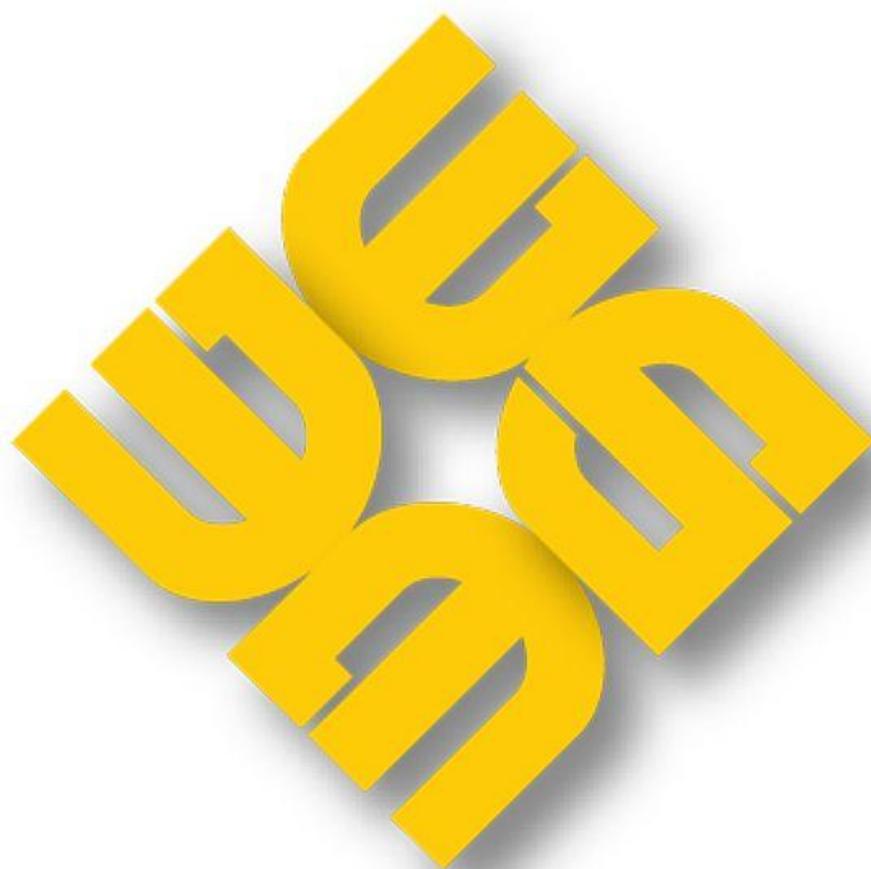


MAG-QMAR-2019-04

# QUARTERLY MARKET ASSESSMENT HIGHLIGHTS

For the Billing Period 26 September to 25 December 2019



**PHILIPPINE  
ELECTRICITY  
MARKET  
CORPORATION**

**MARKET ASSESSMENT GROUP  
(MAG)**

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## EXECUTIVE SUMMARY

This quarterly report assesses the results of the WESM operation for the fourth billing quarter of 2019 (26 September to 25 December 2019) and how the market performed compared with the previous quarter and previous year.

An additional 190-MW registered in the wholesale market during the fourth quarter of 2019 bringing up the total WESM registered capacity to 20,182 MW as of 25 December 2019. Of this total, only 65 percent or an average of 12,888 MW was offered/nominated in the market.

Notwithstanding the increase in registered capacity, tighter supply margin at 1,848 MW on average was observed this quarter compared to 2,111 MW during the third quarter. This was driven by the 2.3 percent quarter-on-quarter decrease in effective supply, from 13,419 MW to 13,106 MW attributable to the higher level of outage. It was noted that average outage capacity increased by 38.2 percent, from 2,320 MW to 3,207 MW. On the other hand, the period experienced slight decrease in demand, including reserve schedule, from 11,307 MW in the third quarter to 11,258 MW in the fourth quarter, following the lower temperatures and observance of holidays.

Consequently, a considerable increase was noted in average market prices in the fourth quarter at PhP5,060/MWh, which was 54.6 percent higher than previous quarter's PhP3,272/MWh. The price spike trigger<sup>1</sup> was breached in 20 trading intervals. On the other hand, sustained high price trigger<sup>2</sup> and price creep up trigger<sup>3</sup> were not breached and the secondary price cap<sup>4</sup> was not imposed during the quarter.

The market share 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). On top is SMC with the highest share in terms of registered capacity, offered capacity, and actual generation. Notwithstanding, PSALM and Semirara Mining Power Corporation ranked as the highest market shareholders when calculated based on spot transactions.

The Herfindahl-Hirschman Index (HHI) by major participant grouping indicated a moderately concentrated market based on registered capacity, offered capacity, actual generation, spot quantity and total trading amount.

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<sup>1</sup> Price spike trigger is breached when the hourly price exceeds the reference level of PhP27,000/MWh for peak hours and PhP16,000/MWh for off-peak hours.

<sup>2</sup> Sustained high price trigger is breached when hourly prices exceed PhP21,600/MWh for 10 consecutive hours

<sup>3</sup> Price creep up trigger is breached when the increase in daily or weekly average prices exceed 20 percent for 4 consecutive days or weeks, respectively

<sup>4</sup> Secondary price cap is imposed when the 120-hour rolling average price exceeds PhP9,000/MWh

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## QUARTERLY MARKET ASSESSMENT REPORT

This quarterly report assesses the results of the WESM operation for the Fourth Billing Quarter of 2019 (26 September to 25 December 2019) and how the market performed compared with the previous quarter and previous year.

### I. Capacity Profile

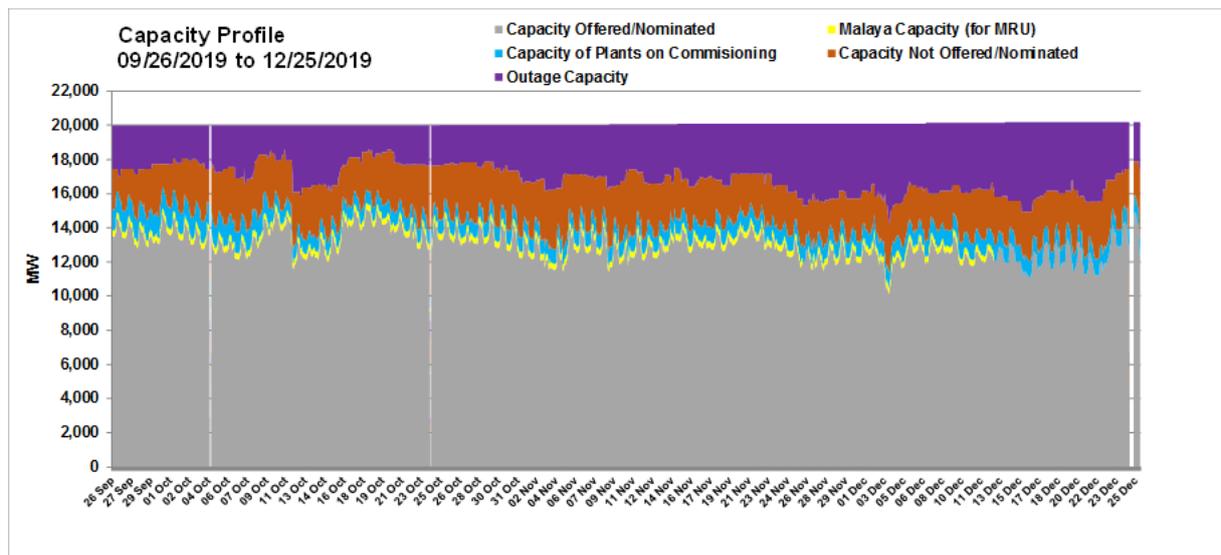
The total WESM registered capacity stood at 20,182 MW by the end of the last billing quarter of 2019, recording a 190-MW increase from 19,992 MW in 25 September 2019. The increase was attributed to the entry of seven (7) biomass facilities during the quarter namely i. North Negros Biomass (25 MW), ii. G2REC Biomass (10.8 MW), iii. BISCOP Biomass (30 MW), iv. CABI Biomass (23.5 MW), v. CEC Biomass (10.8 MW), vi. GIFT Biomass unit 2 (6 MW), and vii. VSGPC Biomass (5.4 MW). In addition, oil-based plant Isabel DPP units 1 to 6 (70 MW in total) registered in the WESM during the quarter as well as hydro plants Loboc 2 HEP (1.2 MW) and Boheco I Sevilla HEP (2.5 MW) and solar plant Ecopark Energy Solar (4.4 MW).

The 455-MW coal plant SBPLC CFTPP started its commercial operations on 10 October 2019 signifying its end of conduct of commissioning tests and beginning of its ability to offer its capacity to the market.

Of the total registered capacity, only 65 percent was offered in the market, averaging 12,888 MW during the quarter. On top of which, about 1 percent or an average of 350 MW was the capacity designation of Malaya TPP as Must Run Unit (MRU)<sup>1</sup> while 5 percent or an average of 918 MW were related to the registered capacities of plants which were still undergoing testing and commissioning.

The remaining registered capacity was either unavailable due to outage, comprising 3,207 MW or 16 percent, or not offered in the market<sup>2</sup>, amounting to 2,644 MW or 13 percent.

**Figure 1. Capacity Profile (Ex-ante), 4<sup>th</sup> Quarter 2019**



<sup>1</sup> Per DOE Department Circular 2014-01-0003, designating the 650-MW Malaya Thermal Plant as a Must-Run Unit in the Wholesale Electricity Spot Market in cases of supply shortfall and to address system security

<sup>2</sup> Subject to compliance monitoring or investigation for possible non-compliance with the submission of offers under the WESM Rules

**Table 1. Capacity Profile (Ex-ante), 4<sup>th</sup> Quarter 2019, 3<sup>rd</sup> Quarter 2019, and 4<sup>th</sup> Quarter 2018**

	4th Quarter 2019 (26 Sep to 25 Dec 2019)		3rd Quarter 2019 (26 Jun to 25 Sep 2019)		4th Quarter 2018 (26 Sep to 25 Dec 2018)		% Q-on-Q Change (3Q 2019 - 2Q 2019)	% Y-on-Y Change (4Q 2018 - 4Q 2019)
	Avg MW	% of RegCap	Avg MW	% of RegCap	Avg MW	% of RegCap		
Outage Capacity	3,207	16%	2,320	12%	2,089	11%	38.2	53.5
Capacity Not Offered/Nominated	2,644	13%	2,656	13%	2,630	14%	(0.5)	0.5
Capacity of Plants on Commissioning	918	5%	1,384	7%	699	4%	(33.6)	31.4
Malaya Capacity (for MRU)	350	1%	350	2%	300	1%	0.0	16.7
Capacity Offered/Nominated	12,888	65%	13,261	66%	13,257	70%	(2.8)	(2.8)
Registered Capacity (by the end of the billing month)	20,182	100%	19,992	100%	18,902	100%	0.9	6.8

**Table 2. Monthly Capacity Profile (Ex-ante), 4<sup>th</sup> Quarter 2019**

	October 2019 (26 Sep to 25 Oct 2019)		November 2019 (26 Oct to 25 Nov 2019)		December 2019 (26 Nov to 25 Dec 2019)	
	Avg MW	% of RegCap	Avg MW	% of RegCap	Avg MW	% of RegCap
Outage Capacity	2,422	12%	3,092	15%	4,111	21%
Capacity Not Offered/Nominated	2,664	13%	2,787	14%	2,476	12%
Capacity of Plants on Commissioning	991	5%	845	4%	921	5%
Malaya Capacity (for MRU)	350	2%	350	2%	350	1%
Capacity Offered/Nominated	13,463	68%	12,982	65%	12,216	61%
Registered Capacity (by the end of the billing month)	20,017	100%	20,082	100%	20,182	100%

## II. Power Plant Outages

### a. Outage Capacity by Plant Type

The fourth quarter of 2019 saw a high level of outage capacity at an average of 3,207 MW driven by the increase of coal plants' outage capacity at 1,841 MW from 1,058 MW during the third quarter. This was attributable to the maintenance outages of Mariveles CFTPP unit 1 (316 MW) from 20 September to 17 December and planned outages of Calaca CFTPP unit 2 (300 MW) from 17 October until the end of the quarter, Pagbilao CFTPP unit 3 (420 MW) from 16 November until the end of the quarter, Sual CFTPP unit 2 (647 MW) from 20 October to 14 November and Sual CFTPP unit 1 (647 MW) from 23 November to 17 December, Masinloc CFTPP unit 2 (344 MW) from 30 October to 2 December, SLTEC CFTPP unit 2 (123 MW) from 18 November until the end of the month.

Oil-based plants' outage capacity averaged at 477 MW due to forced outage of Malaya TPP unit 1 (300 MW) since 3 May 2019 as well as the maintenance outage of Malaya TPP unit 2 (350 MW) since 13 December. As a result, the entire unit of Malaya TPP was unavailable as MRU beginning 13 December until the end of the billing quarter. Meanwhile, geothermal plants' outage capacity averaged at 378 MW attributable to the forced outage of a unit of Tiwi GPP A (59 MW) on top of the existing outages of Makban GPP unit C (110 MW).

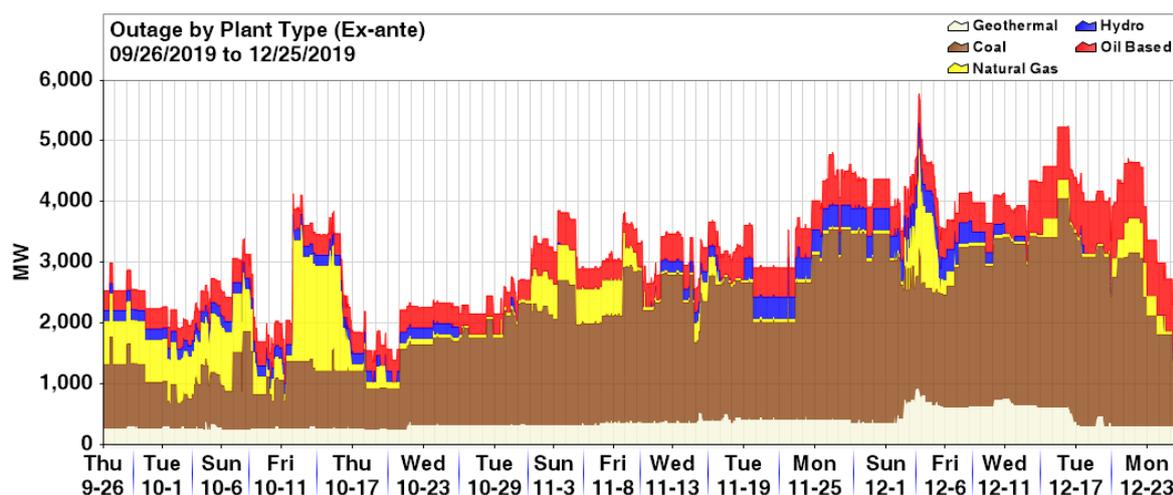
On the other hand, natural gas plants' outage capacity averaged at 360 MW which was mostly attributable to the planned outages of Ilijan NGPP Block A (600 MW) and San Lorenzo NGPP units 1 and 2 (527 MW). Also noted this quarter were the outages of San Gabriel NGPP (420 MW), Ilijan NGPP Blocks A and B (1,200 MW) from 11 to 16 November coinciding with the planned outage of SPEX-Malampaya facility where these plants source their fuel.

Hydro plants observed the least capacity on outage among resource types at an average of 151 MW which was largely due to the planned outages of Kalayaan PSPP units 3 and 4 (360 MW).

Outage capacity was also observed to have generally increased towards the end of the quarter and year. The December billing month saw the highest monthly average during the quarter at 4,111 MW.

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

**Figure 2. Plant Outage Capacity (by Plant Type), 4<sup>th</sup> Quarter 2019**



**Table 3. Outage Summary (Ex-ante), 4<sup>th</sup> Quarter 2019, 3<sup>rd</sup> Quarter 2019, and 4<sup>th</sup> Quarter 2018**

	4th Quarter 2019 (26 Sep to 25 Dec 2019)			3rd Quarter 2019 (26 Jun to 25 Sep 2019)			4th Quarter 2018 (26 Sep to 25 Dec 2018)			% Q-on-Q Change (3Q 2019 - 2Q 2019)			% Y-on-Y Change (4Q 2018 - 4Q 2019)		
	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
Coal	3,448	419	1,841	2,532	135	1,058	1,611	123	754	36.2	210.4	74.0	114.0	240.9	144.1
Natural Gas	2,243	50	360	1,176	0	389	974	0	174	90.7	(7.5)	130.4			106.6
Geothermal	920	253	378	381	231	266	524	328	404	141.7	9.5	41.8	75.7	(22.8)	(6.5)
Hydro	540	0	151	527	145	244	578	50	162	2.5	(100.0)	(38.0)	(6.6)	(100.0)	(6.3)
Oil Based	982	306	477	745	331	363	859	424	595	31.8	(7.6)	31.6	14.3	(27.8)	(19.8)
<b>TOTAL</b>	<b>5,784</b>	<b>1,367</b>	<b>3,207</b>	<b>4,172</b>	<b>988</b>	<b>2,320</b>	<b>2,961</b>	<b>1,202</b>	<b>2,089</b>	<b>38.6</b>	<b>38.4</b>	<b>38.2</b>	<b>95.4</b>	<b>13.7</b>	<b>53.5</b>

**Table 4. Monthly Outage Summary (Ex-ante), 4<sup>th</sup> Quarter 2019**

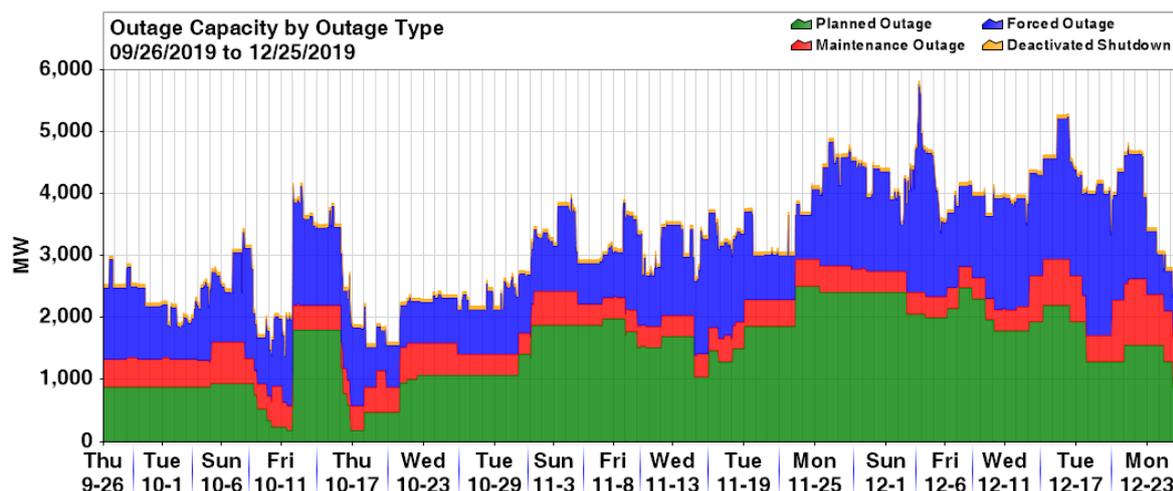
	October 2019 (26 Sep to 25 Oct 2019) in MW			November 2019 (26 Oct to 25 Nov 2019) in MW			December 2019 (26 Nov to 25 Dec 2019) in MW		
	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
Coal	1,611	419	973	3,065	1,336	1,984	3,448	1,098	2,560
Natural Gas	2,243	50	646	577	50	212	1,670	50	226
Geothermal	379	253	276	525	316	366	920	271	493
Hydro	215	0	174	540	0	113	388	0	168
Oil Based	403	316	353	557	306	417	982	456	664
<b>TOTAL</b>	<b>4,134</b>	<b>1,367</b>	<b>2,422</b>	<b>4,371</b>	<b>2,152</b>	<b>3,092</b>	<b>5,784</b>	<b>2,281</b>	<b>4,111</b>

**b. Outage Capacity by Category**

Consistent with the discussion above, high level of outage capacity this quarter were planned outages which recorded an average of 1,509 MW. This posted a 124.6 percent increase compared to previous quarter's 672 MW. It was observed that planned outages were scheduled towards the end of the year to maximize the anticipated low level of demand during the period. Also, it may be recalled that planned outages were scheduled during the first quarter of 2019 to ensure that enough supply was available throughout the summer season particularly during the May Elections.

