

# Electricity spot prices above \$5000/MWh

20 December 2013  
New South Wales



AUSTRALIAN ENERGY  
REGULATOR

## Introduction

The AER is required to publish a report whenever the electricity spot price exceeds \$5000/MWh.<sup>1</sup> The report:

- describes the significant factors contributing to the spot price exceeding \$5000/MWh, including withdrawal of generation capacity and network availability;
- assesses whether rebidding contributed to the spot price exceeding \$5000/MWh;
- identifies the marginal scheduled generating units; and
- identifies all units with offers for the trading interval equal to or greater than \$5000/MWh and compares these dispatch offers to relevant dispatch offers in previous trading intervals.

## Summary

High temperatures across New South Wales (41 degrees at Olympic Park) on 20 December 2013 saw demand reach around 11 300 MW at 1.30 pm AEST and the spot price exceeded \$5000/MWh at 1.30 pm, reaching \$7696/MWh. As well as analysing the 1.30 pm high spot price, this report includes analysis of other high prices between 1.30 pm and 2.30 pm. The five-minute dispatch price exceeded \$5000/MWh eight times during this period, although the spot price (the price for the half-hour trading interval) only exceeded \$5000/MWh for the 1.30 pm trading interval.<sup>2</sup>

A combination of factors contributed to dispatch price exceeding \$5000/MWh from 1.05 pm to 1.25 pm. These factors included:

- High temperatures driving high demand in New South Wales. Hot Conditions prevailed across South Australia, Victoria and New South Wales during this period. Actual demand for the 1.30 pm interval was 561 MW higher than forecast four hours ahead and 314 MW higher than that forecast 12 hours ahead.
- A reduction in the available capacity in New South Wales by around 1200 MW due to physical reasons such as unplanned outages.
- Rebidding of around 1000 MW of capacity into high price bands in New South Wales.
- Network congestion in Victoria (and the response of generators to that network congestion) forcing electricity to flow from New South Wales to Victoria, increasing prices in New South Wales. The counter price flows on the VIC – NSW interconnector during the high priced period accrued around \$3 million worth of negative settlement residues.

<sup>1</sup> This requirement is set out in clause 3.13.7 (d) of the National Electricity Rules.

<sup>2</sup> Further analysis is provided in the 15 to 21 December Electricity weekly report on the [AER website](#).

This event is another example demonstrating the ability of generators to have a significant impact on interconnector flows, often resulting in counter-price flows (flows from a high-priced region to a low-price region). This issue was comprehensively explored in the AER's Special Report on Congestion.<sup>3</sup> In particular, CS Energy in Queensland, GDF Suez in South Australia and Snowy Hydro in Victoria and New South Wales all have generators which can materially affect interconnector flows.

## Analysis

### *Actual and forecast demand*

On Friday 20 December 2013, the temperature in Sydney reached nearly 34 degrees in the CBD and exceeded 40 degrees in the western suburbs. Demand reached 11 296 MW for the 1.30 pm trading interval and continued to rise across the afternoon, reaching 11 917 MW for the 4 pm trading interval. Table 1 compares the actual demand, available capacity and spot price in New South Wales with that forecast by AEMO four and 12 hours ahead of dispatch<sup>4</sup> between 1.30 pm and 2.30 pm.

**Table 1: Actual and forecast demand, spot price and available capacity in New South Wales**

Time	Price (\$/MWh)			Demand (MW)			Availability (MW)		
	Actual	4 hr forecast	12 hr forecast	Actual	4 hr forecast	12 hr forecast	Actual	4 hr forecast	12 hr forecast
<b>1.30 PM</b>	7696	58	55	11 296	10 838	11 019	12 255	13 153	13 645
<b>2.00 PM</b>	2458	62	56	11 501	10 955	11 116	12 333	12 658	13 932
<b>2.30 PM</b>	1271	63	57	11 635	11 009	11 171	12 333	12 658	13 932

Table 1 shows that both price and demand were higher than forecast 12 hours ahead and four hours ahead. Notably, the four hours ahead demand forecast was lower than the 12 hours ahead forecast but there was a slight increase in forecast price.

