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Cap Values - Trends & Drivers

By Stephen Weston

The purpose of this article is to make some observations on the historical value of caps in the NEM, to note and comment on the trends in these values and how they compare to quoted prices and to look at the drivers of cap values in the Victorian region in a bit more depth.

First some preliminaries

By historical value we refer to the unitised cap payout. In this article we calculate this payout over past calendar years and quarters for the various NEM regions. The unitised cap payout is calculated for any specified period of time by summing the positive differences between the relevant spot price and cap strike price and dividing by the number of trading intervals (half-hours) in the specified period. We also define an event as a day in which the strike price is exceeded for at least one trading interval.

In our analysis we consider caps with a strike price of $300/MWh.

Trends

Figures 1 to 3 show the trend in three statistics – cap value (unitised cap payout), number of events, and value per event for the New South Wales, Queensland, Victorian, and South Australian regions of the NEM.

Figure 1 Annual Cap Value (Unitised Payout)

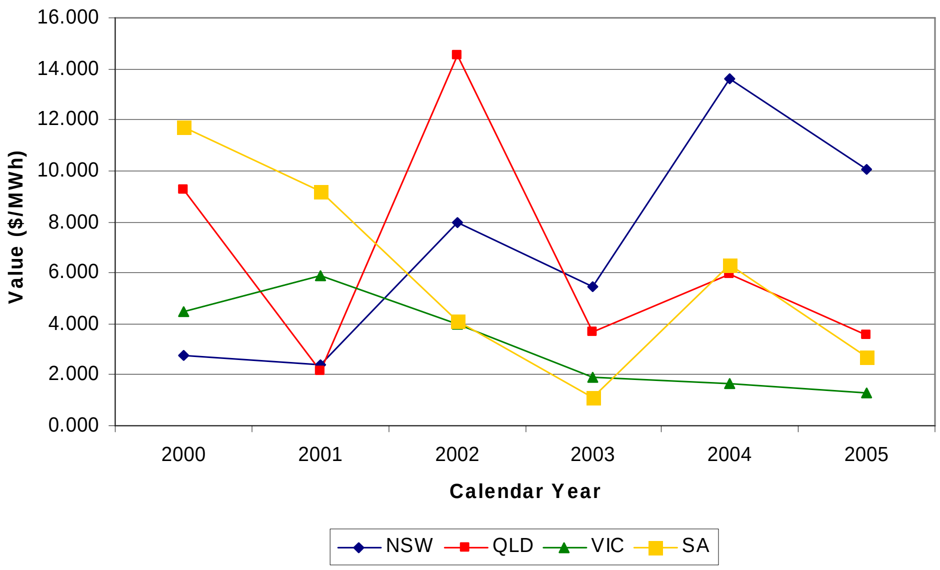

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Figure 1 shows that on an annual basis, historical cap values have ranged between $1.11/MWh in South Australia in 2003 to $14.55/MWh in Queensland in 2002. Victoria has averaged the lowest cap value of all the NEM regions. The trend over the period analysed has been towards lower values in Queensland, Victoria and South Australia, and higher values in New South Wales.

Figure 2 shows trends in the number of events. It is evident that the number of events has reduced over the last three years.

