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Making Australia's electricity market understandable

## **Effects of the **Heatwave** of March 2008 on the South Australian region**

Prepared on: Friday, 16 May 2008

Article located at: <http://www.wattclarity.com.au/Public/Article.aspx?aid=21>

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## **1) Introduction**

Beginning on the 3<sup>rd</sup> of March, 2008 residents of South Australia endured a lengthy 15 consecutive daytime Adelaide temperatures in excess of 35°C (95°F).

This was the **longest recorded heat wave** for an Australian capital city.

As could be expected, the heatwave caused a wide variety of issues for residents of, and businesses operating in, Adelaide (and beyond) – ranging from inconveniences to significant safety issues.

The heatwave was also significant for the South Australian region of Australia's National Electricity Market (NEM), including the following:

- 1) Demand for electricity in South Australia created a new all-time record on three separate occasions;
- 2) ETSA had issues maintaining supply in the distribution system;
- 3) The Instantaneous Reserve Plant Margin (IRPM) for the South Australian Economic Island dropped as low as 7%;
- 4) Spot prices in the market jumped on six separate occasions over the period of the 15-day event:
  - a) In total, 26 separate trading (30-minute) intervals experienced prices above \$5000/MWh;
  - b) South Australia's average pool price for March increased to \$353/MWh;
  - c) These price spikes had the effect of raising the Cumulative Price Total (CPT) over \$150,000 – at which point NEMMCO issued and Administered Price Cap (APC).

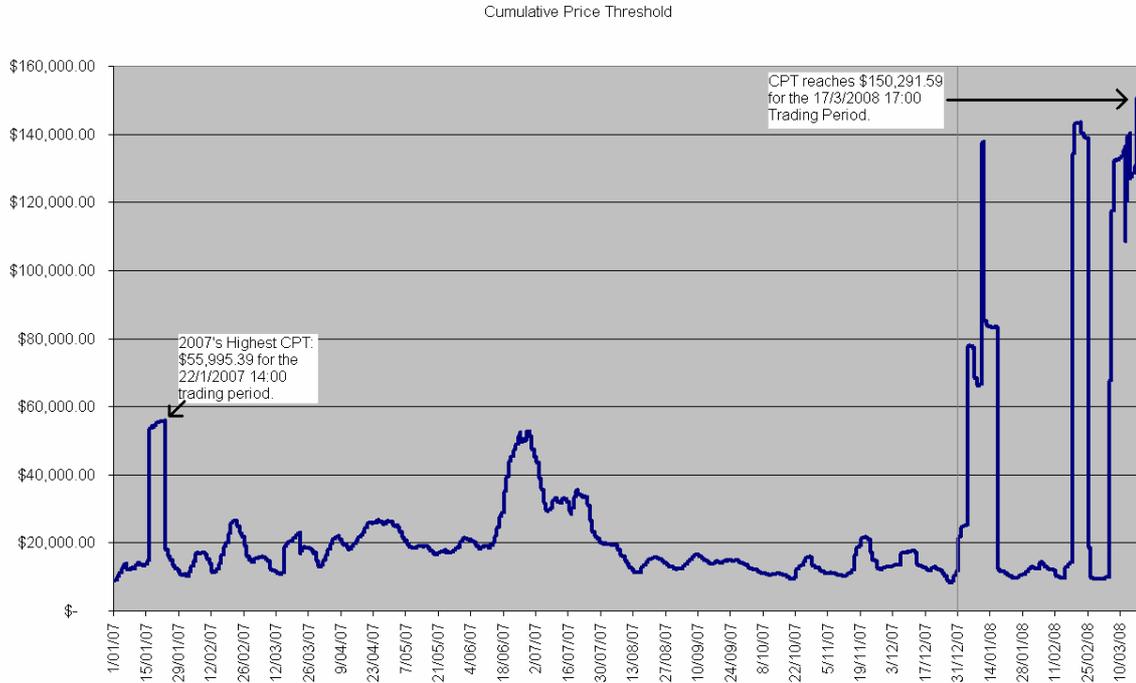
Of these the last is perhaps most significant.

The Cumulative Price Total is a running total of the pool prices over the previous 336 trading periods (i.e. 7 days of 48 half-hourly prices).

To put things in perspective, the following graph (figure 1) shows the trend in South Australia's CPT since the beginning of 2007:



**Figure 1 – Trend in the CPT within SA since January 2007**



Once the CPT passes \$150,000 NEMMCO puts in place restrictions to prevent further high prices. By definition, the threshold is reached when the time-weighted average spot price for the week is above \$892/MWh.

This occurred on the 17<sup>th</sup> of March at 17:00 (NEM time). This was **the only time we have seen this occur** since the NEM started in December 1998.

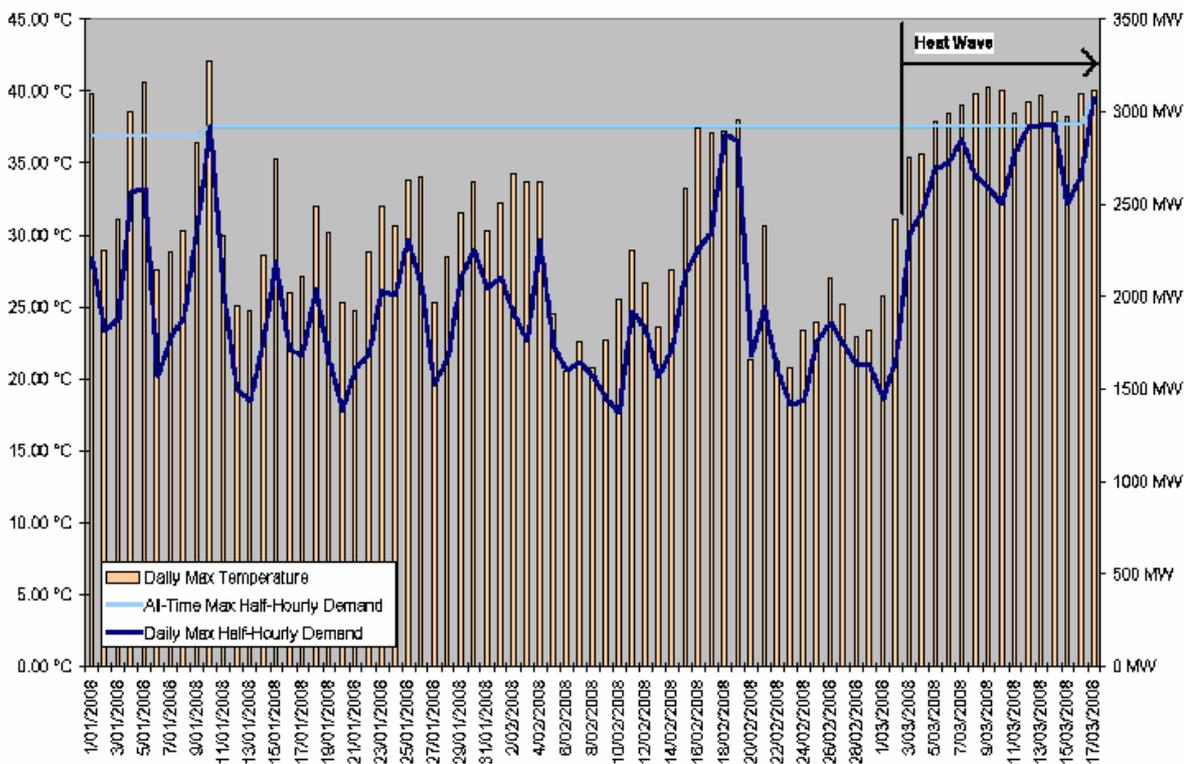
This report considers these effects in further detail.

## 2) Record Demand in SA

During the heatwave, demand for electricity in South Australia broke previous records – on 3 separate occasions.

The following graph (figure 2) shows how South Australian Demand has been influenced by the temperature in Adelaide. The all-time maximum demand has also been shown for reference.

**Figure 2 – Peak Daily Temperature**



As can be seen in the above graph, the a new record for 30-minute demand target was set earlier in the year – on 10<sup>th</sup> January, a day where the peak temperature climbed well above 40°C. On that occasion, the peak was set at 2,920MW.

The following table illustrates how the record demand (set in January) was exceeded on three occasions:

- 1) On Thursday 13<sup>th</sup> March (day #11 in the heatwave) the peak edged up to 2,927MW;
- 2) The next day the peak demand climbed higher still (to 2,934MW);
- 3) Following the weekend temperatures climbed above 3000MW for the first time (to 3,080MW on Monday 17<sup>th</sup> March).

Thankfully this was the last day of the heatwave.

