

Electricity spot prices above \$5000/MWh

22 April 2010
Victoria



AUSTRALIAN ENERGY
REGULATOR

Introduction

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

On Thursday 22 April 2010, the spot price in Victoria exceeded \$5000/MWh over seven trading intervals from 12.30 pm to 4 pm inclusive, reaching close to the price cap.

Planned network outages restricted imports into Victoria from SA and NSW, and Basslink was out of service following its unplanned outage on 17 April. Day ahead bidding by International Power saw significant capacity at Hazelwood and Loy Yang B priced at close to the price cap.

In response to forecast prices of around \$500/MWh for the afternoon, Snowy Hydro rebid to commit the Valley Power Gas turbines. This saw the forecast price fall to below \$40/MWh. Following the reduction in forecast price, LYMMCO rebid capacity into high prices at Loy Yang A, which drove forecast prices to close to the cap.

During the high-price period, there was no capacity priced between \$500/MWh and \$9000/MWh.

Further rebids by Snowy Hydro shifted capacity into negative prices at Murray². As a result of the planned network outage between Murray and Melbourne, flows of up to 700 MW and 200 MW flowed into the lower priced NSW and SA regions, respectively, and led to negative prices in SA. To manage negative settlements residues that accrued on these interconnectors, AEMO invoked constraints which reduced the output from Murray.

In response to these extreme prices, an industrial load turned off at 1.20 pm, causing the five-minute price to fall to around \$9/MWh. Demand increased again from around 2 pm and the price returned to close to the price cap.

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

² The Murray generator is located in the Victorian region and receives the Victoria price. The Snowy region was abolished in July 2008 and as a result Snowy Hydro's Murray generator was moved to the Victoria region and the Tumut stations to NSW.

A step increase in the availability of low priced capacity from 4 pm saw the price fall to below \$30/MWh.

Actual and forecast demand

Figure 1 compares the actual demand and spot price in Victoria on 22 April 2010 with that forecast by AEMO 4 and 12 hours ahead of dispatch.

Figure 1: Actual and forecast demand and spot price

12.30 PM	Actual	4 hr forecast	12 hr forecast
Demand (MW)	6862	6864	6788
Spot Price (\$MWh/h)	5022	37	30
1 PM	Actual	4 hr forecast	12 hr forecast
Demand (MW)	6799	6881	6815
Spot Price (\$MWh/h)	9998	37	30
1.30 PM	Actual	4 hr forecast	12 hr forecast
Demand (MW)	6685	6932	6866
Spot Price (\$MWh/h)	5004	187	32
2 PM	Actual	4 hr forecast	12 hr forecast
Demand (MW)	6673	6973	6904
Spot Price (\$MWh/h)	1751	516	37
2.30 PM	Actual	4 hr forecast	12 hr forecast
Demand (MW)	6847	6973	6898
Spot Price (\$MWh/h)	8383	516	37
3 PM	Actual	4 hr forecast	12 hr forecast
Demand (MW)	6900	6939	6869
Spot Price (\$MWh/h)	9999	37	37
3.30 PM	Actual	4 hr forecast	12 hr forecast
Demand (MW)	6848	6883	6808
Spot Price (\$MWh/h)	9998	9998	29
4 PM	Actual	4 hr forecast	12 hr forecast
Demand (MW)	6783	6809	6745
Spot Price (\$MWh/h)	9998	165	29

With the exception of the 3.30 pm trading interval (where the actual price was close to that forecast four hours ahead), spot prices were significantly higher than forecast.³