Meanwhile, forced outages were still prevalent during the last quarter of the year at 1,201 MW on the average, slightly lower from previous quarter's 1,246 MW.

**Figure 3. Plant Outage Capacity (by Outage Category), 4<sup>th</sup> Quarter 2019**



**Table 5. Outage Summary, by Outage Category, 4<sup>th</sup> Quarter 2019, 3<sup>rd</sup> Quarter 2019, and 4<sup>th</sup> Quarter 2018**

	4th Quarter 2019 (26 Sep to 25 Dec 2019)			3rd Quarter 2019 (26 Jun to 25 Sep 2019)			4th Quarter 2018 (26 Sep to 25 Dec 2018)			% Q-on-Q Change (3Q 2019 - 2Q 2019)			% Y-on-Y Change (4Q 2018 - 4Q 2019)		
	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
Planned	2,510	180	1,509	1,726	145	672	854	113	457	45.4	24.1	124.6	194.0	59.3	229.9
Maintenance	1,073	336	466	1,439	104	386	1,066	60	476	(25.5)	223.1	20.7	0.6	460.0	(2.1)
Forced	3,363	514	1,234	1,999	514	1,201	1,759	661	1,062	68.2	0.0	2.8	91.1	(22.3)	16.3
Deactivated Shutdown	55	55	55	55	55	55	99	99	99	0.0	0.0	0.0	(44.3)	(44.3)	(44.3)

**Table 6. Monthly Outage Summary, by Outage Category, 4<sup>th</sup> Quarter 2019**

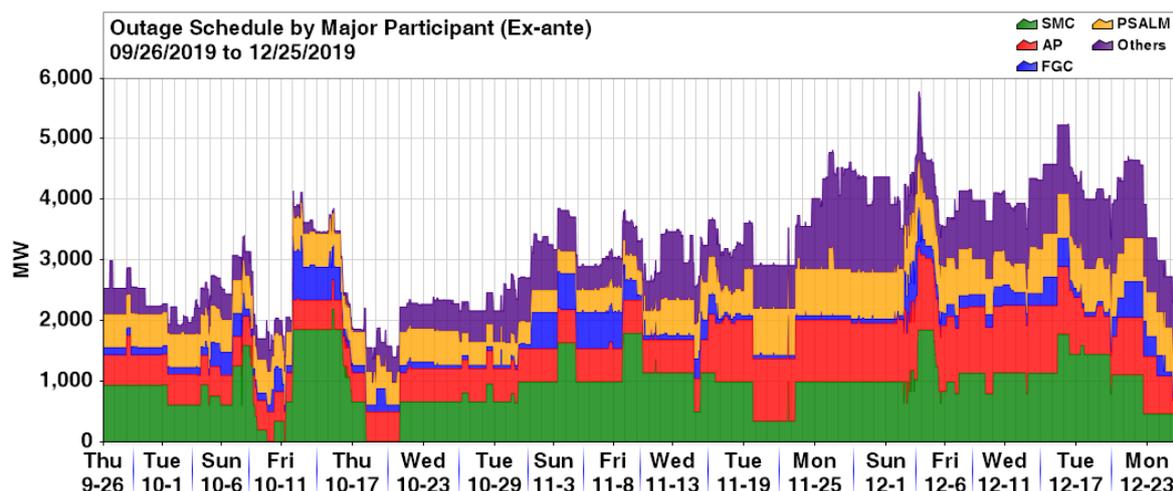
	October 2019 (26 Sep to 25 Oct 2019) in MW			November 2019 (26 Oct to 25 Nov 2019) in MW			December 2019 (26 Nov to 25 Dec 2019) in MW		
	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
	Planned	1,800	180	913	2,510	1,050	1,667	2,485	873
Maintenance	664	341	477	541	341	392	1,073	336	531
Forced	1,925	514	1,018	1,987	652	1,053	3,363	618	1,638
Deactivated Shutdown	55	55	55	55	55	55	55	55	55

**c. Outage Capacity by Major Participant**

Among the major participant groups, San Miguel Corporation (SMC) recorded the highest average outage capacity at 964 MW or 30 percent of this quarter’s outage which involved the planned outages of Sual CFTPP units 1 and 2 (1,294 MW) and Masinloc CFTPP unit 2 (344 MW). Aboitiz Power (AP) came next with an average of 727 MW on outage (22 percent) which involved the maintenance outage of Mariveles CFTPP unit 1 (316 MW) and Pagbilao CFTPP unit 3 (420 MW).

Meanwhile, Power Sector Asset and Liabilities Management (PSALM) accounted for 18 percent of this quarter’s system-wide outage capacity or an average of 585 MW which involved Malaya TPP units 1 and 2 (650 MW) and Kalayaan PSPP units 3 and 4 (360 MW).

**Figure 4. Plant Outage Capacity (by Major Participant Grouping), 4<sup>th</sup> Quarter 2019**



**Table 7. Outage Summary, by Major Participant Grouping, 4<sup>th</sup> Quarter, 3<sup>rd</sup> Quarter 2019, and 4<sup>th</sup> Quarter 2018**

	4th Quarter 2019 (26 Sep to 25 Dec 2019)			3rd Quarter 2019 (26 Jun to 25 Sep 2019)			4th Quarter 2018 (26 Sep to 25 Dec 2018)			% Q-on-Q Change (3Q 2019 - 2Q 2019)			% Y-on-Y Change (4Q 2018 - 4Q 2019)		
	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
SMC	2,192	10	964	1,574	0	614	1,162	50	502	39.3		57.1	88.6	(80.0)	92.0
AP	1,390	209	727	1,384	189	409	852	244	413	0.4	10.6	77.7	63.2	(14.2)	76.1
FGC	1,063	70	236	753	20	176	840	20	211	41.2	251.5	33.9	26.6	251.5	11.9
PSALM	1,116	364	585	904	342	490	991	382	593	23.5	6.4	19.4	12.7	(4.7)	(1.3)
Others	1,769	16	699	1,425	121	632	1,158	160	370	24.1	(86.6)	10.6	52.8	(89.9)	88.7
TOTAL	5,784	1,377	3,210	4,172	988	2,320	2,961	1,202	2,089	38.6	39.4	38.4	95.4	14.5	53.7

**Table 8. Monthly Outage Summary, by Major Participant Grouping, 4<sup>th</sup> Quarter 2019**

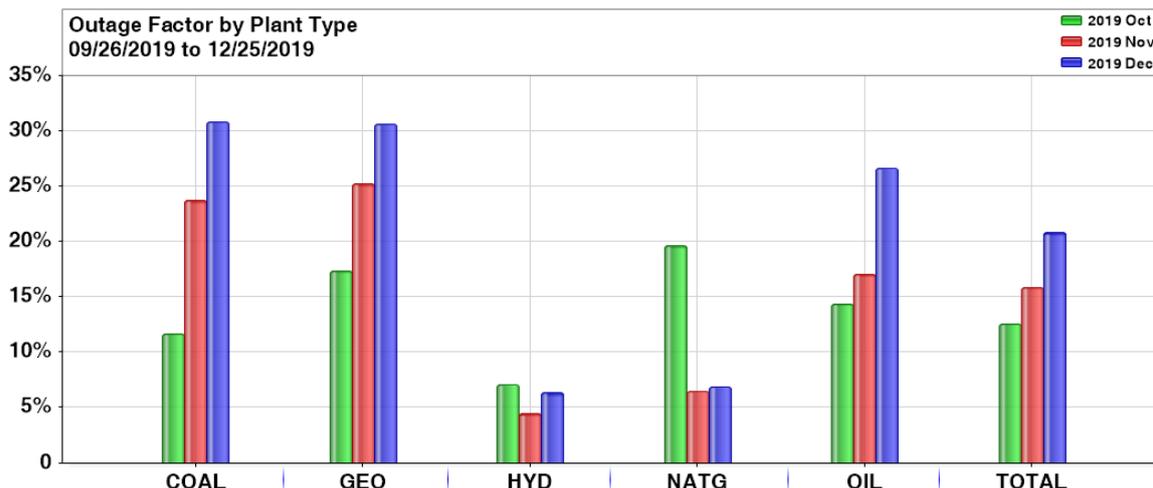
	October 2019 (26 Sep to 25 Oct 2019) in MW			November 2019 (26 Oct to 25 Nov 2019) in MW			December 2019 (26 Nov to 25 Dec 2019) in MW		
	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
SMC	2,192	10	832	1,788	344	968	1,847	465	1,091
AP	821	485	504	1,095	548	701	1,390	209	976
FGC	1,063	70	227	638	70	238	888	70	243
PSALM	613	364	542	946	364	503	1,116	401	713
Others	889	16	324	1,519	391	683	1,769	639	1,089

**d. Outage Factor**

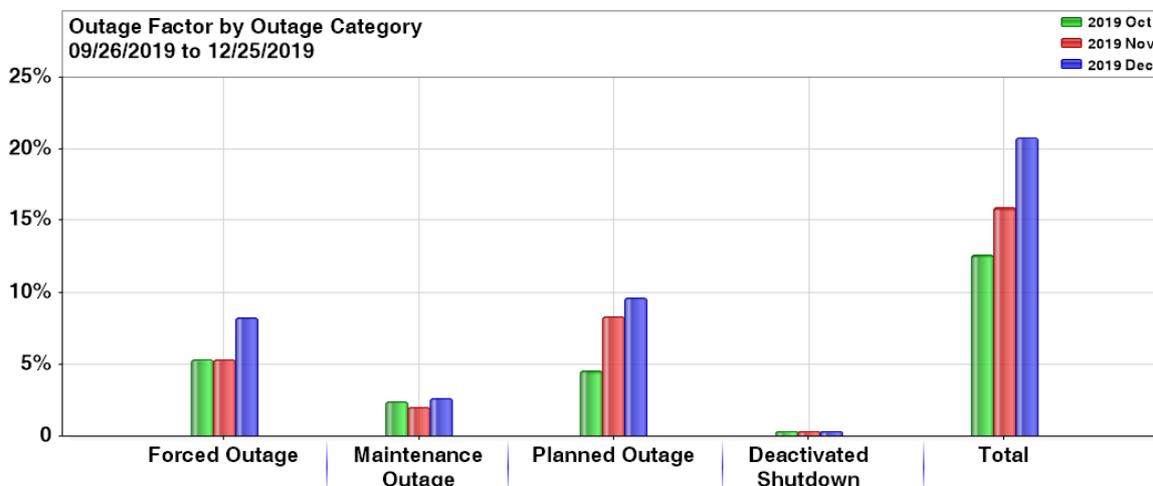
As seen in Table 9 below, the system-wide total outage factor grew from 12.6 percent in October to 15.9 percent in November and eventually to 20.8 percent in December. Planned and forced outage factors were consistently the largest component of the total outage factor in all the billing months, reaching a high of 9.6 percent and 8.2 percent in December.

Meanwhile, among the various resource types, it was noted that coal, geothermal and oil-based plants consistently observed high outage factor throughout the billing quarter. In addition, natural gas plants' outage factor reached 19.6 percent in October, when their planned outages abound, and eventually decreased to less than 7 percent in November and December.

**Figure 5. Outage Factor (by Plant Type), 4<sup>th</sup> Quarter 2019**



**Figure 6. Outage Factor (by Outage Type), 4<sup>th</sup> Quarter 2019**



**Table 9. Outage Factor, 4<sup>th</sup> Quarter 2019**

Plant Type	Total Outage Factor			Forced Outage Factor			Maintenance Outage Factor			Planned Outage Factor			D/S Outage Factor		
	Oct 19	Nov 2019	Dec 2019	Oct 19	Nov 2019	Dec 2019	Oct 19	Nov 2019	Dec 2019	Oct 19	Nov 2019	Dec 2019	Oct 19	Nov 2019	Dec 2019
BAT															
BIOF	3.1	4.1	3.0	1.9	1.9	2.5	1.2	1.9	0.6		0.3				
COAL	11.7	23.7	30.8	5.1	4.6	8.4	3.8	3.8	3.6	2.8	15.4	18.8			
GEO	17.4	25.3	30.6	9.4	16.3	25.5	3.9	1.5	1.0	0.9	4.2	1.0	3.1	3.1	3.1
HYD	7.1	4.4	6.4	0.0	0.1	0.1	1.2	0.0		5.9	4.3	6.2			
NATG	19.6	6.5	6.9	3.4	2.1	4.7	1.2		0.7	15.1	4.4	1.5			
OIL	14.4	17.0	26.7	12.8	12.8	13.2	1.0	2.0	7.5	0.5	2.3	6.0			
SOLR	5.6	0.1	1.3	5.6	0.0	1.3					0.1				
WIND															
Total	12.6	15.9	20.8	5.3	5.3	8.2	2.4	2.0	2.7	4.6	8.3	9.6	0.3	0.3	0.3

### III. Demand and Supply Situation

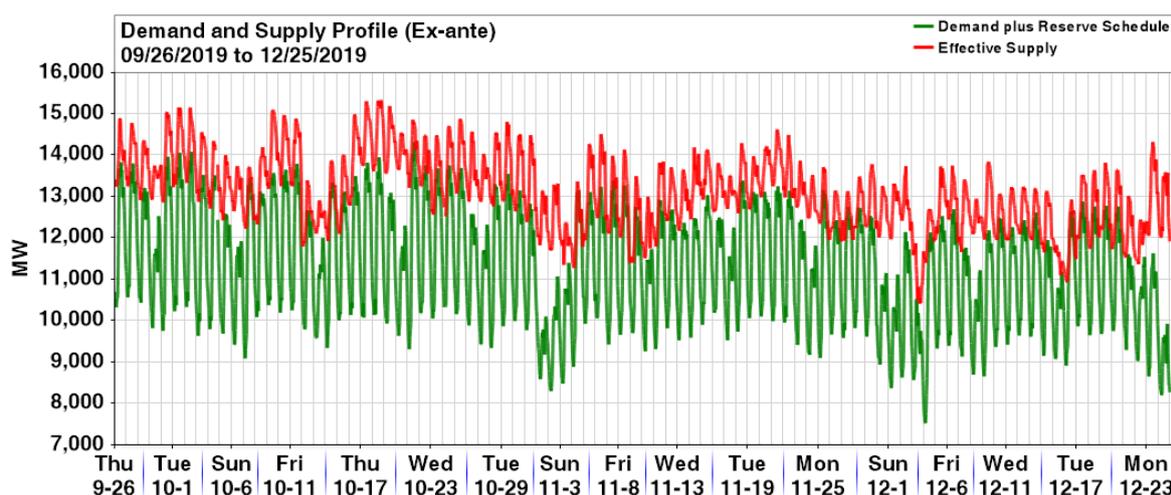
System demand declined towards the end of the year, from 10,662 MW in October down to 9,684 MW in December, attributable to the cooler temperatures during the period and observance of non-working holidays related to the All Saints Day and Christmas season. For the whole quarter, demand averaged at 10,189 MW, resulting in a slight decrease of 0.4 percent in quarterly comparison while a 4.6 percent increase was noted in yearly comparison.

Meanwhile, the reserve schedule averaged at 1,069 MW this quarter. Correspondingly, the demand plus reserve schedule averaged at 11,258 MW.

On the other hand, effective supply<sup>3</sup> was lower by 2.3 percent at an average of 13,106 MW coming from 13,419 MW in the third quarter, following the quarter-on-quarter increase in the capacity on outage. In addition, monthly average effective supply decreased, from 13,719 MW in October to 12,512 MW in December, consistent with the above discussed rise in outage capacity towards the end of the year.

Driven by the decline in supply, quarterly supply margin<sup>4</sup> narrowed by 12.5 percent to an average of 1,848 MW this fourth quarter from 2,111 MW in the third quarter. Monthly average supply margin likewise declined towards the end of the year, mirroring the reduction in available supply.

**Figure 7. Demand and Effective Supply (Ex-ante), 4<sup>th</sup> Quarter 2019**



**Table 10. Demand and Supply Summary (Ex-ante), 4<sup>th</sup> Quarter, 3<sup>rd</sup> Quarter, and 4<sup>th</sup> Quarter 2018**

	4th Quarter 2019 (26 Sep to 25 Dec 2019)			3rd Quarter 2019 (26 Jun to 25 Sep 2019)			4th Quarter 2018 (26 Sep to 25 Dec 2018)			% Q-on-Q Change (3Q 2019 - 2Q 2019)			% Y-on-Y Change (4Q 2018 - 4Q 2019)		
	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
Demand	12,867	6,536	10,189	12,946	7,499	10,228	12,249	5,856	9,740	(0.6)	(12.8)	(0.4)	5.0	11.6	4.6
Reserve Schedule	1,533	379	1,069	1,466	627	1,079	1,608	592	1,098	4.6	(39.6)	(1.0)	(4.7)	(36.0)	(2.6)
Demand plus R/S	14,324	7,528	11,258	13,779	8,414	11,307	13,505	6,692	10,838	4.0	(10.5)	(0.4)	6.1	12.5	3.9
Effective Supply	15,334	10,417	13,106	15,605	11,341	13,419	14,839	10,551	13,075	(1.7)	(8.1)	(2.3)	3.3	(1.3)	0.2
Supply Margin	5,382	21	1,848	4,529	168	2,111	4,655	89	2,237	18.8	(87.6)	(12.5)	15.6	(76.7)	(17.4)

Note: The derived values were non-coincident.

<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 effected 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 11. Monthly Demand and Supply Summary (Ex-ante), 4<sup>th</sup> Quarter 2019**

	October 2019 (26 Sep to 25 Oct 2019) in MW			November 2019 (26 Oct to 25 Nov 2019) in MW			December 2019 (26 Nov to 25 Dec 2019) in MW		
	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
	<b>Demand</b>	12,867	7,990	10,662	12,389	7,438	10,218	12,004	6,536
<b>Reserve Schedule</b>	1,528	723	1,157	1,533	521	1,044	1,391	379	1,006
<b>Demand plus R/S</b>	14,324	9,095	11,819	13,552	8,303	11,262	12,884	7,528	10,690
<b>Effective Supply</b>	15,334	11,803	13,719	14,814	11,282	13,086	14,327	10,417	12,512
<b>Supply Margin</b>	4,095	63	1,900	3,583	21	1,824	5,382	44	1,821

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

##### a. Market Prices

Market prices grew as supply margin thinned out towards the end of the year. An average of PhP5,060/MWh was recorded during the fourth quarter, demonstrating a 54.6 percent increase from PhP3,272/MWh during the third quarter of 2019 and 32.5 percent increase from PhP3,819/MWh during the fourth quarter of 2018.

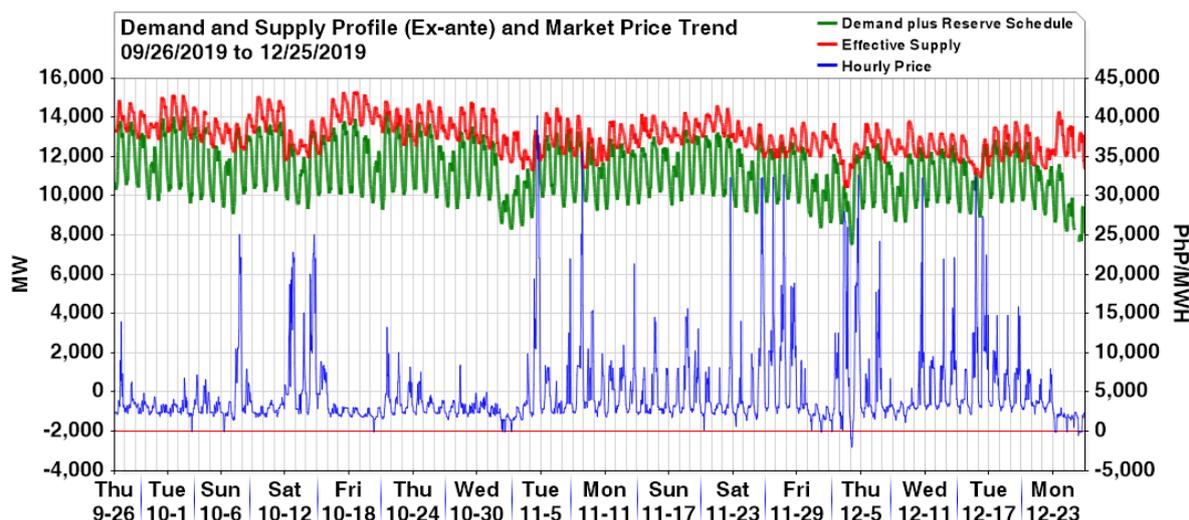
The monthly average prices similarly grew from PhP4,214/MWh in October, to PhP5,114/MWh in November up to PhP5,932/MWh in December. This was consistent with the narrowing supply margin driven by the uptick in outage capacity towards the end of the quarter.

