Electricity spot prices above $5000/MWh

New South Wales, 4 January 2020

28 February 2020

AUSTRALIAN ENERGY REGULATOR

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Contents

1 Obligation 4

2 Summary 5

3 Analysis 6

3.1. Overview of actual and expected conditions 6

3.3. Supply 7

3.3.1 Network availability 7

Table 2: Timeline of network outages 7

3.3.2 Generation 9

3.3.3 Lack of Reserve level 2 13

3.3.4 Reliability and Emergency Reserve Trader (RERT) 13

4 Appendix A: Closing bids 14

5 Appendix B: Significant rebids 19

6 Appendix C: Price setter 22

1 Obligation

The Australian Energy Regulator (AER) regulates energy markets and networks under national legislation and rules in eastern and southern Australia, as well as networks in the Northern Territory. Its functions include:

- monitoring wholesale electricity and gas markets to ensure energy businesses comply with the legislation and rules, and taking enforcement action where necessary;
- setting the amount of revenue that network businesses can recover from customers for using networks (electricity poles and wires and gas pipelines) that transport energy;
- regulating retail energy markets in Queensland, New South Wales, South Australia, Tasmania (electricity only), and the ACT;
- operating the Energy Made Easy website, which provides a retail price comparator and other information for energy consumers;
- publishing information on the performance of energy markets, including the annual State of the energy market report and biennial effective competition report, to assist stakeholders and the wider community.

The AER is required to publish a report whenever the electricity spot price exceeds $5000 per megawatt hour ($/MWh) in accordance with clause 3.13.7 (d) of the National Electricity Rules.

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.

These reports are designed to examine market events and circumstances that contributed to wholesale market price outcomes and are not an indicator of potential compliance issues or enforcement action.

2 Summary

On 4 January 2020 the spot price for electricity for the 4 pm to 6 pm trading intervals in New South Wales exceeded $5000/MWh. The maximum spot price for the day was set during the 5 pm and 5.30 pm trading intervals at $14 700/MWh.

Bushfires in the vicinity of the transmission network around the Snowy Mountains saw multiple outages occur in quick succession leading to the New South Wales to Victoria interconnection being interrupted, electrically separating the two states. With high demand reflecting temperatures above 40°C, limited generation supplies as a result of the network outages and subsequent constraints on other generators to manage the security requirements, the wholesale price rose significantly to reflect the extreme and volatile conditions.

Rebidding of some generation capacity from low to high prices contributed to the price exceeding $5000/MWh.

Shortly after the network outages occurred the market operator, AEMO, declared a Lack of Reserve (LOR) level 2 in New South Wales.

Later in the evening AEMO invoked the Reliability and Emergency Reserve Trader (RERT) mechanism to ensure there was enough supply to meet demand. Despite these conditions, wholesale prices remained below $5000/MWh during this period.

3 Analysis

The following sections provide analysis of the factors that led to the spot price in New South Wales reaching $14 700/MWh for the 4 pm to 6 pm trading intervals.

3.1 Overview of actual and expected conditions

The spot price exceeded $5000/MWh for the 4 pm to 6 pm trading intervals. Maximum temperatures in New South Wales exceeded 40°C on that day. This drove demand to reach a maximum of 12 334 MW at 4.30 pm. This was approximately 2400 MW lower than New South Wales' record maximum demand of 14 760 MW.

Table 1 shows the actual and forecast spot prices along with demand, local generator availability and imports into New South Wales from Victoria for the 4 pm to 6 pm trading intervals in New South Wales.

