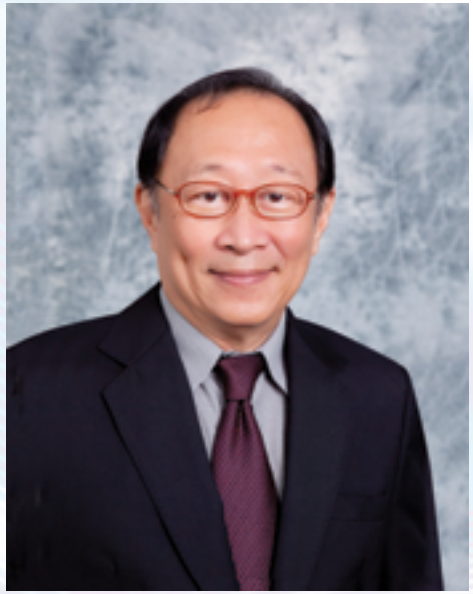
MARKET SURVEILLANCE & COMPLIANCE PANEL

ANNUAL REPORT 2014

National Electricity Market of Singapore

IN MEMORIAM

PROFESSOR LIM CHIN



We are sad to record the passing of Prof Lim Chin, one of the founding members of the Market Surveillance and Compliance Panel (MSCP), on 12 September 2014. Prof Lim was appointed a member of the MSCP in 2002.

Prof Lim obtained his first degree from the University of Malaya. He obtained his Master of Science from the University of British Columbia and his Doctorate from Queen's University, Canada.

Prof Lim had a distinguished academic career. He served in various positions including Head of Department of Business Policy, Faculty of Business Administration, National University of Singapore (NUS) from 1988 to 1991, Visiting Professor, Osaka University in 1992 and in 1995, Vice Dean (Research & Graduate Studies), NUS Business School from 2001 to 2003, and Professor, NUS Business School from 2003 to the date of his demise.

Prof Lim is the author of numerous articles published in leading economic journals of the world, including the American Economic Review, Canadian Journal of Economics, International School of Social Economics and Journal of Public Economics. He is also the author of several books and monographs.

Prof Lim's expertise was sought by many government bodies. Apart from teaching and research, Prof Lim had served in consultative positions with various organisations including the World Bank, Standard Chartered Bank, Monetary Authority of Singapore, Consumer and Corporate Affairs, Government of Canada and the Government Investment Corporation of Singapore, to name a few.

As a key member of the MSCP, Prof Lim had made invaluable contributions, in particular, to the determinations of the MSCP during his tenure of office. His sharp mind and a deep knowledge of economics will be missed by members of the MSCP.

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EXECUTIVE SUMMARY

This annual report by the Market Surveillance and Compliance Panel (MSCP) covers the period 1 January to 31 December 2014. It is based on analyses of data and monitoring indices compiled by the MSCP to assess the performance of the wholesale electricity markets. The MSCP highlights the following observations for 2014:

Supply Indices

- The average supply cushion strengthened 3.8 percentage points from 26.2 percent in 2013 to 30.0 percent in 2014, reflecting continued loosening of supply conditions relative to demand.
- Generation capacity expansion also continued to lower the average capacity ratio of Combined Cycle Gas Turbine (CCGT) units, which declined by 7.6 percentage points to 61.9 percent. The capacity ratio for Steam Turbine (ST) units continued to decline, falling 7.7 percentage points to 0.2 percent.
- The concentration level in the generation sector continued to improve as the combined market share of the three largest generation companies declined substantially by 8.0 percentage points from 69.7 percent to 61.8 percent in 2014.
- On the back of capacity addition, the average total generation outage per period registered in 2014 edged up 3.1 percent to 890MW. However, the average forced outage level per period improved from 37.7MW to 17.8MW.

Demand Indices

- The average demand growth picked up further in 2014, growing from 2.6 percent in 2013 to 3.2 percent in 2014.
- The average monthly electricity demand in 2014 was about 5,346MW, peaking in June at 5,561MW.
- The accuracy of real-time load forecast in 2014 declined slightly with an average forecast error of 3.34 percent, up from 2.99 percent in the previous year.

Market Prices

- The volume-weighted average Wholesale Electricity Price (WEP) of $138.95/MWh in 2014 represented another steep decline of 21.8 percent over 2013. It was also 27.8 percent below the volume-weighted average Vesting Contract Hedge Price (VCHP) of $192.45/MWh.
- The average price of the benchmark 180-centistoke high sulphur fuel oil (180-CST HSFO) fell by US$8.00/bbl (8.1 percent) to US$90.24/bbl in 2014.
- The total reserve cost in 2014 fell 19.3 percent from $59.3 million to $47.9 million. This coincided with a 32.1 percent fall in the average price of contingency reserves.

In reviewing the state of compliance, competition and efficiency of the wholesale electricity markets, the MSCP highlights the following:

- The number of offer variations made after gate closure declined by 15.6 percent in 2014.
- The MSCP made two determinations on rule breaches in 2014, down from six in the previous year.

INTRODUCTION

The Market Rules provide for the Market Surveillance and Compliance Panel (MSCP) to prepare and submit to Energy Market Company Pte Ltd (EMC) an annual report on the conduct of its monitoring and investigation activities. The report is submitted to the Energy Market Authority by EMC. This is the thirteenth report by the MSCP since 2003 on the wholesale electricity markets of the National Electricity Market of Singapore.

The current report covers the period 1 January to 31 December 2014. This review provides the MSCP with the opportunity to highlight significant observations.

The current MSCP members are:

- Thean Lip Ping, Chair;
- Lee Keh Sai;
- TPB Menon;
- Philip Chua; and
- Professor Lim Chin (1 January to 11 September 2014)

Supported by the Market Assessment Unit (MAU) of EMC, the role of the MSCP is to monitor and investigate activities in the wholesale electricity markets and the conduct of market participants, the Market Support Services Licensee, the Power System Operator and EMC to:

- identify breaches of the Market Rules, market manual or system operation manual;
- assess whether the underlying structure of the wholesale electricity markets is consistent with the efficient and fair operation of a competitive market; and
- recommend remedial actions to mitigate the conduct and inefficiencies referred to above.

The Market Rules require this annual report to include a summary of routine reports on MSCP's monitoring and investigation activities, and a summary of any reports regarding the possibility of anti-competitive agreements or the abuse of a dominant position contrary to sections 50 or 51 of the Electricity Act. The report also includes a summary of all complaints or referrals filed and investigations commenced and concluded, and a summary of all investigations conducted by the MSCP concerning offer variations after gate closure reported by EMC. The Market Rules require the report to contain the general assessment by the MSCP of the state of competition and compliance within, and the efficiency of, the wholesale electricity markets.

MARKET MONITORING

Catalogue of Data and Catalogue of Monitoring Indices

To carry out monitoring effectively, the Market Rules provide for the Market Assessment Unit (MAU), under the supervision and direction of the Market Surveillance and Compliance Panel (MSCP), to develop a catalogue of the data[1] it acquires and a catalogue of the monitoring indices[2] that it uses to evaluate the acquired data.

Indicators of Market Performance

The MAU submits regular monitoring updates to the MSCP. These updates include observations of several indicators of market performance which can be broadly classified into supply, demand and price indices. In the following sections, the MSCP reports its observations from these indices for the year under review.

[1] On 29 August 2003, a catalogue of data was adopted by the MSCP after public consultation. It took effect from 1 October 2003. Data is collected according to this catalogue, with the assistance of market entities.

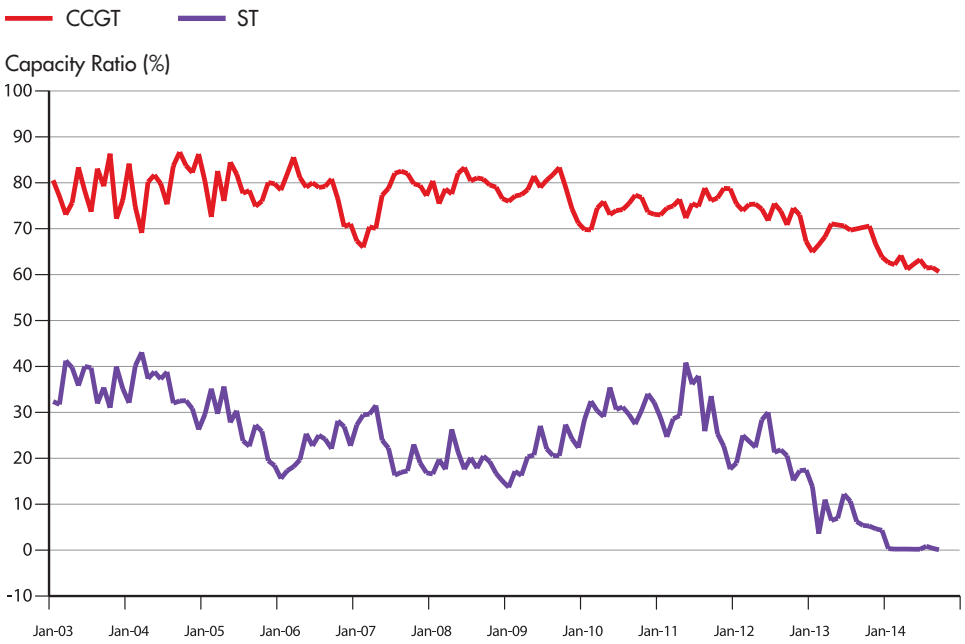
[2] On 29 July 2004, a catalogue of monitoring indices was adopted by the MSCP after public consultation. It took effect from 1 August 2004. The catalogue of monitoring indices is used to evaluate the market data collected.

Table 1: Capacity Ratio (in %) 2014

Month	CCGT	ST	OT	OCGT
Jan 14	62.56	0.25	55.25	0.55
Feb 14	62.10	0.14	47.68	0.06
Mar 14	64.08	0.15	53.84	0.10
Apr 14	61.09	0.15	51.35	0.99
May 14	62.20	0.12	51.37	0.01
Jun 14	63.19	0.11	54.14	0.21
Jul 14	61.37	0.77	51.67	1.05
Aug 14	61.46	0.32	47.85	0.07
Sep 14	60.56	0.00	54.29	0.00
Oct 14	62.21	0.00	53.98	0.48
Nov 14	60.38	0.13	48.29	0.30
Dec 14	61.75	0.12	46.30	0.13
Average	61.91	0.19	51.33	0.33

OT = other facilities, i.e., incineration plants that convert energy from incinerated refuse

Chart 1: Comparison of Capacity Ratio for ST and CCGT



The capacity ratio of generation registered facilities, i.e., the ratio of scheduled generation output to maximum generation capacity of generation registered facilities

The average capacity ratio for Combined Cycle Gas Turbine (CCGT) units decreased 7.6 percentage points to 61.9 percent in 2014 (see Table 1). This decrease was due to the growth in maximum generation capacity of CCGT units. Maximum generation capacity of CCGT units increased 7.7 percent as a result of the entry of one unit from Sembcorp Cogen Pte Ltd, one unit from TP Utilities Pte Ltd and two units from Singapore LNG Corporation Pte Ltd.

The average capacity ratio for Steam Turbine (ST) units fell 7.7 percentage points to 0.2 percent. Although the level of outages and maintenance of ST units remained similar to that in 2013, the average scheduled generation output for ST units decreased 97.5 percent in 2014 as the cheaper CCGT generation was preferred. The maximum generation capacity of ST units increased 3.0 percent.

Meanwhile, the average capacity ratio for Open Cycle Gas Turbine (OCGT) units decreased 0.4 percentage point to 0.3 percent in 2014.

Chart 1 shows the capacity ratios for CCGT and ST units. The downward trend from 2011 to 2013 trailed off and the capacity ratios for CCGT and ST units remained relatively constant in 2014. The monthly capacity ratios for ST units in 2014 were lower than those in 2013 and remained below 1 percent for the rest of the year.

Chart 2: Relationship between USEP and Supply Cushion

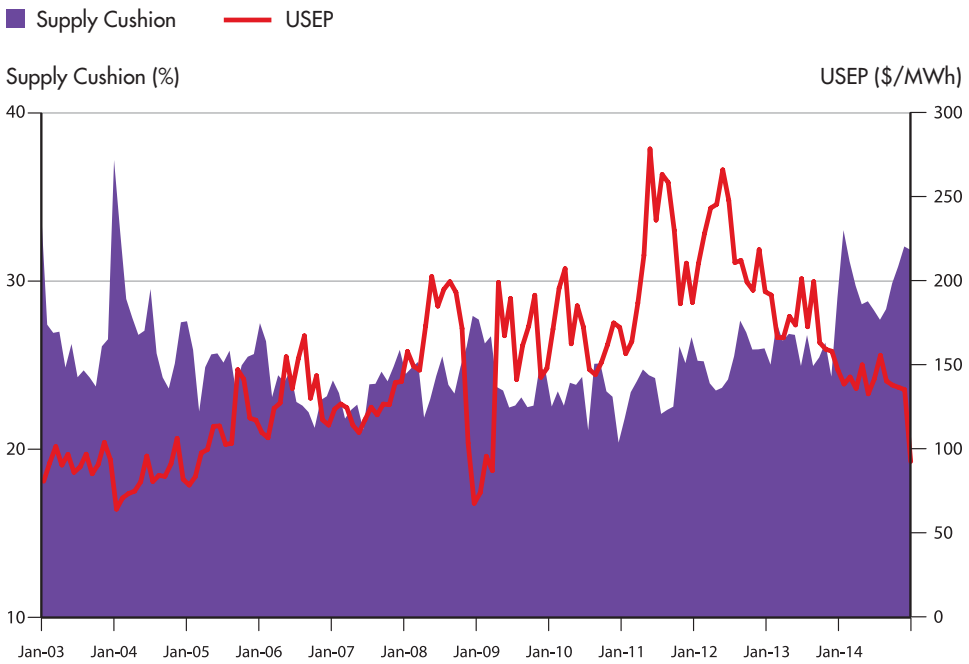


Chart 2 shows the relationship between the Uniform Singapore Energy Price (USEP) and the supply cushion, which measures the level of spare capacity available after dispatch.

