
# Report by
# Market Surveillance and Compliance Panel

**For the period from**
**April 2006 to March 2007**

***16 July 2007***

**This is an edited version of a report prepared for**
**the Energy Market Company Pte Ltd and the Energy Market Authority**
**in accordance with the Singapore Electricity Market Rules.**
**The report has been edited to protect confidential information.**

CONTENTS

## EXECUTIVE SUMMARY

Energy prices in the NEMS headed upwards for the fourth consecutive year by nearly 16 percent from last year's average of $116.54/MWh to $135.04/MWh. This was accompanied by a 3.5 percent rise in the average demand of 4401MW, a tightening supply cushion and continuing rise in fuel costs.

The supply cushion, which measures the amount of spare capacity, dropped further from 25.1 to 22.9 percent for the period under review, mainly due to the rate of increase in supply failing to match that of demand. The average capacity available for dispatch for the period under review only managed to inch higher by 0.5 percent. This paled in comparison to the 3.5 percent growth in average electricity demand.

Although CCGTs had been the main catalyst for improving supply since market start, the momentum waned with only one CCGT commissioned during the period under review. A significant jump in CCGT outages compared to the previous year led to a further deterioration in CCGT supply. This resulted in the market having to fall back on ST supply to meet a rising demand. For the first time since market start, STs therefore registered a gain in market share from 19.1 to 20.3 percent. The decommissioning of an OCGT unit also contributed to the rising ST market share.

In the ancillary market, the MSCP observed notable gains in the average contingency reserve and regulation prices, with the regulation price doubling for a second consecutive year. The regulation market was mainly affected by rising regulation prices between October 2006 and January 2007. The record high regulation price of $749.49/MWh in January 2007 prompted the MSCP to launch an investigation, publishing its report in late March 2007.

In reviewing the state of competition and efficiency of the wholesale electricity markets, the MSCP arrived at the following conclusions:

- The record high regulation prices in January signalled potential weakness in the regulation market structure. The high prices had prompted the EMA to review the regulation market.

- The potential positive effect of a new generation facility, which was under commissioning during the period under review, had yet to be felt.

- In the energy market, the greater utilization of STs to meet demand had led to a reversal of the sliding ST market share trend for the first time since market start.

- Energy prices became more sensitive to changes in the supply cushion as the average supply cushion tightened for the third consecutive year, with growth in demand outstripping that of supply.

- A recently developed econometric model confirmed the MSCP's expectations regarding the relationship between market fundamental factors and the energy price. Having studied the outliers identified by the econometric model, the MSCP was of the view that incidents with offer behavior similar to that leading to the price spike on 15 March 2007 should continue to be monitored. The rest of the outliers could be explained by the forces of demand and supply.

- Overall, vesting contracts had ensured that energy prices continued to hover close to the LRMC of a CCGT.

In terms of market compliance, the MSCP observed that:

- There was a significant reduction in the number of cases of offer variations made after gate closure. This was mainly due to a market rule change which shortened the gate closure period from 2 hours to 65 minutes. Improvements by generation companies in the handling of their offer variations also contributed to a reduction in the number of market rule breaches associated with offer variations made after gate closure.

- Other cases of MSCP determination of market rule breach did not have any significant market impact.

## GLOSSARY

**C**

CCGT - combined cycle gas turbine

**D**

DMP – direct market participant

**E**

EMA - Energy Market Authority
EMC - Energy Market Company Pte Ltd

**H**

HSFO 180 cst – High Sulphur Fuel Oil

**I**

IL – Interruptible load

**L**

LRMC - long run marginal cost

**M**

market rules - Singapore electricity market rules
MAU - Market Assessment Unit
MCE – market clearing engine
MEUC - monthly energy uplift charge
MSCP - Market Surveillance and Compliance Panel
MSSL - market support services licensee
MOS – market outlook scenarios

**N**

NEMS - National Electricity Market of Singapore

**O**

OCGT - open cycle gas turbine
OT - other facilities (i.e. incineration plants)

**P**

PDS - pre-dispatch schedules
PSO - Power System Operator

**S**

SP Services – SP Services Ltd
SRMC - short run marginal cost
ST - steam turbine
STS - short-term schedules

**T**

Temasek Holdings – Temasek Holdings Pte Ltd

**U**

USEP - uniform Singapore energy price

**V**

VCHP – vesting contract hedge price
VCSC - vesting contract settlement credit
VHP – vesting hedge proportion

**W**

WEP - wholesale electricity price

**A USERS' GUIDE TO THE REPORT**

## General

### Data

All real-time and forecast prices and settlement data were provided by EMC.

Vesting contract hedge prices were computed by SP Services based on a formula set by EMA.

Fuel oil data is based on the monthly "Oil Market Report" published by the International Energy Agency. A copy of the report is available from www.oilmarketreport.org.

Data for forecast demand and outages were compiled from reports prepared by the PSO, including advisory notices.

Metered energy quantities were supplied by SP Services as the MSSL. All metered data used in this report is final data.

Throughout this document, the demand figures are based on the forecast demand supplied by the PSO, except for the metered energy demand in sections 2.2 and 3, which was compiled based on metered energy quantities.

**Definition of Peak, Shoulder and Off-peak Periods***

| | **Sunday/PH** | **Weekday** | **Saturday** |
|---|---|---|---|
| **Peak** | - | Period 18-41 | - |
| **Shoulder** | Period 22-33<br>Period 38-47 | Period 1<br>Period 16-17<br>Period 42-48 | Period 1-2<br>Period 17-48 |
| **Off-peak** | Period 1-21<br>Period 34-37<br>Period 48 | Period 2-15 | Period 3-16 |

* Source: *MSSL*

### Period of Review

This report reviews activities mainly over the period of a year from 1 April 2006 to 31 March 2007. Each quarter of the year is denoted as follows:

1Q 2006/07: 1 April 2006 to 30 June 2006
2Q 2006/07: 1 July 2006 to 30 September 2006
3Q 2006/07: 1 October 2006 to 31 December 2006
4Q 2006/07: 1 January 2007 to 31 March 2007

## Supply Indices

Capacity ratio measures the scheduled (by the MCE) 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. 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 generation capacity for each generation company is the maximum capacity in the standing data.

Outages of generation registered facilities are either planned, unplanned or forced:

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

(b) unplanned outage is defined in the System Operation Manual as "the case in which the generation licensee has to carry out immediate rectification works and has less than 1 business day to inform the PSO before intentional de-synchronisation of the generation unit"; and

(c) 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".

For the purpose of this report, planned outages and unplanned outages have been classified as anticipated outages.

## Demand Indices

*STS* are updated every half-hour and cover a time horizon of six hours after the period in which the relevant *STS* is published. The objective of implementing the *STS* is to provide more updated information to market participants and to enable market participants to make better informed and timely decisions.

*PDS* are updated every two hours and cover a time horizon of between 12 and 36 hours after the period in which the relevant *PDS* is published.

*MOS* are released daily and cover a six-day horizon.

## Price Indices

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 *CCGT*. The *EMC*'s settlement system uses the *VCHP* to settle the vesting quantity between the *MSSL* and the generation companies.

The *VHP* is the vesting contract hedge quantity allocated to contestable consumers.

*WEP* is the price that retailers pay for energy in $/MWh. USEP makes up the bulk of WEP. The rest of the components are the AFP, HEUC, MEUC, EMC administrative fees and PSO administrative fees.

Ancillary services comprise the following:

(a) Reserve which is generation capacity that can be called upon to replace scheduled energy supply that is unavailable as a result of a forced outage, or to augment scheduled energy as a result of unexpected demand. There are three classes of reserves: primary reserve, secondary reserve and contingency reserve. Reserve can be offered by generation companies or by consumers in the form of *IL*.

(b) Regulation which enables the output for a generating unit to be frequently adjusted so that any power system frequency variations or imbalance between load and output from the generating facilities can be corrected.

An *IL* is one which can be voluntarily interrupted for a limited duration to enable the power system to return to its normal operating state. By reducing the consumption of energy within a very short period of time, such load helps to restore demand and supply imbalance due to a contingency event. An IL may offer in the three reserve markets; i.e. primary, secondary and contingency reserve. Providers of *IL* compete with generators to provide reserve. *IL* may be provided by a load facility of a DMP or, where the load facility is not owned by a market participant, through a retailer who is a market participant. The DMP or retailer must register all load facilities with the EMC as a 'load registered facility' of the DMP or retailer before that load facility may offer or provide *IL* in the reserve market.

**INTRODUCTION**

The market rules provide for the MSCP to prepare and submit to EMC annually a report on the conduct of its monitoring and investigation activities. The report is then furnished by EMC to the EMA.

This is the fifth report by the MSCP on the wholesale electricity markets of the NEMS. It mainly covers the period 1 April 2006 to 31 March 2007. The market rules require the report to include a summary of routine reports on the conduct of the MSCP's monitoring and investigation activities, including 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 a summary of any investigations conducted by the MSCP in respect of offer variations after gate closure reported by EMC.

The market rules require the report to contain the MSCP's general assessment as to the state of competition and compliance within, and the efficiency of, the wholesale electricity markets.

## MARKET SURVEILLANCE AND COMPLIANCE PANEL

The MSCP is an independent body established under the market rules. Its members are appointed by the EMC Board.

The MSCP comprises the following persons:

(a) Joseph Grimberg SC, Chair;
(b) Lee Keh Sai;
(c) Professor Lim Chin;
(d) TPB Menon; and
(e) David Wong.

The role of the MSCP is to monitor and investigate activities in the wholesale electricity markets and the conduct of market participants, MSSLs, the PSO and EMC to:

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

More specifically, the market rules provide that the MSCP is to monitor and investigate the conduct of market participants, MSSLs, EMC and the PSO and the structure and performance of, and activities in, the wholesale electricity markets of Singapore, including conduct or activities that provide indications of the following phenomena:

(a) breaches of the market rules, a market manual or system operation manual;
(b) actual or potential design or other flaws and inefficiencies in the market rules, market manuals, the system operation manual and other rules and procedures of EMC or the PSO; and
(c) actual or potential design or other flaws in the overall structure of the wholesale electricity markets.

The market rules also provide for the MSCP to provide assistance to the regulator, the EMA, in carrying out its functions in relation to prohibiting anti-competitive agreements and abuse of a dominant position under sections 50 and 51 of the Electricity Act.

## MARKET ASSESSMENT UNIT

The MSCP is supported in its functions by the MAU. The MAU is established by EMC and composed of full-time EMC staff.

The market rules provide for the MAU to, report to and be under the management and administration, of EMC. The market rules also provide for the MAU to, report to and take direction from the Chair of the MSCP, on all matters pertaining to market monitoring and investigation.

## ACTIVITY LEVEL

MSCP members meet as a panel about once a month to review MAU reports, provide supervision and direction to the MAU and perform the functions more specifically referred to above. Panel members also provide their professional contributions to MSCP matters outside of regular meetings, as may be necessary.

## MARKET MONITORING

### Catalogue of Data and Catalogue of Monitoring Indices

To effectively carry out monitoring, the market rules provide for the MAU, under the supervision and direction of the MSCP, to develop a catalogue of the data it acquires and a catalogue of the monitoring indices that it uses to evaluate data so acquired.

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 players.

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.

## Indicators of Market Performance

The MAU has submitted regular monitoring updates to the MSCP. The monitoring updates have included observations of certain indicators of market performance. The indicators can be broadly classified into supply, demand and price indices, as detailed below. The MSCP has widened the scope of its analysis in this report by comparing market behavior over a three-year horizon, instead of comparing only with the previous year. The MSCP believes that with the NEMS having completed its fourth year of operation, a longer horizon can provide further insights into the efficiency of Singapore's liberalized electricity market.

### 1. Supply Indices

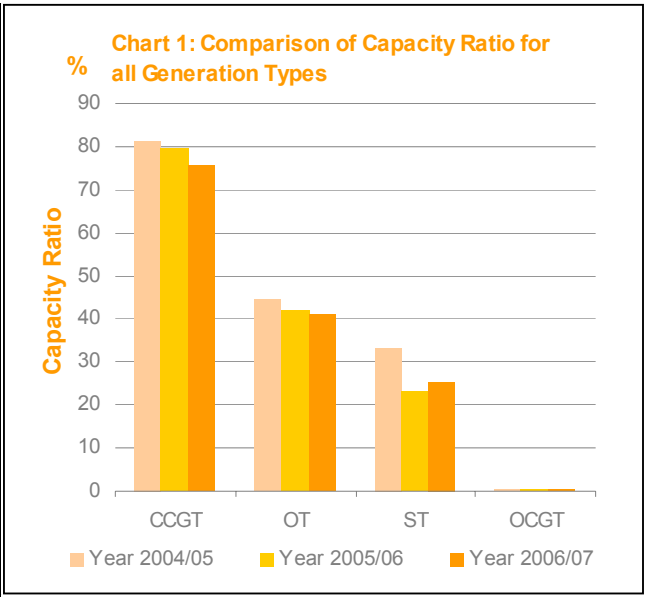
### 1.1 Capacity ratio of generation registered facilities i.e. ratio of scheduled generation output to maximum generation capacity of generation registered facilities

The average capacity ratio for CCGTs dropped further from 79.5 to 75.6 percent (see Table 1). This was primarily due to the commissioning of a new generation unit that started in November 2006. The capacity ratio for CCGTs consistently hovered around the 80 percent mark prior to the introduction of the commissioning unit. During its commissioning period, the unit was unable to reach its maximum generation capacity for most periods. The instantaneous increase in the maximum generation capacity of CCGTs in October 2006 due to the introduction of the commissioning unit, coupled with its low scheduled generation output, led to the lower average CCGT capacity ratio of 71.3 percent in the second half of the year compared to 79.8 percent in the first half of the year. The scheduled generation output from CCGTs was also dragged lower due to higher CCGT outages, which nearly doubled those of the previous year.

In contrast, the average capacity ratio for STs increased from 23.1 to 25.2 percent. This was primarily due to the 13.3 percent jump in the scheduled generation output of STs. The higher growth in output also outpaced the 4.2 percent increase in ST maximum generation capacity.

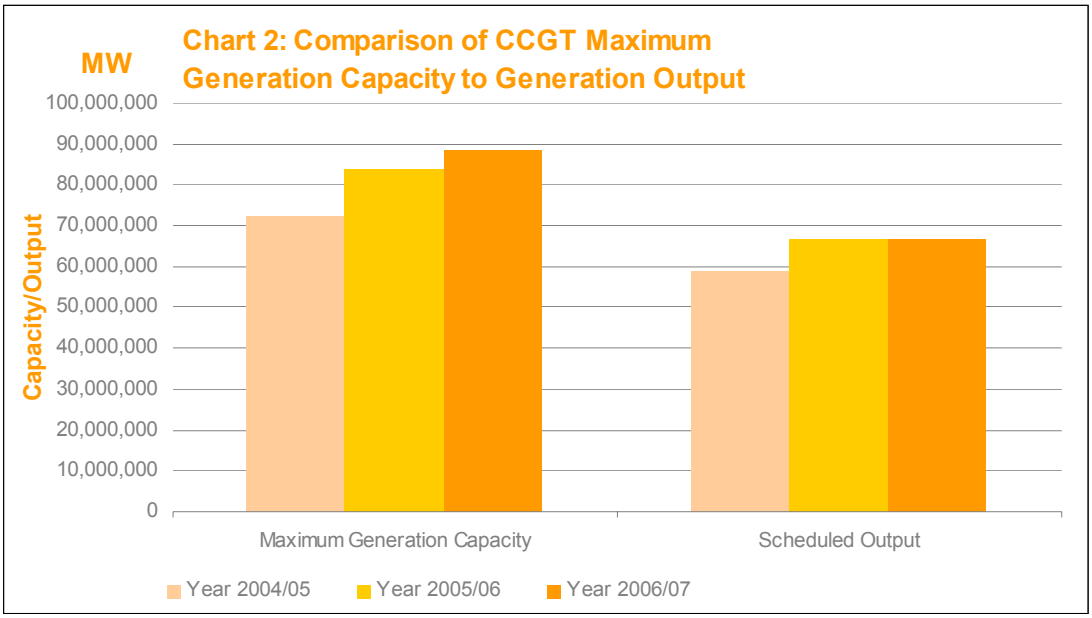
**Table 1: Capacity Ratio (in %)**

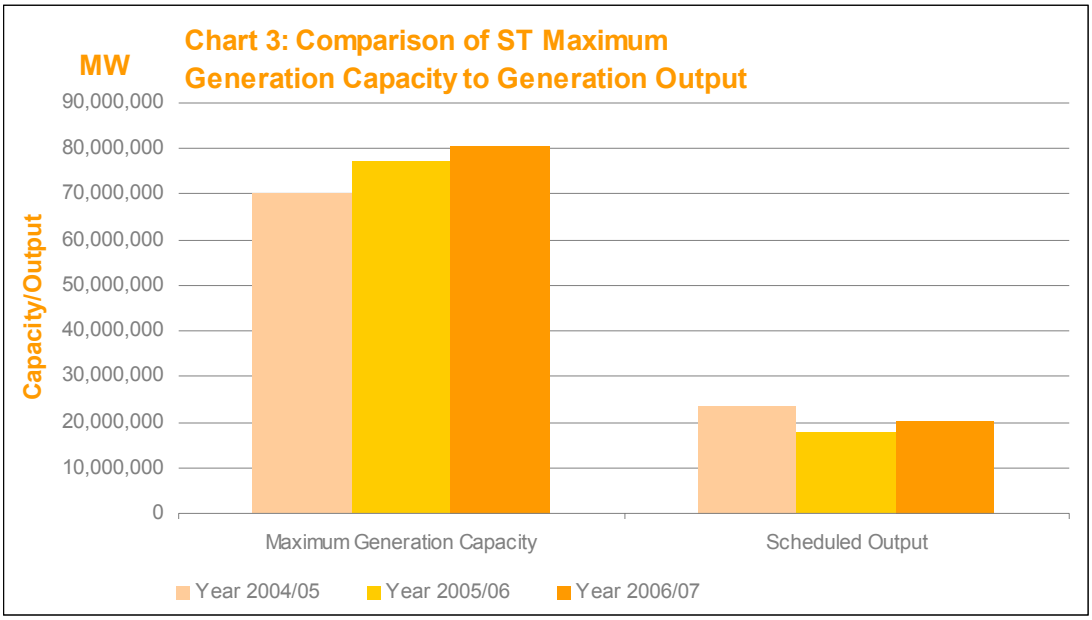
| | Year 2006/07 | | | |
|---|---|---|---|---|
| | CCGT | OT | OCGT | ST |
| Apr-06 | 81.1 | 42.7 | 0.3 | 19.6 |
| May-06 | 78.9 | 41.2 | 0.4 | 25.3 |
| Jun-06 | 79.9 | 41.8 | 0.2 | 22.6 |
| Jul-06 | 78.9 | 42.5 | 0.6 | 24.9 |
| Aug-06 | 79.1 | 41.4 | 1.2 | 24.1 |
| Sep-06 | 80.8 | 38.0 | 0.2 | 22.0 |
| Oct-06 | 76.7 | 42.0 | 0.6 | 28.1 |
| Nov-06 | 76.9 | 41.7 | 0.0 | 26.8 |
| Dec-06 | 71.0 | 41.5 | 0.1 | 22.6 |
| Jan-07 | 67.3 | 43.9 | 0.6 | 27.2 |
| Feb-07 | 65.9 | 39.5 | 0.5 | 29.4 |
| Mar-07 | 70.3 | 38.7 | 0.2 | 29.5 |
| Average: | 75.6 | 41.3 | 0.4 | 25.2 |



Although the increasing maximum generation capacity for CCGTs since 2004/05 was mainly due to new installed capacity, the increase in maximum generation capacity for STs in the last three years was due to other contributing factors. Some of those which occurred this year include the full return of three STs that was previously shut down in 2004/05 for re-configuration. As these plants only gradually returned in 2005, their declared capacity was zero in some parts of 2005/06. A generation company also re-declared a higher ST maximum generation capacity this year after decommissioning one of its OCGT units.

As shown in Charts 2 and 3, although the maximum generation capacity for both CCGTs and STs had increased compared to the previous year, the scheduled generation output for CCGTs had remained flat. In contrast, Chart 3 shows that the scheduled generation output from STs had picked up for the first time since market start.