**Table 1:**

Saturday	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday
1/3/2008	2/3/2008	3/3/2008	4/3/2008	5/3/2008	6/3/2008	7/3/2008
25.7 °C	31.1 °C	35.4 °C	35.7 °C	37.9 °C	38.5 °C	39 °C
1450 MW	1666 MW	2341 MW	2468 MW	2697 MW	2724 MW	2855 MW
8/3/2008	9/3/2008	10/3/2008	11/3/2008	12/3/2008	13/3/2008	14/3/2008
39.8 °C	40.2 °C	40 °C	38.4 °C	39.2 °C	39.7 °C	38.6 °C
2651 MW	2593 MW	2502 MW	2774 MW	2916 MW	2927 MW	2934 MW
15/3/2008	16/3/2008	17/3/2008				
38.3 °C	39.9 °C	40.1 °C				
2500 MW	2657 MW	3080 MW				

As can be seen in this table and figure 2 above, even on the weekend during the heat wave, the demand did not drop below 2,500MW – illustrating how much of the demand in South Australia is driven by air-conditioning load.

Furthermore, as the weather conditions that caused these high temperatures moved eastwards, New South Wales and Victoria also experienced high levels of electricity demand (Victoria broke its previous record on the 14<sup>th</sup> and 17<sup>th</sup> of March).

### 3) Distribution Network Issues

The heat wave, which lasted 15 days, placed unprecedented pressure on the local distribution network.

ETSA (the distribution owner and operator) released a [media statement](#) in which they warned that they could not guarantee continuity of supply. The full text is as follows:

Figure 3 – Media Statement from

The screenshot shows the ETSA Utilities website interface. At the top, there is a navigation bar with the ETSA Utilities logo, a 'Contact ETSA' button with a telephone icon, a 'Site Map' button with a location pin icon, and a 'Search' button. Below the navigation bar is a grid of images representing different services: Residential Services, Business & Government, Contractors & Suppliers, About ETSA, and Careers @ ETSA. A sidebar on the left contains a list of navigation links, including Home, About ETSA, Residential Services, Business & Government, Contractors & Suppliers, Careers at ETSA, News & Information, Development Plans, Fact Sheets, Media Releases, and various news items such as '\$1.2m power boost for Burnside', '\$1.5M to prepare Yorke Peninsula hotspots for summer', '\$180m to upgrade SA power network', '\$74m to prepare SA for summer', 'Beat the Peak' summer demand management trial for Glenelg, 'Biggest graduate recruitment in 10 years', 'Birdman soars for healthy living', 'Copper theft jailing sends warning to criminals', 'Copper thieves must face tougher penalties', 'Distribution network facing unprecedented test', 'Endeavour Australia Cheung Kong Scholarship SA', and 'Endeavour Australia Cheung Kong Scholarship SA'. The main content area displays a media statement dated 13 March 2008, titled 'SA distribution network facing unprecedented test'. The statement begins with 'South Australia is entering its most difficult period for potential power failures.' and includes quotes from Ms Sue Filby, General Manager, Services, regarding the unprecedented test on the distribution network and the company's commitment to minimizing disruption.

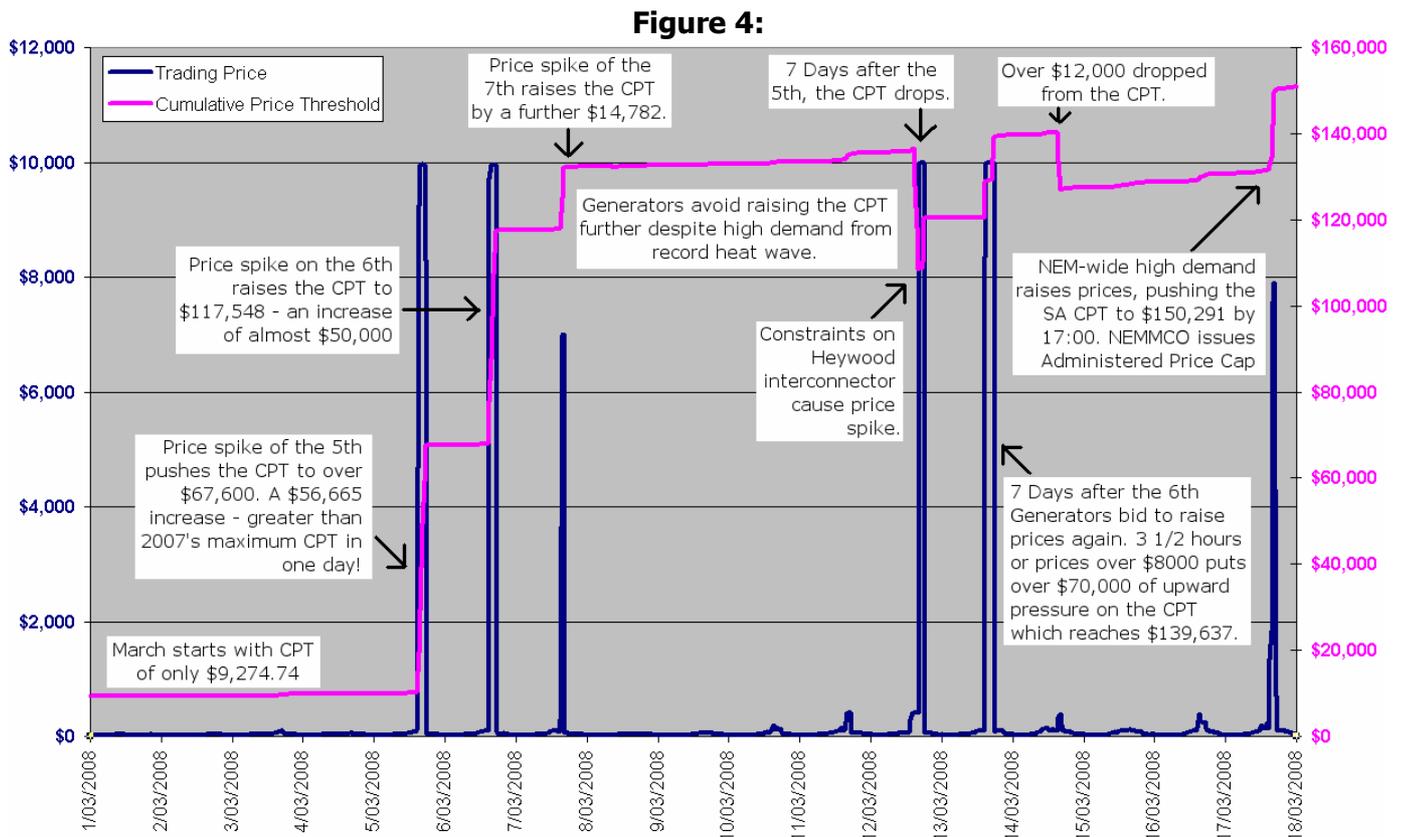
There were [seven minor blackouts](#) across Adelaide on Thursday, 13<sup>th</sup> of March.

In an [online FAQ](#), ETSA Utilities reported that many of the problems experienced during summer months occurred due to a coincidence of:

- 1) High temperatures, impacting on the capability of distribution equipment itself; coupled with
- 2) Higher than expected loading on the networks – driven by increased air-conditioning usage (in essence, households are free to install air-conditioning systems without notifying ETSA that they have done so – and yet ETSA is required to have sufficient network capacity installed to supply load to these units).

## 4) Price Volatility

High demand, along with the economic withholding of capacity by some generators, forced the South Australian electricity price above \$7000 on six different occasions before NEMMCO issued an Administered Price Cap (APC) as the Cumulative Price rose above the Threshold of \$150,000 for the first time ever in the NEM. The following shows the events that pushed South Australian prices upwards and lead to the APC:



South Australian electricity prices had been extremely volatile since the beginning of 2008 with the CPT already having risen over \$100,000 on two occasions:

- 1) 10-11 of January (peaking at \$137,909.53) and
- 2) 18-25 of February (peaking at \$143,553):
  - a) On one occasion the South Australian electricity price exceeded \$9990 for a remarkable 6 hours (12 trading intervals) – the longest period of sustained high prices we have ever seen.
  - b) This day (18/2/2008) alone contributed \$120,074.12 to the CPT (and kept energy prices low for the remaining week).
- 3) However, in the four days prior to the beginning of March there had been no trading price above \$72.72 and the CPT had fallen to \$9,274.74.

The March heat wave then began on the 3<sup>rd</sup> of March and lasted 15 days.

## **(A) 5<sup>TH</sup> MARCH**

Coincidentally, on the 5<sup>th</sup> March it was announced in the press that AGL had come under investigation by the Australian Energy Regulator (AER) for the way in which its Torrens Island power stations had been offered to the market in January and February 2008 (i.e. prior to the heatwave).