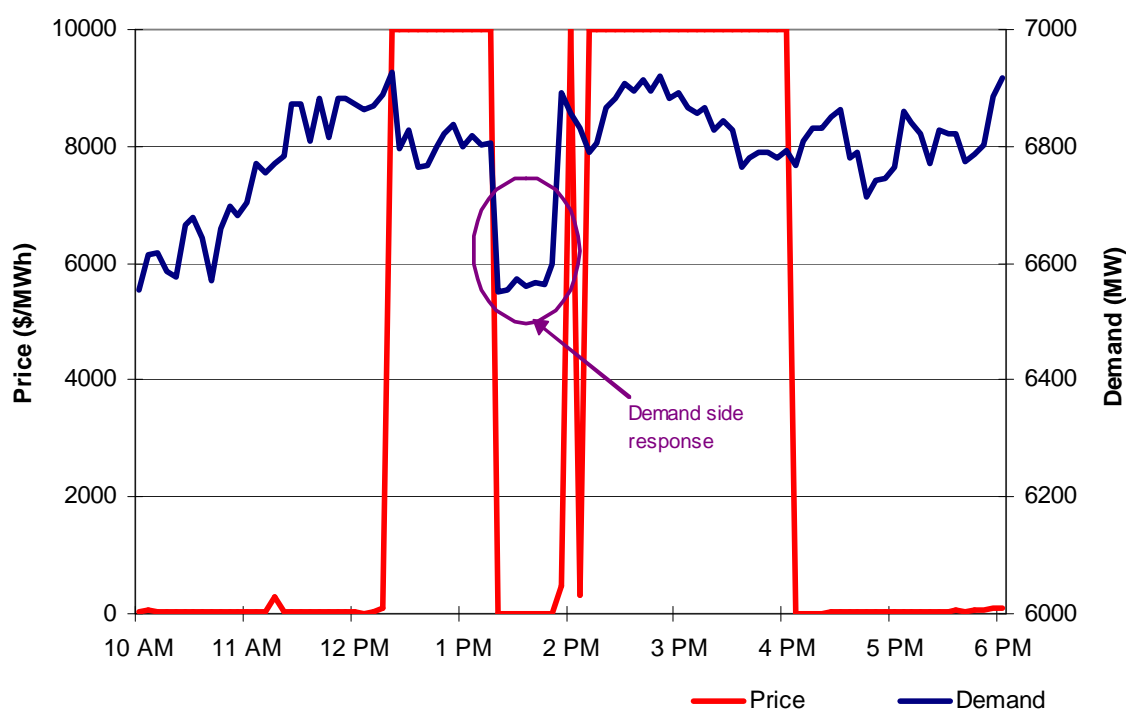
Conditions at the time saw demand up to 300 MW and 247 MW less than that forecast four hours ahead for the 1.30 pm and 2 pm trading intervals as a result of a demand side response (discussed below). At other times, however, demand was close to forecast.

³ As part of its Weekly Market Analysis reports, the AER provides detailed analysis if the spot price exceeds three times the weekly average for a region and is above \$250/MWh. On 22 April there were eight trading intervals in Victoria where this occurred (on seven of these occasions the spot price exceeded \$5000/MWh). As all of these high prices occurred in consecutive trading intervals (from 12.30 pm to 4 pm inclusive), and were all caused by related events, they have been explained as part of this report.

Figure 2 shows price and demand on a five-minute basis, and highlights the demand side response at around 1.15 pm when, according to AEMO, an industrial load was taken out of service⁴. Demand reduced by around 255 MW from 6807 MW at 1.15 pm to 6552 MW at 1.20 pm, which saw the 5-minute dispatch price fall from close to the price cap to around \$9/MWh. Demand remained at this lower level until 1.50 pm and then increased by close to 300 MW to 6893 MW at 1.55 pm. This increase in demand saw the dispatch price return to close to the price cap at 2 pm.

As shown in Figure 2, from 12.20 pm to 1.15 pm, and 2.10 pm to 4 pm the five-minute price was close to the price cap.

Figure 2: Five-minute price and demand



Generator offers

Available capacity was close to that forecast during the high-price period.

Around 8650 MW of generation capacity was offered during the high priced period through initial offers (day ahead). Of this, 4100 MW was priced below \$0/MWh, 2500 MW was priced between \$0/MWh and \$40/MWh, 920 MW was priced between \$40/MWh and \$300/MWh and the remaining 1100 MW was priced above \$9000/MWh.