Figure 2 Number of Events

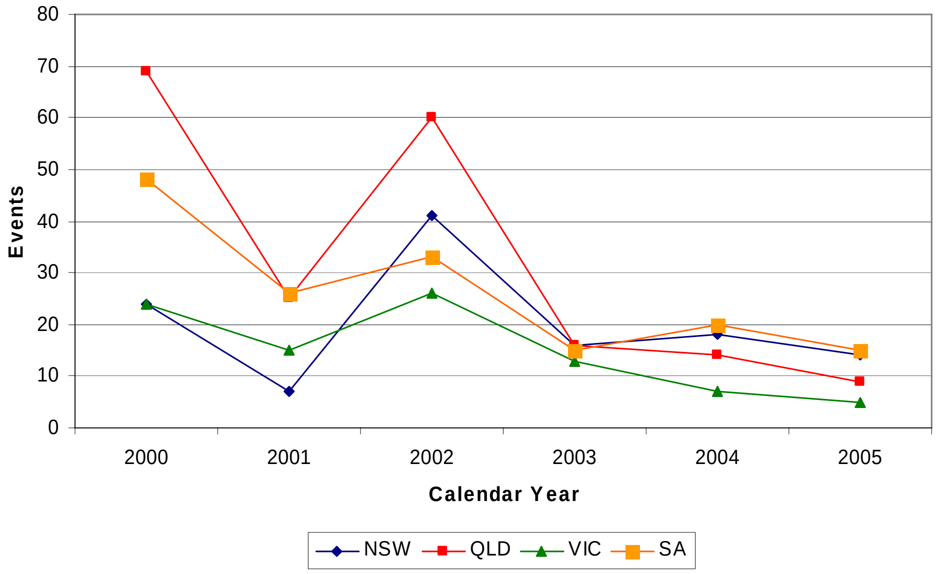

Figure 3 depicts the average value per event. When viewed in conjunction with Figure 2 it is clear that while the number of events has decreased there has been an increase in the value per event. This is most marked in New South Wales but also evident in Queensland. A contributor to the increase in value per event is the increase in the value of the market price cap from $5,000/MWh to $10,000/MWh from 2002.

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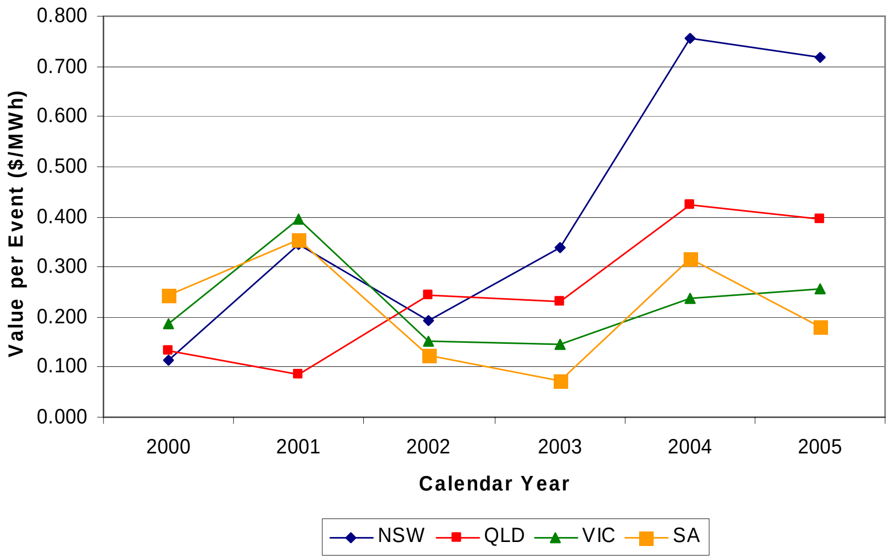
Figure 3 Value per Event



Forward prices for Caps

We next consider quoted prices for caps (June 2006)[1] and compare these to the average value over the historical period in Table 1.

Table 1 Quoted prices for caps compared to historical values

Statistic	NSW	QLD	VIC	SA
Average value	7.04	6.52	3.20	5.87
Price 2007	10.50	9.00	5.35	8.60
App Premium	3.46	2.48	2.15	2.73
STDEV	4.38	4.66	1.87	4.02
k	0.79	0.53	1.15	0.68

It is evident that in all regions, the 2007 price is quoted at a positive premium to the average value over the historical period. This apparent premium can be interpreted in a number of ways including for example as a market consensus of tightening supply. However we will make the assumption that the expected value for 2007 is the average historical value and apply a simple pricing model as follows:

$$P = EV + k\ STDEV$$

[1] Cap prices have subsequently increased and as at 13 September 2006 are $12.25 in NSW, $9.25 in QLD and $7.75 in VIC. It is understood that this has been in response to energy shortages foreshadowed for the Snowy Scheme.