For the press report, see:

Nigel Wilson, The Australian, 5<sup>th</sup> March 2008  
*"Watchdog probes AGL over electricity prices"*

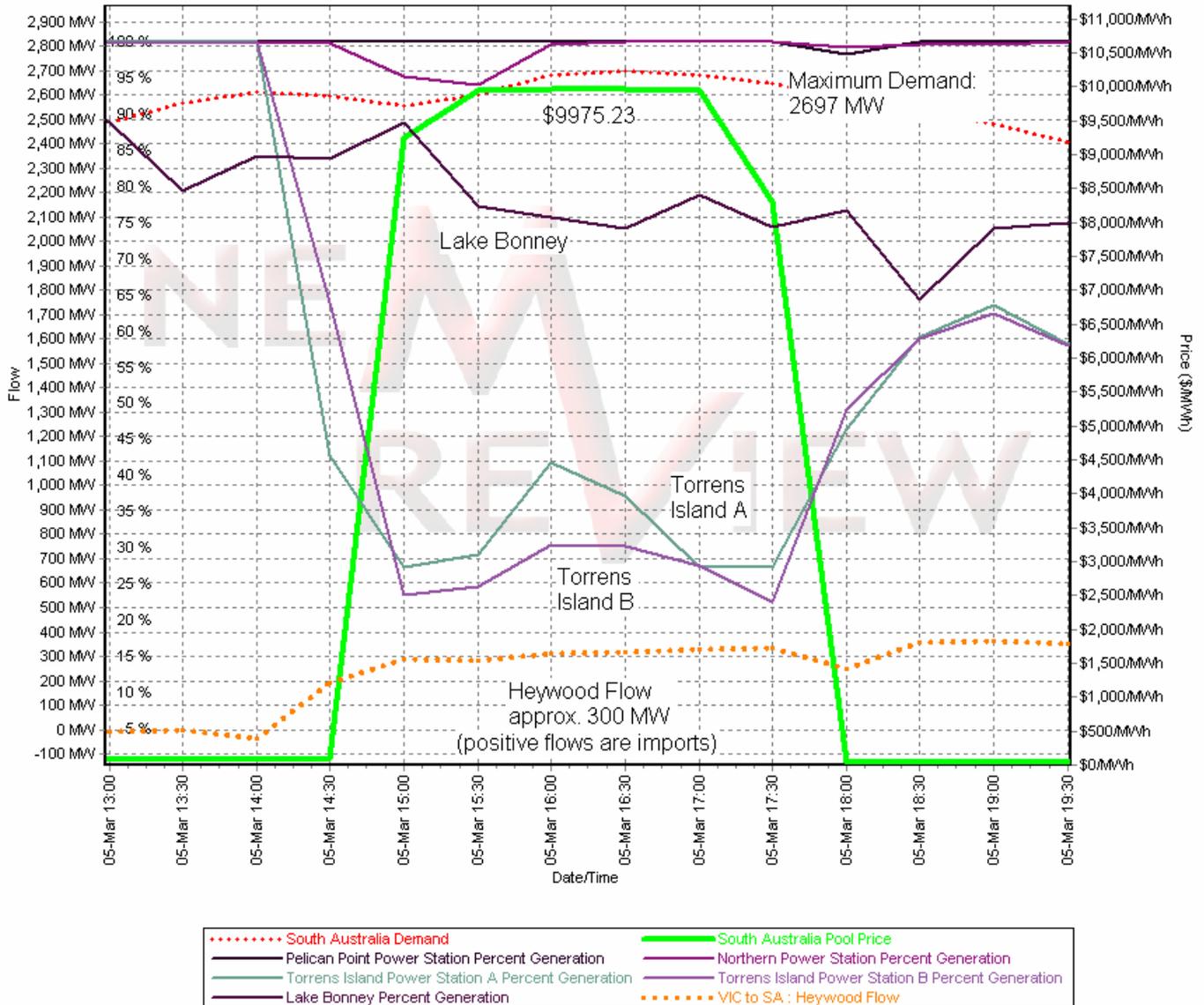
At 15:00 (NEM time) the South Australian trading price rose from \$80.72/MWh to \$9252.07/MWh and remained high until 18:00.

The following graph shows the utilization of some major South Australian power stations during this time:

Figure 6:

Market data between 5-03-2008 and 5-03-2008

Prepared on 18-03-2008



Analysis produced with NEM-Review

[www.nem-review.info](http://www.nem-review.info)

It is possible (through NEM-Review) to infer much about generator bidding behaviour by how they are dispatched in relation to price – any unutilized power is being bid at or above the current price of power.



On the 5<sup>th</sup> we can see that Torrens A and Torrens B power stations reduced their utilisation as the price increased. (both now owned and operated by AGL following their purchase from TRUenergy) dramatically reduced their output such that about **70% of their generation appears to have been bid above \$9900** .

In all this accounts for over 700 MW of power that would normally run at prices much lower than this level.

Other major South Australian stations, including Pelican Point and Northern Power Stations, maintained high levels of generation during this time period. One exception to this is Lake Bonney Wind Farm whose utilization dropped by about 15%, however further analysis shows this was due to an increase in capacity rather than a decrease in output.

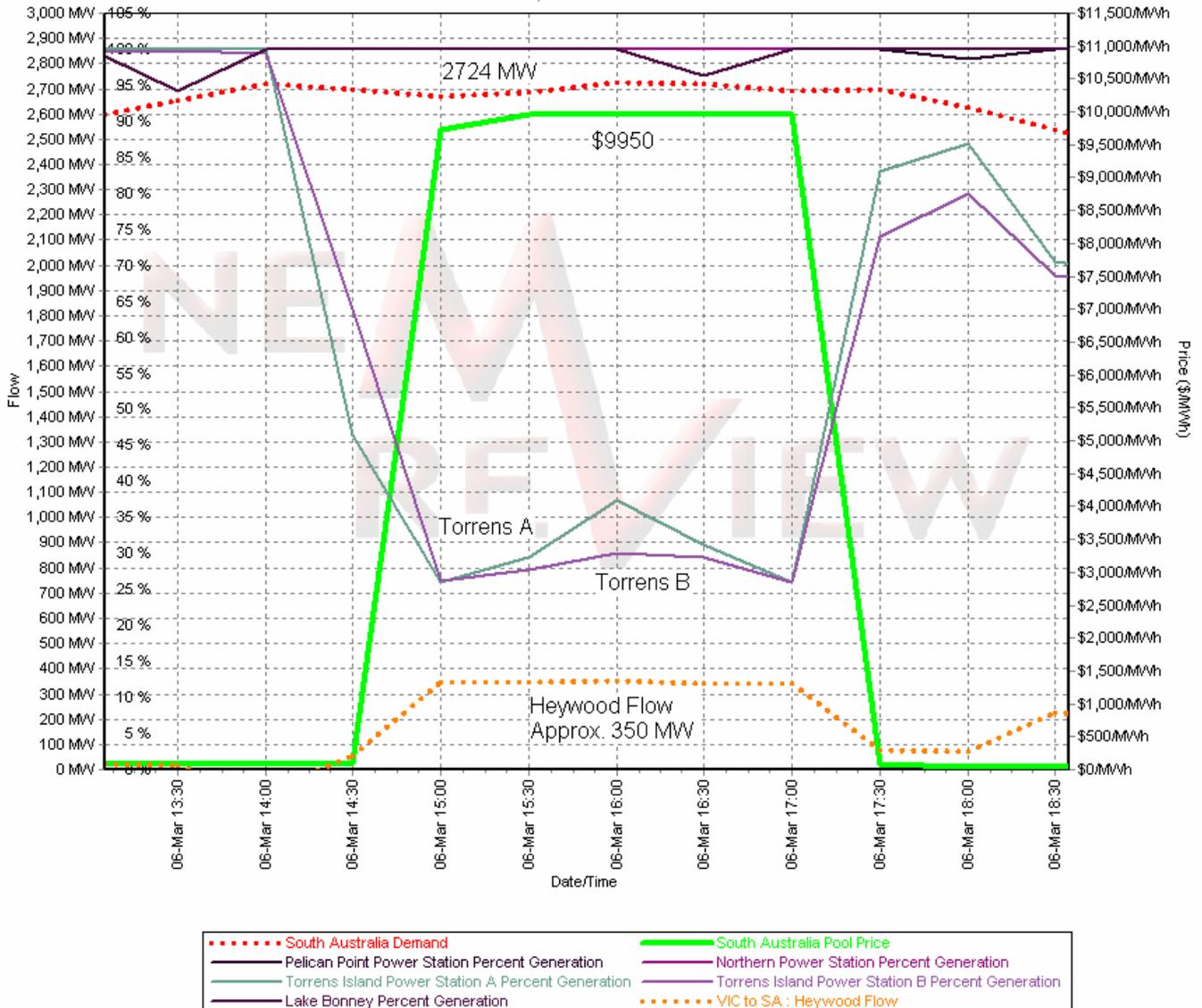
This high price event had the effect of raising the Cumulative Price by \$57,394.08 in only 6 trading intervals (\$57,665.73 over the whole day).



**(B) 6<sup>TH</sup> MARCH**

**Market data between 6-03-2008 and 6-03-2008**

Prepared on 18-03-2008



Analysis produced with NEM-Review

[www.nem-review.info](http://www.nem-review.info)

**Figure 7:**

The following day (6<sup>th</sup> of March) saw **very similar action** to that on the previous day with the exceptions that Lake Bonney produced at full capacity and imported Heywood flow was able to be increased by over 300 MW to help soften demand.