Around 600 MW of the capacity above \$9000/MWh was offered by International Power across Loy Yang B and Hazelwood, and 330 MW was offered by Ecogen at its Jeeralang gas turbines.

Rebidding

At 10.10 am, effective from 10.20 am, Snowy Hydro rebid 200 MW of capacity at its Valley Power Gas Turbines from \$500/MWh into lower price bands (100 MW at \$0/MWh and 100 MW at \$300/MWh). The reason given was “10:09:A manage uncast V-NSW const”. As a result, by 10.30 am forecast prices for the afternoon fell from around \$500/MWh to below \$40/MWh.

⁴ http://www.aemo.com.au/reports/pricing_apr.html

At 10.42 am, for the 12.30 pm to 4 pm trading intervals, LYMMCO rebid 325 MW of capacity at its Loy Yang A Power Station from prices below \$20/MWh to above \$9600/MWh. The reason given was “1042A change in forecast Vic gen and demand at PD 1031”.

At 11.11 am, effective from 11.20 am, Snowy Hydro rebid 500 MW of capacity at its Murray Power Station from prices above \$25/MWh into negative prices. The reason given was “10:09:A manage uncast V-NSW const”. At 11.14 am, effective from 11.20 am, Snowy Hydro rebid the ramp down rate at Murray from 200 MW/min to the minimum allowable of 3 MW/min.⁵ The reason given was “11:10:prices higher than fcast \$270”. At 12.16 pm, effective from 12.25 pm, Snowy Hydro rebid a further 200 MW at Murray into negative prices, resulting in most of the capacity at Murray Power Station being priced at close to the price floor. The reason given was “12:15:A prices hghr thn fcast”.

At 12.21 pm, effective from 12.30 pm, Eraring Energy reduced both the ramp up and ramp down rates at its Hume Power Station from 10 MW/min to 0 MW/min. All (11 MW) of this capacity was priced at close to the floor. The reason given was “1215P to match actual output – plant issues”.⁶

There was no other significant rebidding.

The generators involved in setting the price during the high-price period and how that price was determined by the market systems is detailed in **Appendix A**.

The closing bids for all participants in Victoria with capacity priced at or above \$5000/MWh for the 12.30 pm to 4 pm trading interval are presented in **Appendix B**.

Transmission Constraints

The Basslink interconnector tripped on 17 April as a result of the failure of a valve cooling pipe component in the valve hall causing a leak of demineralised water. The resultant leak caused a corona discharge which caused damage to thyristor valve equipment. Basslink remained out of service until 26 April.

On 22 April there was a planned outage of a Heywood to Moorabool 500 kV line that reduced the capacity for flows between Victoria and South Australia across the Heywood interconnector.

Also on 22 April there was a planned outage of a Dederang to South Morang 330 kV transmission line and the Dederang 2 330/220 kV transformer. The outage had been planned since 16 April. The constraint⁷ used to manage this outage (N>>V-X_DD H2_DDSM_2) bound⁸ for the entire high priced period. This constraint is designed to avoid the overload of the other transformer in the event of a trip of the remaining Dederang to South Morang line.

Figure 3 is a simplified representation of the transmission network in Victoria, highlighting the flow paths into the regional reference node (RRN) at Thomastown, the interconnectors relevant to the constraint and significant generation stations.

⁵ Clause 3.8.3A(b) of the Electricity Rules states that Scheduled Generators must provide a ramp down rate to AEMO of at least the lower of 3 MW per minute or 3 per cent of the full capacity of the Scheduled unit. Refer to the AER Rebidding and Technical Parameter Guideline for more information at www.aer.gov.au.