In addition, price spike events exceeding the reference level of PhP27,000/MWh for peak (1000H-2100H) hours and PhP16,000/MWh for off peak (0100H-0900H & 2200H-2400H) hours, were breached. These include: 14 October (0900H), 4 November (0900H, 1500H, 1600H, 1700H, 1800H and 1900H), 8 November (2100H), 22 November (1800H), 25 November (1600H and 1800H), 27 November (1800H), 3 December (0900H and 1000H), 4 December (1700H and 1800H), 10 December (1800H), 15 December (1800H), and 16 December (0800H and 0900H). These trading intervals were usually marked by high level of outage capacity which resulted in relatively narrow supply margin. Observations on the market trigger events as above discussed have been provided to the Energy Regulatory Commission (ERC).

It is important to note that the secondary cap was not imposed and no price creep-up was recorded during this quarter.

<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.

**Figure 8. Market Price Trend vs. Supply Margin, 4<sup>th</sup> Quarter 2019**



**Table 12. Market Price Summary, 4<sup>th</sup> Quarter 2019, 3<sup>rd</sup> Quarter 2019, and 4<sup>th</sup> Quarter 2018**

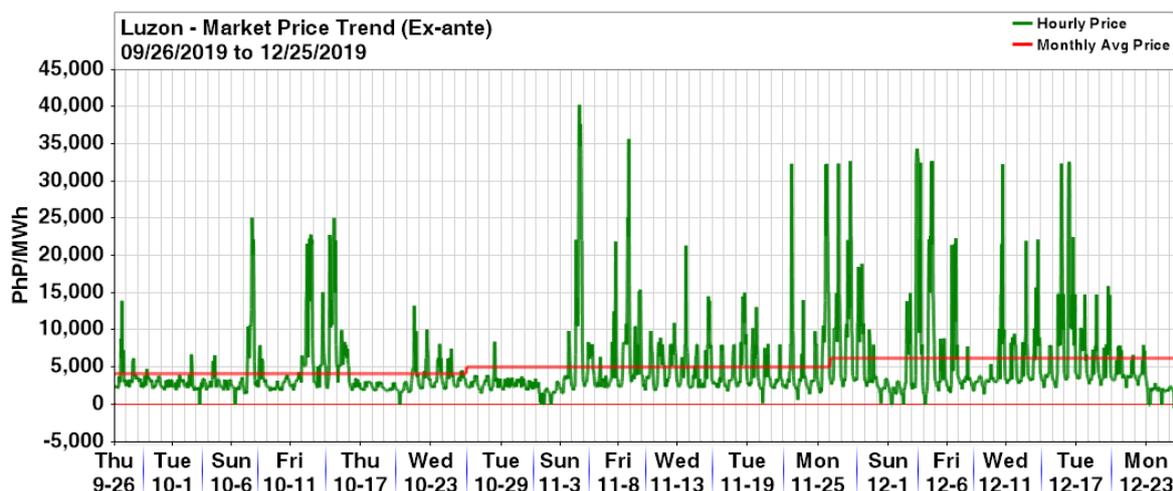
	4th Quarter 2019 (26 Sep to 25 Dec 2019) in PhP/MWh			3rd Quarter 2019 (26 Jun to 25 Sep 2019) in PhP/MWh			4th Quarter 2018 (26 Sep to 25 Dec 2018) in PhP/MWh			% Q-on-Q Change (3Q 2019 - 2Q 2019)			% Y-on-Y Change (4Q 2018 - 4Q 2019)		
	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
System	40,293	-1,955	5,060	23,008	0	3,272	31,707	654	3,819	75.1		54.6	27.1	(398.9)	32.5

**Table 13. Monthly Market Price Summary, 4<sup>th</sup> Quarter 2019**

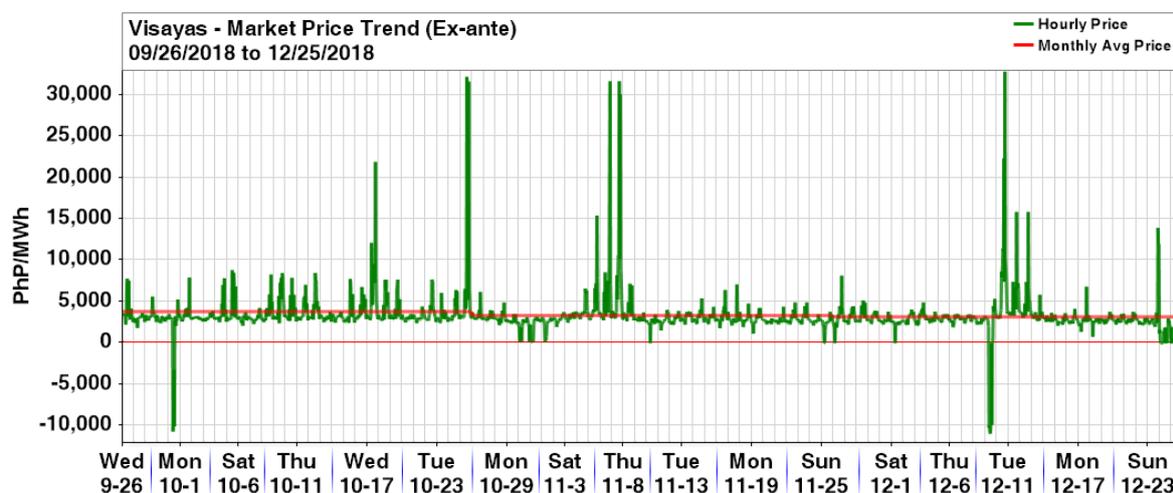
	October 2019 (26 Sep to 25 Oct 2019) in PhP/MWh			November 2019 (26 Oct to 25 Nov 2019) in PhP/MWh			December 2019 (26 Nov to 25 Dec 2019) in PhP/MWh		
	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
System	25,127	0	4,214	40,293	0	5,114	32,748	-1,955	5,932

Frequent occurrence of price separation between Luzon and Visayas was noted to be related to the unavailability of the HVDC link in 62 trading intervals in December. Other instances of price separation between Luzon and Visayas occurred when its scheduled maximum capacity was reached.

**Figure 9. Market Price Trend - Luzon, 4<sup>th</sup> Quarter 2019**



**Figure 10. Market Price Trend - Visayas, 4<sup>th</sup> Quarter 2019**



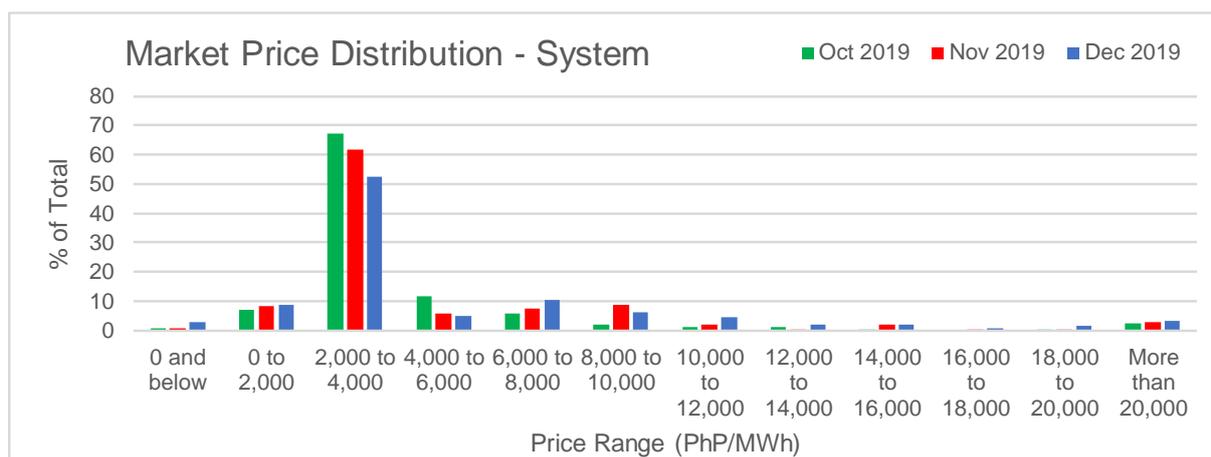
**Table 14. Monthly Regional Price Summary – 4<sup>th</sup> Quarter 2019**

	Luzon in PhP/MWh			Visayas in PhP/MWh			% Difference		
	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
<b>October 2019</b>	25,127	0	4,186	27,523	0	4,360	(8.7)		(4.0)
<b>November 2019</b>	40,292	0	5,084	40,293	0	5,263	(0.0)		(3.4)
<b>December 2019</b>	34,429	-490	6,239	32,748	-10,242	4,466	5.1	95.2	39.7

**b. Price Distribution**

As seen in Figure 11, noticeable decline was observed in the frequency of prices falling within the PhP2,000/MWh to PhP4,000/MWh range from October to December billing months. On the other hand, prices in the range of PhP10,000/MWh and above grew from only 5.4 percent in October to 7.3 percent in November, up to 14 percent in December.

**Figure 11. Price Distribution, 4<sup>th</sup> Quarter 2019**



**Table 15. Monthly Price Distribution – 4<sup>th</sup> Quarter 2019**

Price Range (PhP/MWh)	% Distribution		
	Oct 2019	Nov 2019	Dec 2019
0 and below	0.6	0.5	3.1
0 to 2,000	7.1	8.5	8.8
2,000 to 4,000	67.4	61.8	52.6
4,000 to 6,000	11.8	5.6	5.1
6,000 to 8,000	5.8	7.7	10.3
8,000 to 10,000	1.9	8.6	6.1
10,000 to 12,000	1.3	1.9	4.6
12,000 to 14,000	1.1	0.4	1.9
14,000 to 16,000	0.4	2.0	2.1
16,000 to 18,000	0.0	0.1	0.6
18,000 to 20,000	0.4	0.1	1.5
More than 20,000	2.2	2.7	3.3

**c. Price Duration Curve**

The price duration curves demonstrate the higher market prices during peak<sup>6</sup> hours compared to off-peak<sup>7</sup> hours.

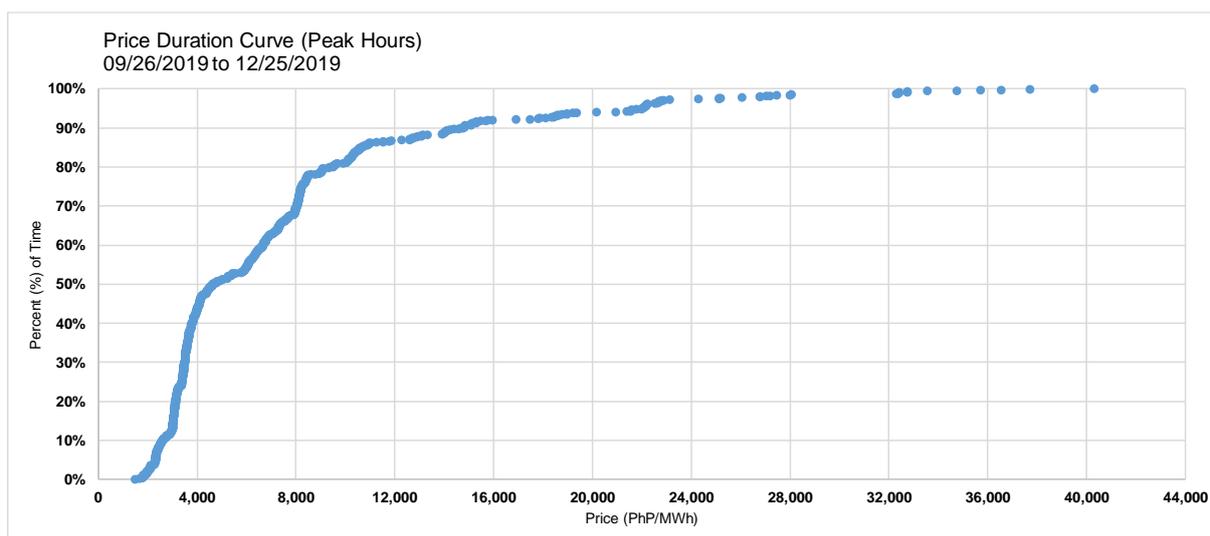
As seen in Figure 13 below, bulk of the market prices during the off-peak hours of the billing month, at 89 percent was at PhP4,000/MWh and below. About 9 percent ranged from above PhP4,000/MWh up to PhP10,000/MWh while the remaining 2 percent were above PhP10,000/MWh.

On the other hand, only 44 percent of the prices during the peak hours were below PhP4,000/MWh as shown in Figure 12. About 37 percent fell within PhP4,000/MWh up to PhP10,000/MWh while 19 percent was above PhP10,000/MWh.

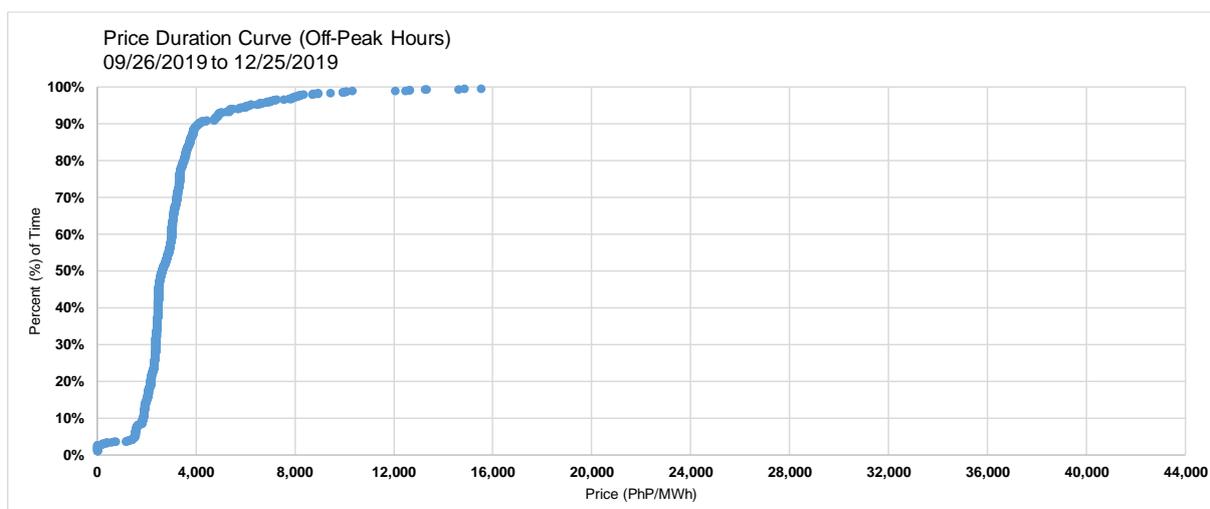
<sup>6</sup>Peak hours include 1000H-2100H from Mondays to Saturdays and 1900H-2000H on Sundays and Holidays

<sup>7</sup>Off-peak hours include 0100H to 0900H and 2200H to 2400H from Mondays to Saturdays and 0100H to 1800H and 2100H to 2400H on Sundays and Holidays

**Figure 12. Price Duration Curve (Peak Period), 4<sup>th</sup> Quarter 2019**



**Figure 13. Price Duration Curve (Off-Peak Period), 4<sup>th</sup> Quarter 2019**



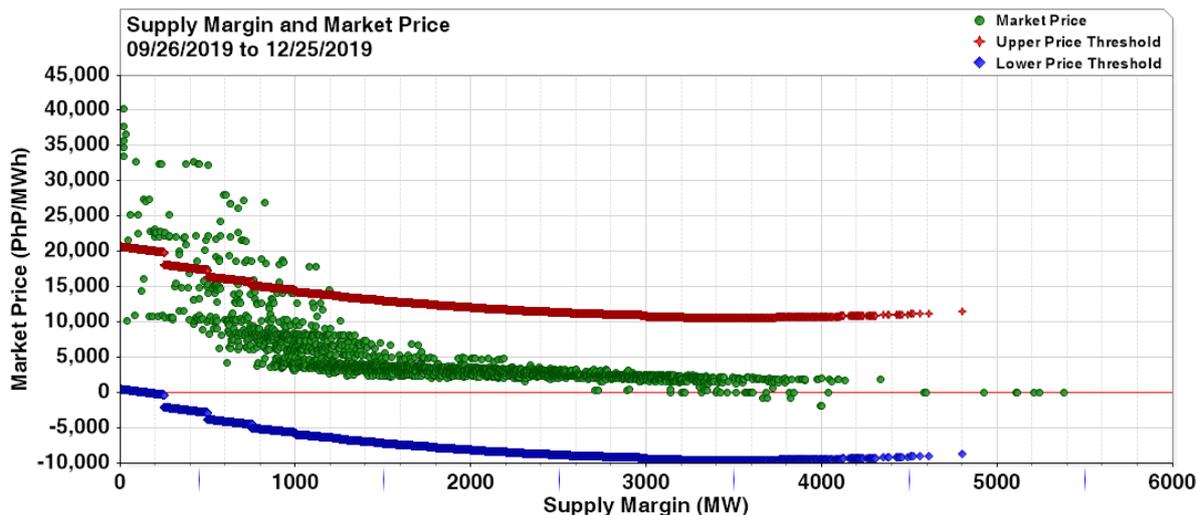
#### **d. Interesting Pricing Event**

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”. Appendix B provides details on the MSC-approved methodology in determining interesting pricing events.

A total of 19 trading intervals in October, 23 trading intervals in November and 38 trading intervals in December recorded market prices higher than the upper price threshold corresponding to the supply margin. On the other hand, no recorded trading interval had market prices falling below the lower price threshold corresponding to their supply margin.

Provided in Table 16 are the details on the market price and supply margin during the said trading intervals and the corresponding reference price threshold for each interesting pricing event.