Table 1: Actual and forecast spot prices, demand and available capacity, and imports from Victoria for New South Wales

Trading interval	Price ($/MWh)		Demand (MW)		Availability (MW)		Imports from Victoria (MW)	
	Actual	4 hr forecast	Actual	4 hr forecast	Actual	4 hr forecast	Actual	4 hr forecast
4 pm	9900	60	12 177	12 420	13 559	14 364	0	915
4.30 pm	14 526	74	12 334	12 513	12 704	14 246	263	849
5 pm	14 700	95	12 148	12 528	11 530	14 134	506	839
5.30 pm	14 700	83	12 154	12 526	11 536	14 007	475	844
6 pm	5149	95	11 977	12 372	11 362	13 888	481	798

Table 1 shows that given the unexpected impact of the bushfires on the transmission network:

- Four hour forecasts did not anticipate prices would exceed $100/MWh.
- Actual generation was up to 2700 MW lower than the four hour forecast.
- Actual imports from Victoria were between 340 MW to 915 MW lower than forecast, reflecting the reduced network capability. As a result New South Wales could not access as much low priced generation from Victoria as expected.
- Demand was lower than the four hour forecast, likely due to customers, especially large customers, reducing their consumption levels in response to the high prices and requests by the New South Wales Government for reductions in non-essential electricity consumption.[1]

[1] https://www.smh.com.au/politics/nsw/every-megawatt-counted-how-nsw-dodged-major-outages-amid-record-demand-20200105-p53owm.html

3.3 Supply