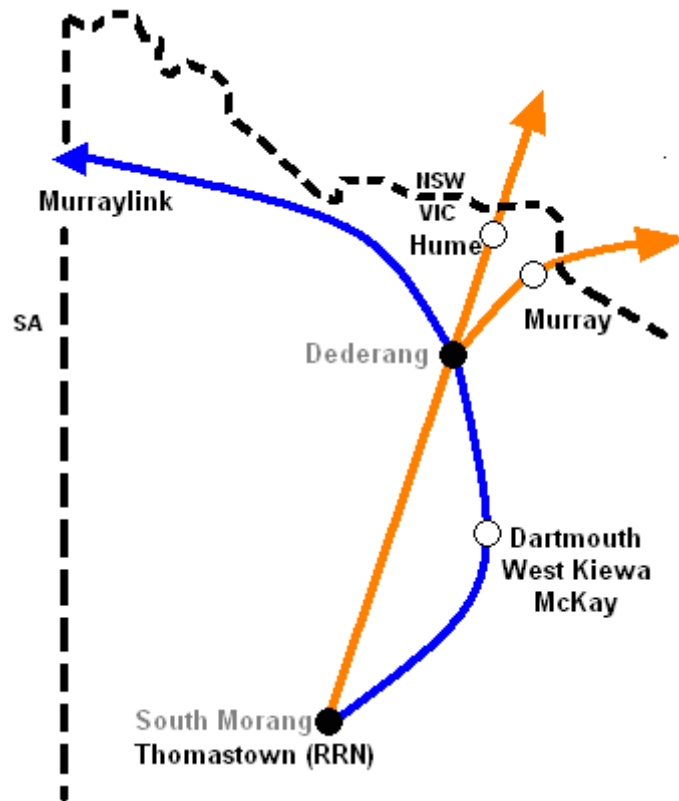
⁶ The AER’s Rebidding Guidelines require generators to provide AEMO a brief, verifiable and specific reason where it provides a ramp rate less than the minimum. Eraring has provided further information to the AER regarding its zero ramp rate.

⁷ Constraint equations are mathematical expressions used in the dispatch engine to describe the physical limitations of the power system.

⁸ When a constraint binds it effects economic dispatch and causes generators to be constrained-on or off.

The blue lines in Figure 3 represent 220 kV transmission lines and the orange lines represent 330 kV transmission lines. The arrows represent the direction of the inter-regional flows, which were counter price (or from high-priced to low-priced regions) due to the above constraint. The circles indicate the generating stations in the vicinity of this constraint.

Figure 3: Simplified network in Victoria and counter-price inter-regional flows



The Murray generator is located in the Victorian region and receives the Victoria price. The Snowy region was abolished in July 2008 and as a result Snowy Hydro's Murray generator was relocated to the Victorian region and the remainder of the Snowy region generation was relocated to the NSW region.

Murray is located north of the Dederang to South Morang lines. When Snowy Hydro rebid capacity at Murray into negative prices (which was lower than the NSW or SA region prices), its capacity was dispatched. To maintain system security, the network constraint would not allow this output to be dispatched south, and instead it was forced into New South Wales across the Vic-NSW interconnector and into South Australia across the Murraylink interconnector. The very low offer price meant that Murray was dispatched in preference to generators in NSW or SA.

Two hours ahead of dispatch, flows across the Vic-NSW interconnector were forecast to be around 20 MW, counter price into New South Wales. The 11 am rebids by Snowy Hydro for Murray resulted in counter price flows of up to 700 MW into New South Wales.

Although Murraylink was flowing into Victoria until 12.15 pm, after that time, as described above, the constraint combined with the Snowy Hydro rebids forced flows into South Australia, reaching a maximum of 220 MW. During this time flows were forecast to be 145 MW into Victoria.

At 12.05 pm, AEMO invoked the constraint #VIC1-NSW1_E_E, to reduce flows into New South Wales and limit negative settlement residues accruing across the Vic-NSW interconnector. The constraint was binding from 12.05 pm, and was violated⁹ for the majority of the time. Negative settlement residues from Victoria to New South Wales of around \$17.4 million accrued during the time of high prices. The constraint also reduced the dispatch of Murray Power Station by up to 240 MW during the period¹⁰.