Available generation capacity at 1.30 pm was around 1400 MW less than that forecast 12 hours ahead and around 890 MW less than that forecast four hours ahead. A majority of the capacity withdrawn was previously at low prices. The rebids withdrawing capacity are detailed in Appendix A.

### *Constraints explanation*

Three constraints, two system normal and one financial, played a major role in the high prices in New South Wales on 20 December 2013:

- S>V\_NIL\_NIL\_RBNW — a system normal constraint preventing the overload of the North West Bend to Robertson 132 kV line (North West Bend to Robertson constraint). It only affects the Murraylink interconnector and has a constraint violation penalty (CVP)<sup>5</sup> of 360 as there is no contingency. Exports from Victoria to South Australia help relieve the constraint.

<sup>3</sup> See <http://www.aer.gov.au/node/18855> (and our submissions to the AEMC's Transmission frameworks review and PC inquiry into network regulation)(footnote all)

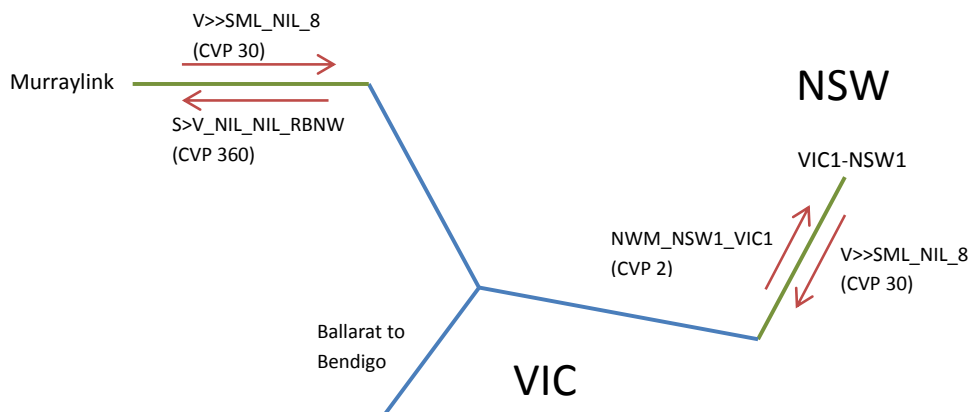
<sup>4</sup> Two of the listed three trading intervals had prices lower than \$5000/MWh but are included in this analysis for completeness.

<sup>5</sup> Constraint Violation Penalties act as multipliers on the market price cap to establish prices associated with violating each type of constraint. This ensures that NEMDE arrives at a physically feasible dispatch solution by violating conflicting constraints in a pre-defined priority based on their relative CVP prices. Constraints with the lower CVP will be violated first.

- V>>SML\_NIL\_8 — a system normal constraint managing the overloading of the Ballarat to Bendigo 220 kV line for the loss of the Shepparton to Bendigo 220 kV line in Victoria (Ballarat to Bendigo constraint). This constraint acts upon Murray Power Station and the Vic-NSW and Murraylink Interconnectors and has a CVP of 30. NEMDE optimises the output from Murray and the interconnector flows against the rating of the Ballarat to Bendigo 220 kV line, which is calculated every 5 minutes. Generation at Murray and imports into Victoria across the Vic-NSW and Murraylink interconnectors help relieve the constraint.
- NRM\_NSW1\_VIC1 — a financial constraint used to manage the accrual of negative residues across the VIC-NSW interconnector (negative residue constraint). It only affects the Vic-NSW interconnector and has a CVP of 2. Reducing exports from New South Wales to Victoria helps relieve the constraint.

Figure 1 shows a simplified diagram of the network involved, the constraints and the direction that each constraint is trying to force flows across the interconnector to relieve the constraint.

**Figure 1: Simplified diagram of the significant network elements affected.**



The three constraints are trying to move interconnectors in opposing directions. The CVP will determine which constraint takes priority over the others.

Once the North West Bend to Robertson constraint binds, its high CVP (360) effectively fixes the flow on Murraylink as an input into the Ballarat to Bendigo constraint.