**Figure 14. Supply Margin and Market Price, 4<sup>th</sup> Quarter 2019**



**Table 16. Interesting Pricing Events (Exceeding the Upper Threshold) – 4<sup>th</sup> Quarter 2019**

Billing Month	Date	Trading Interval	Supply Margin (MW)	Market Price (PhP/MWh)	Upper Price Threshold (PhP/MWh)	Lower Price Threshold (PhP/MWh)	
October	10/07/2019	18	63	25,127	20,733	515	
		19	282	22,109	18,146	-2,072	
		20	485	20,155	18,146	-2,072	
		21	256	22,192	18,146	-2,072	
	10/12/2019	11	723	18,789	16,424	-3,794	
		14	623	19,343	16,424	-3,794	
		16	377	20,927	18,146	-2,072	
		18	232	22,758	20,733	515	
	10/14/2019	19	195	22,881	20,733	515	
		20	488	21,594	18,146	-2,072	
		21	501	22,152	16,424	-3,794	
		9	337	20,076	18,146	-2,072	
		10	546	19,198	16,424	-3,794	
		15	549	21,767	16,424	-3,794	
		16	259	22,669	18,146	-2,072	
	November	11/04/2019	17	199	22,676	20,733	515
			18	107	25,117	20,733	515
			19	171	22,805	20,733	515
			21	321	22,086	18,146	-2,072
			9	338	19,474	18,146	-2,072
			14	45	21,529	20,733	515
11/07/2019		15	34	36,539	20,733	515	
		16	21	40,293	20,733	515	
		17	24	34,750	20,733	515	
		18	24	37,707	20,733	515	
		19	25	33,544	20,733	515	
		20	228	22,119	20,733	515	
	21	200	22,078	20,733	515		
	18	373	22,042	18,146	-2,072		
	19	284	25,187	18,146	-2,072		
	20	206	22,572	20,733	515		
December	11/08/2019	21	21	35,709	20,733	515	
		11/13/2019	18	717	21,383	16,424	-3,794
		11/15/2019	16	1192	14,567	14,305	-5,913
		11/18/2019	18	909	15,675	15,201	-5,017
	11/22/2019	18	226	32,374	20,733	515	
		19	434	22,216	18,146	-2,072	
		16	501	32,283	16,424	-3,794	
		17	678	22,699	16,424	-3,794	
		18	455	32,378	18,146	-2,072	
		19	201	23,106	20,733	515	
20	365	21,965	18,146	-2,072			
December	11/26/2019	18	378	32,415	18,146	-2,072	
		13	569	18,667	16,424	-3,794	
		18	89	32,748	20,733	515	
		19	208	22,687	20,733	515	
	11/27/2019	20	282	22,166	18,146	-2,072	
		11	441	18,528	18,146	-2,072	
		16	835	18,332	15,201	-5,017	
		18	810	18,949	15,201	-5,017	
	11/28/2019	9	828	26,964	15,201	-5,017	
		10	591	28,045	16,424	-3,794	
		11	603	27,983	16,424	-3,794	
		12	629	26,804	16,424	-3,794	
	12/03/2019	13	631	26,758	16,424	-3,794	
		14	716	18,429	16,424	-3,794	
		16	1083	17,840	14,305	-5,913	
		18	678	26,054	16,424	-3,794	
		11	752	18,569	15,201	-5,017	
		12	936	18,435	15,201	-5,017	
	12/04/2019	14	565	18,967	16,424	-3,794	
		15	662	18,581	16,424	-3,794	
		16	707	27,169	16,424	-3,794	
17		693	21,550	16,424	-3,794		
18		418	32,741	18,146	-2,072		
10		1118	17,794	14,305	-5,913		
12/06/2019		16	910	18,096	15,201	-5,017	
18		574	24,272	16,424	-3,794		
16		704	21,567	16,424	-3,794		
18		449	32,352	18,146	-2,072		
12/10/2019	18	630	22,016	16,424	-3,794		
	12/12/2019	18	576	22,198	16,424	-3,794	
	12/13/2019	18	576	22,198	16,424	-3,794	
	18	235	32,399	20,733	515		
12/15/2019	19	258	22,221	18,146	-2,072		
	8	927	18,759	15,201	-5,017		
	9	168	27,378	20,733	515		
	10	139	27,433	20,733	515		
12/16/2019	11	147	27,026	20,733	515		
	18	104	22,525	20,733	515		
	12/19/2019	18	766	15,925	15,201	-5,017	

**V. Pricing Errors, Market Intervention, and Secondary Cap**

System-wide non-congestion pricing errors in the ex-ante affected 32 trading intervals in the ex-ante and 40 trading intervals in the ex-post during the fourth quarter which were related to inappropriate input data which affected the generation of prices and schedules.

In Luzon, the frequency of non-congestion pricing errors affected 23 trading intervals in the ex-ante during the fourth quarter, mostly related to the inappropriate input data which affected the generation of Luzon prices and schedules as well as localized contingency constraint violation on Paco SS transformers. On the other hand, in Visayas, non-congestion pricing errors affected 27 trading intervals during the ex-ante in the fourth quarter mostly related to the localized constraint violation on Palimpinon 1 transformers and over-generation in the region.

Meanwhile, the system-wide application of Price Substitution Methodology (PSM) affected a total of 351 trading intervals in the ex-ante. PSM application this month was mainly due to constraint on Samboan-Amlan Line 1 (Cebu-Negros submarine cable) with 290 affected trading interval and on New Naga-Quiot line with 54 affected trading intervals

System-wide market intervention was declared by the Market Operator on 24 October from 0400H to 0500H due to MMS stoppage. In addition, System Operator-initiated market intervention was declared in Visayas on 4 October from 1600H to 1900H due to Manual Load Dropping and on 25 December from 0100H to 0900H due to tripping of Tabangon - Kananga lines 1 and 2. Finally, secondary cap was not imposed during the quarter.

**Table 17. PEN, PSM, MI, and Sec Cap Summary, 4<sup>th</sup> Quarter 2019**

	Luz-Vis						Luzon						Visayas						Total					
	October		November		December		October		November		December		October		November		December		October		November		December	
	Freq.	% of Time	Freq.	% of Time	Freq.	% of Time	Freq.	% of Time	Freq.	% of Time	Freq.	% of Time	Freq.	% of Time	Freq.	% of Time	Freq.	% of Time	Freq.	% of Time	Freq.	% of Time	Freq.	% of Time
<b>PEN (RTD)</b>	2	0.3	14	1.9	16	2.2	11	1.5	8	1.1	4	0.6	3	0.4	14	1.9	10	1.4	16	2.2	36	4.8	30	4.2
<b>PEN (RTX)</b>	3	0.4	20	2.7	17	2.4	-	-	9	1.2	3	0.4	2	0.3	17	2.3	12	1.7	5	0.7	46	6.2	32	4.4
<b>PSM (RTD)</b>	72	10.0	141	19.0	138	19.2	1	0.1	-	-	1	0.1	3	0.4	3	0.4	25	3.5	76	10.6	144	19.4	164	22.8
<b>PSM (RTX)</b>	69	9.6	123	16.5	126	17.5	-	-	1	0.1	1	0.1	3	0.4	4	0.5	39	5.4	72	10.0	127	17.1	166	23.1
<b>MI</b>	2	0.3	-	-	-	-	-	-	-	-	-	-	4	0.6	-	-	9	1.3	6	0.8	-	-	9	1.3
<b>Secondary Cap</b>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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

Shown in Table 18 below are the non-congestion pricing errors by type during the quarter. It was noted that system-wide non-congestion pricing errors were mostly related to inappropriate input data. It may be noted that a trading interval may record more than 1 type of pricing error notice.

**Table 18. PEN Type Summary, 4<sup>th</sup> Quarter 2019**

	Luz-Vis						Luzon						Visayas						Total						
	October		November		December		October		November		December		October		November		December		October		November		December		
	Freq.	% of Time	Freq.	% of Time	Freq.	% of Time	Freq.	% of Time	Freq.	% of Time	Freq.	% of Time	Freq.	% of Time	Freq.	% of Time	Freq.	% of Time	Freq.	% of Time	Freq.	% of Time	Freq.	% of Time	
<b>PEN (RTD)</b>	2	0.3	14	1.9	16	2.2	11	1.5	8	1.1	4	0.6	3	0.4	14	1.9	10	1.4	16	2.2	36	4.8	30	4.2	
Contingency	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Base Case	-	-	-	-	-	-	7	1.0	-	-	-	-	-	-	11	1.5	1	0.1	7	1.0	11	1.5	1	0.1	
Over-generation	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	1.0	-	-	-	-	-	-	7	1.0	
VoLL	-	-	-	-	-	-	2	0.3	-	-	-	-	3	0.4	3	0.4	3	0.4	5	0.7	3	0.4	3	0.4	
Inappropriate Input Data	2	0.3	14	1.9	16	2.2	2	0.3	8	1.1	4	0.6	-	-	-	-	1	0.1	4	0.6	22	3.0	21	2.9	
<b>PEN (RTX)</b>	3	0.4	20	2.7	17	2.4	-	-	9	1.2	3	0.4	2	0.3	17	2.3	12	1.7	5	0.7	46	6.2	32	4.4	
Contingency	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Base Case	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13	1.7	2	0.3	-	-	13	1.7	2	0.3	
Over-generation	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	1.1	-	-	-	-	-	-	-	8	1.1
VoLL	-	-	-	-	-	-	-	-	1	0.1	-	-	2	0.3	4	0.5	3	0.4	2	0.3	5	0.7	3	0.4	
Inappropriate Input Data	3	0.4	20	2.7	17	2.4	-	-	8	1.1	3	0.4	-	-	-	-	2	0.3	3	0.4	28	3.8	22	3.1	

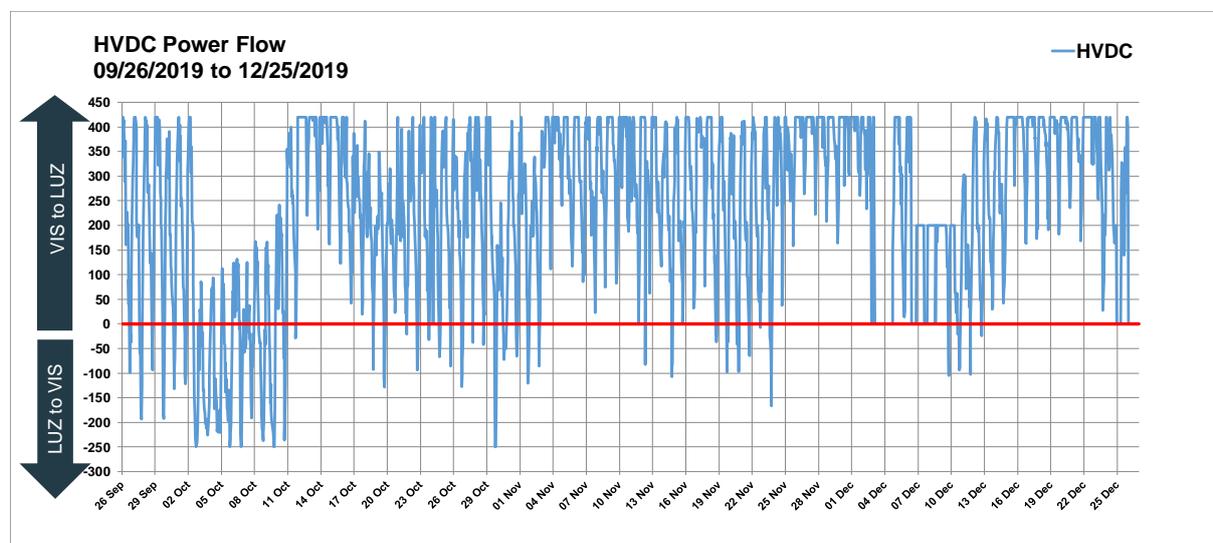
## VI. HVDC Scheduling

Power flow through the HVDC Interconnection was generally directed towards the Luzon region in the ex-ante, for 1,885 trading intervals or 87 percent of the time during the billing quarter, with schedules ranging from 0.2 MW to 420 MW.

On the other hand, the HVDC power flow was directed towards the Visayas for 222 trading intervals or 10 percent of the time in the ex-ante during the quarter, with schedules ranging from 1.1 MW to 250 MW.

Power flow was unavailable on 2 December (2000H to 2200H), from 3 December at 0300H to 4 December at 1700H, 6 December (1000H to 2000H), 7 December (1400H to 2000H), 8 December at 1500H, and 24 December at 2400H, affecting a total of 62 trading intervals in December.

**Figure 15. Summary of HVDC Limits Imposed by NGCP-SO, 4<sup>th</sup> Quarter 2019**



**Table 19. Summary of HVDC Limits Imposed by NGCP-SO and Results of HVDC Schedules (Ex-ante and Ex-post), 4<sup>th</sup> Quarter 2019**

Results of HVDC Scheduling	HVDC Limit during Ex-ante (Visayas/Luzon)									
	(No. of Trading Intervals)									
	October 2019		November 2019		December 2019					
	250/420	Total	440/440	Total	0/0	200/200	250/180	250/200	250/420	Total
<b>Visayas to Luzon</b>	<b>553</b>	<b>553</b>	<b>695</b>	<b>695</b>	-	74	1	8	554	637
Limit Not Maximized	471	471	580	580		9		3	337	349
Limit Maximized	82	82	115	115		65	1	5	217	288
<b>Luzon to Visayas</b>	<b>161</b>	<b>161</b>	<b>49</b>	<b>49</b>	-	4	-	-	8	12
Limit Not Maximized	156	156	47	47		4			8	12
Limit Maximized	5	5	2	2						-
<b>No Flow</b>	-	-	-	-	62				-	62
<b>TOTAL</b>	<b>714</b>	<b>714</b>	<b>744</b>	<b>744</b>	<b>62</b>	<b>78</b>	<b>1</b>	<b>8</b>	<b>562</b>	<b>711</b>

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

Majority of the market prices, at 91 percent, during the billing quarter were below PhP10,000/MWh with coal and natural gas plants as frequent price setters, namely PEDC CFTPP, San Gabriel NGPP, Pagbilao CFTPP, CEDC CFTPP, and Ilijan NGPP.

<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.

**Table 20. Price Setting Frequency Index at PhP10,000/MWh and below, 4<sup>th</sup> Quarter 2019**

	Frequency (Number of trading intervals)								
	PhP0/MWh and below			Above PhP0/MWh to PhP5,000/MWh			Above PhP5,000/MWh to PhP10,000/MWh		
	Oct	Nov	Dec	Oct	Nov	Dec	Oct	Nov	Dec
PEDC CFTPP		5	27	283	224	116			
SAN GABRIEL NGPP	4	4	13	152	166	81			
PAGBILAO CFTPP	4		7	151	127	80			
CEDC CFTPP	4	1	20	109	85	103			
ILIJAN NGPP	2			83	89	144			
PCPC CFTPP			2	100	88	124	4		
KSPC CFTPP			33	52	38	136			
QPPL CFTPP	4	4	10	87	83	62			
SAN LORENZO NGPP	4		13	31	35	88	29		
TPC (SANGI) CFTPP	2	4	36	88	45	22			
ANGAT HEP	4	4	13	72	30	6	20	22	7
SUAL CFTPP	4	4	10	94	27	37			
ANDA CFTPP				64	37	16	8	17	28
STA RITA NGPP	4	4	13	14	35	66	17	14	
APEC CFTPP				62	68	14			
NAVOTAS DPP							28	48	46
TVI CFTPP			12	16	31	38			
CPPC DPP			1				40	29	27
MASINLOC BATTERY				11	41	37			
EAUC DPP			4				37	31	17

Meanwhile, market prices above PhP10,000/MWh, at 9 percent, were set by oil-based led by Bohol DPP, PPC DPP, Limay CCGT, Bauang DPP, and PB 104.

**Table 21. Price Setting Frequency Index Above PhP10,000/MWh, 4<sup>th</sup> Quarter 2019**

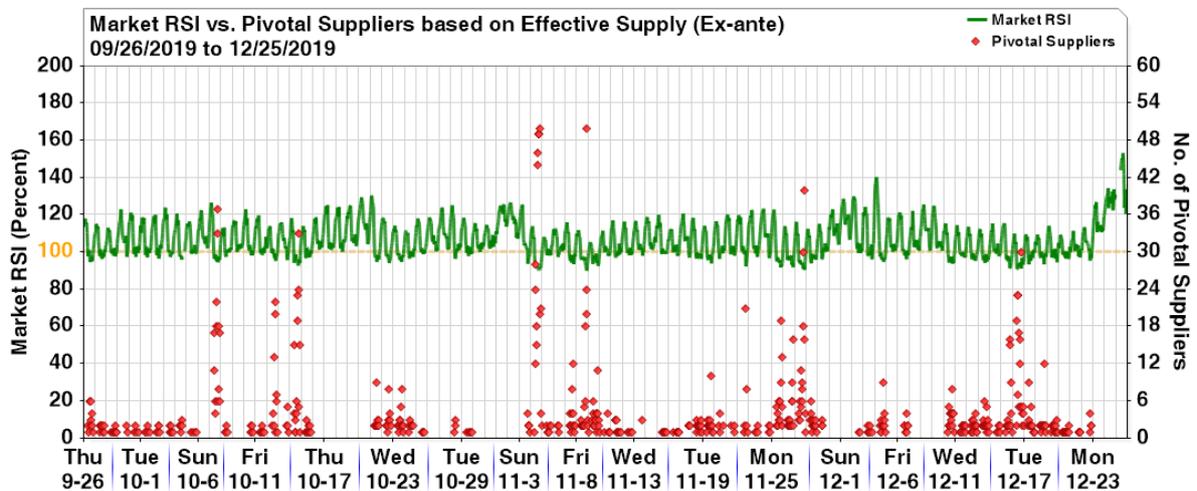
Most Frequent Price Setters at prices above PhP10,000/MWh	Frequency (Number of trading intervals)														
	Above PhP10,000/MWh to PhP15,000/MWh			Above PhP15,000/MWh to PhP20,000/MWh			Above PhP20,000/MWh to PhP25,000/MWh			Above PhP25,000/MWh to PhP30,000/MWh			Above PhP30,000/MWh to PhP32,000/MWh		
	Oct	Nov	Dec	Oct	Nov	Dec	Oct	Nov	Dec	Oct	Nov	Dec	Oct	Nov	Dec
BOHOL DPP				63	65	9			1				6		
PPC DPP	13	20	11	1		1							3	10	1
LIMAY CCGT							16	11	19						1
BAUANG DPP	2	5	15					1	6					1	6
PB 104				20	7	5			1						
SAN ROQUE HEP	1		12											3	13
MILLENNIUM GTPP			12		9	6				2					
ANDA CFTPP	2		4				2		7					3	10
PANAY DPP III	8	3	5											10	
SLPGC GTPP	4	8	9												
ANGAT HEP	4	2	1	5		2	1				1				
CALUMANGAN DPP					1	2								9	2
BACMAN GPP	3			3	1		2								
PANAY DPP I														5	
CIP DPP	1			1			1		1						
CPPC DPP								4							
MAGAT HEP						3									
PB 102	1										2				
SUBIC DPP	1		1												
TAPGC DPP				1											

## VIII. Residual Supply

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

During the entire billing quarter, the market RSI was below the 100 percent mark for 26 percent of the time compared to previous quarter's 19 percent of the time, indicating the relatively more frequent presence of pivotal suppliers this quarter.

**Figure 16. Market RSI vs. Pivotal Suppliers (Ex-Ante), 4<sup>th</sup> Quarter 2019**



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

Provided in Table 22 are the top 20 pivotal suppliers in the market during the billing quarter led by Ilijan NGPP, Sta. Rita NGPP, Pagbilao CFTPP, Sual CFTPP, and SMC Limay CFTPP. In line with the RSI discussion above, presence of pivotal suppliers was observed to be more frequent this quarter totaling 2,461 generator-trading intervals compared to last quarter's 1,151 generator-trading intervals.

<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.

<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.

**Table 22. Pivotal Supplier Frequency Index, 4<sup>th</sup> Quarter 2019**

Top Pivotal Suppliers	Frequency (Number of trading intervals)		
	Oct	Nov	Dec
ILIJAN NGPP	67	166	198
STA RITA NGPP	115	129	169
PAGBILAO CFTPP	53	62	78
SUAL CFTPP	96	24	40
SMC LIMAY CFTPP	33	34	31
MASINLOC CFTPP	40	18	29
KALAYAAN PSPP	20	28	16
SAN LORENZO NGPP	24	8	30
LEYTE A GPP	16	24	19
QPPL CFTPP	19	24	14
SAN ROQUE HEP	17	15	19
SAN GABRIEL NGPP	7	23	20
LIMAY CCGT	15	19	14
SBPLC CFTPP	8	24	15
MARIVELES CFTPP	13	19	14
PEDC CFTPP	13	19	13
TVI CFTPP	8	21	14
MAGAT HEP	16	14	5
CALACA CFTPP	17	15	3
PAGBILAO 3 CFTPP	16	19	

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

Limay CCGT, San Roque HEP, and PPC DPP were considered most frequent pivotal suppliers at the same time price setters at above PhP20,000/MWh. On the other hand, Ilijan NGPP and Sta. Rita NGPP were able to figure as most frequent pivotal suppliers and price setters at below PhP5,000/MWh-level during the same trading interval.