At 12.50 pm, AEMO invoked the constraint #SA1_E_20100422 to reduce flows into South Australia across Murraylink and limit the accumulation of negative settlement residues into South Australia. This constraint bound from 12.50 pm, and also violated for most of the period, until being revoked at 4.10 pm. Negative settlement residues from Victoria to South Australia of around \$1.5 million accrued during the time of high prices. There was an additional period of negative residues that occurred for flows from South Australia to Victoria, when the 5-minute dispatch price in South Australia fell to \$-1000/MWh at 2 pm.

At the times of high prices, imports into Victoria across the Heywood interconnector were limited to around 200 MW.

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⁹ A constraint is deemed to be violating when the mathematical inequality describing the constraint cannot be satisfied.

¹⁰ The constraint also reduced the dispatch of Hume Power Station from 11 MW to 9 MW.

Appendix A – Price setters for 22 April 2010

The following table identifies for the 12.30 pm to 4 pm spot prices above \$5000/MWh each five minute dispatch interval price and the generating units involved in setting the energy price. This information is published by AEMO¹¹. Also shown is the energy offer price involved in determining the dispatch price together with the quantity of that service and the contribution to the total energy price. The 30-minute spot price is the average of the six dispatch interval prices.

Victoria – 12.30 pm

Time	Dispatch price	Participant	Unit	Service	Offer price	Marginal change	Contribution
12:05	\$12.15	Flinders Power	NPS2	Energy	\$11.37	1.07	\$12.15
12:10	\$31.41	Stanwell	STAN-1	Energy	\$29.96	-0.37	-\$11.15
		AGL (SA)	TORRA1	Energy	\$28.77	0.25	\$7.22
		AGL (SA)	TORRA2	Energy	\$28.77	0.25	\$7.22
		AGL (SA)	TORRB2	Energy	\$28.77	0.50	\$14.43
		AGL (SA)	TORRB3	Energy	\$28.77	0.50	\$14.43
		Stanwell	GSTONE1	Raise reg	\$1.99	-0.37	-\$0.74
		Stanwell	STAN-1	Raise reg	\$0.01	0.37	\$0.00
12:15	\$93.84	AGL (SA)	TORRB1	Energy	\$28.77	1.74	\$50.15
		Macquarie Gen.	BW01	Energy	\$22.00	-0.03	-\$0.70
		Macquarie Gen.	BW03	Energy	\$22.00	-0.03	-\$0.70
		Flinders Power	NPS2	Energy	\$11.37	-0.59	-\$6.73
		AGL (SA)	TORRB2	Lower 5 min	\$5.00	2.65	\$13.25
		Delta Electricity	MP2	Lower 5 min	\$0.40	-2.65	-\$1.06
		Delta Electricity	MP2	Lower reg	\$1.40	1.74	\$2.44
		AGL (SA)	TORRB1	Lower reg	\$0.25	-1.74	-\$0.44
		Flinders Power	NPS2	Lower 60 sec	\$40.00	0.91	\$36.28
		Macquarie Gen.	BW01	Lower 60 sec	\$0.01	-0.91	-\$0.01
		AGL (SA)	TORRB3	Lower 6 sec	\$0.04	0.91	\$0.04
		Stanwell	GSTONE6	Raise 5 min	\$1.00	1.74	\$1.74
		AGL (SA)	TORRB1	Raise reg	\$0.25	-1.74	-\$0.44
12:20	\$9998.89	International Power	LOYB2	Energy	\$9998.89	1.00	\$9998.89
12:25	\$9999.34	LYMMCO	LYA3	Energy	\$9999.30	1.00	\$9999.30
		Stanwell	STAN-3	Raise reg	\$0.94	1.00	\$0.94
		LYMMCO	LYA3	Raise reg	\$0.90	-1.00	-\$0.90
12:30	\$9998.90	LYMMCO	LYA2	Energy	\$9998.90	1.00	\$9998.90
Spot price		\$5022/MWh					