The Torrens Island power stations dropped their output by approximately 730 MW (almost 75% of capacity).

The result was five trading periods with prices over \$9,700 that raised the Cumulative Price by \$49,519.43 to six figures at \$117,419.07 .

The Cumulative Price would not fall below \$100,000 again until the NEMMCO issued APC 12 days later.

### **(C) 7<sup>TH</sup> MARCH**

High prices on the 7<sup>th</sup> of March were not nearly as significant as those on the previous two days, only raising the Cumulative Price by \$14,782.05 mainly from two trading periods of \$6,979 and \$7,004 respectively.

As in previous high price events the cause was primarily the Torrens Islands Stations engaging in the '**economic with holding of capacity**'.

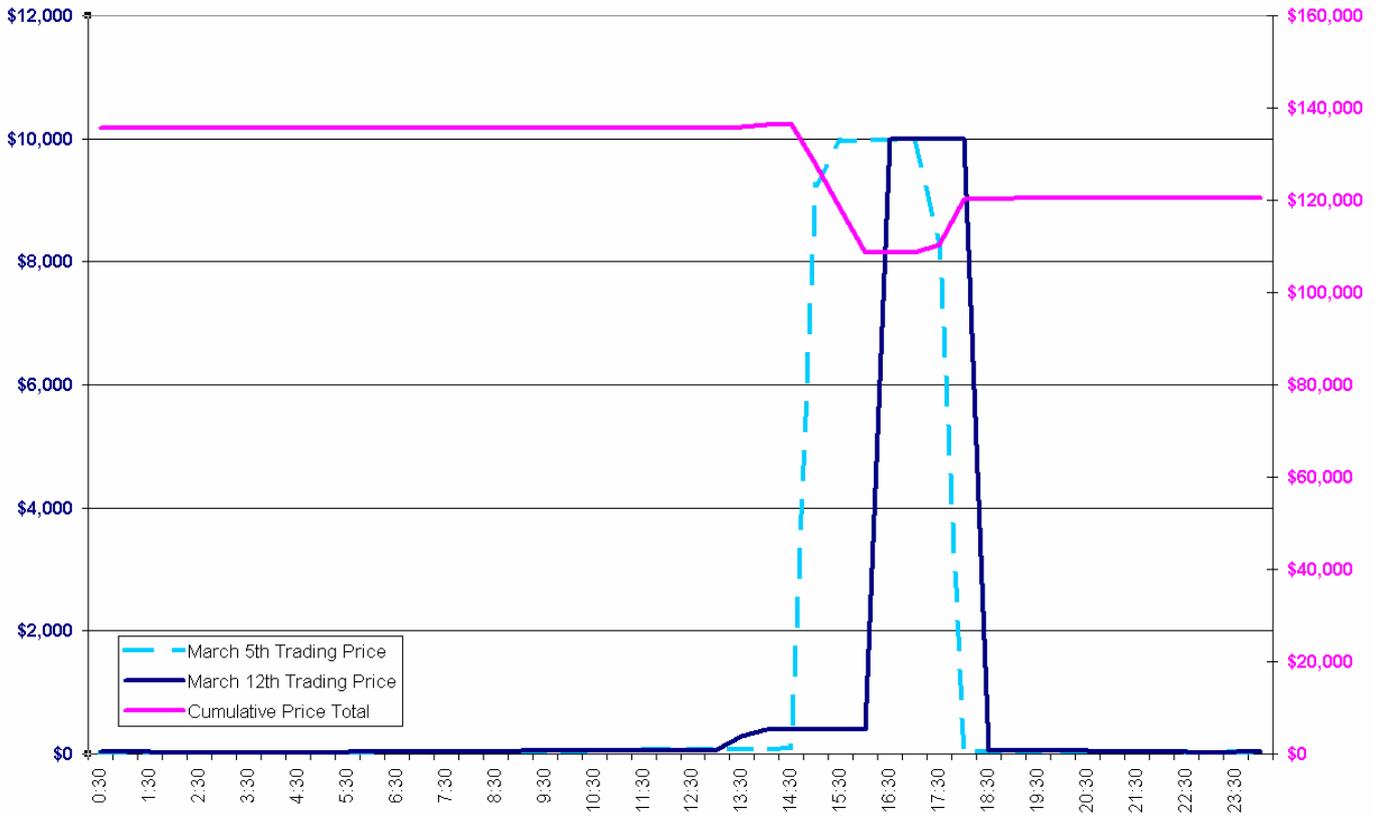
### **(D) 12<sup>TH</sup> MARCH**

On the 12<sup>th</sup> the Cumulative Price began to fall as the inflationary pressure of the 5<sup>th</sup> began to reduce (as the Cumulative Price is the 7 day rolling total of prices).

However, after a short fall, lightning activity saw the constraint limit on the Heywood AC link reduced, resulting in the South Australian trading price rising again.

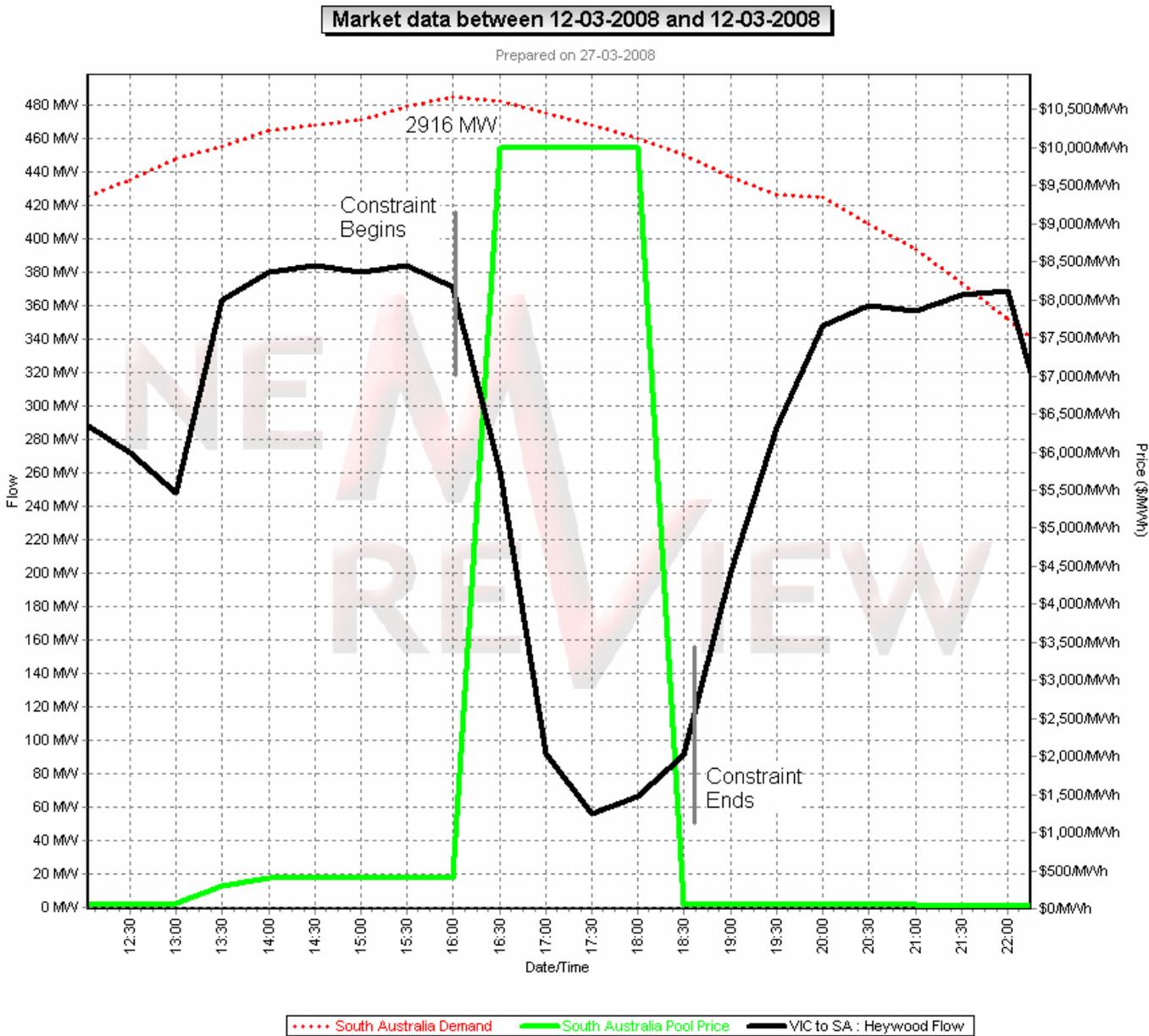
Note in the following graph I have added the price of the 5<sup>th</sup> (in light blue) to show how its effects on the CPT dropped off before higher prices set in:

Figure 8:



A simple graph in NEM-Review shows what effect the constraints on the Heywood interconnector had on the South Australian trading price:

Figure 9:



Analysis produced with NEM-Review

[www.nem-review.info](http://www.nem-review.info)

