 2018	Sep 2018	Aug 2018
BAT										
BIOF										
COAL	16.1	9.3	5.7	7.8	2.1		8.2	1.5		
GEO	24.0	16.8	16.0	9.2	2.3	1.7	0.2	0.4	5.5	5.5
HYD	3.5	10.1	1.2	2.2	0.0	0.0	2.3	7.8		
NATG	4.0	4.4	1.3	0.5	1.9	2.4	0.8	1.5		
OIL	29.3	20.7	25.0	15.5			4.3	5.2		
SOLR										
WIND										
<b>Total</b>	<b>14.0</b>	<b>10.5</b>	<b>7.6</b>	<b>6.8</b>	<b>1.6</b>	<b>0.6</b>	<b>4.3</b>	<b>2.6</b>	<b>0.5</b>	<b>0.5</b>

### III. Demand and Supply Situation

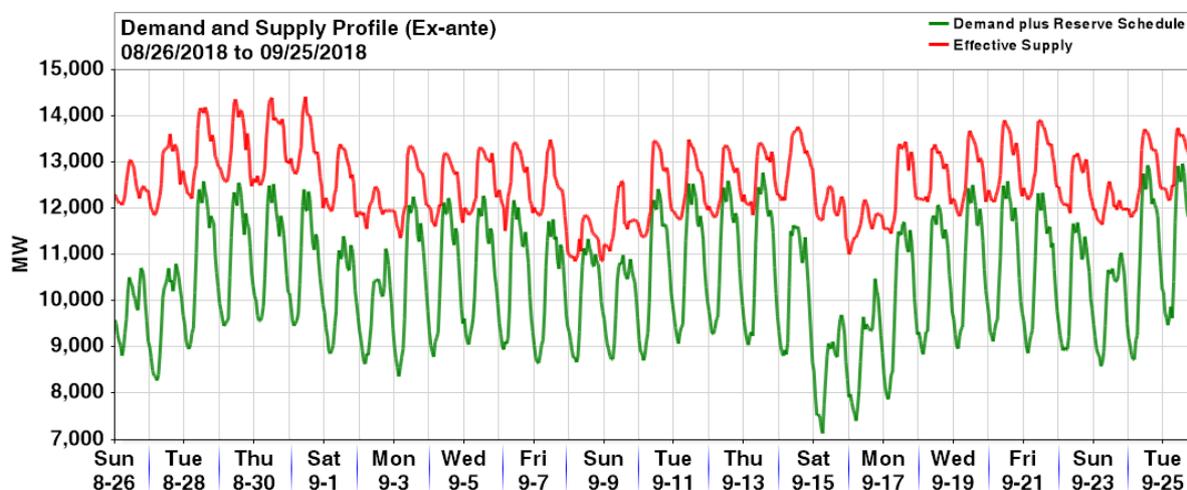
System demand<sup>2</sup> posted a 0.4 decrease from previous month's 9,593 MW to current month's 9,559 MW. Weekly average system demand ranged from 9,374 MW (10 to 16 Sep) to 9,640 MW (17 to 23 Sep).

For this period, the reserve schedule averaged at 885 MW. Consequently, the demand plus reserve schedule averaged at 10,444 MW, demonstrating a 0.4 percent decrease from last month's 10,486 MW.

Similarly, effective supply<sup>3</sup> posted a lower average this month at 12,570 MW from previous month's 12,894 MW attributable to the higher level of outage capacity. Weekly average effective supply ranged from 12,213 MW (3 to 9 September) up to 12,944 MW (27 August to 2 September).

Driven by the decrease in effective supply, supply margin<sup>4</sup> narrowed by 11.7 percent this month at 2,126 MW coming from previous month's 2,408 MW. Following the high level of outage capacity, averaging at 3,087 MW, the week of 3 to 9 September observed the lowest supply margin at an average of 1,799 MW.

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



**Table 5. Demand and Supply Summary (Ex-ante), September 2018 and August 2018**

	September 2018 (In MW)			August 2018 (In MW)			% M-on-M Change (Aug 2018 - Sep 2018)		
	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
<b>Demand</b>	11,932	6,443	9,559	11,654	7,216	9,593	2.4	(10.7)	(0.4)
<b>Reserve Schedule</b>	1,184	615	885	1,209	596	893	(2.1)	3.1	(0.9)
<b>Demand plus R/S</b>	12,975	7,143	10,444	12,702	8,052	10,486	2.1	(11.3)	(0.4)
<b>Effective Supply</b>	14,418	10,859	12,570	14,350	11,515	12,894	0.5	(5.7)	(2.5)
<b>Supply Margin</b>	4,606	405	2,126	4,044	677	2,408	13.9	(40.2)	(11.7)

Note: The derived values were non-coincident.

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

<sup>3</sup>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 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 effective supply. Likewise included is the scheduled output of Malaya plant when it is called to run as Must Run Unit (MRU).

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

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

	26 Aug 2018 (in MW)			27 Aug to 2 Sep 2018 (in MW)			3 to 9 Sep 2018 (in MW)			10 to 16 Sep 2018 (in MW)			17 to 23 Sep 2018 (in MW)			24 to 25 Sep 2018 (in MW)		
	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
Demand	9,802	7,955	8,895	11,672	7,373	9,611	11,272	7,536	9,532	11,748	6,443	9,374	11,501	7,262	9,640	11,932	7,809	10,168
Reserve Schedule	1,037	761	914	1,152	722	922	1,090	696	862	1,074	637	828	1,117	615	872	1,184	765	992
Demand plus R/S	10,715	8,821	9,809	12,591	8,286	10,533	12,275	8,373	10,414	12,778	7,143	10,203	12,595	7,879	10,511	12,975	8,736	11,159
Effective Supply	13,053	12,077	12,460	14,418	11,564	12,944	13,492	10,859	12,213	13,770	11,016	12,421	13,910	11,458	12,642	13,744	11,815	12,830
Supply Margin	3,268	1,661	2,651	3,739	808	2,411	3,245	405	1,799	4,606	563	2,218	3,700	952	2,131	3,214	629	1,670

#### IV. Market Price Outcome<sup>5</sup>

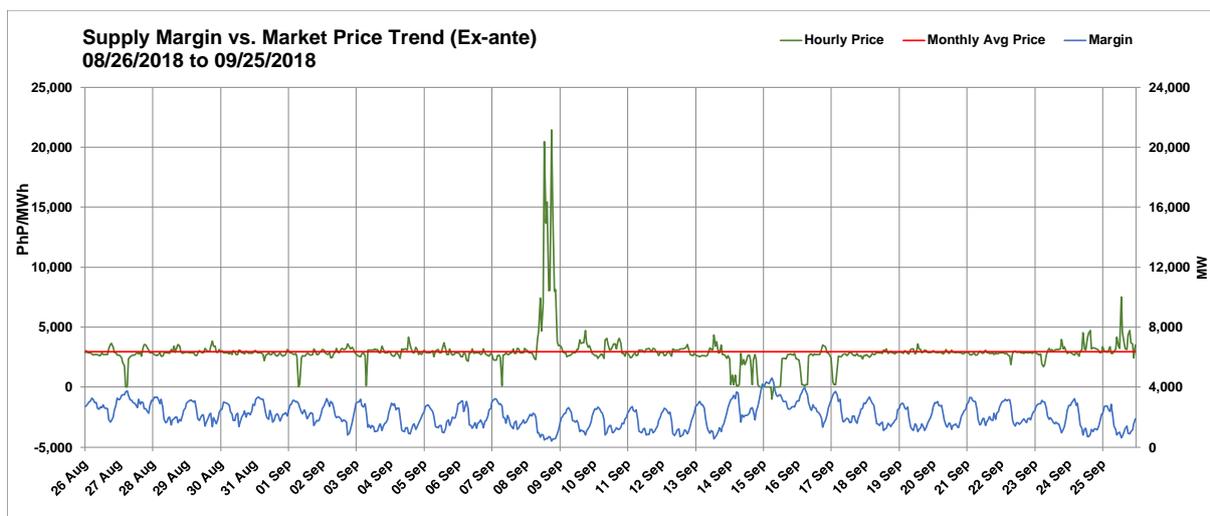
##### A. Market Prices

A 9.3 percent increase was noted in the average market prices this month at PhP2,966/MWh from previous month's PhP2,713/MWh following the tighter supply margin observed this month.

As seen in Figure 7, market prices were generally below PhP5,000/MWh throughout the billing month except on 8 September (11 trading intervals) and on 25 September (at 1400H). As discussed, the day of 8 September saw a high level of outage which averaged at 3,651 MW (ranging from 3,219 MW to 3,920 MW). This left a relatively low average supply margin during the day at 1,147 MW compared to 1,376 MW to 3,266 MW recorded during the rest of the month. The peak hours of 1900H and 1400H of 8 September particularly observed the lowest supply margin at 405 MW and 461 MW, respectively, which resulted in high prices reaching as high as PhP21,453/MWh (1900H) and PhP20,457/MWh (1400H).

The weekly average prices ranged from PhP2,485/MWh from 10 to 16 September up to PhP3,581/MWh from 3 to 9 September.

**Figure 7. Market Price Trend vs. Supply Margin, September 2018**



<sup>5</sup>The 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, September 2018 and August 2018**

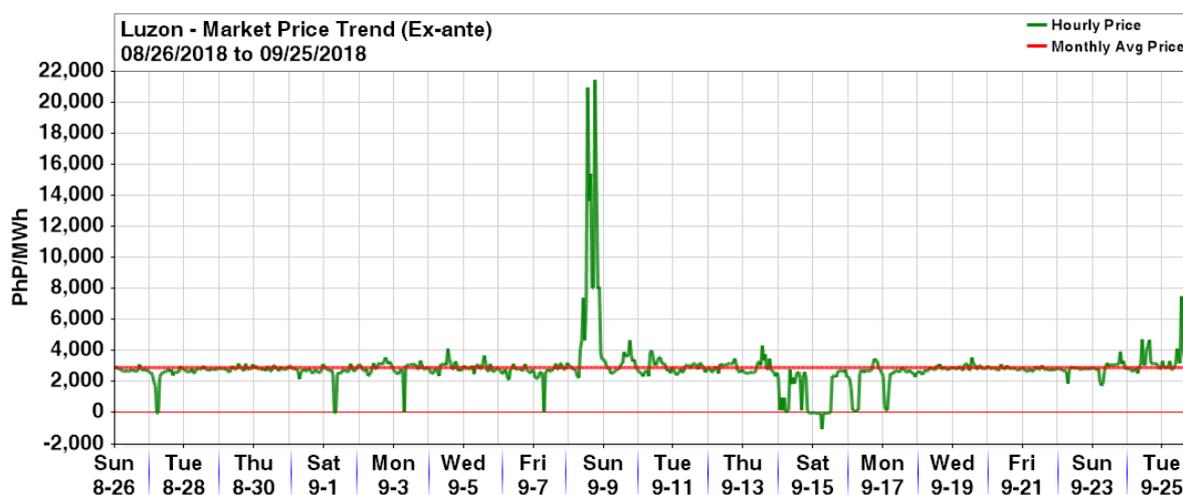
	September 2018 (In PhP/MWh)			August 2018 (In PhP/MWh)			% M-on-M Change (Aug 2018 - Sep 2018)		
	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
Luz-Vis	21,453	-1,023	2,966	7,805	0	2,713	174.9		9.3
Luzon	21,453	-1,023	2,945	5,415	0	2,661	296.1		10.6
Visayas	21,453	-1,023	3,083	29,620	-10,109	2,983	(27.6)	89.9	3.4

**Table 8. Weekly Market Price Summary, September 2018**

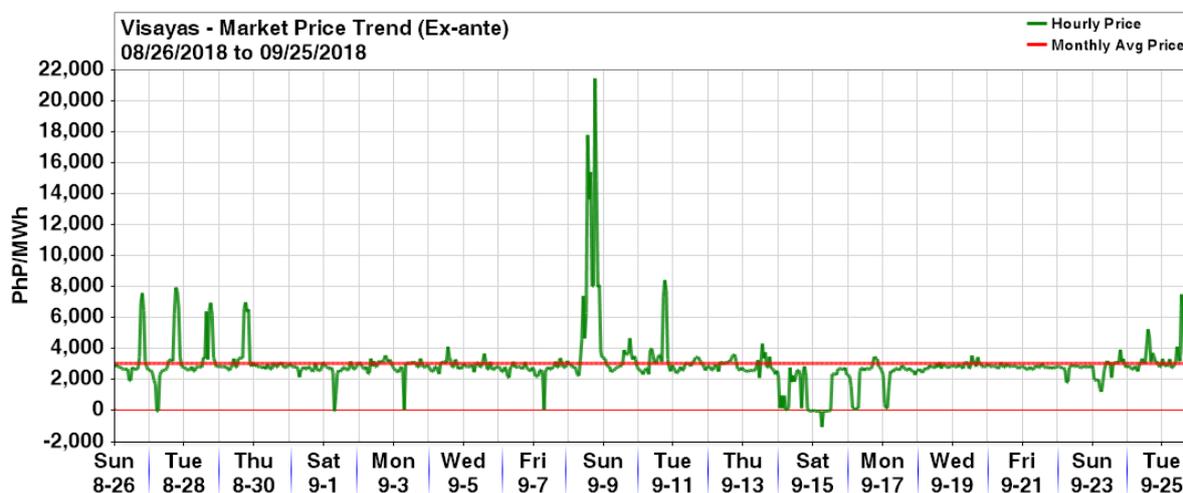
	26 Aug 2018 (in PhP/MWh)			27 Aug to 2 Sep 2018 (in PhP/MWh)			3 to 9 Sep 2018 (in PhP/MWh)			10 to 16 Sep 2018 (in PhP/MWh)			17 to 23 Sep 2018 (in PhP/MWh)			24 to 25 Sep 2018 (in PhP/MWh)		
	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
Luz-Vis	3,646	2,606	2,888	3,838	0	2,835	21,453	89	3,581	4,355	-1,023	2,485	3,969	193	2,819	7,536	2,431	3,459

The market prices in Luzon averaged at PhP2,945/MWh, lower by 4.5 percent than the PhP3,083/MWh recorded in the Visayas region. Price separation was frequently observed from 26 to 29 August usually from 1800H to 2100H when the power flow to Visayas approached or reached the 250-MW limit.