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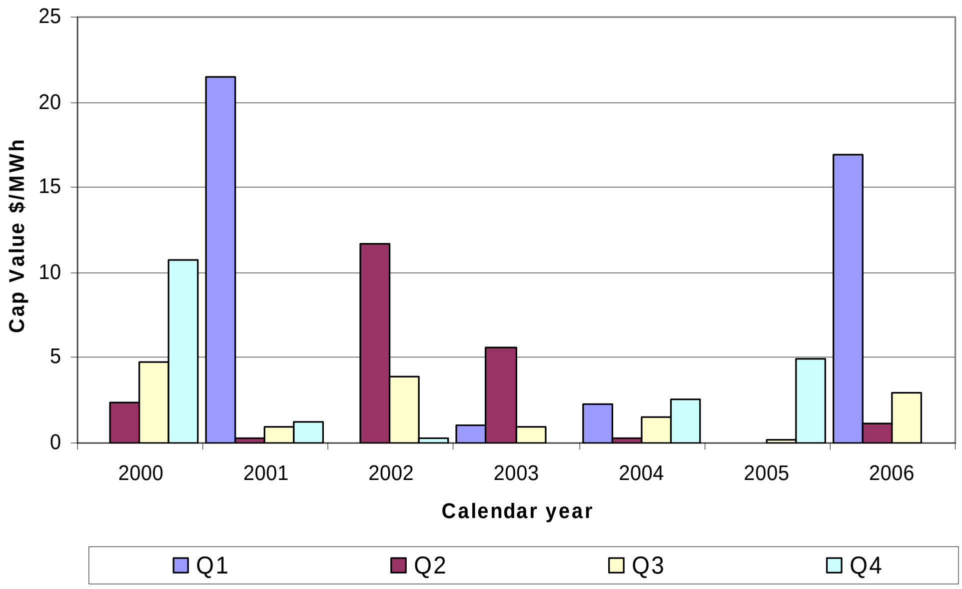
Where P is the cap price, EV and STDEV are historical expected value and standard deviation of the cap value respectively, and k is a volatility multiplier.

The model is motivated by the consideration that buyers of the cap will pay expected value and a premium for volatility. It is evident that in absolute terms, the Victorian region provides the lowest premium to historical value. This is consistent with Victoria exhibiting the lowest price volatility (on an annual basis). In terms of the simple pricing model, the volatility multiplier (k) is significantly higher than for the other regions. This suggests that the Victorian contract might be overpriced or alternatively that the Victorian region is liable to surprise. In support of the "overpriced thesis" one might point out that despite consolidation, the Victorian region remains highly competitive in generation, and following the commissioning of Basslink is the most highly interconnected region. In support of a "fair priced" thesis one might simply point to the Q1 2006 outturn, some aspects of which we consider later.

Perhaps what does loom large in the minds of those pricing Victorian caps is the spectre of Q1 2001 (Figure 4).

Figure 4 Quarterly Cap Values – Victoria 2000 – Q3 2006



As the graph shows, the value of the cap for the first quarter (Q1) of 2001 was $21.52/MWh. Subsequent Q1 outturns were nothing to speak of until $16.88 in Q1 2006. Q1 continues to evoke visions of searing heat waves, record peak demand, and heat and bush fire affected de-rating of generation and transmission capacity. The question is what probability weighting or likelihood do we attach to another Q1 2001?

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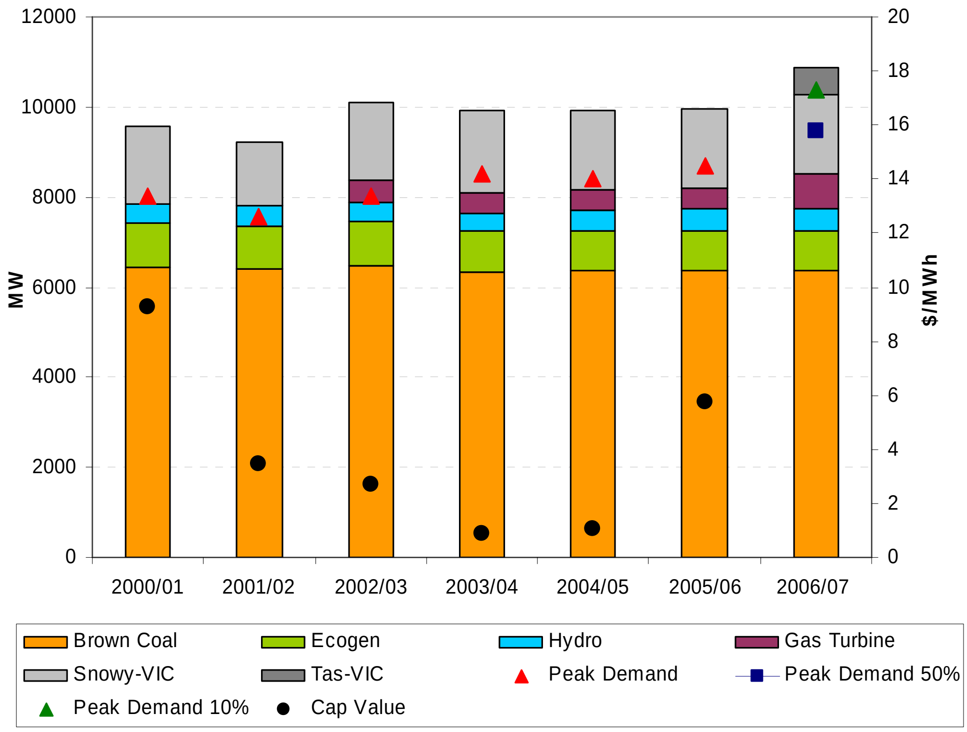
We pursue our enquiry by looking at the supply and demand balance, the number of very hot days, and generator behaviour in terms of the pricing and volume of dispatch offers.