**Table 23. PSI vs PSFI, 4<sup>th</sup> Quarter 2019**

Pivotal Supplier and Price Setters	Frequency (Number of trading intervals)																	
	Above PhP0/MWh to PhP5,000/MWh			Above PhP5,000/MWh to PhP10,000/MWh			Above PhP10,000/MWh to PhP15,000/MWh			Above PhP20,000/MWh to PhP25,000/MWh			Above PhP25,000/MWh to PhP30,000/MWh			Above PhP30,000/MWh to PhP32,000/MWh		
	Oct	Nov	Dec	Oct	Nov	Dec	Jul	Aug	Sep	Oct	Nov	Dec	Oct	Nov	Dec	Oct	Nov	Dec
ILIJAN NGPP	18	6	3															
LIMAY CCGT										9	6	4						
STA RITA NGPP	1	5	5		1													
SAN ROQUE HEP				1			1		2								1	5
PPC DPP																	5	
BAUANG DPP						1						1						2
MAGAT HEP				2	1													
KSPC CFTPP			2															
PANAY DPP III																	1	
PEDC CFTPP			1															
MILLENNIUM GTPP													1					

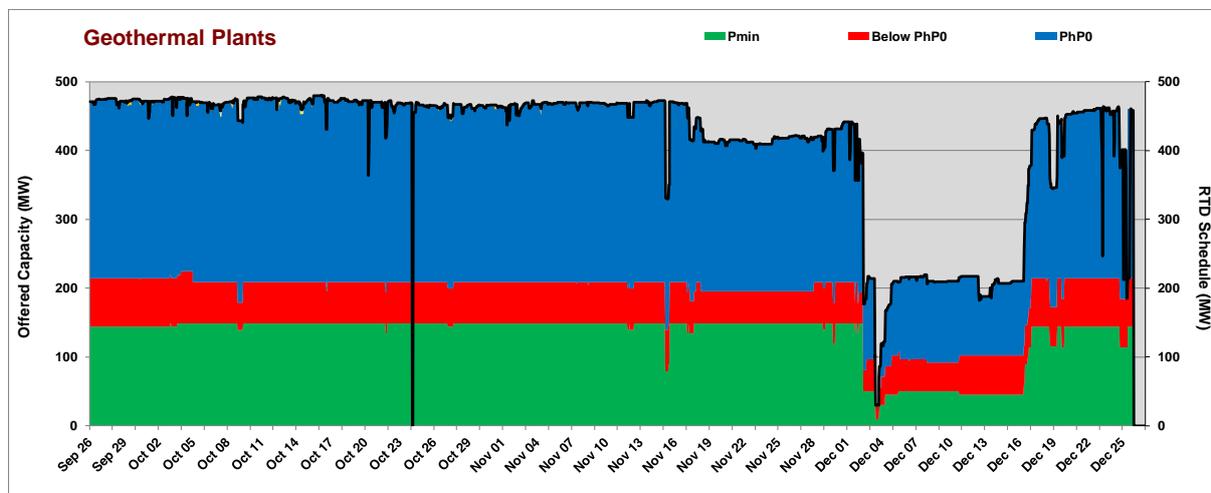
**XI. Generator Offer Pattern**

Luzon geothermal plants offered almost its entire capacity (99.8 percent) at PhP0/MWh and below during the billing quarter. In particular, about 54.2 percent was priced at exactly PhP0/MWh while the remaining 45.6 percent was priced below PhP0/MWh as seen in Figure 17. The remaining 0.2 percent was offered at PhP0/MWh to PhP32,000/MWh.

Accordingly, all of its submitted capacity offers, at 98.5 percent, were scheduled for dispatch in the market.

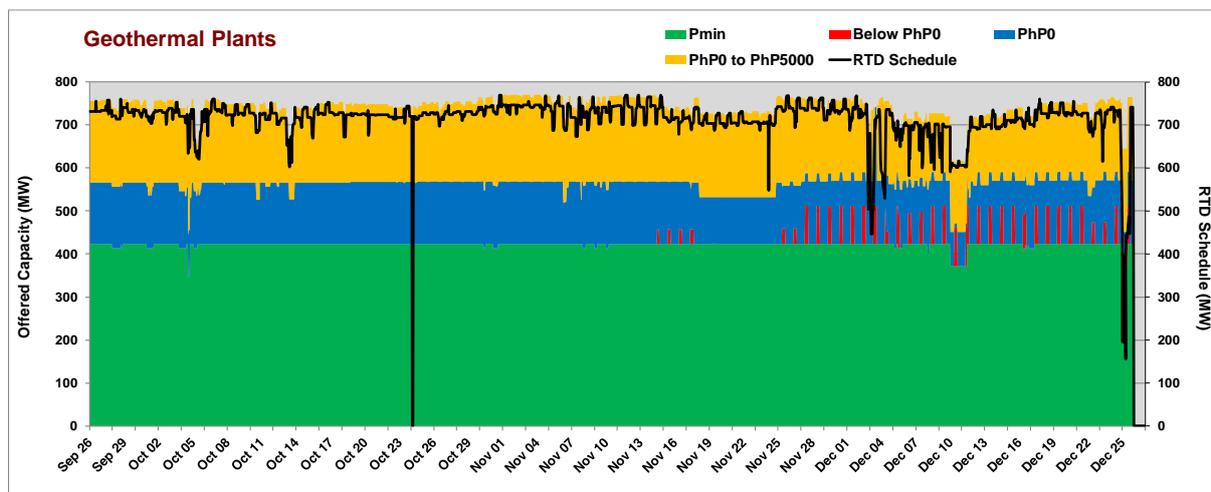
It may be noted that geothermal plants had lower level of capacity offered from 2 December to 16 December following the forced outages of Bacman GPP units 1, 2, and 3 and units of Tiwi GPP C and Tiwi GPP A related to the onslaught of Typhoon Tisoy.

**Figure 17. Geothermal Plants Offer Pattern, Luzon – 4<sup>th</sup> Quarter 2019**



On the other hand, Visayas geothermal plants had slightly higher-priced offers compared to Luzon geothermal plants. About 24.1 percent of Visayas geothermal plants’ offered capacity was priced at above PhP0/MWh up to PhP5,000/MWh while the remaining 75.9 percent was priced at PhP0/MWh and below as seen in Figure 18. It was noted that about 96.6 percent of these capacity offers were scheduled for dispatch.

**Figure 18. Geothermal Plants Offer Pattern, Visayas – 4<sup>th</sup> Quarter 2019**

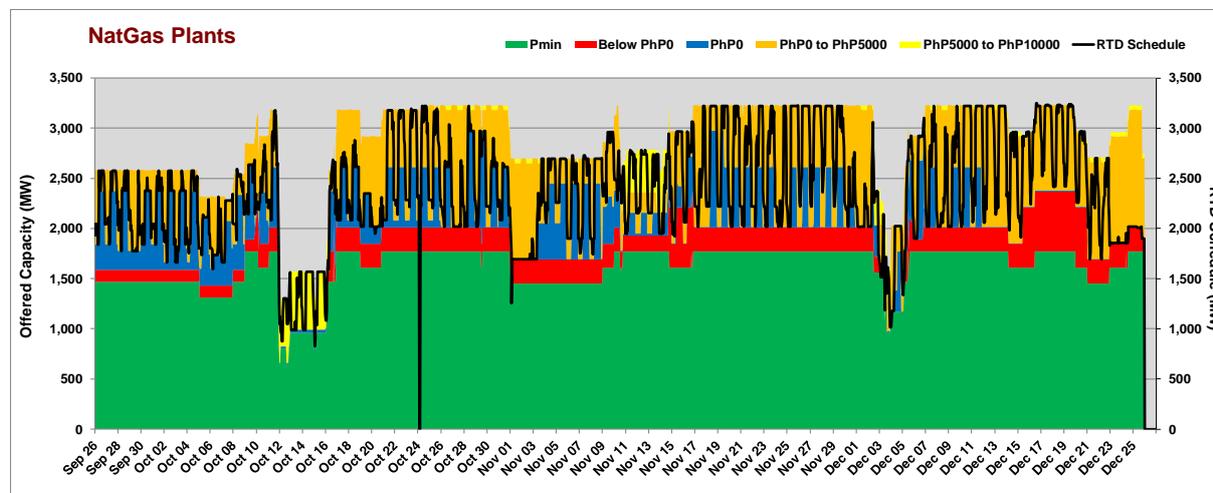


In Figure 19, about 73.2 percent of natural gas plants’ offered capacity was priced at PhP0/MWh and below, 24.9 percent was priced above PhP0/MWh to PhP5,000/MWh and 1.9 percent was priced at above PhP5,000/MWh to PhP10,000/MWh.

About 83.3 percent of the offers of natural gas plants were scheduled for dispatch during the billing quarter.

Natural gas plants offered lower level of capacity from 12 to 15 October when San Gabriel NGPP and Ilijan NGPP Blocks A and B were on outage related to the above discussed planned outage of SPEX-Malampaya facility. Ilijan NGPP Blocks A and B were also placed on forced outage from 2 to 5 December as precautionary measure due to passage of Typhoon Tisoy.

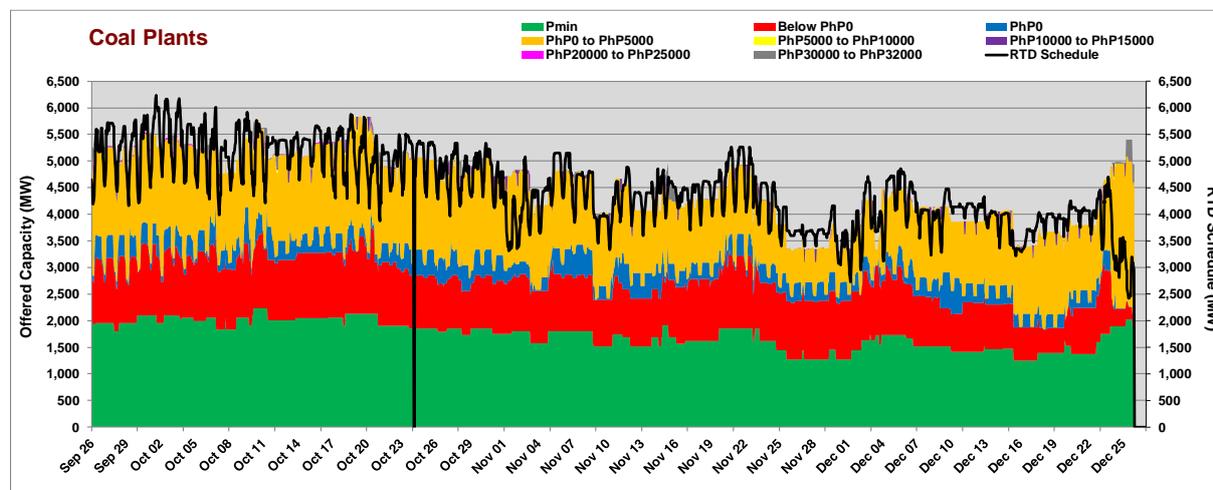
**Figure 19. Natural Gas Plants Offer Pattern, Luzon – 4<sup>th</sup> Quarter 2019**



Luzon coal plants offered 66.6 percent of its capacity at prices ranging from PhP0/MWh and below while 31.9 percent was submitted at prices above PhP0/MWh to PhP5,000/MWh. As seen in Figure 20, a small percentage, at 1.5 percent, were priced between PhP5,000/MWh up to PhP32,000/MWh.

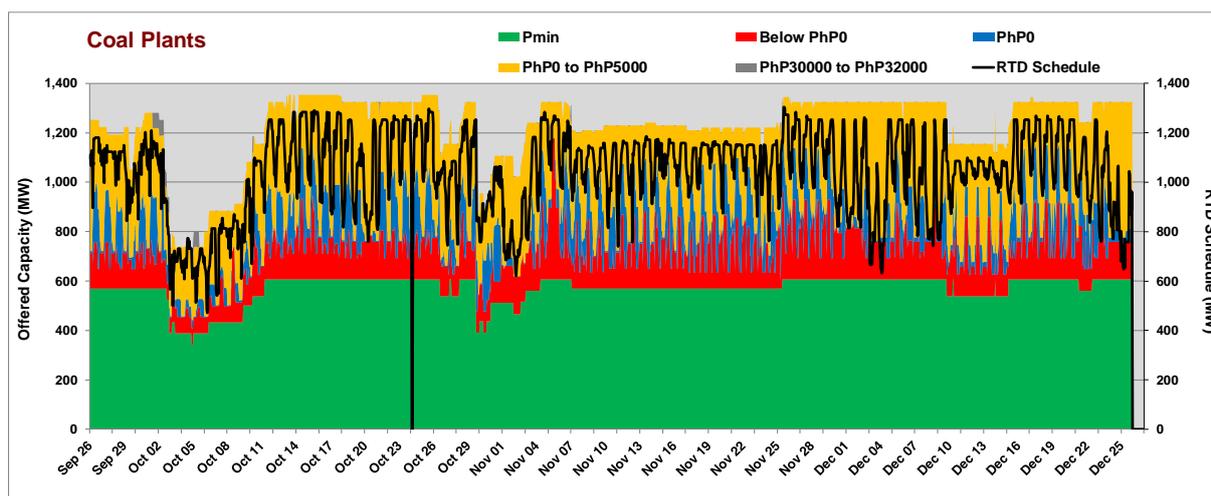
Instances of higher RTD schedule than offered capacity were noted during the quarter following the imposition of over-riding constraints on Luzon coal plants namely Masinloc CFTPP unit 3 and SBPL CFTPP which underwent commissioning tests during the period.

**Figure 20. Coal Plants Offer Pattern – Luzon, 4<sup>th</sup> Quarter 2019**



About 69 percent of Visayas coal plants' capacity offers were priced at PhP0/MWh and below, 30.7 percent at PhP0/MWh to PhP5,000/MWh as seen in Figure 21. A minimal percentage, at 0.3 percent, was offered at prices above PhP5,000/MWh up to PhP32,000/MWh.

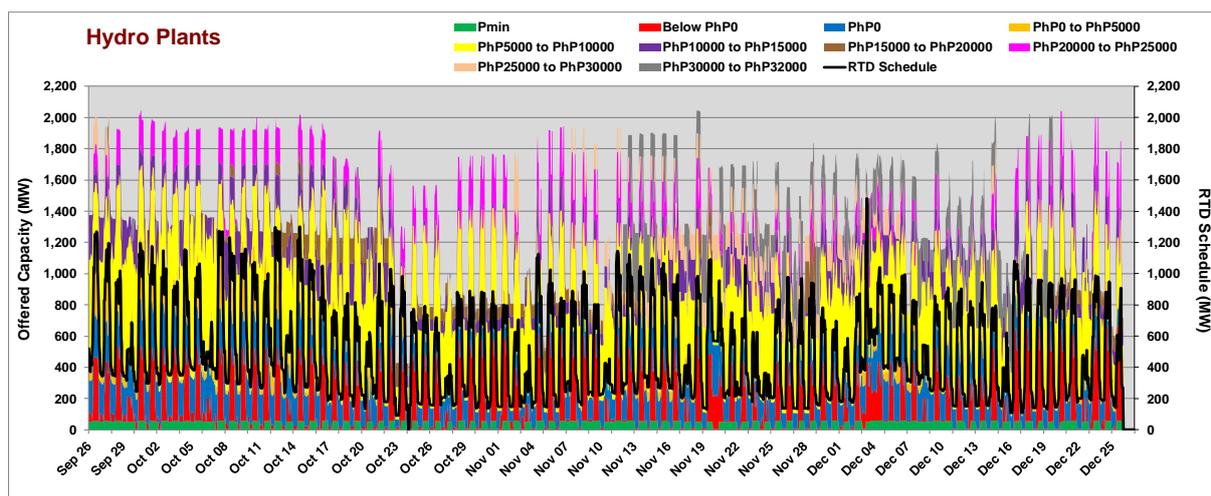
**Figure 21. Coal Plants Offer Pattern, Visayas – 4<sup>th</sup> Quarter 2019**



Luzon hydro plants offered 30 percent of their capacity at PhP0/MWh and below and 5.5 percent at PhP0/MWh up to PhP5,000/MWh. About 39.1 percent was priced at PhP5,000/MWh up to PhP10,000/MWh, 10.7 percent was priced at PhP10,000/MWh up to PhP20,000/MWh and 9 percent was priced at PhP20,000/MWh up to PhP30,000/MWh, and 5.7 percent, was priced at PhP30,000/MWh up to PhP32,000/MWh.

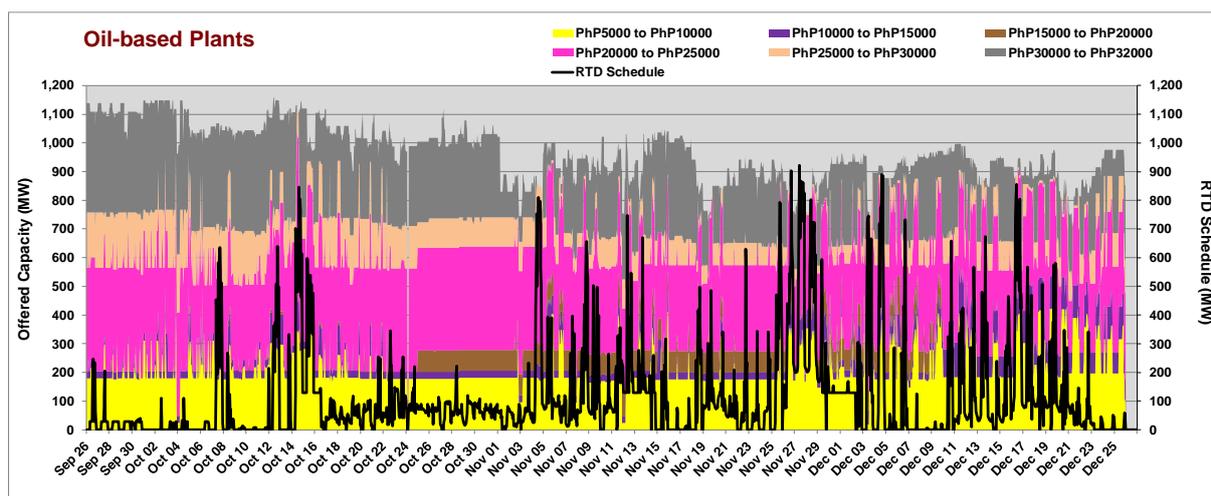
The RTD schedule of Luzon hydro plants include the over-riding constraints imposed on Uddiawan HEP and La Trinidad HEP related to its conduct of commissioning tests.

**Figure 22. Hydro Plants Offer Pattern, Luzon – 4<sup>th</sup> Quarter 2019**



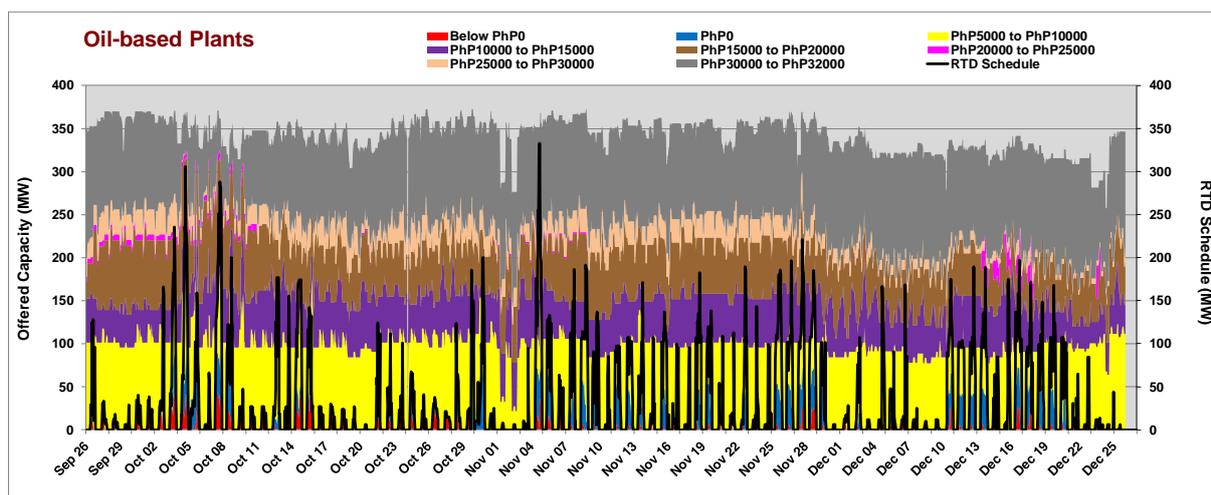
As seen in Figure 22, Luzon oil-based plants submitted the highest offer prices with 33.8 percent at prices above PhP20,000/MWh up to PhP25,000/MWh, 9.8 percent at above PhP25000/MWh up to PhP30,000/MWh, and 24.2 percent at above PhP30,000/MWh up to PhP32,000/MWh. Moreover, 8.8 percent at PhP10,000/MWh to PhP20,000/MWh and only 23.2 percent was priced at above PhP5,000/MWh up to PhP10,000/MWh. The decrease in supply margin this quarter led to the increase in percentage of offered capacity scheduled for dispatch from 5 percent in the third quarter to 11.6 percent this quarter. In particular, 16.9 percent of oil-based plant's capacity was scheduled in December.