**Figure 8. Market Price Trend - Luzon, September 2018**



**Figure 9. Market Price Trend - Visayas, September 2018**



**Table 9. Regional Price Summary – September 2018 and August 2018**

	Luzon (In PhP/MWh)			Visayas (In PhP/MWh)			% Difference		
	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
September 2018	21,453	-1,023	2,945	21,453	-1,023	3,083	0.0	0.0	(4.5)
August 2018	5,415	0	2,661	29,620	-10,109	2,983	(81.7)	(100.0)	(10.8)

**B. Price Distribution**

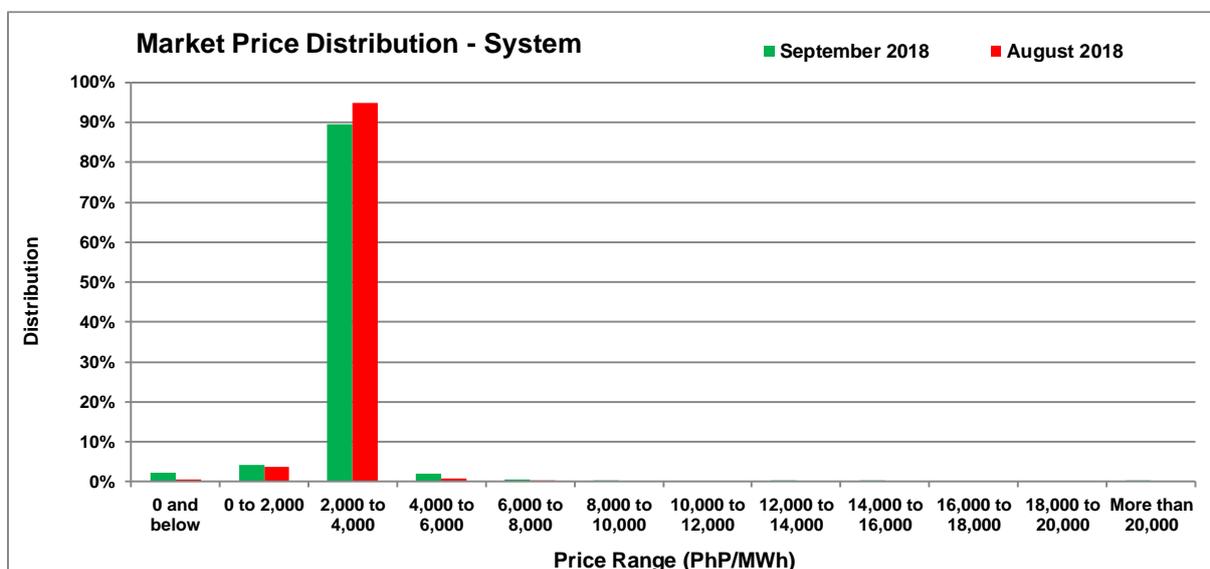
Consistent with the slight increase in average price, the frequency of prices below PhP4,000/MWh decreased to 96.2 percent from previous month’s 99.1 percent. In addition, 1.1 percent of this month’s prices were recorded at above PhP8,000/MWh while it may be recalled that no price was recorded beyond said level in August.

In addition, higher frequency of prices ranging from PhP4,000/MWh to PhP8,000/MWh was recorded this month at 2.7 percent coming from 0.9 percent in the previous month.

**Figure 10. Price Distribution, September 2018 and August 2018**

Price Range (PhP/MWh)	% Distribution	
	September 2018	August 2018
0 and below	2.3	0.7
0 to 2,000	4.3	3.6
2,000 to 4,000	89.7	94.8
4,000 to 6,000	2.2	0.8
6,000 to 8,000	0.5	0.1
8,000 to 10,000	0.4	0.0
10,000 to 12,000	0.0	0.0
12,000 to 14,000	0.1	0.0
14,000 to 16,000	0.3	0.0
16,000 to 18,000	0.0	0.0
18,000 to 20,000	0.0	0.0
More than 20,000	0.3	0.0

**Table 10. Price Distribution – September 2018 and August 2018**



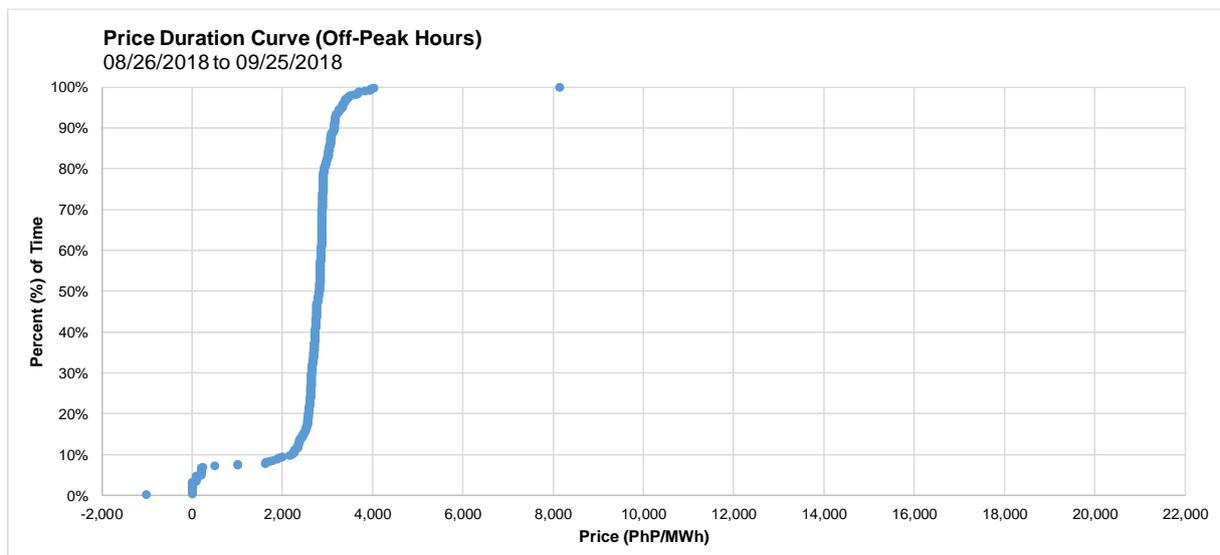
### C. Price Duration Curve

The price duration curves for both the off-peak<sup>6</sup> and peak<sup>7</sup> hours demonstrate the higher market prices, especially in peak hours, during the September billing month when compared to the previous month.

Bulk of the market prices during the off-peak hours of the billing month, at 90 percent, were within the price range PhP2,000/MWh to PhP4,000/MWh (Figure 11). About 6.4 percent was at PhP2,000/MWh and below while the remaining 0.5 percent were above PhP4,000/MWh up to PhP10,000/MWh.

Majority of the prices during the peak hours, at 89.1 percent, were likewise within the PhP2,000/MWh up to PhP4,000/MWh (Figure 12). However, it was observed that market prices during peak hours were higher than the off-peak hours as denoted by the higher frequency of prices above PhP4,000/MWh (at 8.3 percent) and lower frequency of prices at PhP2,000/MWh and below (at 2.6 percent).

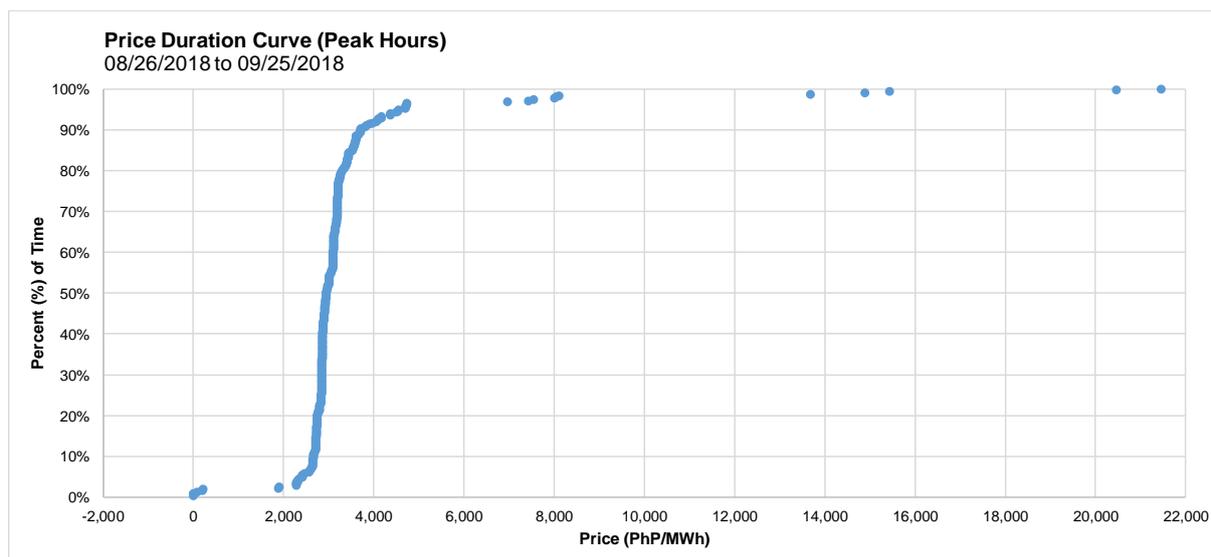
**Figure 11. Price Duration Curve (Off-Peak Period), September 2018**



<sup>6</sup>Off-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

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

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



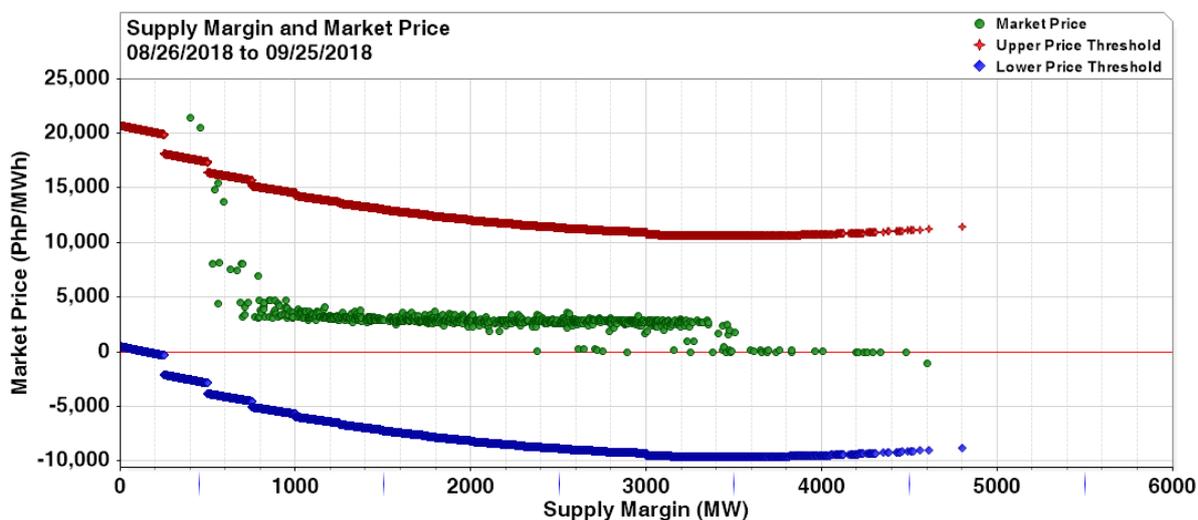
**D. Interesting Pricing Event**

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.