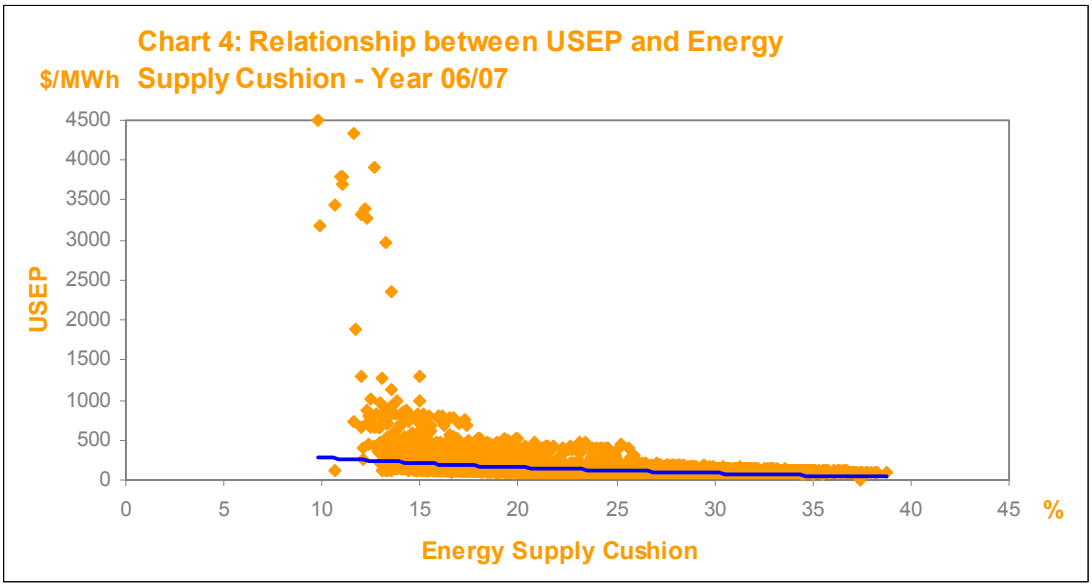
## 1.2 Supply cushion: ratio between (a) supply and demand gap (i.e. difference between total offered volume and system demand) and (b) supply

The energy supply cushion, which measures the spare capacity available after dispatch, dropped from 25.1 to 22.9 percent. The main reasons for the tighter supply cushion were the subdued growth in plant availability and high electricity demand. In the year under review, the 3.5 percent increase in electricity demand was accompanied by only a 0.5 percent increase in average plant availability. This paled in comparison to the previous year where the 4.2 percent increase in electricity demand was met by a 2.9 percent increase in the average plant availability.

Despite an increase in the availability of ST plants by 12.5 percent, the weaker growth in overall plant availability can be explained by the marginal drop in availability of CCGT plants. As only one CCGT unit was commissioned in the past year, the effect of higher anticipated outage and low contribution by the commissioning unit saw CCGT availability inch marginally lower by 0.8 percent.

In contrast, the surge in average electricity demand was accompanied by the hitting of a new high of 5525MW on 27 March 2007.

Chart 4 illustrates the inverse relationship between energy prices (USEP) and the energy supply cushion this year. The chart indicates that as the supply cushion approaches the 10 to 15 percent mark, the chances of observing price spikes increase.




Although a lower supply cushion does not automatically give rise to high prices since it is also necessary to take into account offer prices, Table 2 below confirms that the probability of occurrence of high prices increases as the supply cushion tightens. As shown in Table 2 below, the number of periods with a supply cushion lower than 15 percent has increased dramatically over time from only 31 two years ago to nearly 200 this year. The table also confirms that extreme high prices such as $4500/MWh occurred during periods with a very low supply cushion.

**Table 2: Relationship between Supply Cushion and USEP**

| | Supply Cushion < 15% | | | Supply Cushion ≥ 15% | | |
|---|---|---|---|---|---|---|
| | Number of Periods | Average USEP | Maximum USEP | Number of Periods | Average USEP | Maximum USEP |
| **Year 2004/05** | 31 | 1075.25 | 4500 | 17489 | 84.87 | 1624.68 |
| **Year 2005/06** | 130 | 458.63 | 3569 | 17390 | 114.06 | 2229.60 |
| **Year 2006/07** | 195 | 636.19 | 4500 | 17325 | 129.52 | 828.10 |

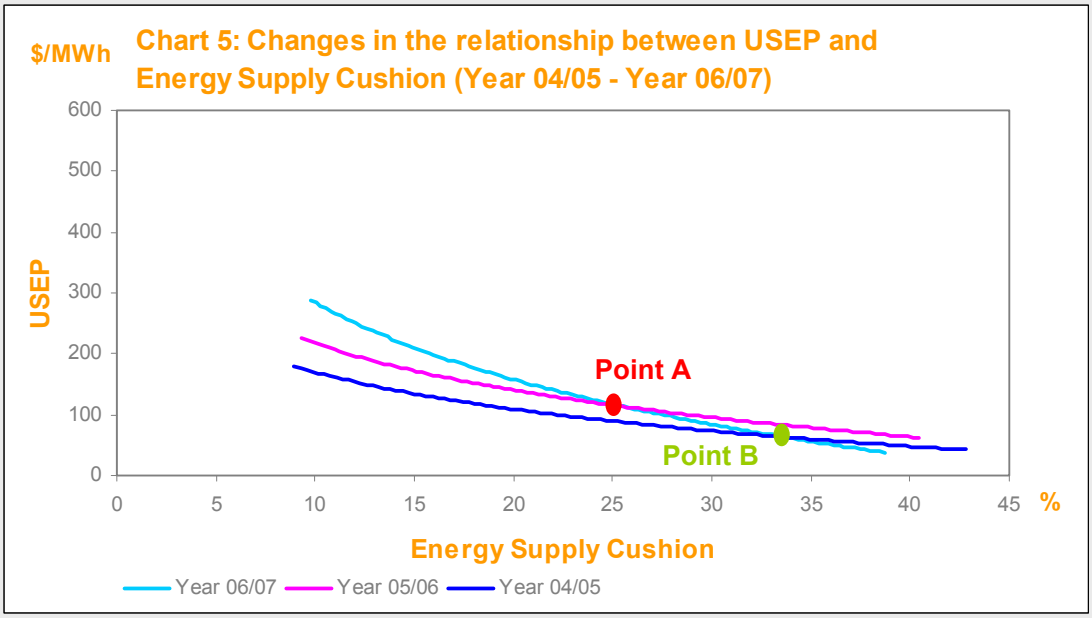
The supply cushion, being a significant index, has been closely monitored as to the effect it has on prices. The MSCP has observed that energy prices in the NEMS have become increasingly responsive to changes in the supply cushion.

**Greater responsiveness of energy price to supply cushion**

A study conducted by the MSCP has shown that energy prices (USEP) have become increasingly responsive to changes in the energy supply cushion. The following section summarises the major observations from this study.

Chart 5 shows the relationship between energy prices and the energy supply cushion in the NEMS since year 2004/05. It is evident that the curve representing the relationship between the energy price and the supply cushion has generally become steeper over time. However, for each decreasing level of the energy supply cushion, the corresponding energy price has not necessarily increased over the last two years. The following may be observed regarding energy prices for this year:

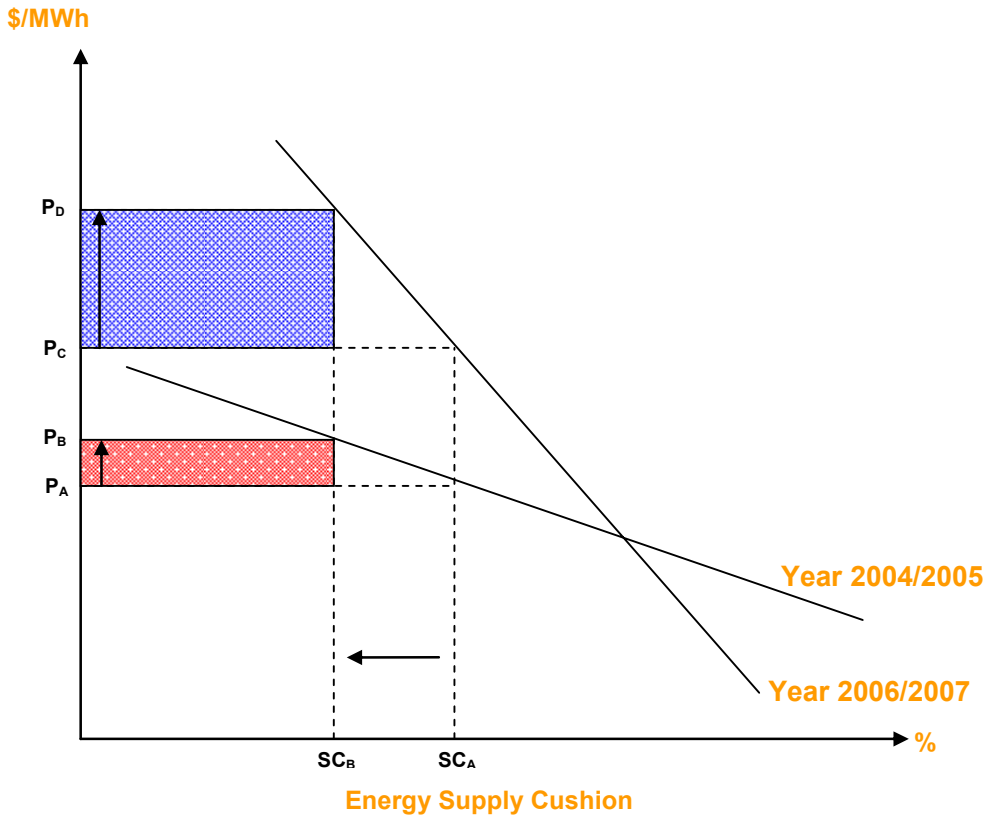
- Point A – From the lowest level of the supply cushion up to point A, the corresponding energy price this year is higher as compared to the previous year. Beyond point A, the opposite is true.
- Point B – From the lowest level of the supply cushion up to point B, the corresponding energy price is higher this year as compared to year 2004/05. Beyond point B, the opposite is true.




To better understand the price impact, Chart 6 contains a simplified representation of the curves for years 2004/05 and 2006/07. As shown in the chart, the line for year 2004/05 has gradually pivoted to the right in year 2006/07. Holding the supply cushion constant at $SC_A$, the energy price has increased from $P_A$ in year 2004/05 to $P_C$ in year 2006/07. The price impact would be more severe if the energy supply cushion were to tighten from $SC_A$ to $SC_B$. In that case, the energy price for 2004/05 and 2006/07 would be $P_B$ and $P_D$ instead of $P_A$ and $P_C$.

Therefore, as the curve representing the relationship between energy price and supply cushion becomes steeper, the steeper rise in energy prices will bring about a more severe impact as the supply cushion tightens. This is evident from the blue shaded area that is larger than the red shaded area in Chart 6.

**Chart 6: Changes in the Relationship between Energy Prices & Supply Cushion**




To confirm the observations quantitatively, a simple regression analysis has also been performed using generation supply and energy demand as the explanatory variables. In this analysis, it is assumed that the energy supply cushion is the only variable that explains USEP. As shown in Table 3, the regression analysis confirms our observations that the energy prices have become more sensitive to changes in the supply cushion's variables. For example, for each MW decrease in supply, the corresponding USEP for 2004/05 increased by $2.21/MWh. However, the rate of increase jumped to $2.79/MWh in 2006/07 for a similar increase in supply. Likewise, for each MW increase in demand, the corresponding USEP for 2004/05 has increased from $1.75/MWh in 2004/05 to $2.42/MWh in 2006/07.

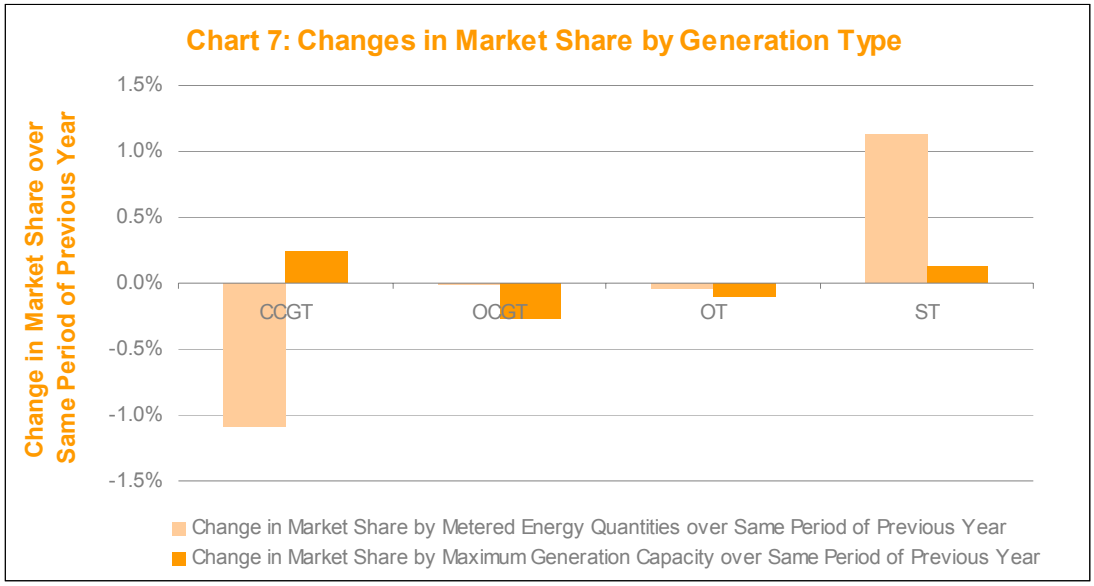
**Table 3: Model Estimation Results**

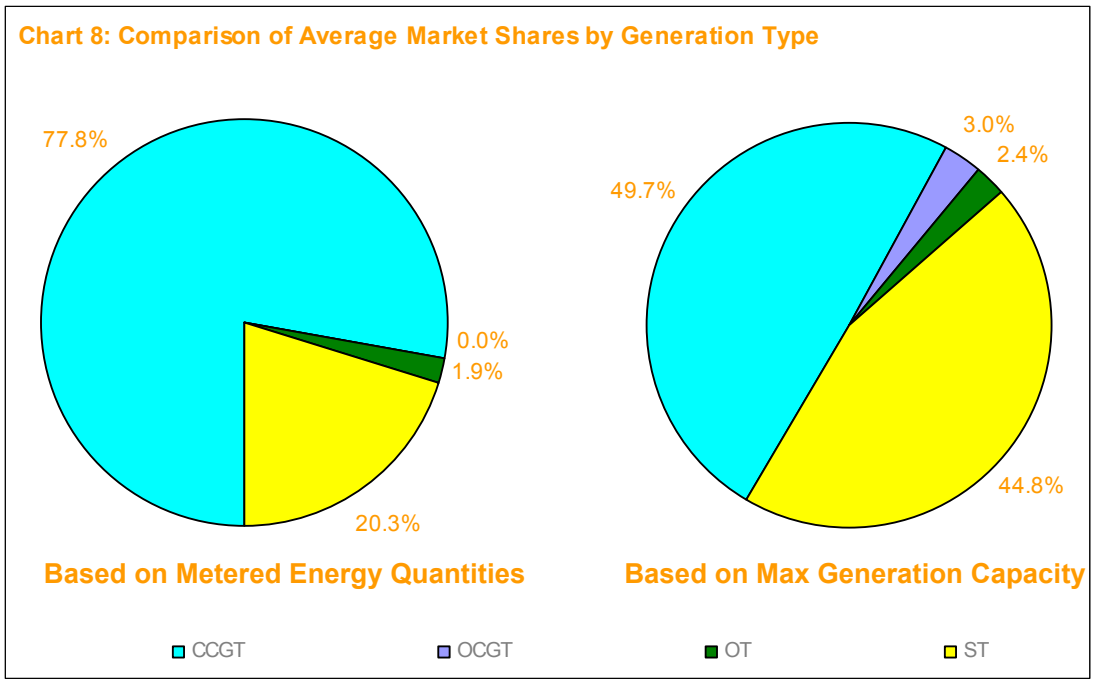
| | Coefficients | |
|---|---|---|
| **Year** | **Supply** | **Demand** |
| **2004/05** | -2.21 | 1.75 |
| **2005/06** | -2.74 | 1.98 |
| **2006/07** | -2.79 | 2.42 |

However, it is too early to comment on the reasons for the increased price sensitivity to the supply cushion or to conclude whether the change in relationship between prices and supply cushion is temporary or permanent. The MSCP will continue to monitor the situation.

## 1.3 Market share

After registering multi-year decline in market share since market start, the ST market share edged higher for the first time this year from 19.1 to 20.3 percent (see Charts 7 and 8). Although the current market share is still well below the 50 percent norm observed prior to market liberalisation, the increase in ST market share on the back of a new CCGT unit commissioning since November 2006 was notable. In fact, the market share for CCGTs had declined.




*Note: The average metered energy quantity for this year was 4,250MW*
*The average maximum generation capacity was 10,217MW*

There were several reasons that led to the higher ST market share. This includes:

a. *Higher CCGT anticipated outages* – One of the main contributors to the higher ST market share was the increase in CCGT anticipated outages, which jumped nearly 60 percent from an average of 286MW to 452MW per period. The major contributor to the higher anticipated outages was a generation company, which accounted for about 36 percent of the increase in anticipated outages due to technical problems. In addition, the introduction of two CCGTs by another generation company, which completed their commissioning in the second half of 2005/06, also contributed to the higher volume of anticipated outages.

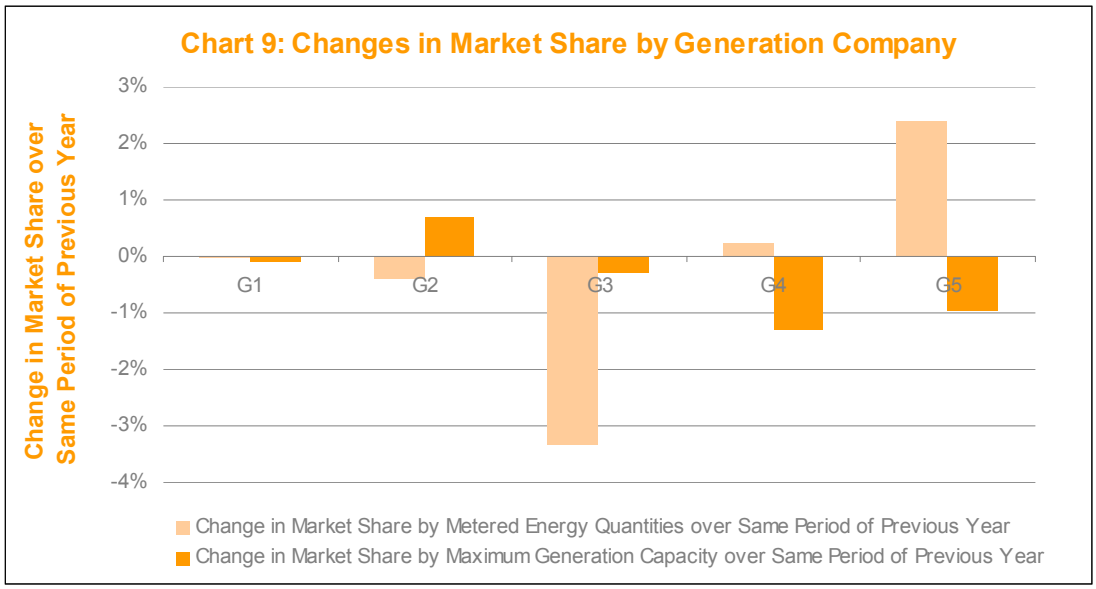
b. *Low contribution from commissioning CCGT unit* – Although the commissioning CCGT unit contributed another 498MW to total installed capacity since November 2006, the unit was not able to contribute consistently to CCGT market share.

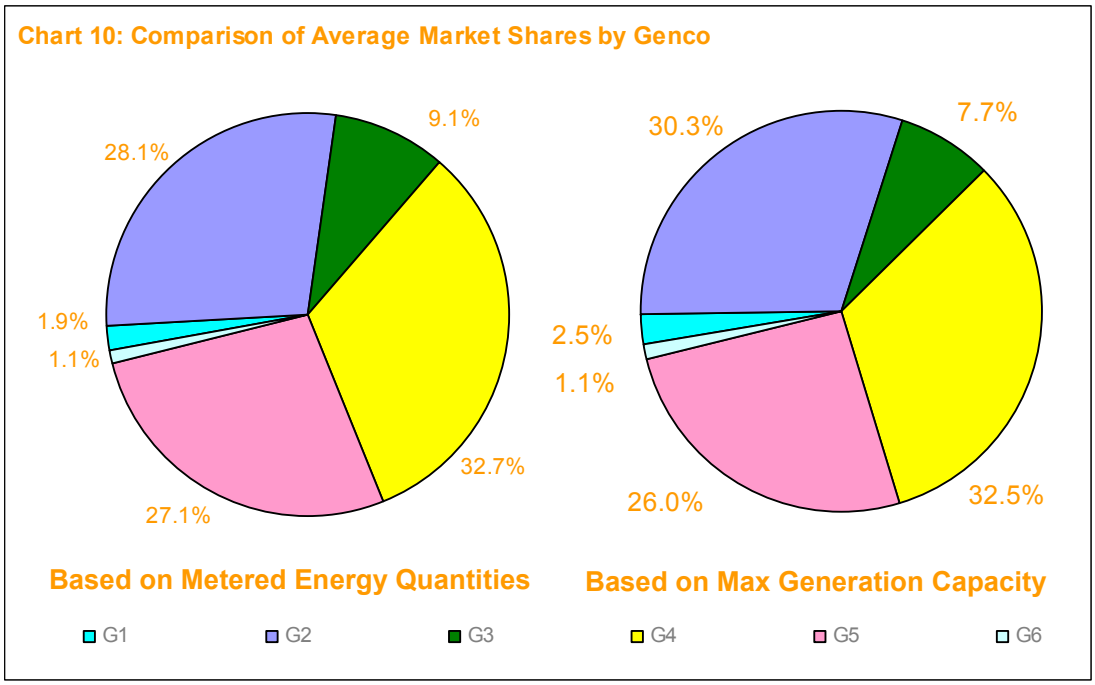
c. *Higher electricity demand* – While electricity demand grew at 3.5 percent, growth in CCGT availability drop from 21.3 to negative 0.8 percent this year due to the above two factors. This implied that alternative sources of supply were required to meet remaining demand. This led to the market turning to STs for supply.

d. *Higher ST capacity* – Higher ST maximum generation capacity this year due to the full return of STs which were previously shut down for re-configuration was an important factor behind ST gains in market share.

e. *Decommissioning of an OCGT plant* – The de-commissioning of a 105MW OCGT plant had also resulted in higher ST maximum generation capacity being made available.