The supply cushion strengthened 3.8 percentage points from 26.2 percent in 2013 to 30.0 percent in 2014. Fuel oil prices fell 8.1 percent and supply rose 9.3 percent, outpacing demand growth of 3.2 percent. These factors caused the USEP to decrease 21.1 percent from $173.24/MWh in 2013 to $136.67/MWh in 2014.

Chart 3: Relationship between USEP and Supply Cushion in 2014

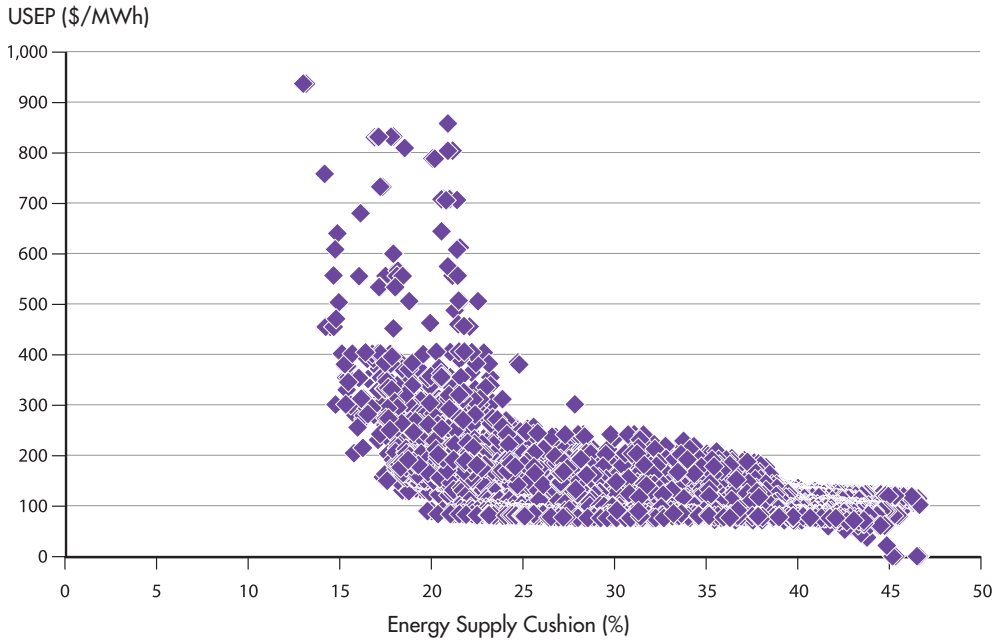


Chart 3 illustrates the relationship between the USEP and supply cushion in 2014. The total number of instances of the USEP being above $500/MWh decreased from 234 in 2013 to 52 in 2014.

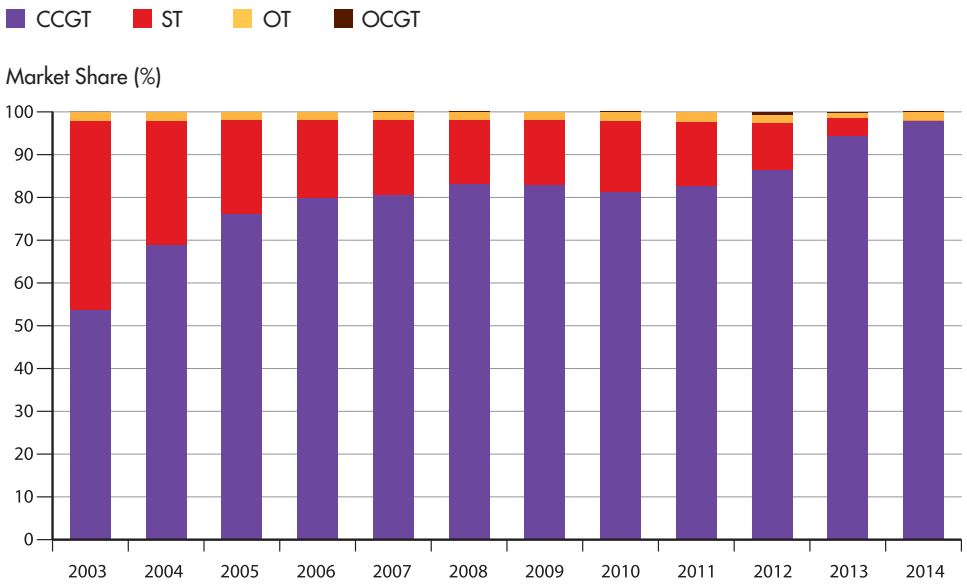
Historically, more occurrences of high prices were observed when the supply cushion fell below 15 percent. However, in 2014, 45 of the 52 occurrences of the USEP going above $500/MWh happened when the supply cushion was 15 percent or above. This was because of the increase in generation capacity. Supply cushion was less than 25 percent in all of the 52 occurrences.

Table 2: Relationship Between Supply Cushion and the USEP

	Supply Cushion < 15%			Supply Cushion ≥ 15%		
Year	No. of periods	Average USEP ($/MWh)	Max USEP ($/MWh)	No. of periods	Average USEP ($/MWh)	Max USEP ($/MWh)
2003	319	272.91	4,500.00	17,201	89.00	1,904.56
2004	74	339.50	4,500.00	17,494	81.26	1,624.68
2005	109	607.48	4,430.65	17,411	106.79	2,229.61
2006	191	477.21	4,500.00	17,329	128.62	930.77
2007	278	332.54	4,500.00	17,242	121.22	988.06
2008	127	391.43	1,126.03	17,441	160.59	955.52
2009	268	599.42	4,499.41	17,252	140.73	1,572.58
2010	498	310.67	3,234.93	17,022	166.41	910.94
2011	289	505.36	4,500.00	17,231	209.96	693.45
2012	82	925.72	4,500.00	17,486	219.19	805.13
2013	128	525.74	2,787.87	17,392	170.64	785.50
2014	12	589.54	936.81	17,508	136.36	857.78

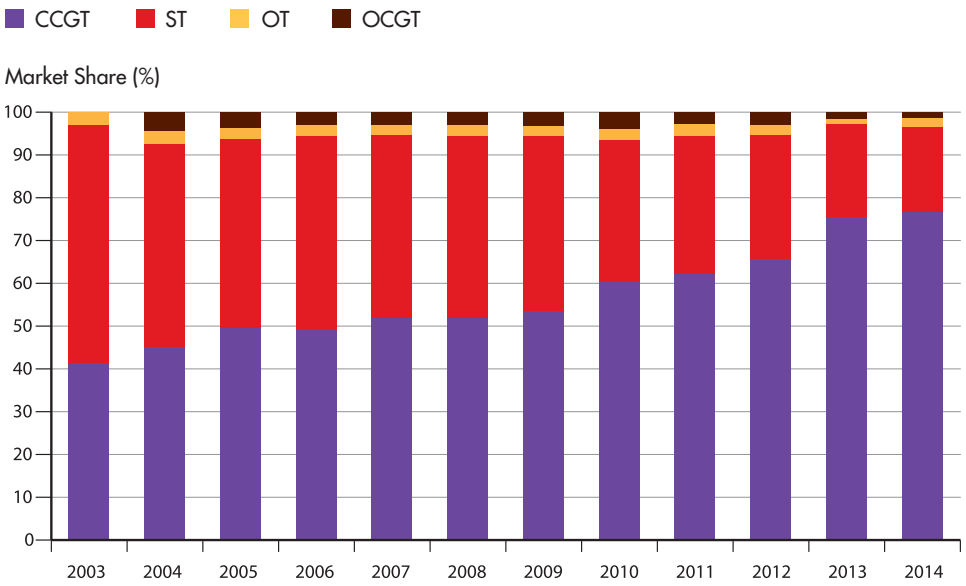
Table 2 shows the USEP movements over the years under two supply cushion scenarios. When the supply cushion was below 15 percent, the average USEP for 2014 was $589.54/MWh, an increase of 12.1 percent from $525.74/MWh in 2013. When the supply cushion was 15 percent or above, the average USEP in 2014 dropped 20.1 percent to $136.36/MWh from $170.64/MWh in 2013. The highest USEP observed for supply cushion below 15 percent was $936.81/MWh, compared to $2,787.87/MWh in 2013. The highest USEP observed when supply cushion was 15 percent or above increased from $785.50/MWh in 2013 to $857.78/MWh in 2014.

Chart 4: Market Share Based on Metered Energy Quantity by Generation Type



Charts 4 and 5 show the yearly market shares by generation types based on metered energy quantity and maximum capacity respectively. Based on metered energy quantity, the market share of CCGT units grew 3.6 percentage points to 97.9 percent. This replaced the market share of ST units, which shrank 4.1 percentage points to close to 0 percent in 2014.

Chart 5: Market Share Based on Maximum Capacity by Generation Type



Based on maximum capacity, the market share of CCGT units grew 1.0 percentage point to 76.5 percent. In contrast, the market share of ST capacity fell 1.7 percentage points to 20.0 percent.

Chart 6: Market Share Based on Metered Energy Quantity by Generation Company

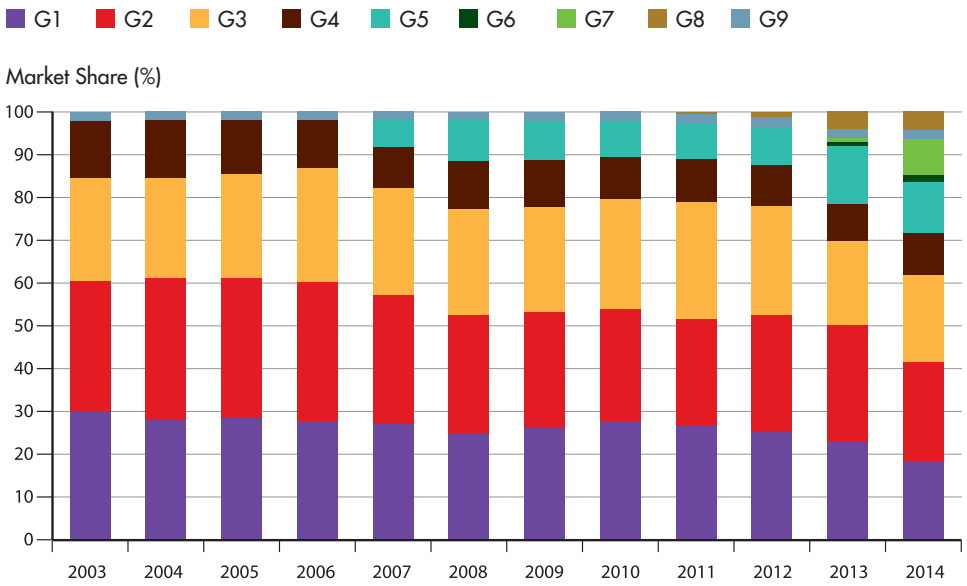
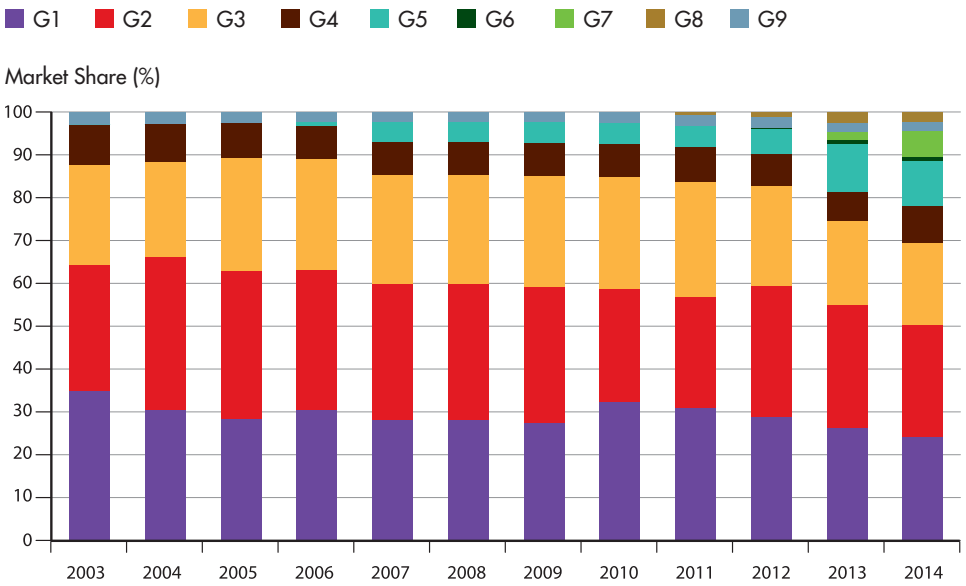


Chart 7: Market Share Based on Maximum Capacity by Generation Company



Charts 6 and 7 show the yearly market shares[3] of all generation companies based on metered energy quantity and maximum capacity respectively.