As seen in Table 11, prices on 8 September at 1400H and 1900H, were considered as interesting pricing events during the September billing month. These trading intervals posted the lowest supply margin recorded during the month following the high level of outage capacity during the day.

Provided also are the details on the supply margin during the said hour and the corresponding reference price threshold for each interesting pricing event.

**Figure 13. Supply Margin and Market Price, September 2018**



**Table 11. Interesting Pricing Events – September 2018**

Date	Hour	Market Price (PhP/MWh)	Supply Margin (MW)	Reference Price Threshold (PhP/MWh)
Sep 08, 2018	14	21,453	405	17,674
Sep 08, 2018	19	20,457	461	17,509

## V. Pricing Errors and Market Intervention

System-wide non-congestion pricing errors affected 16 trading intervals or 2.2 percent of the time in the ex-ante and 10 trading intervals or 1.3 percent of the time in the ex-post during the September billing month, related to inappropriate input data which affected the generation of prices and schedules. This is a decrease from previous month's non-congestion pricing error occurrences that affected 145 trading intervals or 19.5 percent of the time during the ex-ante and 130 trading intervals or 17.5 percent of the time during the ex-post.

In Luzon, the frequency of issuances of non-congestion pricing errors affected nine (9) trading intervals or 1.2 percent of the time in the ex-ante and two (2) trading intervals or 0.3 percent of the time in the ex-post related to the localized constraint violation on Paco, Araneta, and Lumban transformers. This month's figure was higher than previous month's three (3) trading intervals or 0.4 percent of the time in the ex-ante and one (1) trading interval or 0.1 percent of the time in the ex-post.

In Visayas, non-congestion pricing errors affected eight (8) trading intervals or 1.1 percent of the time, lower than last month's 31 trading intervals or 4.2 percent of the time in the ex-ante. Meanwhile, four (4) trading intervals or 0.5 percent of the time were affected in the ex-post, lower than last month's 28 trading intervals or 3.8 percent of the time. These were mainly on account of the localized constraint violation on Calung-Calung and Compostela transformers.

Meanwhile, an increase in the system-wide application of Price Substitution Methodology (PSM) was observed this month, affecting a total of 61 trading intervals or 8.2 percent of the time (previous month's 16 trading intervals or 2.2 percent of the time) in the ex-ante and 45 trading intervals or 6 percent of the time (previous month's 28 trading intervals or 3.8 percent of the time) in the ex-post. PSM application this month was mainly due to constraint on Samboan-Amlan Line 1 (Cebu-Negros submarine cable) and New Naga-Samboan line 1.

**Table 12. PEN, PSM and MI Summary, September 2018**

	Luz-Vis		Luzon		Visayas		Total	
	Freq.	% of Time	Freq.	% of Time	Freq.	% of Time	Freq.	% of Time
<b>PEN (RTD)</b>	16	2.2	9	1.2	8	1.1	33	4.4
<b>PEN (RTX)</b>	10	1.3	2	0.3	4	0.5	16	2.2
<b>PSM (RTD)</b>	61	8.2	-	-	1	0.1	62	8.3
<b>PSM (RTX)</b>	45	6.0	-	-	-	-	45	6.0

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. It was noted that system-wide non-congestion pricing errors, affecting a total of 16 trading intervals in the ex-ante and 10 trading intervals in the ex-post, were related to inappropriate input data.

In Luzon, pricing errors due to base case constraint affected five (5) trading intervals in the ex-ante while contingency-related pricing errors affected three (3) trading intervals in the ex-ante.

In addition, pricing errors due to load shedding affected one (1) trading interval in the ex-ante and three (3) trading intervals in the ex-post.

On the other hand, in the Visayas region, pricing error due to load shedding affected 8 trading intervals during the ex-ante and 4 trading intervals during the ex-post.

**Table 13. PEN Type Summary, September 2018**

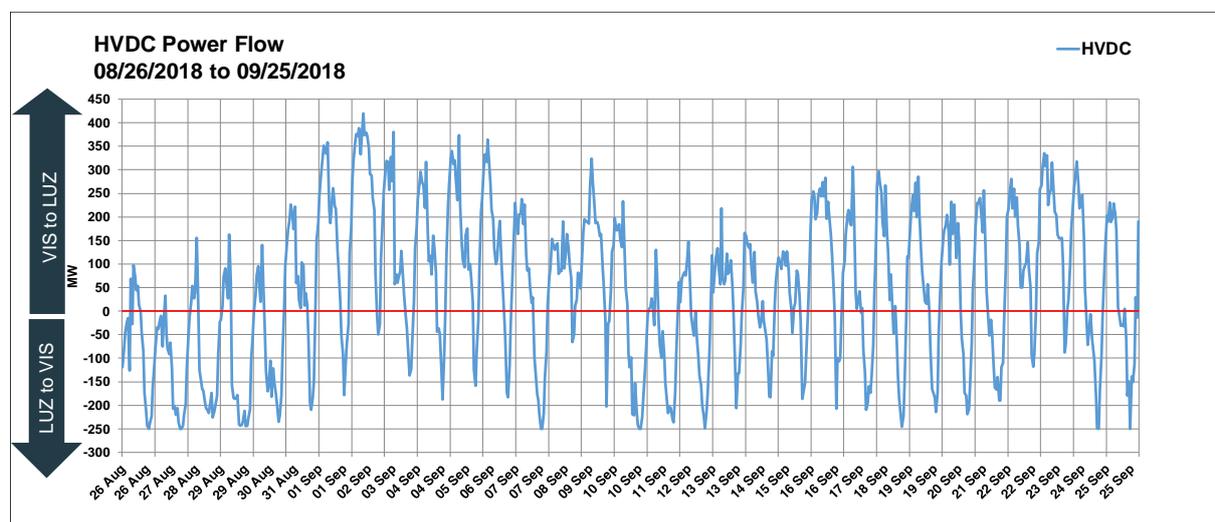
	Luz-Vis		Luzon		Visayas		Total	
	Freq.	% of Time	Freq.	% of Time	Freq.	% of Time	Freq.	% of Time
<b>PEN (RTD)</b>	<b>16</b>	<b>2.2</b>	<b>9</b>	<b>1.2</b>	<b>8</b>	<b>1.1</b>	<b>33</b>	<b>4.4</b>
Contingency	-	-	3	0.4	-	-	3	0.4
Base Case	-	-	5	0.7	-	-	5	0.7
Over-generation	-	-	-	-	-	-	-	-
VoLL	-	-	1	0.1	8	1.1	9	1.2
Inappropriate Input Data	16	2.2	-	-	-	-	16	2.2
<b>PEN (RTX)</b>	<b>10</b>	<b>1.3</b>	<b>2</b>	<b>0.3</b>	<b>4</b>	<b>0.5</b>	<b>16</b>	<b>2.2</b>
Contingency	-	-	-	-	-	-	-	-
Base Case	-	-	-	-	-	-	-	-
Over-generation	-	-	-	-	-	-	-	-
VoLL	-	-	2	0.3	4	0.5	6	0.8
Inappropriate Input Data	10	1.3	-	-	-	-	10	1.3

## VI. HVDC Scheduling

Power flow through the HVDC Interconnection was generally directed towards the Luzon region for 448 trading intervals in the ex-ante during the billing month, with schedules ranging from 0.4 MW to 420 MW. The 420-MW limit was maximized for 1 trading interval during the billing month.

On the other hand, the HVDC power flow was directed towards the Visayas for 296 trading intervals in the ex-ante during the billing month, with schedules ranging from 0.5 MW to 250 MW. It was noted that the 250-MW limit was maximized for 9 trading intervals during the billing month.

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



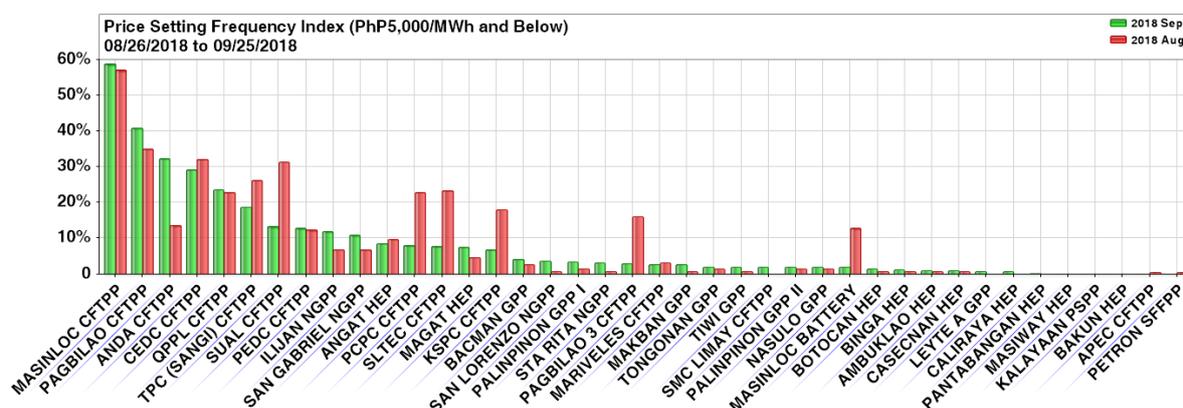
**Table 14. Summary of HVDC Limits Imposed by NGCP-SO and Results of HVDC Schedules (Ex-ante and Ex-post), September 2018**

Results of HVDC Scheduling	HVDC Limit during Ex-ante (Visayas/Luzon)				HVDC Limit during Ex-post (Visayas/Luzon)			
	(No. of Trading Intervals)	Percent of Time	(No. of Trading Intervals)	Percent of Time	(No. of Trading Intervals)	Percent of Time	(No. of Trading Intervals)	Percent of Time
	250/420		Total		250/420		Total	
<b>Visayas to Luzon</b>	<b>448</b>	<b>60%</b>	<b>448</b>	<b>60%</b>	<b>453</b>	<b>61%</b>	<b>453</b>	<b>61%</b>
Limit Not Maximized	447	60%	447	60%	452	61%	452	61%
Limit Maximized <sup>1</sup>	1	0%	1	0%	1	0%	1	0%
<b>Luzon to Visayas</b>	<b>296</b>	<b>40%</b>	<b>296</b>	<b>40%</b>	<b>291</b>	<b>39%</b>	<b>291</b>	<b>39%</b>
Limit Not Maximized	287	39%	287	39%	273	37%	273	37%
Limit Maximized <sup>1</sup>	9	1%	9	1%	18	2%	18	2%
<b>No Flow <sup>1</sup></b>								
	<b>744</b>	<b>100%</b>	<b>744</b>	<b>100%</b>	<b>744</b>	<b>100%</b>	<b>744</b>	<b>100%</b>

## VII. Price Setting Plants<sup>8</sup>

Almost all of the market prices, at 98.4 percent, during the billing month were below PhP5,000/MWh with coal plants as frequent price setters, namely Masinloc CFTPP at 58.7 percent, Pagbilao CFTPP at 40.9 percent, Anda CFTPP at 32.3 percent, CEDC CFTPP at 29.2 percent, and QPPL CFTPP at 23.7 percent.

**Figure 15. Price Setting Frequency Index (PhP5,000/MWh and Below), September 2018 and August 2018**



The market prices ranged between PhP5,000/MWh to PhP10,000/MWh at 0.9 percent of the time, with Visayas oil-based plants mostly setting the prices (TPC Carmen DPP at 2.6 percent, CPPC DPP at 1.5 percent, EAUC DPP at 1.5 percent, PB 101 at 0.5 percent, and PB 102 at 0.3 percent).