This section examines the supply side factors that had an effect on the high price outcomes.

3.3.1 Network availability

The NEM is connected via high voltage interconnectors, through which electricity is transferred between regions. New South Wales is connected to Victoria via the VIC-NSW interconnector, and connected to Queensland via the QNI and Terranora interconnectors. Import and export limits control the maximum amount of electricity that can flow between regions across interconnectors. The market operator, AEMO, manages the flow of electricity across the network using network constraints to ensure that system security is maintained. Constraints are mathematical equations that manage or "limit" flows on specific transmission lines (including interconnectors) for each five minute interval. AEMO uses generator offers and SCADA data to determine the optimal flow of electricity across the network.

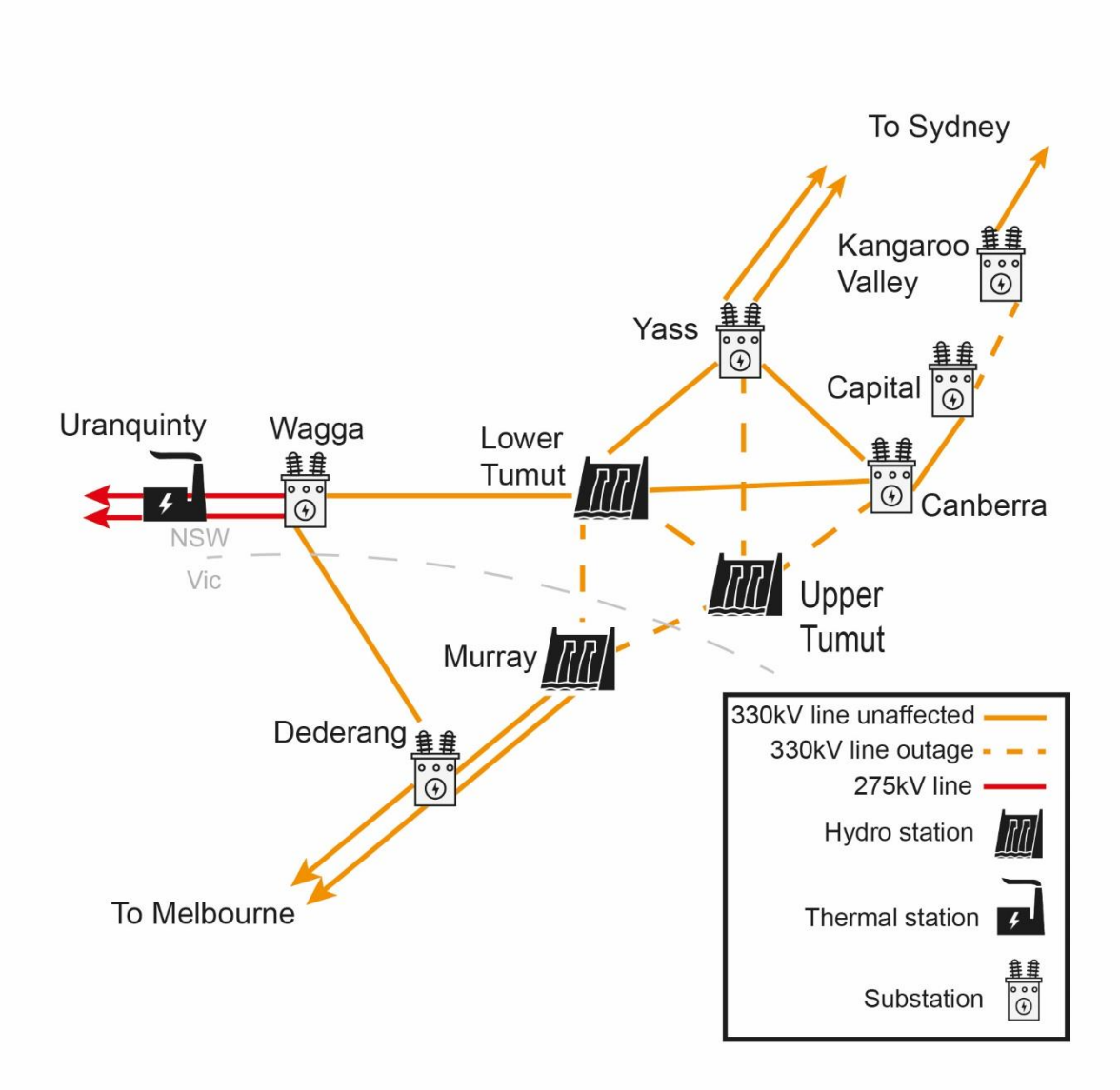
Earlier in the day, AEMO had signalled that the possible loss of available generation or network elements was more likely to occur in the Snowy Mountains region due to extreme bushfire conditions.[2] A series of unplanned network outages around the VIC-NSW interconnector occurred from around 12.30 pm. These are detailed in Table 2 and Figure 1. These outages culminated in the loss of the VIC-NSW interconnector during the 4 pm trading interval after the Upper and Lower Tumut switching stations were interrupted.[3]