NEMDE would then be effectively managing flows on the Vic-NSW interconnector and the output of Murray to balance the negative residue constraint (CVP of 2) and the Ballarat to Bendigo constraint (CVP of 30). Depending on the actual dispatch at the time, the Ballarat to Bendigo constraint should take priority and force flows into Victoria violating the negative residue constraint. While Murray capacity is available, NEMDE will potentially dispatch Murray out of merit order to satisfy the constraint and possibly avoid the negative settlement surplus residue. If Murray is unavailable then the only term which can be controlled is the interconnector flow.

### Events on the day

All of the capacity changes are detailed in Table A.1 in Appendix A and rebids for all of the generators that are relevant to the event are detailed in Table A.2.

High temperatures in the New South Wales and northern Victoria led to high demand in these areas. Under these circumstances, demand in northern Victoria is met by generation from Murray and/or

flows from New South Wales into Victoria and flows on the Ballarat to Bendigo lines. This is represented in the Ballarat to Bendigo constraint.

Between 8.30 am and 9.30 am around 1200 MW of capacity was rebid out of the New South Wales region due to unplanned unit outages on Eraring 2 and Liddell 2. Before the rebids almost all of this capacity was at low prices.

At 10.30 am the Ballarat to Bendigo constraint started to bind and imports into New South Wales across the VIC-NSW interconnector started to reduce.

At 10.55 am the North West Bend to Robertson constraint started to bind virtually fixing the flow from South Australia into Victoria across Murraylink at around 80 MW. This continued until 2.30 pm. Consequently, to relieve the Ballarat to Bendigo constraint, only the generation from Murray and the VIC-NSW interconnector could assist.

Effective from 11.20 am, Snowy Hydro rebid 789 MW of capacity at Murray, in Victoria, to the price cap. This resulted in a reduction in dispatch at Murray from 580 MW to 338 MW. As a result, the Ballarat to Bendigo constraint forced flows into Victoria across VIC-NSW interconnector counter-price.

Effective from 12.10 pm, Macquarie Generation rebid 180 MW of capacity across its portfolio into high prices.

At 12.40 pm AEMO invoked the negative residue constraint to manage counter-price flows across the VIC-NSW interconnector and exports into Victoria reduced slightly.

Effective from 12.45 pm, Snowy Hydro rebid a further 406 MW from Murray capacity to the price cap and increased its ramp down rate from 50 MW/min to 100 MW/min because the unit was being “constrained-on” out of merit order. Despite the significant change in offer price, Murray’s output was virtually unchanged.

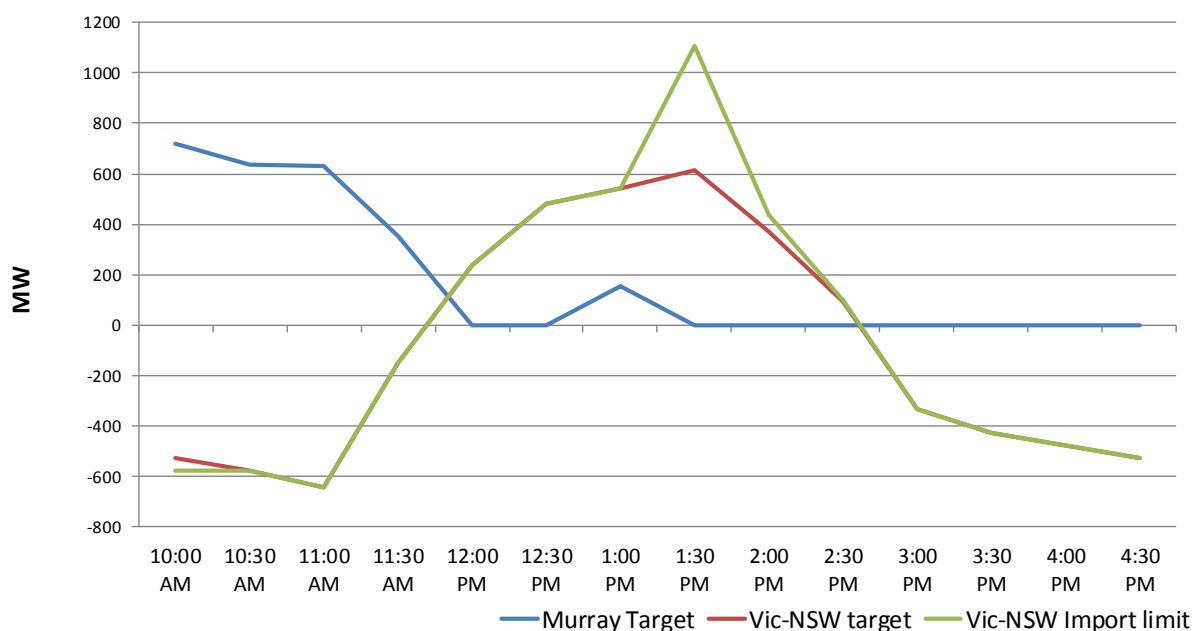
Effective from 12.50 pm, Snow Hydro withdrew Murray’s entire 1351 MW of capacity. This reduced the output of Murray from 463 MW at 12.45 pm to zero at 12.50 pm. Murray could therefore no longer assist in relieving the Ballarat to Bendigo constraint leaving the VIC-NSW interconnector as the only manageable variable. This increased the forced exports from New South Wales to Victoria from 331 MW at 12.45 pm to 781 MW at 12.50 pm, violating the negative residue management constraint.

