MAG-AMAR-2018

ANNUAL MARKET ASSESSMENT REPORT

For the Billing Period 26 December 2017 to 25 December 2018

PHILIPPINE ELECTRICITY MARKET CORPORATION

MARKET ASSESSMENT GROUP (MAG)

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EXECUTIVE SUMMARY

This Annual Market Assessment Report (AMAR) provides an assessment of results of the integrated Luzon and Visayas operations of the Wholesale Electricity Spot Market (WESM) for the period 26 December 2017 to 25 December 2018.

A minimal growth in the WESM registered capacity was observed in 2018 despite the entry of new power plants and increase in existing capacities. The slump in growth was further attributed to the deregistration of some power plants and decrease in existing capacities. This resulted in a decline in the annual rate of increase in registered capacity by the end of 2018, sliding to its slowest level at a 0.74 year-on-year gain in over five years. At the close of the billing year, the total WESM registered capacity only climbed to 18,902 MW, narrowly higher than last year's 18,764 MW.

Capacity offered by scheduled generators comprised about 66 percent of the total registered capacity or 12,394 MW while around 2 percent or 390 MW was nominated by must-dispatch, priority dispatch and non-scheduled generators. The other 3 percent were on account of capacity related to the conduct of testing and commissioning of plants which have yet to start commercial operations (258 MW) and capacity of Malaya TPP as Must Run Unit (418 MW). Outage capacity and capacity not nominated by must-dispatch, priority-dispatch and non-scheduled generators accounted for 6 percent or an average of 1,107 MW.

On the other hand, the level of outage capacity of scheduled generators remained high at 2,252 MW, accounting for 12 percent by the end of 2018.Coal plants comprised the bulk of outage capacity at 46 percent or 1,034 MW followed by oil-based plants at 19 percent or 424 MW.

Capacity not offered by scheduled generators, indicated by the high level of capacity gap, accounted for the remaining 2,197 MW or 12 percent of the total registered capacity in 2018. Overall, coal plants topped the year's share in capacity gap, comprising majority or about 37 percent at an average of 862 MW. In the previous years, hydro plants have continuously accounted for majority of the capacity gap however, during the billing year, it came second after coal plants as it recorded about 34 percent or an average of 786 MW. For the capacity not offered, investigations are being conducted by PEMC-Enforcement and Compliance Office for possible non-compliance with the must-offer rule.

Meanwhile, average system demand plus reserve climbed beyond the 10,000 MW mark as it finished at 10,497 MW amid increase in the economic growth both in Luzon and Visayas. Average effective supply level posted a slim increase this year at 12,625 MW from previous year's 11,652 MW, influenced by the slight improvement in the average outage capacity level in 2018 as earlier mentioned. As a result, the supply margin recovered by 22 percent this year at 2,065 MW from a benign 1,693 MW supply margin recorded the previous year. Sufficient margin between supply and demand generally prevailed during the twelve-month period. Notwithstanding, narrow supply margin was still observed during periods of tight demand and supply conditions, with 10 trading intervals recording supply margin levels below 100 MW.

Over the five-year period, average market price was observed to slump beginning the year 2014 sliding to its lowest level in the year 2016 at PhP 2,947/MWh. This however slowly

recovered by 8 percent bringing the market price by the end of 2018 at PhP 3,618/MWh. During the billing year, market prices in Luzon were higher than in Visayas except during the billing months of May, August, September and November. Particularly, during the August billing month, average market price in Luzon was lower by 10.8 percent than in Visayas.

The system-wide generation mix based on actual generation (metered quantity) during the year showed that coal plants accounted for majority or 49.6 percent, followed by natural gas plants at 26.3 percent, geothermal plants at 11.3 percent, hydro plants at 7.5 percent, and oil-based plants at 1.5 percent. Biomass, solar and wind plants, accounted for the remaining 0.9 percent, 1.5 percent and 1.5 percent, respectively.

In terms of market concentration, the market remained to be dominated by four (4) major participant groups based on registered capacity led by San Miguel Corporation (SMC) with a market share of 23 percent by the end of the year. Aboitiz Power (AP) followed next with market share of about 21 percent, First Gen Corporation (FGC) with 15 percent and Power Sector Asset and Liabilities Management (PSALM) with 11 percent shares. Consequently, the calculated Herfindahl-Hirschman Index (HHI) across the billing year generally denoted a moderately concentrated market based on registered capacity by major participants' grouping, and based on offered capacity. In contrast, HHI value indicated a concentrated market when computed based on actual generation by major participants' grouping across the billing year. The varying conditions of supply availability as well as the offer behavior of plants could have influenced the same.

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ANNUAL MARKET ASSESSMENT REPORT

This Annual Market Assessment Report provides an assessment of the results of the integrated Luzon and Visayas operations of the Wholesale Electricity Spot Market (WESM) for the billing year of 2018 (26 December 2017 to 25 December 2018). This report likewise sets out an overview of the results of market performance, trends and drivers which in turn provide the means to assess competition and conditions in the WESM, as well as the bidding behavior of trading participants.

I. Capacity Profile

The WESM registered capacity continued to climb at 18,902 MW at the close of the billing year 2018, posting a 25 percent increase from 15,126 MW recorded in 2014, as shown in Figure 1. The growth in 2018 was however minimal coming from the previous year's 18,764 MW, only gaining a 0.74 year-on-year rate of increase despite entry of new power plants and increase in existing capacities. The slump in growth was brought about by the deregistration of some power plants and decrease in existing capacities. Information on the changes in the capacities of these plants is detailed in Table 1.

About 92 percent or 17,382 MW of the total WESM registered capacity in 2018 were accounted as capacities of scheduled generators. The remaining 8 percent or 1,520 MW were the combined capacities of must-dispatch, priority dispatch and non-scheduled generators, which was an increase from 3 percent or 451 MW recorded in 2014.

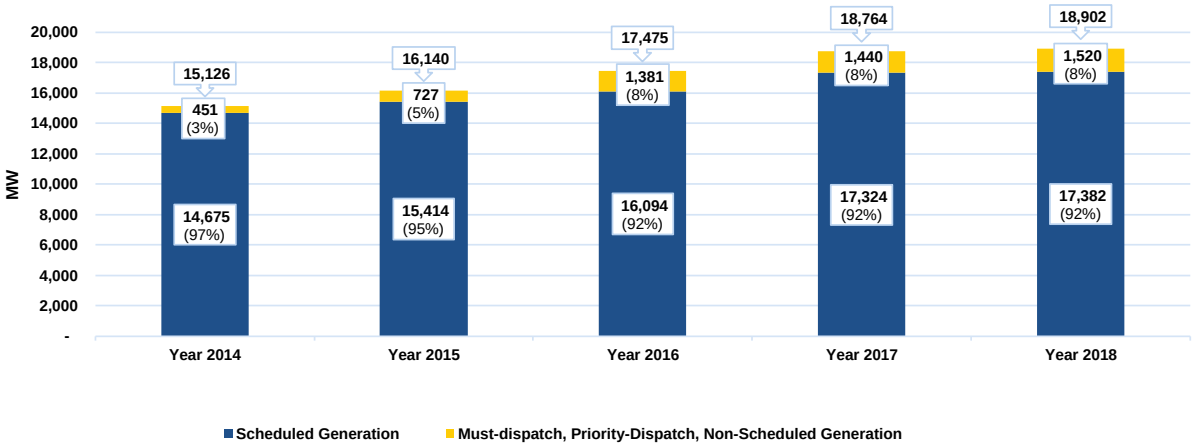


Figure 1. Capacity Profile (Ex-ante) by Generator Classification, 2014 to 2018

Table 1. Change in WESM Registered Capacity, 2017 to 2018

Plant Type	Market Participant Name	Node ID	Capacity		
			Old	New	Change
New Registered Plants					
BIOF	Central Azucarera Don Pedro, Inc.	3CADPI_G01		25.0	25.0
BIOF	San Carlos Biopower Inc.	6SCBIOP_G01		20.0	20.0
COAL	SMC Consolidated Power Corp.	1SMC_G04		150.0	150.0
OIL	Central Negros Power Reliability, Inc.	6CENPRI_U05		6.4	6.4
Plants that Increased Capacity					
BIOF	Central Azucarera de San Antonio	8CASA_G01	4.0	8.0	4.0
COAL	Masinloc Power Partners Co. Ltd.	1MSINLO_G02	315.0	344.0	29.0
HYD	SN Aboitiz Power - Magat, Inc.	1MARIS_U01	3.8	4.3	0.5
HYD		1MARIS_U02	3.8	4.3	0.5
OIL	Southwest Luzon Power Generation Corp.	3SLPGC_G03	23.0	25.0	2.0
OIL		3SLPGC_G04	23.0	25.0	2.0
OIL	PHINMA Energy Corp.	8STBAR_PB	20.0	24.0	4.0
OIL		8STBAR_PB2	20.0	24.0	4.0
SOLR	First Cabanatuan Renewable Ventures Inc.	1CABSOL_G01	9.1	9.1	0.0
Plants that Decreased Capacity					
COAL	Pagbilao Energy Corp.	3PAGBIL_G03	436.0	420.0	-16.0
COAL	Anda Power Corp.	1ANDA_G01	82.0	72.0	-10.0
GEO	AP Renewables Inc.	3ORMAT_G01	12.0	6.0	-6.0
OIL	Cebu Private Power Corp.	5CPPC_G01	70.0	64.0	-6.0
OIL	East Asia Utilities Corp.	5EAUC_G01	49.6	43.5	-6.1
OIL	Therma Mobile, Inc.	2TMO_G01	66.0	63.8	-2.2
OIL		2TMO_G02	67.2	49.0	-18.2
OIL		2TMO_G03	57.0	53.4	-3.6
OIL		2TMO_G04	52.0	46.4	-5.6
Deregistered Plants					
OIL	SPC Power Corp.	5CDPPI_G01	18.0		-18.0
OIL		5CDPPI_G02	18.0		-18.0
				TOTAL:	**138**

In terms of resource type, coal plants hold the largest share of 40 percent in the total registered capacity soaring from 5,442 MW in 2014 to 7,573 MW by the end of 2018, an escalation of about 39 percent over the course of the five-year period.

The introduction of the Feed-in-Tariff System[1], which aims to accelerate the development of emerging renewable energy resources, yielded an influx of solar and biofuel plants particularly in the billing years 2015 and 2016. Despite the notable annual increments in its registered capacities, solar plants remained at 4 percent share while biofuel plants at 1 percent share in the total registered capacity in five years, recording 732 MW and 274 MW, respectively, by the end of 2018. Said plants were among those with the lowest share in the total registered capacity. Wind plants followed suit at 2 percent (427 MW) and battery energy storage system at 0.1 percent (10 MW) shares. Since the start of its market participation in 2016, the registered capacity of battery energy storage system stayed at 10 MW until the end of 2018.

The rest of the resource types showed smaller annual increments but were, nevertheless, among the larger shares in the total registered capacity namely: (1) natural gas plants at 17 percent or 3,290 MW; (2) hydro plants at 13 percent or 2,505 MW; (3) oil-based plants at 12 percent or 2,311 MW; and (4) geothermal plants at 9 percent or 1,782 MW.

[1] Republic Act No. 9513 An Act Promoting the Development, Utilization and Commercialization of Renewable Energy Resources and for Other Purposes

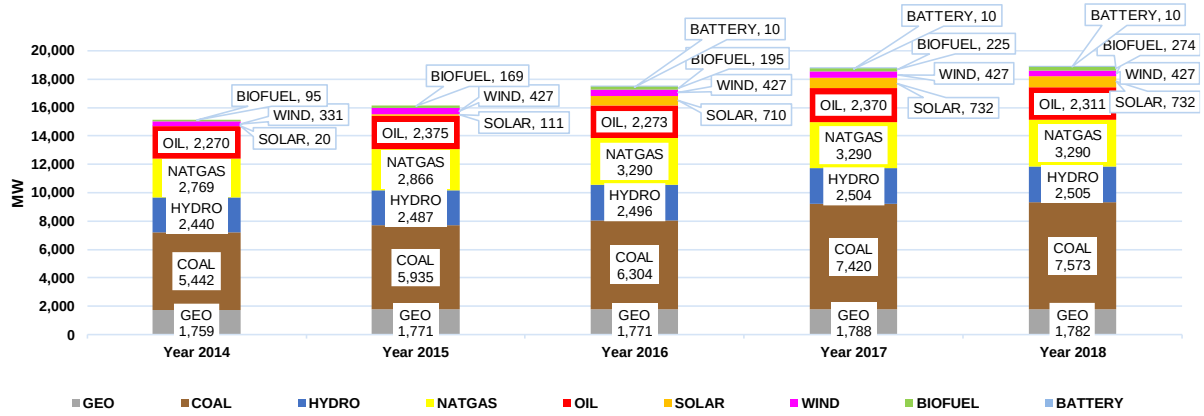


Figure 2. Capacity Profile (Ex-ante) by Resource Type, 2014 to 2018

Of the total registered capacity in 2018, about 66 percent or 12,394 MW was offered in the market by scheduled generators and 2 percent or 390 MW was nominated by must-dispatch, priority dispatch and non-scheduled generators. Meanwhile, the capacity related to the conduct of testing and commissioning of plants which have yet to start commercial operations accounted for 1 percent or an average of 258 MW and the remaining 2 percent or an average of 418 MW was attributed to the capacity of Malaya TPP as Must Run Unit (MRU) to address system security and in cases of supply shortfall.

The level of unavailable capacity accounted for 30 percent which includes outage capacity and capacity not nominated by must-dispatch, priority-dispatch and non-scheduled generators at 6 percent or 1,107 MW, outage capacity from scheduled generators at 12 percent or an average of 2,252 MW, and lastly, capacity not offered by scheduled generators at 12 percent or 2,197 MW. Further investigations are being conducted by PEMC-Enforcement and Compliance Office for the capacity not offered for possible non-compliance with the must-offer rule[2].

It should be noted that following the implementation of central scheduling and dispatch of energy and contracted reserves in Luzon beginning 22 December 2015, and in the Visayas beginning 07 October 2017, ancillary services schedules in both regions have been included as part of the offered capacity in the market.

[2] As provided under the WESM Rules, all scheduled generating units are required to submit their maximum available capacity for central scheduling purpose.

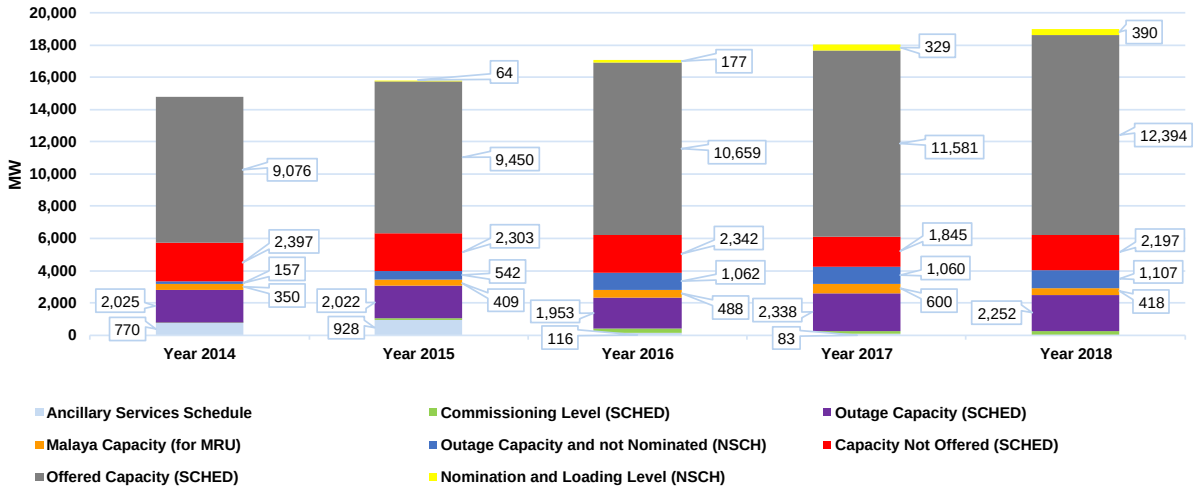


Figure 3. Capacity Profile (Ex-ante) by Component, 2014 to 2018

Table 2. Capacity Profile (Ex-ante), 2014 to 2018

Average Capacity (in MW)	Billing Year				
	2014	2015	2016	2017	2018
Ancillary Services Schedule	770	928	116	83	
Commissioning Level (SCHED)	17	93	267	174	258
Outage Capacity (SCHED)	2,025	2,022	1,953	2,338	2,252
Malaya Capacity (for MRU)	350	409	488	600	418
Outage Capacity and not Nominated (NSCH)	157	542	1,062	1,060	1,107
Capacity Not Offered (SCHED)	2,397	2,303	2,342	1,845	2,197
Offered Capacity (SCHED)	9,076	9,450	10,659	11,581	12,394
Nomination and Loading Level (NSCH)	0	64	177	329	390
Total Registered Capacity (end of billing year)	15,126	16,140	17,475	18,764	18,902

II. Power Plant Outages

A. Outage Capacity by Plant Type

The total average outage capacity slightly eased down to 2,252 MW at the close of the billing year coming from about 2,338 MW the previous year. This was attributable to the 41 percent drop in the average outage capacity of natural gas plants and 17 percent decline for coal plants, which offset the rise in the average outage capacity of oil-based plants at 151.15 percent.

Although on a downtrend, coal plants remained with the highest average outage capacity at 46 percent or 1,034 MW as a result of the forced outages of SLPGC CFTPP unit 1 (150 MW), SMC CFTPP unit 2 (150 MW) and Calaca CFTPP unit 2 (300 MW). In addition, maintenance outages of Sual CFTPP unit 2 (647 MW), GN Power CFTPP unit 2 (316 MW) and Pagbilao CFTPP unit 3 (420 MW) also contributed to the outage capacity of coal plants.

Oil-based plants came in next at 19 percent or an average of 424 MW, mainly due to the yearlong planned outage of SLPGC GTPP unit 4 (23 MW) from 07 April 2017 to 20 April 2018 and its maintenance outage since 15 October 2018. Forced outages of CENPRI DPP unit 2 (4.2 MW) and Limay CCGT units 3 and 7 (both 60 MW) further added to the outage capacity of oil-based plants.

Meanwhile, outage capacity of geothermal plants was recorded at 17 percent or 382 MW, with the forced outages of Makban GPP unit 5 (55 MW), Leyte unit A (32 MW) and Tiwi GPP unit 1 (59 MW) largely contributing to the average outage capacity.

Further, outage capacity of hydro plants averaged at 213 MW due to the planned outage of San Roque HEP unit 3 (145 MW) on top of the forced outages of Casecnan HEP unit 1 (82.5 MW). Lastly, natural gas plants had the lowest outage capacity among resource types at an average of 199 MW linked to the forced outage of San Gabriel NGPP (420 MW) and maintenance outages of San Lorenzo NGPP unit 2 (261.8 MW) and Sta. Rita NGPP unit 2 (255.7 MW).

Provided in Annex A is the list of major plant outages[3].

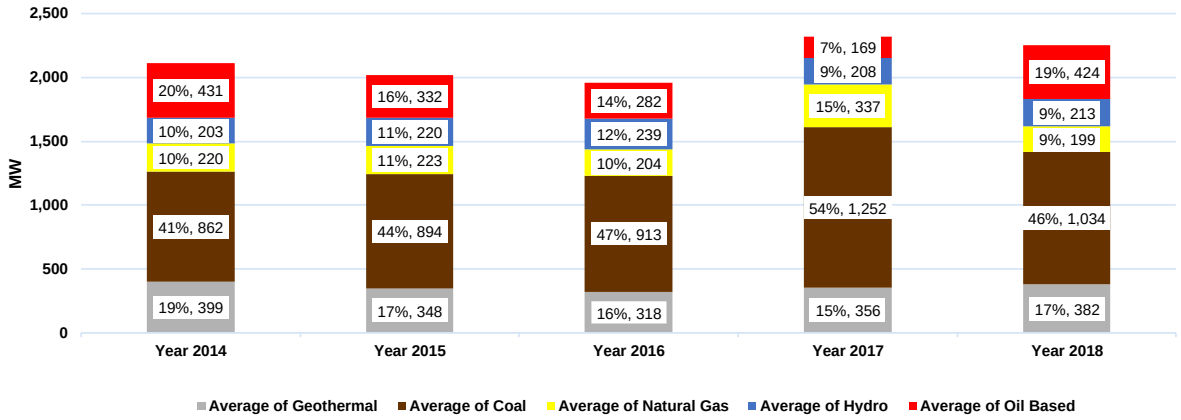


Figure 4. Outage Capacity by Plant Type, 2014 to 2018

Table 3. Outage Summary (Ex-ante) by Plant Type, 2014 to 2018

Average Outage Capacity (in MW)	Billing Year				
	2014	2015	2016	2017	2018
Coal	862	894	913	1,252	1,034
Natural Gas	220	223	204	337	199
Geothermal	399	348	318	356	382
Hydro	203	220	239	208	213
Oil-based	431	332	282	169	424
Sum	**2,114**	**2,017**	**1,956**	**2,321**	**2,252**

[3] Outage list only includes major plants with capacity more than 120 MW.

B. Outage Capacity by Outage Category

Based on category, the system-wide outage capacity was primarily due to forced outages at an average of 955 MW or 42 percent across the year. Forced outage capacity was noticeably high during the third quarter of the year particularly during the July and September billing months, which recorded the highest monthly averages at 1,368 MW and 1,367 MW, respectively. These were the months when major coal plants Sual CFTPP unit 2 (647 MW), Pagbilao CFTPP unit 2 (382 MW), Masinloc CFTPP unit 1 (315 MW) and natural gas plant San Gabriel NGPP unit 1 (420) underwent forced outages.

Planned outage capacity came in next averaging at 752 MW or 33 percent during the year, followed by maintenance outage at 422 MW or 19 percent. Lastly, system-wide outages related to deactivated shutdown averaged at 126 MW or 6 percent.

As seen in Figure 5, planned outage, maintenance outage and outage related to deactivated shutdown showed an increase in MW capacity in contrast with forced outage that slightly weakened in year 2018.

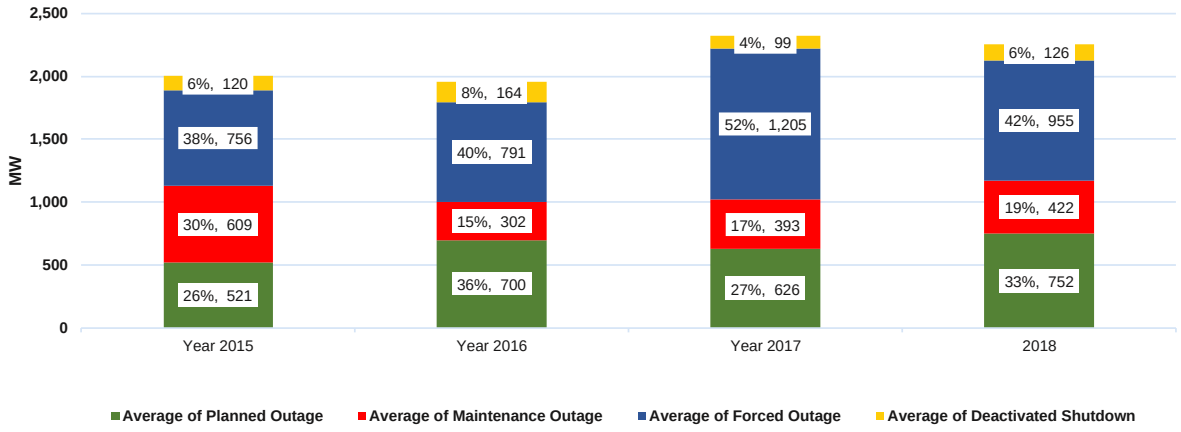


Figure 5. Plant Outage Capacity (by Outage Category), 2014 to 2018

Table 4. Outage Summary, by Outage Category, 2015 to 2018

Average Outage Capacity (in MW)	Billing Year			
	2015	2016	2017	2018
Planned Outage	521	700	626	752
Maintenance Outage	609	302	393	422
Forced Outage	756	791	1,205	955
Deactivated Shutdown	120	164	99	126

III. Demand and Supply Situation

Year 2018 has seen average system demand[4] plus reserve breaching the 10,000 MW mark as it peaked to a 10,497 MW level amid increased economic growth both in Luzon and Visayas.

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

Moreover, system demand is expected to gain more traction in the next five years, with demand being forecasted to grow at about 16,200 MW based on a 5.2 percent growth rate[5].