Embedded generators contributed 4.3 percent and 2.3 percent of the market shares based on metered energy quantity and maximum capacity respectively.

The combined market share of the three largest generation companies, based on metered energy quantity, declined 8.0 percentage points from 69.7 percent in 2013 to 61.8 percent in 2014 due to the installation of generation units from other companies.

[3] The yearly market shares exclude generators operating below 10MW.

Total outages per period increased 3.1 percent from 863MW in 2013 to 890MW in 2014. This quantity of outages represented 7.9 percent of the total installed capacity and was on the back of an average forecast demand of 5,494MW. The increase in total outages was led by higher levels of anticipated outages of CCGT and OT units. This was because more CCGT units were added to the system.

Average forced outages decreased from 37.7MW per period in 2013 to 17.8MW per period in 2014. The reduction was largely caused by a lower level of forced outages of CCGT units.

Chart 8 provides the percentage breakdown of the three types of plant outages. Planned outages made up 98.0 percent of total outages in 2014, while forced outages formed 2.0 percent. This was in contrast to 2013, when planned and forced outages made up 95.6 percent and 4.4 percent respectively.

Chart 8: Composition of Total Plant Outages

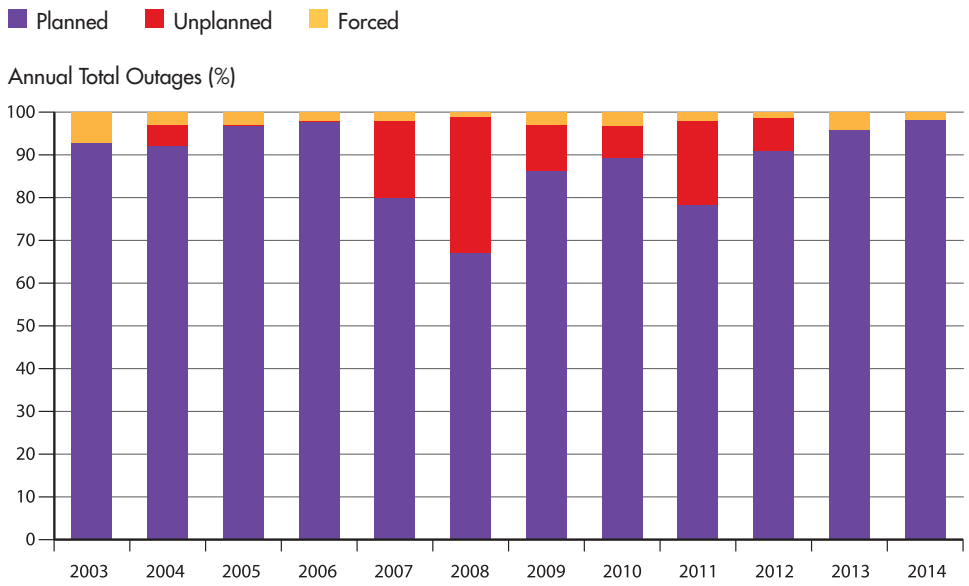


Table 3: Average Outages by Generation Type and Technology in MW (per period)

	Anticipated Outages (MW)								Forced Outages (MW)				Total Outages (MW)
	Planned Outages				Unplanned Outages								
Year	ST	CCGT	OCGT	OT	ST	CCGT	OCGT	OT	ST	CCGT	OCGT	OT	
2003	425	167	5	30	0	0	0	0	4	45	0	1	677
2004	982	204	14	3	64	2	2	0	2	37	0	0	1,309
2005	915	363	22	26	0	1	1	0	7	35	0	0	1,370
2006	854	283	51	17	0	2	1	0	4	21	1	0	1,234
2007	761	348	28	32	159	94	1	7	6	27	0	0	1,464
2008	439	236	1	6	298	26	0	2	2	10	0	0	1,020
2009	826	250	2	13	108	29	0	2	20	7	10	1	1,266
2010	312	391	38	45	22	40	2	1	5	24	0	0	880
2011	387	281	7	10	85	87	1	0	7	11	1	0	878
2012	392	436	5	36	21	51	0	0	1	12	1	0	956
2013	335	483	3	4	0	0	0	0	3	35	0	0	863
2014	316	536	3	17	0	0	0	0	0	18	0	0	890

Chart 9: Average Quarterly Anticipated Outages vs Average USEP

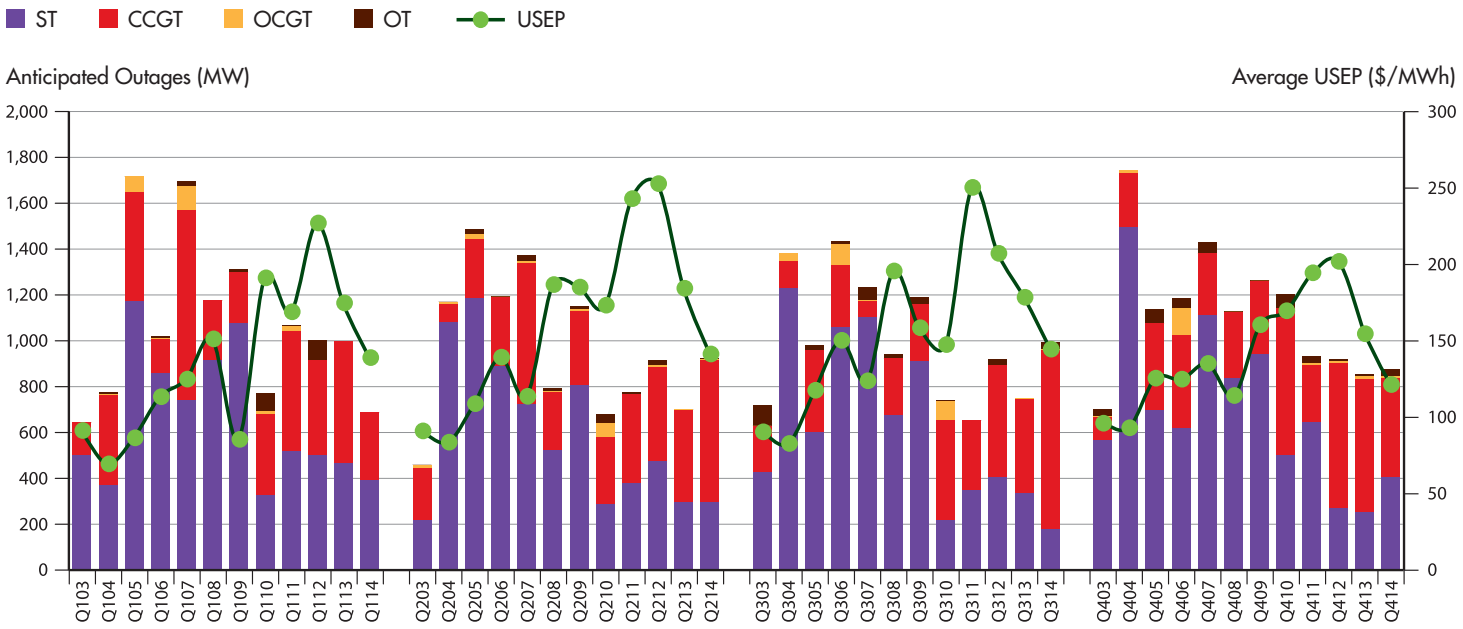


Chart 9 compares the average anticipated outages[4] with the average USEP on a quarterly basis.

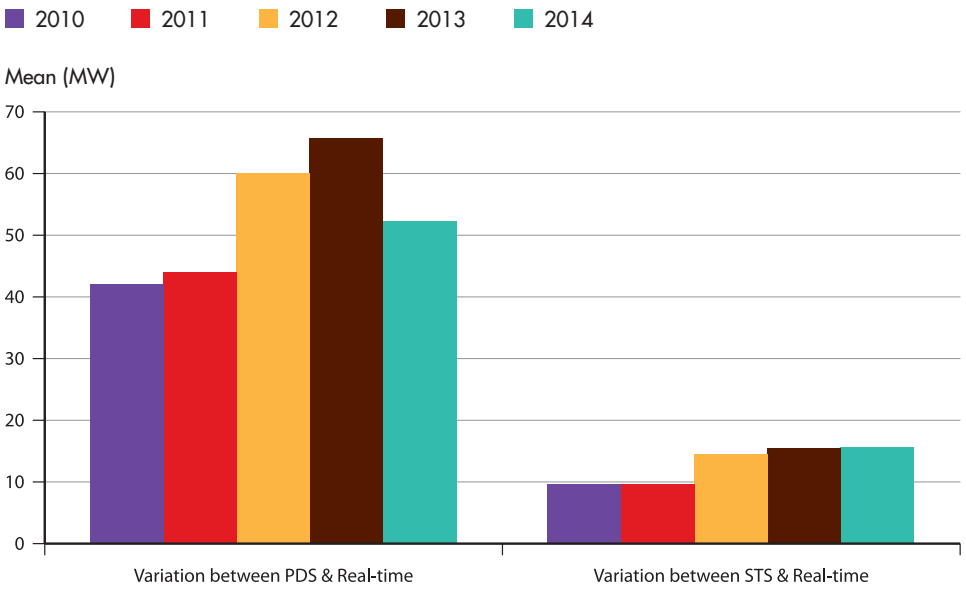
Even though the average level of anticipated outages for Q2 2014 was 32.3 percent higher than that for Q2 2013, the average USEP for Q2 2014 was 23.3 percent lower than that for Q2 2013. The decline in average USEP coincided with lower fuel oil prices in Q2 2014. This was similarly observed in parallel comparisons in Q3 and Q4 2014.

[4] Anticipated outages refer to the sum of planned and unplanned outages. From 1 June 2012, the category of "unplanned outages" was removed. Outages previously classified under unplanned were subsumed under planned or forced outages, depending on the time and duration of occurrence.

Table 4: Variation in Load Forecasts

Year 2014				
	Variation between PDS & Real-time		Variation between STS & Real-time	
Month	Mean (in MW)	Standard Deviation (in MW)	Mean (in MW)	Standard Deviation (in MW)
Jan	41.13	32.79	10.64	8.17
Feb	59.72	49.51	14.06	10.98
Mar	57.40	24.43	13.30	5.36
Apr	14.88	10.22	2.93	1.82
May	32.86	34.85	11.13	11.74
Jun	59.95	36.14	19.27	11.77
Jul	42.67	36.25	14.09	11.96
Aug	83.99	42.37	27.23	13.86
Sep	55.55	35.11	17.72	11.53
Oct	73.47	39.92	23.51	12.62
Nov	53.44	37.18	17.29	12.13
Dec	52.54	47.05	16.69	14.61
Average	52.30	35.49	15.65	10.55

Chart 10: Average Mean Variation between Load Forecast & Real-time



In the National Electricity Market of Singapore (NEMS), three forecast schedules with different time horizons are made available to market participants (MPs). The accuracy of forecast schedules is important for the efficient operation of the market, as it determines how well generation plants can respond to real-time demand conditions.

Table 4 shows the accuracy of the load forecasts as measured by the mean and standard deviation of the variations between forecast and actual real-time load. The variation between the Pre-Dispatch Schedule (PDS) forecast and real-time load was three times as large as the variation between the Short Term Schedule (STS) forecast and real-time load. This is within expectation, as PDS forecasts are updated every two hours, with a forecast horizon of between 12 to 36 hours, compared to STS forecasts which are updated every half-hour, with a forecast horizon of up to six hours.

The average difference between PDS and real-time forecasts in 2014 was lower compared to that in 2013 (see Chart 10). The average difference between STS and real-time forecasts remained comparable.

The accuracy of the load forecast used in generating real-time dispatch and pricing schedules is important for efficient pricing outcomes and system stability.

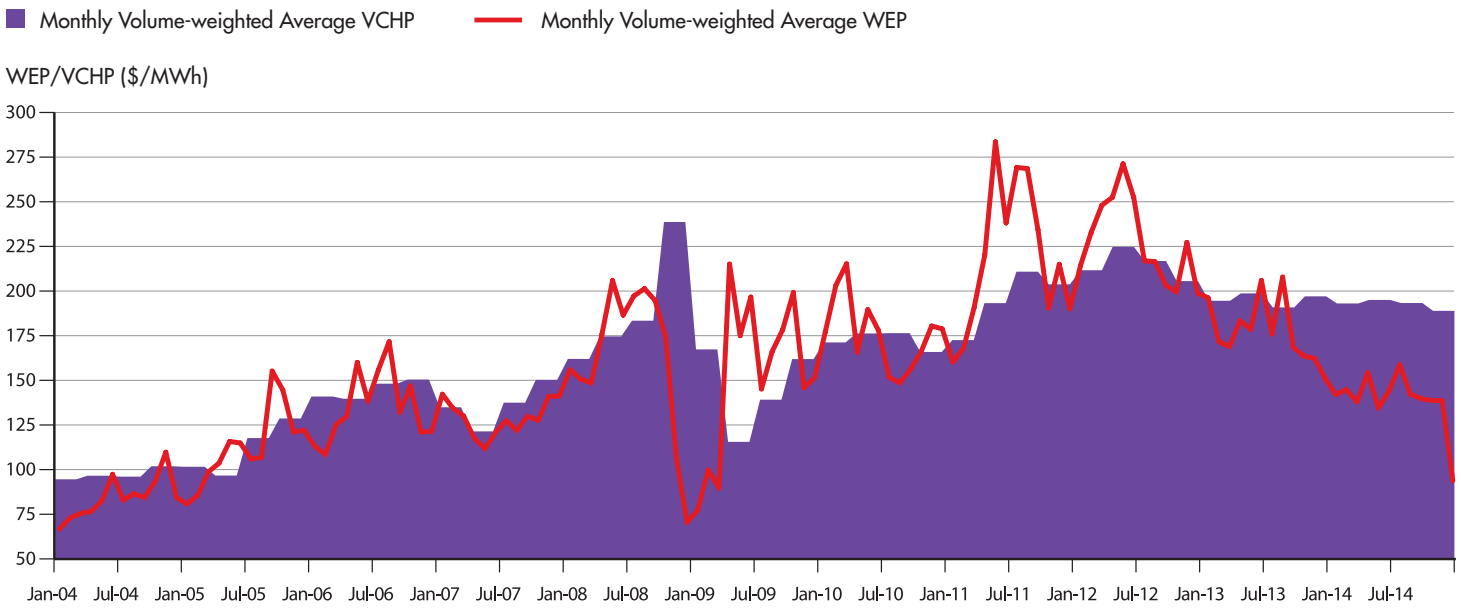
A small amount of variation between real-time load forecast and actual demand (metered energy quantities) is expected. There are a number of factors contributing to this variation. For example, the metered energy quantity based on settlement data furnished by the Market Support Services Licensee (MSSL) excludes the station load and auxiliary load consumption, while the real-time load forecast includes these components. Other factors include loss factors and metering errors.