The relationship between generation from Murray and flows across the VIC-NSW interconnector is shown in Figure 2. When generation from Murray (as shown by the blue line) was reduced, the import limit reduced<sup>6</sup>, eventually forcing flows on the VIC-NSW interconnector (shown by the green and red lines respectively) into Victoria, counter-price.

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<sup>6</sup> The import limit is normally negative. As Murray output decreased to zero the import limit approached zero and then switched such that it was forcing exports from NSW to Victoria.

**Figure 2: Actual import limit and flows on VIC – NSW interconnector Murray generation**



The effects of these constraints on the VIC-NSW interconnector were not forecast.

Table 2 shows the difference between actual and forecast limits and flows, four and 12 hours ahead of dispatch on the Vic-NSW interconnector.

**Table 2: Actual and forecast limits for VIC-NSW interconnector**

Time	Export limit(MW)			Import limit (MW)			Flow into Vic (MW)		
	Actual	4 hr Forecast	12 hr forecast	Actual	4 hr forecast	12 hr forecast	Actual	4 hr forecast	12 hr forecast
<b>1.30 PM</b>	452	679	975	1109	-520	-665	616	-520	-567
<b>2.00 PM</b>	364	783	971	438	-755	-673	370	-755	-567
<b>2.30 PM</b>	73	662	960	97	-603	-671	93	-603	-671

Note: negative numbers indicate flow into the region

Four hours ahead the import limit for the 1.30 pm trading interval for the Vic-NSW interconnector was forecast to be 520 MW from Victoria to New South Wales. The actual import limit was forcing flow in the opposite direction, from New South Wales into Victoria at a maximum of 1109 MW with actual flow at 616 MW for the 1.30 pm trading interval.

### **1.30 pm Trading Interval**

The events during the 1.30 pm trading interval are complex and we describe the events for each 5-minute dispatch interval individually.

#### **1.05 pm**

Three rebids became effective at 1.05 pm, shifting around 900 MW of New South Wales capacity from low to high prices. This included capacity at Vales point, Mount Piper and Snowy Hydro’s Tumut and Guthega facilities.

The dynamic line rating of the Bendigo to Ballarat line decreased requiring an increase in exports to Victoria from 622 MW at 1 pm to 864 MW at 1.05 pm.

This step change in exports was not enough to satisfy the Ballarat to Bendigo constraint so it violated and contributed to setting the New South Wales price at \$7192/MWh (The relationship between the dynamic line rating, constraint violation and price is shown in Figure 3).

*1.10 pm*

Effective from 1.10 pm, Macquarie Generation reduced the availability of Liddell unit 1 by 145 MW, most of which was priced low, due to the unit tripping.

The dynamic rating of the Bendigo to Ballarat line further reduced and the Ballarat to Bendigo constraint continued to violate with Bayswater setting the price at \$12 004/MWh.

*1.15 pm*

At 1.15 pm there was a small reduction in Bendigo to Ballarat dynamic line rating with the Ballarat to Bendigo constraint continuing to be violated and the price being set by Bayswater at \$12 000/MWh.