In this case there were no major drops in generator output; rather the price spike was mainly due to the **loss of access to 300 MW of cheap power.**



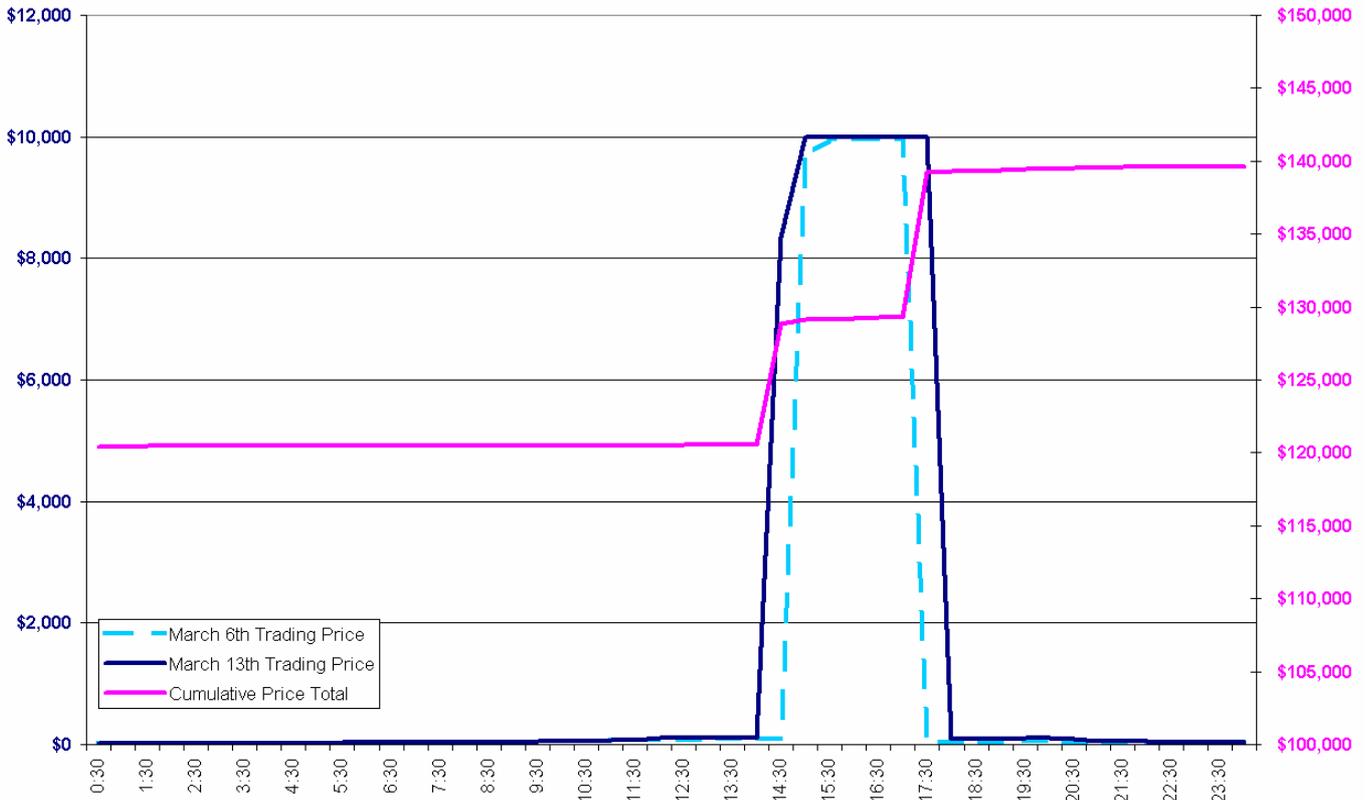
### (E) 13<sup>TH</sup> MARCH

A demand of 2927 MW on Thursday the 13<sup>th</sup> of March broke previous records. Being also 5 days after the price spike on the 6<sup>th</sup> this afforded generators in South Australia another chance to withhold capacity and drive up wholesale prices.

As before I have shown the price rise of the 6<sup>th</sup> in light blue to show how it affected the Cumulative Price on this day. Its age had the effect of creating almost \$50,000 of downward pressure on the Cumulative Price, however, seven trading periods with prices over \$8,000/MWh had the effect of cancelling this out with \$68,350.80 of upward pressure.

In all the Cumulative Price rose by \$19,201.21 .

Figure 10:

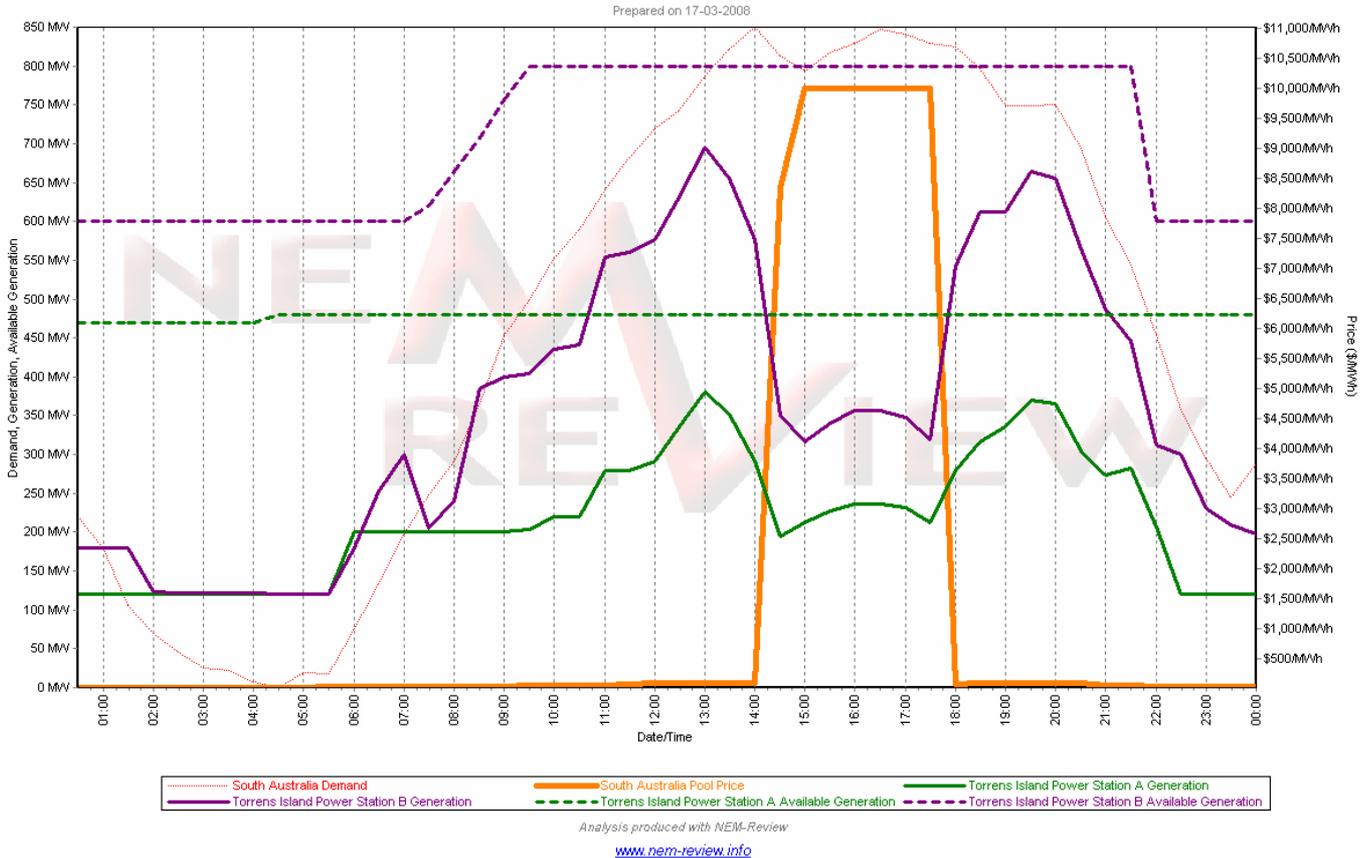


As before the price increase was mainly due to the **economic withholding of capacity**.