**Figure 23. Oil-based Plants Offer Pattern, Luzon – 4<sup>th</sup> Quarter 2019**



On a similar note, Visayas oil-based plants offered their capacities at relatively higher prices when compared with other plant types with 31.2 percent priced above PhP30,000/MWh up to PhP32,000/MWh as seen in Figure 24. Moreover, about 6.3 percent was offered at above PhP20,000/MWh up to PhP30,000/MWh, 32.1 percent at above PhP10,000/MWh to PhP20,000/MWh, and 26.3 percent at above PhP5,000/MWh to PhP10,000/MWh. Only 3.5 percent of their capacity offers were priced at PhP0/MWh and below.

**Figure 24. Oil-based Plants Offer Pattern, Visayas – 4<sup>th</sup> Quarter 2019**



## XII. Capacity Factor

In Luzon, natural gas plants observed the highest utilization during the quarter when measured in terms of registered capacity, among resource types with capacity factor reaching 77 percent in December. Coal and geothermal plants followed with capacity factors ranging from 55 to 75 percent and 37 to 55 percent, respectively. Hydro came next reaching 23 percent in October. Oil-based plants had the lowest utilization ranging from 4 to 8 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' capacity factor was 99 to 100 percent. Coal and natural gas plants similarly posted high

capacity factors at about 98 to 99 percent and 82 to 84 percent, respectively. Meanwhile, hydro plants' capacity factor ranged from 36 to 40 percent. Oil-based plants recorded the lowest utilization in terms of offered capacity at only 7 percent in October up to 17 percent in December. Still, oil-based plants' utilization this quarter was higher compared to mere 3 percent in August and September.

Meanwhile, preferential dispatch plants – biomass plants' capacity factors were recorded at 44 to 50 percent range when measured based on registered capacity, wind plants' capacity factors were recorded from 33 to 58 percent (from only 15 to 27 percent in third quarter), and solar plants with their capacity factors ranging from 16 to 17 percent.

On the other hand, sole battery energy storage facility in the WESM, Masinloc Battery, posted a capacity factor ranging from 8 to 50 percent each when measured in terms of registered capacity, registered capacity net of outage, and offered capacity related to its provision of ancillary services as regulating reserve.

**Table 24. Capacity Factor – Luzon Plants, 4<sup>th</sup> Quarter 2019**

Plant Type	RTD Sched. vs Registered Cap.			RTD Sched. vs Registered less Out. Cap.			RTD Sched. vs Offered Cap.		
	Oct 2019	Nov 2019	Dec 2019	Oct 2019	Nov 2019	Dec 2019	Oct 2019	Nov 2019	Dec 2019
Coal	75%	64%	55%	86%	87%	87%	99.1%	98.1%	98.2%
Natural Gas	66%	75%	77%	83%	80%	82%	83.9%	82.5%	83.6%
Geothermal	55%	53%	37%	70%	75%	67%	99.7%	99.9%	98.8%
Hydro	23%	19%	19%	25%	20%	21%	39.9%	36.1%	36.5%
Oil-based	4%	6%	8%	4%	7%	12%	6.7%	12.0%	16.9%
Wind	33%	54%	58%	33%	54%	58%			
Solar	17%	16%	17%	17%	16%	17%			
Biomass	44%	47%	50%	44%	48%	50%			
Battery	8%	37%	49%	48%	43%	49%	49.8%	49.1%	49.4%

In Visayas, geothermal plants obtained the highest utilization among resource types in terms of registered capacity with capacity factors ranging from 78 to 81 percent. Coal and hydro plants then followed with capacity factors ranging from 73 to 76 percent and from 32 to 41 percent, respectively. Lastly, oil-based plants observed the lowest capacity factors from 5 to 6 percent.

In terms of offered capacity, geothermal plants recorded high capacity factors at 96 to 97 percent while coal plants' capacity factors were at 82 to 87 percent. Meanwhile, oil-based plants posted the lowest capacity factors among the scheduled resources at only 7 to 9 percent.

Wind plants' capacity factors based on registered capacity and based on registered capacity net of outage in the region ranged from 11 to 37 percent, solar plants' capacity factors ranged from 19 to 21 percent and biomass plants' capacity factors ranged from 17 to 24 percent. It may be recalled that biomass plants had minimal to zero utilization in the third quarter denoting its off-milling season.

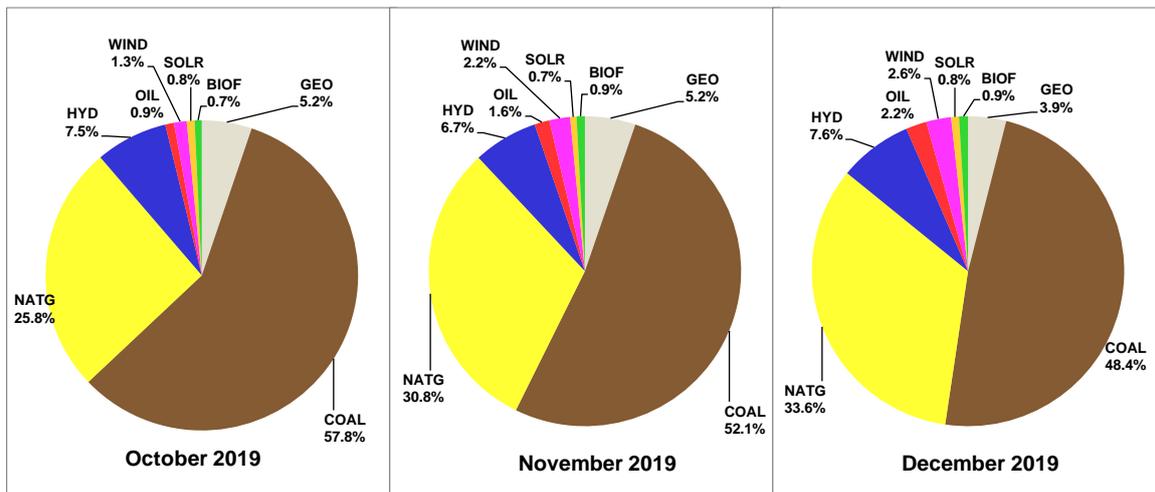
**Table 25. Capacity Factor, Visayas Plants – 4<sup>th</sup> Quarter 2019**

Plant Type	RTD Sched. vs Registered Cap.			RTD Sched. vs Registered less Out. Cap.			RTD Sched. vs Offered Cap.		
	Oct 2019	Nov 2019	Dec 2019	Oct 2019	Nov 2019	Dec 2019	Oct 2019	Nov 2019	Dec 2019
Coal	73%	76%	76%	78%	84%	79%	86%	87%	82%
Geothermal	80%	81%	78%	89%	93%	90%	97%	97%	96%
Hydro	33%	32%	41%	33%	32%	41%			
Oil-based	5%	6%	5%	5%	6%	6%	7%	9%	9%
Wind	11%	18%	37%	11%	18%	37%			
Solar	21%	19%	19%	22%	19%	19%			
Biofuel	17%	18%	23%	17%	18%	24%			

### XIII. Generation Mix

In the Luzon region, coal plants consistently contributed the largest chunk of the metered quantity in all billing months ranging from 48.4 percent to 57.8 percent. Natural gas plants followed comprising about 25.8 to 33.6 percent of the generation mix. Hydro plants and geothermal plants came next accounting for 6.7 percent to 7.6 percent and 3.9 percent to 5.2 percent, respectively. Oil-based plants' contribution was the lowest at 0.9 percent to 2.2 percent. Meanwhile, the contribution of preferential and must-dispatch generating units ranged from 2.9 to 4.3 percent.

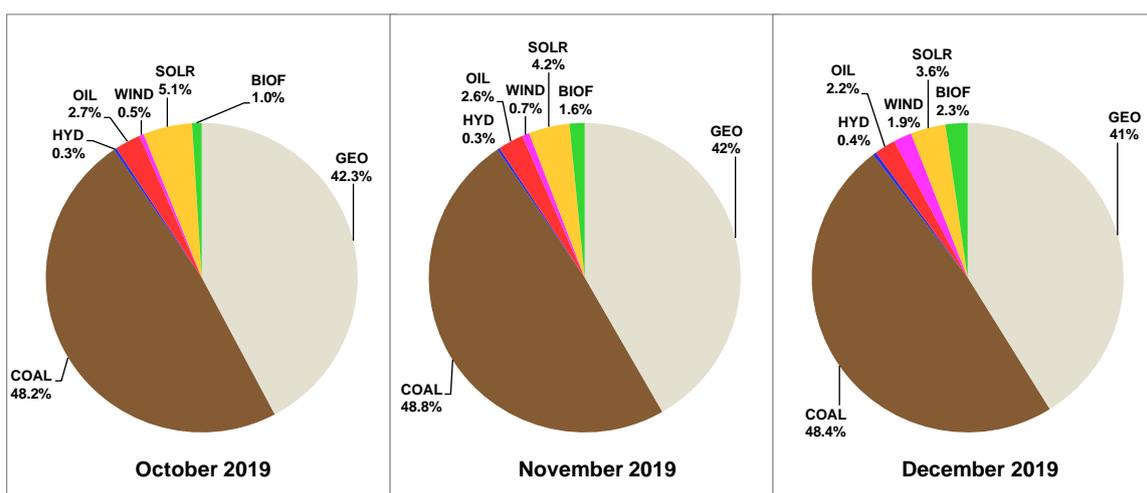
**Figure 25. Generation Mix (Based on Metered Quantity) – Luzon, 4<sup>th</sup> Quarter 2019**



Similarly, in the Visayas region, coal plants had the highest contribution in the generation mix during the billing quarter ranging from 48.2 to 48.8 percent. Geothermal plants followed with shares ranging from 41.2 to 42.3 percent. Meanwhile, oil-based plants' contribution ranged from 2.2 to 2.7 percent and hydro plants had the least contribution at 0.3 to 0.4 percent all throughout the quarter.

On the other hand, preferential and must-dispatch generating units had higher contribution at about 6.6 to 7.8 percent in Visayas compared to 3 to 4 percent in Luzon.

**Figure 26. Generation Mix (Based on Metered Quantity), Visayas – 4<sup>th</sup> Quarter 2019**



#### **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 SMC with a market share of 24 percent by the end of the billing quarter. AP came next with market share of about 20 percent followed by FGC and PSALM at 14 percent and 11 percent, respectively. SMPC followed, albeit distantly, with 5 percent.

It may be noted that higher market shares were recorded for SMC at 26 percent when based on offered capacity and 28 percent when based on actual generation as well as for FGC at 19 percent and 21 percent, respectively, compared to their share based on registered capacity. Their portfolios include mostly base-load plants, such as coal and natural gas plants, which were usually offered at low prices and thus were frequently dispatched in the market. This may likewise be partly attributed to the lower share of PSALM at 5 percent based on offered capacity and at 7 percent based on actual generation considering that one of PSALM’s plant Malaya TPP, which is a designated MRU<sup>11</sup>, do not offer its capacity in the market and do not regularly generate.

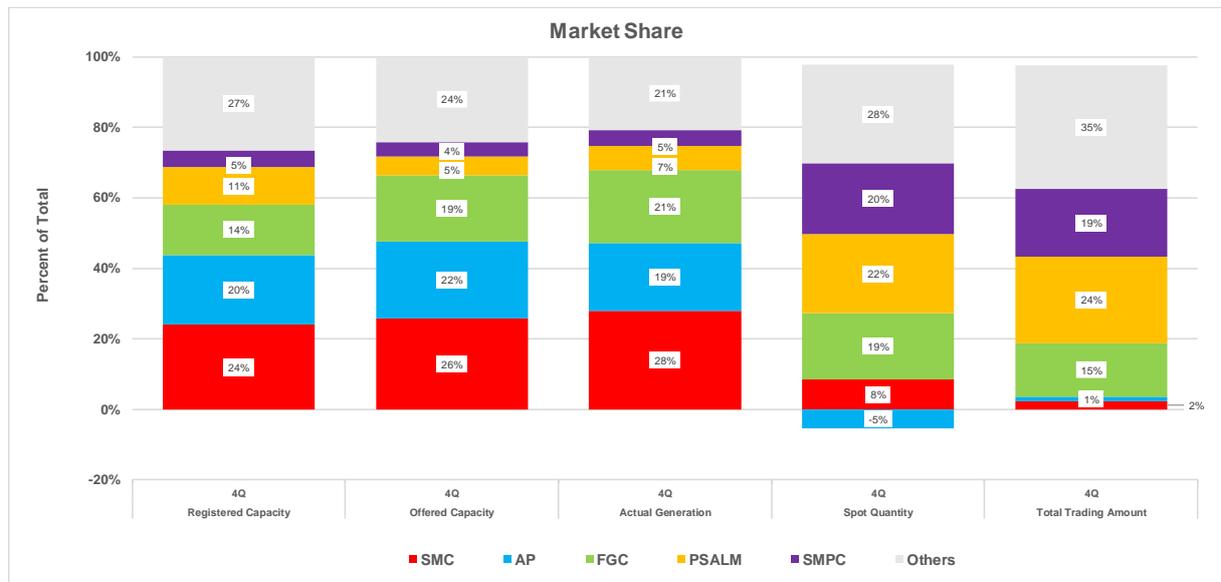
Lower market share based on spot quantity was recorded for SMC at 8 percent. Meanwhile, AP posted as a net buyer from the market resulting in a negative 5 percent share. On the other hand, PSALM and Semirara Mining Power Corporation (SMPC), observed higher market shares in spot quantities, at 22 percent and 20 percent respectively, demonstrating their high spot market exposure.

Correspondingly, PSALM held the highest Total Trading Amount (TTA)<sup>12</sup> share with at 24 percent. SMPC then followed with 19 percent and FGC with 15 percent. SMC and AP came next with only 2 percent and 1 percent, respectively.

<sup>11</sup> Per DOE Department Circular 2014-01-0003, designating the 650-MW Malaya Thermal Plant as a Must-Run Unit in the Wholesale Electricity Spot Market in cases of supply shortfall and to address system security

<sup>12</sup> Total Trading Amount (TTA) refers to the amount of revenue from spot market transactions excluding quantities that are declared by the generators as covered by bilateral power supply contracts, which are settled outside the WESM. Meanwhile, the TTA share of a major participant group is measured as a percentage of its TTA over the TTA of all participants during the period.

**Figure 27. Market Share by Major Participant Group based on Registered Capacity, Offered Capacity, Actual Generation, Spot Quantity, and Total Trading Amount, 4<sup>th</sup> Quarter of 2019**



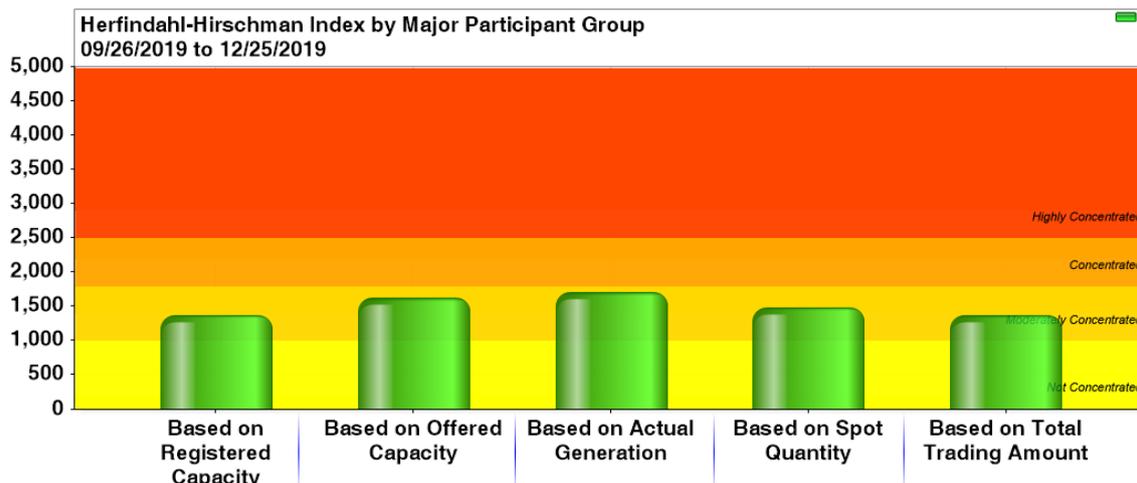
### b. Herfindahl-Hirschman Index (HHI)

The Herfindahl-Hirschman Index (HHI)<sup>13</sup> by major participant grouping indicated a moderately concentrated market during the fourth quarter of 2019 across all calculations – based on registered capacity, offered capacity, actual generation, spot quantity, and total trading amount.

It may be recalled that the HHI levels based on spot quantity and total trading amount was lower in the previous quarter. It was observed that the shares of FGC, PSALM, and SMPC grew this quarter, which drove HHI up, when the shares of SMC and AP declined following their high level of outage this quarter.

<sup>13</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.

**Figure 28. Hourly HHI based by Major Participant Grouping, 4<sup>th</sup> Quarter 2019**



**XV. Spot Exposure**

Spot market transaction of generator-trading participants during the quarter ranged from 13.5 percent in December to 14.6 percent in October of the total energy transaction in the WESM. Still, majority of the total energy injected into the grid was covered by bilateral contracts.

**Figure 29. Spot Market Exposure, 4<sup>th</sup> Quarter 2019**

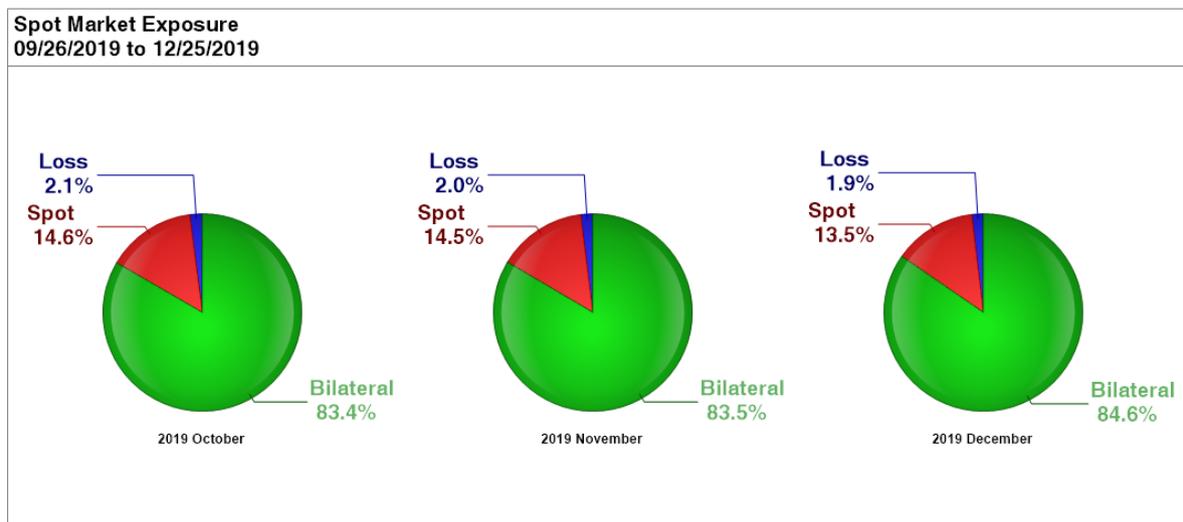
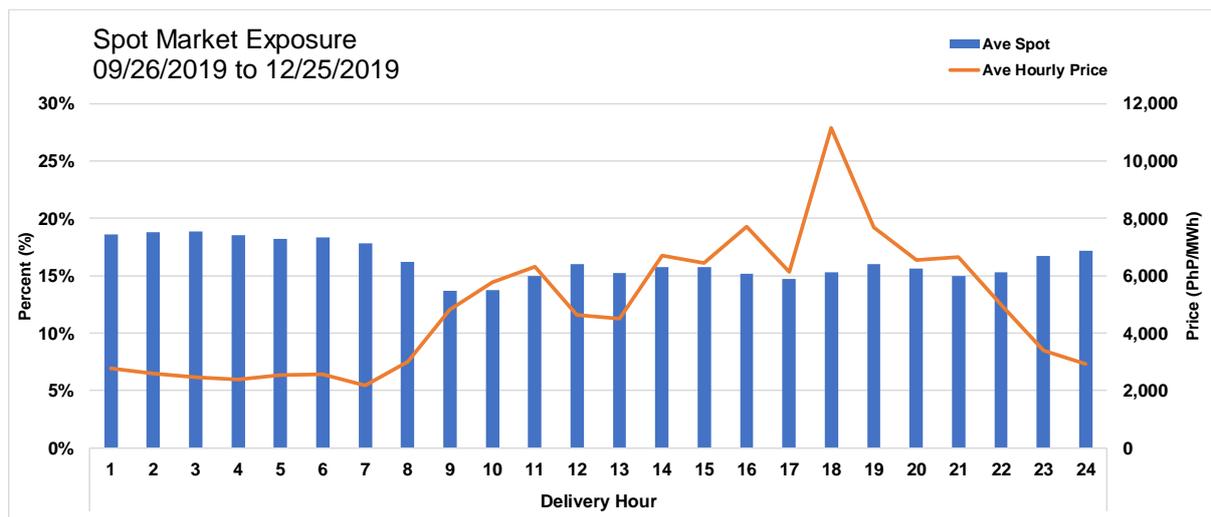


Figure 30 shows the hourly profile of the spot exposure plotted against average hourly price. Relatively higher average spot exposure was noted during the off-peak hours, particularly from 0100H-0700H and 2300H-2400H, than peak hours.