Average effective supply[6] level had a slim increase this year at 12,562 MW from previous year's 11,652 MW, influenced by the improvement in the average outage capacity level in 2018 as earlier discussed. As a result, the supply margin[7] recovered by 12 percent this year at 2,066 MW from a meager 1,849 MW supply margin recorded the previous year.

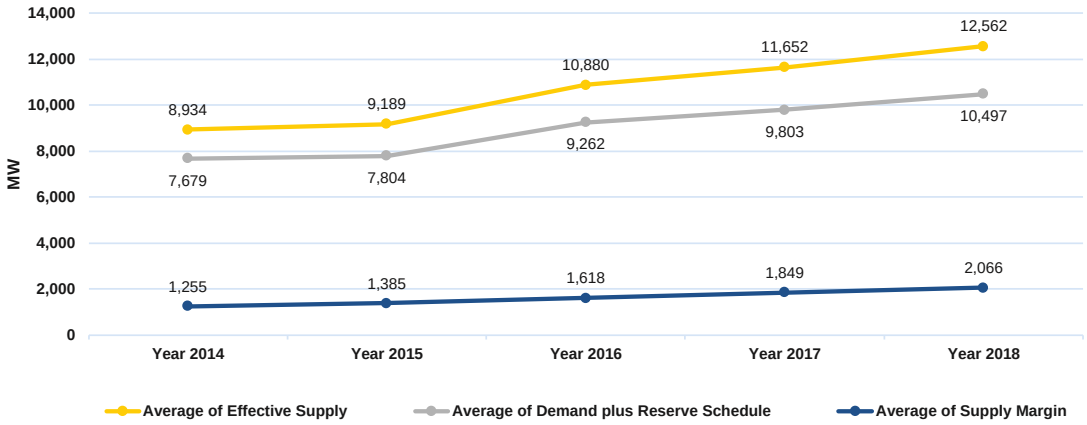


Figure 6. Demand and Effective Supply (Ex-ante), 2014 to 2018

Table 5. Demand and Supply Summary (Ex-ante), 2014 to 2018

Average (MW)	Billing Year				
	2014	2015	2016	2017	2018
Demand plus Reserve Schedule	7,679	7,804	9,262	9,803	10,497
Effective Supply	8,934	9,189	10,880	11,652	12,562
Supply Margin	1,255	1,385	1,618	1,849	2,066

Note: The derived values were non-coincident.

Supply generally exceeded demand during the twelve-month period. Notwithstanding, a few instances of narrow supply margin were observed, tallying a total of 10 trading intervals below 100 MW. Four (4) of these took place in the February billing month while another 4 trading intervals occurred in April, the same months where interesting pricing events were recorded. Details on the interesting pricing events are provided in Section V. D.

5 DOE Power Development Plan 2016 – 2040, source: https://www.doe.gov.ph/sites/default/files/pdf/electric_power/development_plans/pdp_2016-2040.pdf

[6]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).

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

The lowest average monthly supply margins were posted during the summer season particularly in March at 1,431 MW and in April at 1,677 MW. This was mainly due to the high level of demand requirement and a relatively slow recovery of supply during the said season.

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

Average (in MW)	Year 2018											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Demand plus Reserve Schedule	9,370	9,869	10,388	10,409	11,331	10,743	10,442	10,486	10,444	11,196	10,729	10,591
Effective Supply	12,160	11,585	11,819	12,087	13,182	12,794	12,406	12,894	12,570	13,160	13,002	13,065
Supply Margin	2,790	1,716	1,431	1,677	1,851	2,050	1,964	2,408	2,126	1,963	2,273	2,474

IV. Capacity Gap

Generator-trading participants continued to submit capacity offers less than their respective maximum available capacity, as indicated by the high level of capacity gap throughout the billing year. Following relevant provisions in the WESM Rules, these shall be subject to further investigation for possible non-compliance with the must-offer rule.

The average capacity gap for the year increased by 18.8 percent to about 2,337 MW from only 1,967 MW the previous year. This was primarily the result of the significant 65.2 percent increase in average capacity gap of coal plants and 12.5 percent in average capacity gap of oil-based plants. While geothermal plants and natural gas plants recorded a decline in their average capacity gap at 9.3 percent and 6.3 percent, respectively, this was not enough to offset the sharp increase in capacity gap from coal plants.

Overall, coal plants topped the year's share in capacity gap, comprising 37 percent at an average of 862 MW. High level of capacity gap among coal plants was observed in January 2018 at 1,232 MW and February 2018 at 1,230 MW, the same months that recorded the highest monthly average capacity gaps. These were largely due to the testing and commissioning of major coal plants namely, SMC CFTPP units 3 and 4, Pagbilao CFTPP unit 3 and THVI CFTPP units 1 and 2.

As shown in Figure 7, majority of the capacity gap in the previous years are mainly from hydro plants. During the 2018 billing year, however, it only came second after coal plants, recording about 34 percent or an average of 786 MW. Most of the capacity gap observed were due to reasons of water availability and elevation. It is noted that the capacity gap involving hydro plants likewise include the pumping capacity of hydro plant Kalayaan.

The rest of the average capacity gap were attributed to oil-based plants, 16 percent accounting for an average of 368 MW; geothermal plants, 12 percent or an average of 286 MW; and natural gas plants, a minimal 1 percent at an average of 35 MW.

Table 7. Capacity Gap – System, 2018

Plant Type	Capacity Gap By Plant Type (Avg MW), 2018 - System												
	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018	Oct 2018	Nov 2018	Dec 2018	Average
Coal	1,232	1,230	815	714	749	748	668	669	843	805	918	985	865
Natural Gas	8	53	147	45	7	23	22	22	31	19	24	17	35
Geothermal	419	390	339	273	266	223	275	306	215	203	227	295	286
Hydro	781	785	802	841	843	927	867	671	619	646	793	861	786
Oil-based	361	351	394	383	349	360	357	362	409	390	361	336	368
Total	**2,800**	**2,809**	**2,498**	**2,257**	**2,214**	**2,281**	**2,189**	**2,030**	**2,117**	**2,063**	**2,323**	**2,494**	**2,339**

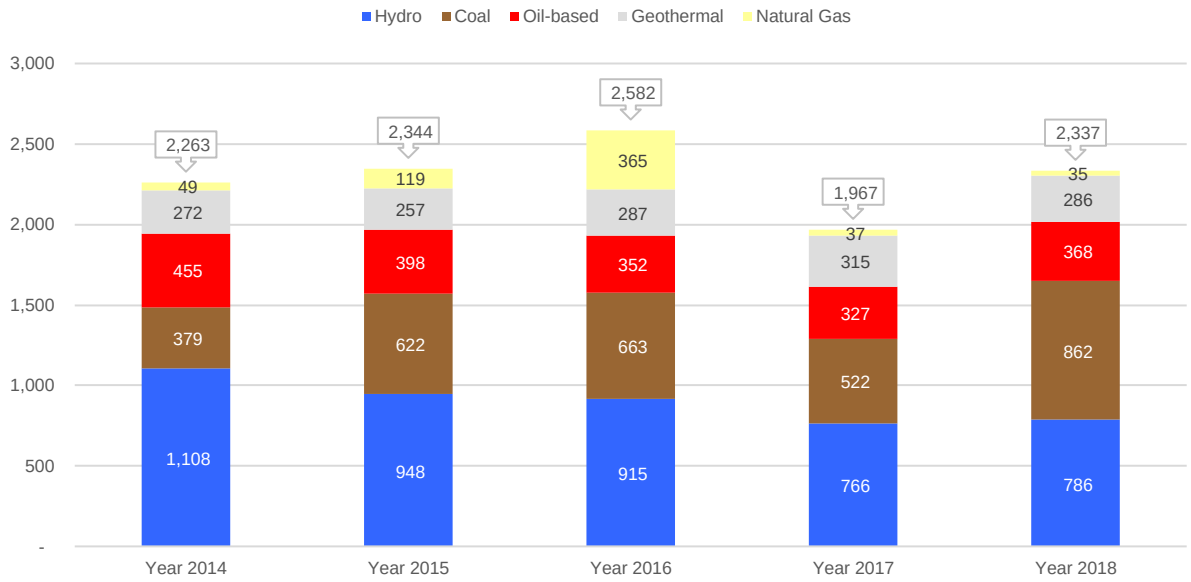


Figure 7. Capacity Gap - System, 2014 - 2018

V. Market Price Outcome[8]

A. Market Prices

Shown in Figure 8, average market price was on a downward trend at the onset sliding to its lowest level in year 2016 at PhP 2,947/MWh. It has slowly recovered over the next two (2) years bringing the average market price at PhP 3,618/MWH by the end of 2018.

Maximum prices were notably lower following the issuance of the WESM Tripartite Committee's Resolution No. 3, series of 2015 which reduced the offer price ceiling from

[8]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.

PhP62,000/MWh to PhP32,000/MWh[9]. Equally affecting the price trend was the ERC's issuance of the price mitigating measure on the secondary price cap[10] imposed in 2014.

As seen in Table 9, monthly average prices were generally below PhP4,000/MWh throughout 2018 except in the summer months of March to June with the highest monthly average price taking place in March at PhP5,095/MWh. As earlier discussed, average monthly supply margin was at its lowest during said month and was, for the most part, due to high level of demand requirement on top of high level of outage capacity. This resulted in a relatively higher average weekly market price which started returning to modest levels only at the latter part of the billing month. Similarly, week-on-week average market prices grew during the April billing month following the tighter supply margin driven by the ballooning demand.

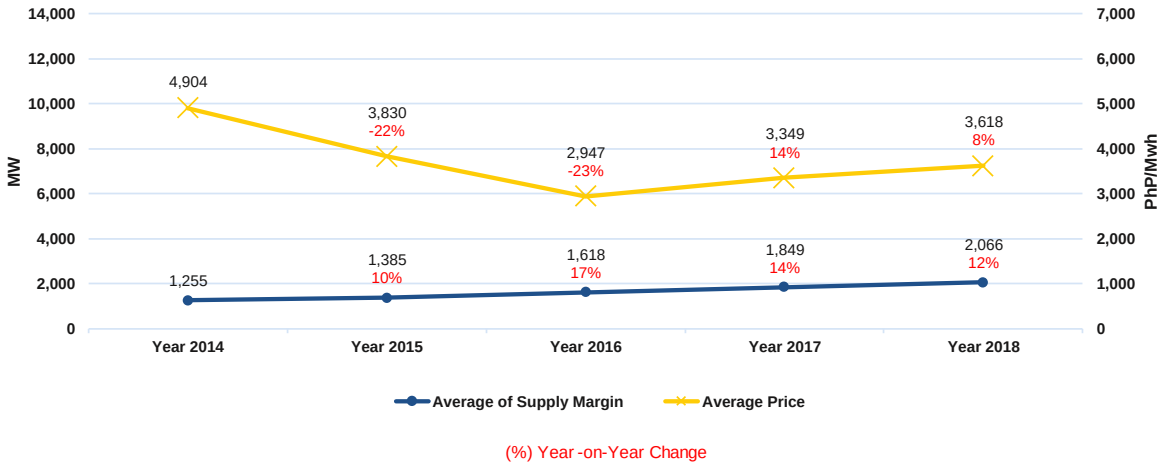


Figure 8. Market Price Trend vs. Supply Margin, 2014 - 2018

Table 8. Market Price Summary - System, 2014 to 2018

2014			2015			2016			2017			2018		
Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
32,604	-84,433	4,904	30,234	-953	3,830	33,467	-100,654	2,947	33,347	-2,661	3,349	32,827	-10,359	3,618

Table 9. Market Price Summary - System, 2018

Market Price - System (in PhP/MWh)	Year 2018											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Maximum	6,668	14,197	31,709	19,286	32,454	19,211	17,473	7,805	21,453	31,707	32,077	32,827
Minimum	-10,359	496	2,363	851	0	1,788	-1,737	0	-1,023	654	0	0
Average	2,387	3,740	5,095	4,196	4,105	4,073	3,794	2,713	2,966	3,819	3,324	3,186

[9] As a price mitigating measure, the WESM Tripartite Committee composed of the DOE, ERC and PEMC issued Resolution No. 3 on 17 December 2015, which adopted the Offer Price Cap at PhP32,000/MWh, as initially set on 27 December 2013. The same Resolution also set the Offer Price Floor in the WESM at negative PhP10,000/MWh effective 01 January 2016.

[10] ERC Resolution No. 20, series of 2014 entitled "Adopting and Establishing a Pre-Emptive Mitigation Measure in the WESM" sets the cumulative price threshold (CPT) equivalent to an average spot price of PhP9,000/MWh over a rolling 7-day period or 168 trading intervals. A breach of the CPT triggers the imposition of a price cap amounting to PhP6,245/MWh.

Figure 9 shows that frequent price spikes above PhP20,000/MWh (five trading intervals) occurred in Luzon during the October billing month driving the average market price for the month at PhP3,822/MWh. Prices were generally lower than PhP9,000/MWh in the course of the billing month except on October 15 and 25, during which relatively tighter supply margins were experienced because of high level of outage capacity involving coal plants and natural gas plants.

Negative prices below PhP10,000/MWh (seven trading intervals) were observed in Luzon during the January billing month bringing the average market price for the month at PhP2,389/MWh. Similarly, negative prices below PhP10,000/MHW (eight trading intervals) were likewise observed in Visayas during the same billing month resulting to the average market price for the month at PhP2,373/MWh as shown in Figure 10. These negative prices were on account of wide supply margin due to the observance of holidays on January 1 to 2, 2018.

Year 2018 saw market prices in Luzon being higher than in Visayas with the exception of May, August, September and November billing months, detailed in Table 10. Particularly, during the August billing month, average market price in Luzon was lower by 10.8 percent than in Visayas.

It was noted that Visayas recorded market prices at a high of PhP29,620/MWh on 25 August at 1900H attributable to the high level of outage in Visayas involving KSPC CFTPP unit 1 and units of Leyte A GPP from 24-25 August. In addition, high demand requirement as well as maximized HVDC event were noted during the peak hour of 1900H. On the other hand, market prices in Visayas reached a low of PhP-10,109/MWh on 26 July at 0700H when wide supply margin was observed coincided with the unavailability of the HVDC.

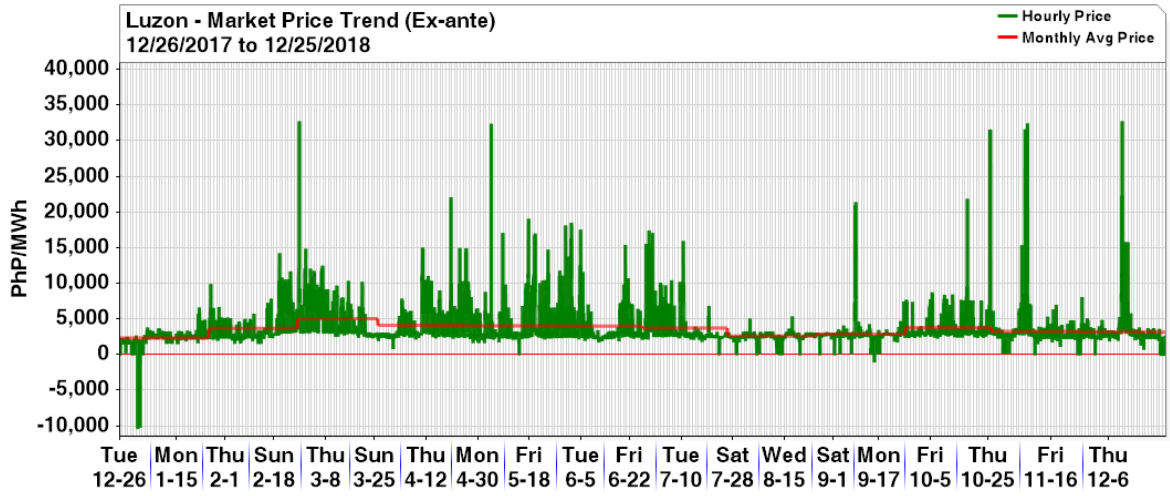


Figure 9. Market Price Trend - Luzon, 2018

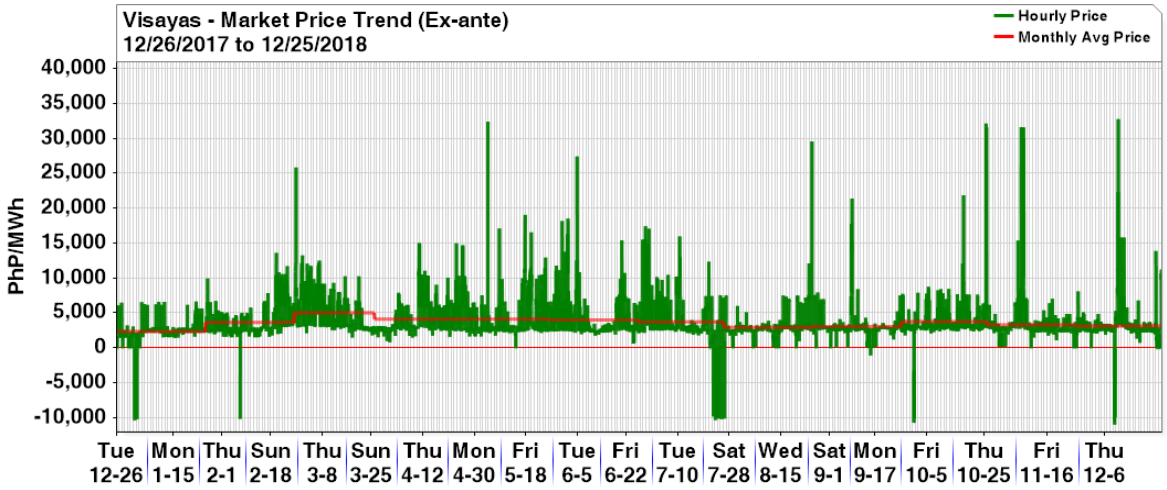


Figure 10. Market Price Trend - Visayas, 2018

Table 10. Monthly Regional Price Summary, 2018

	Luzon in PhP/MWh			Visayas in PhP/MWh			% Difference		
	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
January 2018	6,668	-10,359	2,389	6,668	-10,359	2,373	(0.0)	(0.0)	0.7
February 2018	14,307	1,572	3,750	13,651	-10,135	3,690	4.8	(115.5)	1.6
March 2018	32,827	2,363	5,101	25,874	1,510	5,059	26.9	56.5	0.8
April 2018	22,157	851	4,201	15,065	851	4,168	47.1	0.0	0.8
May 2018	32,453	0	4,095	32,458	0	4,157	(0.0)	-	(1.5)
June 2018	18,563	1,788	4,077	27,468	667	4,051	(32.4)	168.1	0.6
July 2018	17,478	0	3,804	17,473	-10,305	3,744	0.0	(100.0)	1.6
August 2018	5,415	0	2,661	29,620	-10,109	2,983	(81.7)	(100.0)	(10.8)
September 2018	21,453	-1,023	2,945	21,453	-1,023	3,083	0.0	0.0	(4.5)
October 2018	31,635	2,316	3,822	32,187	-10,702	3,808	(1.7)	(121.6)	0.4
November 2018	32,493	0	3,322	31,664	0	3,336	2.6	-	(0.4)
December 2018	32,828	0	3,191	32,827	-10,951	3,164	0.0	(100.0)	0.9

B. Price Distribution

Figure 11 shows the annual distribution of market prices for the five-year period. The same demonstrates that the population of the market prices system-wide was concentrated within the range of above PhP2,000/MWh to PhP4,000/MWh. Such was most apparent in 2018 when 79.3 percent of the entire price points fell under said price range. Another considerable subset is the price range from PhP4,000/MWh to PhP6,000/MWh, comprising 8.0 percent in 2018.

The frequency of prices above PhP2,000/MWh to PhP4,000/MWh increased during the billing year of 2018 while prices above PhP0/MWh to PhP2,000/MWh and above PhP4,000/MWh to PhP6,000/MWh significantly dropped at the close of the billing year.

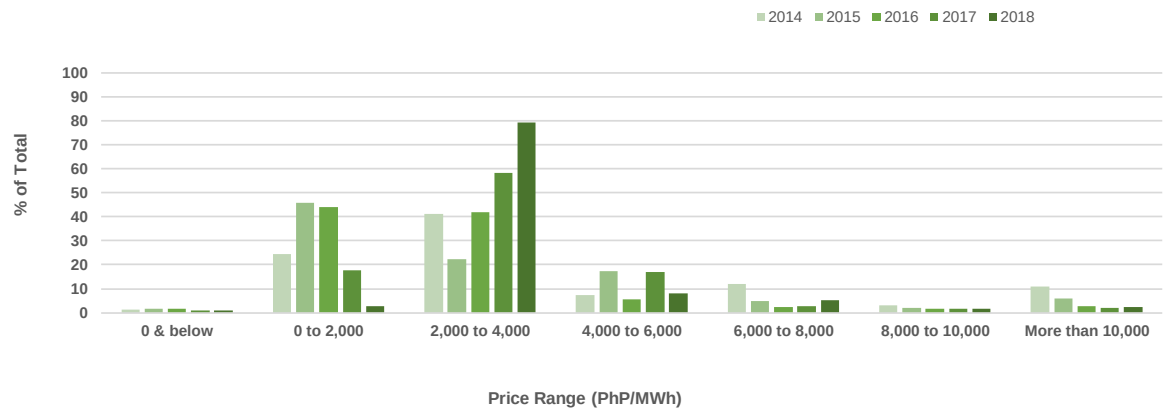


Figure 11. Price Distribution, 2014 to 2018

Table 11. Price Distribution, 2014 to 2018

Price Range (PhP/MWh)	% Distribution				
	2014	2015	2016	2017	2018
0 & below	1.12	1.60	1.74	0.78	0.98
0 to 2,000	24.33	45.94	43.99	17.59	2.66
2,000 to 4,000	41.11	22.40	41.80	58.38	79.32
4,000 to 6,000	7.42	17.16	5.67	17.12	8.01
6,000 to 8,000	12.13	5.00	2.27	2.68	5.32
8,000 to 10,000	3.09	1.88	1.66	1.54	1.53
More than 10,000	10.80	6.03	2.87	1.91	2.18
	100.00	100.00	100.00	100.00	100.00

C. Price Duration Curve

The price duration curves show the higher market prices during peak[11] hours compared to off-peak[12] hours.

In 2018, only 66.0 percent of the prices during the peak hours were within the PhP2,000/MWh up to PhP4,000/MWh, as shown in Figure 12. It was observed that market prices within PhP4,000/MWh up to PhP10,000/MWh was recorded at 28.3 percent and 4.5 percent was above PhP10,000/MWh up to PhP32,000/MWh. Less than one percent was recorded below PhP2,000/MWh.

On the other hand, about 89.7 percent of the market prices during the off-peak hours were within the price range PhP2,000/MWh to PhP4,000/MWh as reflected in Figure 13. About 5.9 percent was at PhP2,000/MWh and below while 4.4 percent were above PhP4,000/MWh up to PhP32,000/MWh.