In the following graph I have contrasted station's available capacity (which was constant during peak demand hours) with their actual output to show how their bidding affected the price:

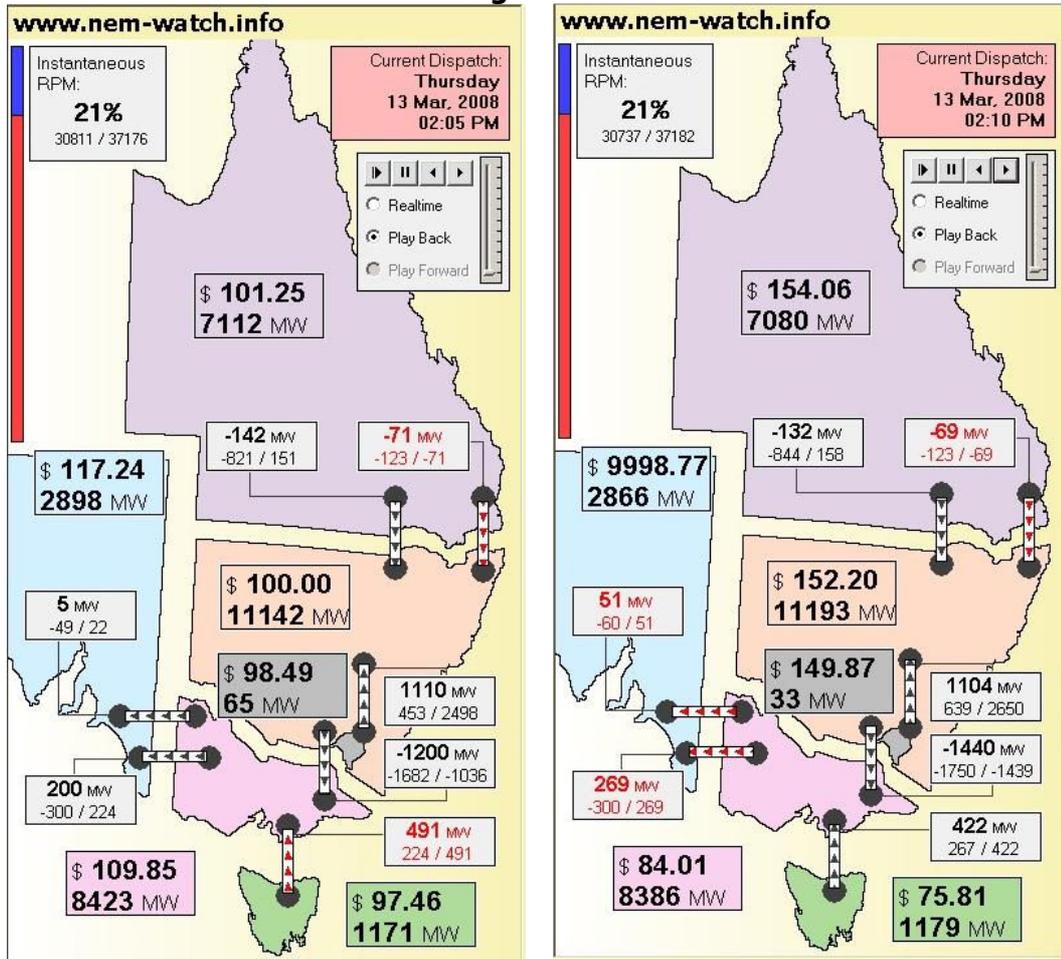
**Figure 11:**

**Market data between 13-03-2008 and 13-03-2008**



This bidding pattern resulted in extremely volatile price activity in South Australia. The following screenshots show the South Australian energy price jump from \$117 (at 14:05 NEM time) to \$9998 (at 14:10 NEM time) in a single 5 minute dispatch period - an 850% increase.

Figure 12:



In converse fashion, when the high price period ended 3 hours and 20 minutes later the price dropped from \$9999 to \$78 in five minutes.

AGL's ability to control the South Australian market can be partly attributed to the low capacity of the SA to VIC (Heywood) interconnector:

- 1) When the interconnector is at capacity no more cheap power can be imported from Victoria, limiting competition, so that a South Australian bidder must set the price for power.
- 2) When this occurs South Australia is effectively "Economically Isolated" from Victoria and the rest of the NEM – meaning some power still flows across the interconnector, but the moderating effect of prices to the east is temporarily removed.

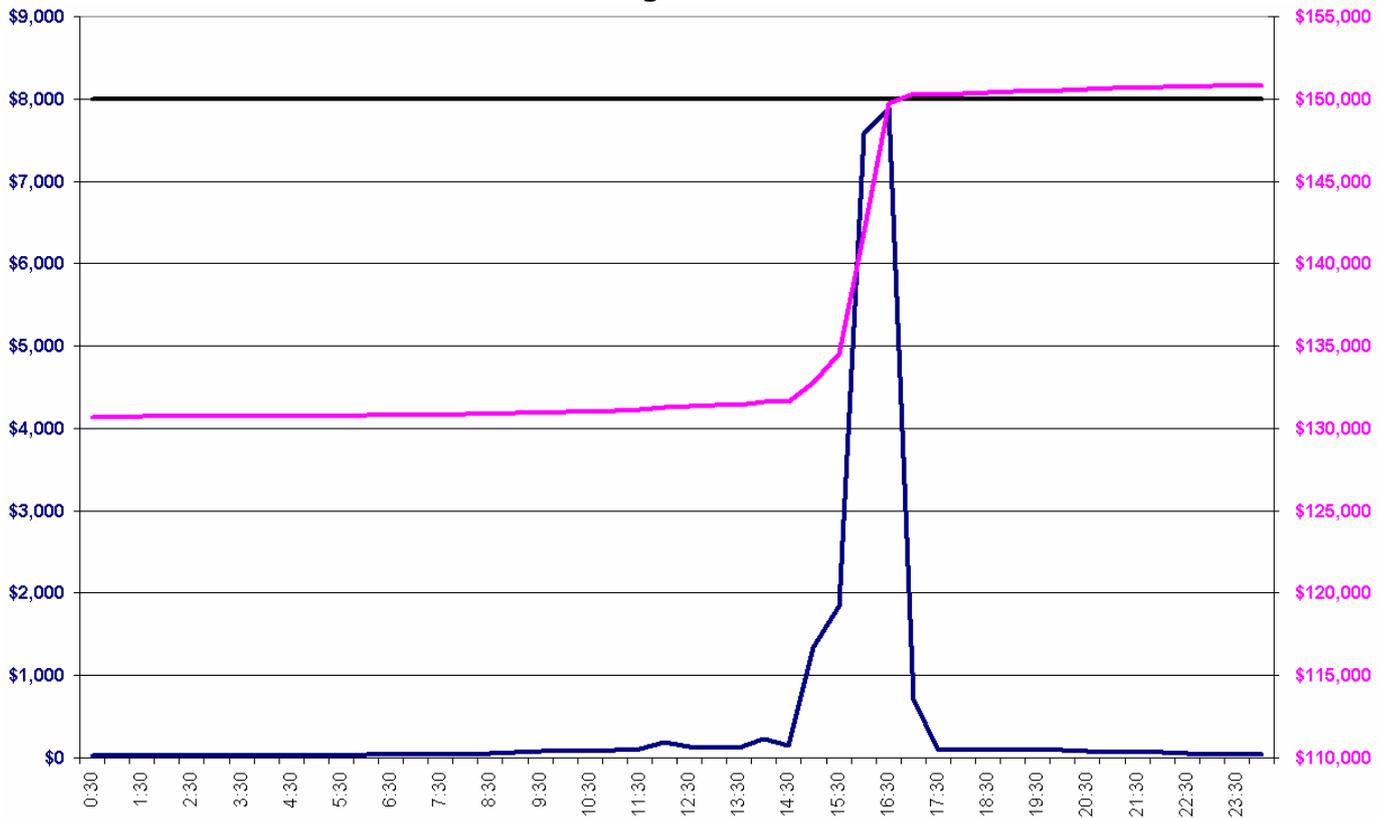
## (F) 17TH MARCH (APC ADMINISTERED)

The 17<sup>th</sup> of March was the first time that South Australian demand surpassed 3000MW (setting a **new record of 3080 MW**) causing it to rely on imported energy via Heywood.