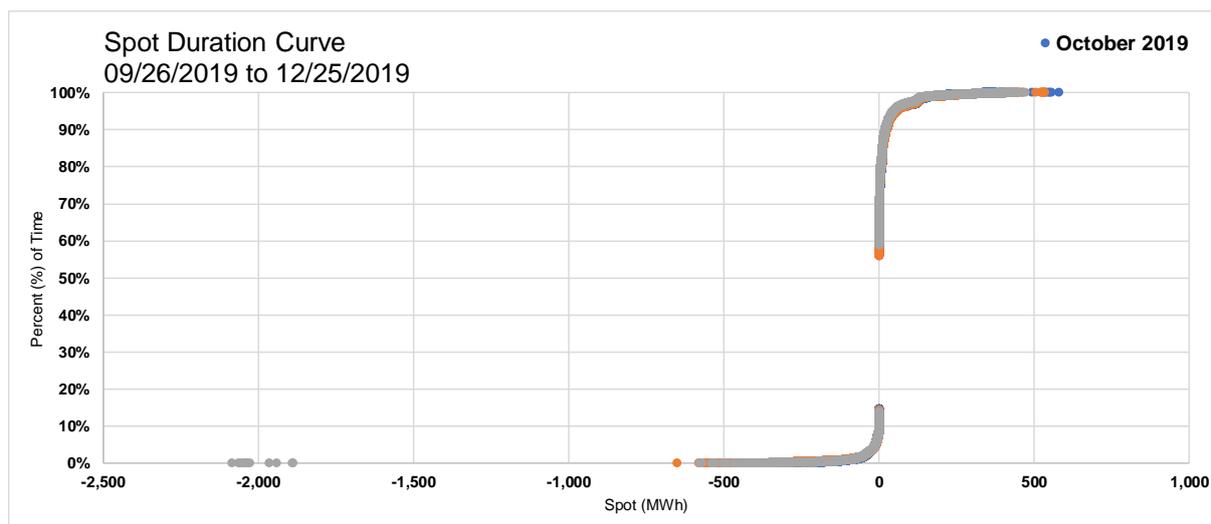
**Figure 30. Hourly Profile of Spot Market Exposure, 4<sup>th</sup> Quarter 2019**



As seen in the spot duration curve<sup>14</sup> below, about 90 percent of the spot quantities fell below 20 MWh consistently during the billing months in review.

Occurrences of spot quantities at around 2,000 MWh were noted in December following the over-declaration of bilateral contract quantity (BCQ) of a small-scale solar plant. On the average, a 278,765 percent deviation in the BCQ from the metered quantity was observed during these intervals. Based on IEMOP’s analysis of the incident, the system of the plant operator was not able to convert the value from kWh to MWh. Notwithstanding, the payables were offset with the receivable of the contracted party.

**Figure 31. Spot Duration Curve, 4<sup>th</sup> Quarter 2019**



<sup>14</sup> The spot duration curve utilizes data on a per generator trading interval, meaning, all the data consisted of spot quantities of every generator per interval for the period considered

## Appendix A. Major Plant Outages

Region	Plant Type	Plant/ Unit Name	Capacity (MW)	Date Out	Date In	Duration (Days)	Outage Type	Remarks	Date Commissioned/ Commercial Operation
LUZON	GEO	Makban 6	55	04/11/2013 22:44			Deactivated Shutdown	Conducted gas compressor test	Apr 1979
VISAYAS	GEO	PGPP2 Unit 4	20	06/27/2014 6:07			Forced Outage	Steam being utilized by Nasulo plant	Aug 1983
VISAYAS	GEO	Upper Mahiao 2	32	09/03/2018 6:01	12/13/2019 15:30	466.40	Forced Outage	Tripped	Jul 1997
LUZON	OIL	SLPGC 4	25	11/22/2018 11:56	12/11/2019 0:01	383.50	Maintenance Outage	On extended maintenance shutdown until 24 April 2019	Mar 2017
LUZON	GEO	Tiwi 1	59	11/29/2018 13:31	10/22/2019 10:31	326.88	Maintenance Outage	Maintenance Outage	Jan 1979
LUZON	GEO	Makban 5	55	02/08/2019 16:08			Forced Outage	Low Steam Supply. Divert Steam Supply to unit 3	Apr 1979
VISAYAS	OIL	PB102 Unit 1	6	04/28/2019 18:16			Forced Outage	Internal fault	Apr 1981
LUZON	OIL	Malaya 1	300	05/03/2019 18:21			Forced Outage	Declared unavailable due to motorization of unit generator caused by the non-opening of phase B of PCB 8-05CB08MAL	Aug 1975
LUZON	GEO	Makban 7	20	07/06/2019 6:12	10/03/2019 21:45	89.65	Maintenance Outage	Maintenance Outage	Apr 1979
VISAYAS	SOLR	San Carlos Sun	46.8	07/13/2019 6:24	10/25/2019 4:12	103.91	Forced Outage	Affected by maintenance of 138KV Bacolod-Cadiz TL and APMS of Cadiz 50MVA TR1 and 2 per PANR-VRCC-2019-06-0084	Mar 2016
LUZON	HYD	Kalayaan 3	180	08/01/2019 0:01	10/20/2019 23:56	81.00	Planned Outage	Planned Outage until 19 October 2019 (GOMP).	May 2004
LUZON	NATG	Avion 1	50.3	08/16/2019 0:01	10/23/2019 22:47	68.95	Forced Outage	Gas turbine trouble	Aug 2015
LUZON	NATG	Avion 2	50.3	08/16/2019 0:01			Forced Outage	Gas turbine trouble	Aug 2015
VISAYAS	GEO	Upper Mahiao 3	32	09/11/2019 9:11	10/04/2019 21:56	23.53	Maintenance Outage	To rectify Turbine bearing vibrations	Jul 1997
LUZON	COAL	Calaca 1	300	09/15/2019 11:53	09/29/2019 12:18	14.02	Forced Outage	Boiler tube leak	Sep 1984
LUZON	COAL	GN Power 1	316	09/20/2019 23:18	12/17/2019 11:14	87.50	Maintenance Outage	To facilitate correction of governor valves	May 2013
LUZON	NATG	Ilijan A2	190	09/21/2019 0:36	10/09/2019 18:39	18.75	Planned Outage	Maintenance Outage until 19 October 2019	Jun 2002
VISAYAS	COAL	Keppo Salcon 1	103	09/22/2019 0:57	10/10/2019 3:45	18.12	Planned Outage	APMS	Nov 2010
LUZON	NATG	Ilijan A1	190	09/23/2019 0:46	10/08/2019 16:10	15.64	Planned Outage	Maintenance Outage until 06 October 2019	Jun 2002
LUZON	NATG	Ilijan A3	220	09/24/2019 0:35	10/08/2019 22:15	14.90	Planned Outage	Maintenance Outage	Jun 2002
LUZON	COAL	Masinloc 3	335	09/24/2019 19:35	10/01/2019 9:52	6.60	Forced Outage	Steam leak at Main Steam Line	Mar 2019
LUZON	COAL	SBPL	455	09/26/2019 11:49	09/26/2019 19:01	0.30	Forced Outage	Tripped due to main transformer trouble (sudden pressure relief trip). On commissioning Test	Apr 2019
VISAYAS	BIOF	URC 1	40	09/28/2019 23:19	09/29/2019 16:13	2.70	Forced Outage	Offline due to boiler problem	Dec 2014
LUZON	COAL	GN Power 2	316	09/27/2019 22:15	09/28/2019 7:07	0.37	Forced Outage	Initial report from plant - main fuel trip	May 2013
LUZON	COAL	Calaca 1	300	10/01/2019 15:36	10/02/2019 4:42	0.55	Forced Outage	Tripped at 230MW load	Sep 1984
VISAYAS	COAL	TPC Sangi 1	60	10/02/2019 17:24	10/08/2019 14:25	5.88	Forced Outage	Affected by tripping of 138kv Colon - Toledo Calungcang Line	Dec 2013
VISAYAS	COAL	TPC Sangi 2	85	10/02/2019 17:24	10/03/2019 2:09	0.36	Forced Outage	Affected by tripping of 138kv Colon - Toledo -Calungcang Line	Dec 2013
VISAYAS	COAL	TPC Sangi 2	85	10/03/2019 9:44	10/06/2019 5:08	2.81	Forced Outage	Emergency Cut-out due to Furnace Temperature Low	Dec 2013
LUZON	COAL	SLPGC 2	150	10/03/2019 15:02	10/13/2019 15:07	10.00	Forced Outage	Unplanned outage due to boiler tube leak	Jan 2015
LUZON	COAL	ANDA 1	72	10/03/2019 17:35	10/03/2019 20:59	0.14	Forced Outage	Affected by the multiple tripping of 69kV feeders at Mexico Substation.(RECLASSIFIED FROM FORCE_OMC OUTAGE)	Apr 2015
LUZON	COAL	APEC 1	52	10/03/2019 17:35	10/04/2019 0:09	0.27	Forced Outage	Affected by the multiple tripping of 69kV feeders at Mexico Substation	Jul 2006
LUZON	COAL	Masinloc 3	335	10/04/2019 4:13	10/04/2019 20:24	0.67	Forced Outage	Tripped at 335MW load. Turbine tripped indication. On Commissioning Test	Mar 2019
VISAYAS	GEO	PGPP1 Unit 1	37.5	10/04/2019 12:41	12/22/2019 0:06	78.48	Forced Outage	Auto-tripped. ongoing investigation on cause of tripping	Aug 1983
VISAYAS	COAL	CEDC 3	82	10/04/2019 21:46	10/04/2019 23:12	0.06	Forced Outage	Affected by Tripping of 138KV Colon - Calungcang Line 1 and 2	Jan 2011
VISAYAS	GEO	Upper Mahiao 4	32	10/04/2019 21:46	12/02/2019 17:19	58.81	Forced Outage	Affected by tripping of 138KV Colon-Calungcang Line 1 and 2	Jul 1987
LUZON	COAL	SMC 1	150	10/04/2019 22:33	10/05/2019 20:03	0.90	Forced Outage	Coal feeder replacement	Nov 2016
LUZON	OIL	Lamay 7	60	10/05/2019 0:01	10/11/2019 10:38	6.44	Planned Outage	Maintenance Outage until 11 October 2019	Dec 1984
LUZON	NATG	Sta. Rita 4	264	10/05/2019 2:36	10/07/2019 21:26	2.78	Maintenance Outage	Maintenance Outage until 07 October 2019	Oct 2001
LUZON	COAL	Sual 1	647	10/06/2019 20:22	10/07/2019 15:03	0.78	Forced Outage	Turbine External Trip	Oct 1999
LUZON	COAL	Sual 1	647	10/07/2019 16:42	10/08/2019 14:06	0.89	Forced Outage	Condenser tube leak	Oct 1999
LUZON	COAL	Masinloc 3	335	10/07/2019 17:01	10/08/2019 11:45	0.78	Forced Outage	Excessive leak at economizer inlet pipe	Mar 2019
VISAYAS	GEO	Mahanagdong B	5	10/08/2019 10:54	10/13/2019 1:59	4.63	Forced Outage	Condenser level high	Jul 1997
LUZON	NATG	Ilijan A1	190	10/08/2019 16:36	10/08/2019 18:09	0.06	Forced Outage	Tripped at 16MW load	Jun 2002
VISAYAS	OIL	PB102 Unit 4	6	10/08/2019 19:40	10/29/2019 20:52	21.05	Forced Outage	Internal trouble	Apr 1981
LUZON	COAL	Calaca 1	300	10/09/2019 16:42	10/09/2019 23:02	0.26	Forced Outage	Excitation system trouble	Sep 1984
LUZON	NATG	Sta. Rita 1	257.3	10/10/2019 4:40	10/11/2019 1:27	0.87	Maintenance Outage	Maintenance Outage	Jun 2000
LUZON	COAL	Masinloc 3	335	10/10/2019 8:49	10/11/2019 5:34	0.86	Forced Outage	Unit on commissioning test	Mar 2019
LUZON	COAL	Sual 1	647	10/11/2019 8:37	10/18/2019 2:46	6.76	Forced Outage	Condenser tube leak	Oct 1999
VISAYAS	OIL	Bohol 3	4.2	10/11/2019 19:26	10/16/2019 19:13	4.99	Forced Outage	Emergency out due to fuel oil leak	Sep 1978
LUZON	NATG	Ilijan B2	190	10/11/2019 22:24	10/16/2019 12:02	4.57	Planned Outage	SPEX-Malampaya on Planned Outage until 12 Oct. 2019.(RECLASSIFIED FROM FORCE_OMC OUTAGE)(RECLASSIFIED FROM FORCE_OMC OUTAGE)	Jun 2002
LUZON	NATG	Ilijan B3	220	10/11/2019 22:38	10/16/2019 19:57	4.89	Planned Outage	SPEX-Malampaya on Planned Outage until 15 Oct. 2019.(RECLASSIFIED FROM FORCE_OMC OUTAGE)(RECLASSIFIED FROM FORCE_OMC OUTAGE)	Jun 2002
LUZON	NATG	Sta. Rita 2	255.7	10/11/2019 22:38	10/12/2019 0:27	0.08	Forced Outage	Tripped at 115MW load. On Fuel change-over	Jun 2000
LUZON	NATG	Ilijan B1	190	10/11/2019 22:50	10/16/2019 18:28	4.82	Planned Outage	SPEX-Malampaya on Planned Outage until 15 Oct. 2019.(RECLASSIFIED FROM FORCE_OMC OUTAGE)(RECLASSIFIED FROM FORCE_OMC OUTAGE)	Jun 2002
LUZON	NATG	Ilijan A1	190	10/11/2019 23:27	10/16/2019 0:41	4.05	Planned Outage	SPEX-Malampaya on Planned Outage until 15 Oct. 2019.(RECLASSIFIED FROM FORCE_OMC OUTAGE)(RECLASSIFIED FROM FORCE_OMC OUTAGE)	Jun 2002
LUZON	NATG	Sta. Rita 3	265.5	10/11/2019 23:34	10/12/2019 19:25	0.83	Forced Outage	Tripped at 226MW load. On Fuel change-over.	Oct 2001
LUZON	NATG	Ilijan A3	220	10/11/2019 23:45	10/16/2019 3:25	4.15	Planned Outage	SPEX-Malampaya on Planned Outage until 15 Oct. 2019.(RECLASSIFIED FROM FORCE_OMC OUTAGE)	Jun 2002
LUZON	NATG	Ilijan A2	190	10/11/2019 23:54	10/16/2019 4:25	4.19	Planned Outage	SPEX-Malampaya on Planned Outage until 15 Oct. 2019.(RECLASSIFIED FROM FORCE_OMC OUTAGE)	Jun 2002
LUZON	NATG	San Gabriel	420	10/11/2019 23:55	10/16/2019 0:02	4.00	Planned Outage	SPEX-Malampaya on Planned Outage until 15 Oct. 2019.(RECLASSIFIED FROM FORCE_OMC OUTAGE)	Mar 2016
LUZON	NATG	Sta. Rita 1	257.3	10/12/2019 14:17	10/12/2019 18:30	0.18	Forced Outage	Cleaning of clogged fuel oil filter	Jun 2000
VISAYAS	GEO	Mahanagdong B	5	10/13/2019 13:10	10/18/2019 0:27	4.47	Forced Outage	Cut in back at 1310H	Jul 1997
VISAYAS	OIL	PDPP3 H	13	10/14/2019 19:01	10/17/2019 17:18	2.93	Forced Outage	Internal trouble	Mar 2005
LUZON	NATG	Sta. Rita 3	265.5	10/15/2019 0:48	10/15/2019 4:25	0.15	Forced Outage	To facilitate cleaning of Suction filter for fuel oil injection pump	Oct 2001
LUZON	COAL	Masinloc 3	335	10/15/2019 5:59	10/15/2019 10:01	0.17	Forced Outage	Tripped due to high thrust bearing temperature. ALD occurred at Meralco and NGCP feeders. Lowest frequency is 59.09Hz	Mar 2019
LUZON	NATG	Ilijan A1	190	10/16/2019 0:41	10/16/2019 2:03	0.06	Forced Outage	Turbine tripped	Jun 2002
LUZON	NATG	Ilijan B2	190	10/16/2019 12:06	10/16/2019 13:52	0.07	Forced Outage	GT Blade hot temperature (high).	Jun 2002
LUZON	NATG	Ilijan B2	190	10/16/2019 15:54	10/16/2019 21:06	0.22	Forced Outage	Tripped at 50MW load.	Jun 2002
LUZON	NATG	Ilijan A1	190	10/16/2019 17:07	10/16/2019 18:30	0.06	Forced Outage	Tripped at 97MW load.	Jun 2002
VISAYAS	COAL	TPC Sangi 1	60	10/17/2019 22:15	10/26/2019 15:01	8.70	Forced Outage	Boiler tube leak	Dec 2013
LUZON	COAL	Calaca 2	300	10/17/2019 23:49			Planned Outage	Maintenance Outage until 02 March 2020	Sep 1984
LUZON	NATG	Sta. Rita 4	264	10/19/2019 0:42	10/19/2019 19:25	0.78	Maintenance Outage	Maintenance Outage until 20 Oct 2019	Oct 2001
VISAYAS	OIL	PB101 Unit 1	6	10/19/2019 18:54	10/21/2019 19:26	2.02	Forced Outage	Affected by line tripping	Jan 1978
VISAYAS	OIL	PB101 Unit 2	6	10/19/2019 18:54	10/22/2019 16:22	2.89	Forced Outage	Affected by line tripping	Jan 1978
VISAYAS	OIL	PB102 Unit 2	6	10/19/2019 18:54	10/22/2019 16:31	2.90	Forced Outage	Affected by line tripping	Apr 1981
VISAYAS	OIL	PB102 Unit 3	6	10/19/2019 18:54	10/22/2019 16:26	2.90	Forced Outage	Affected by line tripping	Apr 1981
LUZON	COAL	Sual 2	647	10/20/2019 23:48	11/14/2019 18:08	24.76	Planned Outage	Maintenance Outage until 11.17.2019 (2400H)	Oct 1999
LUZON	HYD	Kalayaan 1	180	10/21/2019 0:01	10/25/2019 19:13	4.80	Maintenance Outage	Maintenance Outage until 25 October 2019	Aug 1982
LUZON	GEO	Makban 1	63	10/21/2019 13:56	12/04/2019 6:03	43.67	Planned Outage	Annual Overhauling	Apr 1979
VISAYAS	BIOF	FFHC	13	10/21/2019 14:05	10/23/2019 15:01	2.04	Maintenance Outage	Offline due to weekly maintenance	Feb 2009
LUZON	HYD	Manis 1	3.8	10/21/2019 14:40	10/28/2019 16:50	7.09	Maintenance Outage	Maintenance outage-non GOP	Oct 2017
LUZON	HYD	Manis 2	3.8	10/21/2019 14:54	10/31/2019 10:52	9.83	Maintenance Outage	Maintenance outage-non GOP	Oct 2017
VISAYAS	GEO	Mahanagdong B	5	10/21/2019 21:14	10/29/2019 20:37	7.97	Forced Outage	To correct AVR problem	Jul 1997
LUZON	GEO	Tiwi 2	59	10/22/2019 10:32	10/31/2019 23:53	9.56	Planned Outage	To give way to the shutdown of PCBs 81TW8.124	Jan 1979
LUZON	COAL	SLTEC 1	121	10/23/2019 18:25	11/01/2019 2:15	8.31	Forced Outage	Boiler tube leak	Sep 2014
LUZON	COAL	SMC 3	150	10/26/2019 4:38	10/26/2019 18:25	0.57	Forced Outage	Feed water control pump leak	Nov 2017
VISAYAS	COAL	TPC Sangi 2	85	10/26/2019 6:47	10/26/2019 14:47	0.33	Forced Outage	TRIPPING OF STATION SERVICE TRANSFORMER	Dec 2013
VISAYAS	COAL	TPC Sangi 1	60	10/26/2019 15:01	11/09/2019 15:32	14.02	Forced Outage	BOILER 7 TG5 EMERGENCY CUT-OUT DUE TO HIGH VIBRATION OF BEARING NO. 2	Dec 2013
LUZON	COAL	SMC 1	150	10/28/2019 6:08	10/28/2019 20:06	0.58	Forced Outage	Tripped with 150MW load	Nov 2016
LUZON	COAL	SMC 2	150	10/28/2019 6:08	10/28/2019 19:02	0.54	Forced Outage	Tripped with 90MW load	Mar 2017
LUZON	NATG	Sta. Rita 2	255.7	10/29/2019 11:39	10/29/2019 13:18	0.07	Forced Outage	Tripped due to GT Enclosure High Temperature	Jun 2000
VISAYAS	COAL	PALM 1	135	10/29/2019 17:27	11/02/2019 11:01	3.73	Forced Outage	under investigation	Mar 2016
VISAYAS	COAL	PEDC 1	83.7	10/29/2019 17:27	11/04/2019 5				