Supply and Demand Balance

Theoretically, a tightening of supply and demand balance should result in higher cap values which provide an investment signal for new peaking plant. Figure 5 shows the historical trend in supply capacity (installed generation capacity and interconnect capacity since 2000/01) for the Victorian region. Note that owing to the likelihood of coincident high demand in Victoria and South Australia, we do not include interconnect capacity with South Australia. We overlay Victorian peak demand and the historical value of the $300/MWh cap.

Figure 5 Supply Margin and Cap Values



In Figure 6 we provide a scatter plot of supply margin (supply capacity less peak demand) and cap value. There is a very small negative correlation (-0.09) but clearly no obvious relationship between supply margin and price signal. Of course it could be argued that the problem is one of timeframe and that investment has occurred in response to the price signal provided in 2000/01. It could also be argued that comparatively supply was not particularly short in 2000/01 and that the proponents of subsequent investment did not adequately adjust for the special events of 2000/01 including temporary problems with plant availability and anomalous generator behaviour.

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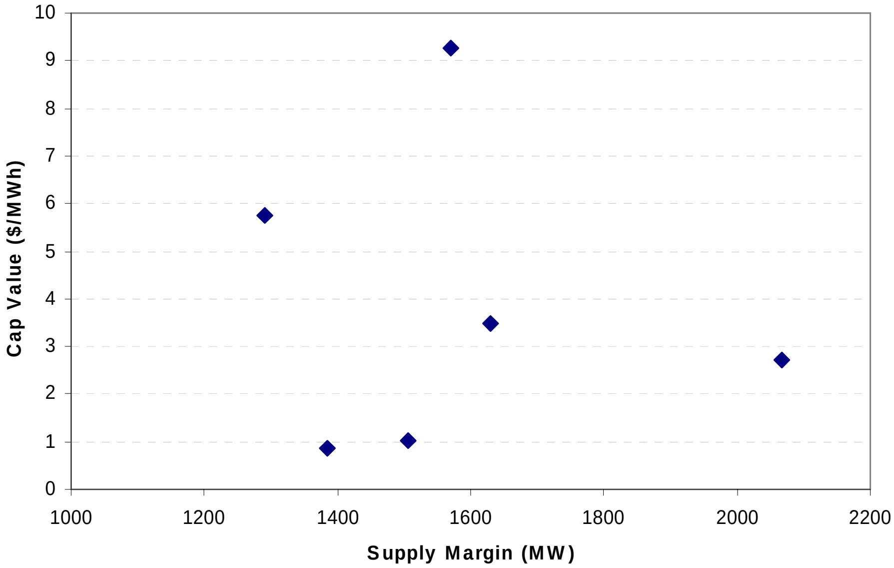
Figure 6 Scatter Plot – Cap Value and Supply Margin



The number of very hot days

Figure 7 shows the response of Victorian demand to temperature. The profiles shown are based on a number of working days in February and March 2005. The maximum temperature reached on each of these days is shown in the legend. Other things being equal (i.e. for the same plant availability and offer price stack), we should expect the hottest days to give rise to the highest maximum demand and thence the highest maximum half-hourly and daily average pool prices.