In terms of generation companies, two of them gained market share in the period under review (see Chart 9). One of them led the gains mainly due to higher contributions from its CCGT portfolio with two newly commissioned plants. In contrast, a generation company experienced a decline in market share based on metered energy quantity from 12.5 to 9.1 percent due to higher plant outages.






*Note: The average metered energy quantity for this year was 4,250MW*
*The average maximum generation capacity was 10,217MW*

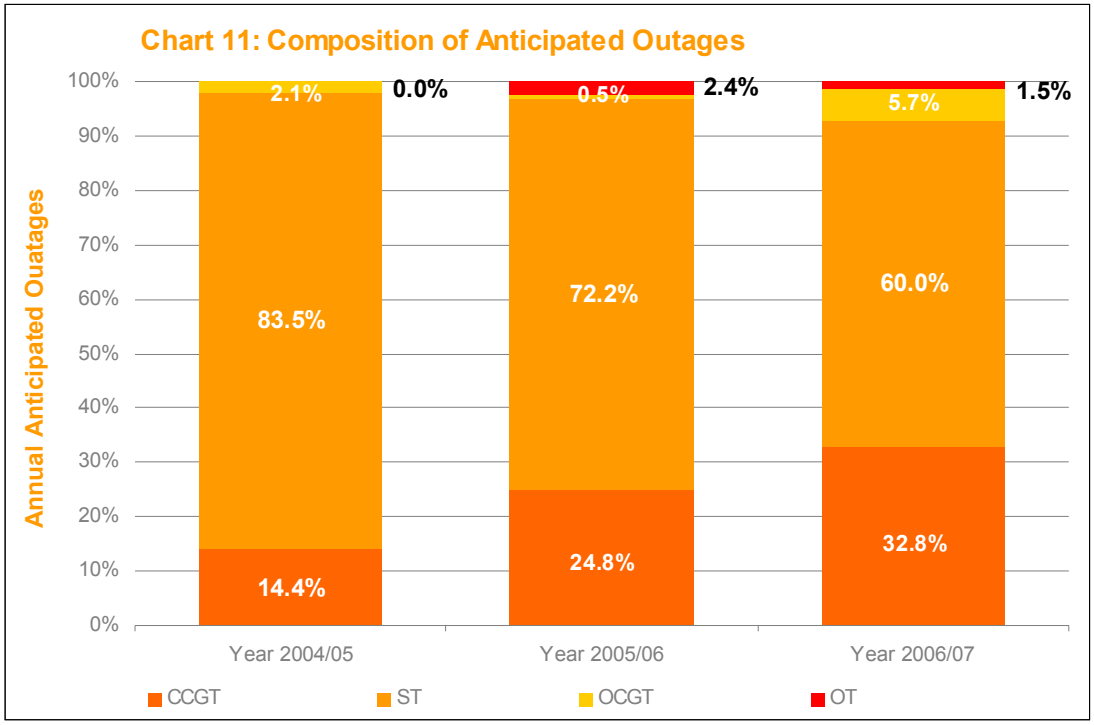
## 1.4 Outages

During the year under review, a total of 24.15 million MW of anticipated outage capacity comprising planned and unplanned outages was registered. This represents a 19.6 percent increase compared to the previous year. As shown in Table 4, the anticipated outage capacity, particularly from CCGTs, has been on the rise in the previous two years. The introduction of more CCGTs and jump in a generation company's plant maintenance were the primary reasons behind the rise in anticipated outage volume from CCGTs. The high anticipated outage volume for STs in year 2004/05 was mainly due to the shut down of three plants for conversion work.

**Table 4: Plant Outages**

| | Anticipated Outages (MW) | | | | | Forced Outages (MW) | Market Total (MW) |
|---|---|---|---|---|---|---|---|
| | ST | CCGT | OCGT | OT | Total | | |
| **Year 2004/05** | 22,935,744 | 3,942,985 | 570,660 | 13,728 | 27,463,117 | 698,347 | 28,161,464 |
| **Year 2005/06** | 14,590,054 | 5,005,468 | 109,723 | 492,676 | 20,197,921 | 724,192 | 20,922,113 |
| **Year 2006/07** | 14,485,610 | 7,925,136 | 1,382,730 | 358,739 | 24,152,215 | 665,982 | 24,818,197 |

As shown in Chart 11, ST generators were the major contributors to total anticipated outages in the NEMS. However, econometric analysis confirms ST outages had little effect on prices. Since market start, competitive pressure has seen the replacement of the less efficient STs by the more efficient CCGTs. As a result, the frequency of ST running has steadily declined and resulted in a shrinking ST generation market share from about 50 percent prior to market start to around 20 percent today. This means that although anticipated outages remained high in certain periods, energy prices may stay relatively unchanged if the majority of the outages are contributed by ST plants, which are in any case mostly not running in real time.



**Significant Price Spikes and Outages**

There were a total of 19 periods where USEP exceeded the $1000/MWh threshold last year (see Table 5). The high prices were usually accompanied by higher than normal outages which brought about tighter than normal supply cushions. In particular, such tight supply conditions were evident during the multiple high price periods observed on 12 August 2006, 21 December 2006 and 6 January 2007:

- 12 August 2006 – As shown in Table 5, USEP topped more than $3000/MWh for six consecutive periods beginning from period 21. With an average of 1897MW of anticipated outages, the supply was already tight prior to the forced outage of a CCGT in period 15 and OCGT in period 22. The market finally relented when rising demand pulled the supply cushion below 13% between periods 21 and 26. These factors inevitably set off price spikes during these periods. Further price spikes were spared when demand slowly tapered off from period 27. Supply improved when the tripping unit was back online from period 34. However, another price spike occurred in period 30 at $1292.77/MWh due to a change in offer.

- 21 December 2006 – Two CCGTs tripped due to a gas supply interruption in period 32. This had caused major load shedding in many parts of the island. However, it was not until period 34 that the tight supply was reflected in USEP when it hit the price cap of $4500/MWh. The delayed effect was mainly due to the discrepancy between the time of tripping and the revised offers submitted by generation companies affected by the outages. The two CCGTs only managed to resynchronize in period 37 and 38 respectively.

- 6 January 2007 – The price spike of $2974.17/MWh was triggered by the tripping of a CCGT unit in period 29 as the supply cushion dropped from 20.6 percent prior to the tripping to 13.3 percent. High prices remained in the next few periods with USEP hitting a high of $4330.33/MWh in period 32. Prices remained high until period 35 when additional supply and lower demand improved the supply cushion.

Other significant price spikes:

- 9 October 2006 – Although total anticipated outage capacity was not as high as for some high price periods, it was mainly contributed by base load CCGTs, as two CCGTs were on planned maintenance. This was further complicated by the withdrawal of a CCGT from the market. As a result, the supply cushion dropped below the crucial 10 percent threshold in period 17 with USEP spiking to $3186.19/MWh. During this period, the more costly ST units were dispatched, leading to a higher USEP.

- 20 January 2007 – Although there was no forced outage recorded on this day, it was noted that two CCGTs were on planned outage. When the commissioning CCGT also lowered its capacity available for dispatch, the supply cushion tightened, leading to a price spike of $1266.71/MWh in period 23. The fact that lower supply occurred during the peak period also contributed to the tighter supply cushion.

- 10 February 2007 – With total outages staying above 2000MW for the entire day, the rising demand pulled the supply cushion to its lowest level of 13.6 percent when demand peaked in period 22. This led to a single price spike of $1126.39/MWh in period 22. The improvement in supply and subsequent drop in demand from period 24 helped improve market conditions as USEP slowly returned to the level seen prior to the price spikes.

- 13 March 2007 – With 53 percent of the anticipated outage capacity contributed by base load CCGTs, supply conditions were not particularly rosy on 13 March. When demand started to pick up and broke the 5000MW barrier from period 18, the supply cushion showed signs of tight supply as it dropped below 15 percent. This saw USEP slowly rising from $125.33/MWh in period 17 to $549.46/MWh in period 21, before hitting a high of $1008.43/MWh in period 22. USEP only managed to slip below $1000/WMh when additional supply came from CCGTs.

- 15 March 2007 – The tighter supply cushion was contributed by a combination of factors with up to three CCGTs on maintenance. Another CCGT was not available for dispatch since its trip on 14 March. With a total of four base load generators not available for dispatch, the withdrawal of two OCGTs from the market in period 18 triggered a price spike of $3447.56/MWh as the supply cushion dropped to a low of 10.7 percent. Prices quickly returned to the previous level when the two OCGTs returned to the market in period 19.

**Table 5: List of High Price Incidents in Year 2006/07**

| | | | Supply Conditions | | |
|---|---|---|---|---|---|
| Period | Date | USEP ($/MWh) | Total Anticipated Outage (MW) | Total Forced Outage (MW) | Supply Cushion (%) |
| **21** | **12-Aug-06** | 3384.38 | 1897.00 | 249.00 | 12.2 |
| **22** | **12-Aug-06** | 3799.24 | 1897.00 | 329.00 | 11.0 |
| **23** | **12-Aug-06** | 3781.60 | 1897.00 | 329.00 | 10.9 |
| **24** | **12-Aug-06** | 3320.70 | 1897.00 | 329.00 | 12.0 |
| **25** | **12-Aug-06** | 3707.66 | 1897.00 | 329.00 | 11.0 |
| **26** | **12-Aug-06** | 3263.31 | 1897.00 | 329.00 | 12.2 |
| **30** | **12-Aug-06** | 1292.77 | 1897.00 | 329.00 | 15.0 |
| **17** | **9-Oct-06** | 3186.19 | 1532.00 | 0.00 | 9.9 |
| **34** | **21-Dec-06** | 4500.00 | 1767.00 | 698.00 | 9.8 |
| **35** | **21-Dec-06** | 1889.41 | 1767.00 | 698.00 | 11.7 |
| **36** | **21-Dec-06** | 1288.92 | 1767.00 | 698.00 | 12.0 |
| **29** | **6-Jan-07** | 2974.17 | 1209.50 | 324.00 | 13.3 |
| **31** | **6-Jan-07** | 3905.26 | 1209.50 | 324.00 | 12.6 |
| **32** | **6-Jan-07** | 4330.33 | 1209.50 | 324.00 | 11.6 |
| **33** | **6-Jan-07** | 2348.23 | 1209.50 | 324.00 | 13.5 |
| **23** | **20-Jan-07** | 1266.71 | 1804.50 | 0.00 | 13.0 |
| **22** | **10-Feb-07** | 1126.39 | 2272.00 | 0.00 | 13.6 |
| **22** | **13-Mar-07** | 1008.43 | 1837.00 | 0.00 | 12.5 |
| **18** | **15-Mar-07** | 3447.56 | 1837.00 | 354.00 | 10.7 |

*Note: Only incidents where USEP exceeded $1000/MWh are considered in this section*

## 2. Demand Indices

### 2.1 Accuracy of pre-dispatch and short-term load forecast

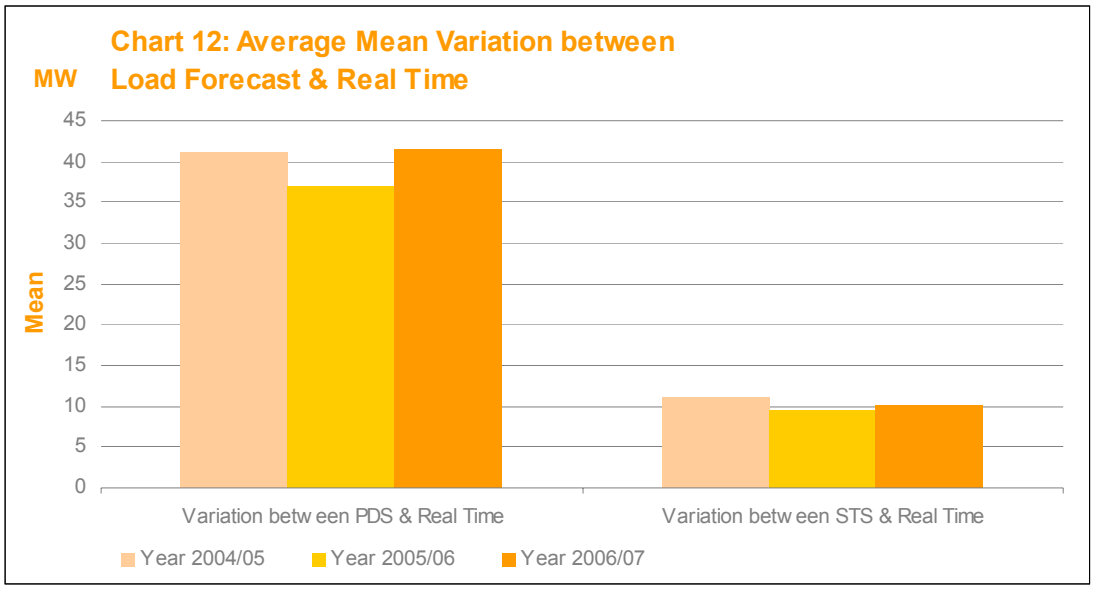
In the NEMS, three forecast schedules with different time horizons are made available to market participants. The accuracy of forecast schedules is important for efficient market operations as it allows generation plants to respond appropriately in real time.

Table 6 shows the accuracy of the load forecast as measured by the mean and standard deviations of the variations between forecast and actual real time figures. Similar to the previous year, the variation between the STS forecast and real time has been smaller than that between PDS forecast and real time by 4 to 5 times. This is within expectation as STS forecasts are updated every half-hour with a forecast horizon of up to 6 hours compared to PDS forecasts which are updated every 2 hours with a forecast horizon of between 12 to 36 hours.

**Table 6: Variation in Load Forecasts**

| | Year 2006/07 | | | |
|---|---|---|---|---|
| | Variation between PDS & Real-time | | Variation between STS & Real-time | |
| | Mean | Standard Deviation | Mean | Standard Deviation |
| **Apr** | 34 | 26 | 9 | 7 |
| **May** | 45 | 30 | 12 | 7 |
| **Jun** | 46 | 26 | 12 | 7 |
| **Jul** | 42 | 30 | 10 | 7 |
| **Aug** | 38 | 27 | 10 | 7 |
| **Sep** | 43 | 32 | 11 | 8 |
| **Oct** | 40 | 35 | 9 | 8 |
| **Nov** | 26 | 22 | 7 | 5 |
| **Dec** | 31 | 26 | 7 | 5 |
| **Jan** | 57 | 32 | 14 | 7 |
| **Feb** | 55 | 52 | 13 | 11 |
| **Mar** | 41 | 22 | 9 | 5 |
| **Average:** | 42 | 30 | 10 | 7 |

Compared to the previous year, there were only slight changes in the average variations between PDS and STS forecasts with real time forecasts (see Chart 12).




## 2.2 Accuracy of real-time load forecast

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

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 observed variation. The metered energy quantity based on settlement data furnished by the 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.

As shown in Table 7, there has only been slight change in the monthly variations between forecast and metered demand since 2004.

**Table 7: Variation in Load Forecast**

| | Monthly Variation (%) | | |
|---|---|---|---|
| | **Year 2004/05** | **Year 2005/06** | **Year 2006/07** |
| **Apr** | 4.29 | 3.33 | 4.02 |
| **May** | 3.91 | 3.62 | 4.18 |
| **Jun** | 3.78 | 3.73 | 4.18 |
| **Jul** | 4.03 | 3.85 | 4.33 |
| **Aug** | 3.72 | 4.10 | 4.15 |
| **Sep** | 3.83 | 4.27 | 3.98 |
| **Oct** | 3.8 | 4.24 | 4.21 |
| **Nov** | 3.74 | 4.23 | 4.18 |
| **Dec** | 3.62 | 4.38 | 4.12 |
| **Jan** | 3.65 | 3.96 | 4.29 |
| **Feb** | 3.64 | 4.28 | 4.52 |
| **Mar** | 3.78 | 3.88 | 4.25 |
| **Average:** | 3.82 | 3.99 | 4.20 |

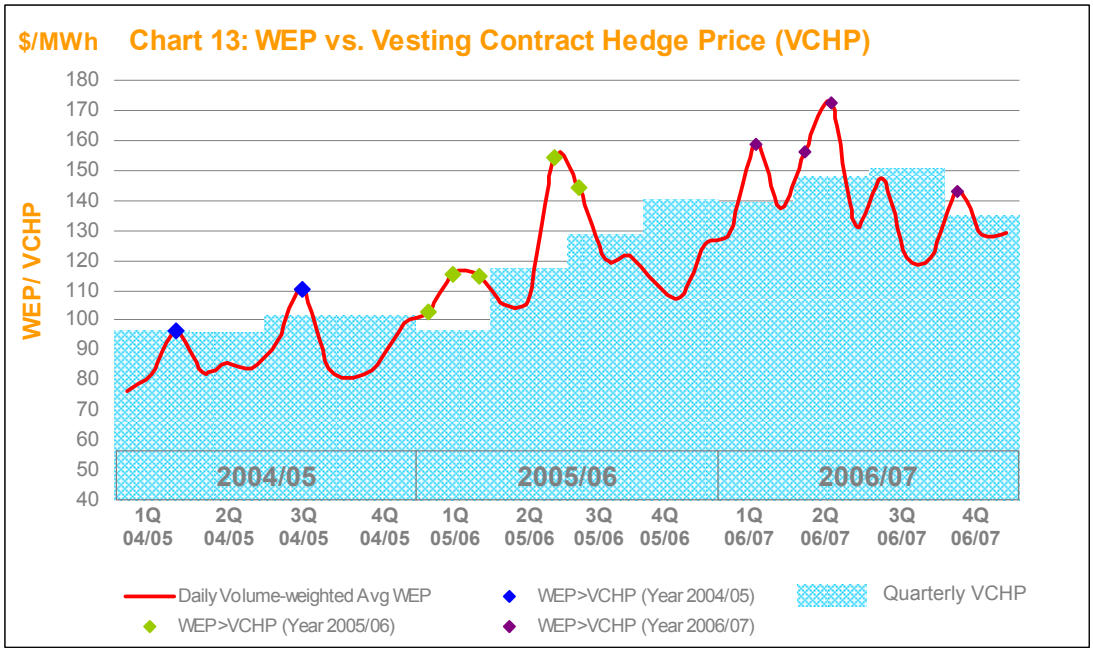
## 3. Price Indices

### 3.1 Vesting contract hedge price

The HSFO 180 cst spot price[1] rose by 5.5 percent this year compared to over 50 percent in the preceding year. Despite the smaller increase in fuel oil spot prices, the average VCHP rose by another 18.5 percent, after registering a 22.3 percent jump in the preceding year. Since fuel oil forward prices instead of spot prices were adopted in the calculation of VCHP, this explains why smaller increases in spot fuel price were not reflected in similar increases in the average VCHP[2]. The VCHP also hit a new high of $150.20/MWh in the third quarter.

The WEP, or the price that retailers pay for energy, exceeded the VCHP on four occasions in May 2006, July 2006, August 2006 and January 2007. This is a decline from the five occasions observed in the previous year (see Chart 13).

With USEP being a major component of WEP, the behavior of WEP is usually representative of energy market conditions. On three occasions where WEP exceeded VCHP, the MSCP observed significant change in the demand or supply conditions in the energy market. In May and July 2006, it was the stronger growth in demand that contributed to higher prices. In contrast, the higher WEP in August 2006 can be attributed to decline in supply. However, the high WEP in January 2007 was mainly due to high regulation charges.




[1] Spot instead of the forward contract prices are used for analysis due to lack of access to details regarding actual contracts struck by generation companies.
[2] More information on the formula used in the calculation of the LRMC can be obtained from the EMA website at http://www.ema.gov.sg.