[11]Peak hours include 1000H-2100H from Mondays to Saturdays and 1900H-2000H on Sundays and Holidays
[12]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

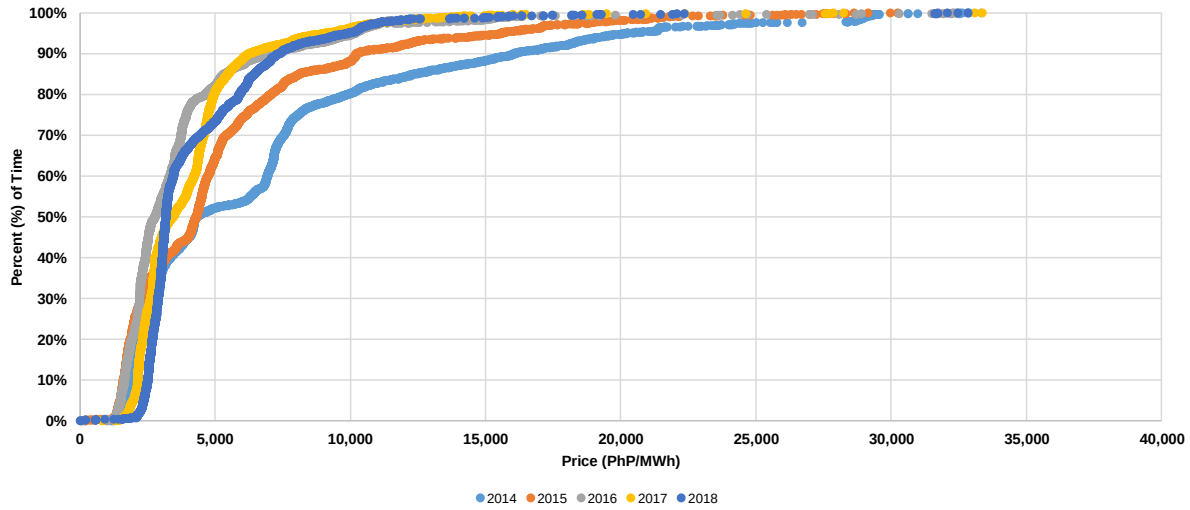
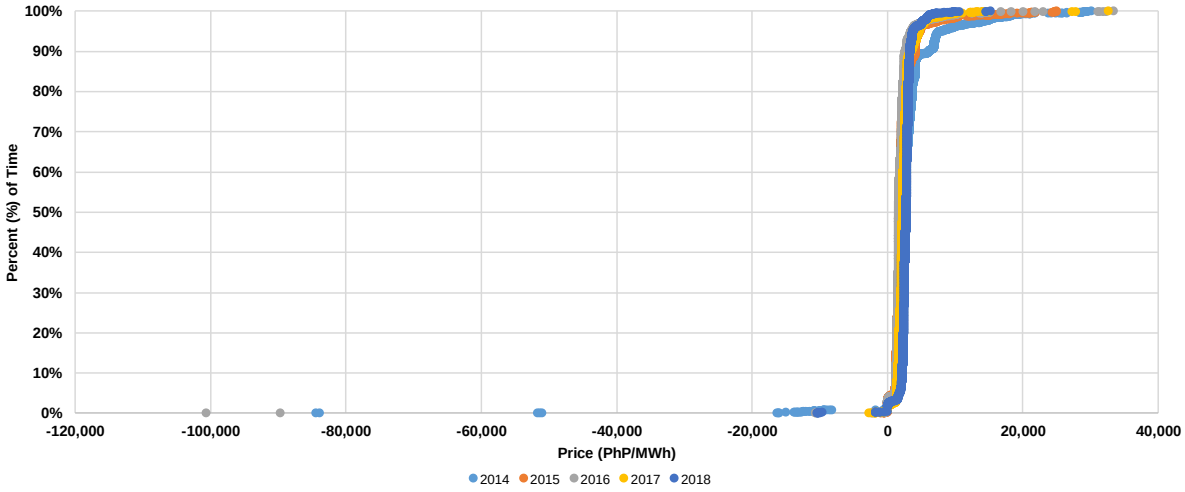
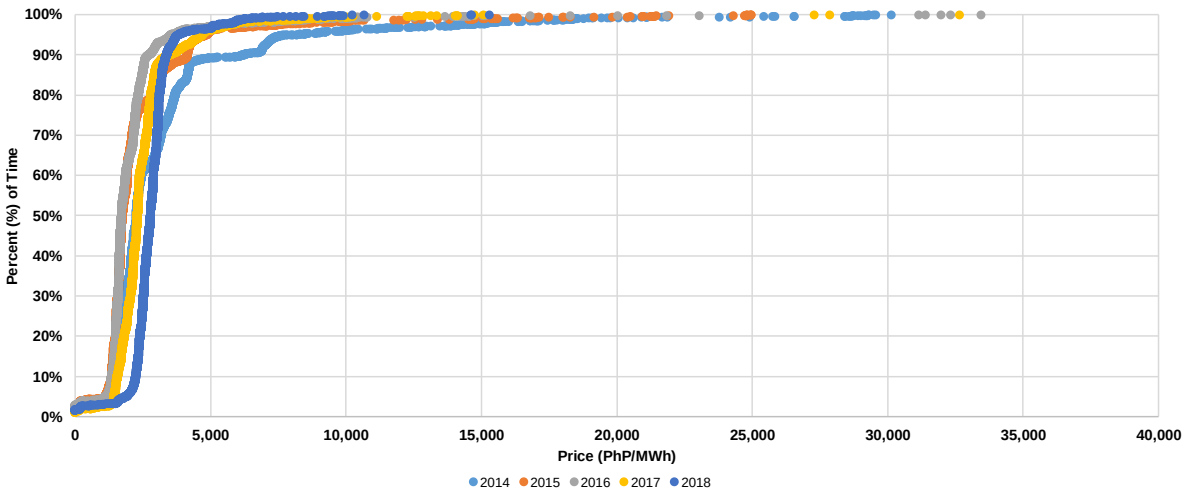


Figure 12. Price Duration Curve (Peak Period), 2014 to 2018



(a)



(b)

Figure 13. Price Duration Curve (Off-Peak Period), 2014 to 2018—(a) all prices (b) without negative prices

D. Interesting Pricing Event

This section provides the assessment highlights of intervals determined to have price outliers based on the relationship of market price and supply margin or also known as “interesting pricing events”. The relationship of supply margin and price is another monitoring metric used to identify any unusual market outcome with a general intent of further assessing a rather unusual event. It should be noted that the supply margin analysis can serve as a tool in detecting interesting pricing events but will not in itself determine definitively the existence of abuse of market power and possible conduct of anti-competitive behavior. Annex B provides details on the MSC-approved methodology in determining interesting pricing events.

A total of 26 trading intervals recorded market prices higher than the upper price threshold in 2018, most of which were confined within June. On other hand, no trading intervals had market prices falling below the lower price threshold.

Provided in Table 12 is the scatter plot of the market price against supply margin during the said trading intervals and the corresponding reference price threshold for each interesting pricing event.

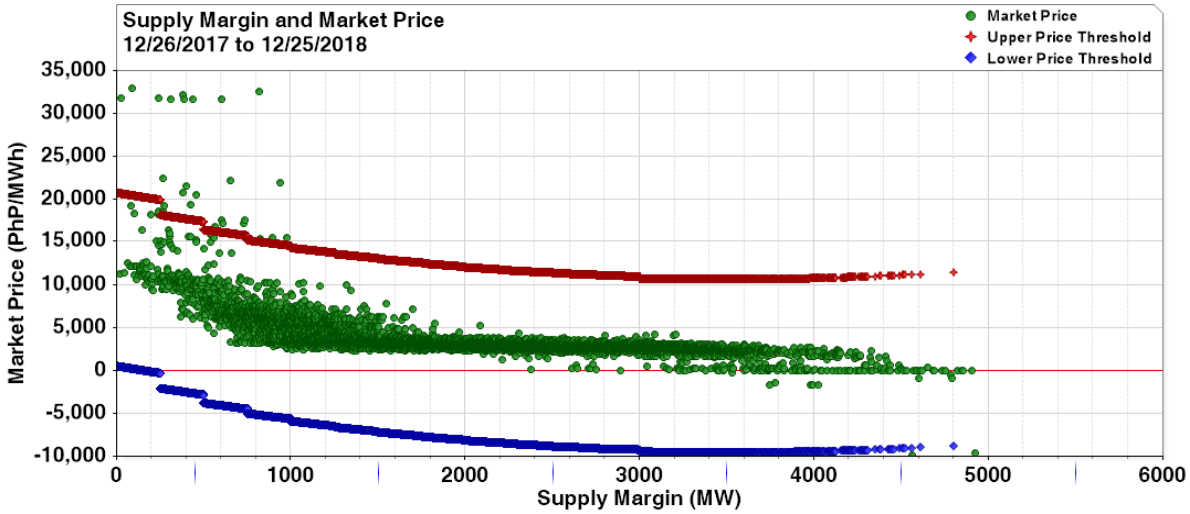


Figure 14. Interesting Pricing Events, 2018

Table 12. Interesting Pricing Events, 2018

Month	Day	Trading Interval	Supply Margin	Market Price	Lower Price Threshold	Upper Price Threshold	Reasons for the High Market Price
February	26	16	29	31,709	515	20,733	• Low effective supply due to high outage capacity and higher capacity not offered.
April	20	14	428	19,286	-2,072	18,146	• High outage capacity attributed to simultaneous planned preventive maintenance of major natural gas, coal and hydro plants; • Occurrence of localized contingency constraint at the Paco substation transformers, resulting in the use of ex-post price; and • Forced outage of one coal plant leading to the dispatch of one hydro plant at higher offer price.
May	04	16	818	32,454	-5,017	15,201	• Higher-priced capacity offers from major oil-based, hydro and natural gas plants; and • Forced outage of major natural gas plant resulting in dispatch of hydro and oil-based plants at higher offer price.
	08	16	612	17,146	-3,794	16,424	• Lower effective supply due to high capacity on outage and decline in the available capacity from solar plants.
	19	19	568	16,711	-3,794	16,424	• Higher rate of increase in system demand than the effective supply; and • High capacity on outage and lower available capacity from variable renewable energy resources attributable to the non-availability of solar plants at night.
		22	830	15,302	-5,017	15,201	
June	01	14	268	18,563	-2,072	18,146	• Interval was under price substitution mechanism (PSM) due to a constraint violation as a result of N-1 contingency hence, the estimated reference price of PhP 18,902/MWh was used. Without the PSM, the price could have been higher due to the high system demand and low effective supply following the forced outage of one coal plant, on top of existing outages of other plants.
	04	19	277	19,211	-2,072	18,146	• Higher rate of increase in system demand than the effective supply; and • High capacity on outage due to forced outages of major natural gas and oil-based plants, on top of the existing outages for other plants.
	20	10	896	15,466	-5,017	15,201	• Higher demand requirement; and • Lower effective supply due to the forced outage of coal plant, on top of the existing outages for other plants.
	28	16	603	17,453	-3,794	16,424	• Lower effective supply due to high outage capacity
		17	735	17,473	-3,794	16,424	
	29	21	729	17,123	-3,794	16,424	
September	08	14	461	20,457	-2,072	18,146	• Occurrence of forced outage of major coal plant; and • Higher demand requirement during afternoon and evening peak hours.
		19	405	21,453	-2,072	18,146	
October	17	18	940	21,917	-5,017	15,201	• Occurrence of forced outage of 1 coal plant and higher demand requirement during evening peak hours.
	25	14	241	31,707	515	20,733	• Occurrence of forced outage of 1 natural gas plant, limited offers of many generators nad shift of some capacity to ancillary services from energy of the previous day.
		15	441	31,600	-2,072	18,146	
		16	658	22,056	-3,794	16,424	
		18	603	31,635	-3,794	16,424	
November	05	18	977	15,433	-5,017	15,201	• Occurence of forced outage of 1 natural gas plant and 1 coal plant
	06	20	381	20,716	-2,072	18,146	
		21	311	31,664	-2,072	18,146	
	07	16	390	31,652	-2,072	18,146	
		18	385	32,077	-2,072	18,146	
December	10	16	269	22,342	-2,072	18,146	• Occurrence of forced outage and limited offers of major coal plants
		18	89	32,827	515	20,733	

VI. Pricing Errors and Market Intervention

Throughout the billing year, issuances of non-congestion pricing errors in the ex-ante affected a total of 667 trading intervals, accounting for 7.6 percent of the time.

System-wide, it was noted that 343 trading intervals or 3.9 percent were subjected to non-congestion pricing errors. Meanwhile, issuances of non-congestion pricing errors in Luzon during the ex-ante were noted 2.2 percent of the time during the year, affecting a total of 191 trading intervals. October and November saw the most monthly occurrence of non-congestion pricing error issuances with 39 and 58 trading intervals, respectively. Majority of the reason for the issuances was on account of the localized contingency constraint violation on Paco transformer.

On the other hand, non-congestion pricing errors in Visayas during the ex-ante was noted 1.6 percent of the time in 2018, affecting 140 trading intervals. The highest frequency was

observed in August, which recorded 31 non-congestion Pricing Error Notice (PEN) in the ex-ante. Meanwhile, 28 trading intervals or 3.8 percent of the time were affected in the ex-post, higher than previous month's 14 trading intervals. These were mainly on account of the localized constraint violation on Amlan transformers.

System-wide application of Price Substitution Methodology (PSM) were likewise observed during the period with a total of 1,802 trading intervals in the ex-ante, and 1,592 trading intervals in the ex-post. This represented 20.6 percent of trading intervals in the ex-ante and 18.2 percent of the time in the ex-post throughout the billing year.

As shown in Table 13 below, the March billing month recorded the highest number of system-wide PSM application this year, affecting 263 trading intervals or 39.1 percent of the time in the ex-ante. The PSM application during this month was mainly due to the constraint on Samboan-Amlan Line 1 (Cebu-Negros submarine cable) and constraint on Bacolod-Barotac line 1 (Negros-Panay submarine cable).

System-wide PSM applications were also more frequently observed during the February billing month, affecting a total of 217 trading intervals (29.2 percent of the time) in the ex-ante run and 200 trading intervals (26.9 percent of the time) in the ex-post run. The PSM application during this month was likewise mainly due to the constraint on Samboan-Amlan Line 1 (Cebu-Negros submarine cable) and constraint on Quezon - San Jose line 2 as a result of N-1 contingency on Quezon - San Jose line 1.

On the other hand, there were market intervention events initiated by the Market Operator in two (2) trading intervals on 6 April at 0100H due to Force Majeure Event resulting in un-implementable RTD schedule and on 12 April at 0400H due to the simulation of the business continuity plan and disaster recovery procedures. This was the lowest number of market intervention recorded since the start of the WESM in 2006.

Table 13. PEN-PSM Summary, 2018

	PEN-PSM Summary - 2018																					
	Jan 2018		Feb 2018		Mar 2018		Apr 2018		May 2018		Jun 2018		Jul 2018		Aug 2018		Sep 2018		Oct 2018		Nov 2018		Dec 2018	
	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
	PEN (RTD)																							
System	13	1.7	4	0.5	7	1.0	40	5.4	15	2.1	2	0.3	6	0.8	145	19.5	16	2.2	43	6.0	7	0.9	4	0.6
Luzon	8	1.1	1	0.1	6	0.9	8	1.1	26	3.6	5	0.7	5	0.7	3	0.4	9	1.2	39	5.4	58	7.8	-	-
Visayas	18	2.4	2	0.3	13	1.9	2	0.3	11	1.5	10	1.3	14	1.9	31	4.2	8	1.1	4	0.6	3	0.4	7	1.0
Total	39	5.2	7	0.9	26	3.9	49	6.6	47	6.5	17	2.3	25	3.5	179	24.1	33	4.4	86	11.9	68	9.1	11	1.5
	PEN (RTX)																							
System	2	0.3	-	-	3	0.4	9	1.2	9	1.3	2	0.3	4	0.6	130	17.5	10	1.3	35	4.9	7	0.9	3	0.4
Luzon	-	-	-	-	-	-	-	-	1	0.1	2	0.3	-	-	1	0.1	2	0.3	2	0.3	2	0.3	1	0.1
Visayas	16	2.2	3	0.4	15	2.2	2	0.3	14	1.9	9	1.2	14	1.9	28	3.8	4	0.5	4	0.6	5	0.7	4	0.6
Total	18	2.4	3	0.4	18	2.7	11	1.5	24	3.3	13	1.7	18	2.5	159	21.4	16	2.2	41	5.7	14	1.9	8	1.1
	PSM (RTD)																							
System	97	13.0	217	29.2	263	39.1	189	25.4	161	22.4	179	24.1	80	11.1	16	2.2	61	8.2	125	17.4	111	14.9	84	11.7
Luzon	4	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.1	-	-	-	-
Visayas	-	-	1	0.1	1	0.1	7	0.9	-	-	1	0.1	-	-	-	-	1	0.1	-	-	-	-	-	-
Total	101	13.6	218	29.3	264	39.3	196	26.3	161	22.4	180	24.2	80	11.1	16	2.2	62	8.3	126	17.5	111	14.9	84	11.7
	PSM (RTX)																							
System	83	11.2	200	26.9	261	38.8	185	24.9	155	21.5	164	22.0	72	10.0	28	3.8	45	6.0	78	10.8	117	15.7	84	11.7
Luzon	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.1	-	-	-	-
Visayas	-	-	1	0.1	1	0.1	7	0.9	-	-	1	0.1	-	-	-	-	-	-	2	0.3	1	0.1	4	0.6
Total	83	11.2	201	27.0	-	-	192	25.8	155	21.5	165	22.2	72	10.0	28	3.8	45	6.0	81	11.3	118	15.9	88	12.2

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

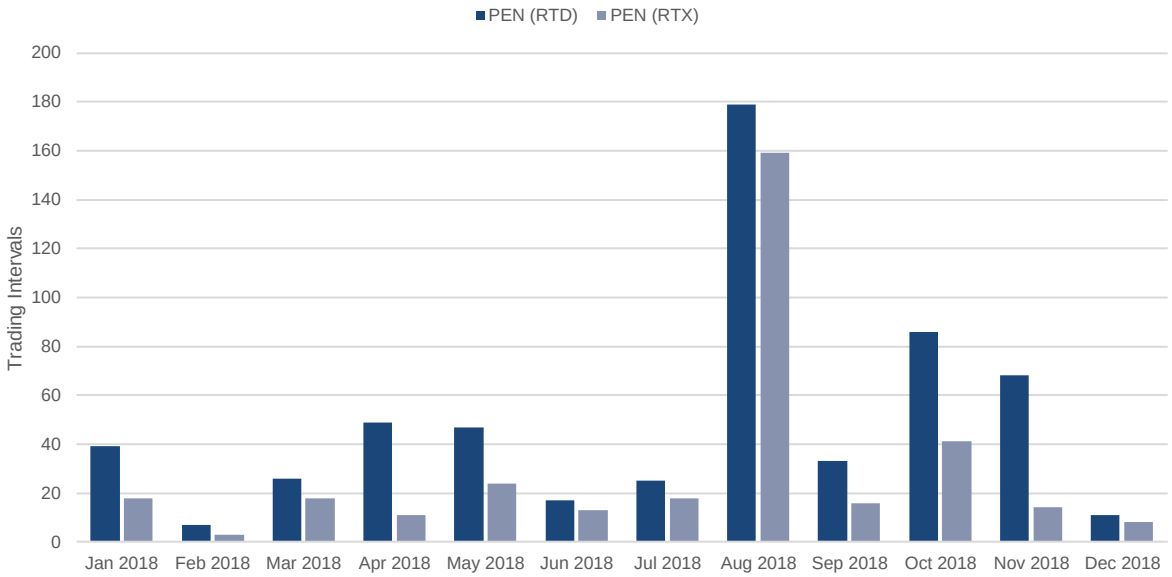


Figure 15. PEN Monthly Frequency Summary, 2018

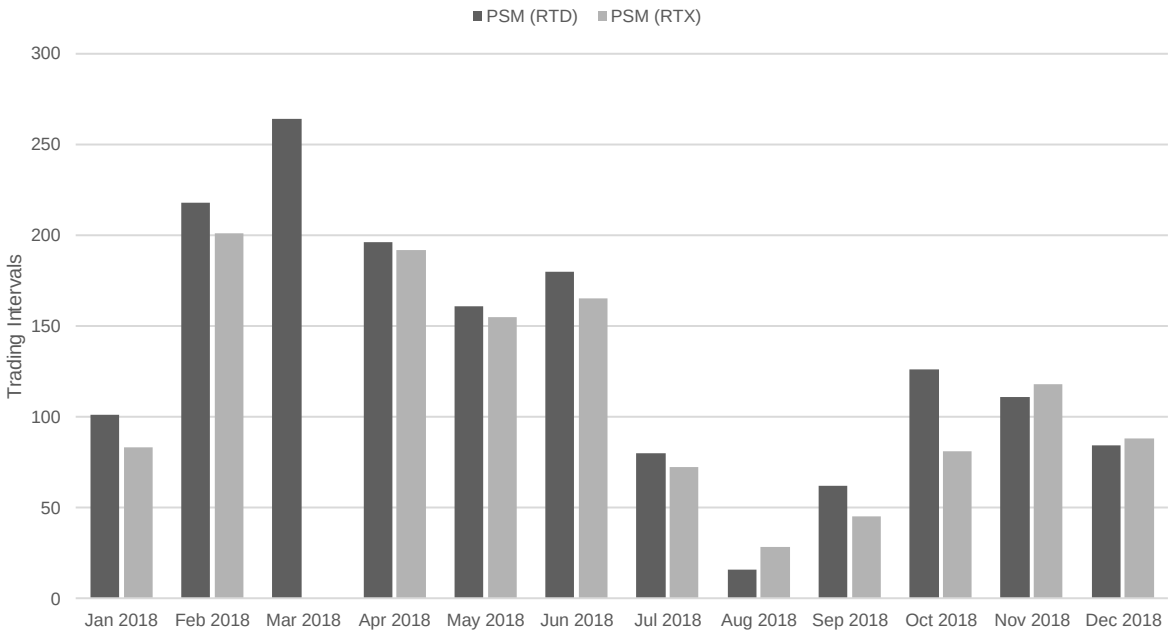


Figure 16. PSM Monthly Frequency Summary, 2018

Shown in Figure 17 and Table 14 are the non-congestion pricing errors by PEN type throughout the billing year, reflecting the occurrence of multiple types of PEN for a number of trading intervals.

Issuances of pricing errors due to inappropriate input data during the ex-ante garnered the highest frequency across the year, affecting a total of 304 trading intervals (3.5 percent). While base case-related non-congestion pricing errors totaled 149 issuances during the year (1.7 percent of the time).

Note that the pricing errors due to inappropriate input data were mostly observed in August, affecting a total of 145 trading intervals during the ex-ante run and 131 trading intervals during ex-post. On the other hand, issuance of base case-related non-congestion pricing errors was highest during the November billing month, affecting 58 trading intervals.