In 2014, there was a decrease in the accuracy of the real-time load forecast. As seen in Table 5, the average load forecast error increased from 2.99 percent in 2013 to 3.34 percent in 2014.

Table 5: Percentage of Variation in Real-time Load Forecast

Month	2007	2008	2009	2010	2011	2012	2013	2014
Jan	4.29	3.93	3.46	3.18	3.24	2.73	3.00	3.46
Feb	4.52	4.01	3.48	3.74	2.93	2.82	2.83	3.28
Mar	4.25	3.77	3.40	3.64	2.95	2.93	2.75	3.00
Apr	4.40	3.97	3.50	3.74	3.13	3.01	2.34	3.20
May	4.20	3.89	3.41	3.83	1.96	2.76	2.77	3.27
Jun	4.11	3.76	3.93	3.15	2.65	2.61	3.00	3.10
Jul	4.05	3.96	3.45	3.17	3.36	2.75	3.04	3.30
Aug	3.94	3.68	3.54	3.54	3.14	2.86	2.90	3.70
Sep	3.94	3.70	3.34	3.42	3.20	2.93	3.24	3.29
Oct	4.21	3.74	3.54	3.56	3.01	2.81	3.28	3.26
Nov	3.88	3.40	3.28	3.62	2.94	3.05	3.23	3.82
Dec	3.74	3.60	3.24	3.64	2.88	3.17	3.46	3.35
Average	4.13	3.78	3.46	3.52	2.95	2.87	2.99	3.34

Chart 11: Monthly Volume-weighted Average VCHP vs WEP



The volume-weighted average Vesting Contract Hedge Price[5] (VCHP) fell 1.4 percent from $195.26/MWh in 2013 to $192.45/MWh in 2014. Meanwhile, the average price of the benchmark 180-centistoke high sulphur fuel oil (180-CST HSFO) decreased at a faster rate of 8.1 percent, from US$98.24/bbl in 2013 to US$90.24/bbl in 2014.

At $138.95/MWh, the 2014 volume-weighted average Wholesale Electricity Price (WEP) was lower than the average VCHP by 27.8 percent. This was much greater than the 9.0 percent difference between WEP and VCHP observed in 2013. The volume-weighted average WEP in 2014 was a 21.8 percent decrease over the volume-weighted average WEP of $177.78/MWh in 2013. Chart 11 tracks the movements of the volume-weighted average WEP and VCHP.

[5] The volume-weighted VCHP takes into account the LNG, balance and tendered vesting prices after considering volume adjustment.

Chart 12: Comparisons of Actual Demand

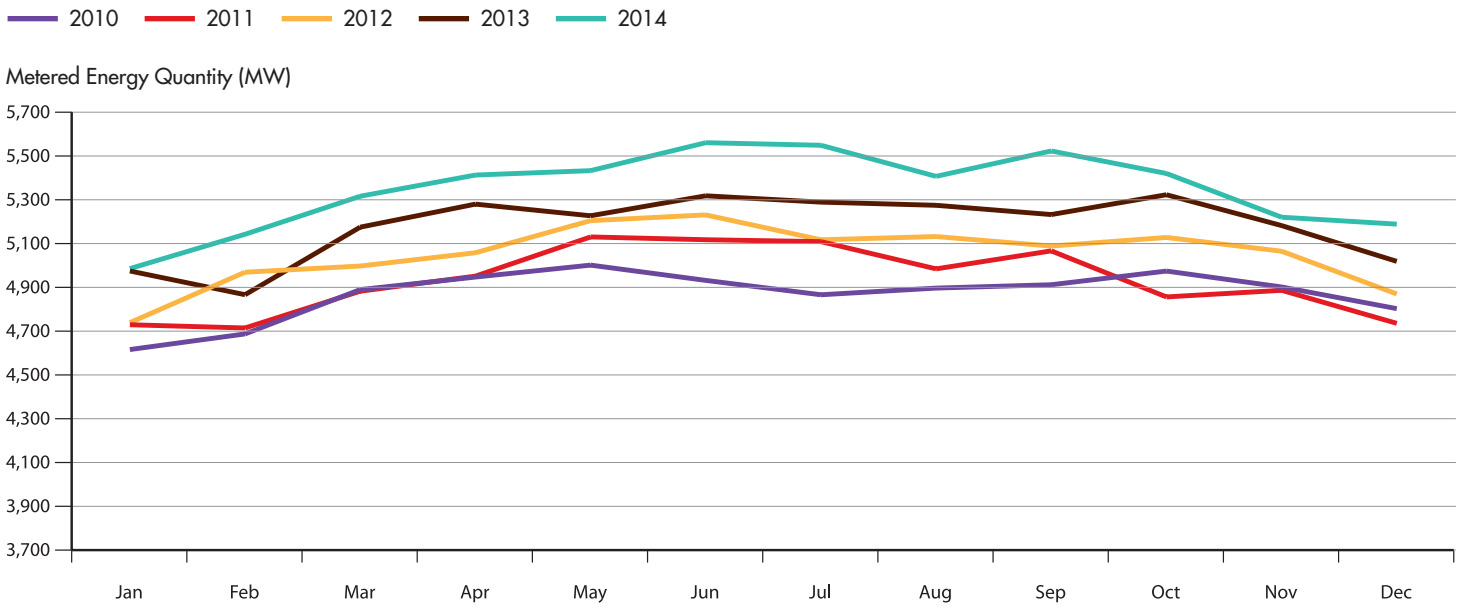


Chart 12 shows the actual demand (computed from the metered energy quantity) from 2010 to 2014. In 2014, demand growth was evident during the year and averaged 3.2 percent, compared to 2.6 percent in 2013.

The average system demand for the year was about 5,346MW. The peak average monthly system demand was 5,561MW in June 2014. Both figures are the highest since the market started in 2003.

Table 6: Monthly Average Correlation Coefficient of the WEP and Metered Energy Quantity

	2013			2014		
Month	Correlation Coefficient, r	r^2	Number of days with r > 0.5	Correlation Coefficient, r	r^2	Number of days with r > 0.5
Jan	0.73	0.54	29	0.66	0.44	28
Feb	0.66	0.44	22	0.62	0.38	20
Mar	0.57	0.33	20	0.62	0.39	23
Apr	0.60	0.37	22	0.63	0.40	25
May	0.70	0.48	28	0.35	0.12	11
Jun	0.63	0.39	22	0.54	0.29	20
Jul	0.59	0.34	25	0.68	0.46	25
Aug	0.65	0.43	25	0.60	0.36	21
Sep	0.63	0.40	24	0.66	0.43	24
Oct	0.63	0.40	21	0.64	0.41	25
Nov	0.47	0.23	17	0.63	0.40	24
Dec	0.71	0.51	27	0.41	0.17	18
Average	0.63	0.40	282	0.59	0.35	264

The correlation coefficient r in Table 6 measures the strength of the relationship between the WEP and metered energy quantity. A positive correlation indicates that as demand increases, energy price follows and vice versa. The square of the correlation coefficient r^2 can be interpreted as the proportion of variance in prices that can be explained by variations in demand.

In 2014, low r values were observed in May and December. The highest r value of 0.68 was seen in July. There was a total of 264 days when r was greater than 0.5 in 2014. The average r value in 2014 was 0.04 lower than that in 2013.

Chart 13: Correlation between WEP & Metered Energy Quantity in 2014

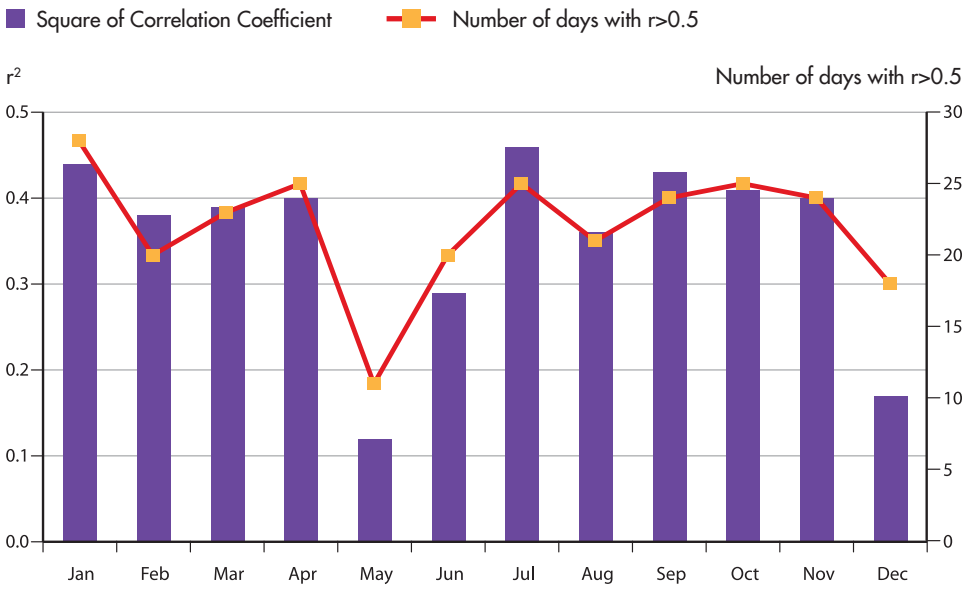


Chart 13 illustrates the correlation between the WEP and metered energy quantity in 2014. The highest correlation in the year was observed in July 2014, when the r^2 value reached 0.46 and there were 25 days when r was greater than 0.5. The lowest r^2 value of 0.12 was observed in May, when there were only 11 days with r greater than 0.5.

Chart 14: Correlation between WEP & Metered Energy Quantity

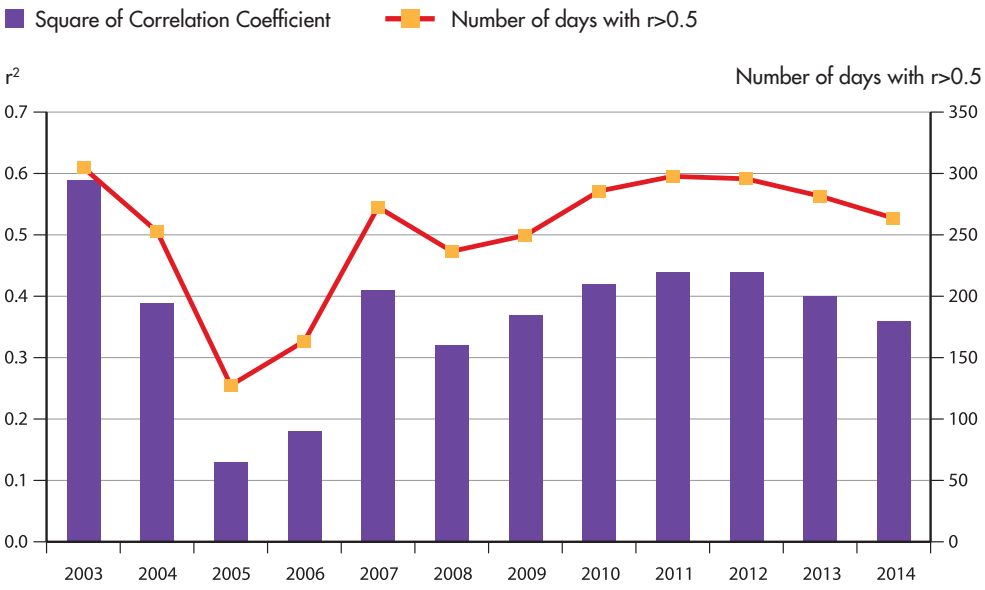


Chart 14 shows the correlation between the WEP and metered energy quantity between 2003 and 2014. After a sharp decline from 2003 to 2005, there was a steady increase in both the square of correlation coefficient and the number of days with r>0.5. The square of correlation coefficient and the number of days with r>0.5 began to climb again from 2006 to 2007.

In 2008, the correlation between the WEP and the metered energy quantity fell below the 2007 level, indicating a tendency for non-demand factors to drive prices. From 2008 to 2013, there was a gradual return to 2007 levels, indicating a stronger correlation between demand and prices. In 2014, there was a slight decrease in both the square of correlation coefficient and the number of days with r greater than 0.5.