## 3.2 WEP

### *3.2.1 Metered energy quantity*

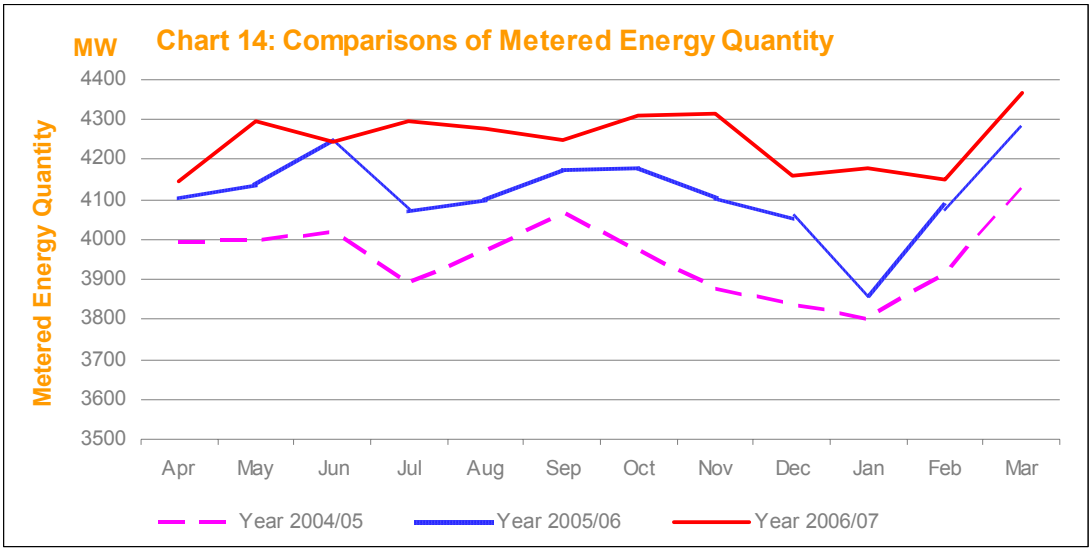
Although average metered demand grew at a slower pace of 3.3 percent compared to 4 percent in the previous year, peak demand (IEQ) registered a new high of 5350MW on 27 March 2007.

In general, the demand pattern as measured by metered energy quantity was similar between 2004/05 and 2005/06 and can be broadly divided into three peaks and four phases:

- The first peak was observed in June before dipping in the following month;
- Demand slowly recovered and reached a second peak in September;
- Demand either remained flat or weakened before reaching a trough in January;
- Demand rebounded sharply and hit a third peak and year's high in March.

However, the demand curve this year was flatter than the previous two years, as shown in Chart 14. In addition, it also exhibited some deviations from the norm observed in the previous two years:

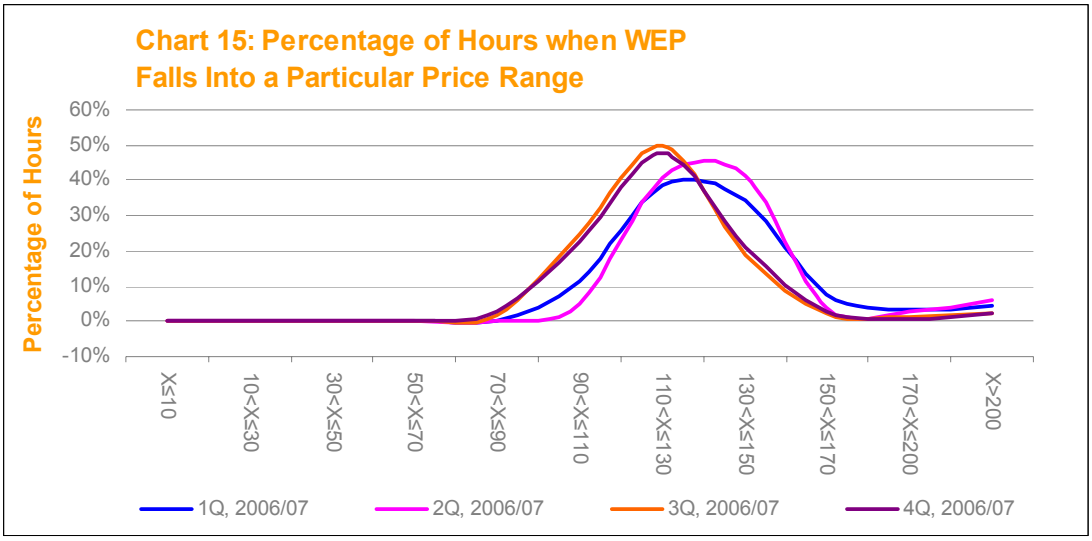
- The first and second peak shifted to October and November, which were usually associated with weaker demand;
- Not only did demand not peak in June and September, it actually turned lower;
- There was no trough in January demand.

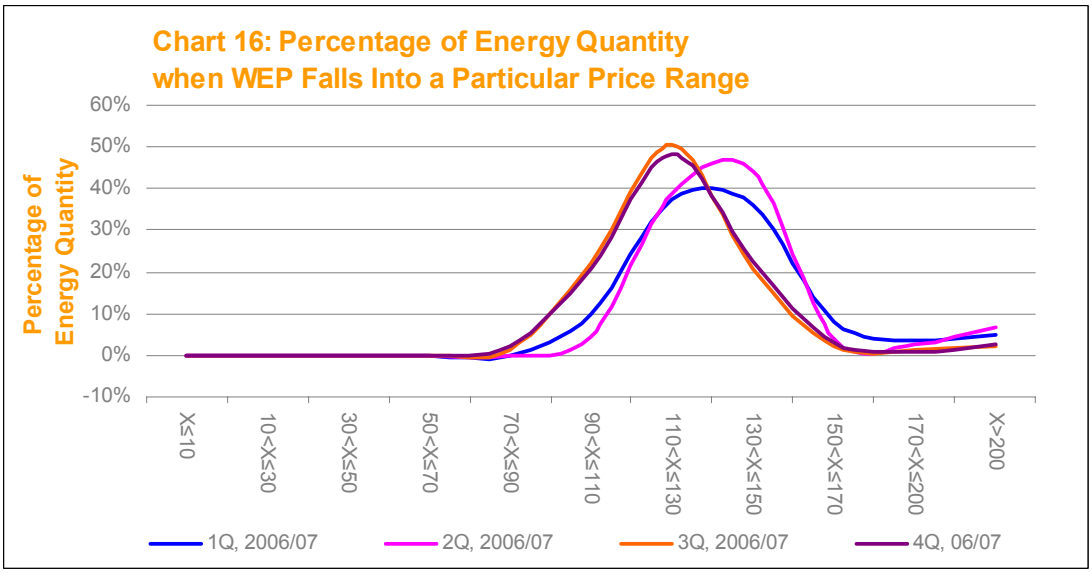


### *3.2.2 Frequency distribution of WEP according to (a) percentage of hours of occurrence and (b) percentage of energy quantity affected*

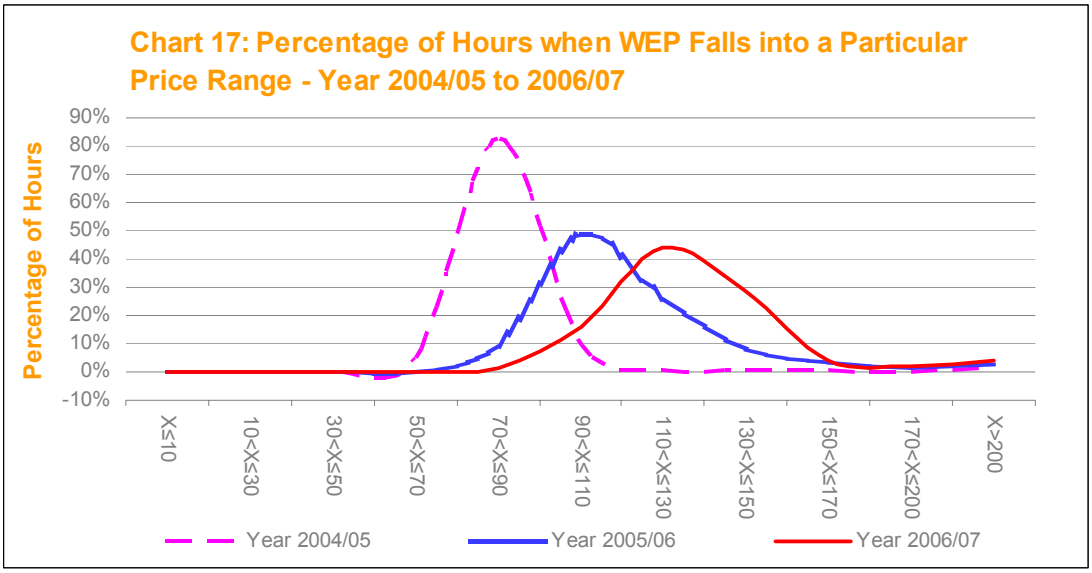
As shown in Chart 15, the mean for WEP in the first, third and forth quarters of the year rose from $90-$110/MWh last year to the $110-$130/MWh range. The highest price was registered in the second quarter with the mean for WEP hitting $130-$150/MWh range.

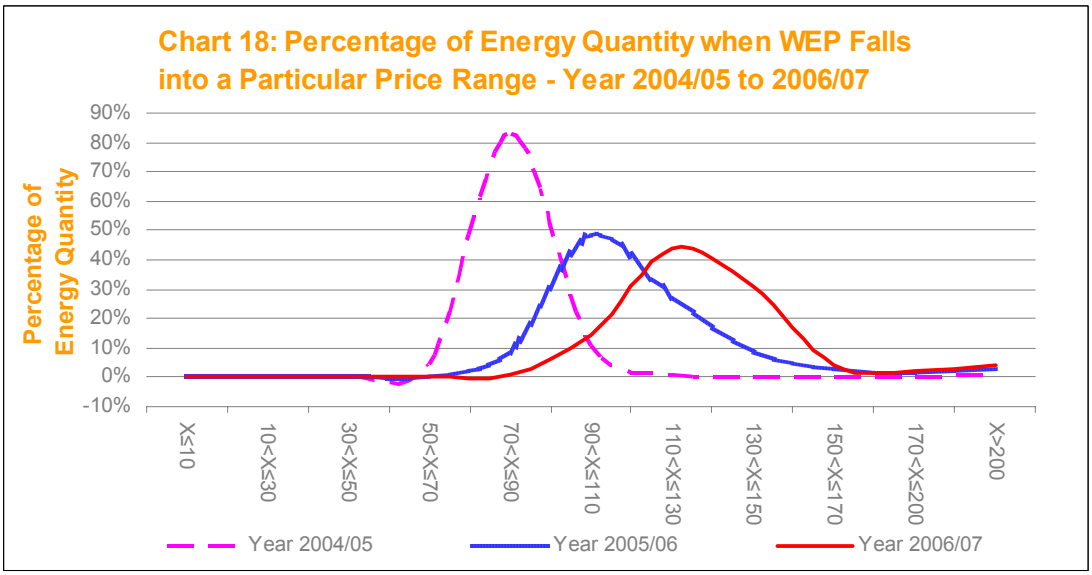
The frequency distribution of WEP according to percentage of energy quantity (see Chart 16) followed a similar pattern to the percentage of hours. The mean for the first, third and forth quarters of the year was in the $110-$130/MWh range before hitting a high of $130-$150/MWh range in the second quarter.



To assess the long term price trend for the NEMS, the MSCP compared the price distribution curve for the current year with those for the last two years. As shown in Chart 17, the mean for WEP has gradually shifted to the right as it increased from the $70-$90/MWh range in year 2004/05 to the $110-$130/MWh range this year. Similarly, Chart 18 shows the same long term trend in the frequency distribution of WEP according to the percentage of energy quantity.

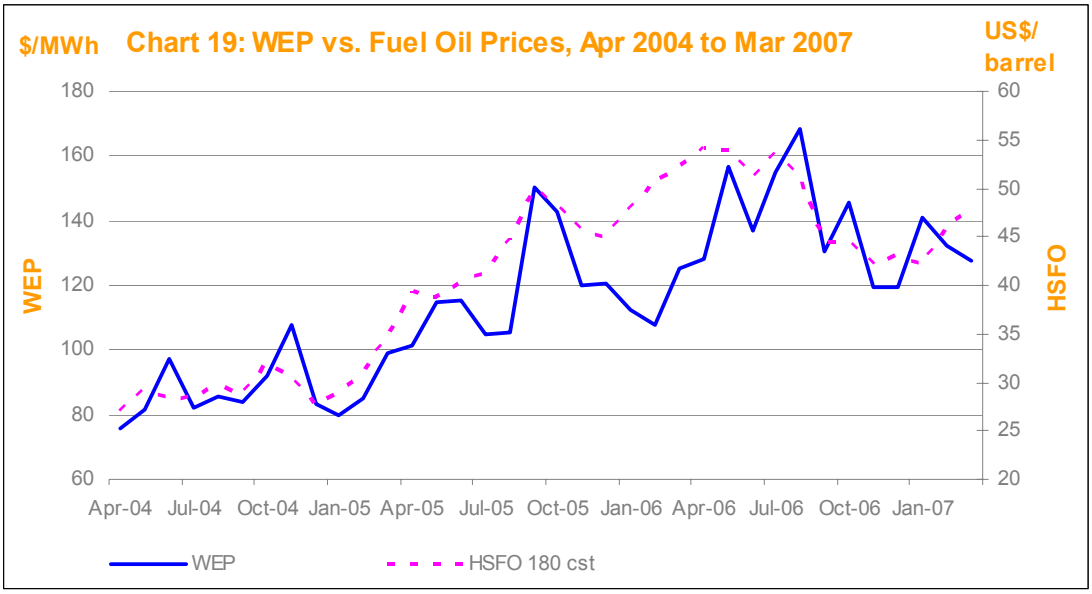


### *3.2.3 Correlation between WEP and fuel oil prices*

The relationship between fuel oil prices (HSFO 180 cst) and WEP continued to hold as the average WEP rose in tandem with the higher fuel oil prices. On average, the spot price for HSFO 180 cst increased by 5.5 percent to US$47.84 a barrel. This is significantly lower than the 50 percent jump observed the previous year. As a result, the rate of increase in the WEP this year slowed to 16.9 percent compared to 34.9 percent last year.

As shown in Chart 19, the average WEP has declined since the second quarter of the year following the decline in fuel oil prices.



**How Fuel Oil Prices Affect Energy Supply?**

With NEMS dominated by thermal generators, fuel oil prices play a pivotal role in determining electricity prices. Although generation companies usually sign long term contracts for gas delivery from Indonesia and Malaysia, the gas price is nonetheless tied to the fluctuation of fuel oil prices.

As shown in Chart 20, as prices for the benchmark HSFO 180 cst surged upward from US$27.6 a barrel in December 2004 (point A) to around US$54 a barrel during the April-May 2006 period (point B), total capacity supply at less than $100/MWh dropped significantly from 87 percent in March 2005 (point C) to 62 percent in August 2006 (point D). In addition, the Chart shows the following:

- *Shift in capacity offers to higher price band* – As the percentage of offers at less than $100/MWh declined, the percentage of offers that fell between $100.01/MWh and $500/MWh increased proportionately;
- *Lag in energy price effect* – Chart 20 also shows that fuel oil prices started to move higher beginning from December 2004, but the energy price as shown in Chart 19 only started to establish its upward trend three months later in March 2005. The time lag is within expectation and serves to confirm that generation companies had hedged positions in fuel oil.

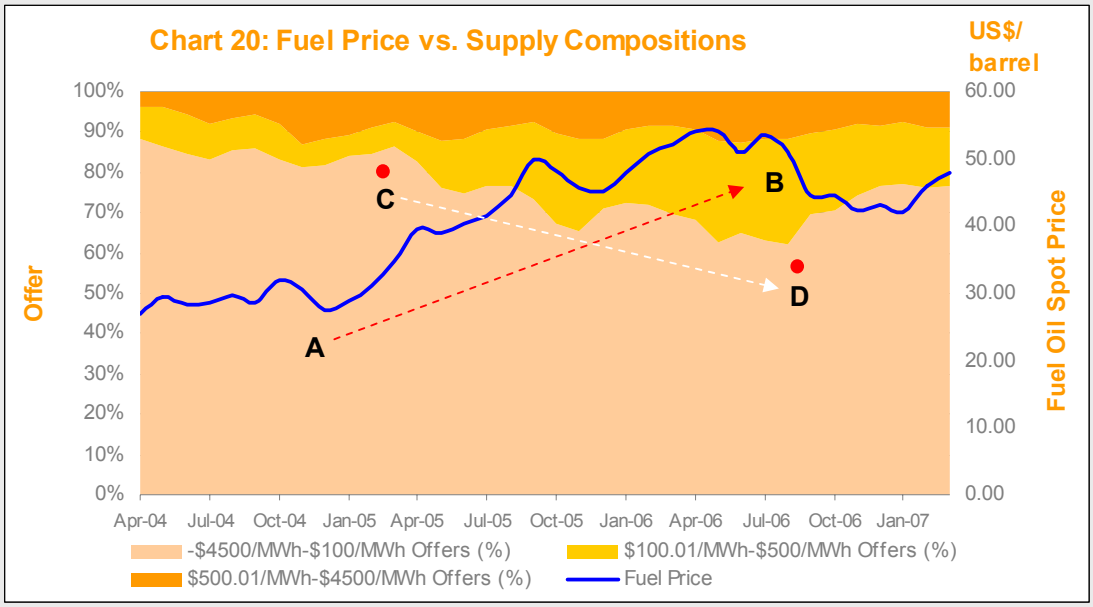



Chart 21 and 22 below show how the rising fuel oil prices may be translated into energy prices in the NEMS through more expensive energy offers (as indicated by the lower volume of offers at less than $100/MWh).

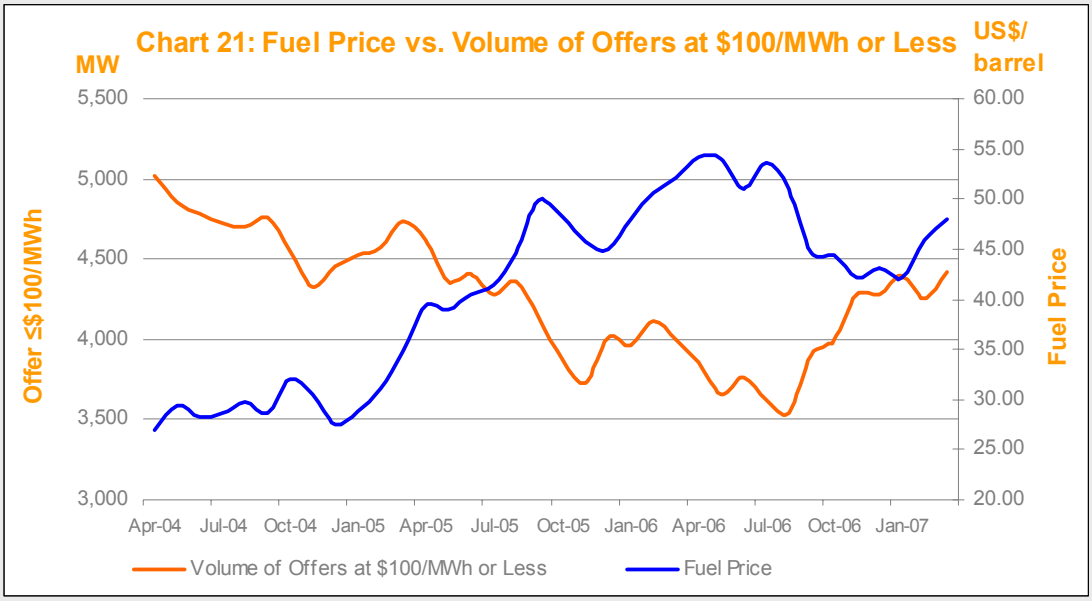


Chart 21: Fuel Price vs. Volume of Offers at $100/MWh or Less
MW
US$/ barrel
Offer ≤$100/MWh
Fuel Price
5,500
5,000
4,500
4,000
3,500
3,000
60.00
55.00
50.00
45.00
40.00
35.00
30.00
25.00
20.00
Apr-04 Jul-04 Oct-04 Jan-05 Apr-05 Jul-05 Oct-05 Jan-06 Apr-06 Jul-06 Oct-06 Jan-07
Volume of Offers at $100/MWh or Less
Fuel Price

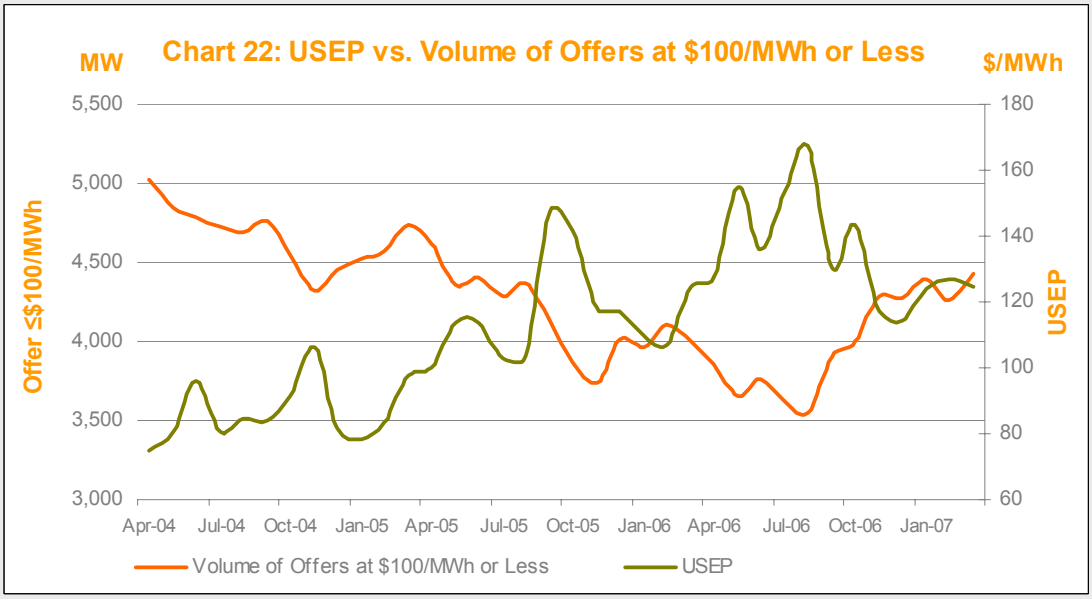


Chart 22: USEP vs. Volume of Offers at $100/MWh or Less
MW
$/MWh
Offer ≤$100/MWh
USEP
5,500
5,000
4,500
4,000
3,500
3,000
180
160
140
120
100
80
60
Apr-04 Jul-04 Oct-04 Jan-05 Apr-05 Jul-05 Oct-05 Jan-06 Apr-06 Jul-06 Oct-06 Jan-07
Volume of Offers at $100/MWh or Less
USEP

## 3.3 Ancillary prices

### *3.3.1 Reserve Prices*

As the energy supply cushion tightened for the third year running, energy prices continued to climb with prices in the reserve market following suit. The higher reserve prices are reflected in the total reserve payment by generation companies in Chart 22 below. As shown in the chart, after registering nearly 85 percent jump in total reserve costs last year, the growth in reserve costs was more moderate this year at 22 percent.