Table 14. PEN Type Summary, 2018

PEN Type Summary - 2018	Jan 2018		Feb 2018		Mar 2018		Apr 2018		May 2018		Jun 2018		Jul 2018		Aug 2018		Sep 2018		Oct 2018		Nov 2018		Dec 2018	
	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
SYSTEM																								
PEN (RTD)	**13**	**1.7**	**4**	**0.5**	**7**	**1.0**	**40**	**5.4**	**15**	**2.1**	**2**	**0.3**	**6**	**0.8**	**145**	**19.5**	**16**	**2.2**	**43**	**6.0**	**7**	**0.9**	**5**	**0.7**
Contingency	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-		-		-
Base Case	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-		-	1	0.1
Over-generation	4	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-		-		-
VoLL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-		-		-
Inappropriate Input Data	9	1.2	4	0.5	7	1.0	40	5.4	15	2.1	2	0.3	6	0.8	145	19.5	16	2.2	43	6.0	7	0.9	4	0.6
		-		-		-		-		-		-		-		-		-		-		-		-
PEN (RTX)	**2**	**0.3**	**-**	**-**	**3**	**0.4**	**9**	**1.2**	**9**	**1.3**	**2**	**0.3**	**4**	**0.6**	**130**	**17.5**	**10**	**1.3**	**35**	**4.9**	**7**	**0.9**	**3**	**0.4**
Contingency	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-		-
Base Case	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-		-
Over-generation	1	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-		-
VoLL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-		-
Inappropriate Input Data	1	0.1	-	-	3	0.4	9	1.2	9	1.3	2	0.3	4	0.6	130	17.5	10	1.3	35	4.9	7	0.9	3	0.4
LUZON																								
PEN (RTD)	**8**	**1.1**	**1**	**0.1**	**6**	**0.9**	**8**	**1.1**	**26**	**3.6**	**5**	**0.7**	**6**	**0.8**	**14**	**1.9**	**9**	**1.2**	**39**	**5.4**	**66**	**8.9**	**-**	**-**
Contingency	-	-	-	-	6	0.9	7	0.9	23	3.2	3	0.4	5	0.7	11	1.5	3	0.4		-		-		-
Base Case	4	0.5	1	0.1	-	-	-	-	-	-	-	-	-	-	-	-	5	0.7	36	5.0	55	7.4		-
Over-generation	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-		-		-
VoLL	4	0.5	-	-	-	-	-	-	3	0.4	2	0.3	-	-	3	0.4	1	0.1	3	0.4	11	1.5		-
Inappropriate Input Data	-	-	-	-	-	-	1	0.1	-	-	-	-	1	0.1	-	-	-	-		-		-		-
		-		-		-		-		-		-		-		-		-		-		-		-
PEN (RTX)	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**0.1**	**2**	**0.3**	**-**	**-**	**1**	**0.1**	**2**	**0.3**	**2**	**0.3**	**9**	**1.2**	**1**	**0.1**
Contingency	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-		-
Base Case	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	1	0.1
Over-generation	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-		-
VoLL	-	-	-	-	-	-	-	-	1	0.1	2	0.3	-	-	-	-	2	0.3	2	0.3	9	1.2		-
Inappropriate Input Data	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.1	-	-	-	-		-		-
VISAYAS																								
PEN (RTD)	**18**	**2.4**	**2**	**0.3**	**14**	**2.1**	**2**	**0.3**	**15**	**2.1**	**10**	**1.3**	**14**	**1.9**	**31**	**4.2**	**8**	**1.1**	**4**	**0.6**	**3**	**0.4**	**7**	**1.0**
Contingency	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-		-		-
Base Case	16	2.2	-	-	13	1.9	2	0.3	5	0.7	4	0.5	3	0.4	-	-	-	-	1	0.1	3	0.4		-
Over-generation	-	-	2	0.3	-	-	-	-	-	-	1	0.1	3	0.4	-	-	-	-	1	0.1		-	3	0.4
VoLL	-	-	-	-	1	0.1	-	-	10	1.4	5	0.7	6	0.8	31	4.2	8	1.1	2	0.3		-	4	0.6
Inappropriate Input Data	2	0.3	-	-	-	-	-	-	-	-	-	-	2	0.3	-	-	-	-		-		-		-
		-		-		-		-		-		-		-		-		-		-		-		-
PEN (RTX)	**16**	**2.2**	**3**	**0.4**	**15**	**2.2**	**2**	**0.3**	**18**	**2.5**	**9**	**1.2**	**14**	**1.9**	**28**	**3.8**	**4**	**0.5**	**4**	**0.6**	**5**	**0.7**	**4**	**0.6**
Contingency	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-		-
Base Case	16	2.2	1	0.1	15	2.2	1	0.1	5	0.7	3	0.4	4	0.6	-	-	-	-	2	0.3		-		-
Over-generation	-	-	2	0.3	-	-	-	-	-	-	-	-	4	0.6	-	-	-	-	1	0.1		-	4	0.6
VoLL	-	-	-	-	-	-	1	0.1	13	1.8	6	0.8	6	0.8	28	3.8	4	0.5	1	0.1	5	0.7		-
Inappropriate Input Data	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-		-
TOTAL																								
PEN (RTD)	**39**	**5.2**	**7**	**0.9**	**27**	**4.0**	**50**	**6.7**	**56**	**7.8**	**17**	**2.3**	**26**	**3.6**	**190**	**25.5**	**33**	**4.4**	**86**	**11.9**	**76**	**10.2**	**12**	**1.7**
Contingency	-	-	-	-	6	0.9	7	0.9	23	3.2	3	0.4	5	0.7	11	1.5	3	0.4	-	-	-	-	-	-
Base Case	20	2.7	1	0.1	13	1.9	2	0.3	5	0.7	4	0.5	3	0.4	-	-	5	0.7	37	5.1	58	7.8	1	0.1
Over-generation	4	0.5	2	0.3	-	-	-	-	-	-	1	0.1	3	0.4	-	-	-	-	1	0.1	-	-	3	0.4
VoLL	4	0.5	-	-	1	0.1	-	-	13	1.8	7	0.9	6	0.8	34	4.6	9	1.2	5	0.7	11	1.5	4	0.6
Inappropriate Input Data	11	1.5	4	0.5	7	1.0	41	5.5	15	2.1	2	0.3	9	1.3	145	19.5	16	2.2	43	6.0	7	0.9	4	0.6
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PEN (RTX)	**18**	**2.4**	**3**	**0.4**	**18**	**2.7**	**11**	**1.5**	**28**	**3.9**	**13**	**1.7**	**18**	**2.5**	**159**	**21.4**	**16**	**2.2**	**41**	**5.7**	**21**	**2.8**	**8**	**1.1**
Contingency	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Base Case	16	2.2	1	0.1	15	2.2	1	0.1	5	0.7	3	0.4	4	0.6	-	-	-	-	2	0.3	-	-	1	0.1
Over-generation	1	0.1	2	0.3	-	-	-	-	-	-	-	-	4	0.6	-	-	-	-	1	0.1	-	-	4	0.6
VoLL	-	-	-	-	-	-	1	0.1	14	1.9	8	1.1	6	0.8	28	3.8	6	0.8	3	0.4	14	1.9	-	-
Inappropriate Input Data	1	0.1	-	-	3	0.4	9	1.2	9	1.3	2	0.3	4	0.6	131	17.6	10	1.3	35	4.9	7	0.9	3	0.4

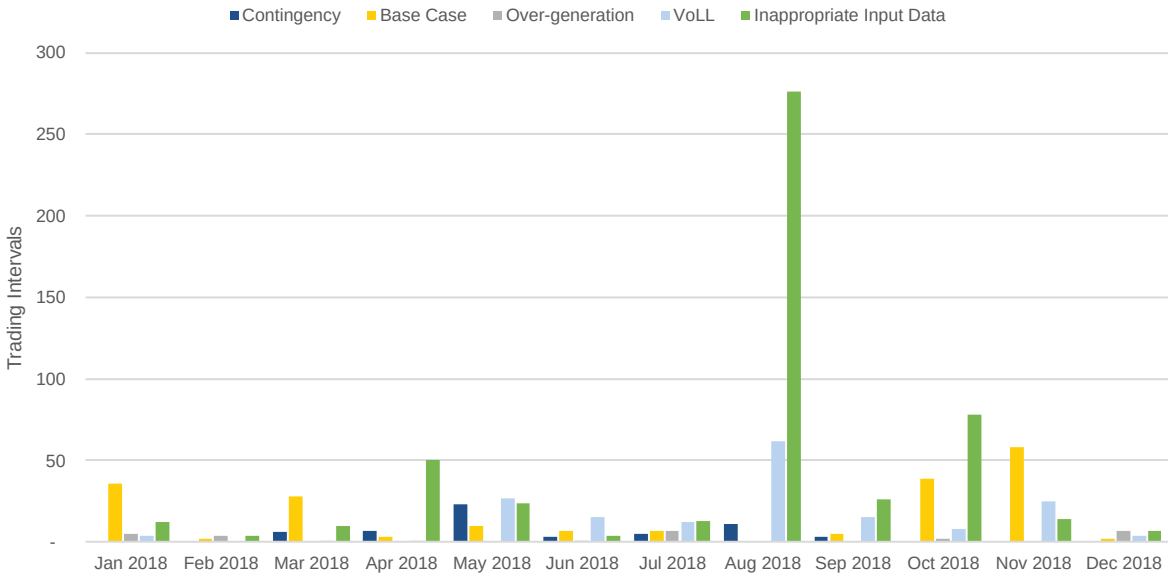


Figure 17. Monthly Frequency by PEN Type – Ex Ante, 2018

VII. HVDC Scheduling

The Luzon and Visayas regions were able to import and export power through the Leyte-Luzon High Voltage Direct Current (HVDC) Link. The Visayas plants exported cheaper energy to Luzon by as much as 420 MW, while the Luzon plants exported energy to Visayas by as much as 250 MW.

The HVDC power flow was predominantly directed towards Luzon, accounting for 6,627 trading intervals during the ex-ante, or 76 percent of the time during the year, while 1,952 trading intervals or 22 percent was attributed to the power flow from Luzon to Visayas. The remaining 2 percent (179 trading intervals) corresponded to the HVDC unavailability throughout the period, which in turn resulted in the regional price separation between the Luzon and Visayas.

HVDC was unavailable for two (2) trading intervals on 7 February at 0300H and 0400H, due to the refilling of SF6 gas at the converter transformer and on 21 August at 0900H related to the conduct of open line test of HVDC Line 2 and reconfiguration of L1-Ground to Line 2-Ground scheme.

In addition, no power flowed between Luzon and Visayas grids from 2 July at 0900H until 25 July 2018, affecting 136 trading intervals, and on 26 July from 0100H to 2200H, affecting 22 trading intervals, related to the annual preventive maintenance of the HVDC link. Likewise, no power flowed in the HVDC link on 16 October from 0900H to 1200H due to opening of breaker while Naga-Tayabas line was on outage.

The HVDC power flow going to Luzon was maximized for a total of 51 trading intervals in the ex-ante, while the power flow going to Visayas was maximized in 78 trading intervals. This resulted in the regional separation of prices during the affected intervals. Higher incidence of maximization of the HVDC power flow directed towards Visayas was observed on January, attributable to the wide supply margin which prevailed in Luzon during this month, which effectively pushed the power flow from Luzon to Visayas.

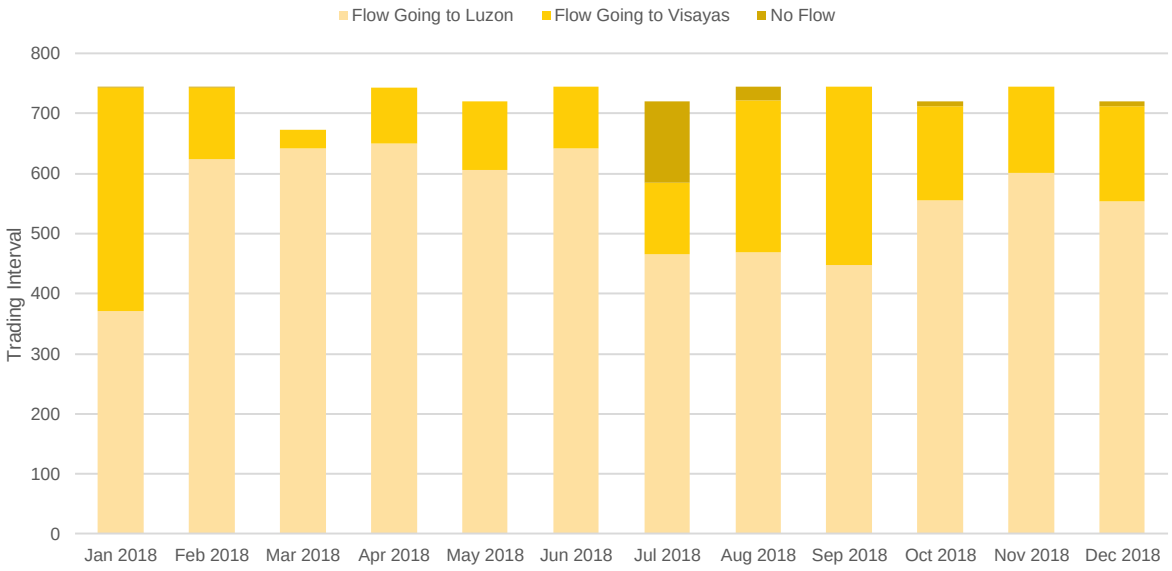


Figure 18. HVDC Power Flow Schedule – Monthly Frequency, 2018

Table 15. Monthly Frequency of HVDC Power Flow, 2018

	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018	Oct 2018	Nov 2018	Dec 2018	Total
Flow Going to Luzon	371	624	642	650	606	642	466	468	448	555	601	554	6,627
Limit Not Maximized	371	617	630	629	605	640	466	468	447	555	600	548	6,576
Limit Maximized	-	7	12	21	1	2	-	-	1	-	1	6	51
Flow Going to Visayas	372	118	30	92	114	102	118	253	296	157	143	157	1,952
Limit Not Maximized	324	118	30	92	114	102	118	244	287	150	141	154	1,874
Limit Maximized	48	-	-	-	-	-	-	9	9	7	2	3	78
No Flow	1	2	-	-	-	-	136	23	-	8	-	9	179
Total Trading Intervals	744	744	672	742	720	744	720	718	744	720	744	720	8,732

Table 16. Monthly Summary of HVDC Schedules (MW), 2018

	Flow Going to Luzon												
	Jan 2018	**Feb 2018**	**Mar 2018**	**Apr 2018**	**May 2018**	**Jun 2018**	**Jul 2018**	**Aug 2018**	**Sep 2018**	**Oct 2018**	**Nov 2018**	**Dec 2018**	**Annual**
Max	285.95	420.00	420.00	420.00	420.00	420.00	366.72	403.33	420.00	418.22	419.71	420.00	420.00
Min	0.29	0.36	1.96	1.43	0.08	1.77	1.19	0.26	0.42	0.23	1.05	1.02	0.08
Avg	89.17	185.84	215.54	203.48	185.18	199.87	166.34	158.32	153.70	164.15	175.72	181.39	173.23
	Flow Going to Visayas												
Max	-0.20	-0.34	-0.23	-0.67	-0.17	-0.28	-0.66	-0.16	-0.51	-1.01	-1.31	-0.30	-0.16
Min	-250.00	-213.35	-136.23	-186.53	-175.39	-150.86	-173.01	-250.00	-250.00	-250.00	-250.00	-250.00	-250.00
Avg	-121.16	-74.84	-49.29	-66.71	-78.08	-64.61	-80.76	-103.13	-124.13	-93.48	-90.80	-97.44	-87.04

VIII. Price Setting Plants[13]

[13] 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

Almost all or 99.2 percent of the market prices during the billing year were prices PhP10,000/MWh and below, with coal plants as the recurring price setters. The top five (5) price setting plants for prices PhP10,000/MWh and below were Masinloc CFTPP, Pagbilao CFTPP, Sual CFTPP, QPPL CFTPP and CEDC CFTPP.

Table 17. Price Setting Frequency Index at PhP0/MWh and Below, 2018

Most Frequent Price Setters at prices PhP10,000/MWh and below		Frequency (Number of trading intervals)												
Rank	Plant Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1	MASINLOC CFTPP	277	112	7	36	116	124	263	424	437	85	296	317	2,494
2	PAGBILAO CFTPP	261	199	35	80	176	176	146	260	304	179	199	189	2,204
3	SUAL CFTPP	138	150	130	242	207	234	261	235	99	130	156	178	2,160
4	QPPL CFTPP	231	4	34	214	187	99	174	170	176	150	130	124	1,693
5	CEDC CFTPP	147	92	16	48	133	113	122	239	217	170	130	150	1,577
6	ILIJAN NGPP	111	131	114	158	54	139	178	51	89	174	91	110	1,400
7	PCPC CFTPP	131	111	126	85	81	95	128	170	59	107	126	124	1,343
8	ANDA CFTPP		56	39	65	177	140	148	102	240	112	151	100	1,330
9	TPC (SANGI) CFTPP	38	12	50	71	142	69	116	195	140	166	119	96	1,214
10	SLTEC CFTPP	46	4	33	114	199	191	86	173	57	31	129	139	1,202
11	PEDC CFTPP	118	90	117	104	64	88	97	94	97	83	66	93	1,111
12	SAN LORENZO NGPP	174	115	141	132	92	62	65	5	28	39	10	39	902
13	STA RITA NGPP	116	177	170	167	77	40	38	5	23	12	17	26	868
14	SAN GABRIEL NGPP	13	33	41	35	72	18	84	50	81	134	129	71	761
15	KSPC CFTPP	170	41	2	13	91	64	53	134	50	21	24	45	708
16	AVION NGPP		78	58	118	92	91	33	1	1	27	16	11	526
17	ANGAT HEP	58	34	55	31	7		34	73	64	63	21	20	460
18	PAGBILAO 3 CFTPP				22	21	50	52	120	21	2	56	116	460
19	NAVOTAS DPP	85	67	67	60	59	45					1		384
20	TPC (CARMEN) DPP	20	27	47	35	47	33	33	29	19	12	7	2	311
21	EAUC DPP	13	24	45	38	23	28	35	10	11	14	17	13	271
22	MAGAT HEP	32	8	38	3	15	8	17	34	56	12	21	16	260
23	BACMAN GPP	22	4			4	31	11	19	30	13	24	43	201
24	SMC LIMAY CFTPP	51	46	14	41	1	22			15		5		195
25	MASINLOC BATTERY	3					1	39	96	15	1	27	8	190
26	MARIVELES CFTPP	50	5			3	5	1	24	19		19	57	183
27	CPPC DPP	5	20	26	7	7	18	31	21	11	15	5	6	172
28	TAPGC DPP	7	37	28	20	12	8	35			16	5	2	170
29	PALINPINON GPP I	31	9		11	2	4	26	11	26	8	11	23	162
30	BAUANG DPP		19	43	23	37	23	1						146
31	SUBIC DPP		14	29	18	10	21	19			10	1	3	125
32	BINGA HEP	6	1	14	6	10	16	15	5	9	8	26	7	123
33	PALINPINON GPP II	25	2	2	5	1	1	25	10	15	1	4	24	115
34	CIP DPP		17	23	16	6	13	25			1			101
35	NASULO GPP	23	1	2		1		23	10	15	1	3	22	101
36	MAKBAN GPP	26	2			2		6	5	19		3	20	83
37	AMBUKLAO HEP	6	1	11	8	11	8	4	5	8		3	7	72
38	TIWI GPP	24				2		3	5	15		3	20	72
39	TONGONAN GPP					1		22	10	15		3	21	72
40	BOTOCAN HEP	22				1			5	11		2	20	61
41	LEYTE A GPP	21	1					16	1	6		1	7	53
42	CASECNAN HEP	22				1			5	7		1	13	49
43	PANTABANGAN HEP	10	3	9	1		3	8		3	3		9	49
44	SAN ROQUE HEP		10	26	2						3		2	43
45	PB 101	4	9	17					7	4				41
46	MASIWAY HEP	22						3		1			5	31
47	BATANGAS DPP		2	11	2	3	1	2			2	1	1	25
48	BAKUN HEP	9					4		1	1		1	6	22
49	HEDCOR HEP	22												22
50	CALIRAYA HEP	6				1				5			6	18
51	PB 102	1	4	6	1		1		1	2			1	17
52	APEC CFTPP	2				1			4	1		3	2	13
53	PETRON SFFPP	5	2					2	4					13
54	PB 104										7			7
55	CALACA CFTPP	6												6
56	KALAYAAN PSPP	5								1				6
57	SLPGC CFTPP	4												4
58	MAIBARARA GPP	2												2
59	PANAY DPP III				1		1							2
60	CALUMANGAN DPP			1										1

Meanwhile, 0.7 percent of the market prices were above PhP10,000/MWh to PhP20,000/MWh. These prices were mostly set by Bohol DPP, PB 104 and Limay CCGT.

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 18. Price Setting Frequency Index at Above PhP10,000/MWh to PhP20,000/MWh, 2018

Most Frequent Price Setters at prices Above PhP10,000/MWh and PhP20,000/MWh		Frequency (Number of trading intervals)												
Rank	**Plant Name**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
1	BOHOL DPP					3	3	17	12	2				37
2	PB 104								26	2	1			29
3	LIMAY CCGT		1	1	6	5	5	3						21
4	CALUMANGAN DPP		1			2		5		1		2	4	15
5	SAN ROQUE HEP			3	5		1	2				1		12
6	NABAS DPP		1		1	6	1	1					1	11
7	BAUANG DPP					1	2	5						8
8	SLPGC GTPP					1	1	5		1				8
9	ANGAT HEP			2	2	2								6
10	CIP DPP					1	1	3						5
11	PANAY DPP I											1	3	4
12	PANAY DPP III							1	1				2	4
13	TAPGC DPP				1			2					1	4
14	ANDA CFTPP							2						2
15	CEBU DPP II	1					1							2
16	NAVOTAS DPP												2	2
17	PANTABANGAN HEP			1				1						2
18	SUBIC DPP					1							1	2
19	SAN GABRIEL NGPP			1										1
20	SMC LIMAY CFTPP			1										1

On the other hand, market prices above PhP20,000/MWh very rarely occurred, which was recorded at only 0.1 percent of the time. The top three (3) price setting plants for prices above PhP20,000/MWh were Calumangan DPP, Limay CCGT and Navotas DPP.

Table 19. Price Setting Frequency Index at Above PhP20,000/MWh to PhP32,000/MWh, 2018

Most Frequent Price Setters at prices Above PhP20,000/MWh and PhP32,000/MWh		Frequency (Number of trading intervals)												
Rank	**Plant Name**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
1	CALUMANGAN DPP						1	2	1		1		4	9
2	LIMAY CCGT					1				2	2	1	1	7
3	NAVOTAS DPP										3	3		6
4	SAN ROQUE HEP					1						1	1	3
5	AVION NGPP			1							1			2
6	CPPC DPP										2			2
7	ANDA CFTPP												1	1
8	BACMAN GPP											1		1
9	KALAYAAN PSPP				1									1
10	SAN GABRIEL NGPP			1										1
11	SLPGC GTPP												1	1
12	SUBIC DPP			1										1
13	TAPGC DPP			1										1

IX. Residual Supply

The presence of pivotal suppliers was noted in 20.2 percent of the time during the billing year, as demonstrated by the resulting hourly Market Residual Supply Index (Market RSI)[14] below the 100 percent threshold. Meanwhile, majority or 79.8 percent of the remaining trading intervals indicated that the system-wide effective supply level was very much sufficient in meeting demand requirements most of the time. This was manifested through the hourly market RSI of more than or equal to 100 percent.

Following the tight supply margin events in March and April, the market RSI fell below the 100 percent mark more often occurring in 45.8 percent and 39percent of the time, respectively, and exhibiting the highest number of pivotal suppliers during the period.

Market RSI levels improved this year when compared with billing year 2017, indicated by the occurrence of market RSI of less than 100 percent at 26.9 percent in the previous year.

Table 20. Market RSI Summary – System, 2018

	Market RSI (%) Distribution by Billing Month, 2018 - System												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg
Less than 100%	1.9	27.4	45.8	39.0	29.9	22.6	25.0	2.7	13.6	21.0	9.5	6.9	20.2
Mor than or equal to 100%	98.1	72.6	54.2	61.0	70.1	77.4	75.0	97.3	86.4	79.0	90.5	93.1	79.8

Table 21. Market RSI Summary – System, 2017

	Market RSI (%) Distribution by Billing Month, 2017 - System												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg
Less than 100%	2.4	27.2	42.2	24.2	42.9	43.4	31.3	26.6	30.7	27.0	24.3	4.2	26.9
Mor than or equal to 100%	97.6	72.8	57.8	75.8	57.1	56.6	68.8	73.4	69.3	73.0	75.7	95.8	73.1

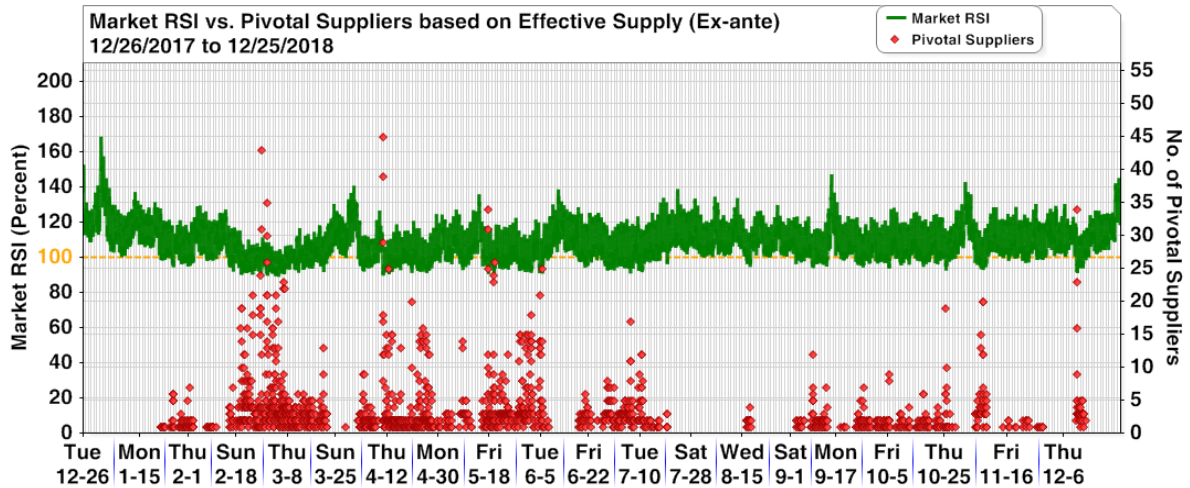


Figure 19. Market RSI vs. Pivotal Suppliers (Ex-Ante), 2018

[14] 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.

X. Pivotal Suppliers[15]

Thirty-three (33) plants from Luzon and 15 plants from the Visayas became system-wide pivotal suppliers during the billing year, indicating that the capacity of these plants became critical in meeting the total demand at a particular trading interval.

Major coal plants Sual CFTPP, Pagbilao CFTPP, Masinloc CFTPP and Mariveles CFTPP, and natural gas plant Ilijan NGPP, Sta. Rita NGPP and San Lorenzo NGPP, as well as hydro plant Kalayaan PSPP topped the list of pivotal suppliers from Luzon. Large generating plants Sual CFTPP, Ilijan NGPP and Sta. Rita NGPP became pivotal in 15.7 percent, 14.5 percent and 13.2 percent of the time during the year. Major plants Pagbilao CFTPP, Masinloc CFTPP and Mariveles CFTPP distantly followed with 4.7 percent, 2.7 percent and 2.5 percent. Hydro plant Kalayaan PSPP and natural gas plant San Lorenzo NGPP likewise became pivotal suppliers at 3.1 and 2.5 percent of the time.