MARKET MONITORING: Energy Indices: Frequency Distribution of the WEP by (a) Percentage of Hours of Occurrence and (b) Percentage of Energy Quantity Affected

Chart 15: Percentage of Hours When WEP Falls Into a Particular Price Range

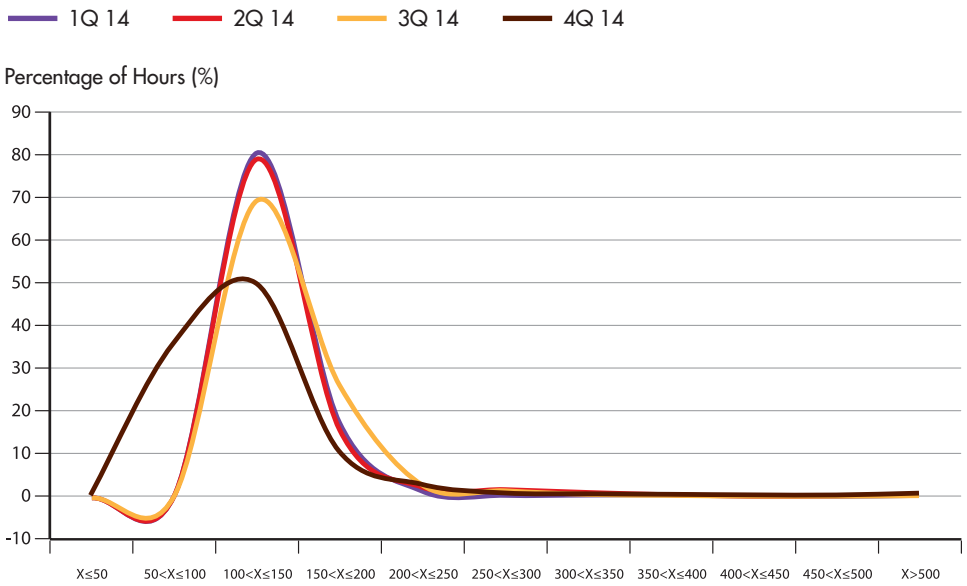


Chart 15 illustrates the distribution of the WEP based on percentage of hours of occurrence in 2014. Prices for the first three quarters mostly settled in the $100/MWh to $150/MWh tranche. In the fourth quarter, the WEP exhibited a slight leftward shift due to prices falling below $100/MWh in the month of December.

Chart 16: Percentage of Energy Quantity When WEP Falls Into a Particular Price Range

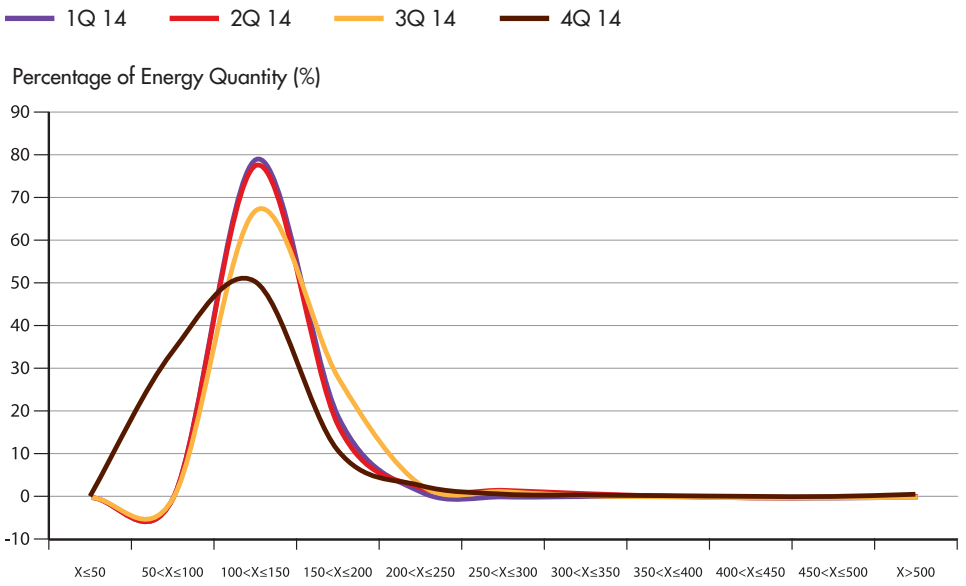


Chart 16 illustrates the distribution of the WEP based on percentage of energy quantity. The distribution is similar to that of the WEP by percentage of hours of occurrence (Chart 15).

MARKET MONITORING: Energy Indices: Frequency Distribution of the WEP by (a) Percentage of Hours of Occurrence and (b) Percentage of Energy Quantity Affected

Chart 17: Percentage of Hours When WEP Falls Into a Particular Price Range

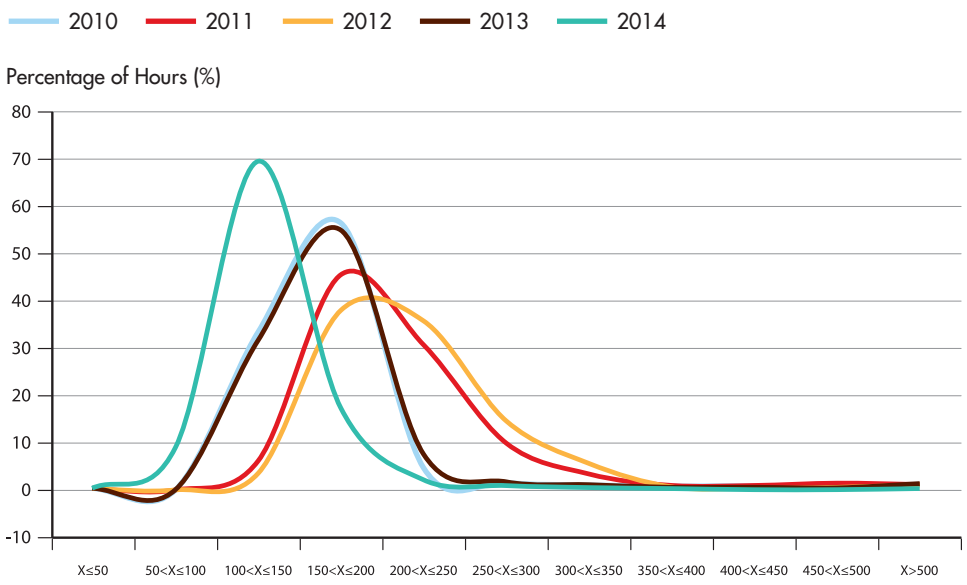


Chart 17 juxtaposes the historical price distribution curves with the price distribution curve of 2014, allowing us to examine longer-term trends. Between 2010 and 2012, the percentage of hours of WEP distribution has gradually shifted to a higher price range. 2013 and 2014 saw the trend reversing, with the WEP eventually settling in the $100/MWh to $150/MWh tranche in 2014.

Chart 18: Percentage of Energy Quantity When WEP Falls Into a Particular Price Range

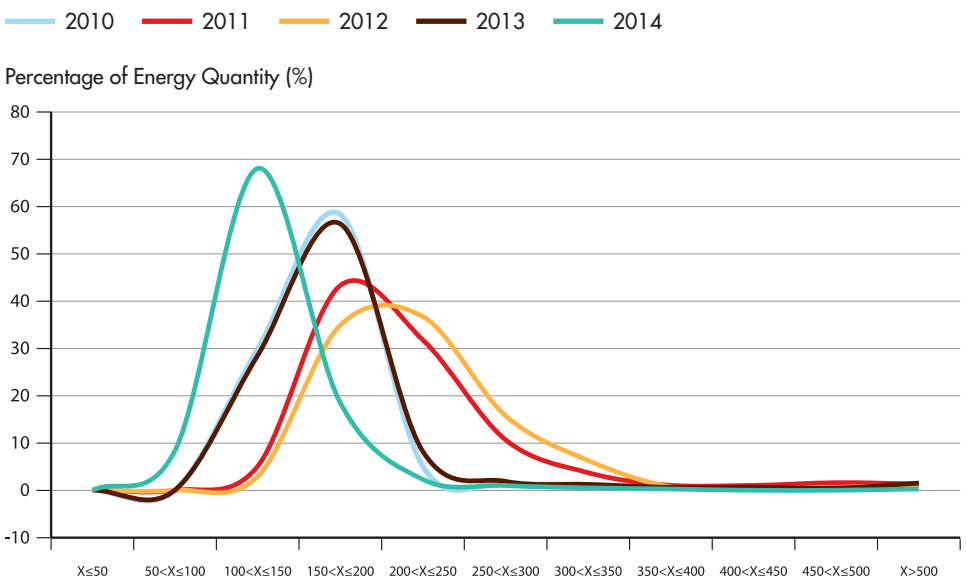


Chart 18 shows the long-term trend in the distribution of the WEP from 2010 to 2014 based on percentage of energy quantity, permitting the same observations as Chart 17.

Chart 19: Index of VCHP, WEP, Fuel Oil (180-CST HSFO), Electricity Tariff

Chart 19 shows the correlation between the high sulphur fuel oil (180-CST HSFO) price, the VCHP, the WEP and electricity tariff. In 2014, the fuel oil price traded at an average of US$90.24/bbl, about 8.1 percent lower than 2013. The WEP declined at a more rapid pace of 21.5 percent to reach $137/MWh in 2014. The peak monthly average WEP of $155.71/MWh was recorded in July 2014.

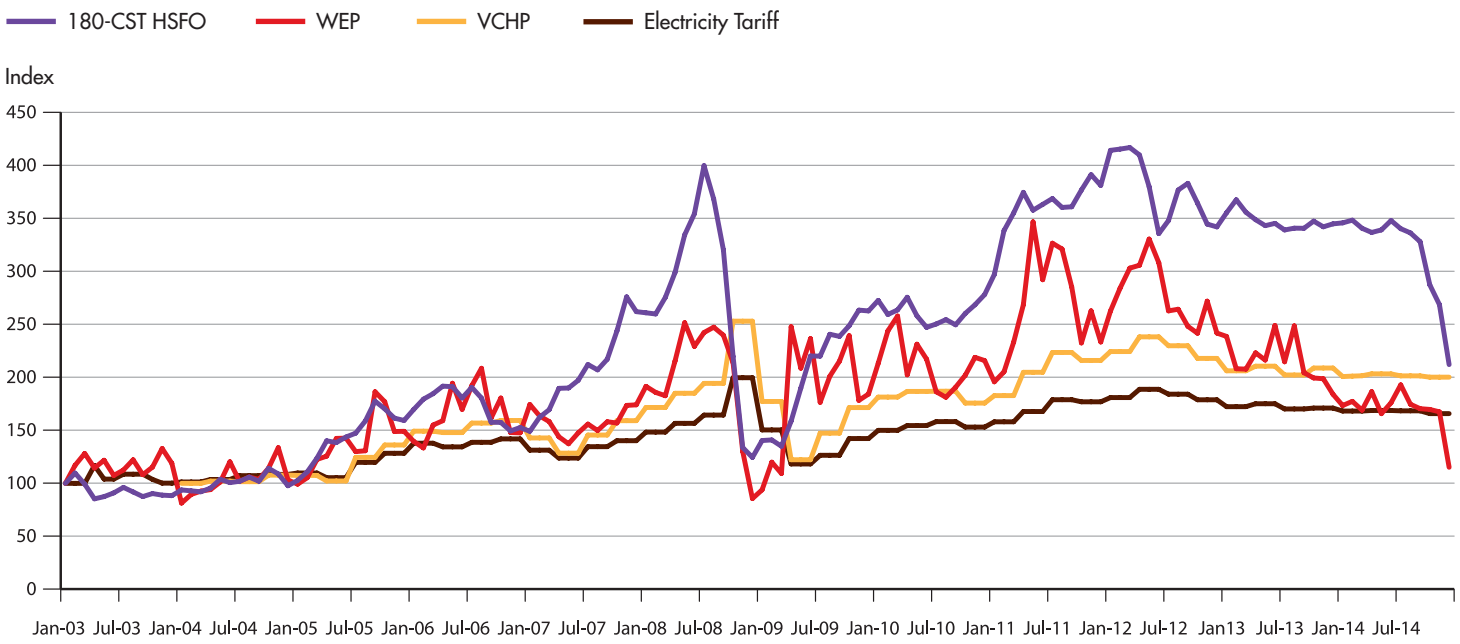
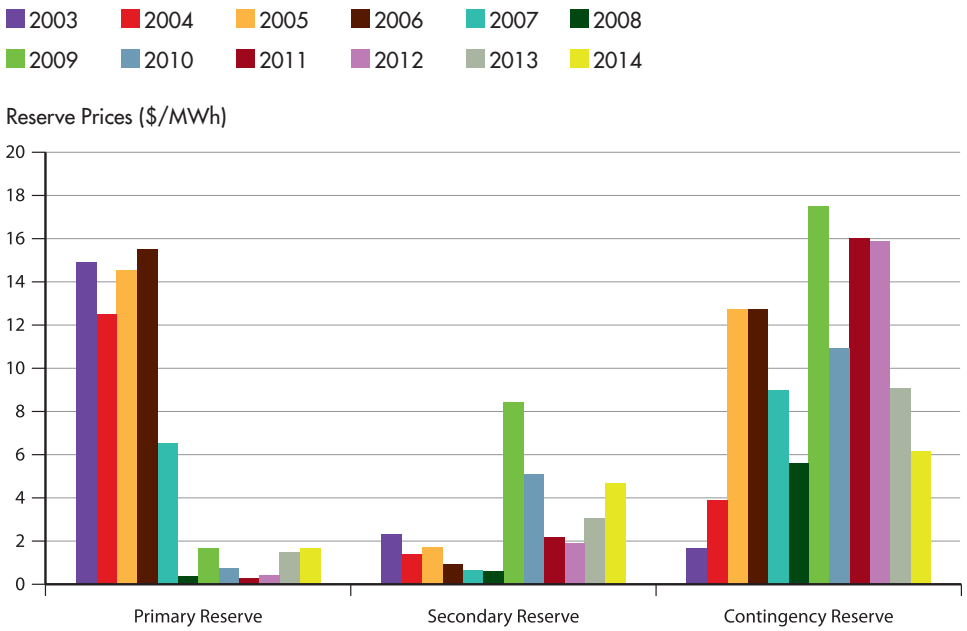
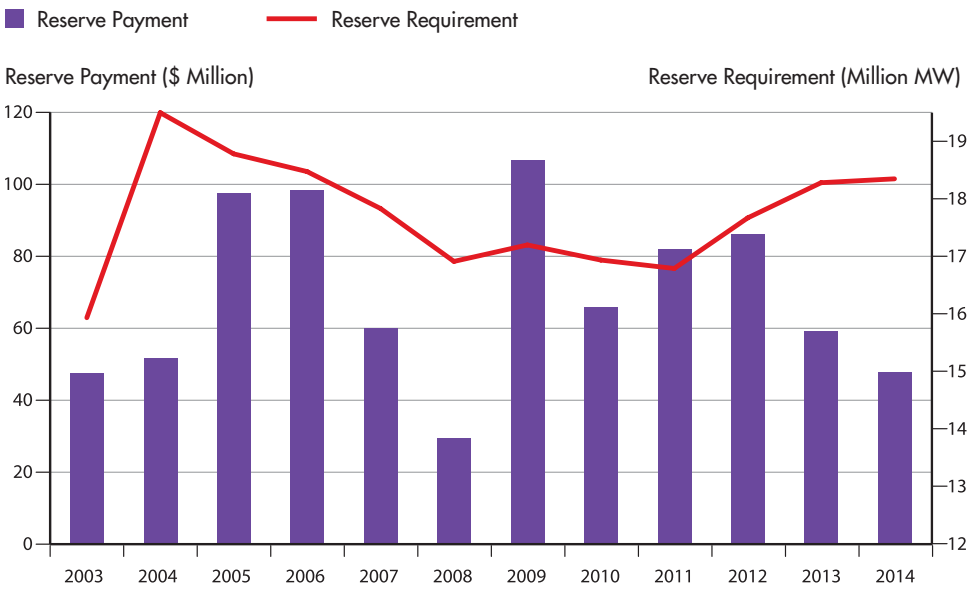