## Appendix A. Major Plant Outages

Region	Plant Type	Plant/ Unit Name	Capacity (MW)	Date Out	Date In	Duration (Days)	Outage Type	Remarks	Date Commissioned/ Commercial Operation
LUZON	OIL	BPPC 3	70	11/01/2019 6:24	11/04/2019 22:01	3.65	Maintenance Outage	Maintenance Outage until 04 November 2019	Aug 1994
VISAYAS	COAL	CEDC 1	82	11/02/2019 0:33	11/02/2019 21:58	0.89	Forced Outage	To conduct repair of steam drum leak	Apr 2010
VISAYAS	BIOF	FFHC	13	11/02/2019 1:11	11/05/2019 5:10	3.17	Maintenance Outage	Offline due to weekly maintenance	Feb 2009
VISAYAS	BIOF	HPCO	3	11/02/2019 7:15	11/04/2019 15:02	2.33	Maintenance Outage	Offline for weekly maintenance	Jan 2015
VISAYAS	BIOF	URC 1	40	11/02/2019 7:31	11/05/2019 1:52	2.76	Maintenance Outage	Offline for weekly maintenance	Dec 2014
LUZON	COAL	Sual 1	647	11/03/2019 6:34	11/04/2019 19:33	1.54	Forced Outage	Tripped with 542MW load.(RECLASSIFIED FROM FORCE. OMC OUTAGE)	Oct 1999
LUZON	NATG	Ilijan B2	190	11/04/2019 9:44	11/04/2019 11:44	0.08	Forced Outage	Tripped with 190MW load	Jun 2002
VISAYAS	GEO	Mahanagdong A	5	11/05/2019 5:07	12/03/2019 1:19	27.84	Forced Outage	To facilitate replacement of exciter busted diode. ETD-- 07 Nov 2019 at 0500H.	Jul 1997
VISAYAS	COAL	Keppo Salcon 2	103	11/07/2019 1:21	11/25/2019 8:28	18.30	Planned Outage	UNIT CUT-OUT FOR ANNUAL PMS	Mar 2011
VISAYAS	GEO	Upper Mahiao 1	32	11/07/2019 15:24	12/03/2019 0:09	25.36	Forced Outage	Ground fault.	Jul 1997
VISAYAS	GEO	Leyte 1	41	11/07/2019 19:52	11/30/2019 10:21	22.60	Forced Outage	Lube oil trip. block pressure low.	Jun 1983
LUZON	COAL	Sual 1	647	11/08/2019 18:52	11/10/2019 9:21	1.60	Forced Outage	Emergency Shutdown due to Boiler Tube Leak	Oct 1999
LUZON	COAL	SMC 3	150	11/08/2019 19:38	11/16/2019 13:48	7.76	Forced Outage	Emergency Shutdown due to Boiler Tube Leak	Nov 2017
LUZON	OIL	Limay 2	60	11/09/2019 0:05			Planned Outage	Planned Outage	May 1993
LUZON	NATG	Sta. Rita 4	264	11/10/2019 13:15	11/10/2019 16:34	0.14	Forced Outage	Tripped at 112MW load	Oct 2001
LUZON	COAL	SLTEC 2	122.9	11/11/2019 10:02	11/17/2019 23:39	6.38	Forced Outage	Boiler tube leak.	Aug 2015
LUZON	NATG	Ilijan A3	220	11/11/2019 12:14	11/11/2019 13:28	0.05	Forced Outage	Tripped with 154MW load.	Jun 2002
LUZON	COAL	SBPL	455	11/11/2019 23:14	11/13/2019 20:11	1.87	Forced Outage	Pressure Relief Device protection activation of Unit Transformer	Apr 2019
LUZON	HYD	Kalayaan 2	180	11/12/2019 0:01	11/16/2019 19:39	4.82	Planned Outage	Planned Outage until 17 November 2019	Aug 1982
LUZON	COAL	SBPL	455	11/14/2019 10:52	11/14/2019 16:12	0.22	Forced Outage	Tripping of Primary Air and Forced Draft Fan	Apr 2019
LUZON	NATG	Sta. Rita 1	257.3	11/14/2019 18:22	11/16/2019 16:28	1.92	Forced Outage	Tripped while on the process of fuel changeover due to combustion chamber trouble	Jun 2000
VISAYAS	GEO	Upper Mahiao 3	32	11/15/2019 0:31	11/29/2019 7:54	14.31	Maintenance Outage	Corrective maintenance for turbine bearing high vibration scheduled until Nov. 18	Jul 1997
LUZON	COAL	Sual 2	647	11/15/2019 7:50	11/19/2019 17:42	4.41	Forced Outage	Boiler Tube Leak	Oct 1999
LUZON	COAL	Pagbilao 3	420	11/16/2019 0:59	12/25/2019 2:03	39.04	Planned Outage	Planned Outage (GOP).	Jul 2017
LUZON	NATG	Sta. Rita 1	257.3	11/16/2019 17:28	11/16/2019 19:07	0.07	Forced Outage	Tripped due to GT High Temperature	Jun 2000
LUZON	COAL	SLTEC 2	122.9	11/18/2019 0:01			Planned Outage	Planned Outage until 22 December 2019 (GOP).	Aug 2015
LUZON	OIL	Limay 4	90	11/18/2019 0:01			Planned Outage	Maintenance Outage until 18 December 2019	May 1993
VISAYAS	GEO	PGPP1 Unit 3	37.5	11/18/2019 1:21	11/24/2019 17:49	6.69	Forced Outage	Auto-tripped with indication-- Overspeed. Affected by earthquake	Aug 1983
LUZON	GEO	Tiwi 6	57	11/18/2019 6:08	11/28/2019 0:17	9.76	Maintenance Outage	Maintenance Outage(APRI requested) until 25 November 2019.	Jan 1979
LUZON	HYD	Kalayaan 3	180	11/19/2019 0:01	12/08/2019 4:02	19.17	Planned Outage	Planned Outage until 05 December 2019	May 2004
LUZON	HYD	Kalayaan 4	180	11/19/2019 0:01	12/10/2019 1:12	21.05	Planned Outage	Planned Outage until 10 December 2019	May 2004
VISAYAS	GEO	Mahanagdong B	5	11/19/2019 10:41			Forced Outage	Due to condenser level high.	Jul 1997
LUZON	BIOF	IBEC	18.3	11/20/2019 11:03	11/23/2019 0:02	2.54	Forced Outage	Travelling grate trouble	Jul 2015
LUZON	COAL	ANDA 1	72	11/21/2019 7:15	11/21/2019 9:01	0.07	Forced Outage	Main stop valve trouble	Apr 2015
LUZON	COAL	Sual 2	647	11/22/2019 16:40	11/22/2019 18:53	0.09	Forced Outage	Tripping of Boiler feed pump C.	Oct 1999
LUZON	COAL	Sual 1	647	11/23/2019 7:45	11/27/2019 19:20	24.48	Planned Outage	Planned Outage	Oct 1999
LUZON	COAL	QPPL	460	11/24/2019 16:51	11/29/2019 7:48	4.62	Forced Outage	Inlet Valve trouble of Forced Draft Fan(DFD)-A and High Furnace Pressure.	May 2000
LUZON	COAL	SBPL	455	11/25/2019 14:28	11/27/2019 0:48	1.43	Forced Outage	Induced Draft Fan (IDF) hydraulic leak trouble.	Apr 2019
VISAYAS	COAL	TPC Sangi 1	60	11/26/2019 3:18	12/17/2019 1:39	20.93	Forced Outage	Tube leak	Dec 2013
VISAYAS	BIOF	URC 1	40	11/26/2019 21:13	12/02/2019 3:25	5.26	Forced Outage	Emergency isolation due to Boiler trouble	Dec 2014
LUZON	COAL	SBPL	455	11/27/2019 3:25	12/01/2019 6:39	4.13	Forced Outage	Emergency shutdown due to IDP blade pitch regulator trouble	Apr 2019
LUZON	COAL	QPPL	460	11/29/2019 20:11	12/02/2019 3:57	2.32	Forced Outage	Primary air duct problem.	May 2000
LUZON	GEO	Bacman 1	60	12/02/2019 9:13	12/17/2019 0:17	14.63	Forced Outage	Due to Typhoon Tisoy	Sep 1993
LUZON	GEO	Bacman 3	20	12/02/2019 10:11	12/16/2019 15:55	14.24	Forced Outage	Due to Typhoon Tisoy	
LUZON	GEO	Bacman 2	60	12/02/2019 10:13	12/16/2019 10:24	14.01	Forced Outage	Due to Typhoon Tisoy	Sep 1993
LUZON	GEO	Tiwi 6	57	12/02/2019 10:28	12/16/2019 16:46	14.26	Forced Outage	Due to typhoon Tisoy	Jan 1979
LUZON	GEO	Tiwi 2	58	12/02/2019 10:35	12/16/2019 18:29	14.33	Forced Outage	Due to typhoon Tisoy	Jan 1979
LUZON	GEO	Tiwi 5	57	12/02/2019 11:45	12/16/2019 8:51	13.88	Forced Outage	On house load operation due to typhoon Tisoy	Jan 1979
LUZON	NATG	San Gabriel	420	12/02/2019 11:48	12/03/2019 21:07	1.39	Forced Outage	due to Natural Gas Fuel Supply Restriction from SPEX Malampaya Onshore Gas Plant	Mar 2016
VISAYAS	GEO	Upper Mahiao 3	32	12/02/2019 17:19	12/05/2019 0:07	2.28	Forced Outage	Affected by the auto-blocking of 350kV HVDC	Jul 1997
LUZON	COAL	Masinloc 2	344	12/02/2019 18:20	12/02/2019 20:07	0.07	Forced Outage	Tripped due to main ignitor and burner gun	Jun 1998
LUZON	NATG	Ilijan A1	190	12/02/2019 20:20	12/05/2019 3:25	2.30	Forced Outage	Preventive measure for the passage of Typhoon TISOY.	Jun 2002
LUZON	COAL	Masinloc 2	344	12/02/2019 23:08	12/03/2019 1:52	0.11	Forced Outage	Tripped with 68MW load.	Jun 1998
VISAYAS	GEO	Upper Mahiao 1	32	12/03/2019 0:09	12/05/2019 7:50	2.32	Forced Outage	Affected by the auto-blocking of 350kV HVDC.	Jul 1997
VISAYAS	GEO	Mahanagdong A	5	12/03/2019 1:19	12/05/2019 7:50	2.27	Forced Outage	Affected by the auto-blocking of 350kV HVDC.	Jul 1997
LUZON	COAL	Masinloc 2	344	12/03/2019 2:28	12/03/2019 7:31	0.21	Forced Outage	Tripped by re-heater protection	Jun 1998
LUZON	NATG	Ilijan B2	190	12/03/2019 8:20	12/05/2019 8:28	2.01	Forced Outage	Ilijan NGPP precautionary measure due to passage of Typhoon TISOY.	Jun 2002
LUZON	GEO	Makban 7	20	12/03/2019 8:45	12/05/2019 10:02	2.05	Forced Outage	Plant decision as precautionary measures for the passage of Typhoon Tisoy.	Apr 1979
LUZON	GEO	Makban 8	20	12/03/2019 8:45	12/05/2019 12:29	2.16	Forced Outage	Plant decision as precautionary measures for the passage of Typhoon Tisoy.	Apr 1979
LUZON	NATG	Sta. Rita 1	257.3	12/03/2019 9:46	12/03/2019 14:55	0.21	Forced Outage	Plant decision as precautionary measures for the passage of Typhoon Tisoy	Jun 2000
LUZON	NATG	Ilijan B3	220	12/03/2019 14:35	12/05/2019 10:01	1.81	Forced Outage	Ilijan NGPP precautionary measure due to passage of Typhoon TISOY.	Jun 2002
LUZON	NATG	Ilijan B1	190	12/03/2019 14:47	12/05/2019 12:26	1.90	Forced Outage	Ilijan NGPP precautionary measure due to passage of Typhoon TISOY.	Jun 2002
LUZON	NATG	Ilijan A3	220	12/03/2019 14:58	12/05/2019 1:27	1.44	Forced Outage	Ilijan NGPP precautionary measure due to passage of Typhoon TISOY.	Jun 2002
LUZON	NATG	Ilijan A2	190	12/03/2019 15:10	12/04/2019 23:46	1.36	Forced Outage	Ilijan NGPP precautionary measure due to passage of Typhoon TISOY.(RECLASSIFIED FROM FORCE. OMC OUTAGE)	Jun 2002
LUZON	COAL	SBPL	455	12/03/2019 16:42	12/03/2019 21:07	0.18	Forced Outage	Due to arching at 230kV Breaker affected by the passage of Typhoon Tisoy	Apr 2019
VISAYAS	OIL	Bohol 3	4.2	12/03/2019 17:34	12/06/2019 22:08	3.19	Forced Outage	Emergency shutdown. surging turbo charger at A-bank.	Sep 1978
LUZON	NATG	Sta. Rita 1	257.3	12/03/2019 21:25	12/04/2019 0:38	0.13	Forced Outage	Tripped at 180MW load while on change-over from oil to gas	Jun 2000
VISAYAS	GEO	Upper Mahiao 3	32	12/05/2019 0:07			Forced Outage	Emergency shutdown requested by customer to facilitate rotor transfer to Unit 2.	Jul 1997
VISAYAS	GEO	Upper Mahiao 4	32	12/05/2019 3:45	12/25/2019 13:01	20.39	Forced Outage	Loss of 125 DC supply in the control valve	Jul 1997
LUZON	NATG	Ilijan B2	190	12/05/2019 14:48	12/06/2019 18:25	1.15	Forced Outage	Lube oil high temperature	Jun 2002
LUZON	COAL	SMC 2	150	12/06/2019 2:15			Planned Outage	Planned Outage until 20 December 2019.(GOP)	Mar 2017
LUZON	COAL	Calaca 1	300	12/06/2019 17:01	12/22/2019 22:07	16.21	Forced Outage	Emergency shutdown due to boiler tube leak	Sep 1984
LUZON	NATG	Ilijan B2	190	12/06/2019 18:38	12/06/2019 20:23	0.07	Forced Outage	Combustor cooling low differential pressure	Jun 2002
LUZON	COAL	Masinloc 3	335	12/07/2019 2:31	12/09/2019 7:20	2.20	Planned Outage	On Commissioning Test	Mar 2019
LUZON	GEO	Makban 7	20	12/07/2019 21:33			Forced Outage	High Turbine Bearing vibration.	Apr 1979
LUZON	COAL	ANDA 1	72	12/09/2019 5:30	12/09/2019 6:34	0.04	Forced Outage	Tripped	Apr 2015
LUZON	COAL	Masinloc 2	344	12/09/2019 23:43	12/12/2019 18:11	2.77	Forced Outage	Boiler Tube Leak	Jun 1998
LUZON	GEO	Makban 8	20	12/10/2019 18:10			Maintenance Outage	Maintenance outage.	Apr 1979
VISAYAS	SOLR	San Carlos 1	19.8	12/11/2019 14:34			Forced Outage	Emergency offline due to burnt 69kV PCB.	May 2014
LUZON	OIL	SLPGC 3	25	12/11/2019 23:00			Maintenance Outage	Maintenance outage until December 27 2019	Mar 2017
LUZON	OIL	SLPGC 4	25	12/11/2019 23:53			Maintenance Outage	Maintenance outage until December 27 2019	Mar 2017
LUZON	COAL	Masinloc 3	335	12/12/2019 20:46	12/16/2019 9:11	3.52	Forced Outage	Steam leak at main steam header line.	Mar 2019
LUZON	OIL	Malaya 2	350	12/13/2019 0:01			Maintenance Outage	Maintenance outage until 31 December 2019	Apr 1979
LUZON	COAL	SLPGC 1	150	12/13/2019 9:04			Planned Outage	Maintenance Outage	Jan 2015
VISAYAS	OIL	PB102 Unit 4	6	12/13/2019 17:59	12/16/2019 17:18	2.97	Forced Outage	Offline due to Voltage problem.	Apr 1981
LUZON	NATG	San Lorenzo 2	261.8	12/14/2019 4:34	12/16/2019 10:40	2.25	Planned Outage	Maintenance Outage	Sep 2002
LUZON	COAL	Sual 2	647	12/15/2019 8:57	12/19/2019 20:25	4.48	Forced Outage	Boiler Tube Leak.	Oct 1999
VISAYAS	OIL	PB102 Unit 4	6	12/16/2019 17:51			Forced Outage	High exhaust gas temperature	Apr 1981
VISAYAS	COAL	TPC Sangi 1	60	12/17/2019 6:05			Forced Outage	Generator differential trip	Dec 2013
LUZON	COAL	Sual 1	647	12/17/2019 19:40	12/22/2019 15:49	4.84	Forced Outage	Tripped due to turbine shaft axial displacement problem	Oct 1999
LUZON	COAL	Masinloc 1	315	12/19/2019 23:53			Maintenance Outage	Maintenance outage until December 24 2019	Jun 1998
LUZON	NATG	Sta. Rita 2	255.7	12/20/2019 0:29	12/22/2019 21:02	2.86	Maintenance Outage	Maintenance outage until December 22 2019	Jun 2000
LUZON	OIL	Limay 1	60	12/20/2019 2:14	12/23/2019 19:53	3.74	Forced Outage	Tripped at 51 MW load. High temperature thrust bearing	May 1993
LUZON	COAL	GN Power 1	316	12/20/2019 10:53	12/23/2019 18:52	3.33	Forced Outage	Condenser tube leak	May 2013

## Appendix B. Methodology in Determining Interesting Pricing Events

### 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).