On the other hand, large geothermal plant Leyte A GPP was the most frequent pivotal supplier among the Visayas plants during the billing year at 1.6 percent, followed by coal plants PEDC CFTPP, CEDC CFTPP, KSPC CFTPP and PCPC CFTPP at 0.9 percent, 0.6 percent 0.3 percent, and 0.2 percent, respectively.

It was observed that the frequency by which generating plants became pivotal was higher during the March and April billing months, the same months which demonstrated tight demand and supply.

Provided in Table 18 are the pivotal suppliers in the market during the billing year.

[15] 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, 2018

Top Pivotal Suppliers		Frequency (Number of trading intervals)												
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Rank	Plant Name	LUZON PLANTS												
1	SUAL CFTPP		131	306	288	201	168	170	20	2	11	40	42	1,379
2	ILIJAN NGPP		120	243	58	163	146	160	16	97	151	70	48	1,272
3	STA RITA NGPP	14	155	210	199	141	114	103		62	80	48	34	1,160
4	PAGBILAO CFTPP		87	123	24	42	59	13	1	12	17	21	13	412
5	KALAYAAN PSPP		27	63	59	36	42	9	1	9	14	9	2	271
6	MASINLOC CFTPP		10	32	49	36	47	26		9	11	5	9	234
7	SAN LORENZO NGPP		37	63	39	24	32	16		2	5		4	222
8	MARIVELES CFTPP		13	14	52	31	41	33		8	9	14	3	218
9	SAN GABRIEL NGPP		21	30	16	11	28	5			1	6		118
10	SMC LIMAY CFTPP		8	31	24	9	24	1		1	1	6	3	108
11	CALACA CFTPP		8	13	32	13	14	14		1	4	7	2	108
12	SAN ROQUE HEP		23	48	11	6	1	1		1	1	6	4	102
13	PAGBILAO 3 CFTPP			2	28	14	28				1	4	4	81
14	QPPL CFTPP				32	14	5	9		1	3	6	4	74
15	LIMAY CCGT		5	20	15	8	19	1			1	2	3	74
16	MAGAT HEP		15	40	3	8		1				3	3	73
17	MAKBAN GPP		4	18	4	6	2					2	2	38
18	BAUANG DPP		2	19	4	6	2					2	2	37
19	SLTEC CFTPP			17	7	6	4						1	35
20	NAVOTAS DPP		2	18	4	6	2						1	33
21	ANGAT HEP		1	16	4									21
22	BINGA HEP		1	8	3	2	1						2	17
23	BACMAN GPP			6	4	3							1	14
24	SLPGC CFTPP			3		5	1				1		3	13
25	AMBUKLAO HEP			3	3	1							1	8
26	TIWI GPP			4	3								1	8
27	AVION NGPP			4	2	1							1	8
28	PANTABANGAN HEP			3	2								1	6
29	SUBIC DPP			3	2	1								6
30	ANDA CFTPP			2	2									4
31	TAPGC DPP			1	1									2
32	CASECNAN HEP			1										1
33	CALIRAYA HEP				1									1
Rank	Plant Name	VISAYAS PLANTS												
1	LEYTE A GPP		12	43	28	13	28	7		1	1	6	3	142
2	PEDC CFTPP		10	33	6	7	13	1			1	3	3	77
3	CEDC CFTPP		7	24	7	6	4				1	2	2	53
4	KSPC CFTPP			8	2	6	3	1					2	22
5	PCPC CFTPP			7	4	2							1	14
6	TPC (SANGI) CFTPP			5	4	3	1						1	14
7	PALINPINON GPP I			2	3	2							1	8
8	TONGONAN GPP			1	2	2							1	6
9	CPPC DPP			1	2									3
10	PANAY DPP III			1	2									3
11	PALINPINON GPP II			1	2									3
12	NASULO GPP			1	1									2
13	TPC (CARMEN) DPP			1	1									2
14	EAUC DPP			1	1									2
15	PB 101				1									1

XI. Price-Setters and Pivotal Plants

Some suppliers that were pivotal during the year also became price setters in the same trading interval, making them both pivotal and price-setting plants at the same time.

For prices PhP10,000/MWh and below, natural gas plants Ilijan NGPP, Sta. Rita NGPP and San Gabriel NGPP were the most frequent price-setters and pivotal suppliers at the same time at 2.2 percent, 0.4 percent and 0.1 percent of the time, respectively. This is followed by coal plant Sual CFTPP at 1.3 percent and hydro plants Magat HEP, San Roque HEP and Binga HEP at 0.2 and 0.2 percent of the time, respectively.

Oil-based plant Limay CCGT dominated the list of price-setters and pivotal suppliers within the higher price range of above PhP10,000/MWh to PhP20,000/MWh at 0.1 percent of the time. Hydro plant San Roque HEP, oil-based plant Bauang DPP and natural gas plant San Gabriel NGPP followed at 0.08 and 0.01 of the time, respectively.

Finally, hydro plant San Roque HEP and natural gas plant Avion NGPP showed the most frequency of being pivotal and price-setter simultaneously, for prices above PhP20,000/MWh to PhP32,000/MWh. It may be observed that San Roque HEP and San Gabriel NGPP were both price setters and top pivotal suppliers, in all price ranges.

Table 23. Price Setters and Pivotal Suppliers, 2018

Most Frequent Price Setters and Pivotal Suppliers	Frequency (Number of trading intervals)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
PhP10,000/MWh and below													
ILIJAN NGPP		1	3	2	3	4	29	13	57	46	20	15	193
SUAL CFTPP		8	9	48	20	7	9	8				1	110
STA RITA NGPP	4	9		9	1	4			3		1		31
MAGAT HEP		2	12	1	2						2		19
SAN ROQUE HEP		8	8										16
SAN GABRIEL NGPP			2	1	1								4
BINGA HEP												1	1
Above PhP10,000/MWh and PhP20,000/MWh													
LIMAY CCGT			1	4	2	5							12
SAN ROQUE HEP			1	4		1	1						7
BAUANG DPP						1							1
SAN GABRIEL NGPP			1										1
Above PhP20,000/MWh and PhP32,000/MWh													
SAN ROQUE HEP											1	1	2
AVION NGPP			1										1
KALAYAAN PSPP				1									1
LIMAY CCGT												1	1
SAN GABRIEL NGPP			1										1
SUBIC DPP			1										1
TAPGC DPP			1										1

XII. Generator Offer Pattern

Among all plant types, the geothermal plants in Luzon consistently offered their capacity at the lowest prices, with 55.9 percent of their total offers priced at PhP0/MWh and the remaining 44.1 percent priced at negative.

Noticeable during the billing months of March, April and May 2018 were instances of higher RTD schedule than offered capacity as a result of the imposition of over-riding constraints on Maibarara GPP unit 2 for its conduct of testing and commissioning starting 9 March until 30 April.

Considering the low offer prices of the Luzon geothermal plants, 99.9 percent of their offered capacity was scheduled for dispatch in the market during the year.

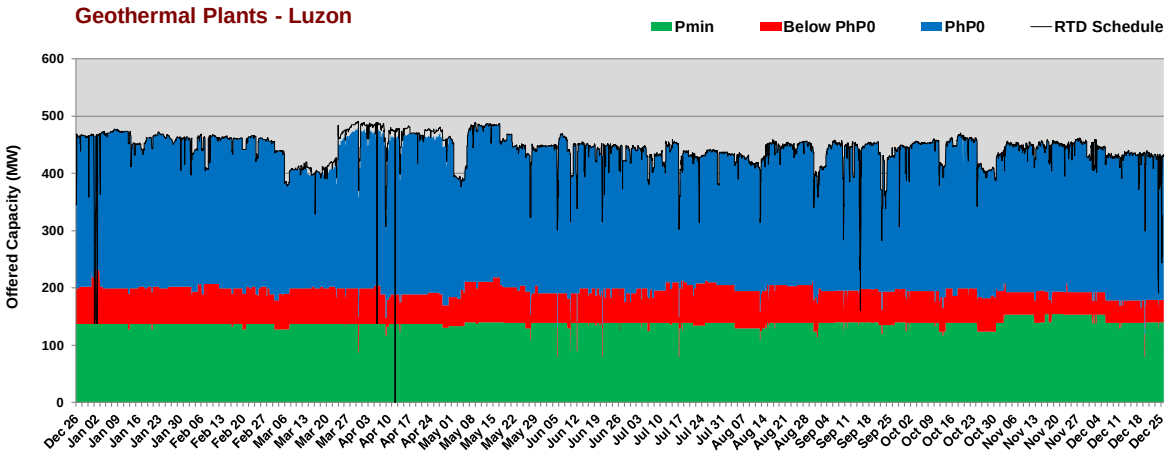


Figure 20. Geothermal Plants Offer Pattern, Luzon, 2018

On the other hand, the offer prices of the geothermal plants in the Visayas were higher than those in Luzon, though majority of its capacity offers at 61.9 percent were submitted at below PhP0/MWh. The 15.2 percent were capacity offers priced at PhP0/MWh while 22.8 percent were priced above PhP0/MWh to PhP5,000/MWh.

Dip in the offered capacity of the Visayas geothermal plants was noted at the start of the billing year, following the high outage incidence involving Leyte A and Palinpinon GPP unit 1 (on forced outages). Further, occurrences of higher RTD schedule than offered capacity was noted in some intervals during the billing month of January 2018 as a result of the imposition of over-riding constraints on TVI CFTPP for its conduct of commissioning tests.

About 96.8 percent of the total offered capacity of the region's geothermal plants were scheduled for dispatch across the billing year.

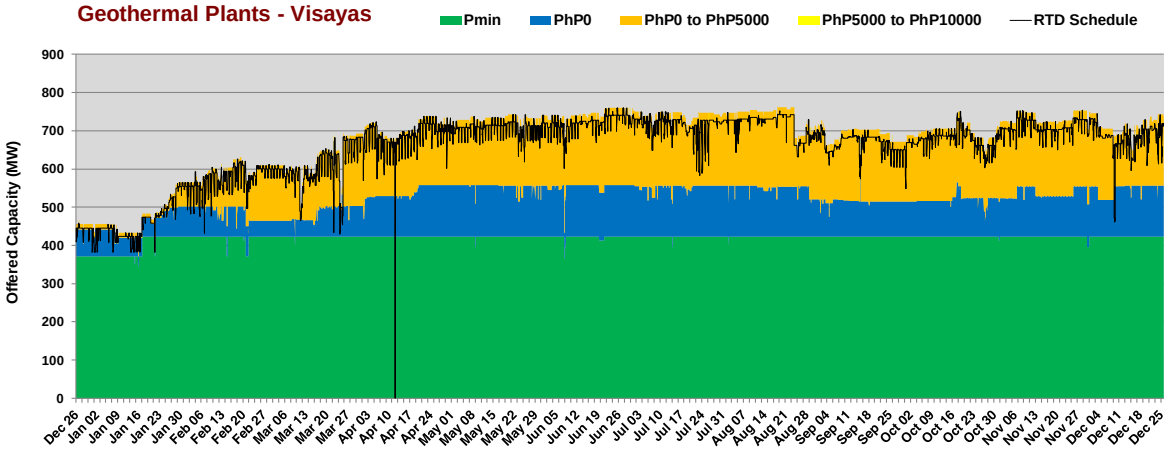


Figure 21. Geothermal Plants Offer Pattern, Visayas, 2018

About 69 percent of the natural gas plants' capacity offers were priced PhP0/MWh and below, 27.2 percent was priced above PhP0/MWh to PhP5,000/MWh and 1.7 percent was priced at above PhP5,000/MWh to PhP10,000/MWh. A portion, at 2.1 percent, was offered at prices above PhP30,000/MWh up to PhP32,000/MWh.

Low level of natural gas plants' offered capacity was noted on 27 to 31 December following the forced outages of Sta. Rita NGPP units 1, 3, and 4, San Lorenzo NGPP, and Ilijan Block B unit 1 on top of the maintenance outage of Sta. Rita NGPP unit 2 and planned outage of San Gabriel NGPP. Similarly, lower level of offered capacity was noted beginning 20 January related to the maintenance outages of Sta. Rita NGPP unit 1, Ilijan NGPP Block B, and Avion NGPP.

Likewise, relatively lower level of natural gas plants' capacity was offered during the first half of February billing month following the maintenance outage of Ilijan Block B until 10 February.

Accordingly, about 78.6 percent of the offers of natural gas plants were scheduled for dispatch during the year.

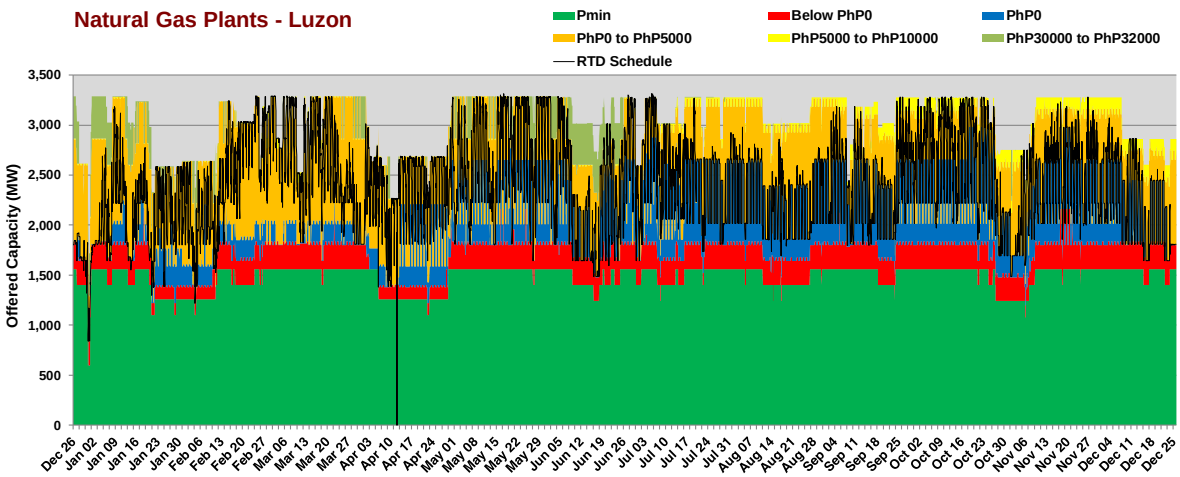


Figure 22. Natural Gas Plants Offer Pattern, Luzon, 2018

The coal plants in Luzon submitted the bulk of its capacity offers at PhP0/MWh and below, accounting for 59.0 percent of its total capacity offers throughout the year. Offer prices from PhP0/MWh to PhP5,000/MWh comprised about 38.8 percent, while 1.0 percent were priced at above PhP5,000/MWh to PhP10,000/MWh. The remaining 1.6 percent were capacity offers submitted above PhP10,000/MWh.

Higher RTD schedule than offered capacity was noted in some intervals during the billing months of January, February and March 2018 as a result of the imposition of over-riding constraints on Pagbilao CFTPP unit 3 and SMC Limay CFTPP unit 3 for the conduct of testing and commissioning.

Similar occurrences were observed in some intervals during the billing month of April as SMC Limay CFTPP continued with its conduct of its testing and commissioning. Likewise, Masinloc CFTPP unit 2 started its conduct of testing and commissioning and performance tests during the same month which continued until the billing month of May 2018, contributing to the higher RTD schedule than offered capacity during the said billing months.

About 89.3 percent of the capacity offers of Luzon coal plants were scheduled for dispatch within the year.

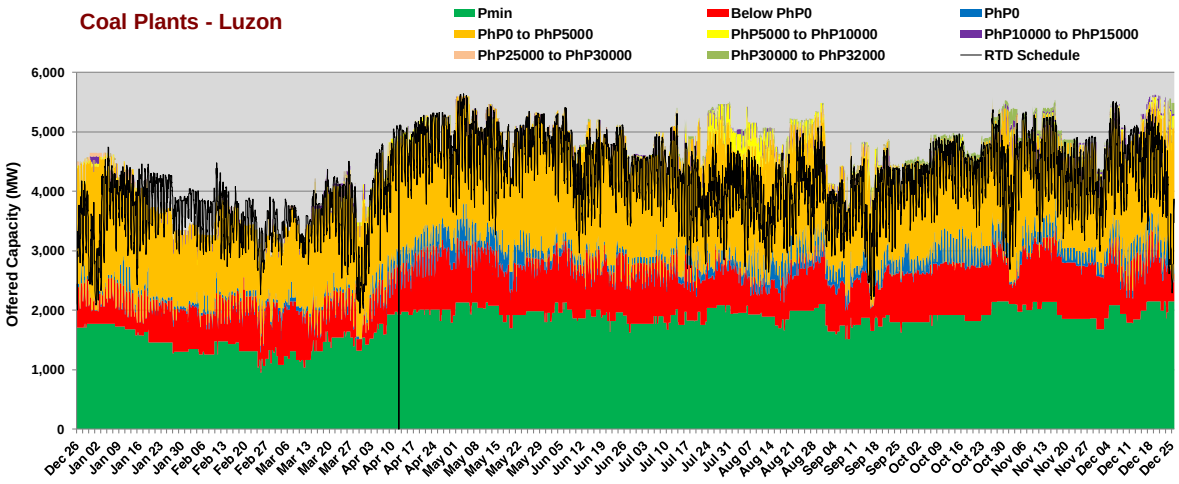


Figure 23. Coal Plants Offer Pattern – Luzon, 2018

On the other hand, majority or 65.5 percent of the offers of the Visayas coal plants were priced below PhP0/MWh while another 4.1 percent were priced at PhP0/MWh. Offers above PhP0/MWh to PhP5,000/MWh comprised a significant 32.8 percent of the total capacity offers of the Visayas coal plants. Meanwhile, 1.5 percent were apportioned in offer prices above PhP5,000/MWh to PhP10,000/MWh while the remaining 0.1 percent were priced even higher at above PhP30,000/MWh to PhP32,000/MWh.

Occurrences of higher RTD schedule than offered capacity was noted in some intervals during the January, February, March and April 2018 billing months as a result of the imposition of over-riding constraints on TVI CFTPP for its conduct of testing and commissioning.

About 85.6 percent of the offered capacity from Visayas coal plants was scheduled for dispatch during the year.

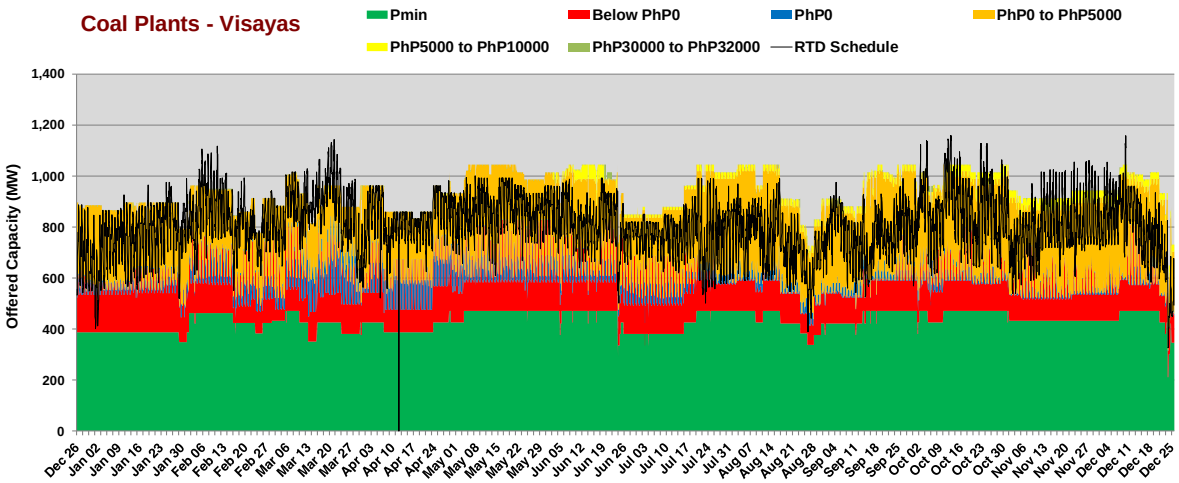


Figure 24. Coal Plants Offer Pattern, Visayas, 2018

Hydro plants offered their capacity at higher prices majority of which, comprising 36.1 percent of their total offers during the year, are priced above PhP5,000/MWh to PhP10.000/MWh. Meanwhile, 7.8 percent constituted of offer prices above PhP10,000/MWh to PhP20,000/MWh while 7.5 percent were priced above PhP20,000/MWh to PhP30,000/MWh. About 5.1 percent were priced even higher at above PhP30,000/MWh to PhP32,000/MWh. Nevertheless, it should be noted that some of the large hydro plants are ancillary services providers and were thus submitting their capacity offers at higher prices.

Lower priced capacity offers were likewise observed from hydro plants, with 11.0 percent of the capacity offers priced above PhP0/MWh to PhP5,000/MWh while another 13.6 percent were priced at PhP0/MWh. The remaining 19.0 percent were capacity offers submitted at PhP0/MWh and below. It is noted that more capacities were offered by hydro plants at PhP0/MWh during the second half of the billing year, as shown in Figure 21. As expected, dip in the level of capacity offers of hydro plants was likewise observed during the summer months of May and June.

Only about 44.3 percent of the offers of hydro plants had been scheduled for dispatch during the year. Their capacity offers were dispatched more frequently in August at 73.3 percent and September at 74.1 percent.

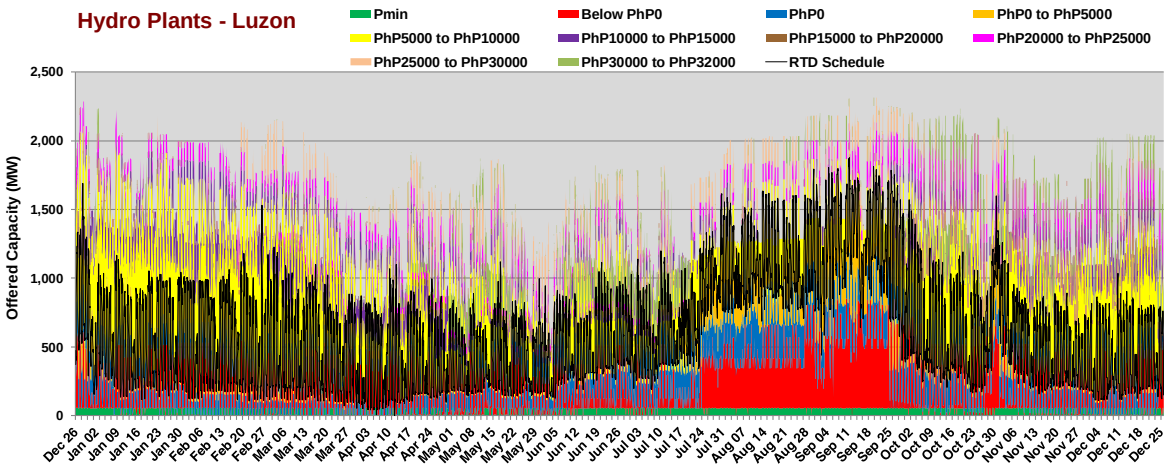


Figure 25. Hydro Plants Offer Pattern, Luzon, 2018

Luzon oil-based plants continued to submit the highest priced capacity offers during the year. Bulk of their capacity offers comprising of 31.1 percent were priced above PhP30,000/MWh to PhP32,000/MWh. About 18.2 percent were priced at above PhP15,000/MWh to PhP20,000/MWh, while 17 percent were priced above PhP5,000/MWh to PhP10,000/MWh.

Meanwhile, another 11.5 percent comprised of offers submitted above PhP20,000/MWh to PhP25,000/MWh, while 10.6 percent were priced above PhP10,000/MWh to PhP15,000/MWh and another 10.1 percent were priced above PhP25,000/MWh to PhP30,000/MWh. The remaining 1.4 percent were offer prices at above PhP0/MWh to PhP5,000/MW.

Considering the high priced capacity offers of Luzon oil-based plants, only 9.7 percent of its total offers was scheduled for dispatch during the year. Notwithstanding, the offered capacity of oil-based plants that were scheduled for dispatch during the March and April billing months (at 26.2 percent and 21.2 percent, respectively), were notably higher than the 9.7 percent annual average. It may be noted that events of tight demand and supply condition occurred across these billing months.