Chart 20: Average Reserve Prices



From Chart 20, it can be seen that the average primary reserve price and average secondary reserve price increased by 10.8 percent and 51.8 percent in 2014 to reach $1.67/MWh and $4.70/MWh respectively. On the other hand, average contingency reserve price fell by 32.1 percent in 2014 to reach $6.20/MWh.

Chart 21: Annual Reserve Cost and Requirement



The total reserve cost decreased 19.3 percent from $59.3 million in 2013 to $47.9 million in 2014, as seen in Chart 21.

Chart 22: Number of IL Activations in 2014

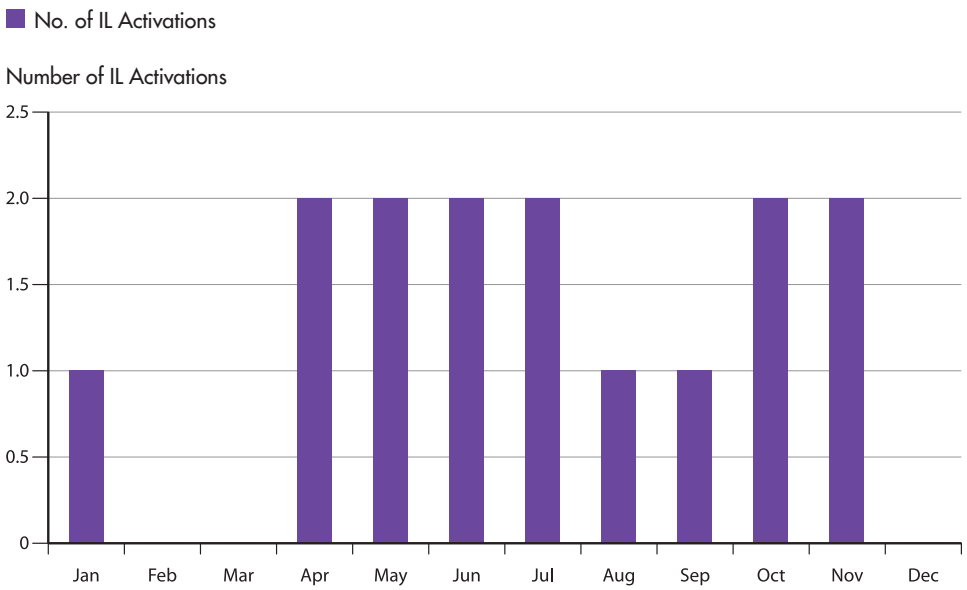
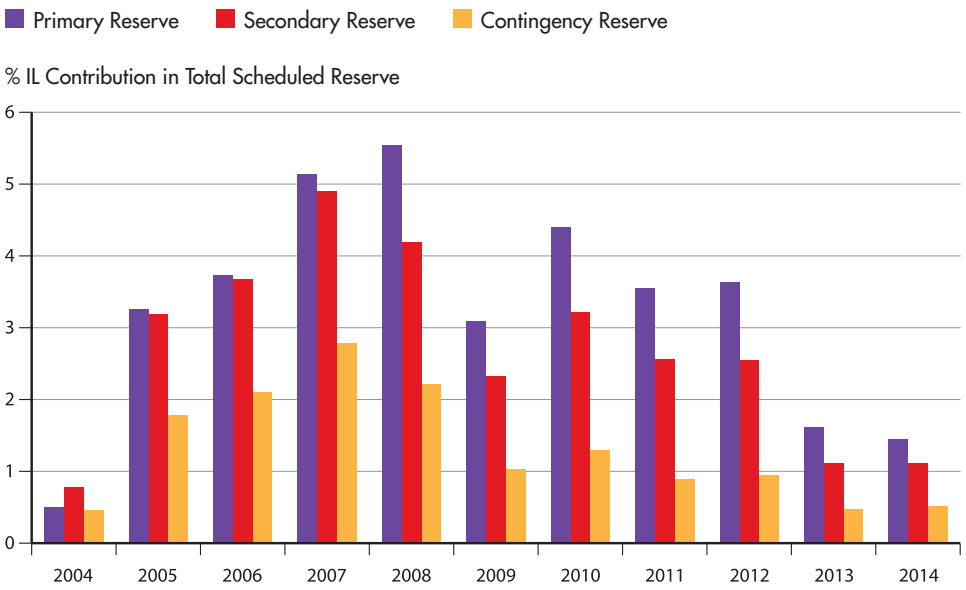
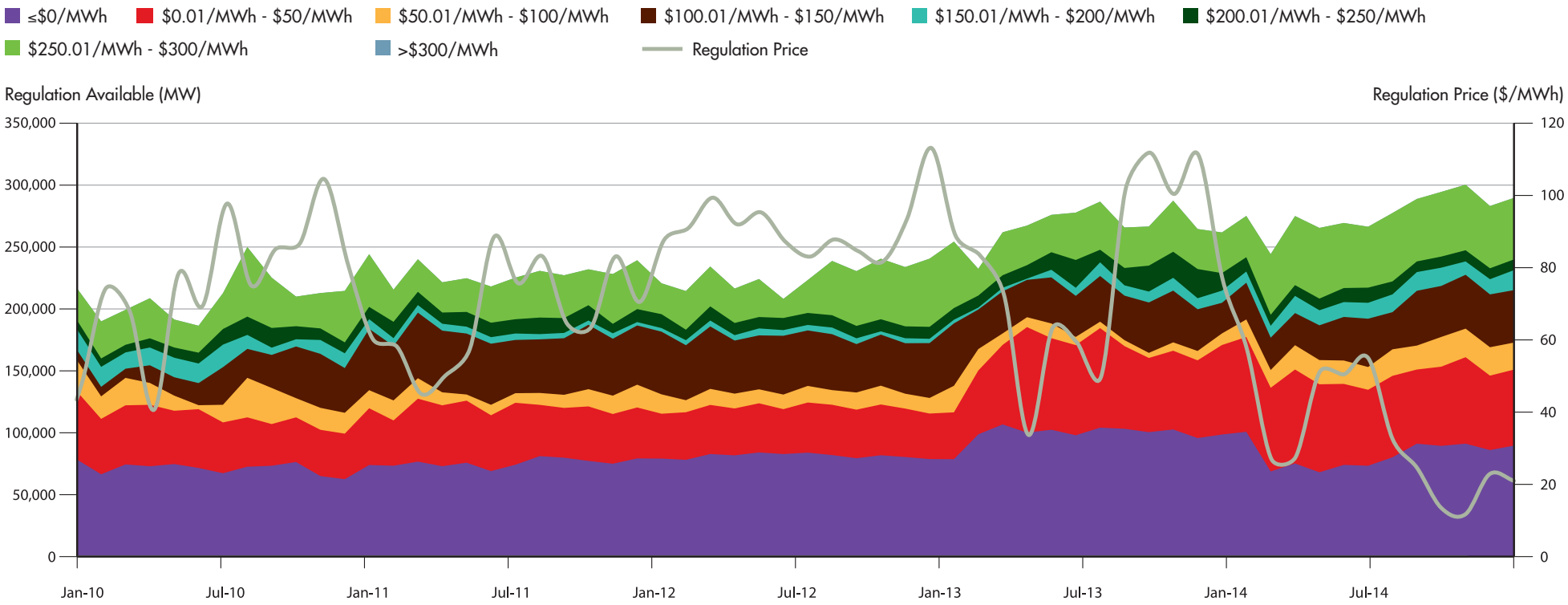


Chart 23: Total Percentage Contribution from IL in Three Classes of Scheduled Reserve



From Chart 22, it can be observed that in 2014, Interruptible Load (IL) was activated on 15 occasions to provide reserve, compared to 20 occasions in 2013. IL was activated on two occasions each for the months of April, May, June, July, October and November, and one occasion each in January, August and September. Despite the drop in IL activations, the percentage contributions from IL in secondary and contingency reserve classes in 2014 were at levels similar to that of 2013, as seen in Chart 23. There was a slight drop in the percentage contribution from IL in primary reserve.

Chart 24: Regulation Availability vs Regulation Price



The average regulation price decreased 58.5 percent from $79.50/MWh in 2013 to $33.00/MWh in 2014. The 2014 peak monthly regulation price of $57.60/MWh was observed in January.

Chart 24 shows the regulation offer patterns in various offer tranches. The biggest change can be observed in the "≤$0/MWh" offer tranche, where the proportion of offers decreased by 7.5 percentage points to reach 29.6 percent in 2014. The biggest increase of 5.2 percentage points can be observed in the "$250.01/MWh - $300/MWh" offer tranche.

ECONOMETRIC MODEL AND OUTLIER PRICES

ECONOMETRIC MODEL AND OUTLIER PRICES

In 2007, the Market Surveillance and Compliance Panel (MSCP) started using an econometric model to identify and analyse high price incident[6]. The model provides a means of estimating the average Uniform Singapore Energy Price (USEP) through the use of independent variables, including the Combined Cycle Gas Turbine (CCGT) supply, Steam Turbine (ST) supply, energy supply cushion, offers lower than $100/MWh, energy demand, reserve cushion and lagging fuel oil prices. The model is also adjusted to differentiate planned outages from generation companies with different portfolios, and forced outages by month, day-of-week, and year via the use of dummy variables.

As part of the effort to review and enhance the model, following the publication of the 2008 MSCP Annual Report, the issue of multicollinearity between variables within the model was tackled. While multicollinearity does not affect the predictive and detection powers of the model, it may misrepresent the explanatory power of the variables in the model. In particular, the coefficients of the independent variables may be distorted to some degree. In addition, some variables may be statistically insignificant.

To reduce multicollinearity in the model, stepwise regression was used. Stepwise regression is a statistical technique in which variables are added to a model in a forward selection or backward elimination procedure to determine their contribution to the regression model. The statistical significance of the variable is measured by its additional contribution to the residual sum of squares (RSS). If the RSS is not improved significantly by the addition of a variable, the variable is left out of the final model.

By employing stepwise regression, it was found that selecting three variables would create a model with an R-squared value of 80.6 percent. The three variables selected were: lagged fuel oil price, supply cushion and CCGT supply.

Table 7 provides the following observations, which are in line with expectations:

- a one unit increase in the logarithm of the lagged fuel oil price will bring about a 0.92 unit increase in the logarithm of the USEP;
- a one unit increase in the logarithm of the supply cushion will bring about a 0.70 unit decrease in the logarithm of the USEP; and
- a one unit increase in the logarithm of the CCGT supply will bring about a 0.60 unit decrease in the logarithm of the USEP.

[6] Details of the model and its methodology can be found in the paper, "How Market Fundamental Factors Affect Energy Prices in the NEMS—An Econometric Model", available on www.emcsg.com.