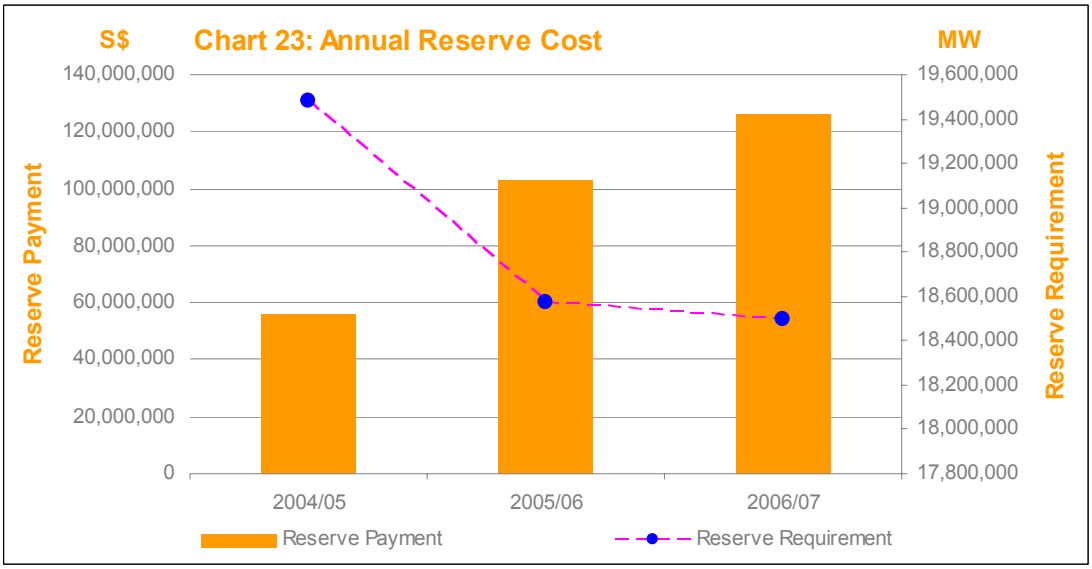



Chart 23 also highlights that the surge in reserve costs was not the result of higher reserve requirements. The MSCP observed that the reserve requirements for all classes of reserve had been declining with the commissioning of new CCGT units. Since the purpose of reserve is to safeguard against shortfall in energy, reserve requirements are determined based on the highest quantity of energy output that a single generation unit is scheduled to provide in real time. This will ensure that there is sufficient backup generation capacity in the event that generation unit trips in real time. However, as the number of generation units capable of providing energy increase (due to commissioning of new generation units), the load for each generation unit supplying energy in real time is likely to decline. This will result in a reduction in reserve requirements.

Despite lower reserve requirements, the MSCP observed that the average reserve price for all classes of reserve has increased in the last few years. Although reserve availability has increased while reserve requirements have declined, reserve offer prices have generally increased. The primary reason for higher reserve offer prices may be the higher opportunity cost as energy prices have increased. Rising fuel oil prices have served to worsen the supply situation.

Besides increasing reserve costs, the MSCP observed that reserve price spikes contributed significantly to higher average reserve prices. This is confirmed by Table 9, which shows that the average reserve price for up to 99 percent of the time is much lower compared to the average price. For example, the average primary reserve price was only $6.44/MWh in year 2004/05 when the 1 percent of outlier prices or price spikes is not taken into account. This compares with the average of $12.72/MWh when the outliers are included. It can therefore be concluded that the much higher average primary reserve price was mainly due to price spikes which averaged $629.20/MWh during this period.

**Table 9: Reserve Price Trends**

| | Primary ($/MWh) | | | Secondary ($/MWh) | | | Contingency ($/MWh) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Average | *Up to 99%* | *Last 1%* | Average | *Up to 99%* | *Last 1%* | Average | *Up to 99%* | *Last 1%* |
| **Year 2004/05** | 12.72 | 6.44 | 629.20 | 1.26 | 0.45 | 79.87 | 4.77 | 2.10 | 267.46 |
| **Year 2005/06** | 16.75 | 11.26 | 563.88 | 1.80 | 1.10 | 70.60 | 12.84 | 9.09 | 384.89 |
| **Year 2006/07** | 16.98 | 11.35 | 571.40 | 1.44 | 1.08 | 35.92 | 17.52 | 11.37 | 630.18 |

**IL as Reserve Provider**

IL was launched in Singapore on 1st January 2004. However, it was not until July 2004 that the first registration of an IL provider was received. Currently, there are three IL providers with a total of 26MW capacity for primary, secondary and contingency reserve respectively. For reasons of system security, the PSO has determined that the total of all scheduled primary, secondary and contingency reserve from IL should not exceed 10%, 20% and 30% of the respective total system reserve requirements. Total contribution from IL in all classes of reserve is only slightly more than 3 percent this year. Based on the current market share for IL, there is still room for more reserves to be provided by IL before hitting the limit set by the PSO.

**Potential benefits of IL**

Some of the enunciated benefits of opening up the reserve market to participation from loads in the Singapore wholesale electricity market are that this may bring about the following benefits:

- *Improved security of supply* – There is higher availability of reserves as the existing reserves by generators are supplemented by reserves from IL. There is also diversification in the form of reserve available. While generators offer reserves by providing the ability to increase their energy output, IL, in contrast, provides the capability to reduce their energy consumption.
- *Faster response time* – IL restores the supply and demand balance much faster as instantaneous reduction of energy consumption is involved as opposed to time required for ramping up by generators.
- *Increased competition* – The expansion of the reserve market increases competition and may lead to lower reserve prices. In addition, IL can free up generation capacity, which in turn can result in additional energy availability. Thus, energy prices may potentially also face downward pressure.
- *Reduced investment for peak demand* – In the long run, IL may help to reduce investment in generation and transmission needed to cater for peak demand.

**The price effect of IL**

The impact of IL on the reserve price has been limited due to its current small market share. However, the involvement of IL as a reserve provider has certainly helped to boost reserve capacity offered at zero prices. As shown in Charts 24 and 25, the proportion of reserve offers at $0/WMh or less have increased from 25.5 percent prior to the introduction of IL offers to 27 percent when IL reserve offers are taken into consideration.

**Conclusion**

With the current low IL market share, it is difficult for IL to unleash its full potential. However, since IL facilities boost lower price band offer capacity, IL participation can bring about potential benefits in the long run.

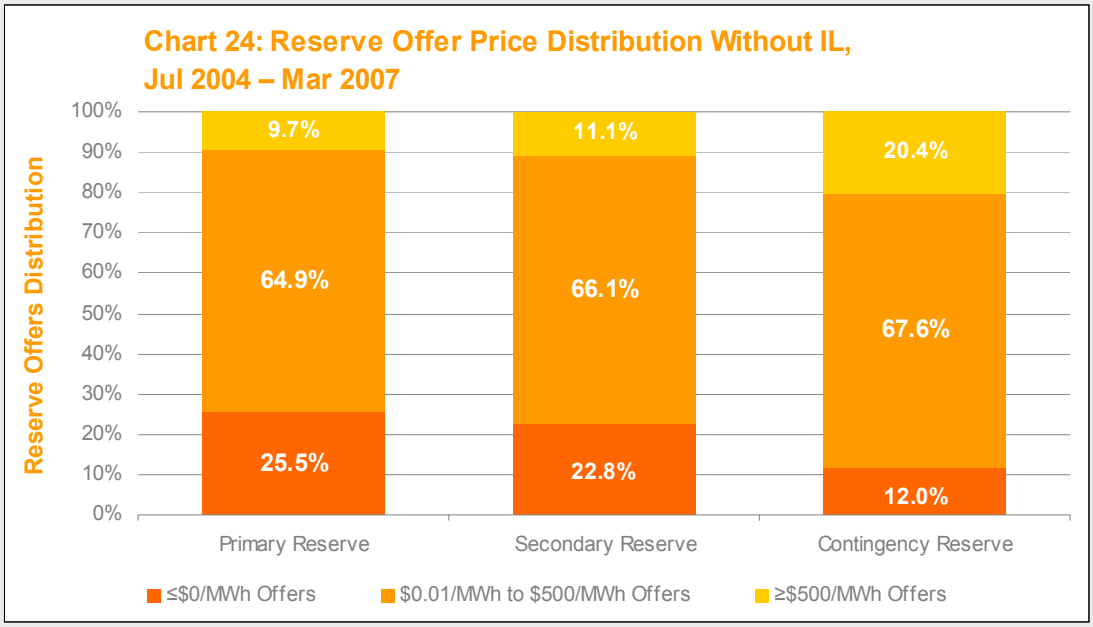


Chart 24: Reserve Offer Price Distribution Without IL, Jul 2004 – Mar 2007
Reserve Offers Distribution
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
9.7%
64.9%
25.5%
11.1%
66.1%
22.8%
20.4%
67.6%
12.0%
Primary Reserve
Secondary Reserve
Contingency Reserve
≤$0/MWh Offers
$0.01/MWh to $500/MWh Offers
≥$500/MWh Offers

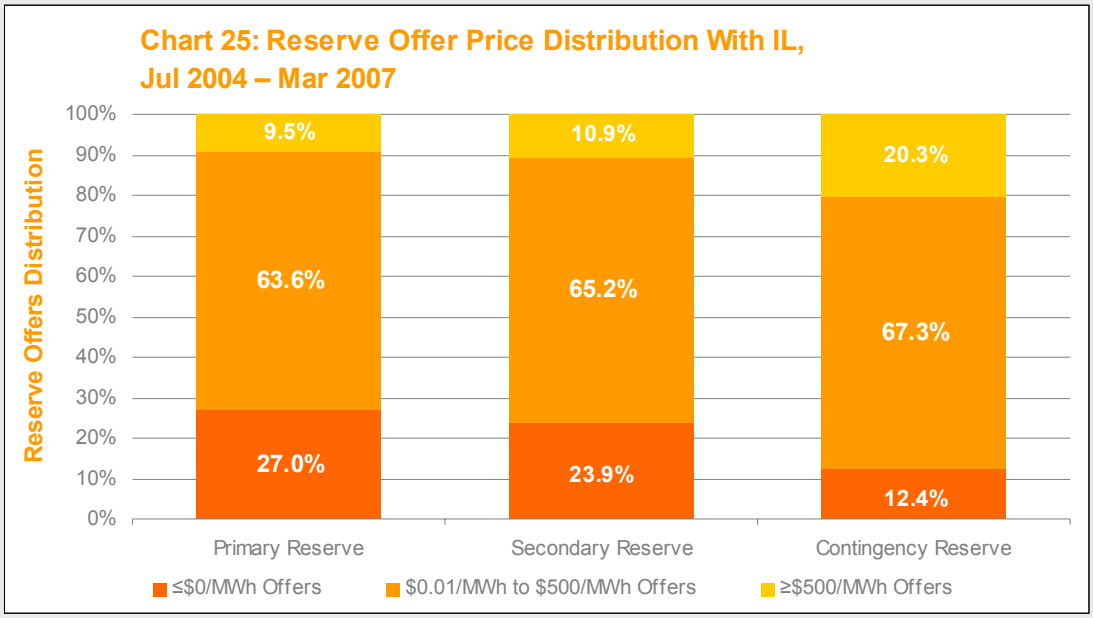
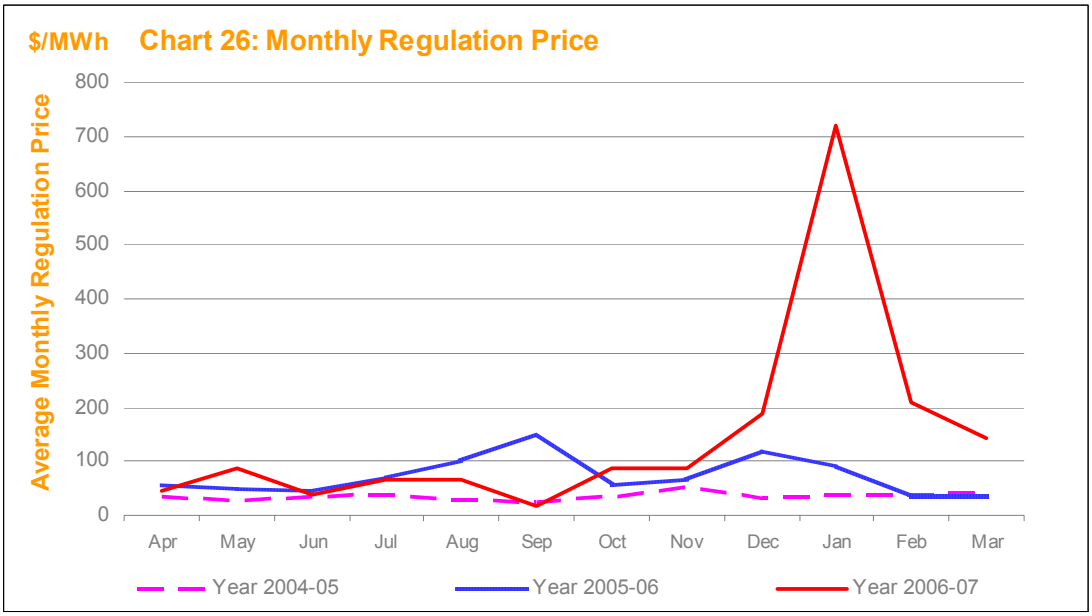


Chart 25: Reserve Offer Price Distribution With IL, Jul 2004 – Mar 2007
Reserve Offers Distribution
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
9.5%
63.6%
27.0%
10.9%
65.2%
23.9%
20.3%
67.3%
12.4%
Primary Reserve
Secondary Reserve
Contingency Reserve
≤$0/MWh Offers
$0.01/MWh to $500/MWh Offers
≥$500/MWh Offers

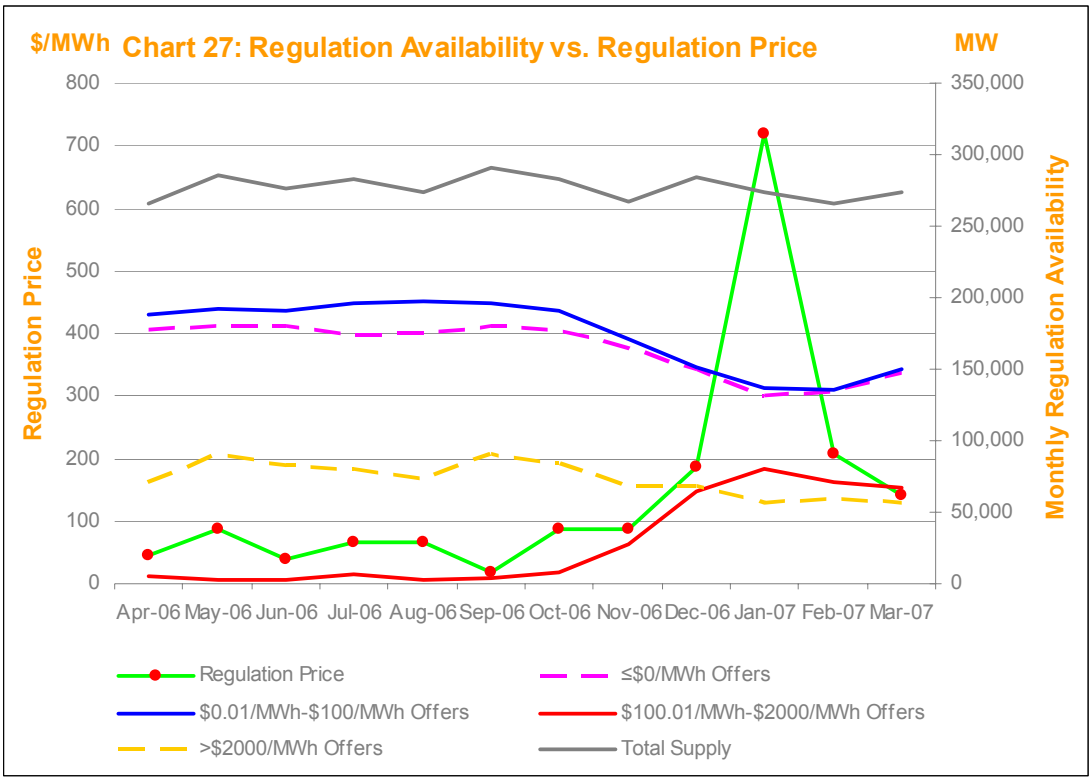
### *3.3.2 Regulation Prices*

The average regulation price doubled for the second consecutive year mainly due to the high prices in the last six months of the year (October 2006 to March 2007). The average regulation price for the first half of the year (April to September 2006) was $53.33/MWh compared to $238.18/MWh in the second half of the year. This pushed the average price from $72.43/MWh in the previous year to $145.76/MWh this year. As shown in Chart 26 below, the regulation price trend between October 2006 and March 2007 deviated from the historical trend in the previous three years.




The MSCP conducted an investigation into the high regulation prices seen in the latter half of the year and a report entitled “Investigation into High Regulation Prices Occurring from October 2006 to January 2007” is available at the EMC website.

Essentially, the MSCP observed that although total regulation availability remained flat for the year (see grey line in Chart 27), the composition of offers had changed drastically such that offers from the lowest price stack (≤$100/MWh) and highest price stack (>$2000/MWh) had shifted to the price range of $100.01/MWh to $2000/MWh since October 2006. This coincided with the start of a high regulation price trend in October 2006. The high price trend peaked in January 2007 before reversing in tandem with a pick up in low price offers (≤$100/MWh).


$/MWh
Chart 27: Regulation Availability vs. Regulation Price
MW
Regulation Price
Monthly Regulation Availability
800
700
600
500
400
300
200
100
0
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
Apr-06 May-06 Jun-06 Jul-06 Aug-06 Sep-06 Oct-06 Nov-06 Dec-06 Jan-07 Feb-07 Mar-07
Regulation Price
≤$0/MWh Offers
$0.01/MWh-$100/MWh Offers
$100.01/MWh-$2000/MWh Offers
>$2000/MWh Offers
Total Supply

## 3.4 Price Analysis

This year the MSCP adopted a new methodology in identifying and analyzing high price incidents using an econometric model. The model seeks to estimate the quantitative relationship between energy prices and market fundamental factors which affect energy prices. It also assists in the identification of outlier prices which then prompt further analysis. Details of the model can be found in the paper "How Market Fundamental Factors Affect Energy Prices in the NEMS - An Econometric Model" available at the EMC website.

**Relationship between Energy Prices and Market Fundamental Factors**

Using the econometric model, we have analysed the energy prices for the period under review and the results are presented in Table 10a and 10b. Column 1 contains a list of the market fundamental factors which were studied to understand how they affect energy prices. Column 2 sets out the effect that each factor had on energy prices for the period under review. Column 3 interprets the results obtained.