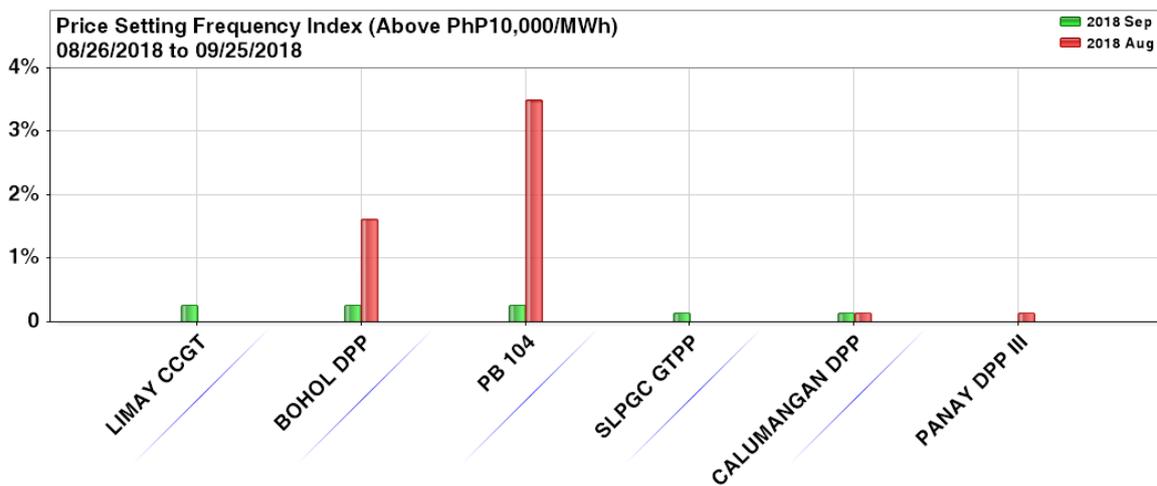
<sup>8</sup> A generator trading node is considered as a price setter when its last accepted offer price is between 95% to 100% of its nodal price. A generating plant is considered as price setter if at least one of its trading nodes was price setter in a given trading hour. The determination of the 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 (Above PhP5,000/MWh to PhP10,000/MWh), September 2018 and August 2018**



In addition, market prices above PhP10,000/MWh (0.7 percent of the time) were also observed which were set by oil-based plants led by Limay CCGT, Bohol DPP, and PB 104 each at 0.3 percent. SLPGC GTTP and Calumangan DPP were also able to set at the said level for 0.1 percent of the time each.

**Figure 17. Price Setting Frequency Index (Above PhP10,000/MWh), September 2018 and August 2018**



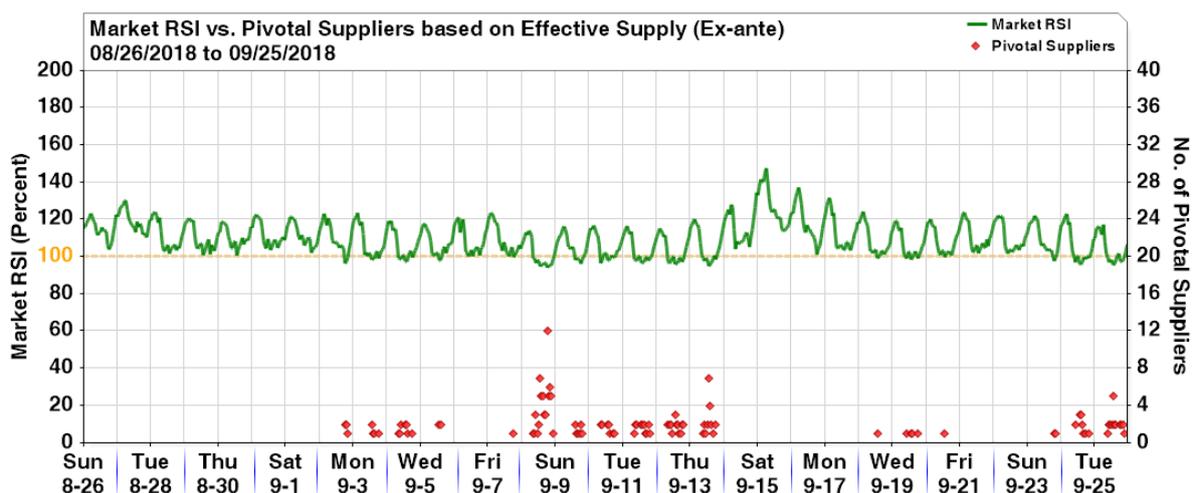
## VIII. Residual Supply

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

Consistent with the tighter supply margin this month, the market RSI was above the 100 percent mark for 86 percent of the time or in 643 trading intervals (previous month's 97 percent or 724 trading intervals), indicating that there were no pivotal suppliers for the majority of the trading intervals during the billing month.

<sup>9</sup> 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.

**Figure 18. Market RSI vs. Pivotal Suppliers (Ex-Ante), September 2018**

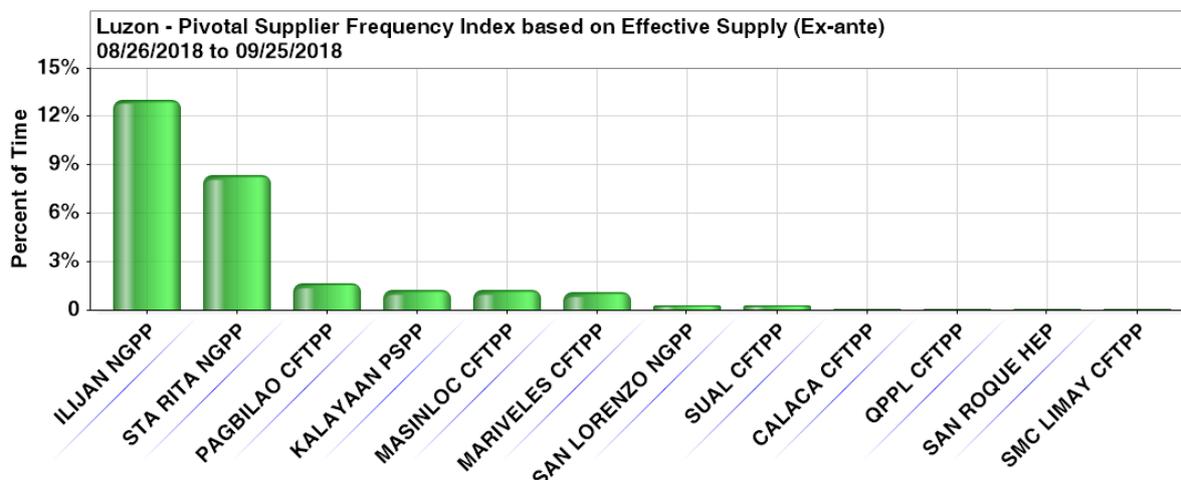


**IX. Pivotal Suppliers<sup>10</sup>**

A total of 12 Luzon plants emerged as pivotal suppliers during the September billing month led by natural gas plants Ilijan NGPP for having been pivotal for 13 percent of the time and Sta. Rita NGPP for 8.3 percent. Other Luzon plants namely Pagbilao CFTPP, Kalayaan PSPP, Masinloc CFTPP, and Mariveles CFTPP.

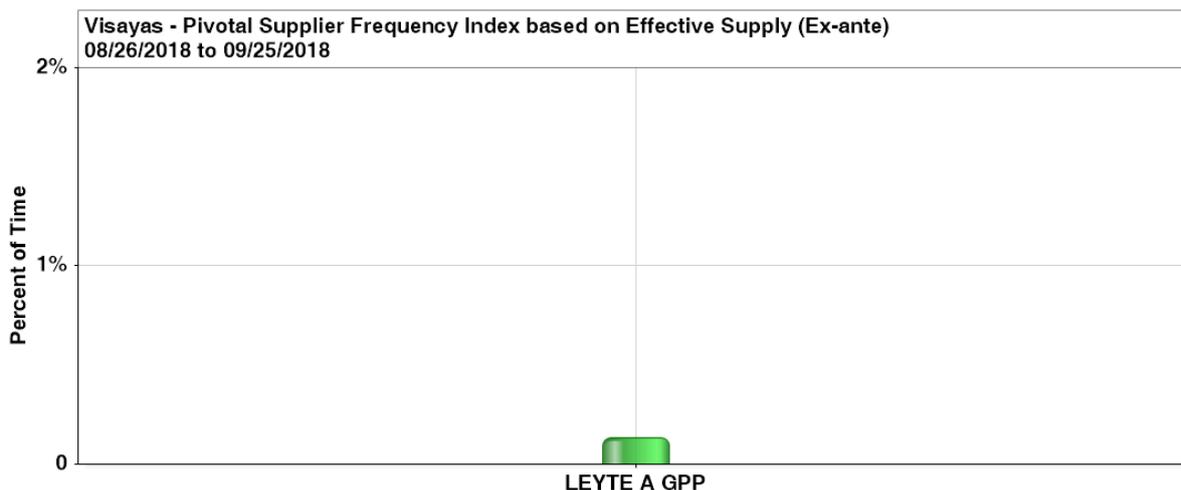
Only one (1) Visayas plant Leyte A GPP (0.1 percent) emerged as pivotal supplier this billing month.

**Figure 19. Pivotal Supplier Frequency Index - Luzon, September 2018**



<sup>10</sup> 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.

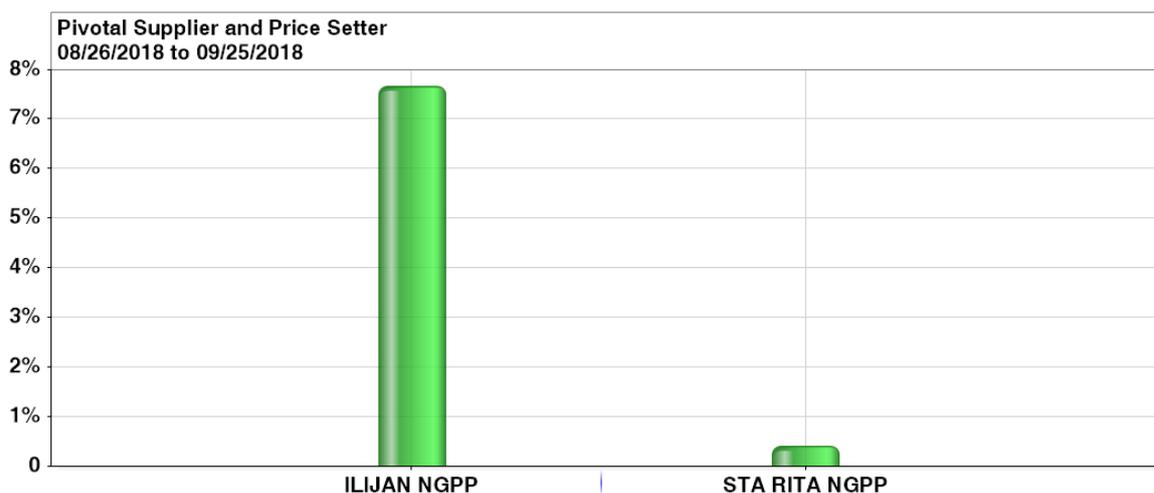
**Figure 20. Pivotal Supplier Frequency Index - Visayas, September 2018**



**X. Price-Setters and Pivotal Plants**

Only two (2) Luzon plants became price setters at the same time that they were pivotal namely Ilijan NGPP at 7.7 percent and Sual CFTPP at 0.4 percent.

**Figure 21. PSI vs. PSFI, September 2018**

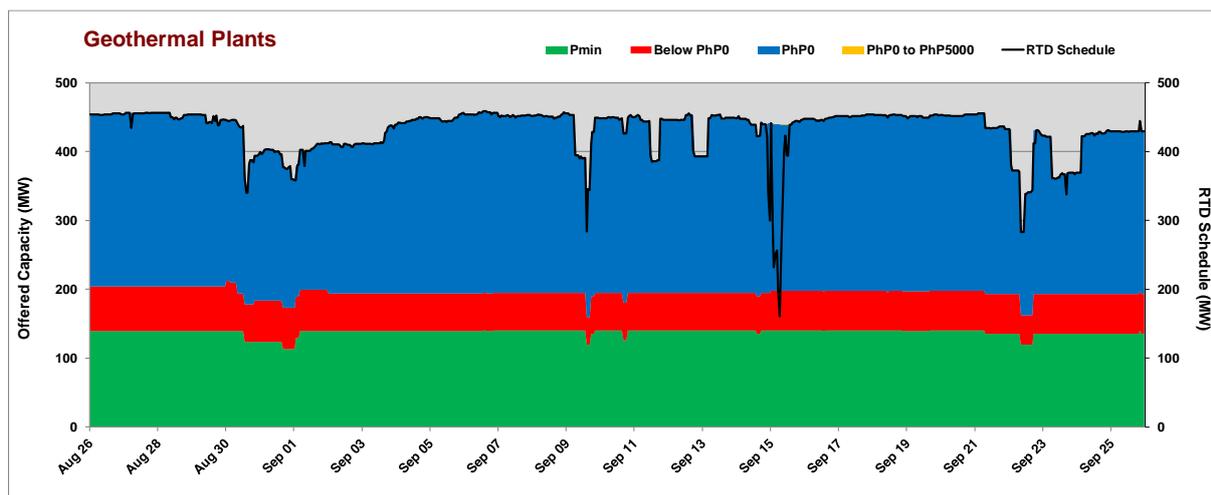


**XI. Generator Offer Pattern**

Luzon geothermal plants offered almost its entire capacity (99.9 percent) at PhP0/MWh and below. In particular, about 54.9 percent was priced at exactly PhP0/MWh while the remaining 45 percent was priced below PhP0/MWh (Figure 22). The remaining 0.1 percent was offered at PhP0/MWh to PhP5,000/MWh.