Table 2: Timeline of network outages

Time	Line impacted	Market notice
12.33 pm	Upper Tumut to Lower Tumut 64 330 kV line	72277
1.24 pm	Upper Tumut to Lower Tumut 64 330 kV line	72281
1.51 pm	Murray to Upper Tumut 65 330 kV line	72282
2.35 pm	3W Capital to Kangaroo Valley 330 kV line	72284
2.38 pm	Upper Tumut to Yass 330 kV line	72885
3.16 pm	Murray to Lower Tumut 330 kV line	72288

[2] AEMO Market Notice 72269.
[3] AEMO Market Notices 72277, 72281, 72282, 72284, 72285, 72288, and 72291.

Figure 1: Network configurations



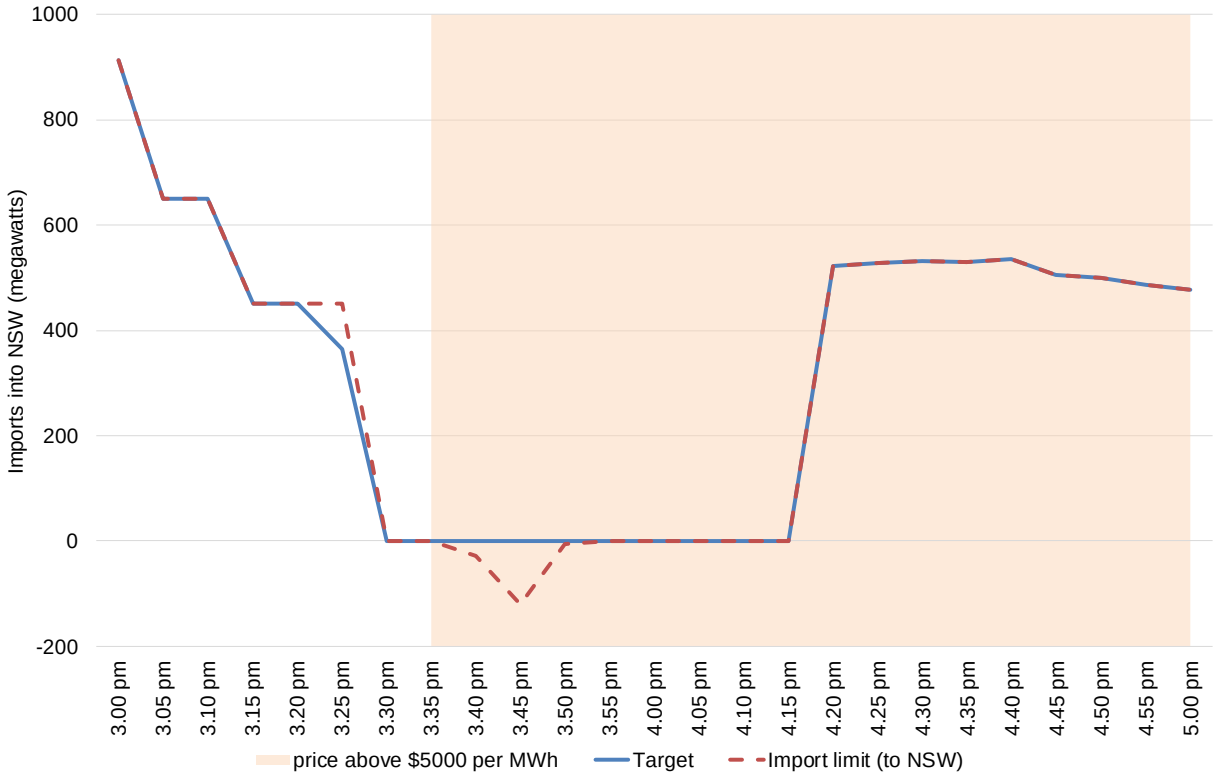
Due to the network outages, generation in the surrounding areas could not physically get to market (detailed further under section 3.3.2), and imports into New South Wales over the VIC-NSW interconnector during the 12.30 pm to 3.30 pm trading intervals were reduced. Imports from Victoria were 470 MW lower than expected, about half of what was forecast four hours ahead.

Figure 2 shows imports into New South Wales reduced by up to 900 MW between 3 pm and 3.30 pm, and from the 3.35 pm dispatch interval onwards New South Wales was separated from Victoria during the high price trading intervals.

While it may look like imports increased again after 4.15 pm, the VIC-NSW interconnector remained offline. The recorded flows are due to AEMO directing energy through an alternative pathway around the outages, from Dederang in Victoria to Wagga Wagga in New South Wales.[4]

[4] Market Notice 77229

Figure 2: Imports into New South Wales over the VIC-NSW interconnector



Note - for this chart imports are shown as flows into New South Wales from Victoria. A negative import value means that flows were into Victoria.

The outage of the VIC-NSW interconnector resulted in an additional 460 MW of imports from Queensland into New South Wales over the QNI interconnector, up to its maximum nominal capacity of 1000 MW during the high price intervals.

3.3.2 Generation

This section discusses the amount and price of generation capacity available on the day.

Installed summer capacity in New South Wales is around 16 500 MW. On 1 January 2020 AEMO issued a market notice[5] stating that forecast temperatures were equal to or greater than the reference temperature used to determine summer ratings and generator offers should reflect that. Less than 14 500 MW was offered just before the loss of the interconnector, mostly due to de-rating of plants due to forecast (and then actual) extreme temperatures.

Table 3 lists the main generators with reduced capacity at 3 pm (compared to their maximum summer rating) and why. Some of this capacity came back online for the high price intervals.