**Table 10a: Estimation Results of the Econometric Model**

| Variable | Year 2006/07 Coefficient | Interpretation |
|---|---|---|
| CCGT Supply | -1.18 | • The results show that for every 10 percent increase in CCGT supply, the energy price decreased by approximately 11.8 percent.<br>• However, for a similar increase in ST supply, the energy price was lower by only 3 percent.<br>• Therefore, the results from the model confirm the following:<br>a. An inverse relationship between supply and energy prices;<br>b. Greater sensitivity of prices to CCGT compared to ST supply. |
| ST Supply | -0.30 | |
| Supply cushion | -0.52 | • For every 10 percent increase in the supply cushion, the energy price decreased by approximately 5.2 percent.<br>• The result confirms the inverse relationship between the supply cushion and prices. |
| Offer | -0.71 | • For every 10 percent increase in offers at $100/MWh or less, energy prices declined by approximately 7.1 percent.<br>• The result confirms the inverse relationship between such offers and prices. |

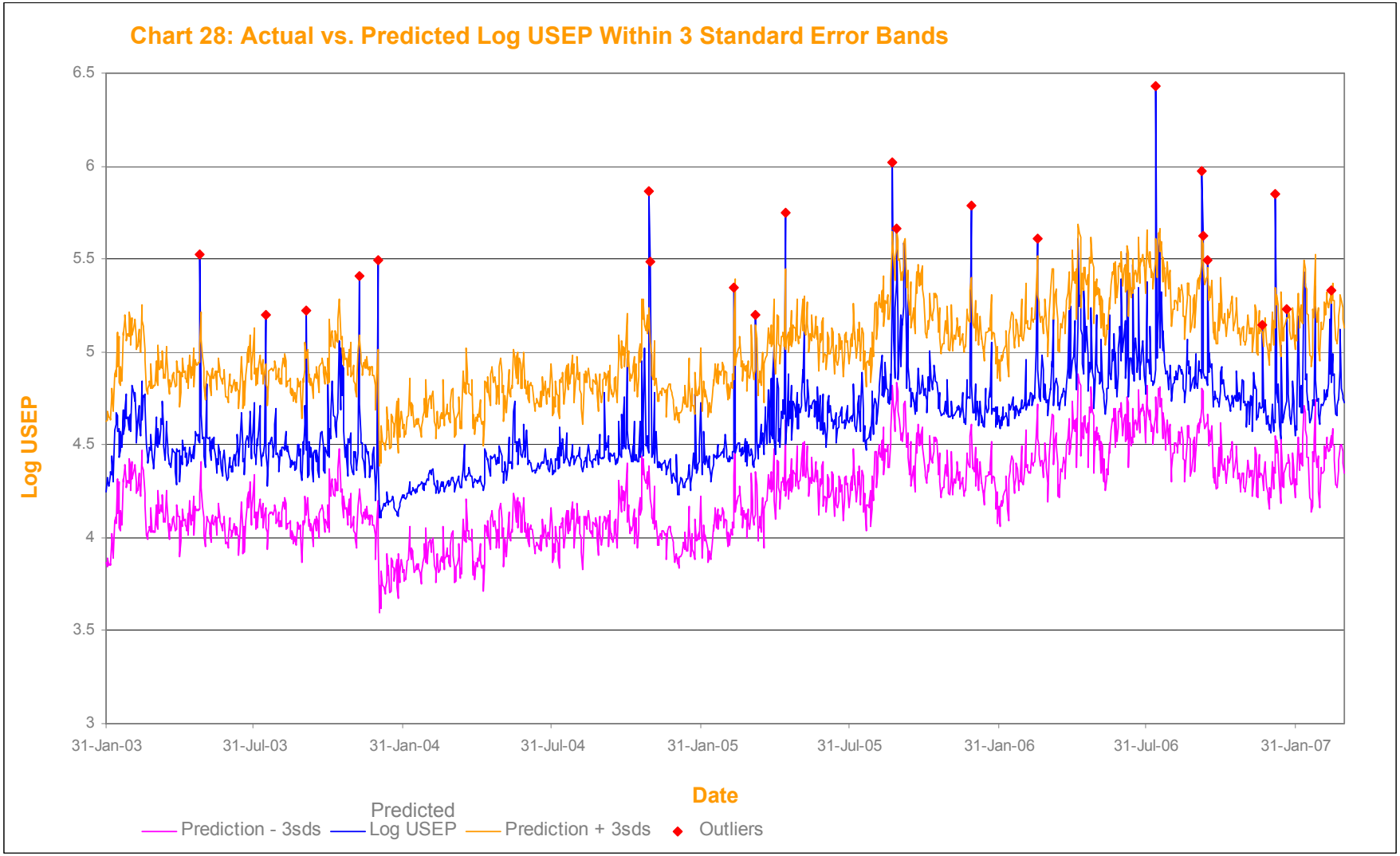
| Variable | Year 2006/07 Coefficient | Interpretation |
|---|---|---|
| Demand | 1.66 | • The result confirms that demand had a negative impact on electricity prices.<br>• For every 10 percent increase in demand, the energy price increased by 16.6 percent. |
| Reserve cushion | -0.52 | • For every 10 percent increase in the reserve cushion, the energy price decreased by 5.2 percent.<br>• The result confirms the inverse relationship between the reserve cushion and prices. |
| Fuel oil price | 2.48 | • For every 10 percent increase in fuel oil prices, the electricity price increased by 24.8 percent.<br>• The result confirms the significant effect that fuel oil prices have on energy prices. |
| CCGT planned outages A | -0.04 | • To understand the effect of outages on prices, planned outages for CCGTs are divided into two groups, depending on whether the generation companies own any ST plants.<br>• The rationale for splitting CCGT planned outages into two groups is due to the observation that generation companies with STs (CCGT planned outages A) use them to make up the loss in market share and to meet vesting contract commitments due to CCGT planned outages. As a result, the impact on supply conditions varies depending on whether the market is provided with any replacement capacity during CCGT planned outages. |
| CCGT planned outages B | 0.07 | • On the other hand, planned outages from generation companies that do not own any STs (CCGT planned outages B) have a positive effect on prices. |
| Forced outages dummy | 0.05 | • The estimation results show that forced outages led to a marginal increase in energy prices in year 2006/07. |

**Table 10b: Model Diagnostics**

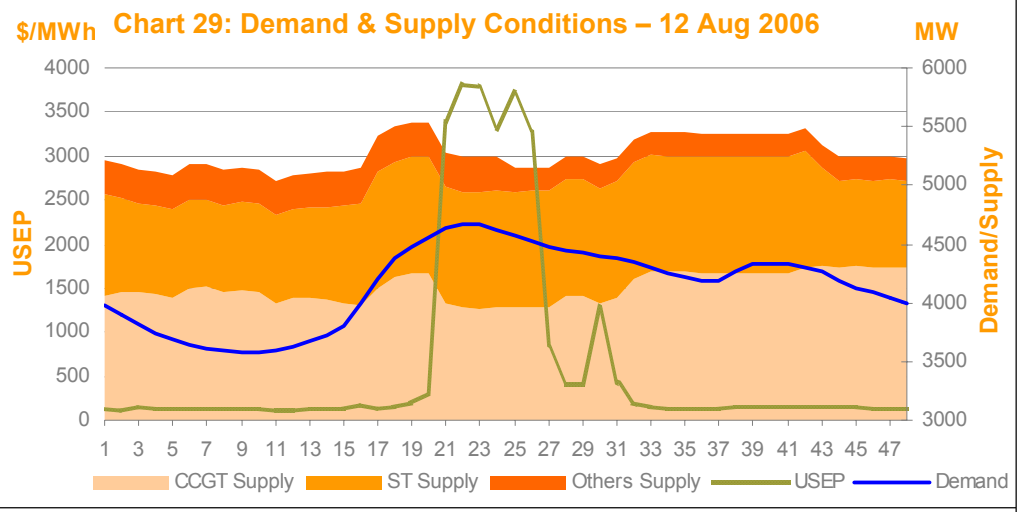
| **Model Diagnostic** | |
|---|---|
| R-squared | 0.59 |
| Adjusted R-squared | 0.56 |
| LM test of Serial Correlation | Present |
| White Heteroskedasticity test | Present |
| Number of observations | 365 |

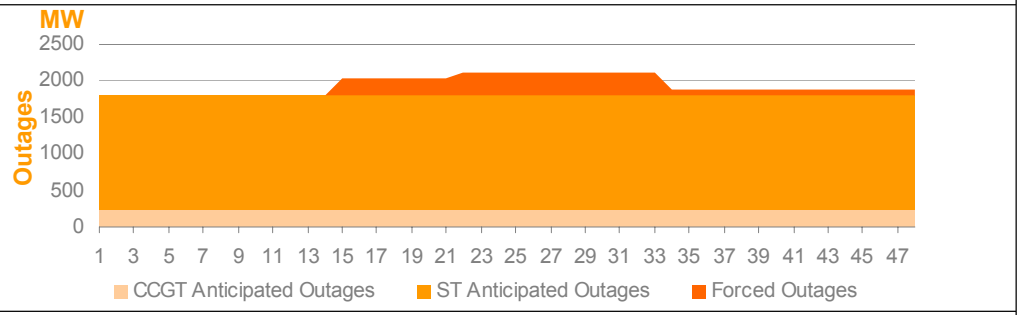
**Identification of Outlier Prices**

Having established the econometric model, Chart 28 shows the estimated efficient prices, the upper and lower bands, and the outliers for the year under review. A total of eight daily USEPs were identified as outliers.




**Note: The predicted USEP is computed based on data from 1 Jan 2003 to 31 March 2007**



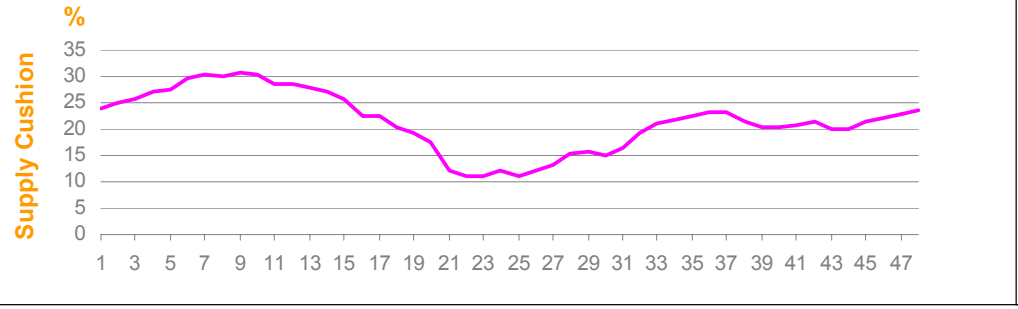




**Table 12: 12 August 2006**

| Date | Saturday, 12 Aug 2006 | All Saturdays in Aug 2006 |
|---|---|---|
| Daily USEP ($/MWh) | 618.84 | 282.10 |
| Max USEP ($/MWh) | 3,799.24 | 3,799.24 |
| No. of USEP ≥ $1000/MWh | 7 | 7 |
| Demand (MW) | 4,141 | 4219.87 |
| Supply Cushion (in %) | 21.48 | 21.55 |
| Offers ≤$100/MWh (in %) | 62.16 | 63.10 |

## Summary

Although a CCGT tripped from period 15 onwards, it was not until period 21 that offers from this unit dropped to zero, dragging the supply cushion down from 17.6 to 12.2 percent. This led to six periods of consecutive high prices in excess of $3000/MWh as the supply cushion stayed between 10 and 12 percent.

During the six periods of consecutive high prices, contingency reserve and regulation also hit the price caps of $3250/MWh and $2750/MWh respectively.

Supply was affected by another OCGT tripping in period 22. However, with demand subsiding from period 25, the effect of the lost supply was minimal. The energy price only managed to return to the level prior to the CCGT tripping in period 32 when the tripping unit resynchronized to the grid.

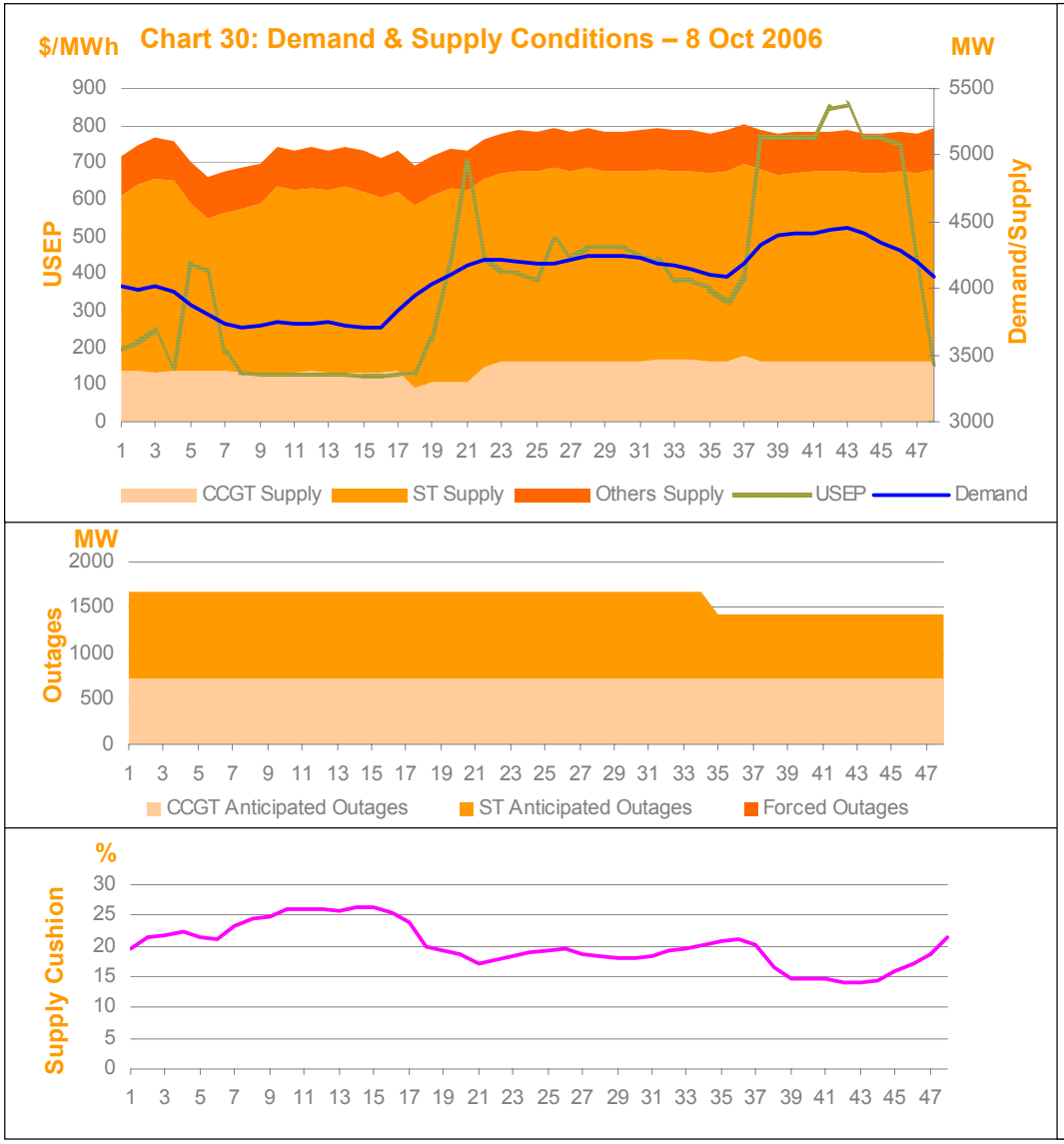


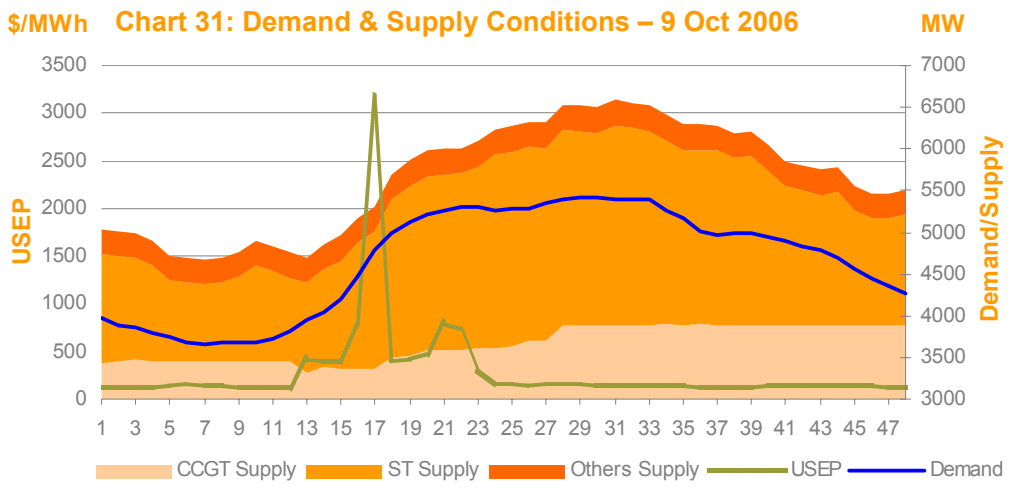

**Table 13: 8 October 2006**

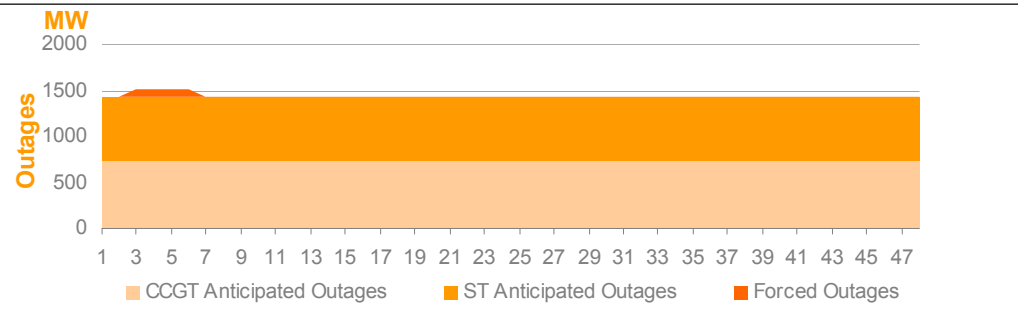
| Date | Sunday, 8 Oct 2006 | All Sundays in Oct 2006 |
|---|---|---|
| Daily USEP ($/MWh) | 393.48 | 0.63 |
| Max USEP ($/MWh) | 852.87 | 852.87 |
| No. of USEP ≥ $1000/MWh | 0 | 0 |
| Demand (MW) | 4,080 | 3993.61 |
| Supply Cushion (in %) | 20.09 | 23.35 |
| Offers ≤$100/MWh (in %) | 63.94 | 68.23 |

## Summary

Supply conditions on October 2006 were generally tight due to the lower availability of CCGTs, which dropped nearly 8 percent compared to September 2006. With average demand topping 4465MW or the third highest for the period under review, the supply cushion for October 2006 was at its lowest this year.

Hence, it is not surprising that the average energy price on 8 October topped $393.5/MWh even without any major price spikes in excess of $1000/MWh or sudden drop in supply due to forced outages.



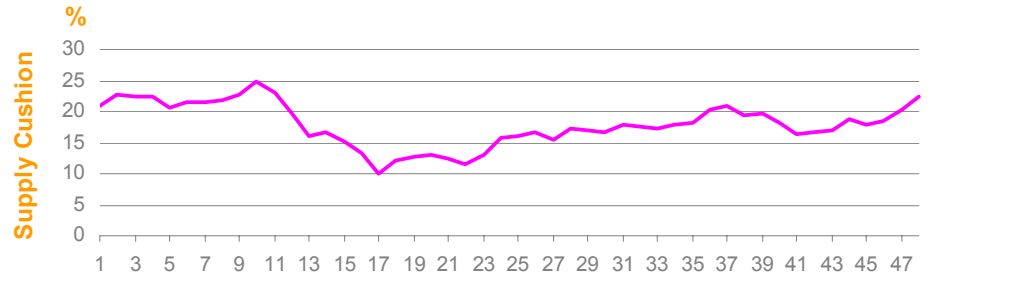



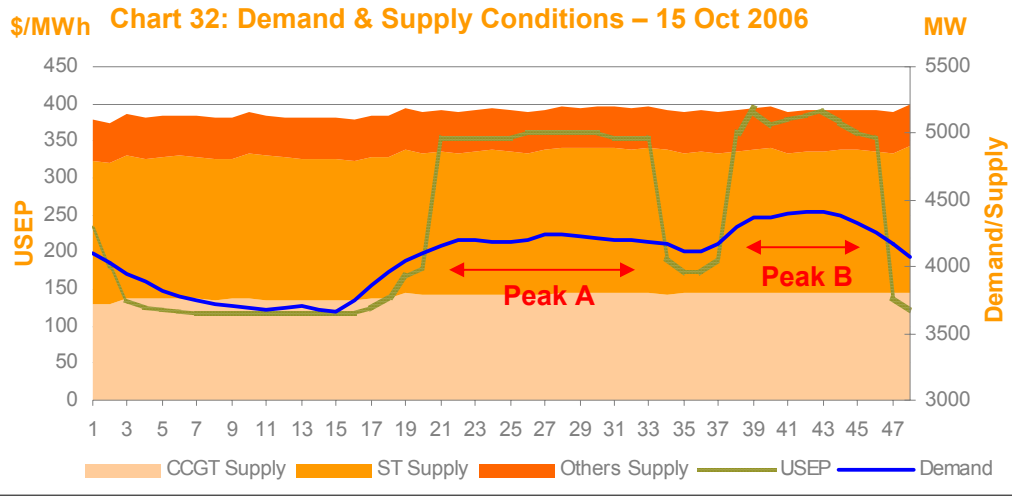

**Table 14: 9 October 2006**

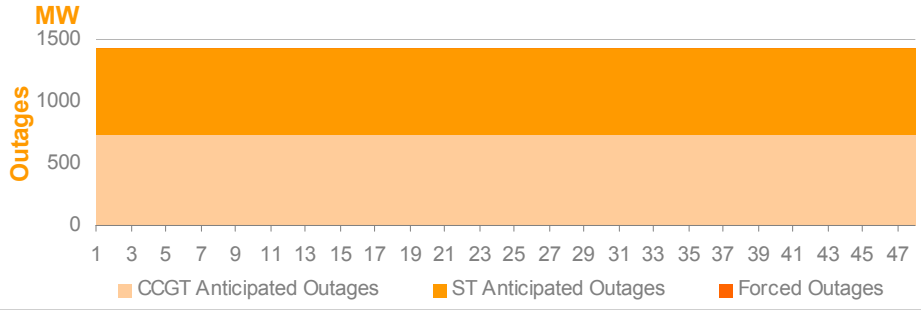
| Date | Monday, 9 Oct 2006 | All Mondays in Oct 2006 |
|---|---|---|
| Daily USEP ($/MWh) | 276.90 | 153.48 |
| Max USEP ($/MWh) | 3186.19 | 3186.19 |
| No. of USEP ≥ $1000/MWh | 1 | 1 |
| Demand (MW) | 4657 | 4576.16 |
| Supply Cushion (in %) | 17.94 | 20.98 |
| Offers ≤$100/MWh (in %) | 67.54 | 72.06 |

## Summary

After registering an average USEP of nearly $400/MWh on Sunday, the tight supply conditions continued on Monday despite improvement in average supply from 5104MW to 5664MW. This was mainly due to the failure of supply to catch up with a rising demand, which jumped from 4080MW to 4657MW. As a result, the average supply cushion dropped to 17.9%.