Figure 7 Victorian Demand and Maximum Daily Temperature

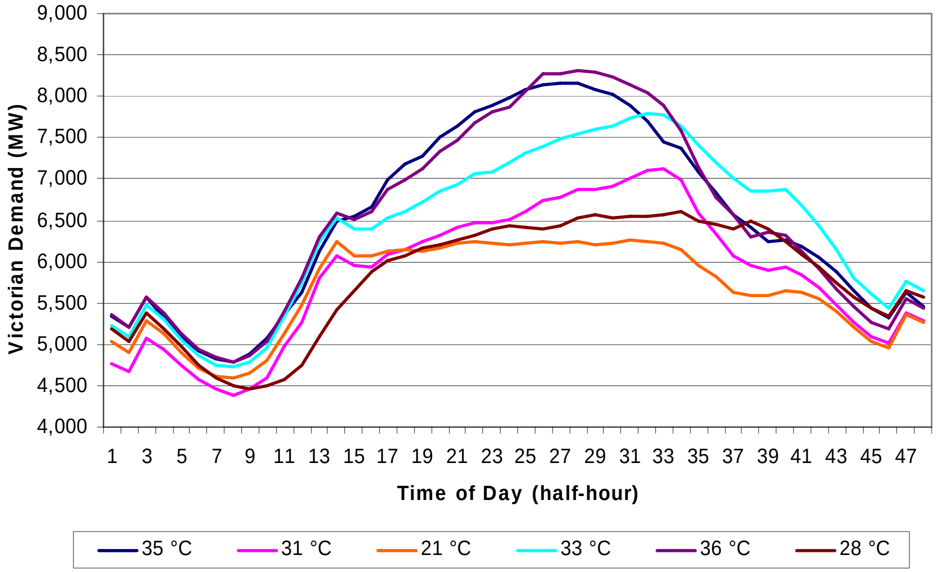


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Table 2 explores the relationship between high price days and high temperature days.

Table 2 High Price Days and High Temperature Days

YEAR	P	T30	T35	T40	PT30	PT35	PT40	PT30/T30	PT35/T35	PT40/T40
2000	24	35	11	0	2	1	0	6%	9%	0%
2001	15	34	15	1	9	7	0	26%	47%	0%
2002	26	31	11	0	0	0	0	0%	0%	0%
2003	13	37	12	2	5	2	0	14%	17%	0%
2004	7	26	6	3	3	2	2	12%	33%	67%
2005	5	38	8	1	4	2	1	11%	25%	100%

In the above table P denotes the number of days on which the maximum price was greater than $300/MWh (high price days), T30 denotes the number of days on which the maximum temperature exceeded 30 degrees, PT30 is the number of days on which the maximum temperature exceeded 30 degrees and the maximum price was greater than $300/MWh and PT30/T30 is the conditional probability of a high price day given a high temperature day or alternatively the "conversion efficiency" of high temperature days to high price days. The same analysis is undertaken for days with maximum temperature exceeding 35 degrees and 40 degrees.

Clearly because demand increases with temperature, other things being equal we have good reason to expect this conditional probability or "conversion efficiency" to increase with temperature[2]. Small sample issues aside this is exactly what we do see.

The table shows that 2001 actually had considerably fewer high price events than 2000 or 2002, however the events that it did have were characterised by higher prices. The table also shows clearly that the high price events in 2001 had a lot more to do with high temperatures than in 2000 or 2002. Did 2001 have more hot days? This depends on how we define our hot day threshold. Based on a threshold of 35 degrees, the answer is yes – a few more than in any of 2000, 2002 and 2003. The years 2004 and 2005 had considerably less. How about conversion efficiency? In 2001, nearly half of the days with a maximum temperature greater than 35 degrees were converted into high price days compared to the next highest efficiency of a third in 2004.

Generator Behaviour

With respect to spot price outcomes, the shape of the supply curve is of greater relevance than the available capacity or supply margin. Of course as supply margin is reduced it is likely that there will be less competition to supply the marginal MW increasing the likelihood of higher prices.

[2] A more comprehensive analysis would separate days into working and non-working days.