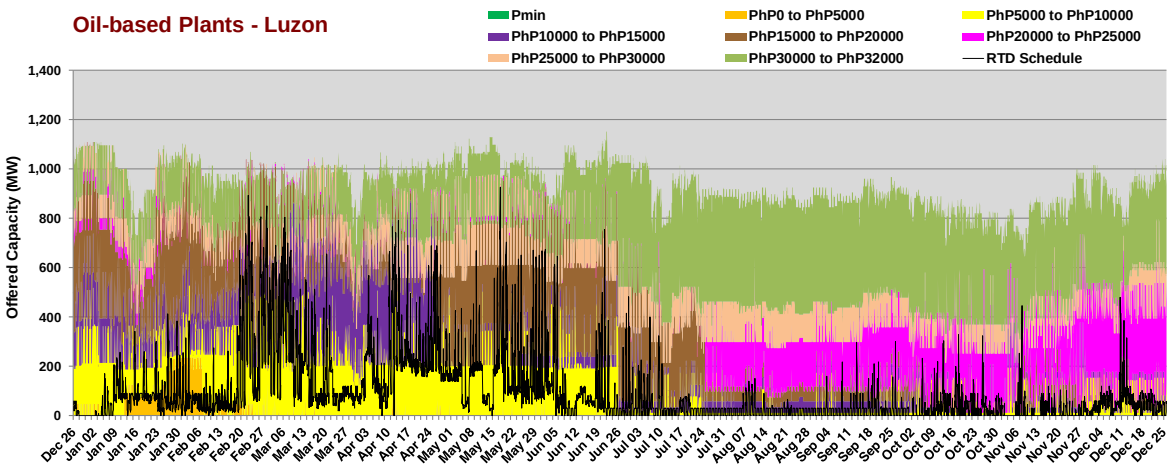


Figure 26. Oil-based Plants Offer Pattern, Luzon, 2018

High offer prices were likewise observed among the Visayas oil-based plants during the year. Nevertheless, their offer prices were still lower when compared with the offer prices of the oil-based plants in Luzon.

A significant chunk of the capacity offers of the Visayas oil-based plants ranged above PhP5,000/MWh to PhP10,000/MWh. This comprised 45.5 percent of the total offers of the Visayas oil-based plants for the year. Meanwhile, 10.3 percent of the capacity offers were submitted above PhP10,000/MWh to PhP15,000/MWh while another 24.1 percent were priced higher at above PhP15,000/MWh to PhP20,000/MWh. About 1.2 percent of the offers were priced above PhP20,000/MWh to PhP25,000/MWh, another 9.5 percent were capacity offers ranging above PhP25,000/MWh to PhP30,000/MWh while about 6.8 percent were priced above PhP30,000/MWh to PhP32,000/MWh. The remaining 2.6 percent were lower priced offers. Of which, 2.5 percent comprised of offers priced at PhP0/MWh while 0.1 percent were priced below PhP0/MWh.

Change in the offer pattern of the Visayas oil-based plants was observed as they offer more capacity in the market from April to June, though these were offered within the higher price range of above PhP15,000/MWh to PhP20,000/MWh. Visayas oil-based plants continued to offer frequently in the same range until the close of the billing year.

Consequently, only 5.9 percent of the capacity offers of the Visayas oil-based plants were scheduled for dispatch. However, their capacity offers were dispatched more frequently from in March accounting for 16.4 percent of their total capacity offers during this month.

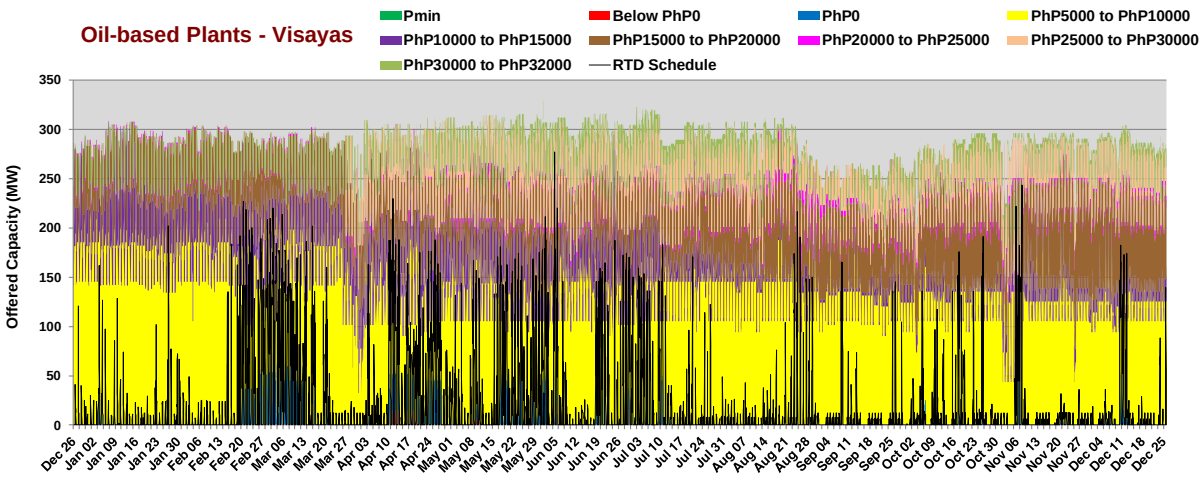


Figure 27. Oil-based Plants Offer Pattern, Visayas, 2018

XIII. Capacity Factor

For the billing year 2018, natural gas, coal and geothermal plants showed higher utilization among all resource types system-wide, with capacity factors of 72.7 percent, 60.3 percent and 57.8 percent, respectively, when measured based on registered capacity. For hydro plants, only about 27 percent of its registered capacity was actually utilized while the capacity factor of oil-based plants was even lower at only 5.7 percent.

Similarly, capacity factors determined based on available capacity (where outages are netted out) and offered capacity would show higher utilization among natural gas, coal and geothermal plants which submitted most of their capacity offers at relatively lower prices. On the other hand, hydro plants recorded their utilization based on available capacity at 29.3 percent and 46.4 percent based on offered capacity, while oil-based plants demonstrated lower utilization levels at 6.8 percent based on available capacity and 10.7 percent based on offered capacity. The low utilization of hydro plants is consistent with their limited offer submission as reflected in their high level of capacity gap.

On the other hand, wind and solar plants have capacity factors of about 30.3 percent and 17.8 percent, respectively. Note that solar plants are available only during the day time and the bulk of their contribution was between 0800H to 1500H during the billing year. Meanwhile, biomass plants posted their utilization level at 31.1 percent in terms of registered capacity and 34.1 percent in terms of available capacity.

The sole battery energy storage facility in the WESM, Masinloc Battery, posted a capacity factor of about 3 percent when measured in terms of registered capacity and available capacity, and about 3.2 percent when measured in terms of offered capacity.

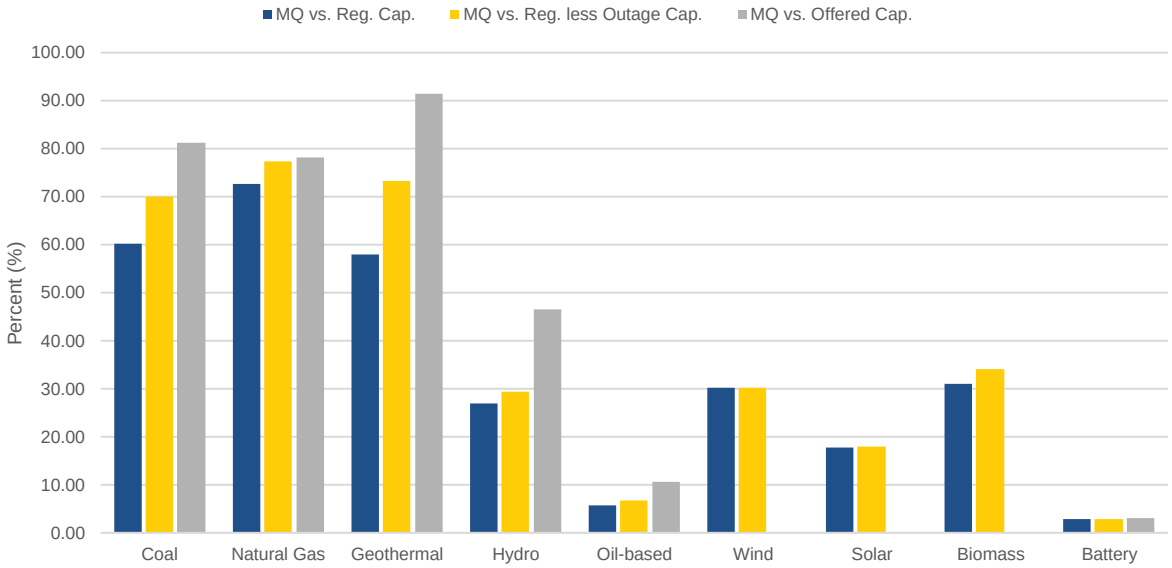


Figure 28. Capacity Factor – System, 2018

Table 24. Capacity Factor – System, 2018

Plant Type	Metered Quantity vs Registered Capacity (%)												
	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018	Oct 2018	Nov 2018	Dec 2018	Average
Coal	54.02	53.85	52.98	62.27	69.97	67.25	61.44	57.67	55.66	63.29	62.91	61.86	60.26
Natural Gas	60.63	71.94	83.78	68.79	80.13	71.11	76.92	68.75	70.61	80.99	69.86	68.25	72.65
Geothermal	45.06	52.01	59.39	60.06	60.61	60.57	59.59	60.24	58.05	59.05	59.92	59.39	57.83
Hydro	27.55	23.90	21.90	16.76	17.07	19.48	26.17	45.95	51.20	29.48	24.67	19.46	26.97
Oil-based	4.70	7.29	12.40	11.18	10.07	7.76	3.48	2.01	2.91	2.38	1.56	3.12	5.74
Wind	50.92	43.00	38.12	32.92	14.58	20.22	16.48	28.12	13.33	23.43	35.94	46.21	30.27
Solar	15.11	18.28	19.11	21.71	21.05	16.83	15.36	16.52	16.50	19.08	17.90	16.07	17.79
Biomass	35.22	37.30	29.57	37.65	36.43	29.40	25.01	23.65	22.93	31.80	32.21	32.25	31.12
Battery	0.60	3.27	2.79	7.29	12.61	1.24	1.41	1.17	1.27	1.58	1.51	1.02	2.98

Plant Type	Metered Quantity vs Registered less Outage Capacity (%)												
	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018	Oct 2018	Nov 2018	Dec 2018	Average
Coal	63.05	71.55	71.96	73.93	74.97	73.85	71.98	63.57	66.29	73.53	67.86	67.79	70.03
Natural Gas	66.34	82.91	84.44	80.43	81.87	74.19	80.63	71.92	73.34	81.46	74.85	74.67	77.25
Geothermal	60.45	64.58	74.58	74.58	74.43	76.93	74.31	72.44	76.32	78.70	77.23	74.79	73.28
Hydro	28.08	24.60	23.65	19.74	20.47	23.05	29.27	51.03	53.03	31.60	26.82	20.42	29.31
Oil-based	5.08	7.70	12.64	12.46	12.15	10.17	4.62	2.53	4.11	3.57	2.05	3.92	6.75
Wind	50.92	43.00	38.12	32.92	14.58	20.22	16.48	28.12	13.33	23.43	35.94	46.21	30.27
Solar	15.12	18.29	19.13	21.80	21.07	16.87	15.45	16.53	17.37	19.20	17.92	16.09	17.90
Biomass	36.76	37.98	33.16	39.85	37.24	33.65	32.44	30.56	27.10	33.50	33.35	33.28	34.07
Battery	0.60	3.27	2.79	7.29	12.61	1.24	1.41	1.17	1.27	1.58	1.51	1.02	2.98

Plant Type	Metered Quantity vs Offered Capacity (%)												
	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018	Oct 2018	Nov 2018	Dec 2018	Average
Coal	78.22	91.87	86.16	83.81	84.00	83.20	80.33	70.51	76.12	83.69	78.27	78.08	81.19
Natural Gas	66.63	83.65	89.62	81.52	82.27	74.63	81.27	72.40	74.10	81.85	75.52	74.98	78.20
Geothermal	87.57	89.61	91.96	92.47	91.59	91.87	90.76	91.32	91.92	92.19	92.13	91.89	91.27
Hydro	41.79	38.14	36.78	36.05	35.74	43.42	53.78	74.96	75.10	44.22	43.72	33.62	46.44
Oil-based	8.65	13.38	22.74	20.98	17.73	14.10	6.59	3.94	5.87	4.93	3.32	5.97	10.68
Battery	1.51	4.00	3.22	7.42	12.62	1.26	1.41	1.17	1.27	1.58	1.51	1.02	3.16

Shown in Figure 29, regional calculation of capacity factors indicates better utilization among the coal and natural gas plants in Luzon than the other resource types in the region in terms of registered and available capacities. Coal plants posted their utilization at 64 percent and 76.2 percent, respectively, based on registered and available capacity, while natural gas plants was at 72.7 percent and 77.3 percent. The rest of the resource types in Luzon exhibited levels of utilization less than 50 percent during the year.

Meanwhile, higher capacity factors were recorded by all plant types when measured based on offered capacity. The capacity factor of geothermal plants was the highest in Luzon at 92.3 percent, indicating that their capacity offers when submitted in the market are generally scheduled and dispatched. Coal and natural gas plants posted their respective utilization levels at 84.5 percent and 78.2 percent, while hydro and oil-based plants recorded 46.4 percent and 11.4 percent, respectively.

In the Visayas, geothermal plants demonstrated the highest capacity factor at 70.3 percent (based on registered capacity), 78.4 percent (based on available capacity), and 90.5 percent (based on offered capacity), as indicated in Figure 30. Coal plants followed distantly with capacity factors of 44.3 percent, 47 percent and 65.8 percent, respectively. Other plant types in the Visayas showed lower levels of utilization less than 50 percent during the year.

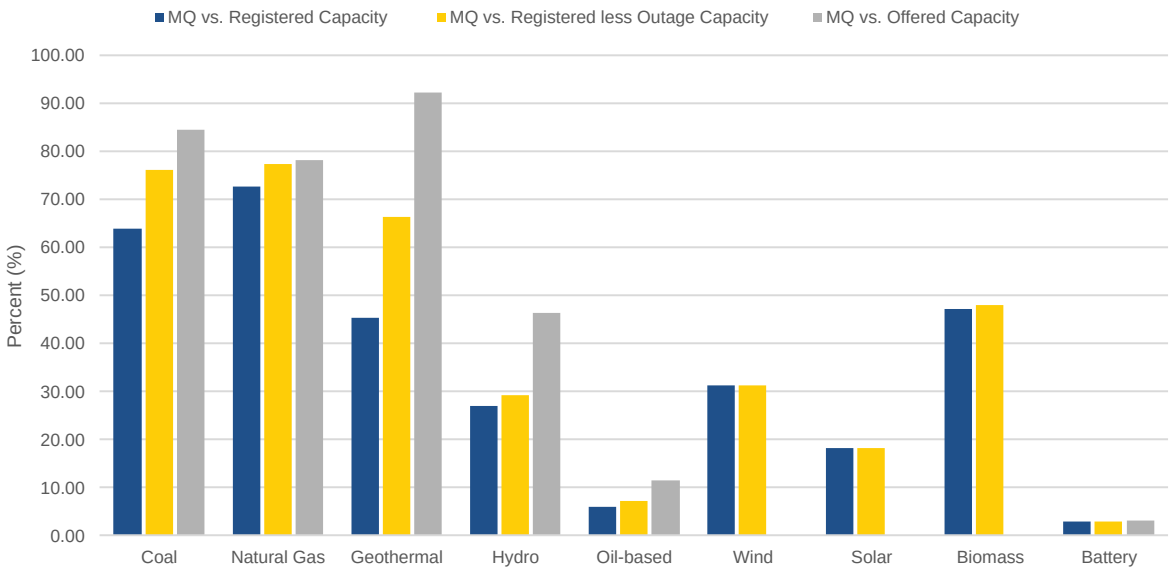


Figure 29. Capacity Factor – Luzon, 2018

Table 25. Capacity Factor – Summary (Luzon and Visayas), 2018

LUZON

Plant Type	MQ vs. Reg. Cap.	MQ vs. Reg. less Outage Cap.	MQ vs. Offered Cap.
Coal	63.98	76.15	84.52
Natural Gas	72.65	77.25	78.20
Geothermal	45.44	66.31	92.32
Hydro	26.97	29.31	46.44
Oil-based	6.00	7.30	11.43
Wind	31.21	31.21	
Solar	18.28	18.28	
Biomass	47.13	48.04	
Battery	2.98	2.98	3.16

VISAYAS

Plant Type	MQ vs. Reg. Cap.	MQ vs. Reg. less Outage Cap.	MQ vs. Offered Cap.
Coal	44.27	46.97	65.71
Geothermal	70.29	78.44	90.48
Oil-based	4.85	4.93	8.22
Wind	26.84	26.84	
Solar	17.45	17.64	
Biomass	14.72	16.14	

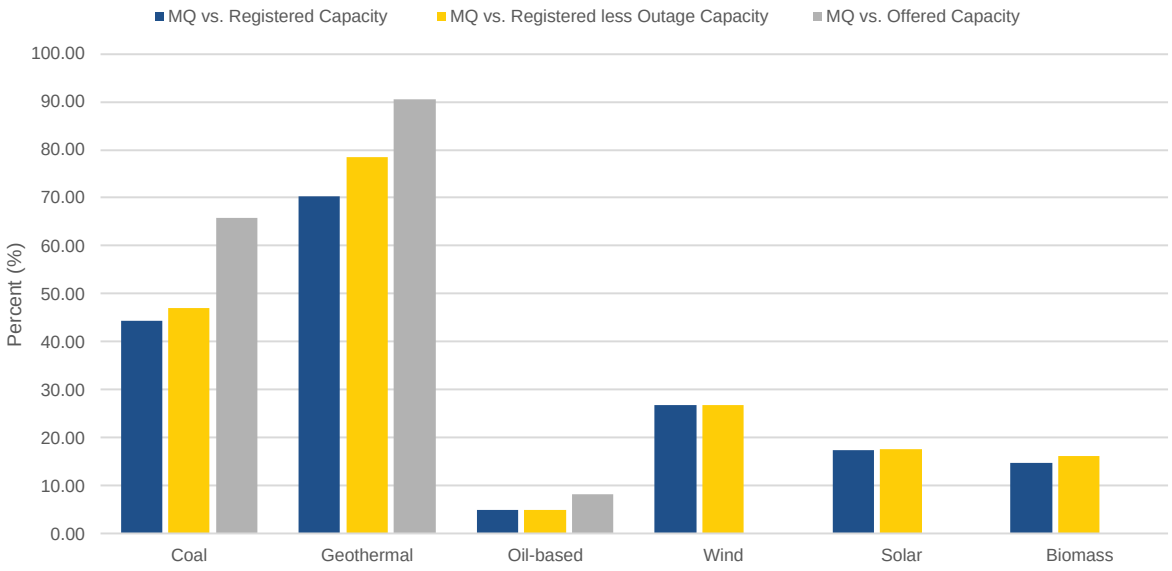


Figure 30. Capacity Factor – Visayas, 2018

XIV. Generation Mix

Coal plants accounted for majority or 49. percent of the system-wide generation mix for the current year based on actual generation (metered quantity), followed by natural gas plants accounting for 26.3 percent, and geothermal plants at 11.3 percent during the year. Hydro plants came next, contributing 7.5 percent, while oil-based plants comprised the next 1.5 percent.

Coal plants recorded higher generation in April, May, November and December, accounting for 51.1 percent, 52.4 percent, 52.1 and 52.4 percent, respectively, of the total metered quantity during said months. However, the highest monthly contribution of coal plants to the generation mix was at 53.3 percent in June, as other plant types decreased in their actual generation during the month. Meanwhile, coal plants demonstrated low generation in March, and September, during which months, high outage capacity among coal plants was noted. Higher generation of natural gas plants was noted during the billing month of March, consistent with their low outage capacity on this month. July and October also saw higher generation from natural gas plants while lower generation was observed in January when their outage capacity was also quite high.

Geothermal plants demonstrated higher generation during the second quarter of the year, and hit their lowest in January, as reflected in their contribution to the total generation mix at 10 percent. In contrast, hydro plants recorded lower generation during the billing months of April to June, but surged a high of 12.6 percent and 14.1 percent during August and September, respectively. Oil-based plants recorded 3.7 percent of the generation mix during the March billing month, its highest during the year, while posting its lowest in November at 0.4 percent.

Biomass, solar and wind plants, accounted for the remaining 0.9 percent, 1.5 percent and 1.5 percent, respectively, of the total generation mix for 2018. The seasonality of these plants is reflected in their monthly contribution to the generation mix, with solar plants recording increases in generation during the months leading to summer (February to March) and during the summer month of April as well. Meanwhile, wind plants recorded a drop in their generation during the first half of the year. Likewise, lower generation was observed from biomass plants which started during the second quarter until the third quarter but gradually increased during the end of the year, indicating that a number of biomass plants were generally off-season during the second and third quarter.

Table 26. Generation Mix (Based on Metered Quantity) – System, 2018

	Generation Mix (%) based on Metered Quantity - System, 2018												
	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018	Oct 2018	Nov 2018	Dec 2018	Average
BAT	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BIOF	1.09	1.12	0.97	1.06	0.94	0.80	0.69	0.66	0.64	0.84	0.89	0.93	0.88
COAL	49.91	47.10	44.43	51.05	52.43	53.27	49.88	46.95	45.74	49.78	52.06	52.36	49.58
GEO	10.03	10.97	10.43	11.90	10.98	11.55	11.65	11.81	11.39	10.95	11.66	11.83	11.26
HYD	8.67	7.10	6.14	4.66	4.34	5.23	7.21	12.62	14.06	7.69	6.77	5.46	7.50
NATG	24.83	27.93	30.73	25.09	26.71	24.96	27.68	24.81	25.48	27.67	25.11	25.10	26.34
OIL	1.39	2.02	3.69	2.91	2.40	1.95	0.89	0.51	0.74	0.57	0.39	0.81	1.52
SOLR	1.38	1.58	1.73	1.76	1.56	1.31	1.23	1.33	1.32	1.45	1.43	1.31	1.45
WIND	2.71	2.17	1.87	1.56	0.63	0.92	0.77	1.32	0.62	1.04	1.68	2.20	1.46

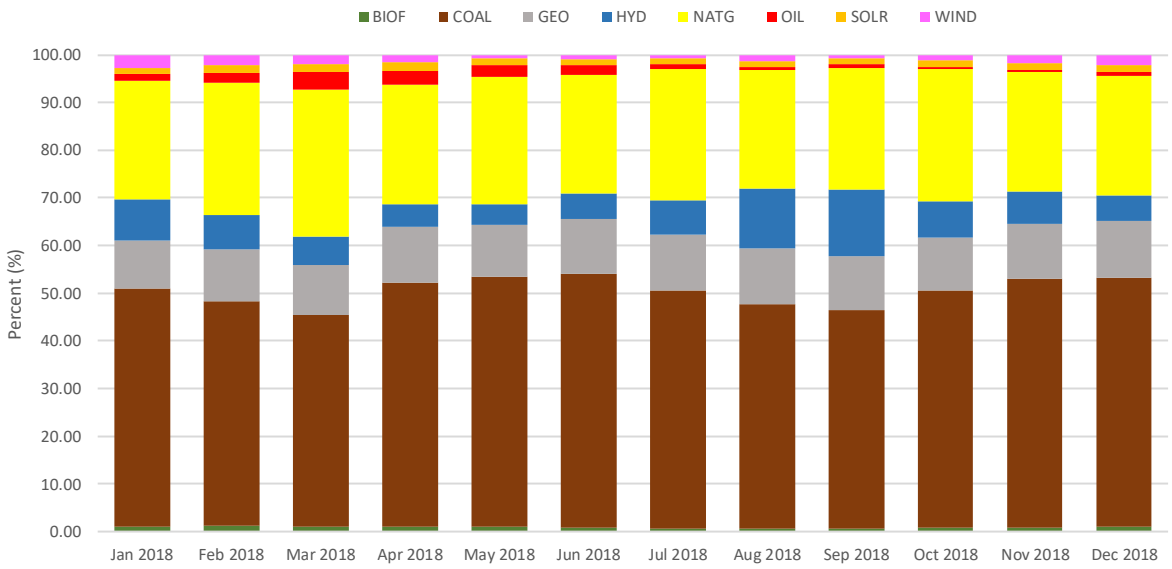


Figure 31. Generation Mix (Based on Metered Quantity), System, 2018

The regional generation mix in Luzon showed almost the same trend as the system-wide generation mix. Coal plants contributed the largest portion in the Luzon generation mix at 50.4 percent, followed by natural gas plants at 31.1 percent, hydro plants at 8.8 percent, geothermal plants at 5.3 percent and oil-based plants at 1.5 percent. Wind plants came next at 1.4 percent, followed by biomass and solar plants at 0.8 and 0.7 percent, respectively.