Victoria – 1 pm

Time	Dispatch price	Participant	Unit	Service	Offer price	Marginal change	Contribution
12:35	\$9997.70	Ecogen Energy	NPS	Energy	\$9997.70	1.00	\$9997.70
12:40	\$9997.70	Ecogen Energy	NPS	Energy	\$9997.70	1.00	\$9997.70
12:45	\$9998.19	Hazelwood Power	HWPS2	Energy	\$9998.19	1.00	\$9998.19
12:50	\$9997.70	Ecogen Energy	NPS	Energy	\$9997.70	1.00	\$9997.70
12:55	\$9997.70	Ecogen Energy	NPS	Energy	\$9997.70	1.00	\$9997.70
13:00	\$9997.70	Ecogen Energy	NPS	Energy	\$9997.70	1.00	\$9997.70
Spot price		\$9998/MWh					

¹¹ Details on how the price is determined can be found at www.aemo.com.au

Victoria – 1.30 pm

Time	Dispatch price	Participant	Unit	Service	Offer price	Marginal change	Contribution
13:05	\$9998.19	Hazelwood Power	HWPS2	Energy	\$9998.19	1.00	\$9998.19
13:10	\$9998.89	International Power	LOYB2	Energy	\$9998.89	1.00	\$9998.89
13:15	\$9998.59	Hazelwood Power	HWPS6	Energy	\$9998.59	1.00	\$9998.59
13:20	\$9.10	LYMMCO	LYA1	Energy	\$9.10	1.00	\$9.10
13:25	\$9.30	LYMMCO	LYA3	Energy	\$9.30	1.00	\$9.30
13:30	\$8.84	International Power	LOYB2	Energy	\$8.84	1.00	\$8.84
Spot price		\$5004/MWh					

Victoria – 2.30 pm

Time	Dispatch price	Participant	Unit	Service	Offer price	Marginal change	Contribution
14:05	\$305.29	Flinders Power Snowy Hydro	NPS2 MURRAY	Energy Energy	\$11.37 -\$1000.00	0.99 -0.29	\$11.30 \$294.00
14:10	\$9998.89	International Power	LOYB2	Energy	\$9998.89	1.00	\$9998.89
14:15	\$9997.70	Ecogen Energy	NPS	Energy	\$9997.70	1.00	\$9997.70
14:20	\$9998.19	Hazelwood Power	HWPS2	Energy	\$9998.19	1.00	\$9998.19
14:25	\$9997.70	Ecogen Energy	NPS	Energy	\$9997.70	1.00	\$9997.70
14:30	\$9997.70	Ecogen Energy	NPS	Energy	\$9997.70	1.00	\$9997.70
Spot price		\$8383/MWh					

Victoria – 3 pm

Time	Dispatch price	Participant	Unit	Service	Offer price	Marginal change	Contribution
14:35	\$9998.89	International Power	LOYB2	Energy	\$9998.89	1.00	\$9998.89
14:40	\$9998.99	International Power	LOYB1	Energy	\$9998.99	1.00	\$9998.99
14:45	\$9998.89	International Power	LOYB2	Energy	\$9998.89	1.00	\$9998.89
14:50	\$9998.89	International Power	LOYB2	Energy	\$9998.89	1.00	\$9998.89
14:55	\$9998.19	Hazelwood Power	HWPS2	Energy	\$9998.19	1.00	\$9998.19
15:00	\$9997.70	Ecogen Energy	NPS	Energy	\$9997.70	1.00	\$9997.70
Spot price		\$9999/MWh					

Victoria – 3.30 pm

Time	Dispatch price	Participant	Unit	Service	Offer price	Marginal change	Contribution
15:05	\$9997.70	Ecogen Energy	NPS	Energy	\$9997.70	1.00	\$9997.70
15:10	\$9997.70	Ecogen Energy	NPS	Energy	\$9997.70	1.00	\$9997.70
15:15	\$9997.70	Ecogen Energy	NPS	Energy	\$9997.70	1.00	\$9997.70
15:20	\$9997.70	Ecogen Energy	NPS	Energy	\$9997.70	1.00	\$9997.70
15:25	\$9997.70	Ecogen Energy	NPS	Energy	\$9997.70	1.00	\$9997.70
15:30	\$9997.70	Ecogen Energy	NPS	Energy	\$9997.70	1.00	\$9997.70
Spot price		\$9998/MWh					