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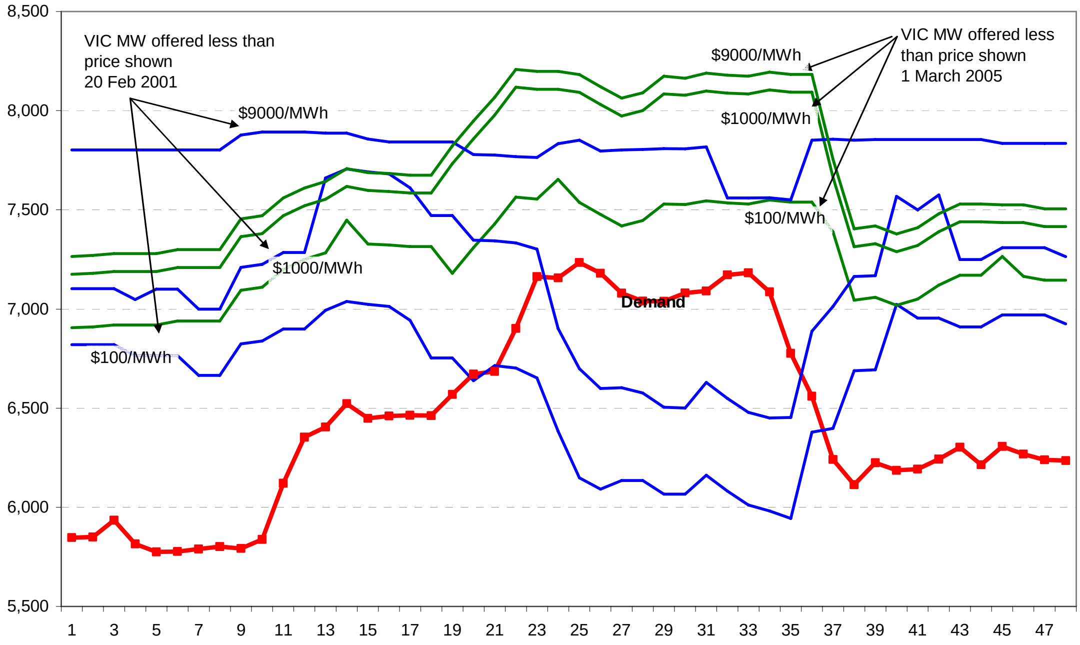
However given that demand is supplied, price outcomes will depend on the way generators price their dispatch offers. This point is supported by the analysis presented in Figure 8 which compares the total MW offered between specified price levels on two Q1 hot days in 2001 and 2005 respectively. The demand shown is the demand on 1 March 2005. On the day in 2005 the amount of capacity offered at less than $100/MWh is higher during the high demand period of the day. By contrast on the day in 2001 it is reduced by more than 1000MW. By inspection, the 2001 generator supply curve implies prices in excess of $1,000/MWh for the duration of the high demand period whereas the 2005 generator supply curve implies prices of less $100/MWh for this period.

Figure 8 Analysis of Dispatch Offers 2001 and 2005



In forming a view as to prospective future cap values, it will be relevant to consider to what extent the behavioural dynamics of 2001 were related to aspects of ownership and industry structure at the time, and whether the same imperatives and opportunities are likely to exist at the present time.

Quarterly Prices

Another interesting question is the relativity between prices for the various quarters.

Quoted cap prices have implied an expectation that the value in Q1 is nearly three times higher than Q4[3]. Is this reasonable? One test is as follows –

[3] Q1 2007 $13.00 and Q4 $4.20, 27 June 2006.

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Value ($) = average number of hot days x conversion efficiency x expected value per day x number of days in period.

If we assume that conversion efficiency and expected value per day is the same in the different quarters and that non-working days will not be converted the ratio of interest is

WDQ1 x ANHDQ1 / WDQ4 x ANHDQ4

Where:

> WDQ1 and WDQ4 are the number of working days in Q1 and Q4 respectively.
>
> ANHDQ1 and ANHDQ4 are the average number of hot days in Q1 and Q4 respectively.

The values of ANHDQ1 and ANHDQ4 can be calculated by information published by the Bureau of Meteorology which summarises the average number of hot days (over 149 years of history in the case of Melbourne) for different maximum temperature thresholds by month. This information is presented as Quarterly data in Table 3.

Table 3 Average number of days exceeding maximum daily temperatures

Max Daily Temp	Q1	Q2	Q3	Q4	All	All 6yrs
>30	19.6	0.5	0	9.6	29.7	33.5
>35	7.2	0	0	2.4	9.6	10.5
>40	1.1	0	0	0.2	1.3	1.2

Given that the number of working days in Quarters 1 and 4 are approximately equal the ratio reduces to ANHDQ1 / ANHDQ4 = 7.2/2.4 = 3. This is therefore consistent with market quoted prices referred to earlier[4].

Quarter 1 2006

Quarter 1 2006 cap value outturns were $16.88 in Victoria, $12.67 in New South Wales, $11.11 in South Australia, and $10.46 in Queensland. This could be taken to suggest that the market's insistence on primacy of Q1 cap value in Victoria has been vindicated.