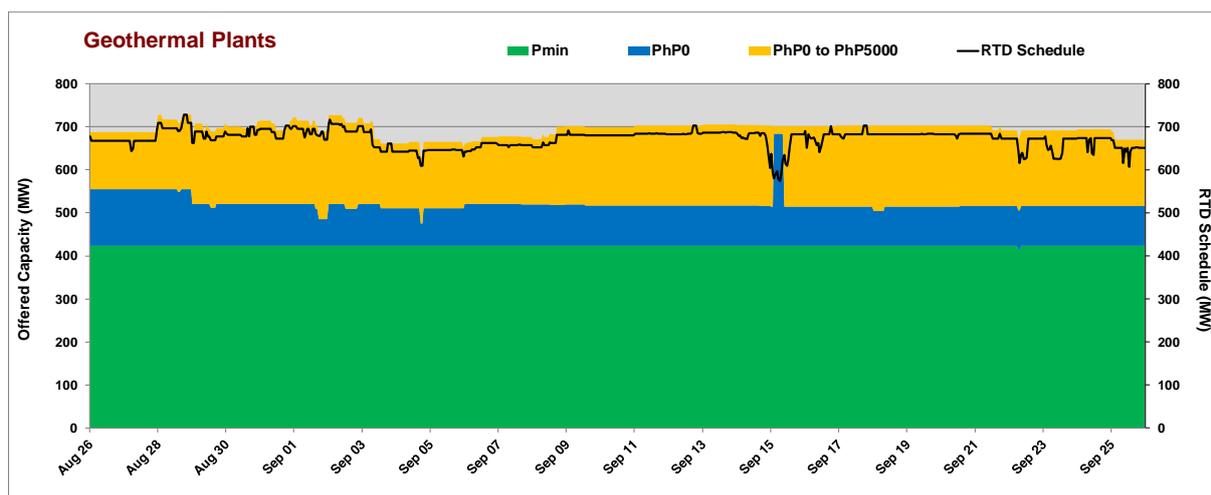
Accordingly, all of its submitted capacity offers, at 99.2 percent, were scheduled for dispatch in the market.

**Figure 22. Geothermal Plants Offer Pattern, Luzon – September 2018**



On the other hand, Visayas geothermal plants had slightly higher-priced offers compared to Luzon geothermal plants. It was noted that about 25 percent of Visayas geothermal plants' offered capacity was priced at above PhP0/MWh up to PhP5,000/MWh while the remaining 75 percent was priced at PhP0/MWh and below (Figure 23). It was noted that about 96.8 percent of these capacity offers were scheduled for dispatch.

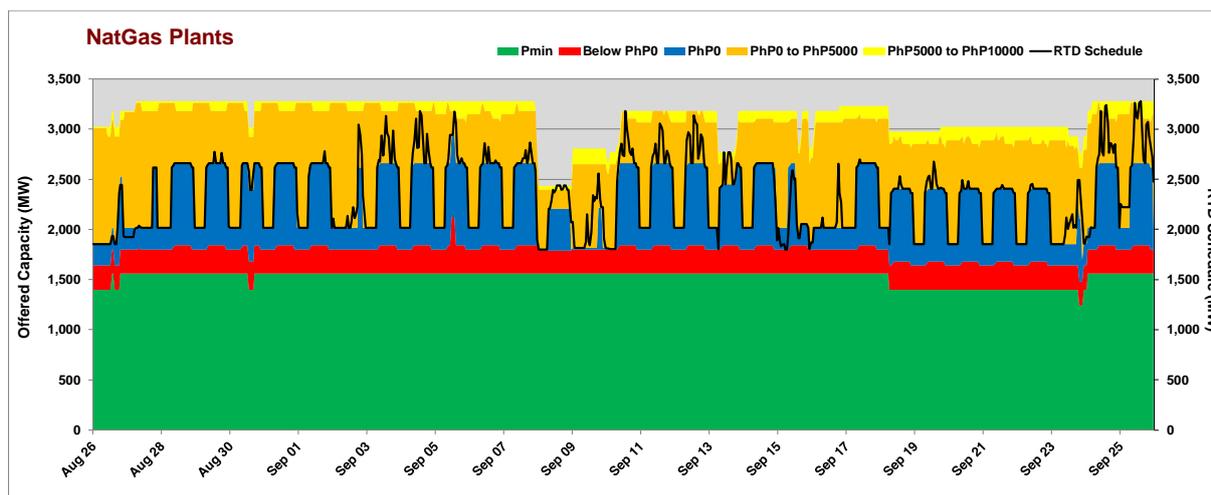
**Figure 23. Geothermal Plants Offer Pattern, Visayas – September 2018**



About 73 percent of the natural gas plants' capacity offers were priced at PhP0/MWh and below, 24.1 percent was priced above PhP0/MWh to PhP5,000/MWh and 2.9 percent was priced at above PhP5,000/MWh to PhP10,000/MWh (Figure 24).

Accordingly, about 74.5 percent of the offers of natural gas plants were scheduled for dispatch within the month.

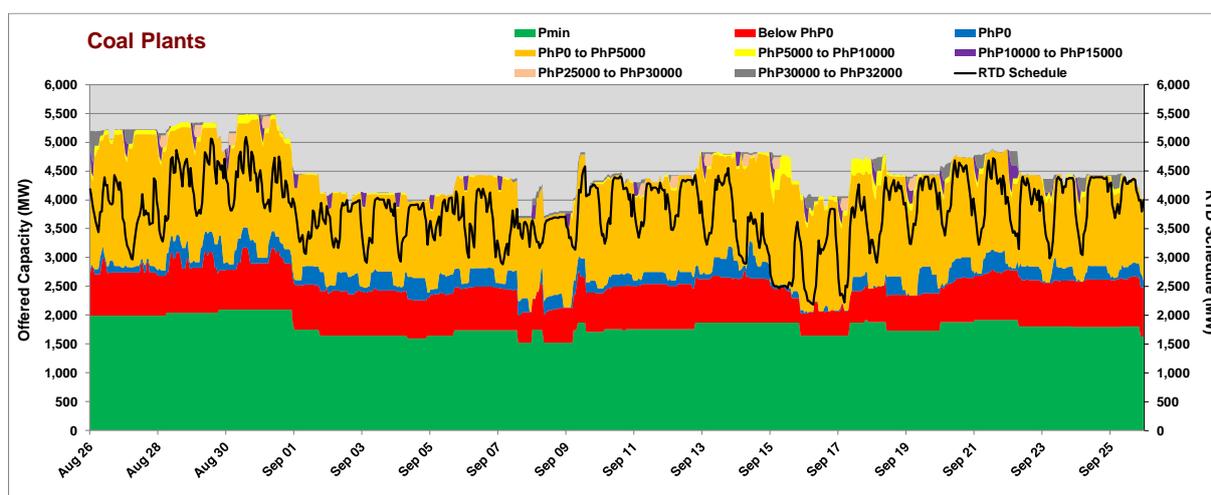
**Figure 24. Natural Gas Plants Offer Pattern, Luzon – September 2018**



Luzon coal plants submitted 60.3 percent of its capacity offers at prices ranging from PhP0/MWh and below while 36.9 percent was submitted at prices above PhP0/MWh to PhP5,000/MWh (Figure 25). About 1.8 percent (previous month’s 5.1 percent) of their offered capacity were priced between PhP5,000/MWh to PhP15,000/MWh. The remaining 1.1 percent of the capacity offers were priced at PhP25,000/MWh to PhP32,000/MWh which were mostly submitted by, Anda CFTPP.

About 83.6 percent of the capacity offers of Luzon coal plants were scheduled for dispatch within the month.

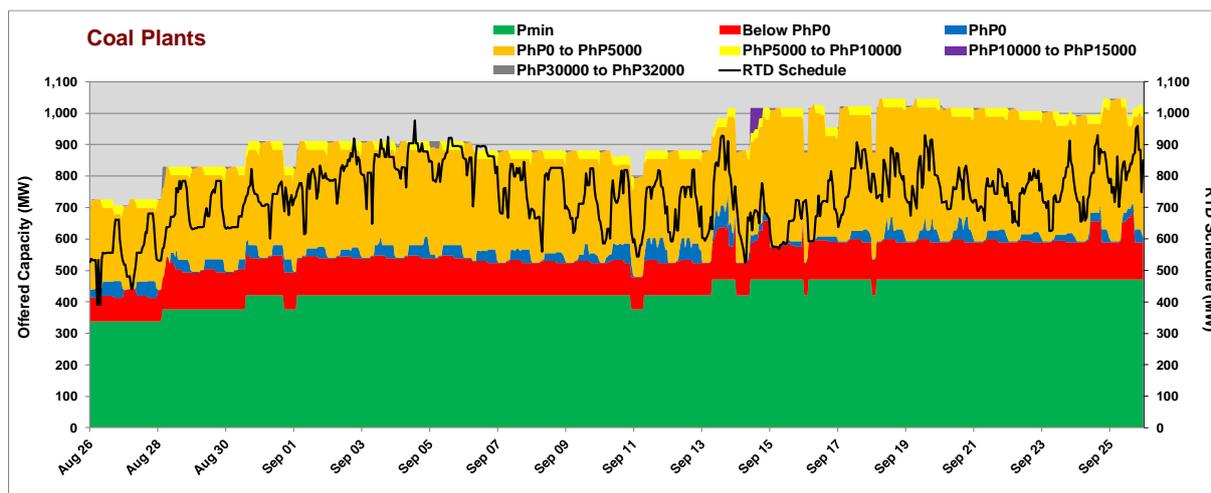
**Figure 25. Coal Plants Offer Pattern – Luzon, September 2018**



Meanwhile, 62 percent of Visayas coal plants’ capacity offers was priced at PhP0/MWh and below, 37.9 percent at above PhP0/MWh to PhP15,000/MWh. A minimal percentage, at 0.1 percent, was offered at prices ranging between PhP30,000/MWh and PhP32,000/MWh which were mostly from KSPC CFTPP units 1 and 2 (Figure 26).

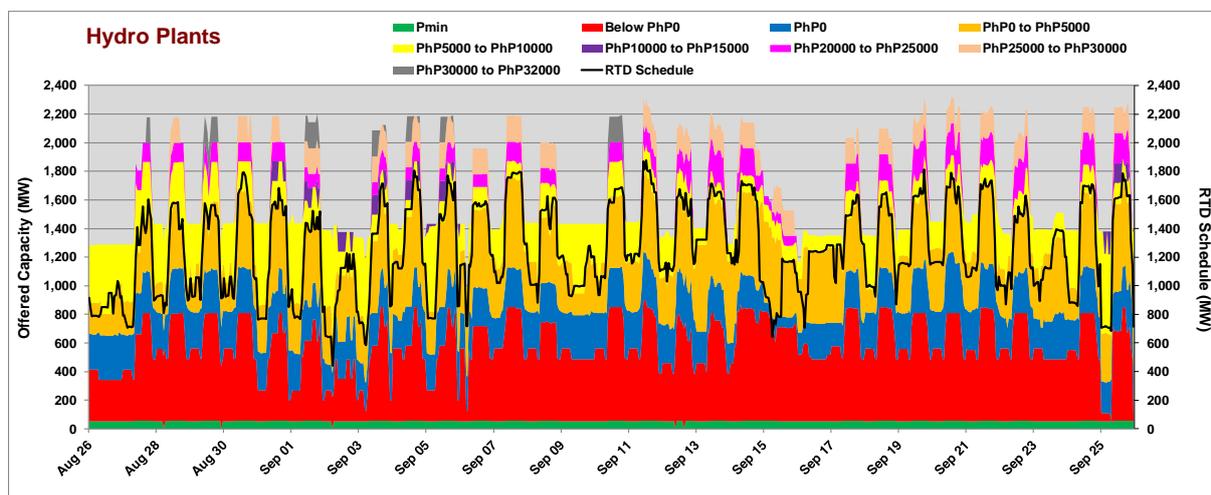
About 80.3 percent of the offered capacity from Visayas coal plants was scheduled for dispatch.