Table 7: Estimation Results – January 2003 to December 2014

Variable	Coefficient	P-value
Constant	8.44	0.00
LOG (Lagged Fuel Oil Price)	0.92	0.00
LOG (Supply Cushion)	-0.70	0.00
LOG (CCGT Supply)	-0.60	0.00
Model Diagnostics		
R-squared	0.81	
Adjusted R-squared	0.81	
Number of observations	4,353	

Chart 25: Actual vs Predicted LOG USEP Within Three Standard Error Bands

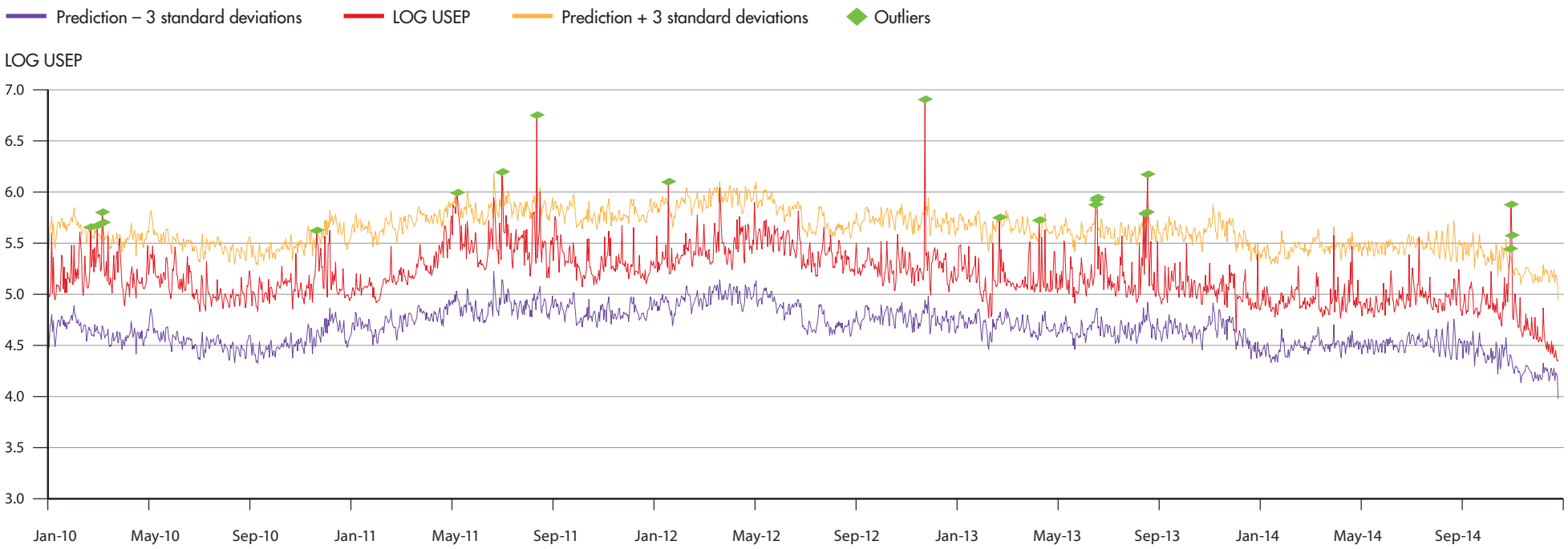
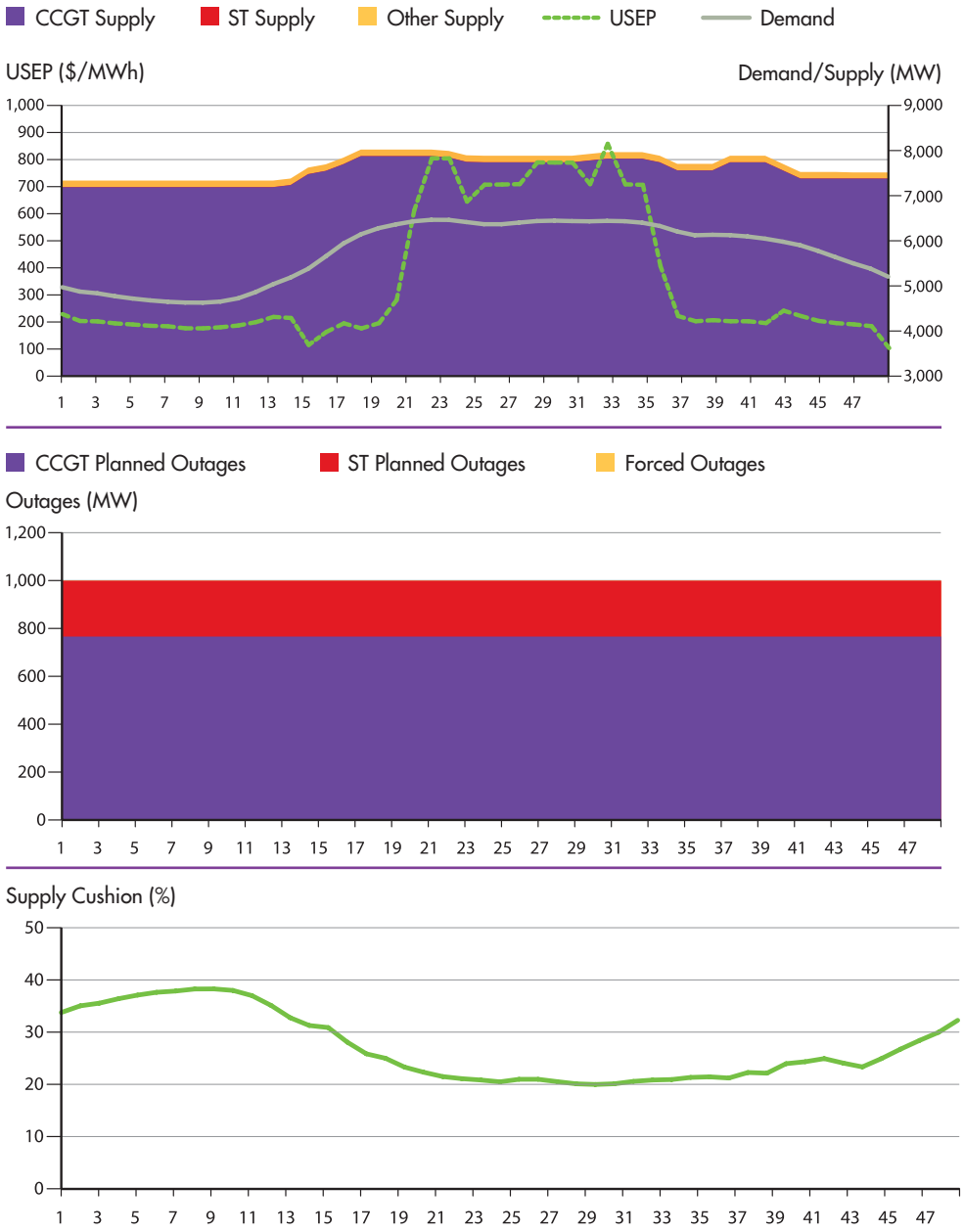


Chart 25 illustrates the actual daily average USEP, the upper and lower bands of the estimated USEP, and the outliers identified by the econometric model, from January 2010 to December 2014. For 2014, there were three days in which outlier prices were detected by the model. Two of the days will be discussed in this report as the third day saw the same phenomenon, albeit on a smaller scale.

Chart 26: Demand and Supply Conditions – 4 November 2014



Date	Tuesday 4 Nov 2014	All Tuesdays in Nov 2014
Daily USEP ($/MWh)	357.77	169.84
Max USEP ($/MWh)	857.78	857.78
No. of USEP ≥ $1,000/MWh	0	0
Demand (MW)	5,741.37	5,558.37
Supply Cushion (in %)	27.16	30.68
Offers ≤ $100/MWh (in %)	68.75	67.28

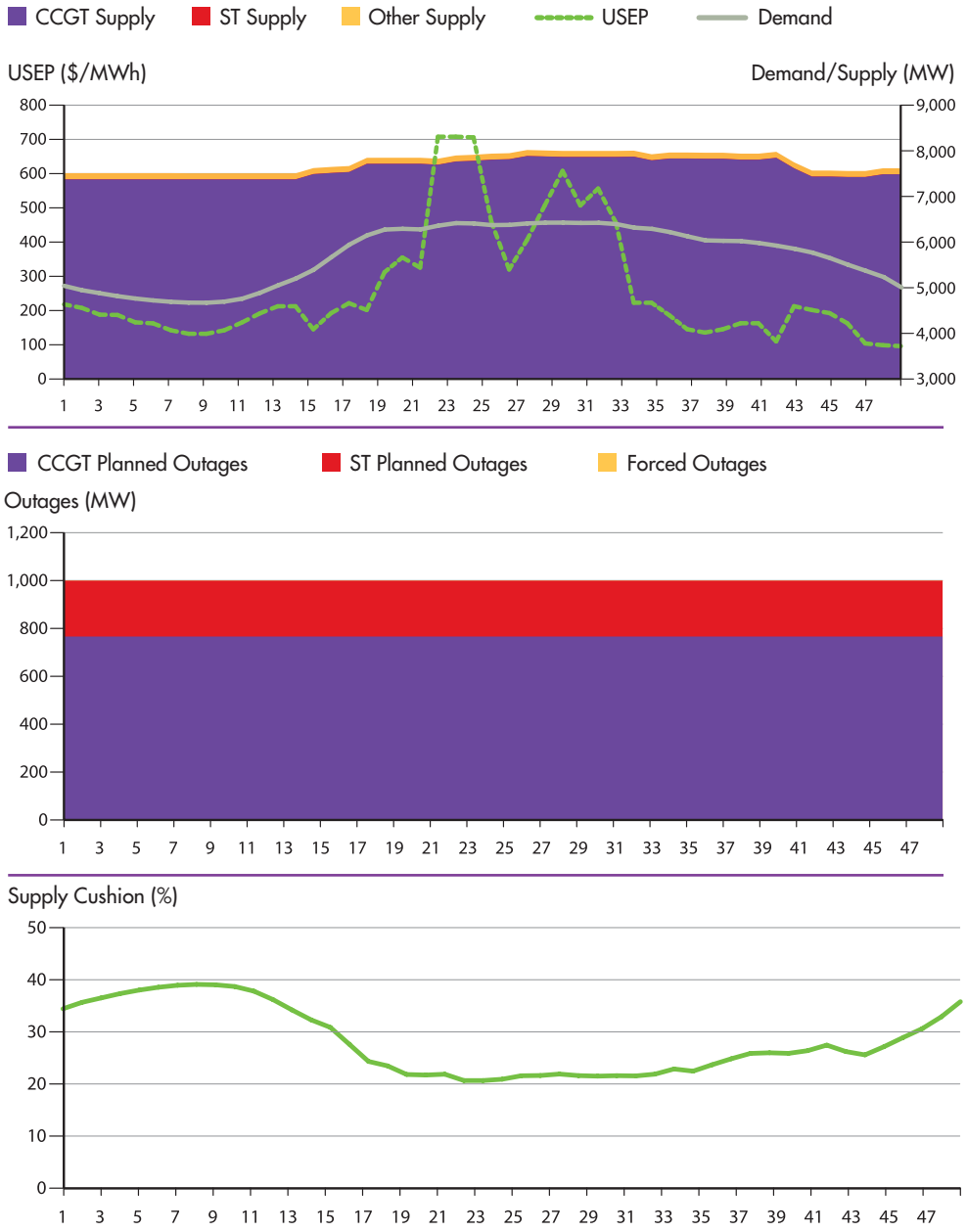
Summary

On Tuesday, 4 November 2014, there were 15 periods during which the USEP rose above $400/MWh, reaching as high as $857.78/MWh.

The high prices were largely due to price separation experienced during some of the periods, which in turn was caused by security constraints being reached on some transmission lines.

In addition, there was a high level of planned maintenance (998.46MW) due to five CCGT/COGEN/TRIGEN units and one ST unit being taken out of the grid. Higher demand and lower supply pushed the supply cushion of the affected periods down to around 20 percent.

Chart 27: Demand and Supply Conditions – 5 November 2014



Date	Wednesday 5 Nov 2014	All Wednesdays in Nov 2014
Daily USEP ($/MWh)	264.79	146.10
Max USEP ($/MWh)	707.48	707.48
No. of USEP ≥ $1,000/MWh	0	0
Demand (MW)	5,706.66	5,559.85
Supply Cushion (in %)	28.21	31.00
Offers ≤ $100/MWh (in %)	69.56	66.64

Summary

On 5 November 2014, the USEP went above $400/MWh for ten periods, hitting $707.48/MWh at its peak.

The reasons for the high USEP were similar to the ones on 4 November 2014. While there was no price separation recorded during the periods of high prices, some offer variations were observed just before gate closure.

During the periods of high USEP, planned maintenance was around 1,020.46MW. This, coupled with the higher demand, provided further upward price pressure.