*1.20 pm*

Effective from 1.20 pm, Delta Electricity's Colongra unit two capacity was reduced by 155 MW, a majority of which had been priced at zero. To compensate, Delta rebid 100 MW of capacity at Vales Point unit 5 from high prices to low prices.

The Bendigo to Ballarat dynamic line rating remained stable with the Ballarat to Bendigo constraint still violating and the price was set by the constraint at \$7338/MWh.

*1.25 pm*

The Bendigo to Ballarat dynamic line rating increased but the Ballarat to Bendigo constraint continued to violate and set the price at \$7338/MWh.

*1.30 pm*

The Bendigo to Ballarat dynamic line rating increased and stopped the Ballarat to Bendigo constraint from violating.

Delta Electricity rebid 170 MW of capacity at Colongra unit one from high prices to low prices.

Snowy Hydro rebid a total of 494 MW of capacity at Tumut, Upper Tumut and Guthega from high prices to negative prices and the dispatch price fell to \$299/MWh.

Figure 3 shows the relationship between the dynamic line rating, constraint violation and the New South Wales dispatch price from 12.35 pm and 3.00 pm.

**Figure 3: Dynamic line rating, constraint violation and New South Wales dispatch price**



As figure 3 shows, reductions in the Bendigo to Ballarat dynamic line rating also occurred later in the afternoon, at 1.40 pm and 2.25 pm, and the Bendigo to Ballarat constraint violated again in each occasion. During these periods of constraint, the dispatch interval prices were set to around \$7300/MWh and the spot prices for 2 pm and 2.30 pm reached \$2478/MWh and \$1271/MWh respectively.

During the high priced period around \$3 million worth of negative settlement residues accrued across the VIC-NSW interconnector.

The generators involved in setting the price during the high-price periods, and how that price was determined by the market systems is detailed in **Appendix B**. The closing bids for all participants in New South Wales with capacity priced at or above \$5000/MWh for the high-price periods are set out in **Appendix C**.

## A Rebids for 20 December 2013

Table A.1 shows the significant capacity withdrawn from the market, the participant, unit, time price and the rebid reason for the 1.30 pm trading interval.

**Table A.1: Significant available capacity in New South Wales and Victoria withdrawn from the market**

Participant	Unit	Time of rebid	Reduced capacity (MW)	Capacity <\$5000 (MW)	Capacity >\$5000 (MW)	Reason
Macquarie Generation	Liddell 2	8.20am	230	230		Boiler leak (Returned from a planned outage on the 18 December)
		8.52am	250	250		Boiler leak
Origin Energy	Eraring 2	9.17am	720	700	20	2 ID fan shutdown
Snowy Hydro	Murray (Victoria)	12.42pm	1351		1351	12:41:A Murray constrained on at voll - price \$1
Macquarie Generation	Liddell 1	1.02pm	145	110	35	1300P LD1 415V elec board trip
Delta	Colongra 2	1.13pm	155	155		1312P Unit tripped high bearing temp
<b>NSW Totals</b>			<b>1500</b>	<b>1445</b>	<b>55</b>	

Capacity from Murray, owned by Snowy Hydro, is in Victoria and is included in this table but not in the totals for New South Wales as it had a material impact on the constraints that led to the negative settlement surplus.

Table A.2 shows for the 1.30 pm trading interval, the material rebids, the time it was made, and became effective and which participant and which unit/s were affected. It also shows the volume, price and the reason for the rebid.