**Figure 26. Coal Plants Offer Pattern, Visayas – September 2018**



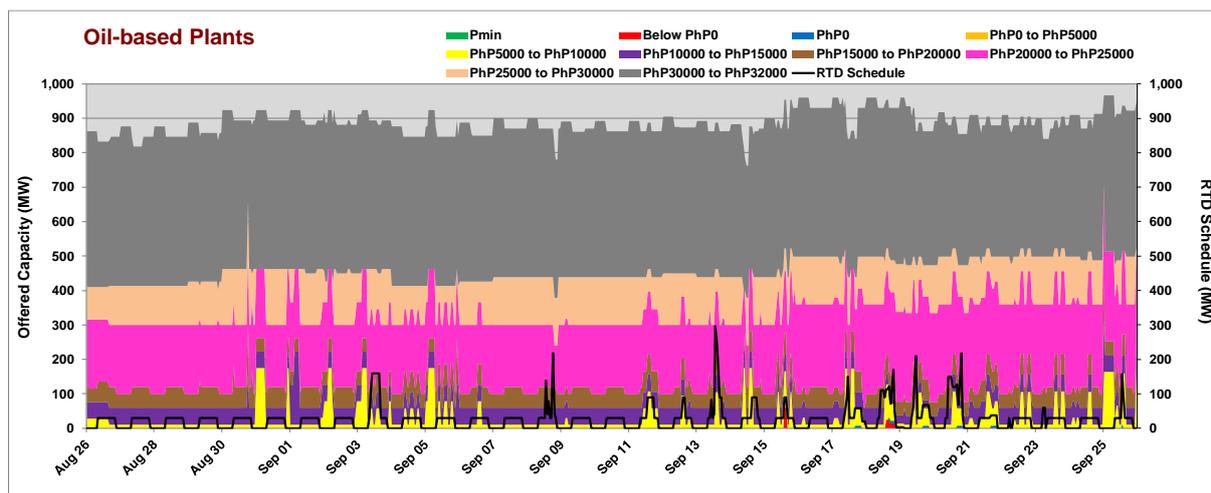
Luzon hydro plants priced 51.1 percent of their capacity at PhP0/MWh and below while 24.8 percent at PhP0/MWh up to PhP5,000/MWh. About 15.4 percent was priced at PhP5,000/MWh up to PhP15,000/MWh and 7.9 percent was priced at PhP20,000/MWh up to PhP30,000/MWh. The remaining 0.7 percent was priced at PhP30,000/MWh up to PhP32,000/MWh.

**Figure 27. Hydro Plants Offer Pattern, Luzon – September 2018**



Luzon oil-based plants submitted the highest offer prices with bulk of their offers, at 48.5 percent, priced at above PhP30,000/MWh up to PhP32,000/MWh. Moreover, 11.3 percent was offered at PhP10,000/MWh to PhP20,000/MWh while 36.6 percent at PhP20,000/MWh to PhP30,000/MWh (Figure 28). It was noted that only 3.6 percent of its capacity offers priced at PhP10,000/MWh and below.

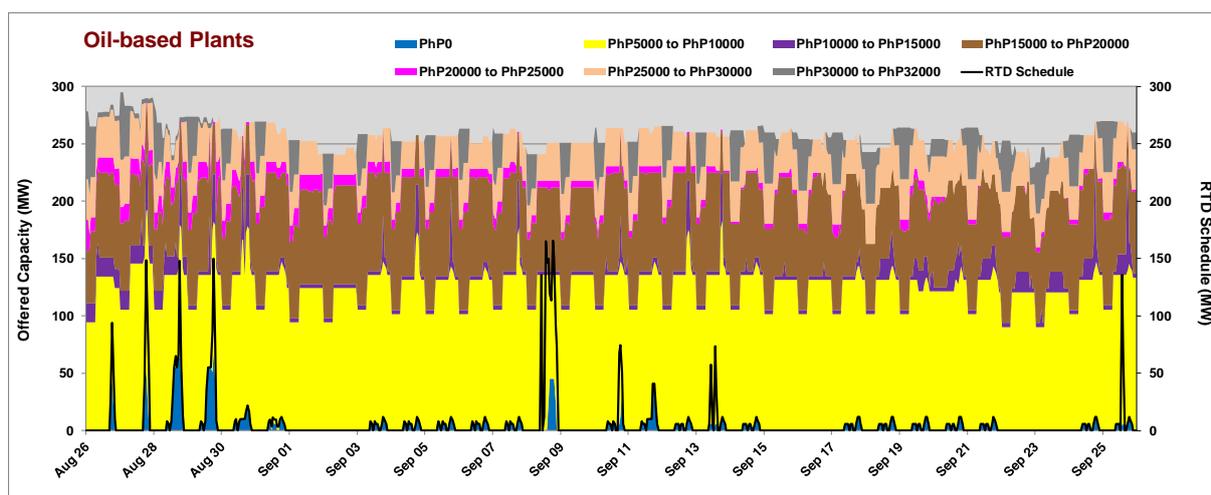
**Figure 28. Oil-based Plants Offer Pattern, Luzon – September 2018**



Similarly, Visayas oil-based plants offered their capacities at relatively higher prices when compared with other plant types with 19.6 percent priced above PhP20,000/MWh (Figure 29). About 47.3 percent was offered at PhP5,000/MWh to PhP10,000/MWh, 3.3 percent at PhP10,000/MWh to PhP15,000/MWh and 28.5 percent at PhP15,000/MWh to PhP20,000/MWh. Only 1.4 percent of their capacity offers were priced at PhP0/MWh and below.

About 2.5 percent of Visayas oil-based plants' capacity offered were scheduled for dispatch during the billing month.

**Figure 29. Oil-based Plants Offer Pattern, Visayas – September 2018**



## **XII. Capacity Factor**

### **Luzon**

Natural gas plants observed the highest utilization when measured in terms of registered capacity among resource types with capacity factor at 71 percent. Coal and hydro plants followed with capacity factors of 59 percent and 51 percent, respectively. Geothermal and oil-

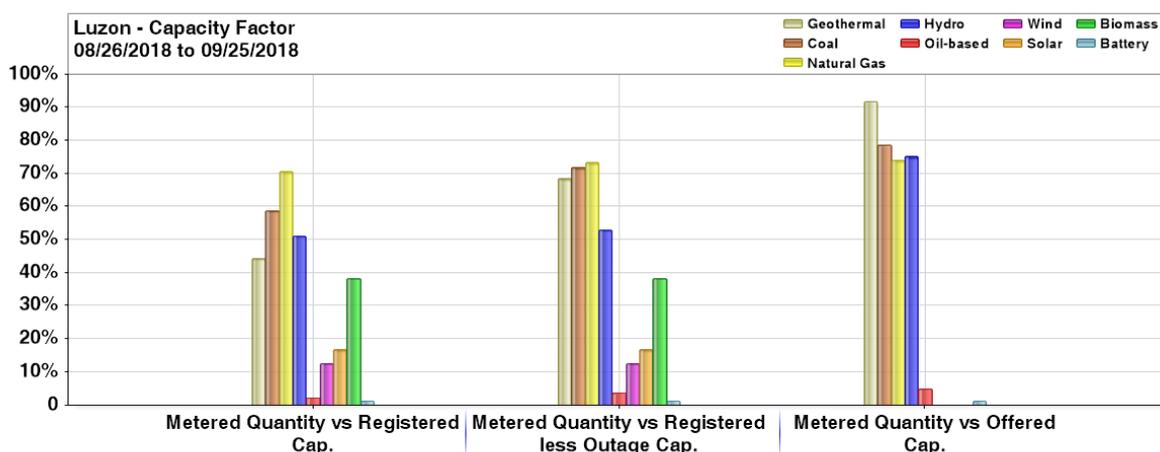
based plants came next at 44 percent and 2 percent, respectively. On the other hand, when measured in terms of registered capacity net of outage, natural gas and coal plants obtained the highest utilization at 73 percent and 72 percent, respectively. Geothermal plants followed with a capacity factor of 69 percent, hydro plants with 53 percent, and oil-based plants with 4 percent.

Utilization among lower-priced plants was highest when measured in terms of offered capacity, indicating that capacities, when offered, are generally scheduled for dispatch. Geothermal plants posted the highest capacity factor at 92 percent. Coal plants followed with 79 percent while hydro and natural gas plants recorded capacity factors at 75 and 74 percent each. Oil-based plants had lower capacity factor, at 5 percent.

Meanwhile, preferential dispatch plants – biomass plants’ capacity factors were posted at 38 percent when measured based on registered capacity and based on registered less outage capacity while solar plants recorded the same capacity factors at 17 percent each. On the other hand, lower utilization level was noted for Luzon wind plants with their capacity factors based on registered capacity, and registered less outage capacity each at 13 percent.

On the other hand, sole battery energy storage facility in the WESM, Masinloc Battery, posted a capacity factor of 1 percent each when measured in terms of registered capacity, registered capacity net of outage, and offered capacity.

**Figure 30. Capacity Factor – Luzon Plants, September 2018**

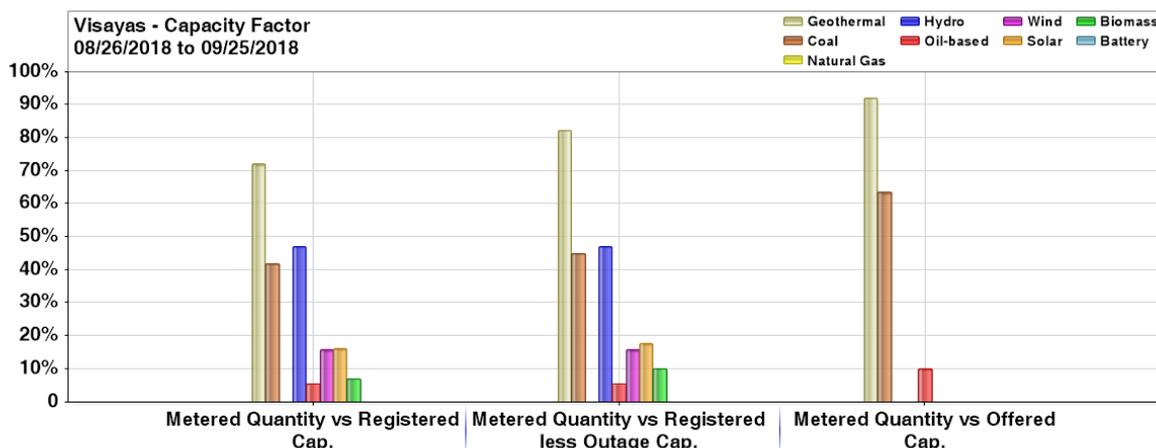


In Visayas, geothermal plants obtained the highest utilization among resource types in terms of registered capacity with capacity factors at 72 percent. Hydro and coal plants then followed with capacity factors at 47 percent and 42 percent, respectively. In terms of registered capacity net of outage, geothermal recorded its capacity factors at 82 percent, hydro plants at 47 percent and coal plants had 45 percent. Oil-based plants recorded the lowest utilization each at 6 percent when measured in terms of registered capacity and percent when measured in terms of registered capacity net of outage.

In terms of offered capacity, geothermal plants recorded a capacity factor at 92 percent while coal plants’ capacity factor was at 64 percent. Meanwhile, oil-based plants posted a capacity factor of 10 percent.

Wind plants’ capacity factors based on registered capacity and based on registered capacity net of outage in the region was recorded at 16 percent while solar plants recorded the same at 16 percent and 18 percent, respectively. Biomass plant recorded a capacity factor of 7 percent when measured in terms of registered capacity and 10 percent when measured in terms of registered capacity net of outage.

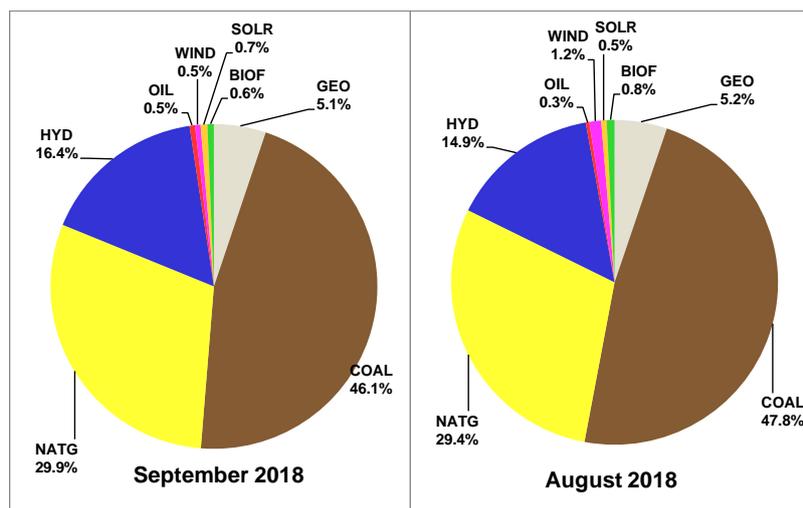
**Figure 31. Capacity Factor, Visayas Plants – September 2018**



**XIII. Generation Mix**

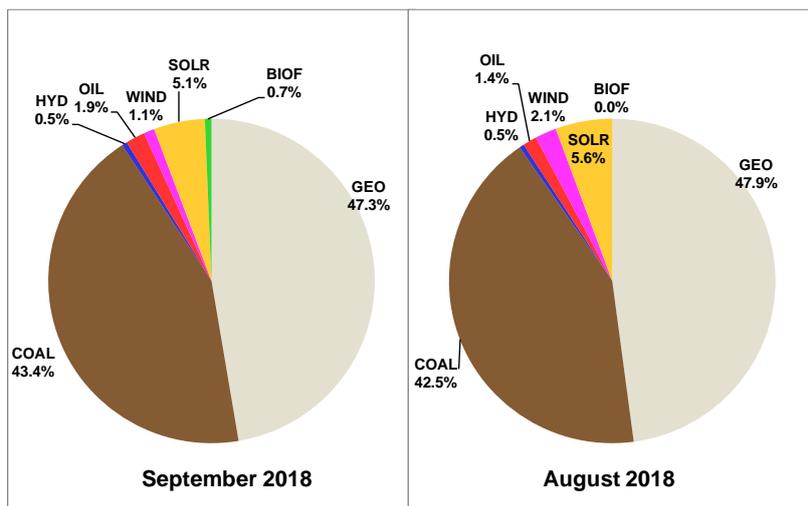
Coal plants contributed the largest chunk of the total energy injected at 46.1 percent (previous month’s 47.8 percent). Natural gas plants followed with 29.9 percent (previous month’s 29.4 percent). Hydro and geothermal plants came next with 16.4 percent and 5.1 percent, respectively. Oil-based plants’ contribution was recorded at 0.5 percent. Meanwhile, the contribution of preferential and must-dispatch generating units was recorded at 1.9 percent.