The tight supply saw the supply cushion dropping to a low of 9.9% in period 17 with USEP reaching as high as $3186.19/MWh. However, with new supply coming from both CCGTs and STs from period 18 onwards, USEP managed to remain below $1000/MWh until a more sustainable recovery trend was observed from period 24.



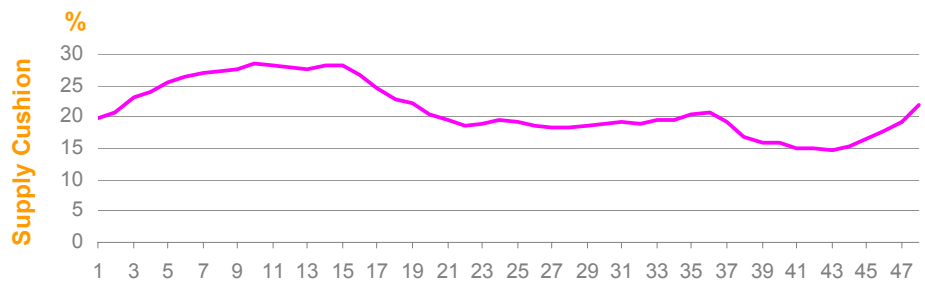



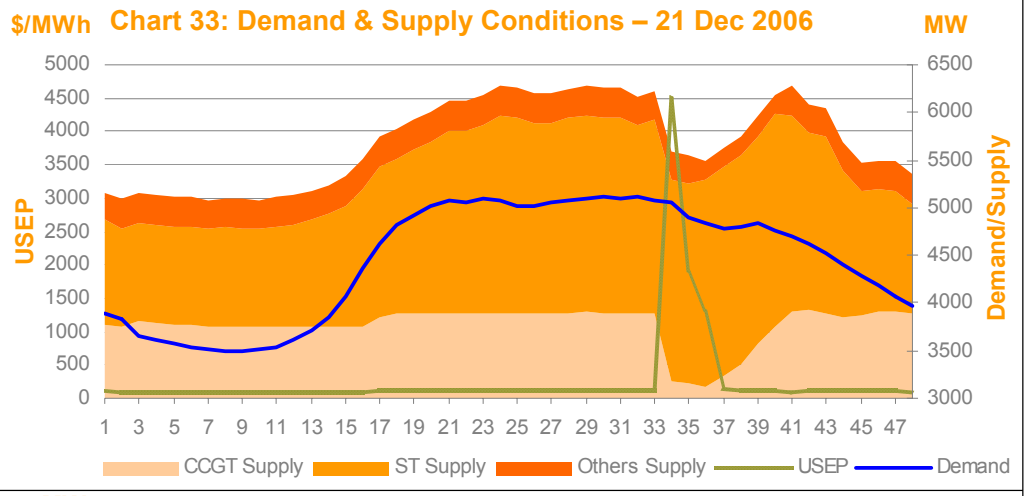

**Table 15: 15 October 2006**

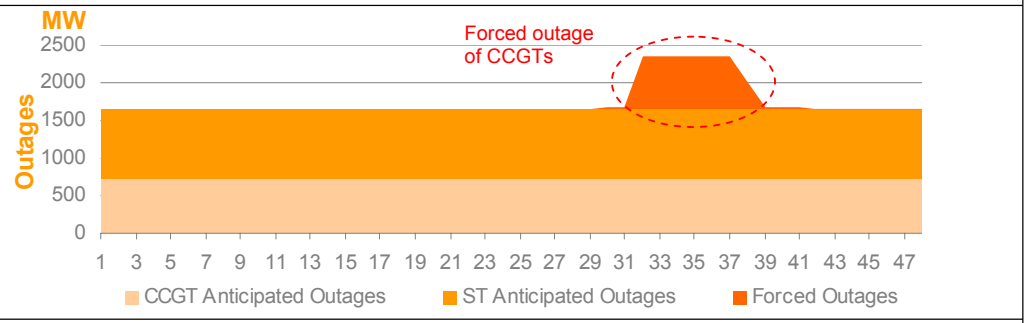
| Date | Sunday, 15 Oct 2006 | All Sundays in Oct 2006 |
|---|---|---|
| Daily USEP ($/MWh) | 233.74 | 197.90 |
| Max USEP ($/MWh) | 392.36 | 852.87 |
| No. of USEP ≥ $1000/MWh | 0 | 0 |
| Demand (MW) | 4085 | 3993.61 |
| Supply Cushion (in %) | 21.18 | 23.35 |
| Offers ≤$100/MWh (in %) | 66.51 | 68.23 |

## Summary

The price pattern on 15 October mimicked that of the previous Sunday (8 Oct 2006) with marginal improvement in the supply condition, as a CCGT returned from planned maintenance. With higher capacity coming from the base load generator, the percentage of capacity offered at $100/MWh or less improved from 63.9 to 66.5 percent compared to the previous week.

The flat supply pattern and the absence of any forced outages indicate that the high price pattern was mainly driven by tight supply instead of price spikes. As shown in chart 28, USEP jumped to over $300/MWh and remained there for several periods during the two peak periods as indicated by areas A and B. During these high prices of over $300/MWh, the supply cushion also dropped. On both occasions, prices only returned to the normal level when demand subsided.



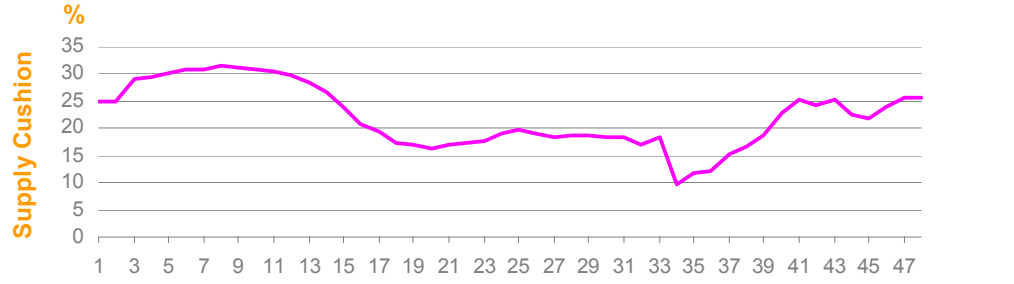




**Table 16: 21 December 2006**

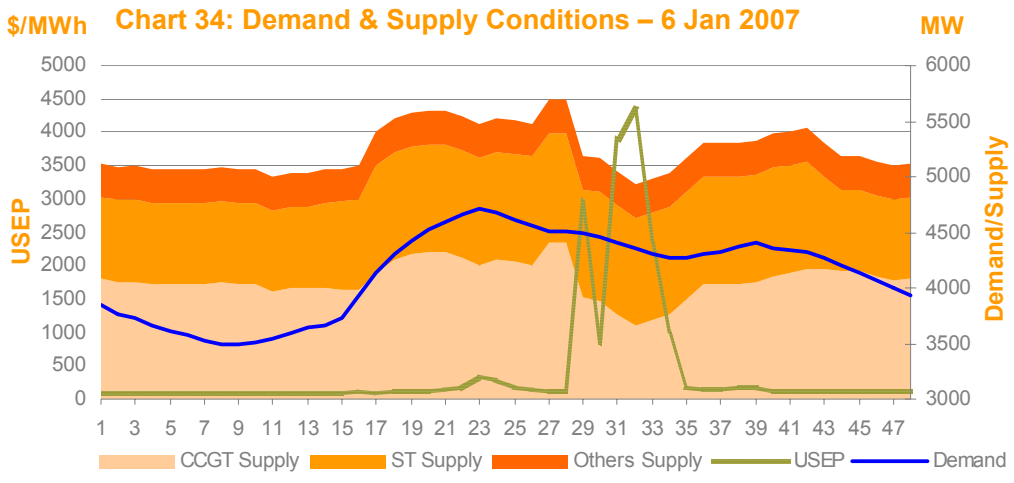
| Date | Thursday, 21 Dec 2006 | All Thursdays in Dec 2006 |
|---|---|---|
| Daily USEP ($/MWh) | 261.25 | 144.43 |
| Max USEP ($/MWh) | 4500.00 | 4500.00 |
| No. of USEP ≥ $1000/MWh | 3 | 3 |
| Demand (MW) | 4445 | 4465 |
| Supply Cushion (in %) | 22.15 | 24 |
| Offers ≤$100/MWh (in %) | 76.77 | 76.81 |

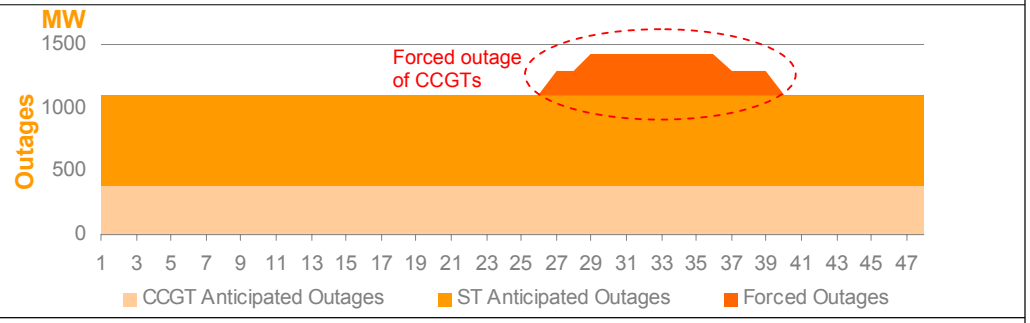
## Summary

The price spikes on 21 December were triggered by a gas supply interruption, which led to the tripping of two CCGTs. The event also caused load shed in some areas as USEP hit the price cap of $4500/MWh in period 34. During this period, the sudden drop in supply pulled the supply cushion below the 10 percent mark.

However, as the gas supply interruption happened during the periods of subsiding demand, only three periods of high prices in excess of $1000/MWh were recorded. The average supply only managed to recover to the level prior to the gas supply interruption in period 40 as the tripped units slowly returned to normal operation.

The event on 21 December 2006 was caused by sudden supply interruption rather than tight supply throughout the day. It is obvious from the Table above and various charts that supply conditions were generally favorable prior to and after the gas supply interruption.



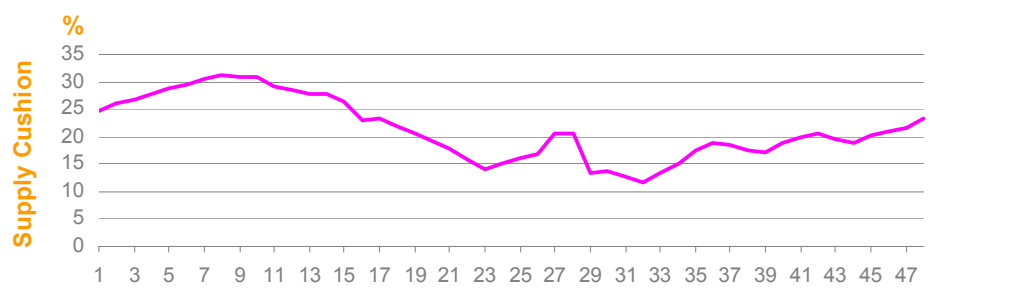




**Table 17: 6 January 2007**

| Date | Saturday, 6 Jan 2007 | All Saturdays in Jan 2007 |
|---|---|---|
| Daily USEP ($/MWh) | 428.71 | 224.02 |
| Max USEP ($/MWh) | 4330.33 | 4330.33 |
| No. of USEP ≥ $1000/MWh | 4 | 5 |
| Demand (MW) | 4128 | 4130.51 |
| Supply Cushion (in %) | 21.38 | 22.43 |
| Offers ≤$100/MWh (in %) | 78.00 | 77.52 |

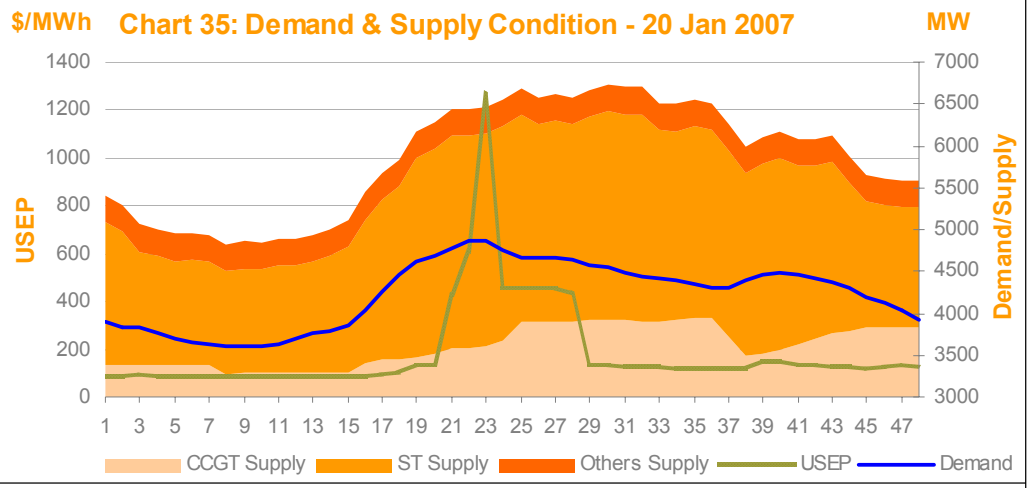
## Summary

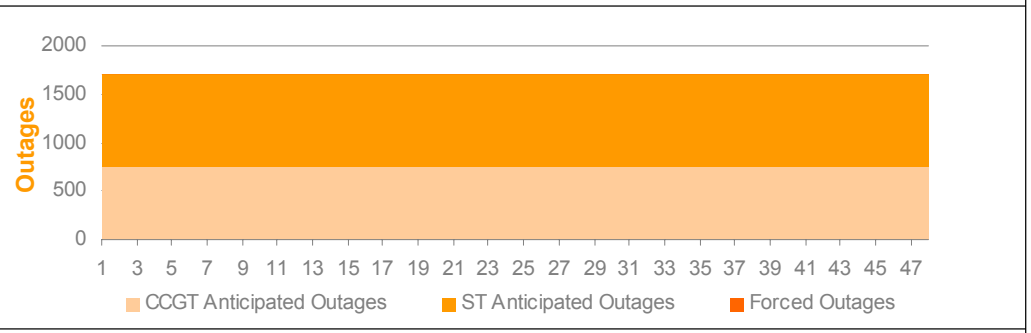
The event on 6 January 2007 was very similar to 21 December 2007 as the price spikes were caused by sudden supply interruption in the form of generation forced outages. However, there were two major differences in supply conditions:

a. *Higher dependency on CCGTs* – The market relied more on CCGTs for supply on 6 January 2007 compared to 21 December 2006. The ratio of CCGT supply to ST was in the range of 5:2 compared to 5:1 on 21 December 2006. As a result, the subsequent forced outages of CCGTs had a more profound effect on prices as there was less ST capacity to replace the lost load.

b. *Tighter supply* – Supply conditions were tighter on 6 January with USEP already hitting close to $350/MWh a few periods prior to the forced outages.

Both the tighter supply and higher dependency on CCGTs are possible reasons for the high prices despite there being a higher percentage of offers at $100/MWh or less. During the affected periods, some reserve classes and regulation also hit their price caps.



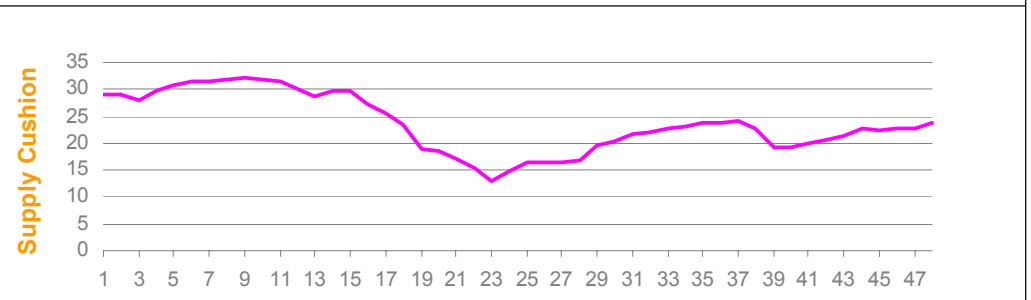



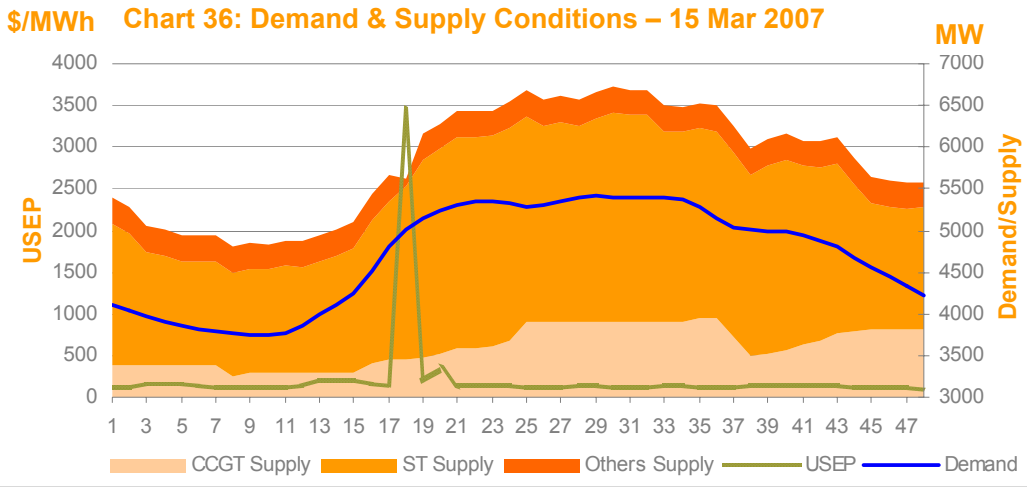

**Table 18: 20 January 2007**

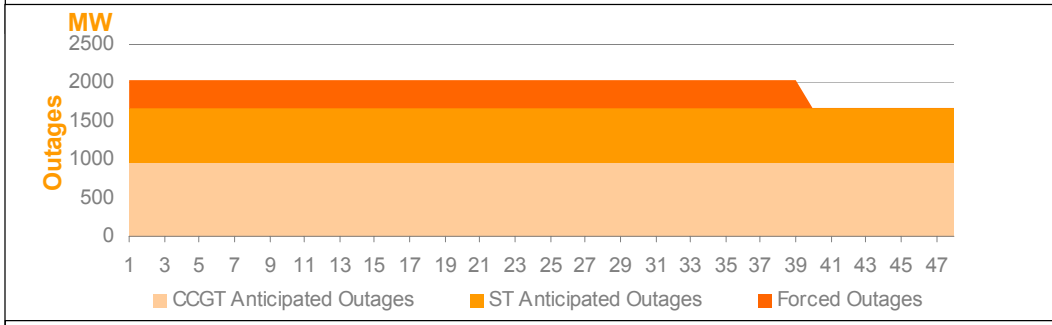
| Date | Saturday, 20 Jan 2007 | All Saturdays in Jan 2007 |
|---|---|---|
| Daily USEP ($/MWh) | 186.30 | 224.02 |
| Max USEP ($/MWh) | 1266.71 | 4330.33 |
| No. of USEP ≥ $1000/MWh | 1 | 5 |
| Demand (MW) | 4222 | 4130.51 |
| Supply Cushion (in %) | 23.65 | 22.43 |
| Offers ≤$100/MWh (in %) | 76.55 | 77.24 |

## Summary

Although over 1800MW of average anticipated outages was recorded, the supply cushion on 20 January was generally at a comfortable level. There was also no sudden interruption of supply in the form of forced outages.

The high prices were mainly due to the withdrawal of offers by the commissioning unit when energy demand was on the rise. This led to rising energy prices from period 19, which eventually hit a high of $1266.71/MWh in period 23. The high prices remained above $400/MWh until period 29 when the commissioning unit returned.