**Table A.2: Significant Rebids by New South Wales generators for the 1.30 pm trading interval**

Time		Participant	Plant	Move			Reason
Submitted	Effective			MW	From \$/MWh	To \$/MWh	
12.02pm	12.10pm	Macquarie Generation	BW02,03,04,LD01,03	180	<55	>11 500	1156A VIC to NSW i/c limit materially different to forecast
12.54pm	1.05pm	Delta	VP5,VP6	220	<62	12 961	1253A actual demand is 150MW higher 30MIN PD at 1300
12.56pm	1.05pm	EnergyAustralia	MP1	190	51	12 425	12:55 A adj bands \$NSW 349.80 VS 276 30MPD @ 1300
12.57pm	1.05pm	Snowy (NSW)	Tumut3, Upptumut, Guthega	486	<440	12 744	12:56 A NSW: 5MPD price \$73.80 hgr thn 30MPD 13:15@12:32
1.12pm	1.20pm	Delta	VP5	110	13 100	<299	1310P CG2 bearing temperature
1.22pm	1.30pm	Delta	CG1	170	13 100	<299	1321P C2 unit tripped rearrange production
1.23pm	1.30pm	Snowy (NSW)	Tumut3, Upptumut, Guthega	494	>12 800	-1000	13:22:A mnage 5/30 settle risk



## B Price setters for 20 December 2013

The following table identifies for the trading interval in which the spot price exceeded \$5000/MWh, each five minute dispatch interval price and the generating units involved in setting the energy price. This information is published by AEMO.<sup>7</sup> The 30-minute spot price is the average of the six dispatch interval prices.

### New South Wales – 1.30 pm

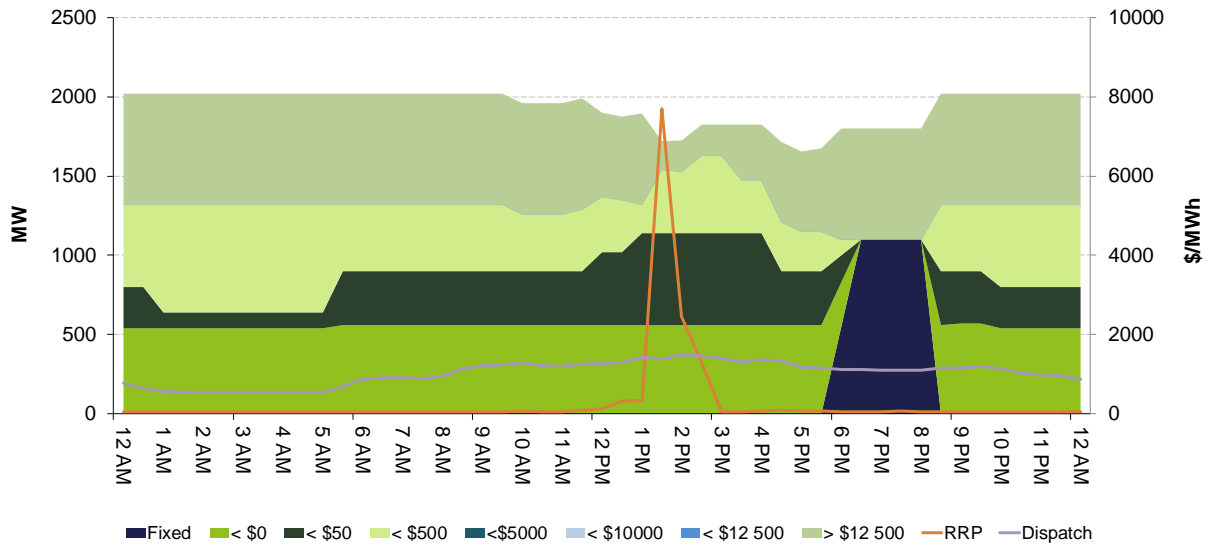
Time	Dispatch Price	Participant	Unit	Service	Offer price	Marginal Change	Contribution
13:05	\$7192.30		SML_NIL_8		\$393000.00	0.08	\$31440.00
			NRM_NSW1_VIC1		\$26200.00	-0.94	-\$24628.00
		Hydro Tasmania	CETHANA	Energy	\$26.30	0.96	\$25.25
		Hydro Tasmania	GORDON	Lower 60 sec	\$0.50	0.88	\$0.44
		Hydro Tasmania	CETHANA	Lower 6 sec	\$0.30	0.88	\$0.26
		Basslink	T-V-MNSP1,VIC1	Energy	\$0.01	0.88	\$0.01
13:10	\$12004.00	Mac Gen	BW02	Energy	\$12004.00	1.00	\$12004.00
13:15	\$12008.00	Mac Gen	BW04	Energy	\$12008.00	1.00	\$12008.00
13:20	\$7337.54		SML_NIL_8		\$393000.00	0.08	\$31440.00
			NRM_NSW1_VIC1		\$26200.00	-0.96	-\$25152.00
		LYMMCO	LYA1	Energy	\$45.20	0.48	\$21.70
		LYMMCO	LYA2	Energy	\$45.20	0.41	\$18.53
			ENOF,LYA1,3,LYA3,3		\$0.00	-100.88	\$0.00
			ENOF,LYA1,3,LYA4,3		\$0.00	-100.88	\$0.00
			ENOF,LYA2,3,LYA3,3		\$0.00	-86.47	\$0.00
			ENOF,LYA2,3,LYA4,3		\$0.00	-86.47	\$0.00
13:25	\$7337.81		SML_NIL_8		\$393000.00	0.08	\$31440.00
			NRM_NSW1_VIC1		\$26200.00	-0.96	-\$25152.00
		Hazelwood Power	HWPS7	Energy	\$43.68	0.89	\$38.88
13:30	\$299.00	Delta Electricity	CG1	Energy	\$299.00	1.00	\$299.00
			ENOF,CG1,7,CG2,7		\$0.00	50.00	\$0.00
<b>Spot Price</b>		<b>\$7696/MWh</b>					