**Figure 32. Generation Mix (Based on Metered Quantity) – Luzon, September 2018 and August 2018**



In the Visayas region, geothermal plants had the highest contribution at 47.3 percent (previous month’s 47.9 percent) of the total metered quantity this month followed by coal plants with 43.4 percent (previous month’s 42.5 percent). Oil-based and hydro plants came next with 1.9 percent and 0.5 percent respectively. Meanwhile, solar plants’ contribution was recorded at 5.1 percent, wind plants at 1.1 percent and biofuel at 0.7 percent.

**Figure 33. Generation Mix (Based on Metered Quantity), Visayas – September 2018 and August 2018**

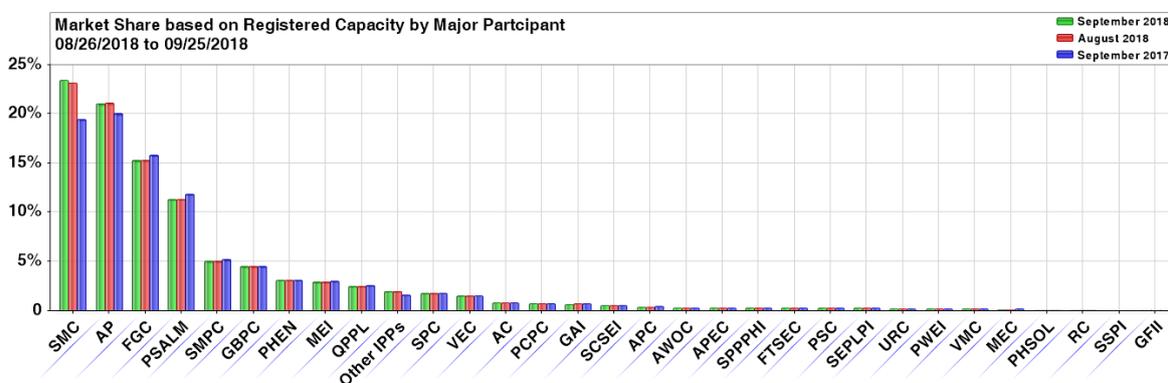


**XIV. Market Concentration**

**a. Market Share**

The integrated Luzon and Visayas market remained to be dominated by four (4) major participant groups based on registered capacity led by San Miguel Corporation (SMC) with a market share of 23.4 percent, which was slightly higher than previous month’s 23.1 percent, related to the registration of SMC Limay CFTPP unit 4. Aboitiz Power (AP) came next with market share of 21 percent. First Gen Corporation (FGC) and Power Sector Asset and Liabilities Management (PSALM) followed with 15.2 percent and 11.3 percent, respectively. Semirara Mining Power Corporation (SMPC) and Global Business Power Corporation (GBPC) came next with market shares of 5.1 percent and 4.5 percent, respectively.

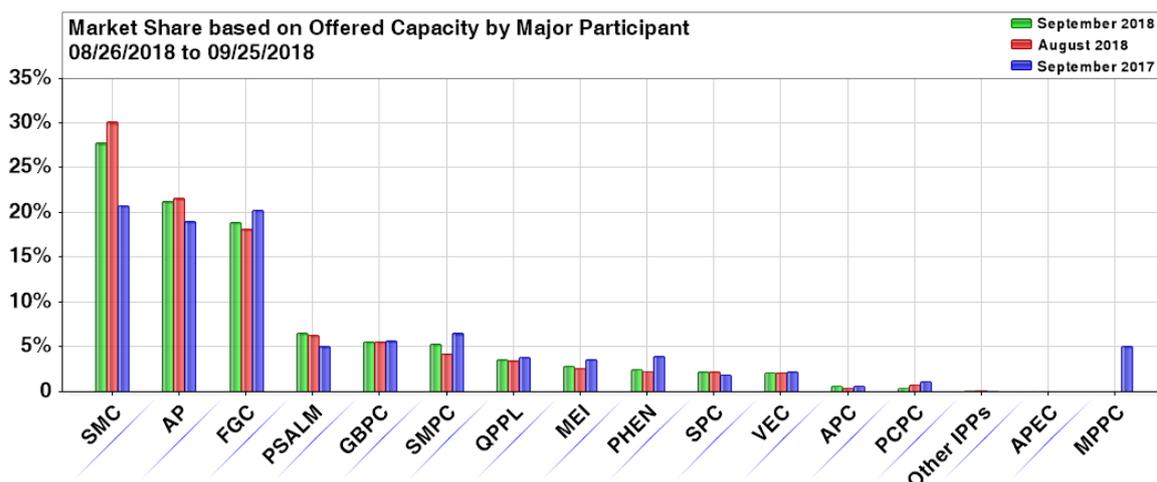
**Figure 34. Market Share by Major Participant Group based on Registered Capacity September 2018, August 2018, and September 2017**



Similarly, when market share is calculated based on offered capacity of scheduled generators, SMC group held the largest share of the market at 27.9 percent. AP held the second highest share at 21.3 percent while FGC had 19 percent.

PSALM and GBPC were also among the highest market shareholders with 6.6 percent and 5.6 percent of the offered capacity, respectively.

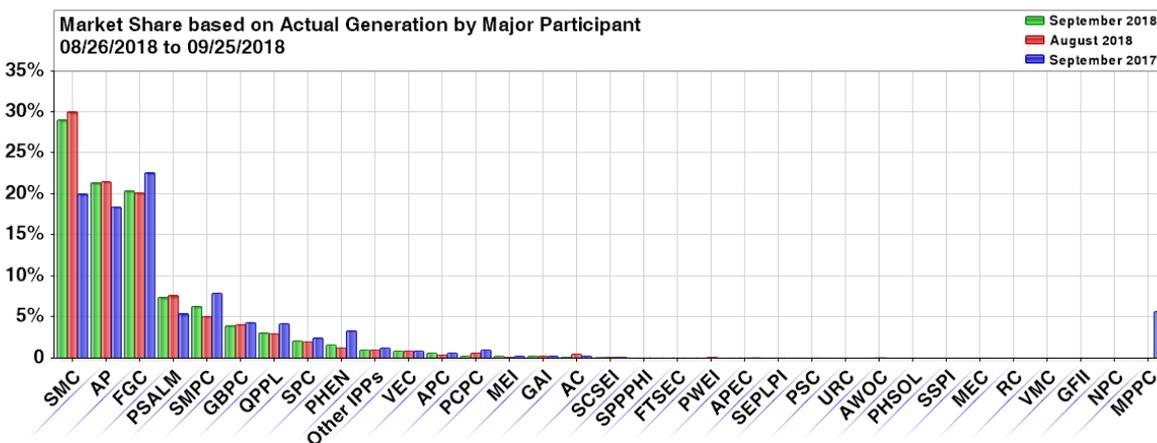
**Figure 35. Market Share by Major Participant Group based on Offered Capacity, September 2018, August 2018 and September 2017**



Meanwhile, when market share is calculated based on actual generation of scheduled generators, SMC group likewise held the largest share of the market at 29.1 percent. FGC and AP then followed with 21.4 percent and 20.4 percent, respectively.

SMPC and PSALM were also among the highest market shareholders 7.4 percent and 6.3 percent of the actual generation, respectively.

**Figure 36. Market Share by Major Participant Group based on Actual Generation, September 2018, August 2018 and September 2017**



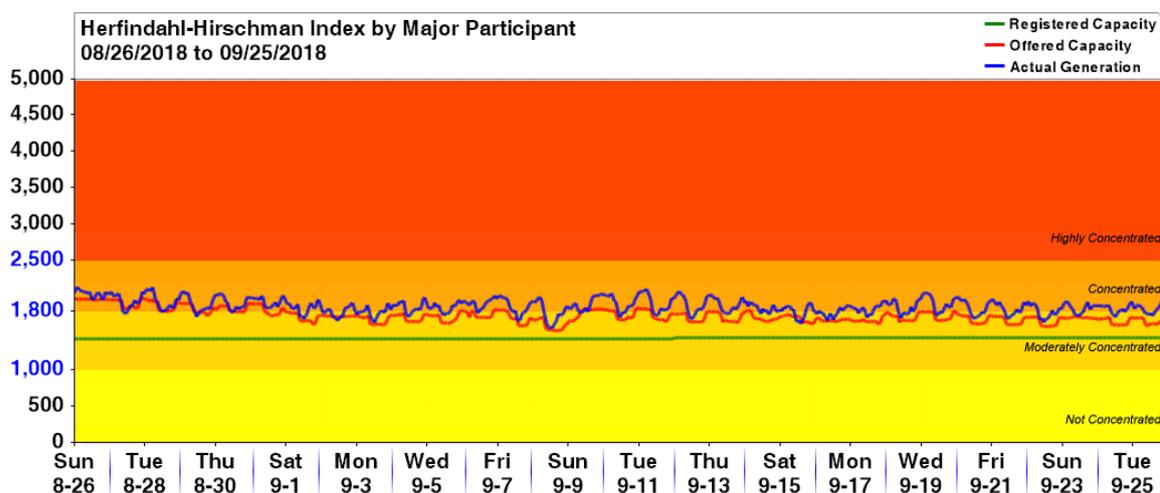
**b. Herfindahl-Hirschman Index (HHI)**

The Herfindahl-Hirschman Index (HHI)<sup>11</sup> calculated based on registered capacity by major participants' grouping indicated a moderately concentrated market throughout the September billing month. Meanwhile, when measured in terms of offered capacity, 560 trading intervals

<sup>11</sup> 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.

(75.3 percent of the time) showed a moderately concentrated market while the remaining 184 trading intervals (24.7 percent) showed a concentrated market. On the other hand, HHI calculation based on actual generation indicated a concentrated market more frequently at 555 trading intervals (74.6 percent) while the remaining 189 trading intervals (25.4 percent) indicated a moderately concentrated market.

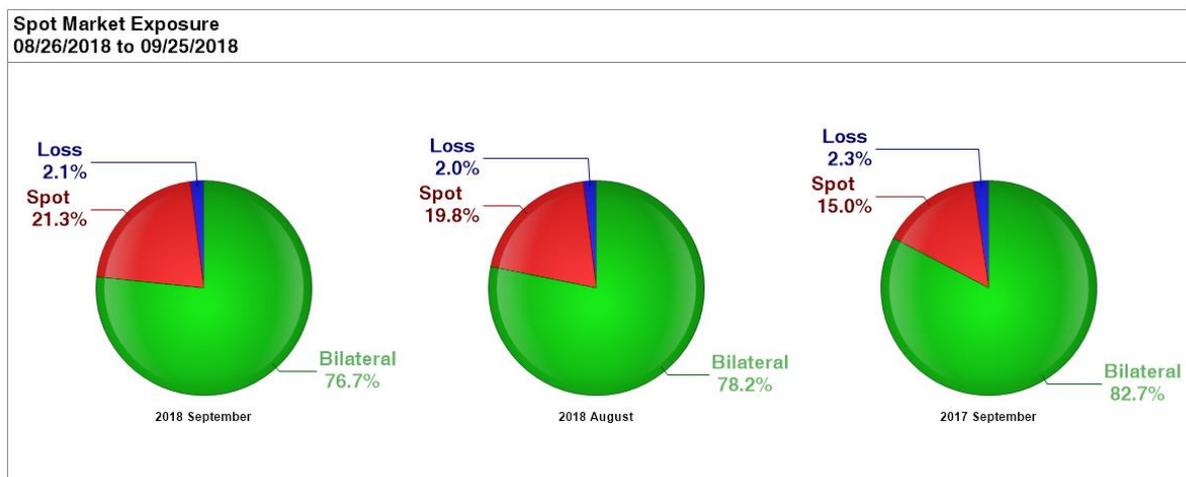
**Figure 37. Hourly HHI based by Major Participant Grouping, September 2018**



## XV. Spot Exposure

Spot market transaction of generator-trading participants comprised about 21.3 percent of the total energy transaction in the WESM. This was higher than previous month's 19.8 percent and previous year's 15 percent. Still, majority of the total energy injected into the grid was covered by bilateral contracts.