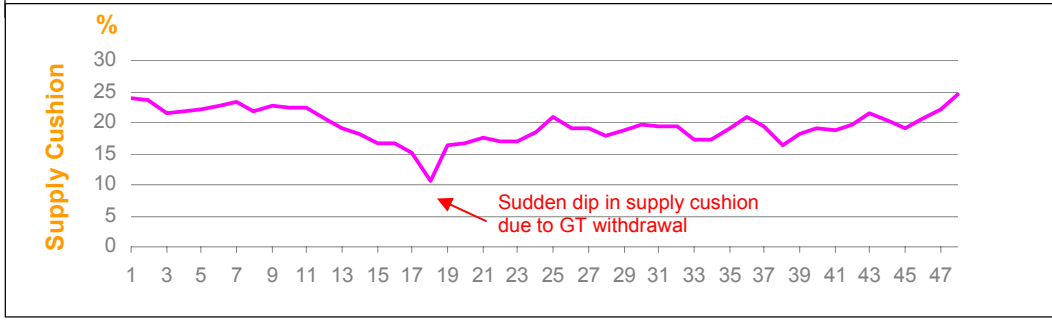




**Table 19: 15 March 2007**

| Date | Thursday, 15 Mar 2007 | All Thursdays in Mar 2007 |
|---|---|---|
| Daily USEP ($/MWh) | 206.64 | 128.89 |
| Max USEP ($/MWh) | 3447.56 | 3447.56 |
| No. of USEP ≥ $1000/MWh | 1 | 1 |
| Demand (MW) | 4703 | 4637 |
| Supply Cushion (in %) | 19.51 | 21.76 |
| Offers ≤$100/MWh (in %) | 76.17 | 77.71 |

## Summary

A sudden withdrawal of OCGT capacity of nearly 220MW in period 18 saw USEP hitting a high of $3447.56/MWh. Both contingency reserve and regulation also hit their price caps due to shortfall of supply. There was no evidence that the withdrawal was caused by a forced outage.

Usually, OCGTs are required to meet demand only during periods of tight supply. However, with the withdrawal, there was virtually no OCGT capacity available for dispatch in period 18 as the remaining OCGT was shut down for maintenance.

In addition, supply conditions on 15 March were already tight prior to the withdrawal of supply from the OCGT as the average supply cushion was only 19.5%. In the last three years, less than 3% of the trading day had a supply cushion lower than 20%. The withdrawal had prompted the supply cushion for period 18 alone to hit 10%.

The MSCP will continue to monitor such incidents.

## INVESTIGATIONS

### Summary of Investigation Activities

Under the market rules, the MSCP may initiate an investigation into any activities in the wholesale electricity markets or the conduct of a market participant, the MSSL, EMC or the PSO that is brought to the attention of the MSCP by way of a referral or complaint from any source, or that the MSCP determines as warranting an investigation.

The MSCP may refuse to commence or may terminate an investigation where the MSCP 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.

The following table reflects the position with regard to investigation and enforcement activities from market start on 1 January 2003 to 31 March 2007, with the last column focusing on the period under review.

**Table 20: Investigation and Enforcement Statistics**

| **Rule Breaches** | **1 Jan 2003 to 31 Mar 2007** | **1 Apr 2006 to 31 Mar 2007** |
|---|---|---|
| **(A) Total number of offer variations after gate closure** | **23,405** | **2,131** |
| **Total number of cases closed** | **23,127** | **4,533** |
| ■ number where MSCP determined a breach | 105 | 1 |
| ■ number where MSCP determined no breach | 3,780 | 2,397 |
| ■ number where MSCP decided to take no further action | 19,242 | 2,135 |
| | | |
| **(B) Total number of cases (excluding offer variations after gate closure) of which:** | **113** | **15** |
| ■ number of self-reports | 98 | 14 |
| ■ number of referrals or complaints | 8 | 0 |
| ■ number initiated by MSCP | 6 | 1 |
| **Total number of cases closed** | **106** | **24** |
| ■ number where MSCP determined a breach | 74 | 19 |
| ■ number where MSCP determined no breach | 10 | 3 |
| ■ number where MSCP decided to take no further action | 22 | 2 |
| | | |
| **(C) Number of formal MSCP hearings** | **1** | **0** |
| | | |
| **(D) Enforcement Action** | | |
| ■ Highest financial penalty imposed on a party in breach | **$66,000** | **$7,500** |
| ■ Total financial penalties imposed on parties in breach | **$138,500** | **$7,500** |
| | | |

| | | |
|---|---|---|
| **(E) Costs** | | |
| ■ Highest award of costs imposed on a party in breach | **$23,000** | **$1,000** |
| ■ Total costs imposed on parties in breach | **$86,800** | **$19,800** |
| | | |
| **Market Efficiency and Fairness** | **1 Jan 2003 to 31 Mar 2007** | **1 Apr 2006 to 31 Mar 2007** |
| **(A) Total number of cases of which:** | **3** | **1** |
| ■ number of referrals or complaints | 2 | 1 |
| ■ number initiated by MSCP | 1 | 0 |
| **(B) Total number of cases closed** | **2** | **1** |

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 MAU, under the supervision and direction of the MSCP, to develop a set of information requirements to assist the EMA to fulfill 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 finalized 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 and 28 January 2004.

The MAU regularly provides data to the Authority 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.

The EMA has also clarified that the role of the MSCP is to report possible cases of anti-competitive behaviour to the EMA should any be detected. All investigations into anti-competitive behaviour are under the purview of the EMA.

In the course of monitoring and investigative activities carried out from April 2006 to March 2007, the MSCP and MAU did not made any report to the EMA regarding any complain 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 WHOLESALE ELECTRICITY MARKETS

Under the market rules, the MSCP is required to provide a general assessment as to the state of competition and compliance within, and the efficiency of, the wholesale electricity markets. Our assessment is as follows:

### State of Competition and Efficiency of the Wholesale Electricity Markets

#### ***Market Competitiveness***

#### *Recent Market Developments*

The MSCP noted that a number of events took place recently that may affect the competitiveness of the NEMS:

- *Impending generation assets sale* – Temasek Holdings announced plans to sell its generation assets in September 2007 and is expected to complete the sales within a 1 to 1.5 year timeframe.
- *Changes to Gas Act* – Changes to the Gas Act were passed in May 2007 to help potential new entrants overcome barriers to entry.
- *Independent electricity supplier* – Big consumers have recently proposed to the EMA to allow independent companies to provide dedicated electricity supplies to them. This means that big consumers can potentially choose not to purchase electricity from the existing generation companies who participate in the NEMS.

The MSCP is monitoring these developments and their implications will be studied as more information is available and the relevant policies become clearer.

#### *Effect of New CCGT Supply*

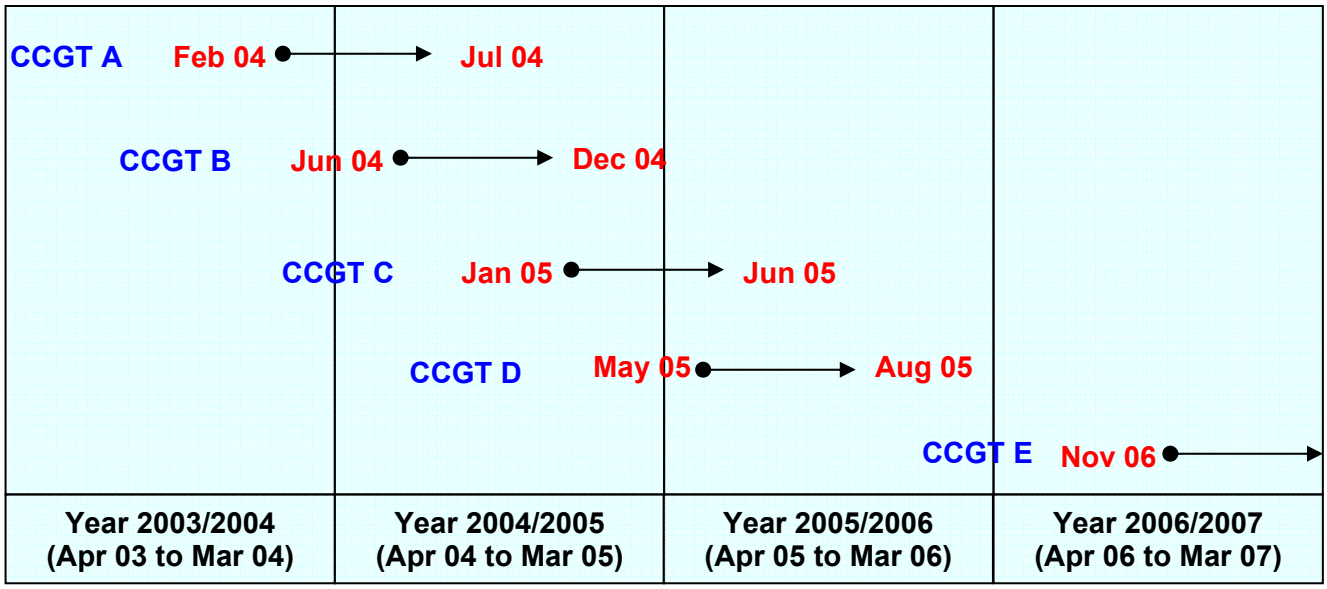
The average maximum generation capacity surpassed the 5000MW mark for the first time since market start with the introduction of a 498MW capacity CCGT unit[3] from a new generation company on November 2006. It was also the first time that new generation capacity was not provided by one of the three largest generation companies in the NEMS.

[3] The unit has since been registered as two units with maximum capacity of 245MW each.

Although the introduction of capacity from a new generation company lowered the combined market share based on maximum generation capacity for the three largest generation companies slightly from 89.5 to 87.9 percent, this did not prevent them from enjoying a bigger combined market share based on metered energy demand. The primary reason for their gain in combined market share is due to a significant drop in plant availability from another generation company as a result of outages. The contribution by the new generation company was also insignificant as the plant was under commissioning during the period under review.

The introduction of new capacity has potential benefits with regard to the supply cushion and increased competition in the NEMS. However, the expected positive effects were not yet felt during the period under review. This is because the contribution to supply from the new plant was minimal as it was only introduced in November 2006. Furthermore, the unit was not able to offer any ancillary services (reserve and regulation) during its commissioning period, which lasted until April 2007.

Based on historical data since market start, a delayed effect in supply from a new commissioning unit is not unusual. As shown in the diagram below, it usually takes a new generating plant several months for testing before it can contribute positively in terms of supply. A total of five new CCGTs were introduced since market start. For example, although one of them submitted its first energy offer in February 2004, resulting in instantaneous increase of 360MW in maximum generation capacity, the total CCGT supply was relatively unchanged for year 2003/04. It took another five months before the unit completed its commissioning in July 2004. As a result the positive supply impact was only felt in year 2004/05 when supply from CCGTs jumped more than 700MW as that unit (and another one which was commissioned in the early part of that year) became commercially operational.




**Legend:**

Generation Facility Name — Date of First Energy Offer — Commissioning Period → Date of Commercial Operation

### *Tightening Supply Cushion*

Despite a higher maximum generation capacity with the commissioning of a new CCGT unit in November 2006, the supply cushion continued to drop for the third year running. The failure of generation supply, as measured by plant availability or offers, to catch up with the growing electricity demand, is the primary reason behind the tightening supply cushion.

Although a lower supply cushion does not automatically give rise to high prices since it is also necessary to take into account offer prices, the historical trend and study described in section 1.2 confirm that the probability of occurrence of high prices increases as the supply cushion tightens. Energy prices have also become increasingly sensitive to changes in the supply cushion. The tightening supply cushion is a primary cause of higher energy prices and increasing occurrence of price spikes.

### *Signs of Changing Supply Conditions*

Since market start in 2003, competitive pressure has forced most generation companies to shift from the less efficient STs to CCGTs. As a result, new generation capacity was commissioned, as shown in Table 21 below. The increase in CCGT maximum generation capacity had contributed positively to the total supply as average CCGT availability jumped almost 50 percent from 2710MW three years ago to 4050MW for the period under review.

This year, the trend of technological shift from STs to CCGTs continued with the commissioning of another 498MW of capacity. However, the impressive rise in CCGT availability was countered as this figure dropped marginally from an average of 4081MW to 4050MW. There were two major reasons for the lower CCGT availability:

- *Commissioning plant not reached full potential* – Although the new 498MW plant had been commissioning since November 2006, it became commercially operational only in April 2007. Therefore, it did not reach its true potential during the period under review. This was evident as the new generation company's market share for the year remained low.
- *Jump in CCGT outages* – The availability of CCGTs was also affected by a significant jump in anticipated outages as the figure jumped from an average per period of 285MW last year to 452MW this year. The major contributor to the higher anticipated outages was due to technical problems experienced by a generation company. The outages from this generation company alone had accounted for about 36 percent of the increase in anticipated outages.

**Table 21: New Capacity and its Relationship to CCGT Availability**

| Year | New Capacity by Maximum Generation Capacity (MW) | Average CCGT Capacity Available for Dispatch (MW) | Anticipated CCGT Outages (MW) | Demand (MW) |
|---|---|---|---|---|
| 2003/04 | 360 | 2710 | 211 | 3903 |
| 2004/05 | 720 | 3363 | 225 | 4081 |
| 2005/06 | 360 | 4081 | 285 | 4253 |
| 2006/07 | 498 | 4050 | 452 | 4401 |

In the absence of an increase in CCGT availability and with the emergence of favorable conditions for the running of STs, discussed in section 1.3, the continuing growth in demand led to a change in supply patterns. To meet higher demand, the market increasingly turned to STs for supply. This has seen ST market share rising from 19.1 to 20.3 percent this year.

## Market Price Behavior

### *Energy Price, Fuel Oil Price and Vesting Contracts*

As fuel oil is the major cost component in electricity generation, it is not surprising that energy spot prices continued to follow the fuel oil price trend closely as shown in section 3.2.3.

Generally, vesting contracts continued to show effectiveness in reigning in average energy prices, with the average energy spot price (USEP) of $135.04/MWh staying within the average VCHP of $143.05/MWh. With the introduction of the new generation company, the vesting contract level will be reduced to 55 percent, beginning from July 2007[4].

### *High Regulation Prices and Market Structure Issue*

While vesting contracts and the availability of excess capacity have kept the energy market competitive, similar factors are not present in the regulation market. The following factors also increase the potential for high regulation prices and price spikes:

- *Requirements for regulation dispatch* – There are several conditions that a generating unit must meet before it can be considered for regulation dispatch. Foremost is the requirement that the unit must be dispatched for energy. The unit must also stay within a predefined regulation range called regulation minimum and regulation maximum for regulation dispatch. These conditions can give rise to volatility in regulation prices as the failure of a single generator to meet these conditions can lead to a sudden drop in regulation supply and cause price spikes.
- *High market concentration* – The regulation market is also more concentrated than the energy market with only four generation companies capable of providing regulation.

[4] See Vesting Contract Level for 1 January 2007 to 31 December 2008, published by the EMA in June 2007.

As mentioned earlier, the MSCP had in March 2007 issued a report of its investigation into high regulation prices, which had occurred from October 2006 to January 2007. In the report, the MSCP had concluded that the regulation market structure warranted further review and noted that the EMA was investigating the situation. The EMA has since engaged a consultant to review the current regulation market structure.

***Price Outliers Using an Econometric Model***

Using an econometric model, a total of eight daily USEP were identified as potentially abnormal prices for the period under review. After conducting further analysis as described in section 3.4, the MSCP concluded that there were reasonable grounds to believe that the outliers were still in-line with changes in market fundamentals. However, the MSCP will continue to pay more attention to similar incidents as that on 15 March 2007 where the sudden withdrawal of a generating unit was the direct cause of high prices. The MSCP will also continue to improve the current econometric model so that more meaningful price warnings can be identified.

**State of Compliance within the Wholesale Electricity Markets**

Ensuring compliance with the market rules is important in the operation of a competitive and reliable electricity market. Market participants who breach the rules may be subject to sanctions if the MSCP considers it appropriate.

Our assessment as to the state of compliance within the wholesale electricity markets is set out below.

**Offer Variations after Gate Closure**

The table shows the number of offer variations after gate closure submitted by market participants.

| | |
|---|---|
| No of offer variations made after gate closure for year 2006/07 | 2150 |
| No of offer variations made after gate closure for year 2005/06 | 4691 |
| % reduction in offer variations made after gate closure for year 2006/07 | 54.2% |

The 54.2 percent reduction in number of offer variations made after gate closure for the period under review compared to the previous year was mainly due to two factors:

- The market rules change that took effect on 19 January 2006 to reduce the gate closure period from 2 hours to 65 minutes.

- Improvement in the manner in which market participants managed their offers. During the periods under review, 2 new market participants made offer variations after gate closure from July 2006 and December 2006 respectively. They contributed to a high number of the offer variations made after gate closure due to their plants having a high number of forced outages. However, the existing market participants made fewer offer variations after gate closure.

During the year, the MSCP was also satisfied that the vast majority of offer variations made after gate closure were permissible under the market rules.

However, the MSCP made a determination of rule breach by a generation company in relation to offer variations made after gate closure for period 27 on 23 August 2005. On that day, within the 2 hours immediately prior to the dispatch period for period 27, the generation company changed its offer to a zero quantity of energy for one of its generating units. A mistake was made in relation to the offer variation as the offer variation was actually intended for another generating unit that had tripped during commissioning. Due to the error, energy which would otherwise have been available from the first generating unit was not made available. This resulted in a significant increase in USEP, regulation, primary and contingency reserve prices as follows:

| | **Period 26** | **Period 27** |
|---|---|---|
| Generating unit offer | 340MW | 0MW |
| USEP ($/MWh) | 80.98 | 171.26 |
| Regulation ($/MWh) | 29 | 94.93 |
| Primary Reserve ($/MWh) | 6.31 | 48.45 |
| Secondary Reserve ($/MWh) | 0.30 | 1.04 |
| Contingency Reserve ($/MWh) | 10.63 | 52.63 |

The MSCP determined on 24 August 2006 that the generation company had breached section 10.4.1 of Chapter 6 of the market rules. The MSCP noted that the generation company had self-reported the breach and taken remedial action. Nonetheless, the MSCP was of the view that the generation company had at the relevant time not exercised sufficient due diligence in putting in place an adequate offer variation process which could have enabled avoidance of the breach. The breach had significant impact on the wholesale electricity markets. The MSCP therefore imposed a financial penalty of $7,500 and ordered the payment of costs of $800 against the generation company.

**Rule Breaches**

For the period 1 April 2006 to 31 March 2007, the MSCP made 19 determinations regarding rule breaches. 17 determinations were made against the market operator, EMC, and 2 against the system operator, PSO.

There were 16 rule breach determinations made against EMC for its failure to determine, release or publish information relating to dispatch schedules on time due to technology problems. There was a case of rule breach by EMC for an inadvertent release of confidential information of a market participant. The two breaches by the PSO were for its failure to send network status files to the market clearing engine due to technology problems. The MSCP noted that these breaches were all self-reported and were found not to have had any significant impact on the wholesale electricity markets. Investigation costs of $1000 were imposed in each of the 19 cases.

## CONCLUSION

With the NEMS approaching its fifth year of operation, the surveillance and compliance function under the purview of the MSCP has become increasingly demanding. The development of the econometric model is part of the effort to improve analytical capability as the NEMS matures.

In assessing the efficiency and competitiveness of the wholesale electricity markets, the MSCP observed that the record high regulation prices in January signalled potential weakness in the regulation market structure. The high prices had prompted the EMA to review the regulation market.

The potential positive effect of a new generation facility, which was under commissioning during the period under review, had yet to be felt. Historical data had shown that it might take several months before these positive effects may be observed.

Turning to the energy market, an increase in CCGT anticipated outages resulted in base load generation supply failing to keep up with the continuing upward shift in demand. This prompted a greater utilization of STs to meet demand and led to a reversal of the sliding ST market share trend for the first time since market start.

Energy prices became more sensitive to changes in the supply cushion as the average supply cushion tightened for the third consecutive year, with growth in demand outstripping that of supply. Understanding the reasons for the increased sensitivity and whether it will persist will require a longer period of observation.

The econometric model confirmed our expectations regarding the relationship between market fundamental factors and the energy price. It also provided a means of identifying outlier prices which takes into account dynamic market conditions. Reliance need not be placed only on a static benchmark to pick out high prices for analysis. Having studied the outliers identified by the econometric model, we are of the view that incidents with offer behavior similar to that leading to the price spike on 15 March 2007 should continue to be monitored. The rest of the outliers could be explained by the forces of demand and supply.

Overall, notwithstanding the above observations, vesting contracts had ensured that energy prices continued to hover close to the LRMC of a CCGT.

In terms of market compliance, the MSCP observed that there was a significant reduction in the number of cases of offer variations made after gate closure. This was mainly due to a market rule change which shortened the gate closure period from 2 hours to 65 minutes. Improvements by generation companies in the handling of their offer variations also contributed to a reduction in the number of market rule breaches associated with offer variations made after gate closure. Other cases of MSCP determination of market rule breach did not have any significant market impact.

Professor Lim Chin
for Chair, Market Surveillance and Compliance Panel
13 July 2007