<sup>7</sup> Details on how the price is determined can be found at [www.aemo.com.au](http://www.aemo.com.au)

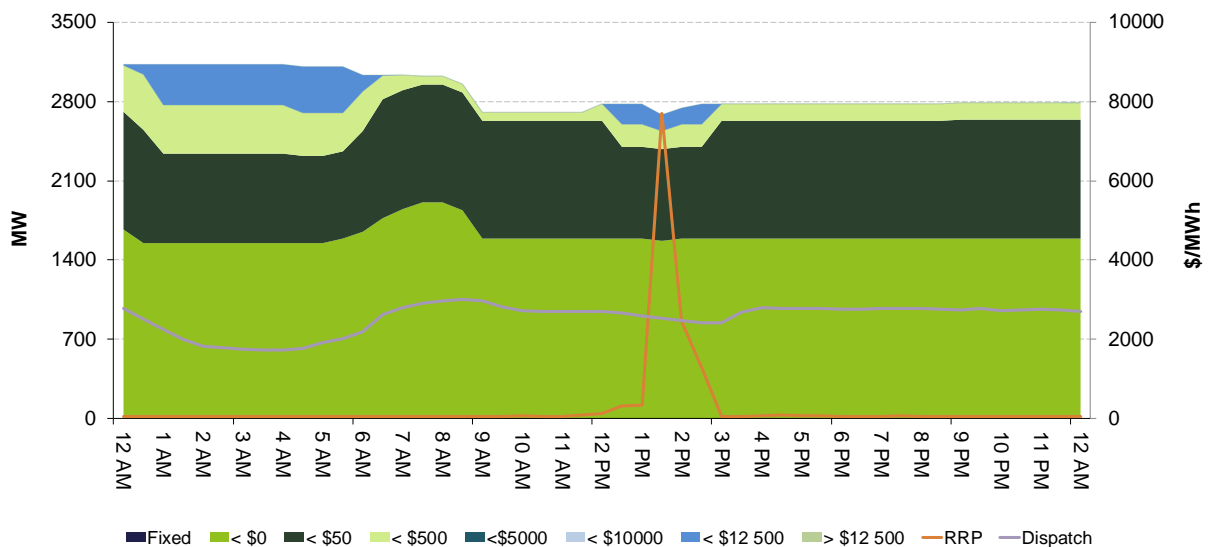
## C Closing bids for 20 December 2013

Figures C1 to C3 highlight the half hour closing bids for participants in New South Wales with significant capacity priced at or above \$5000/MWh during the periods in which the spot price exceeded \$5000/MWh. They also show generation output and the spot price.

**Figure C.1 Delta Electricity (Colongra, Vales Point) closing bid prices, dispatch and spot price**



**Figure C.2 Macquarie Generation (Bayswater, Hunter Valley GT, Liddell) closing bid prices, dispatch and spot price**



**Figure C.3 EnergyAustralia (Mt Piper, Tallawarra and Wallerawang) closing bid prices, dispatch and spot price**