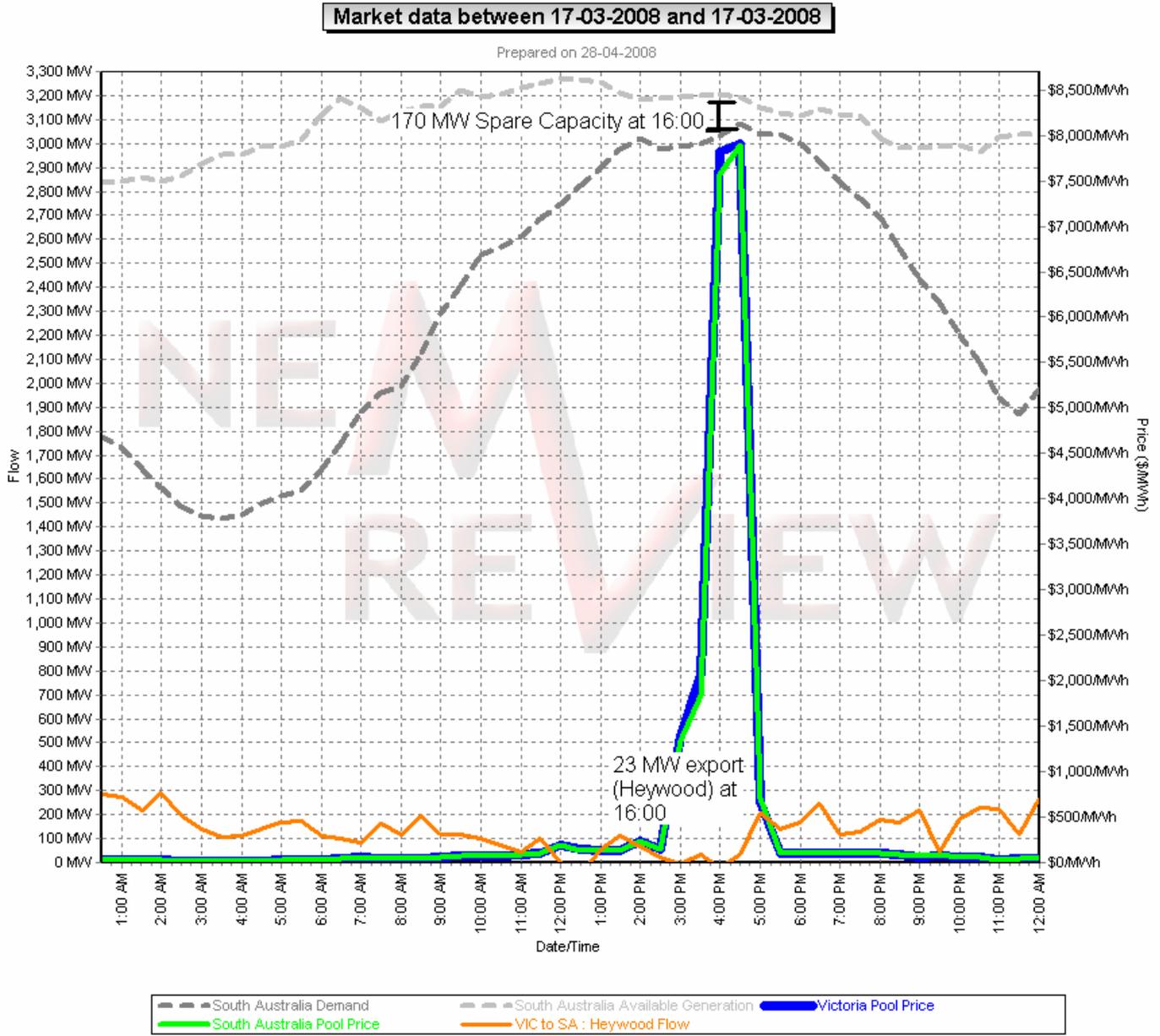
Unfortunately for SA generators other states in the NEM were also experiencing high prices due to the eastward movement of the weather that had caused South Australia's high temperatures. **Victoria set a new demand record of 9818 MW.** Thus the Cumulative Price passed the \$150,000 Threshold during the 17:00 dispatch interval and NEMMCO issued an Administered Price Cap.

The movement of the CPT on the 17<sup>th</sup> is shown here:

Figure 13:



South Australian and Victorian prices were very closely bound during the 17<sup>th</sup>, such that during the height of South Australian demand the Heywood Interconnector was exporting 23 MW even as the spare generation within the state dropped to only 91 MW!



Analysis produced with NEM-Review

[www.nem-review.info](http://www.nem-review.info)

**Figure 14:**

Pelican Point, Northern, and Torrens Island power stations were all running above 90% utilization during this peak period.

We use the term "Economic Island" to describe a set of regions that are economically separated from the rest of the NEM due to interconnector constraints



(meaning that the price in an Economic Island must be set by a bidder in that Island). We can calculate the IRPM of an Economic Island as follows:

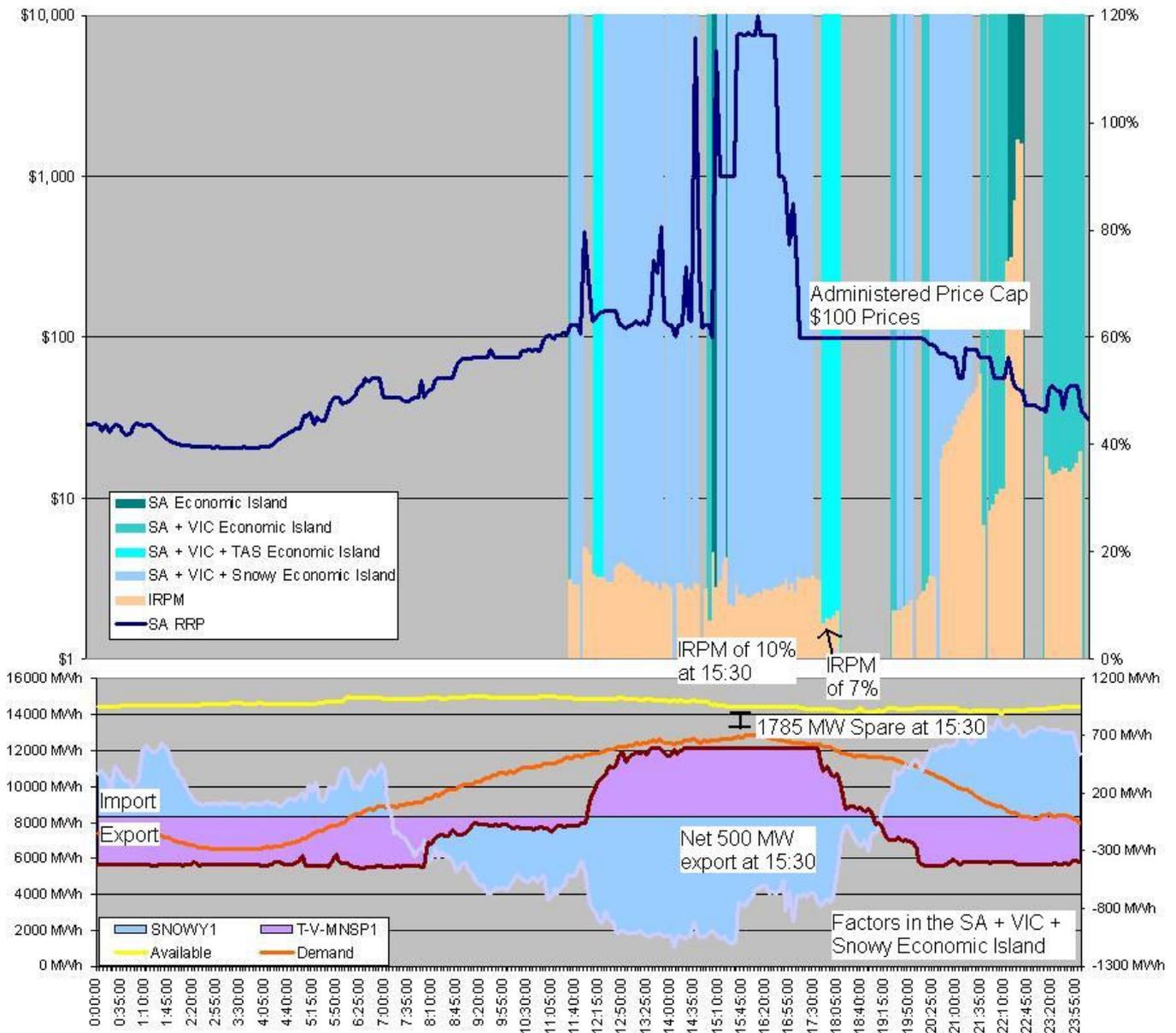
$$\frac{\text{Capacity} - (\text{Demand} + \text{NetExports})}{\text{Demand} + \text{NetExports}}$$

South Australia was part of several Economic Islands during the 17<sup>th</sup>.

The following graph shows the Economic Islands that were in place (and the corresponding IRPMs) when the Snowy1, V-SN, or V-SA interconnections were constrained. It also includes the factors impacting on the SA+Victoria+Snowy Economic Island which was in place for most of the high price incidents of that day.