Likewise, coal plants dominated the Visayas generation mix based on metered quantity at 45.1 percent, closely followed by geothermal plants at 43.9 percent. Solar plants held the next largest, though distant at 5.4 percent, oil-based plants at 2 percent, wind plants at 1.8 percent and biomass plants at 1.4 percent. The Visayas hydro plants contributed the remaining 0.4 percent.

Table 27. Generation Mix (Based on Metered Quantity) – Luzon, 2018

	Generation Mix (%) based on Metered Quantity - Luzon, 2018												
	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018	Oct 2018	Nov 2018	Dec 2018	Average
BAT	0.00	0.00	0.00	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BIOF	0.87	0.88	0.70	0.89	0.85	0.86	0.82	0.78	0.64	0.74	0.75	0.70	0.79
COAL	49.80	46.94	43.99	52.52	53.73	54.94	51.02	47.77	46.14	50.31	53.62	54.11	50.41
GEO	6.07	5.86	5.13	5.73	5.04	5.14	5.15	5.19	5.14	5.07	5.26	5.33	5.34
HYD	9.89	8.30	7.23	5.50	5.07	6.13	8.43	14.85	16.42	8.98	7.94	6.44	8.76
NATG	28.78	33.01	36.55	29.85	31.43	29.54	32.72	29.36	29.91	32.58	29.73	29.86	31.11
OIL	1.21	2.00	3.70	3.03	2.46	1.90	0.64	0.35	0.53	0.45	0.32	0.76	1.45
SOLR	0.77	0.84	0.91	0.91	0.81	0.62	0.57	0.54	0.67	0.79	0.76	0.69	0.74
WIND	2.60	2.16	1.78	1.55	0.61	0.88	0.64	1.17	0.55	1.08	1.61	2.12	1.40

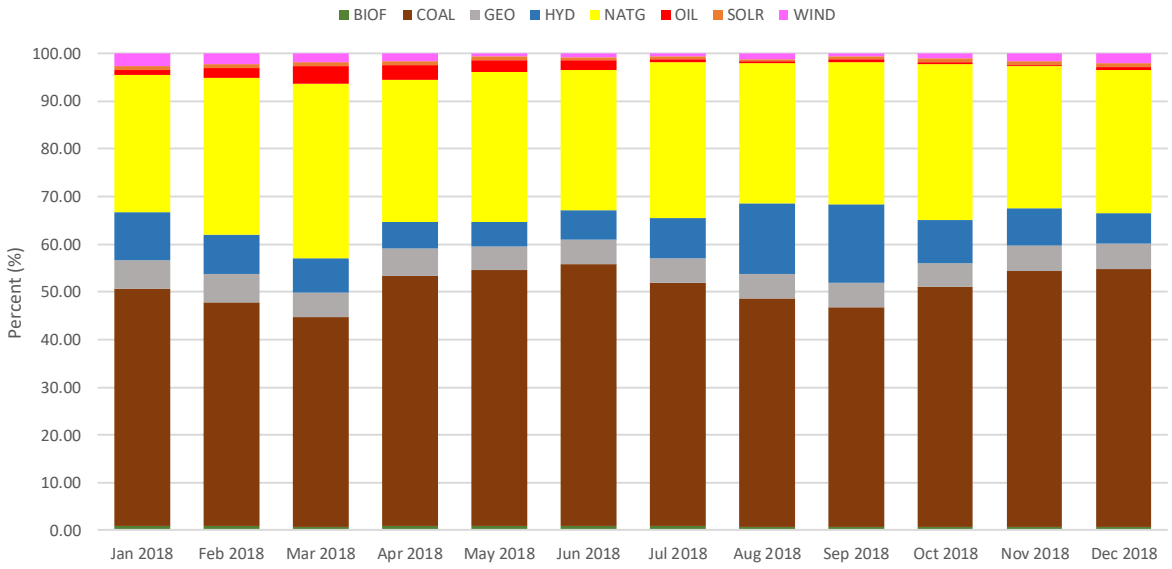


Figure 32. Generation Mix (Based on Metered Quantity) – Luzon, 2018

Table 28. Generation Mix (Based on Metered Quantity) – Visayas, 2018

	Generation Mix (%) based on Metered Quantity - Visayas, 2018												
	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018	Oct 2018	Nov 2018	Dec 2018	Average
BAT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BIOF	2.44	2.42	2.40	1.93	1.45	0.46	0.00	0.00	0.65	1.41	1.66	2.13	1.41
COAL	50.56	48.01	46.76	43.28	45.06	44.16	43.63	42.51	43.45	46.81	43.56	43.14	45.08
GEO	34.93	39.12	38.42	44.43	44.61	46.56	47.30	47.89	47.34	44.12	46.51	46.11	43.94
HYD	0.99	0.54	0.40	0.25	0.22	0.36	0.52	0.47	0.53	0.42	0.35	0.28	0.44
NATG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
OIL	2.51	2.10	3.63	2.27	2.10	2.21	2.24	1.39	1.90	1.24	0.82	1.07	1.96
SOLR	5.20	5.62	6.07	6.23	5.81	5.09	4.85	5.63	5.07	5.17	5.06	4.62	5.37
WIND	3.37	2.20	2.33	1.62	0.76	1.17	1.47	2.11	1.06	0.84	2.04	2.66	1.80

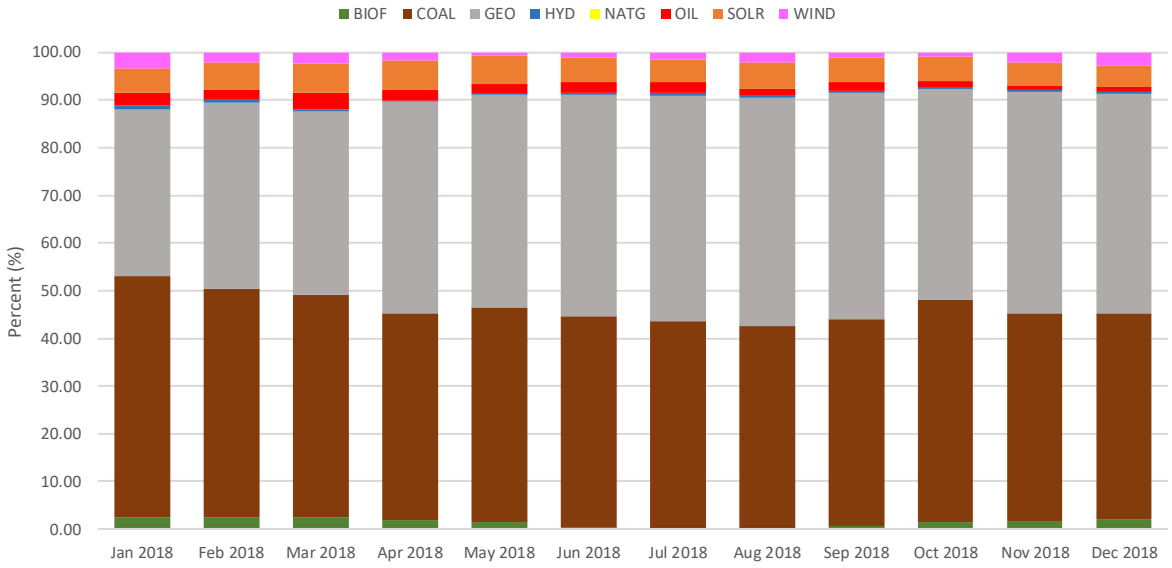


Figure 33. Generation Mix (Based on Metered Quantity), Visayas, 2018

XV. 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. San Miguel Corporation (SMC) led with a market share of 23 percent by the end of the year, which was slightly higher from 21 percent in 2014. Aboitiz Power (AP) followed next with market share of about 21 percent. First Gen Corporation (FGC) and Power Sector Asset and Liabilities Management (PSALM) followed with 15 percent and 11 percent, respectively.

It may be noted that SMC's market shares grew to 28 percent when based on offered capacity and actual generation while AP's shares remained at 21 percent and FGC's to 19 percent when based on offered capacity and 21 percent on actual generation. PSALM, on the other hand, recorded lower market shares at 6 percent based on offered capacity and 7 percent based on actual generation.

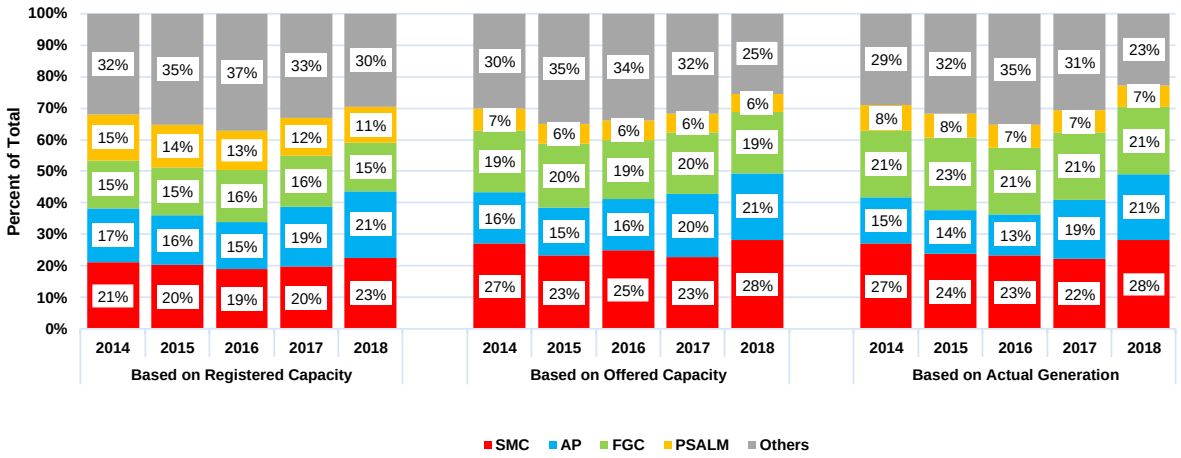


Figure 34. Market Share by Major Participant Grouping, 2014 - 2018

B. Herfindahl-Hirschman Index (HHI)

The Herfindahl-Hirschman Index (HHI)[16] calculated based on registered capacity by major participants' grouping indicated a moderately concentrated market throughout the five-year period.

[16] 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-ised 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.

When measured in terms of offered capacity, the previous years showed that the market was moderately concentrated at 95 to 99 percent of the time (averaging at 7,702 trading intervals) while it showed a concentrated market around 1 to 5 percent of the time (averaging at 243 trading intervals). This trend however changed in the year 2018 when the market was recorded to be moderately concentrated around 62 percent of the time (3,324 trading intervals), significantly lower than the prior years. On the other hand, the market was recorded concentrated for the remaining 38 percent of the time (5,434 trading intervals), a sharp increase when compared from the previous years.

Meanwhile, the HHI calculation based on actual generation in the year 2018 indicated a concentrated market more frequently at 5,413 trading intervals (62 percent) while 3,345 trading intervals (38 percent) showed a moderately concentrated market.

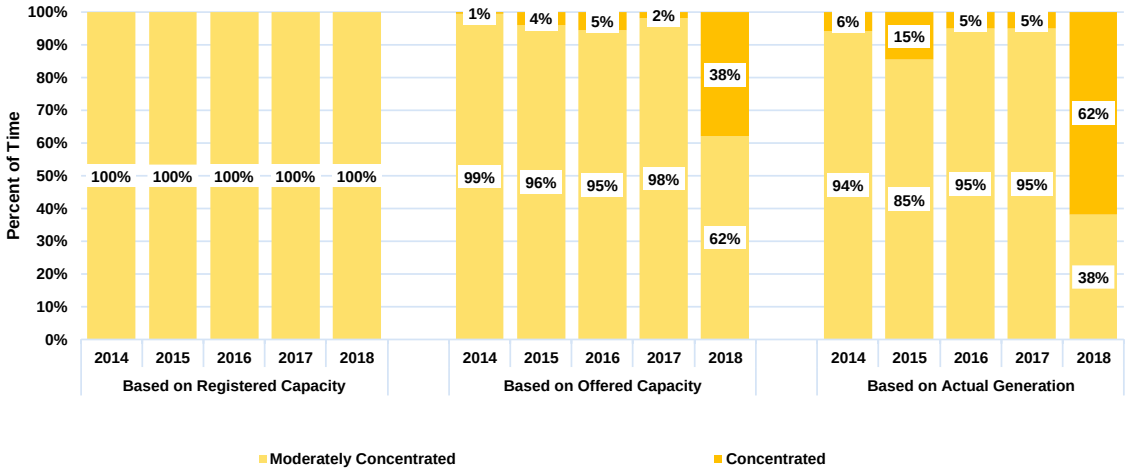


Figure 35. Herfindahl-Hirschman Index by Major Participant Grouping, 2014 - 2018

Annex A. Outage Summary

Region	Plant Type	Plant/Unit Name	Capacity (MW)	Date Out	Date In	Duration (Days)	Outage Type	Remarks	Date of Registration/ Commissioning/ Commercial Operation
LUZON	COAL	1SUAL_G02	647	01/18/2018 23:48	02/09/2018 17:35	22	Planned Outage	Planned outage until 12 February 2018	Oct 1999
LUZON	COAL	1SUAL_G02	647	02/10/2018 20:40	02/11/2018 1:48	0	Forced Outage	On emergency shutdown for transformer hotspot correction	Oct 1999
LUZON	COAL	1SUAL_G02	647	02/28/2018 8:17	02/28/2018 22:20	1	Forced Outage	Tripped by unit transformer 2 differential relay	Oct 1999
LUZON	COAL	1SUAL_G02	647	04/29/2018 10:32	04/30/2018 21:56	1	Forced Outage	Tripped by generator transformer protection	Oct 1999
LUZON	COAL	1SUAL_G02	647	07/21/2018 11:16	07/23/2018 14:31	2	Forced Outage	Boiler tube leak	Oct 1999
LUZON	COAL	1SUAL_G02	647	09/07/2018 12:55	09/07/2018 22:16	0	Forced Outage	Boiler drum low	Oct 1999
LUZON	COAL	1SUAL_G02	647	09/07/2018 22:30	09/07/2018 23:06	0	Forced Outage	Tripped at 145 MW load	Oct 1999
LUZON	COAL	1SUAL_G02	647	09/08/2018 7:12	09/09/2018 4:51	1	Forced Outage	Air compressor trouble	Oct 1999
LUZON	COAL	1SUAL_G02	647	09/15/2018 22:07	09/17/2018 7:15	1	Forced Outage	Emergency shutdown due to coal conveyor trouble	Oct 1999
LUZON	COAL	1SUAL_G02	647	02/25/2018 3:28	02/25/2018 11:27	0	Maintenance Outage	Hotspot correction at main transformer high side	Oct 1999
LUZON	COAL	1SUAL_G02	647	03/28/2018 23:52	03/30/2018 22:34	2	Maintenance Outage	Maintenance outage until 2 April 2018 (Non GOMP)	Oct 1999
LUZON	COAL	1SUAL_G02	647	05/18/2018 23:43	05/19/2018 22:05	1	Maintenance Outage	Maintenance outage until 20 May 2018	Oct 1999
LUZON	COAL	1SUAL_G02	647	11/16/2018 23:28	12/04/2018 4:20	17	Maintenance Outage	Maintenance outage until 16 Dec 2018	Oct 1999
LUZON	COAL	1SUAL_G01	647	08/31/2018 23:48	10/26/2018 3:42	55	Planned Outage	On maintenance until 30 October 2018	Oct 1999
LUZON	COAL	1SUAL_G01	647	07/13/2018 23:41	07/16/2018 1:27	2	Maintenance Outage	Maintenance outage until 18 July 2018	Oct 1999
LUZON	NATG	3STA-RI_G04	264	07/07/2018 4:36	07/13/2018 5:34	6	Planned Outage	Maintenance outage until 11 July 2018	Oct 2001
LUZON	NATG	3STA-RI_G04	264	11/18/2018 6:33	11/18/2018 10:57	0	Planned Outage	Gas turbine/compressor washing	Oct 2001
LUZON	NATG	3STA-RI_G04	264	12/30/2017 20:50	12/31/2017 21:27	1	Forced Outage	Loss of GT Bus Communication	Oct 2001
LUZON	NATG	3STA-RI_G04	264	08/26/2018 14:14	08/26/2018 18:44	0	Forced Outage	Fuel leak	Oct 2001
LUZON	NATG	3STA-RI_G04	264	01/13/2018 4:29	01/15/2018 9:23	2	Maintenance Outage	MO until 14 January 2018	Oct 2001
LUZON	NATG	3STA-RI_G04	264	04/22/2018 6:37	04/22/2018 19:18	1	Maintenance Outage	GT offline compressor washing	Oct 2001
LUZON	NATG	3STA-RI_G03	265.5	07/14/2018 4:26	07/16/2018 3:35	2	Planned Outage	Maintenance outage until 15 July 2018	Oct 2001
LUZON	NATG	3STA-RI_G03	265.5	08/11/2018 4:43	08/17/2018 2:24	6	Planned Outage	Maintenance outage until 15 August 2018	Oct 2001
LUZON	NATG	3STA-RI_G03	265.5	12/30/2017 20:50	12/31/2017 16:32	1	Forced Outage	Loss of GT Bus Communication	Oct 2001
LUZON	NATG	3STA-RI_G03	265.5	05/27/2018 1:11	05/27/2018 6:35	0	Forced Outage	Actuation of GT protection	Oct 2001
LUZON	NATG	3STA-RI_G03	265.5	05/27/2018 13:36	05/27/2018 16:32	0	Forced Outage	Emergency shutdown for rectification of GT communication	Oct 2001
LUZON	NATG	3STA-RI_G03	265.5	08/17/2018 3:22	08/17/2018 7:19	0	Forced Outage	Fuel gas leak	Oct 2001
LUZON	NATG	3STA-RI_G03	265.5	08/26/2018 14:14	08/26/2018 18:44	0	Forced Outage	Fuel leak	Oct 2001
LUZON	NATG	3STA-RI_G03	265.5	01/06/2018 5:27	01/07/2018 21:38	2	Maintenance Outage	Maintenance outage until 7 January 2018	Oct 2001
LUZON	NATG	3STA-RI_G03	265.5	03/18/2018 6:47	03/18/2018 17:52	0	Maintenance Outage	GT off line compressor washing	Oct 2001
LUZON	NATG	3STA-RI_G03	265.5	10/21/2018 6:36	10/21/2018 17:29	0	Maintenance Outage	Offline compresor washing	Oct 2001
LUZON	NATG	3STA-RI_G02	255.7	02/25/2018 15:17	02/26/2018 2:44	0	Forced Outage	Tripped while on fuel change over from natural gas to fuel oil	Jun 2000
LUZON	NATG	3STA-RI_G02	255.7	08/14/2018 14:19	08/14/2018 15:48	0	Forced Outage	GT protection actuated	Jun 2000
LUZON	NATG	3STA-RI_G02	255.7	08/26/2018 14:14	08/26/2018 18:44	0	Forced Outage	Fuel leak	Jun 2000
LUZON	NATG	3STA-RI_G02	255.7	10/24/2018 21:59	10/26/2018 3:51	1	Forced Outage	Steam leak at condensate pre-heater pipe.	Jun 2000
LUZON	NATG	3STA-RI_G02	255.7	12/27/2017 4:24	12/31/2017 17:47	5	Maintenance Outage	Shutdown for maintenance outage until 31 Dec 2017	Jun 2000
LUZON	NATG	3STA-RI_G02	255.7	02/11/2018 6:46	02/11/2018 13:37	0	Maintenance Outage	GT off line compressor washing until 1800H	Jun 2000
LUZON	NATG	3STA-RI_G02	255.7	06/23/2018 4:31	06/24/2018 20:36	2	Maintenance Outage	Maintenance outage until 24 June 2018	Jun 2000
LUZON	NATG	3STA-RI_G02	255.7	08/05/2018 6:39	08/05/2018 12:48	0	Maintenance Outage	Compressor washing	Jun 2000
LUZON	NATG	3STA-RI_G02	255.7	08/17/2018 4:53	08/26/2018 11:52	9	Maintenance Outage	Maintenance outage	Jun 2000
LUZON	NATG	3STA-RI_G02	255.7	09/18/2018 6:44	09/23/2018 23:45	6	Maintenance Outage	Maintenance outage	Jun 2000
LUZON	NATG	3STA-RI_G01	257.3	02/17/2018 20:25	02/23/2018 21:32	6	Planned Outage	Planned outage until 22 February 2018	Jun 2000
LUZON	NATG	3STA-RI_G01	257.3	12/30/2017 20:50	12/31/2017 11:51	1	Forced Outage	Loss of GT Bus Communication	Jun 2000
LUZON	NATG	3STA-RI_G01	257.3	02/16/2018 9:02	02/16/2018 17:02	0	Forced Outage	Naptha valve trouble	Jun 2000
LUZON	NATG	3STA-RI_G01	257.3	02/16/2018 18:30	02/16/2018 22:00	0	Forced Outage	Naptha valve trouble	Jun 2000
LUZON	NATG	3STA-RI_G01	257.3	02/17/2018 9:23	02/17/2018 11:15	0	Forced Outage	On fuel testing	Jun 2000
LUZON	NATG	3STA-RI_G01	257.3	02/17/2018 11:41	02/17/2018 14:02	0	Forced Outage	On fuel testing	Jun 2000
LUZON	NATG	3STA-RI_G01	257.3	02/17/2018 14:26	02/17/2018 16:21	0	Forced Outage	On fuel testing	Jun 2000
LUZON	NATG	3STA-RI_G01	257.3	02/17/2018 17:11	02/17/2018 19:41	0	Forced Outage	On fuel testing	Jun 2000
LUZON	NATG	3STA-RI_G01	257.3	08/26/2018 14:14	08/26/2018 18:44	0	Forced Outage	Fuel leak	Jun 2000
LUZON	NATG	3STA-RI_G01	257.3	09/23/2018 18:38	09/23/2018 21:01	0	Forced Outage	Combustion problem	Jun 2000
LUZON	NATG	3STA-RI_G01	257.3	11/05/2018 22:06	11/06/2018 3:50	0	Forced Outage	Gas Turbine protection actuated	Jun 2000
LUZON	NATG	3STA-RI_G01	257.3	01/20/2018 4:47	01/22/2018 0:41	2	Maintenance Outage	MO until 21 January 2018	Jun 2000
LUZON	NATG	3STA-RI_G01	257.3	06/30/2018 4:29	07/01/2018 21:31	2	Maintenance Outage	GT offline compressor washing	Jun 2000
LUZON	NATG	3STA-RI_G06	261.8	01/28/2018 16:20	01/28/2018 23:31	0	Planned Outage	To conduct off line compressor washing until 28 January 2018 2400H (Unit tripped during the conduct of liquid fuel commissioning test prior to scheduled maintenance)	Sep 2002
LUZON	NATG	3STA-RI_G06	261.8	12/30/2017 20:50	12/31/2017 0:40	0	Forced Outage	Loss of GT Bus Communication	Sep 2002
LUZON	NATG	3STA-RI_G06	261.8	12/31/2017 5:14	12/31/2017 13:54	0	Forced Outage	Tripped (still under investigation)	Sep 2002
LUZON	NATG	3STA-RI_G06	261.8	01/28/2018 12:35	01/28/2018 14:29	0	Forced Outage	Tripped by actuation of acceleration protection relay with 53 MW load	Sep 2002
LUZON	NATG	3STA-RI_G06	261.8	06/19/2018 18:48	06/21/2018 19:45	2	Forced Outage	Turbine bearing high temperature	Sep 2002
LUZON	NATG	3STA-RI_G06	261.8	08/30/2018 12:07	08/30/2018 15:22	0	Forced Outage	Tripped by generator protection	Sep 2002
LUZON	NATG	3STA-RI_G06	261.8	11/08/2018 12:30	11/08/2018 19:03	0	Forced Outage	Tripped with 75MW load	Sep 2002
LUZON	NATG	3STA-RI_G06	261.8	11/08/2018 22:21	11/09/2018 3:17	0	Forced Outage	To facilitate repair of leak at LP control valve	Sep 2002
LUZON	NATG	3STA-RI_G06	261.8	06/09/2018 3:29	06/19/2018 2:57	10	Maintenance Outage	Maintenance outage until 14 June 2018	Sep 2002
LUZON	NATG	3STA-RI_G06	261.8	10/27/2018 0:18	11/08/2018 12:01	12	Maintenance Outage	Maintenance outage until Nov. 02. 2018	Sep 2002
LUZON	NATG	3STA-RI_G06	261.8	12/15/2018 4:30	12/16/2018 23:18	2	Maintenance Outage	Off line compressor washing	Sep 2002
LUZON	NATG	3STA-RI_G05	264.8	12/22/2018 4:19	12/23/2018 19:25	2	Planned Outage	Offline compressor washing	Sep 2002
LUZON	NATG	3STA-RI_G05	264.8	12/30/2017 20:50	12/31/2017 1:39	0	Forced Outage	Loss of GT Bus Communication	Sep 2002
LUZON	NATG	3STA-RI_G05	264.8	12/31/2017 5:14	12/31/2017 12:16	0	Forced Outage	Tripped (still under investigation)	Sep 2002
LUZON	NATG	3STA-RI_G05	264.8	02/26/2018 11:47	02/26/2018 14:57	0	Forced Outage	Tripped while on fuel changeover from gas to fuel oil	Sep 2002
LUZON	NATG	3STA-RI_G05	264.8	07/08/2018 4:48	07/08/2018 8:24	0	Forced Outage	Corrective maintenance of static excitation equipment	Sep 2002
LUZON	NATG	3STA-RI_G05	264.8	11/24/2018 4:53	11/24/2018 6:32	0	Forced Outage	Tripped at 161MW load. System Frequency is 59.64hz	Sep 2002
LUZON	NATG	3STA-RI_G05	264.8	02/04/2018 6:36	02/04/2018 12:38	0	Maintenance Outage	Off line washing	Sep 2002
LUZON	NATG	3STA-RI_G05	264.8	06/16/2018 4:12	06/18/2018 1:01	2	Maintenance Outage	Maintenance outage until 17 June 2018	Sep 2002
LUZON	NATG	3STA-RI_G05	264.8	07/22/2018 6:35	07/22/2018 16:33	0	Maintenance Outage	GT off line compressor washing	Sep 2002
LUZON	NATG	3STA-RI_G05	264.8	10/27/2018 4:55	11/07/2018 7:16	11	Maintenance Outage	Maintenance outage until Nov. 02. 2018	Sep 2002
LUZON	NATG	3SNGAB_G01	420	12/28/2017 0:01	12/31/2017 3:09	3	Planned Outage	Planned outage until 30 December 2017 (GOMP)	Mar 2016
LUZON	NATG	3SNGAB_G01	420	04/09/2018 19:01	04/12/2018 16:19	3	Forced Outage	Not available due to excitation problem until 11 April 2018	Mar 2016
LUZON	NATG	3SNGAB_G01	420	04/12/2018 17:19	04/12/2018 18:29	0	Forced Outage	High boiler level	Mar 2016
LUZON	NATG	3SNGAB_G01	420	05/19/2018 8:01	05/19/2018 17:04	0	Forced Outage	Water leak on condensate line	Mar 2016
LUZON	NATG	3SNGAB_G01	420	06/28/2018 23:21	06/29/2018 10:04	0	Forced Outage	Emergency shutdown due to natural gas supply restriction from Malampaya Onshore Gas Plant	Mar 2016
LUZON	NATG	3SNGAB_G01	420	07/28/2018 0:01	07/29/2018 0:04	1	Forced Outage	Emergency maintenance	Mar 2016
LUZON	NATG	3SNGAB_G01	420	09/07/2018 23:32	09/10/2018 7:04	2	Forced Outage	Other feedwater pump problems	Mar 2016
LUZON	NATG	3SNGAB_G01	420	09/15/2018 12:13	09/15/2018 15:03	0	Forced Outage	Emergency shutdown due to gas vent valve trouble	Mar 2016
LUZON	NATG	3SNGAB_G01	420	09/15/2018 20:40	09/15/2018 23:36	0	Forced Outage	Emergency shutdown due to gas vent valve trouble	Mar 2016
LUZON	NATG	3SNGAB_G01	420	02/11/2018 7:47	02/12/2018 5:08	1	Maintenance Outage	Maintenance outage	Mar 2016
LUZON	NATG	3SNGAB_G01	420	03/04/2018 0:01	03/05/2018 1:13	1	Maintenance Outage	Maintenance outage. Gas restriction effective 0200H March 4 2018	Mar 2016
LUZON	NATG	3SNGAB_G01	420	06/30/2018 0:45	07/02/2018 23:50	3	Maintenance Outage	Maintenance outage until 2 July 2018	Mar 2016
LUZON	NATG	3SNGAB_G01	420	09/13/2018 6:34	09/13/2018 18:24	0	Maintenance Outage	Shutdown to rectify leak at gas supply system	Mar 2016
LUZON	NATG	3SNGAB_G01	420	12/08/2018 0:36			Maintenance Outage	Maintenance outage until 22 December 2018	Mar 2016
LUZON	COAL	3QPPL_G01	459	01/26/2018 23:59	03/15/2018 7:55	1,136	Planned Outage	Planned outage until 12 March 2018 (GOMP)	May 2000
LUZON	COAL	3QPPL_G01	459	03/15/2018 8:16	03/15/2018 11:20	3	Forced Outage	Turbine high vibration	May 2000
LUZON	COAL	3QPPL_G01	459	03/15/2018 15:03	03/16/2018 3:49	13	Forced Outage	Turbine high vibration	May 2000
LUZON	COAL	3QPPL_G01	459	03/16/2018 4:49	03/18/2018 2:53	46	Forced Outage	Turbine high vibration	May 2000
LUZON	COAL	3QPPL_G01	459	03/18/2018 4:40	03/18/2018 16:32	12	Forced Outage	Turbine high vibration. ETI 22 March 2018	May 2000
LUZON	COAL	3QPPL_G01	459	03/18/2018 23:12	03/19/2018 2:59	4	Forced Outage	Turbine high vibration. System Frequency 59.36 Hz	May 2000
LUZON	COAL	3QPPL_G01	459	03/19/2018 11:07	03/19/2018 13:17	2	Forced Outage	Turbine high vibration	May 2000
LUZON	COAL	3QPPL_G01	459	03/19/2018 14:16	03/20/2018 15:42	25	Forced Outage	Tripped due to turbine high vibration	May 2000
LUZON	COAL	3QPPL_G01	459	04/06/2018 23:05	04/08/2018 5:15	30	Forced Outage	Hydraulic oil leak at control valve no 2	May 2000
LUZON	COAL	3QPPL_G01	459	05/30/2018 10:54	06/02/2018 21:58	83	Forced Outage	Detached common discharge pipeline at sea water. Cooling supply system	May 2000