INVESTIGATIONS

Table 8: Investigation and Enforcement Statistics

	Rule Breaches	1 Jan 2003 to 31 Dec 2014	1 Jan to 31 Dec 2014
(A)	**Total number of offer variations after gate closure received**	34,070	1,214
	Total number of cases closed	33,707	1,321
	- cases in which the MSCP determined a breach	128	0
	- cases in which the MSCP determined no breach	13,969	1,300
	- cases in which the MSCP took no further action	19,610	21
(B)	**Origin of cases (excluding offer variations after gate closure)**	172	6
	- self-reports	147	6
	- referrals or complaints	18	0
	- initiated by the MSCP	7	0
	Total number of cases closed	172	6
	- cases in which the MSCP determined a breach	118	2
	- cases in which the MSCP determined no breach	12	4
	- cases in which the MSCP took no further action	41	0
	- cases in which the MSCP issued suspension order	1	0
(C)	**Number of formal MSCP hearings**	5	0
(D)	**Enforcement action**		
	- highest financial penalty imposed on a party in breach	$842,861	0
	- total financial penalties imposed on parties in breach	$1,108,861	0
(E)	**Costs**		
	- highest award of costs imposed on a party in breach	$43,750	$1,500
	- total costs imposed on parties in breach	$210,575	$3,000

Market Efficiency and Fairness	1 Jan 2003 to 31 Dec 2014	1 Jan to 31 Dec 2014
Total number of cases	7	0
- referrals or complaints	2	0
- initiated by the MSCP	5	0
Total number of cases closed	7	0

Under the Market Rules, the Market Surveillance and Compliance Panel (MSCP) may initiate an investigation into any activities in the wholesale electricity markets or into the conduct of a market participant, the Market Support Services Licensee, Energy Market Company or the Power System Operator that is brought to its attention by way of a referral or complaint from any source, or that the MSCP of its own volition determines as warranting an investigation.

The MSCP may refuse to commence or may terminate an investigation when it is of the view that a complaint, referral or investigation is frivolous, vexatious, immaterial or unjustifiable, not directly related to the operation of the wholesale electricity markets, or within the jurisdiction of another party.

Table 8 reflects the position with regard to investigation and enforcement activities from the start of the market on 1 January 2003 to 31 December 2014, with the last column focusing on the period under review.

Reports of determinations of breach made by the MSCP are published in accordance with the Market Rules.

SECTIONS 50 AND 51 OF THE ELECTRICITY ACT

Information Requirements to Assist the Authority

The Market Rules provide for the Market Assessment Unit (MAU), under the supervision and direction of the Market Surveillance and Compliance Panel (MSCP), to develop a set of information requirements to assist the Energy Market Authority (EMA) to fulfil its obligations with respect to prohibiting anti-competitive agreements and abuse of a dominant position under sections 50 and 51 of the Electricity Act.

The first set of information requirements was finalised in consultation with the EMA and published on 27 March 2003. As the market evolved, modifications to the information requirements were published on 18 August 2003, 28 January 2004 and 3 April 2012.

The MAU regularly provides data to the EMA according to the information requirements.

Reports to the Authority

The Market Rules provide for the MSCP to include in its report a summary of reports that have been made to the EMA regarding any complaint that may have been received or any information that may have been uncovered, that may indicate the possibility of anti-competitive agreements, or the abuse of a dominant position, contrary to sections 50 or 51 of the Electricity Act.

In the course of monitoring and investigative activities carried out from January 2014 to December 2014, the MSCP and MAU did not make any report to the EMA regarding any complaints that may have been received or any material evidence that may have been uncovered that may indicate the possibility of anti-competitive agreements, or the abuse of a dominant position contrary to sections 50 or 51 of the Electricity Act.

ASSESSMENT OF THE WHOLESALE ELECTRICITY MARKETS

Under the Market Rules, the Market Surveillance and Compliance Panel (MSCP) is required to provide a general assessment of the state of competition and compliance within, and the efficiency of, the wholesale electricity markets. The MSCP's assessment is as follows:

Market Structure and Competition

Entry of new market participants and new facilities

There was a total of three new market participants (MPs) joining the National Electricity Market of Singapore (NEMS) in 2014.

Two MPs joined the NEMS as a wholesaler (generation) in 2014. They are CGNPC Solar-Biofuel Power (S) Pte Ltd which operates one solar biomass plant rated at 9.9MW, and Sunseap Leasing Pte Ltd with a 1.02MW generating capacity through solar leasing.

CPvT Energy Asia Pte Ltd joined the NEMS in February 2014 as an interruptible load (IL) service provider[7].

Apart from new MPs joining the NEMS, new generation facilities were also registered in the NEMS in 2014. These included one 403.8MW Combined Cycle Gas Turbine (CCGT) unit from SembCorp Cogen Pte Ltd and one 32.5MW CCGT unit from TP Utilities Pte Ltd. Two units of 7.8MW each from Singapore LNG Corporation Pte Ltd[8] were also registered in the NEMS in November 2014.

De-registration/De-rating of facility

Senoko Energy Pte Ltd de-registered two of its gas turbines in June 2014. These were generation registered facilities with a generating capacity of 105MW each.

[7] As of 31 March 2015, CPvT Energy Asia Pte Ltd has not registered any interruptible load facility in the NEMS.

[8] Registered as MP in the NEMS in March 2013.

Market Price Behaviour

Further energy price decrease in 2014

Energy prices continued to decline in 2014. The Uniform Singapore Energy Price (USEP) decreased 21.1 percent from $173.24/MWh in 2013 to $136.67/MWh in 2014, while the Wholesale Electricity Price (WEP) decreased 21.5 percent from $174.41/MWh to $137.00/MWh. Energy prices were below the vesting contract prices for over 70 percent of the time in 2014.

The decrease in energy prices was largely due to the faster rate of supply growth compared to demand (supply cushion strengthened 3.8 percentage points from 26.2 percent in 2013 to 30.0 percent in 2014), and the reduction in fuel oil prices by 8.1 percent in 2014.

Efficiency of the Electricity Markets

Productive efficiency

Riding on the 2013 trend, the market share of CCGT units continued to rise in 2014. The market shares of CCGT units based on injection quantities and maximum capacity increased by 3.6 percentage points and 1.0 percentage point respectively. Correspondingly, there were declines of 4.1 percentage points and 1.7 percentage points of Steam Turbine's (ST) market share based on injection quantities and maximum capacity respectively. Overall, this represented further improvements in productive efficiency.

Pricing efficiency

Prices generally reflected relative supply and demand conditions in 2014.

Looking Ahead

Greater competition in the power sector

New generating capacities from SembCorp Cogen Pte Ltd (of 400MW) and Tuaspring Pte Ltd (of 411MW) are expected to come online in the near future.

Introduction of demand response programme

The demand response programme is expected to be implemented in 2015, after required system changes have been made. Under the programme, contestable consumers will be allowed to actively reduce their load in response to high prices in return for payments through the sharing of system-wide savings.

Expanding retail contestability

As part of the EMA's goal to fully liberalise the electricity market, the contestability threshold will be further reduced to 2,000kWh on 1 July 2015. This follows the reductions in the contestability threshold from 10,000kWh to 8,000kWh on 1 April 2014, and then to 4,000kWh on 1 October 2014.

Lowering of vesting contract level

The vesting contract level will be reduced over a two-year period. It will first be lowered from 40% to an intermediate level of 30% for the first half of 2015 and 25% for the second half of 2015, and then further lowered to 20% for 2016.

Implementation of the automatic penalty scheme

From the third quarter of 2015, generation registered facilities (GRFs) will be penalised for deviating from dispatch instructions under an automatic penalty scheme (APS). Under the APS, a GRF that deviates by more than 10MW from its real-time dispatch schedule (or its short-term schedule as the case may be) will be penalised automatically, unless excluded under prescribed circumstances set out in the Market Rules.

Ensuring compliance with the Market Rules is important in the operation of a competitive and reliable electricity market. MPs that breach the rules may be subject to sanctions if the Market Surveillance and Compliance Panel (MSCP) considers it appropriate.

The assessment of the state of compliance within the wholesale electricity markets is set out below.

Offer Variations After Gate Closure

Table 9 compares the number of offer variations after gate closure submitted by MPs in 2014 and the previous year.

There were 1,214 cases of offer variations made after gate closure in 2014. This was 15.6 percent lower than in 2013 despite the fact that there were five new generation units carrying out commissioning tests in the year. The main contributor of the offer variations made after gate closure was again an interruptible load provider who submitted a high number of offer variations after gate closure due to its equipment experiencing many outages.

The MSCP was satisfied that the offer variations made after gate closure did not give rise to any significant concerns.

Rule Breaches

For the period from 1 January to 31 December 2014, the MSCP made two determinations regarding rule breaches. The two determinations were made against Energy Market Company Pte Ltd (EMC). The rule breach determinations were as follows:

- EMC failed to determine, release and publish real-time and short-term dispatch schedules on 25 November 2013.
- EMC failed to determine, release and publish short-term and real-time schedules on time on 20 July 2014.

Overall, there were no major compliance issues arising within the wholesale electricity markets in 2014.

Table 9: Offer Variations After Gate Closure

Number of offer variations made after gate closure from 1 January 2013 to 31 December 2013	1,439
Number of offer variations made after gate closure from 1 January 2014 to 31 December 2014	1,214
Decrease in number of offer variations made after gate closure for year 2014 from previous year	15.6%

CONCLUSION

CONCLUSION

The Market Surveillance and Compliance Panel (MSCP) is generally satisfied with the state of compliance in the National Electricity Market of Singapore (NEMS) in 2014. Only two cases of rule breach required determinations from the MSCP. The number of gate closure violations also declined noticeably from the previous year and did not create any significant market impact.

For the second year running, wholesale electricity prices in 2014 were significantly (21 percent) lower than a year ago. Both additional generation capacities and a sharp decline in fuel prices towards the end of the year contributed to the overall lower wholesale price environment. From the competition point of view, it was encouraging that the combined market share of the three largest generation companies has continued to decline towards the 60-percent mark, showing that dilution of market concentration has been steady. Also continuing last year's trend, energy prices stayed below vesting contract prices for over 70 percent of the time. The market share of Combined Cycle Gas Turbine (CCGT) units (based on injection quantities) continued to head upwards to 97.9 percent in 2014. Overall, these statistics are very positive in terms of increased competition in the wholesale electricity markets.

The movements of wholesale energy prices continued to be in response to changes in the underlying demand and supply drivers, and were within reasonable expectation. Outlier prices were observed on only three days, which largely coincided with technical constraints and equipment maintenance or outages.

Looking ahead in 2015, the MSCP expects competitive pressure to be maintained in the wholesale electricity markets. Schemes allowing for demand response and further lowering of the threshold for retail contestability can be looked forward to for more efficiency gains in the electricity sector.

USER GUIDE

Data

- All real-time and forecast prices and settlement data are provided by Energy Market Company Pte Ltd (EMC).
- Vesting Contract Hedge Prices (VCHP) are computed by SP Services Ltd (SP Services) based on a formula set by the Energy Market Authority.
- Data for forecast demand and outages is compiled from reports prepared by the Power System Operator (PSO), including advisory notices.
- Metered energy quantities are supplied by SP Services as the Market Support Services Licensee (MSSL). All metered data used in this report is final data, derived after any settlement reruns.
- Throughout this document, demand figures are based on the forecast demand supplied by the PSO, except where metered energy quantities are indicated.
- Combined Cycle Gas Turbine (CCGT) units refer to all generating units clustered under the CCGT/COGEN/TRIGEN umbrella.

Supply Indices

- Capacity ratio measures the scheduled (by the Market Clearing Engine) output of energy, reserve and regulation as a ratio of a generation registered facility's maximum generation capacity at a given time.
- Supply cushion is the ratio between (a) the supply and demand gap (i.e., the difference between total offered volume and demand) and (b) supply. This index measures supply adequacy. It indicates the level of unused capacity that was offered but not scheduled, and could be called up if required. The total offered volume refers to the total amount of energy offered by all generation registered facilities. Demand refers to the demand forecast by the PSO used to determine the real-time dispatch schedule for energy.
- Market share is computed based on the generation output of each company. The maximum capacity for each generation company is the registered maximum capacity in the standing data.
- Under the Market Rules and System Operation Manual (SOM), outages of generation registered facilities are defined as follows:

Table 10: Definition of Peak, Shoulder and Off-peak Periods*

	Sunday/Public Holiday	Weekday	Saturday
Peak	-	Periods 18-41	-
Shoulder	Periods 21-35 Periods 38-46	Periods 15-17 Periods 42-48	Periods 17-47
Off-peak	Periods 1-20 Periods 36-37 Periods 47-48	Periods 1-14	Periods 1-16 Period 48

*Source: MSSL

a. planned outage is defined in the SOM to "include both the Annual Outage plan for overhaul, retrofitting or inspection and the Short-term Outage Plan for urgent repair or maintenance"; and

b. forced outage is defined in the Market Rules as "an unanticipated intentional or automatic removal from service of equipment or the temporary de-rating of, restriction of use or reduction in performance of equipment".

There may be slight differences in the calculation of outages in the Annual Report of the MSCP and the NEMS Market Report due to differing methodologies.

Vesting Contracts

The VCHP is calculated by the MSSL every three months. It is determined using the long-run marginal cost of the most efficient technology in the Singapore power system, i.e., the Combined Cycle Gas Turbine. EMC's settlement system uses the VCHP to settle the vesting quantity between the MSSL and the generation companies.

Periods

Each day is divided into 48 half-hour periods. Period 1 is from 0000 to 0029 and Period 48 is from 2330 to 2359.

Important Notice

This publication is meant only for general information and nothing in it may be construed as advice. Whilst the Market Surveillance and Compliance Panel (MSCP) has taken reasonable care in the preparation of this publication, the MSCP does not warrant its suitability for any purpose. You should always consult your professional advisors before relying on this publication to make any decision.

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