During this quarter there were seven days in Victoria on which the maximum half-hourly price exceeded $300/MWh. Table 4 presents statistics relevant to the three highest days in terms of average price.

[4] It is noted that the ratio is currently nearly 6 as a consequence of the upward movement in the quoted value for Q1 2007 believed to be associated with foreshadowed Snowy energy shortages.

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Table 4 High Price Days in Victoria Q1 2006

Day	Average Price (VIC)	Max HH Price (VIC)	Max Temp (MEL)	Average Price (SA)	Average Price (NSW)
24 Feb	662.53	9134.14	36.5	60.55	31.26
26 Jan	344.12	7416.16	39.6	359.28	23.19
23 Feb	343.95	6997.03	35.1	183.87	23.74

Further details of these days are provided by the displays shown as Figures 9 to 11 which were created using the IES market data visualisation software NEO.

Briefly these high price outcomes were associated with high temperature and high demand. Interestingly the New South Wales average price was low on each of these days suggesting limitations on available transfer capacity to Victoria which was indeed the case on 23 and 24 February. The outcomes of these days demonstrate the reliance of the Victorian region on imports from Snowy.

Figure 9 24 February 2006

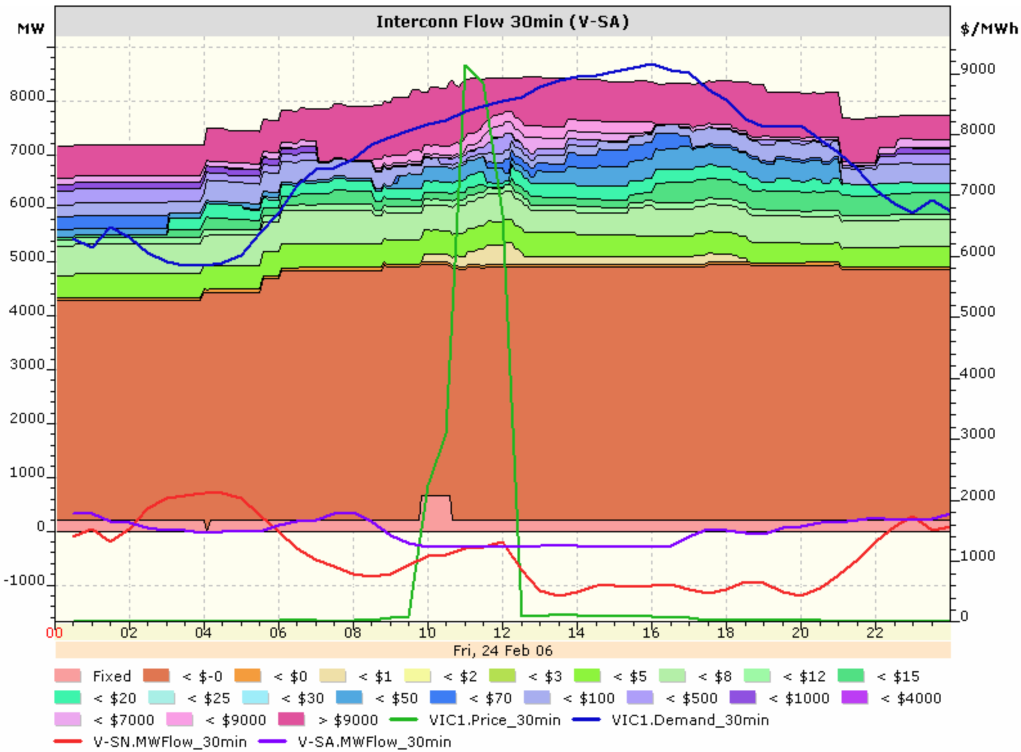

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Figure 10 26 January 2006

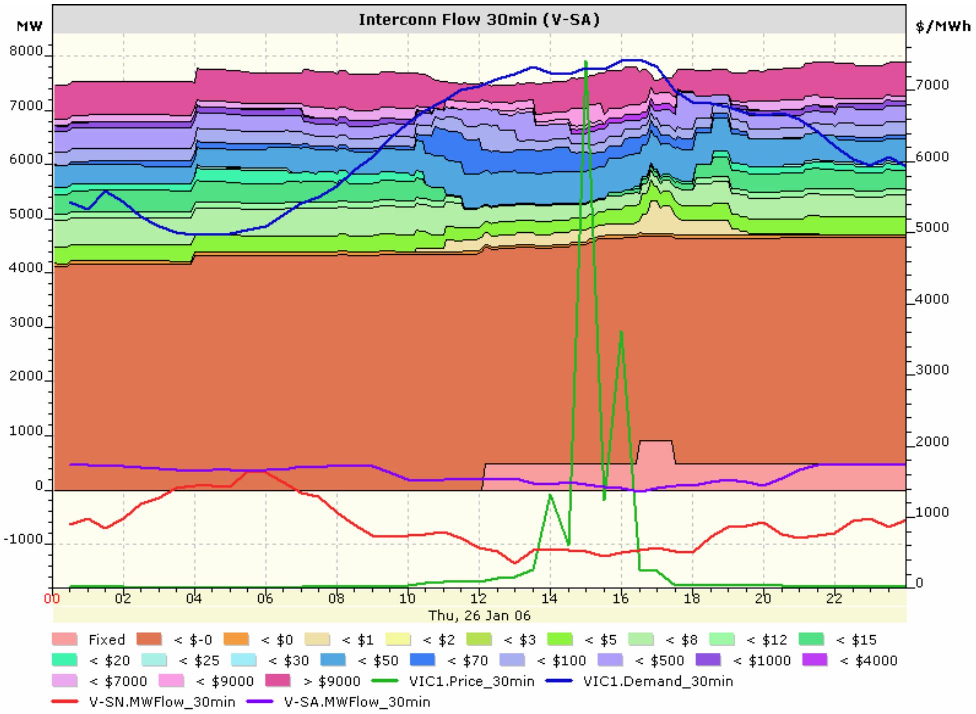
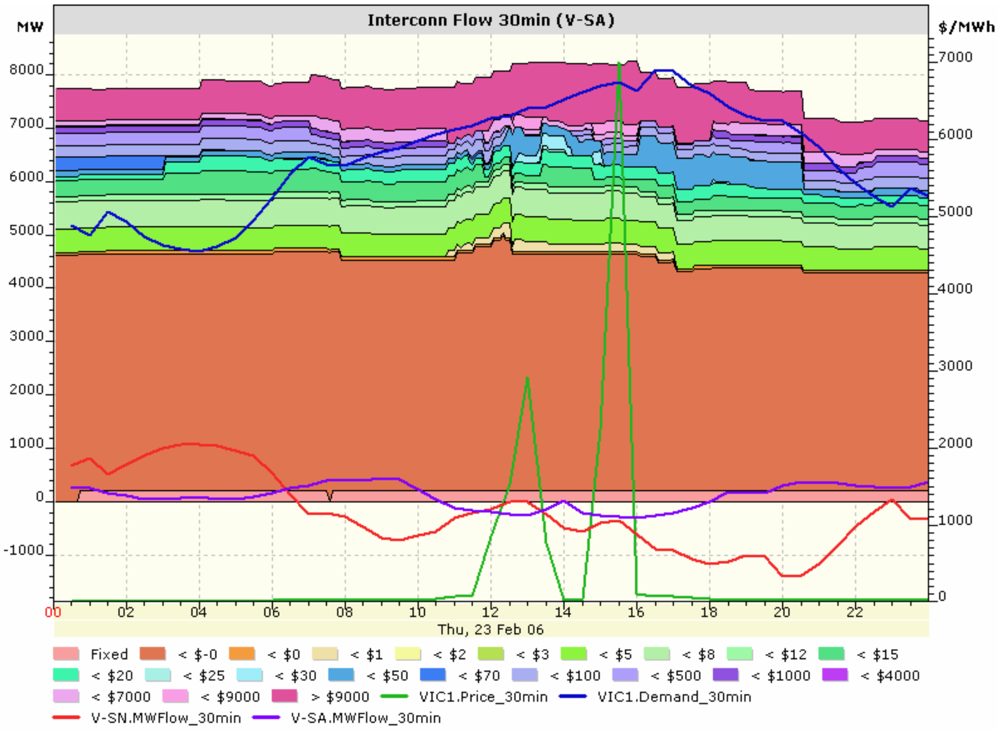


Figure 11 23 February 2006



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Conclusions

In any year the value of high strike price caps (we have considered the $300/MWh strike price cap) depends on the occurrence of a relatively small number of high price events. The number and intensity of these events is related to the balance between supply and demand. However this fundamental relationship can be dominated by generator behaviour and weather and plant availability outturns. For these reasons cap values are highly volatile and uncertain.

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