Victoria – 4 pm

Time	Dispatch price	Participant	Unit	Service	Offer price	Marginal change	Contribution
15:35	\$9998.49	Hazelwood Power	HWPS8	Energy	\$9998.49	1.00	\$9998.49
15:40	\$9998.89	International Power	LOYB2	Energy	\$9998.89	1.00	\$9998.89
15:45	\$9998.89	International Power	LOYB2	Energy	\$9998.89	1.00	\$9998.89
15:50	\$9997.70	Ecogen Energy	NPS	Energy	\$9997.70	1.00	\$9997.70
15:55	\$9997.70	Ecogen Energy	NPS	Energy	\$9997.70	1.00	\$9997.70
16:00	\$9997.70	Ecogen Energy	NPS	Energy	\$9997.70	1.00	\$9997.70
Spot price		\$9998/MWh					

Appendix B – Closing bids

Figures B1 – B4 highlight the half hour closing bids for participants in Victoria with significant capacity priced at or above \$5000/MWh during the trading interval in which the spot price exceeded \$5000/MWh. It also shows the generation output of that participant and the spot price.

Figure B1: Ecogen Energy closing bid prices, dispatch and spot price

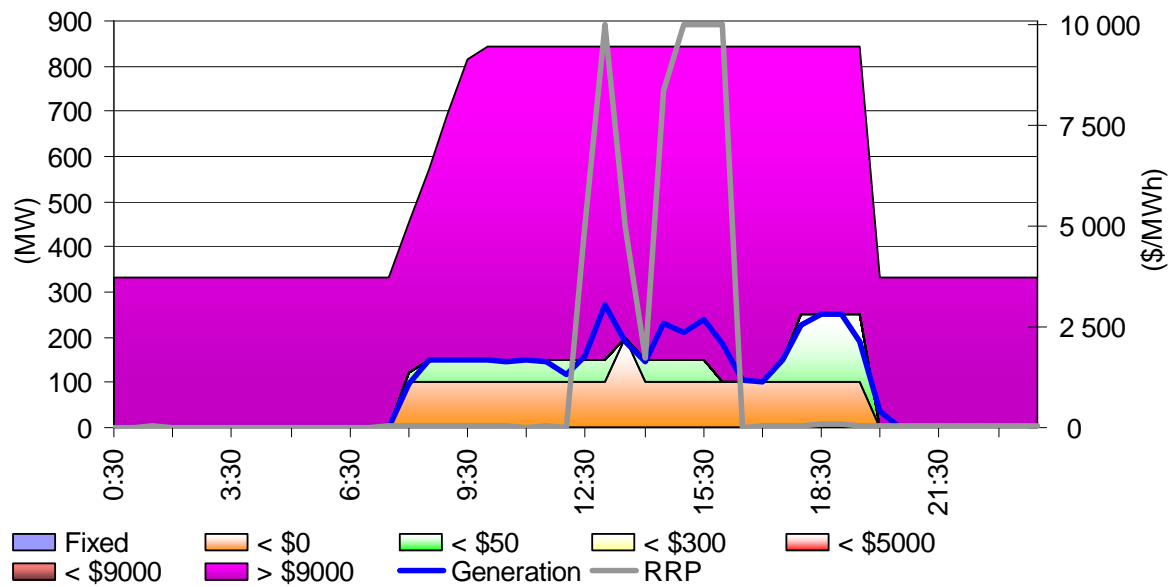


Figure B2: LYMMCO closing bid prices, dispatch and spot price

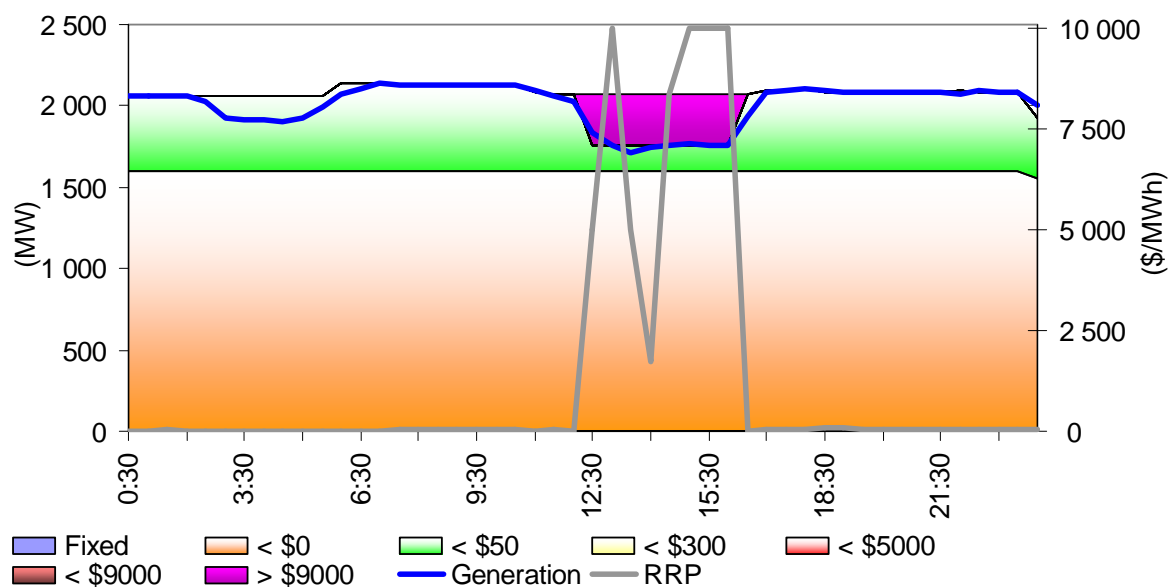


Figure B3: Loy Yang B closing bid prices, dispatch and spot price

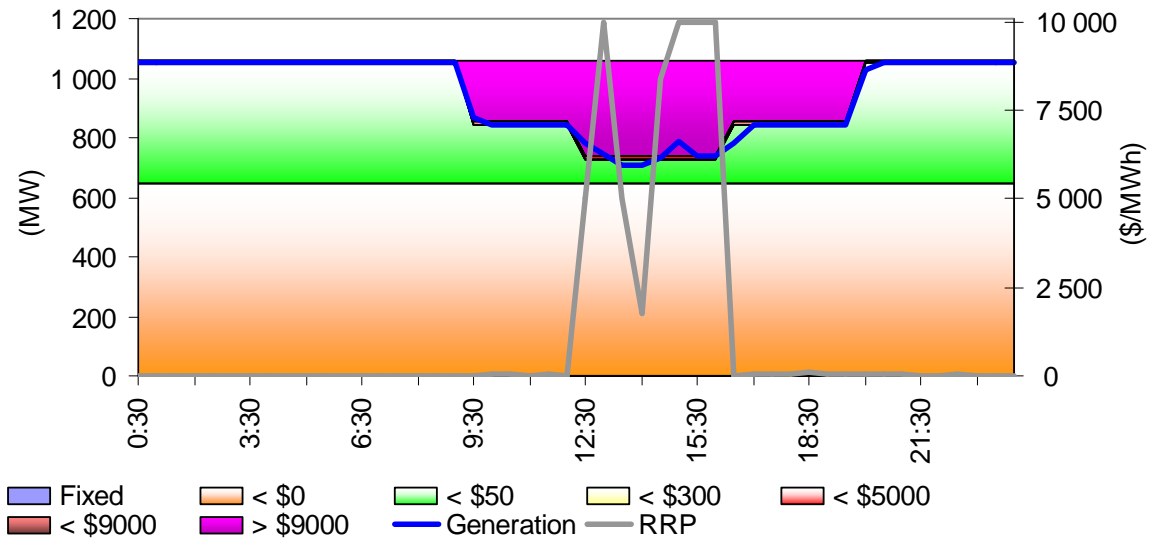


Figure B4: Hazelwood closing bid prices, dispatch and spot price