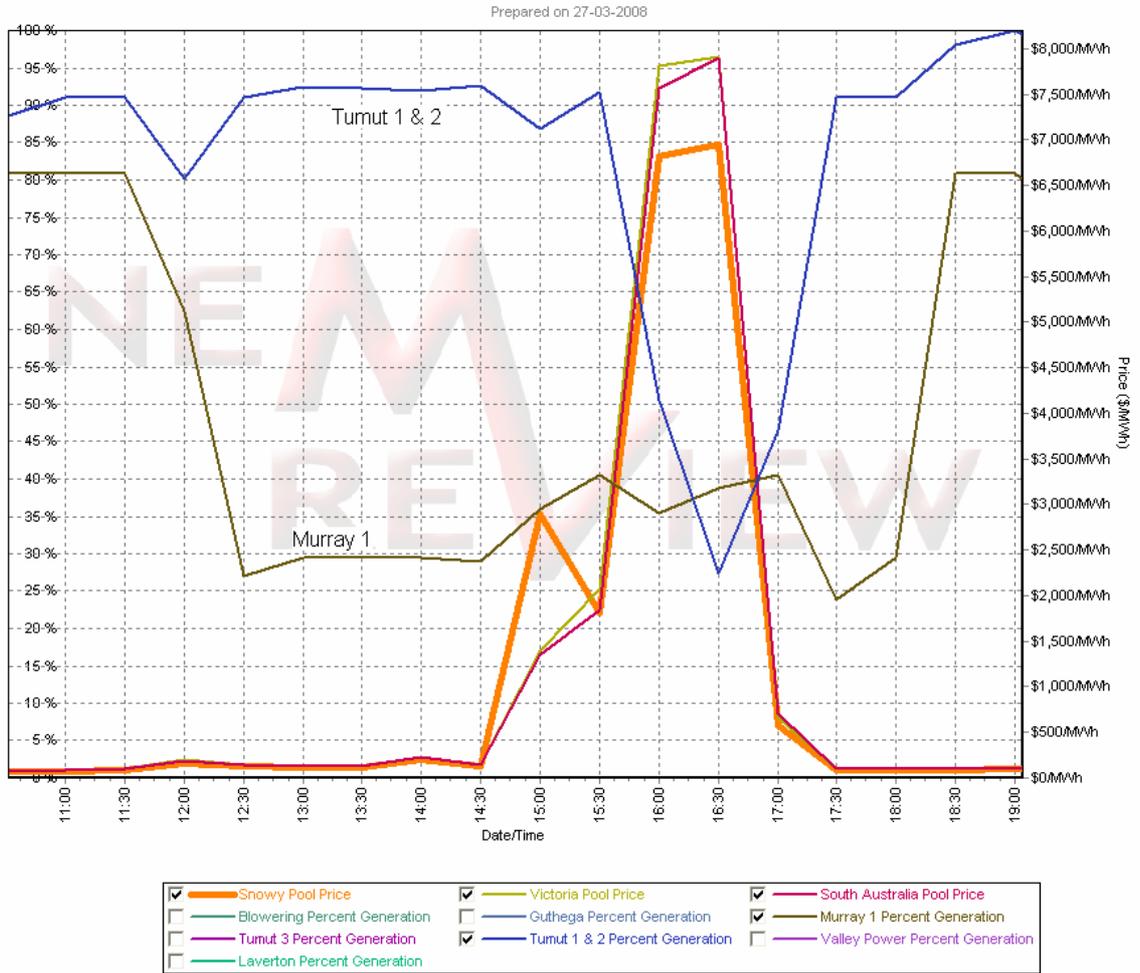
Figure 15:



Along with high demand, it appears that 2 stations in the Snowy region economically withheld capacity – Murray 1 and Tumut 1 & 2 bid almost 75% of their capacities at or above the \$7000 Snowy Trading Price. This accounts for 1,358MW of unutilized capacity.

**Figure 16:**

**Market data between 17-03-2008 and 17-03-2008**



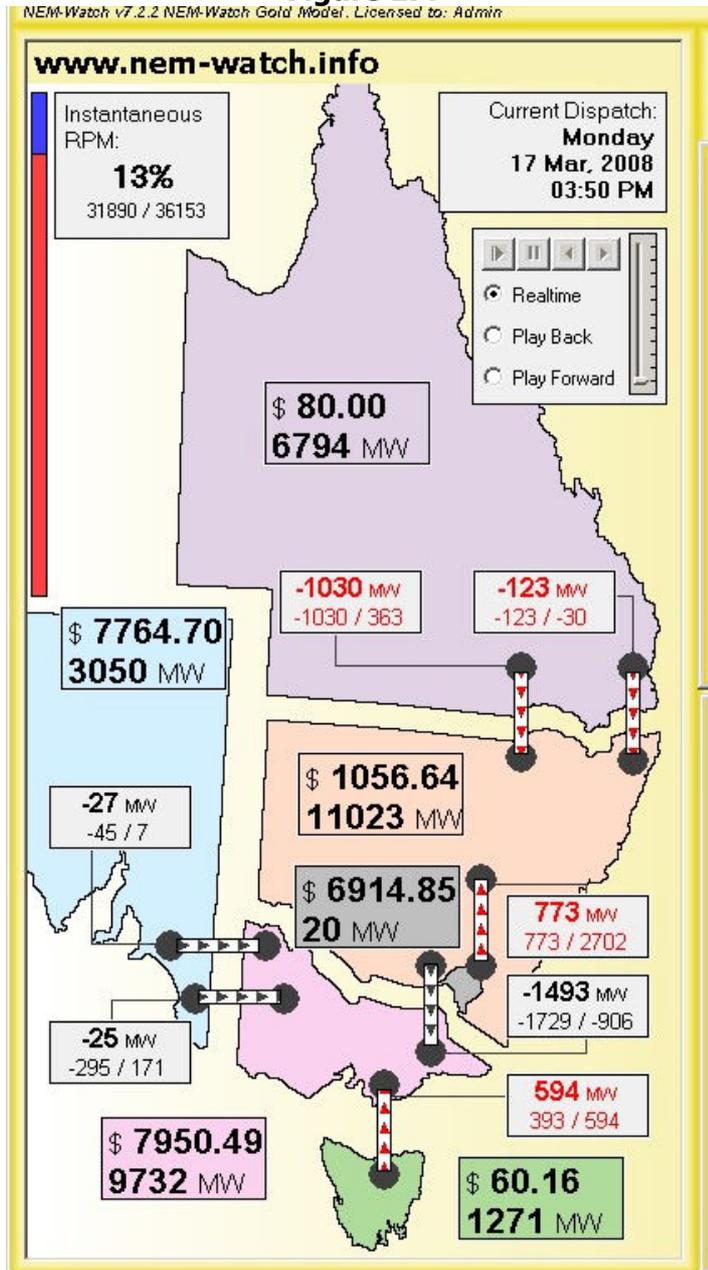
Analysis produced with NEM-Review  
[www.nem-review.info](http://www.nem-review.info)

These stations drove up Snowy’s power price upon which South Australia and Victoria relied (they had an 1850MW deficit).

The combined effect was high prices across several regions of the NEM. Below is a screenshot of NEM-Watch, showing the high price event:



**Figure 17:**



Then, immediately after the Cumulative Price surpassed \$150,000 , prices were capped at \$100 in South Australia. NEMMCO Issued the market notice for this event at 5:04 pm (updated through NEM-Watch).

From : NEMMCO  
To : NEMITWEB1  
Creation Date : 17/03/2008 17:04:06

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Notice ID : 20898  
Notice Type ID : ADMINISTERED PRICE CAP  
Notice Type Description : Administered price periods declared.  
Issue Date : 17/03/2008  
External Reference : ADMINISTERED PRICE PERIOD in South  
Australia Region - 17 March 2008

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Reason :

NEMMCO MARKET NOTICE

ADMINISTERED PRICE PERIOD in South Australia Region

The sum of the spot prices for the last 336 trading intervals in South Australia Region has exceeded the cumulative price threshold of \$150000. Therefore NEMMCO has determined that an Administered Price Period will apply from 17:30 Trading Interval 17 March 2008, until further notice in accordance with NER CI 3.14

An Administered Price Cap will apply during this period and will be \$100/MWh between 7am (07:30 trading interval) and 11pm (23:00 trading interval) on working days and \$50/MWh at all other times. This cap price will apply to Energy dispatch prices and to all Market Ancillary Service Prices in the South Australia Region.

Similarly an Administered Price Floor will apply during this period and will be -\$100/MWh between 7am (07:30 trading interval) and 11pm (23:00 trading interval) on working days and -\$50/MWh at all other times. This floor price will only apply to energy prices in the South Australia Region (Market Ancillary Service Prices are limited to a minimum price of \$0/MWh at all times).

Dispatch prices in adjacent Regions will be automatically adjusted in

accordance with NER CI 3.14.2(e).

NEMMCO will monitor the sum of the spot prices and issue a further Market Notice when the Administered Price Period is ended.

Bob Rigoni  
Power System Operations Manager

The APC was lifted for the 4:00 trading interval on the 19<sup>th</sup> after the CTP fell below \$150,000 and pre-dispatch data forecasted it would not exceed this again in the next business day.

## **5) Summary of Observations**

On the 17<sup>th</sup> of March, the last day of a 15 day historic heat wave, the Cumulative Price rose above \$150,000 (the Cumulative Price Threshold) for the first time since the inception of the NEM (more than 9 years ago). As a result, NEMMCO administered price caps (as required under the market rules).

The high prices that caused the Cumulative Price to reach the Threshold occurred due to:

- 1) Extreme demand in South Australia over the period of the heat wave stretched available capacity;
- 2) Selective "Economic Withholding of Capacity" on the part of some generators helped the Cumulative Price remain high for much of the period;
- 3) The progression of the hot weather into Victoria brought with it huge demand in that region as well, stretching capacity in both region and driving prices high due to local shortages – hence triggering the APC as South Australian generators lost control of their trading strategy.

However, this was not without its reward as, according to the Australian Financial Review (18/3/2008), AGL generated an extra \$60 million in revenue during the heat wave. We estimate that Pelican Point and Northern stations made over \$64 and \$68 million dollars respectively during the heat wave.