Annex A. Outage Summary

Region	Plant Type	Plant/Unit Name	Capacity (MW)	Date Out	Date In	Duration (Days)	Outage Type	Remarks	Date of Registration/ Commissioning/ Commercial Operation
LUZON	COAL	3QPPL_G01	459	06/04/2018 5:28	06/05/2018 15:40	34	Forced Outage	Repair of circulating water pump A and water box inlet	May 2000
LUZON	COAL	3QPPL_G01	459	06/21/2018 6:29	06/21/2018 12:53	6	Forced Outage	Turbine trouble	May 2000
LUZON	COAL	3QPPL_G01	459	08/18/2018 1:47	08/18/2018 13:05	11	Forced Outage	Pulverizer trouble	May 2000
LUZON	COAL	3QPPL_G01	459	09/25/2018 20:24	09/26/2018 9:04	13	Forced Outage	Emergency shutdown due to main turbine control valve #1 trouble	May 2000
LUZON	COAL	3QPPL_G01	459	10/06/2018 5:32	10/06/2018 15:27	10	Forced Outage	Turbine bearing high vibration	May 2000
LUZON	COAL	3QPPL_G01	459	11/30/2018 0:38	12/02/2018 15:10	63	Forced Outage	Boiler Tube Leak	May 2000
LUZON	COAL	3QPPL_G01	459	12/23/2018 5:52	12/23/2018 22:47	17	Forced Outage	Tripped with 185MW load	May 2000
LUZON	COAL	3PAGBIL_G03	436	01/04/2018 15:27	01/05/2018 0:51	9	Planned Outage	Tripped while conducting 50 percent load rejection test from 420 MW	Jul 2017
LUZON	COAL	3PAGBIL_G03	436	01/06/2018 5:38	01/06/2018 10:10	5	Planned Outage	Unit tripped during the process of boiler feed pump run back test from 420 MW to 210 MW load	Jul 2017
LUZON	COAL	3PAGBIL_G03	436	01/06/2018 22:05	01/08/2018 22:42	49	Planned Outage	On commissioning test	Jul 2017
LUZON	COAL	3PAGBIL_G03	436	02/14/2018 16:39	02/16/2018 16:31	48	Planned Outage	On commissioning test	Jul 2017
LUZON	COAL	3PAGBIL_G03	420	12/25/2018 2:07	12/25/2018 3:56	2	Forced Outage	High drum level	Jul 2017
LUZON	COAL	3PAGBIL_G03	436	12/23/2017 0:17	12/26/2017 23:41	95	Forced Outage	Still on commissioning test. Tripping of auxillary transformer 1 and 230kV Bus B	Jul 2017
LUZON	COAL	3PAGBIL_G03	436	03/11/2018 9:23	03/11/2018 22:04	13	Forced Outage	Hot spot correction. Phase A (high side) of unit transformer	Jul 2017
LUZON	COAL	3PAGBIL_G03	420	06/27/2018 0:54	07/11/2018 12:08	347	Maintenance Outage	Maintenance outage until 1 July 2018. Repair of high economizer gas temperature	Jul 2017
LUZON	COAL	3PAGBIL_G03	420	09/01/2018 1:28	09/09/2018 5:23	196	Maintenance Outage	Maintenance outage until 7 September 2018	Jul 2017
LUZON	COAL	3PAGBIL_G02	382	06/07/2018 2:52	07/05/2018 16:51	686	Planned Outage	Maintenance outage until 5 July 2018	Mar 1996
LUZON	COAL	3PAGBIL_G02	382	02/25/2018 21:51	02/26/2018 16:13	18	Forced Outage	Derailed submersible flight conveyor. Ash handling system	Mar 1996
LUZON	COAL	3PAGBIL_G02	382	07/06/2018 11:28	07/06/2018 15:49	4	Forced Outage	Emergency shutdown for hotspot correction at unit transformers lightning arrester phase A	Mar 1996
LUZON	COAL	3PAGBIL_G02	382	07/06/2018 23:35	07/07/2018 9:16	10	Forced Outage	Emergency shutdown for hotspot correction at unit transformers lightning arrester phase A	Mar 1996
LUZON	COAL	3PAGBIL_G02	382	07/10/2018 5:00	07/10/2018 18:05	13	Forced Outage	Hotspot correction at high side of Transformer phase A & B	Mar 1996
LUZON	COAL	3PAGBIL_G02	382	07/29/2018 16:36	07/29/2018 20:17	4	Forced Outage	Tripped due to PLC control trouble	Mar 1996
LUZON	COAL	3PAGBIL_G02	382	07/31/2018 11:50	08/05/2018 14:13	122	Forced Outage	Boiler tube leak	Mar 1996
LUZON	COAL	3PAGBIL_G02	382	09/09/2018 14:20	09/12/2018 17:34	75	Forced Outage	Emergency shutdown due to boiler tube leak	Mar 1996
LUZON	COAL	3PAGBIL_G02	382	11/03/2018 21:40	11/05/2018 8:09	34	Forced Outage	Superheater control valve leak	Mar 1996
LUZON	COAL	3PAGBIL_G01	382	04/01/2018 2:01	04/29/2018 11:12	681	Planned Outage	Planned outage until 30 April 2018	Mar 1996
LUZON	COAL	3PAGBIL_G01	382	04/29/2018 22:34	04/30/2018 0:06	2	Planned Outage	Shutdown for turbine mechanical overspeed test	Mar 1996
LUZON	COAL	3PAGBIL_G01	382	02/24/2018 4:56	02/24/2018 15:22	10	Forced Outage	Emergency shutdown due to submersible flight conveyor trouble	Mar 1996
LUZON	COAL	3PAGBIL_G01	382	05/16/2018 17:47	05/17/2018 20:57	27	Forced Outage	Submerge flight conveyor problem	Mar 1996
LUZON	COAL	3PAGBIL_G01	382	11/10/2018 10:00	11/11/2018 21:05	35	Forced Outage	Submerge flight conveyor trouble	Mar 1996
LUZON	COAL	3PAGBIL_G01	382	06/15/2018 0:57	06/16/2018 15:36	39	Maintenance Outage	Maintenance outage until 17 June 2018	Mar 1996
LUZON	COAL	3PAGBIL_G01	382	09/22/2018 8:15	10/05/2018 13:36	317	Maintenance Outage	Maintenance outage until 6 October 2018	Mar 1996
LUZON	COAL	1MSINLO_G02	315	01/14/2018 12:01	03/22/2018 20:55	1,617	Planned Outage	Annual overhauling until 2 March 2018	Jun 1998
LUZON	COAL	1MSINLO_G02	315	03/25/2018 7:45	03/25/2018 10:50	3	Planned Outage	Shutdown for turbine commissioning test	Jun 1998
LUZON	COAL	1MSINLO_G02	315	03/22/2018 21:01	03/24/2018 16:02	43	Forced Outage	Reheater protection trouble	Jun 1998
LUZON	COAL	1MSINLO_G02	315	03/24/2018 16:35	03/24/2018 20:46	4	Forced Outage	Turbine trouble	Jun 1998
LUZON	COAL	1MSINLO_G02	315	03/27/2018 1:41	04/03/2018 11:34	178	Forced Outage	Suspected boiler tube leak	Jun 1998
LUZON	COAL	1MSINLO_G02	315	04/03/2018 11:40	04/03/2018 18:01	6	Forced Outage	Tripped due to generator trouble	Jun 1998
LUZON	COAL	1MSINLO_G02	315	04/05/2018 3:32	04/05/2018 11:54	8	Forced Outage	Actuation of HP windage turbine protection	Jun 1998
LUZON	COAL	1MSINLO_G02	315	04/22/2018 5:05	04/22/2018 15:36	11	Forced Outage	High pressure (HP) heaters trouble (initial information)	Jun 1998
LUZON	COAL	1MSINLO_G02	315	04/25/2018 15:54	04/26/2018 10:31	19	Forced Outage	Pressure relief valve trouble	Jun 1998
LUZON	COAL	1MSINLO_G02	315	05/08/2018 7:56	05/10/2018 23:01	63	Forced Outage	HP turbine windage protection high temperature	Jun 1998
LUZON	COAL	1MSINLO_G01	315	03/20/2018 11:33	04/02/2018 7:46	308	Forced Outage	Suspected boiler tube leak	Jun 1998
LUZON	COAL	1MSINLO_G01	315	04/02/2018 8:36	04/02/2018 10:33	2	Forced Outage	Suspected boiler tube leak	Jun 1998
LUZON	COAL	1MSINLO_G01	315	04/20/2018 13:58	04/20/2018 19:04	5	Forced Outage	Tripped due to air heater trouble	Jun 1998
LUZON	COAL	1MSINLO_G01	315	04/25/2018 15:54	04/26/2018 4:43	13	Forced Outage	Pressure relief valve trouble	Jun 1998
LUZON	COAL	1MSINLO_G01	315	07/09/2018 2:58	07/09/2018 7:47	5	Forced Outage	Master fuel detector trip actuation	Jun 1998
LUZON	COAL	1MSINLO_G01	315	07/09/2018 8:18	07/09/2018 11:57	4	Forced Outage	Tripped by furnace draft high	Jun 1998
LUZON	COAL	1MSINLO_G01	315	07/09/2018 12:20	07/09/2018 15:05	3	Forced Outage	Tripped by furnace draft high	Jun 1998
LUZON	COAL	1MSINLO_G01	315	07/09/2018 17:17	07/10/2018 17:00	24	Forced Outage	Boiler trouble	Jun 1998
LUZON	COAL	1MSINLO_G01	315	07/10/2018 18:09	07/11/2018 5:25	11	Forced Outage	Primary air fan malfunction	Jun 1998
LUZON	COAL	1MSINLO_G01	315	07/11/2018 6:23	07/13/2018 1:13	43	Forced Outage	Primary air fan malfunction	Jun 1998
LUZON	COAL	1MSINLO_G01	315	09/01/2018 17:44	09/05/2018 16:07	94	Forced Outage	Emergency shutdown due to boiler tube leak	Jun 1998
LUZON	COAL	1MSINLO_G01	315	10/17/2018 6:51	10/22/2018 15:58	129	Forced Outage	Air and Gas flow restriction	Jun 1998
LUZON	COAL	1MSINLO_G01	315	11/06/2018 18:49	11/08/2018 22:51	52	Forced Outage	Tripped with 223MW load. Pulverizer Mill fire	Jun 1998
LUZON	COAL	1MSINLO_G01	315	12/23/2018 3:46	12/23/2018 9:38	6	Forced Outage	Problem at auto-plant control system	Jun 1998
LUZON	OIL	3MALAYA_G02	350	04/10/2018 10:01	04/22/2018 15:53	294	Forced Outage	Boiler tube leak	Apr 1979
LUZON	OIL	3MALAYA_G02	350	04/23/2018 9:26	05/02/2018 12:00	219	Forced Outage	Excessive gas leak at economizer expansion joint	Apr 1979
LUZON	OIL	3MALAYA_G02	350	05/19/2018 13:01			Forced Outage	Burn air heater 2A	Apr 1979
LUZON	OIL	3MALAYA_G02	350	03/28/2018 0:01	03/28/2018 18:40	19	Maintenance Outage	Maintenance outage until 31 March 2018	Apr 1979
LUZON	OIL	3MALAYA_G01	300	02/20/2018 15:04	02/26/2018 12:00	141	Forced Outage	Trippd due to turbine vacuum extreme low	Aug 1975
LUZON	OIL	3MALAYA_G01	300	07/01/2018 21:41	07/14/2018 15:50	306	Forced Outage	Excessive packing leat at MV1-B (secondary inlet valve)	Aug 1975
LUZON	OIL	3MALAYA_G01	300	09/03/2018 7:24	09/03/2018 8:19	1	Forced Outage	Tripped with 10 MW load	Aug 1975
LUZON	OIL	3MALAYA_G01	300	09/03/2018 15:05	10/16/2018 12:33	1,029	Forced Outage	Tripping of two condensate pumps A and B	Aug 1975
LUZON	OIL	3MALAYA_G01	300	10/16/2018 19:03	10/23/2018 14:00	163	Forced Outage	Emergency shutdown low vacuum and excessive leak at turbine side	Aug 1975
LUZON	OIL	3MALAYA_G01	300	12/19/2017 0:01	01/04/2018 23:59	408	Maintenance Outage	Maintenance outage (Non-GOMP)	Aug 1975
LUZON	OIL	3MALAYA_G01	300	05/03/2018 15:52	06/13/2018 15:36	984	Maintenance Outage	Maintenance outage until 20 May 2018	Aug 1975
LUZON	NATG	3ILIJAN_G02	220	01/20/2018 23:35	02/10/2018 21:44	502	Maintenance Outage	MO until 12 February 2018	Jun 2002
LUZON	NATG	3ILIJAN_G01	220	04/06/2018 0:44	04/28/2018 17:54	545	Planned Outage	Maintenance outage until 30 April 2018 (Reclassified)	Jun 2002
LUZON	NATG	3ILIJAN_G01	220	04/06/2018 0:44			Maintenance Outage	Maintenance outage until 30 April 2018	Jun 2002
LUZON	COAL	1MARVEL_G02	316	03/27/2018 13:43	04/04/2018 16:44	195	Forced Outage	High bearing temperature	May 2013
LUZON	COAL	1MARVEL_G02	316	02/18/2018 0:20	03/27/2018 12:04	900	Maintenance Outage	Maintenance outage until 25 March 2018	May 2013
LUZON	COAL	1MARVEL_G01	316	03/09/2018 0:38	03/13/2018 22:51	118	Planned Outage	Planned outage until 13 March 2018 (GOMP)	May 2013
LUZON	COAL	1MARVEL_G01	316	02/24/2018 4:27	02/27/2018 17:09	85	Forced Outage	Emergency shutdown due to submerge scraper conveyor trouble	May 2013
LUZON	COAL	1MARVEL_G01	316	03/02/2018 23:51	03/04/2018 20:19	44	Forced Outage	Tripped due to low condenser vacuum	May 2013
LUZON	COAL	1MARVEL_G01	316	03/27/2018 21:37	03/28/2018 10:20	13	Forced Outage	Derailed scraper conveyor	May 2013
LUZON	COAL	1MARVEL_G01	316	07/16/2018 21:59	07/20/2018 11:13	85	Forced Outage	Derailed submerge scraper conveyor and Mills A and B trouble	May 2013
LUZON	COAL	1MARVEL_G01	316	08/15/2018 4:29	08/19/2018 22:32	114	Forced Outage	Submerged scrapper conveyor trouble	May 2013
LUZON	COAL	1MARVEL_G01	316	12/10/2018 0:29	12/14/2018 18:13	114	Forced Outage	Drum level transmitter problem	May 2013
LUZON	COAL	3CALACA_G02	300	12/15/2017 22:43	04/08/2018 0:10	2,713	Planned Outage	Maintenance outage until 15 March 2018 (GOMP)	Sep 1984
LUZON	COAL	3CALACA_G02	300	05/05/2018 19:43	05/05/2018 23:29	4	Forced Outage	Turbine-generator vibration	Sep 1984
LUZON	COAL	3CALACA_G02	300	05/15/2018 12:06	05/27/2018 22:25	298	Forced Outage	Emergency shutdown due to boiler tube leak	Sep 1984
LUZON	COAL	3CALACA_G02	300	05/28/2018 1:47	05/28/2018 5:04	3	Forced Outage	Evacuation valve trouble	Sep 1984
LUZON	COAL	3CALACA_G02	300	05/28/2018 6:28	05/30/2018 13:48	55	Forced Outage	Control valve trouble	Sep 1984
LUZON	COAL	3CALACA_G02	300	05/30/2018 19:16	05/30/2018 20:47	2	Forced Outage	Control valve trouble	Sep 1984
LUZON	COAL	3CALACA_G02	300	05/31/2018 2:58	05/31/2018 7:54	5	Forced Outage	Tripped due to rotor vibration	Sep 1984
LUZON	COAL	3CALACA_G02	300	06/01/2018 7:55	06/01/2018 21:59	14	Forced Outage	Tripped at 260 MW. System frequency at 59.42 Hz	Sep 1984
LUZON	COAL	3CALACA_G02	300	06/20/2018 8:36	06/21/2018 0:08	16	Forced Outage	Tripped at 280MW load	Sep 1984
LUZON	COAL	3CALACA_G02	300	06/21/2018 7:27	06/22/2018 21:10	38	Forced Outage	Tripped at 280MW load	Sep 1984
LUZON	COAL	3CALACA_G02	300	06/22/2018 23:23	06/23/2018 2:33	3	Forced Outage	Turbine IP valve oil leak	Sep 1984
LUZON	COAL	3CALACA_G02	300	06/27/2018 14:12	06/27/2018 23:58	10	Forced Outage	Generator lock out activated due to signal from high side PCB24	Sep 1984
LUZON	COAL	3CALACA_G02	300	08/06/2018 6:17	08/17/2018 4:07	262	Forced Outage	Tripped with 197 MW load	Sep 1984
LUZON	COAL	3CALACA_G02	300	09/18/2018 9:48	09/19/2018 19:47	34	Forced Outage	Pulverizer tripping	Sep 1984
LUZON	COAL	3CALACA_G02	300	12/21/2018 11:42	12/22/2018 1:02	13	Forced Outage	Intercept valve failure. sudden closing	Sep 1984
LUZON	COAL	3CALACA_G02	300	12/22/2018 1:33	12/22/2018 10:38	9	Forced Outage	Main turbine temperature drop trip.	Sep 1984
LUZON	COAL	3CALACA_G02	300	12/08/2018 1:08	12/16/2018 15:35	206	Maintenance Outage	Maintenance outage until 15 December 2018	Sep 1984
LUZON	COAL	3CALACA_G01	300	03/02/2018 8:09	03/17/2018 18:22	370	Forced Outage	Boiler slugging trouble	Sep 1984
LUZON	COAL	3CALACA_G01	300	06/08/2018 19:50	06/12/2018 22:09	98	Maintenance Outage	Repair of boiler tube leak at heat recovery area until 14 June 2018	Sep 1984

Annex B. Methodology in Determining Interesting Pricing Events

Supply margin is defined as the MW difference between the system effective supply[1] and demand requirement plus reserve schedules[2].

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[3]. Further, the following criteria were considered in the determination of thresholds:

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

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

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

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

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

Annex B. Methodology in Determining Interesting Pricing Events

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”.