**Figure 38. Spot Market Exposure, September 2018, August 2018, and September 2017**



## Appendix A. Major Plant Outages

Region	Plant Type	Plant/ Unit Name	Capacity (MW)	Date Out	Date In	Duration (Days)	Outage Type	Remarks
LUZON	GEO	Tiwi 3	43.7	10/23/2005 13:26			Deactivated Shutdown	Tiwi 3 decommissioned since May 26 2009
LUZON	GEO	Makban 6	55	04/11/2013 22:44			Deactivated Shutdown	Conducted gas compressor test
VISAYAS	GEO	PGPP2 Unit 4	20	06/27/2014 6:07			Forced Outage	Steam being utilized by Nasulo plant
LUZON	GEO	Makban 5	55	03/12/2017 1:55			Forced Outage	High turbine vibration
LUZON	HYD	Angat M 3	50	01/29/2018 0:01			Planned Outage	Annual overhauling until 29 July 2018
LUZON	COAL	SLPGC 1	150	03/06/2018 5:02	09/17/2018 12:16	195.30	Forced Outage	On emergency shutdown due to turbine vibration
LUZON	HYD	San Roque 3	145	03/12/2018 16:15	08/27/2018 13:05	167.87	Planned Outage	Planned Outage. ETI 8 September 2018
LUZON	OIL	Malaya 2	350	05/19/2018 13:01			Forced Outage	Burn air heater 2A
LUZON	GEO	Makban 8	20	06/05/2018 13:21	08/30/2018 18:26	86.21	Maintenance Outage	Maintenance outage until December 2018
LUZON	COAL	SLTEC 2	122.9	06/18/2018 6:14			Forced Outage	Isolated due to tripping Calaca-Salong Line
LUZON	OIL	Limay 3	60	06/22/2018 8:01			Planned Outage	Maintenance outage until 23 October 2018
LUZON	OIL	Limay 2	60	07/23/2018 0:02	09/15/2018 16:31	54.69	Planned Outage	Maintenance outage until 6 September 2018
LUZON	GEO	Makban 9	20	08/06/2018 10:22	08/29/2018 16:16	23.25	Maintenance Outage	Maintenance outage
LUZON	COAL	SMC 2	150	08/10/2018 23:23	08/29/2018 12:11	18.53	Planned Outage	Maintenance outage until 24 August 2018
LUZON	GEO	Tiwi 1	59	08/12/2018 11:11			Forced Outage	Low steam supply
LUZON	COAL	SLTEC 1	121	08/16/2018 9:32	08/28/2018 3:22	11.74	Forced Outage	Boiler tube leak
VISAYAS	COAL	PALM 1	135	08/17/2018 0:01	09/13/2018 2:10	27.09	Planned Outage	Annual preventive maintenance
LUZON	NATG	Sta. Rita 2	255.7	08/17/2018 4:53	08/26/2018 11:52	9.29	Maintenance Outage	Maintenance outage
VISAYAS	COAL	Kepco Salcon 1	103	08/23/2018 15:01	08/28/2018 1:35	4.44	Forced Outage	Boiler tube leak
VISAYAS	GEO	Upper Mahiao 1	32	08/24/2018 0:09	08/28/2018 0:37	4.02	Forced Outage	To rectify defective main steam line pressure control valve and replacement of moto
VISAYAS	GEO	Upper Mahiao 2	32	08/24/2018 0:10	08/28/2018 0:45	4.02	Forced Outage	To rectify defective main steam line pressure control valve and replacement of moto
VISAYAS	GEO	Upper Mahiao 4	32	08/24/2018 0:12	08/29/2018 1:56	5.07	Forced Outage	To rectify defective main steam line pressure control valve and replacement of moto
VISAYAS	OIL	PB102 Unit 3	6	08/24/2018 8:44	08/27/2018 11:18	3.11	Forced Outage	Unusual sound at cylinder 2L
VISAYAS	COAL	CEDC 1	82	08/25/2018 23:11	08/30/2018 11:14	4.50	Forced Outage	Manually cut out due to possible tube leak
LUZON	NATG	Sta. Rita 1	257.3	08/26/2018 14:14	08/26/2018 18:44	0.19	Forced Outage	Fuel leak
LUZON	NATG	Sta. Rita 2	255.7	08/26/2018 14:14	08/26/2018 18:44	0.19	Forced Outage	Fuel leak
LUZON	NATG	Sta. Rita 3	265.5	08/26/2018 14:14	08/26/2018 18:44	0.19	Forced Outage	Fuel leak
LUZON	NATG	Sta. Rita 4	264	08/26/2018 14:14	08/26/2018 18:44	0.19	Forced Outage	Fuel leak
VISAYAS	GEO	Leyte 1	35	08/29/2018 1:09			Maintenance Outage	PMS
LUZON	GEO	Makban 2	63	08/29/2018 8:22	08/31/2018 22:58	2.61	Forced Outage	Reverse power actuation while conducting internal test
VISAYAS	OIL	CENPRI 2	4.2	08/29/2018 17:32			Forced Outage	Low water jacket pressure trip indication
LUZON	NATG	San Lorenzo 2	261.8	08/30/2018 12:07	08/30/2018 15:22	0.14	Forced Outage	Tripped by generator protection
LUZON	GEO	Makban 1	63	08/30/2018 12:08			Forced Outage	Busted bushing at high side phase A of Makban Unit 1 transformer
LUZON	GEO	Makban 9	20	08/30/2018 19:19			Forced Outage	On reserve shutdown pending availability of steam supply
VISAYAS	COAL	CEDC 3	82	08/31/2018 16:21	08/31/2018 23:35	0.30	Forced Outage	Stocked up feedwater control valve
LUZON	COAL	Sual 1	647	08/31/2018 23:48			Planned Outage	On maintenance until 30 October 2018
LUZON	COAL	Pagbilao 3	420	09/01/2018 1:28	09/09/2018 5:23	8.16	Maintenance Outage	Maintenance outage until 7 September 2018
LUZON	GEO	Makban 8	20	09/01/2018 9:20	09/25/2018 20:18	24.46	Forced Outage	Put on reserve shutdown pending availability of steam supply (steam optimization)
LUZON	COAL	Masinloc 1	315	09/01/2018 17:44	09/05/2018 16:07	3.93	Forced Outage	Emergency shutdown due to boiler tube leak
VISAYAS	OIL	PB101 Unit 3	6	09/02/2018 17:36	09/06/2018 17:55	4.01	Forced Outage	Internal trouble
VISAYAS	GEO	Mahanagdong B1	5	09/03/2018 1:22	09/08/2018 20:51	5.81	Forced Outage	To facilitate retapping of Maha B topping cycle 230 kV line
VISAYAS	GEO	Upper Mahiao 1	32	09/03/2018 6:01			Forced Outage	Tripped
VISAYAS	GEO	Upper Mahiao 2	32	09/03/2018 6:01			Forced Outage	Tripped
LUZON	OIL	Malaya 1	300	09/03/2018 15:05			Forced Outage	Tripping of two condensate pumps A and B
LUZON	COAL	SLPGC 2	150	09/04/2018 7:41	09/04/2018 17:54	0.43	Forced Outage	Low condenser vacuum
LUZON	COAL	Sual 2	647	09/07/2018 12:55	09/07/2018 22:16	0.39	Forced Outage	Boiler drum low
VISAYAS	OIL	Bohol 1	4	09/07/2018 13:41	09/15/2018 18:06	8.18	Forced Outage	Unusual sound of turbocharger
LUZON	COAL	Sual 2	647	09/07/2018 22:30	09/07/2018 23:06	0.03	Forced Outage	Tripped at 145 MW load
LUZON	NATG	San Gabriel	420	09/07/2018 23:32	09/10/2018 7:04	2.31	Forced Outage	Other feedwater pump problems
LUZON	NATG	Avion 1	50.3	09/08/2018 0:01	09/16/2018 17:18	8.72	Planned Outage	Maintenance outage until 15 September 2018
LUZON	NATG	Avion 1	50.3	09/08/2018 0:01			Maintenance Outage	Maintenance outage until 15 September 2018
LUZON	COAL	Sual 2	647	09/08/2018 7:12	09/09/2018 4:51	0.90	Forced Outage	Air compressor trouble
LUZON	COAL	SLPGC 2	150	09/09/2018 13:30	09/09/2018 22:48	0.39	Forced Outage	Generator electrical fail
LUZON	COAL	Pagbilao 2	382	09/09/2018 14:20	09/12/2018 17:34	3.13	Forced Outage	Emergency shutdown due to boiler tube leak
LUZON	NATG	Avion 2	50.3	09/10/2018 0:01	09/19/2018 17:00	9.71	Planned Outage	Maintenance outage until 17 September 2018
VISAYAS	COAL	CEDC 3	82	09/10/2018 22:26	09/11/2018 5:02	0.28	Forced Outage	To conduct correction of stocked up feed water control valve
LUZON	NATG	San Gabriel	420	09/13/2018 6:34	09/13/2018 18:24	0.49	Maintenance Outage	Shutdown to rectify leak at gas supply system
VISAYAS	COAL	PALM 1	135	09/14/2018 5:30	09/14/2018 7:47	0.10	Forced Outage	Run back test
LUZON	HYD	Angat M 4	50	09/15/2018 12:03	09/19/2018 13:10	4.05	Forced Outage	Tripped due to unit transformer trouble
LUZON	NATG	San Gabriel	420	09/15/2018 12:13	09/15/2018 15:03	0.12	Forced Outage	Emergency shutdown due to gas vent valve trouble
LUZON	NATG	San Gabriel	420	09/15/2018 20:40	09/15/2018 23:36	0.12	Forced Outage	Emergency shutdown due to gas vent valve trouble
LUZON	COAL	Sual 2	647	09/15/2018 22:07	09/17/2018 7:15	1.38	Forced Outage	Emergency shutdown due to coal conveyor trouble
LUZON	HYD	Ambuklao 1	35	09/16/2018 5:29	09/18/2018 22:41	2.72	Forced Outage	Turbine assembly problem
LUZON	COAL	SLPGC 1	150	09/17/2018 20:14	09/20/2018 20:36	3.02	Forced Outage	Tripped due to high turbine vibration
LUZON	HYD	Sta. Rita 2	255.7	09/18/2018 6:44	09/23/2018 23:45	5.71	Maintenance Outage	Maintenance outage
LUZON	COAL	Calaca 2	300	09/18/2018 9:48	09/19/2018 19:47	1.42	Forced Outage	Pulverizer tripping
LUZON	GEO	Makban 7	20	09/21/2018 7:39			Planned Outage	Affected by pre arranged shutdown of Makban CD 230 kV tie line
LUZON	HYD	Casacnan 1	82.5	09/21/2018 22:25			Forced Outage	Turbine bearing vibration
LUZON	COAL	Pagbilao 1	382	09/22/2018 8:15			Maintenance Outage	Maintenance outage until 6 October 2018
LUZON	NATG	Sta. Rita 1	257.3	09/23/2018 18:38	09/23/2018 21:01	0.10	Forced Outage	Combustion problem
VISAYAS	GEO	Upper Mahiao 4	32	09/24/2018 18:05			Forced Outage	125 VDC and 48 VDC failure
VISAYAS	OIL	PB101 Unit 3	6	09/24/2018 19:32			Forced Outage	Low lube oil inlet pressure
VISAYAS	COAL	TPC Sangi 1	60	09/25/2018 10:24	09/25/2018 14:03	0.15	Forced Outage	Affected by line tripping of Dascon and Carcon Line
VISAYAS	OIL	Bohol 2	4	09/25/2018 13:11			Forced Outage	Lube oil pressure too low
LUZON	COAL	QPPL	459	09/25/2018 20:24			Forced Outage	Emergency shutdown due to main turbine control valve #1 trouble
LUZON	GEO	Makban 8	20	09/25/2018 20:35			Forced Outage	Auto tripped due to over frequency relay caused by auto tripping of 230 kV breaker

## Methodology in Determining Interesting Pricing Events

Supply margin is defined as the MW difference between the system effective supply<sup>1</sup> and demand requirement plus reserve schedules<sup>2</sup>.

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 thresholds<sup>3</sup>. 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  $\pm 3$  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”.

<sup>1</sup> 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).

<sup>2</sup> 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.

<sup>3</sup> 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](http://www.albertamsa.ca).