[5] Market Notice 72247

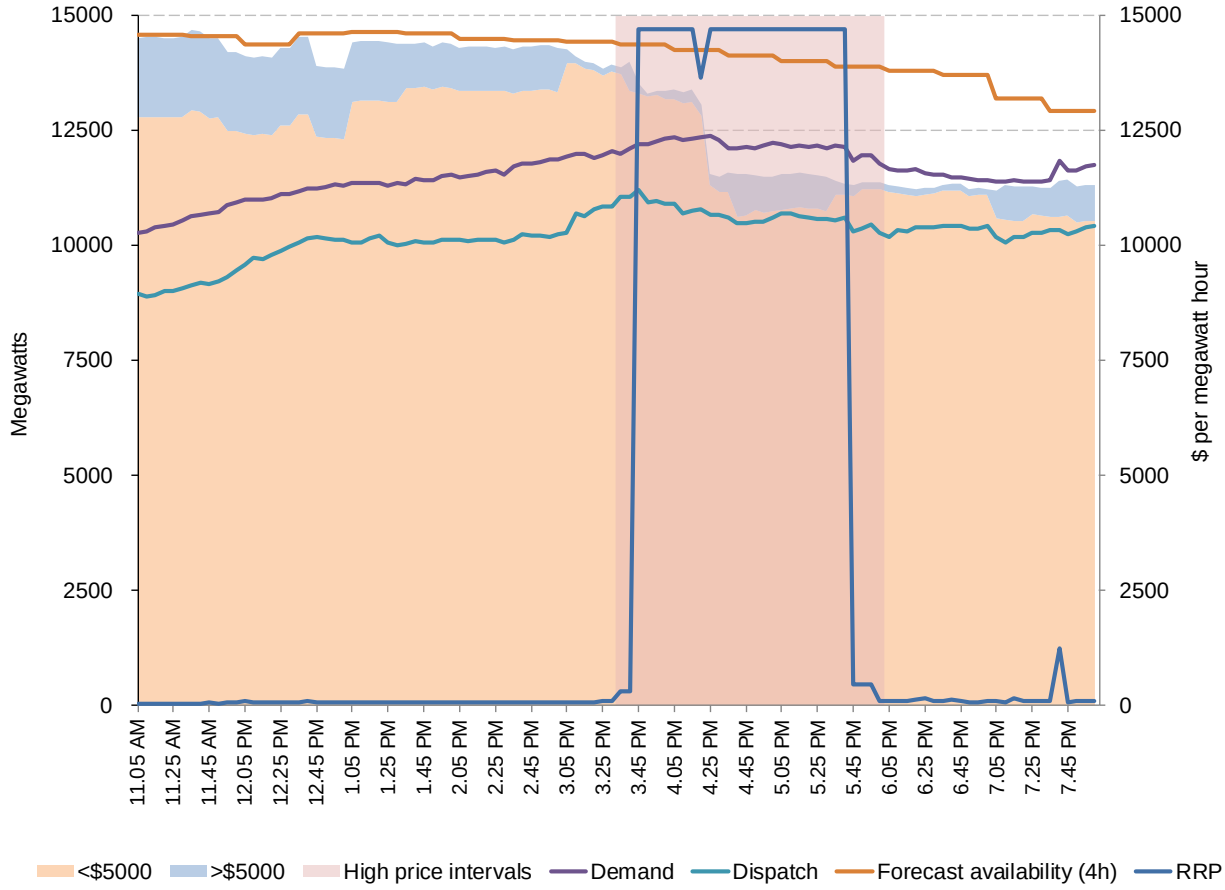
Table 3: Available capacity at 3 pm

Station	Summer rating (MW)	Offered availability (MW)	Difference (MW)	Reason
Bayswater	2520	2420	100	Technical issues related to fuel mills
Eraring	2880	2580	300	Ambient temperature issues then availability further constrained off due to loss of the interconnector
Liddell	1800	1560	240	Technical issues
Sapphire Wind Farm	187	10	177	Low wind output
Shoalhaven	240	0	240	Existing planned outage
Smithfield	104	0	104	Unavailable but came on during high price intervals
Uranquinty	640	524	116	Ambient temperature issues then availability further constrained off due to loss of the interconnector
White Rock Wind Farm	172	9	163	Low wind output
Total			**1440**	

Figure 3 shows actual generation availability in New South Wales, also known as closing bids. The figure shows the actual capacity offered by generators including amendments to their offers to match changes to their own economic and/or physical positions. Capacity offered below $5000/MWh is shown in beige and capacity offered above $5000/MWh is in light blue. The purple and blue lines show the demand (MW) and spot price ($/MWh) for electricity in New South Wales respectively. The orange line shows the availability for 4 January that was forecast at 12.30 pm the day prior (the initial forecast run for 4 January).

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 A: Closing bids*.

Figure 3: generation availability for New South Wales



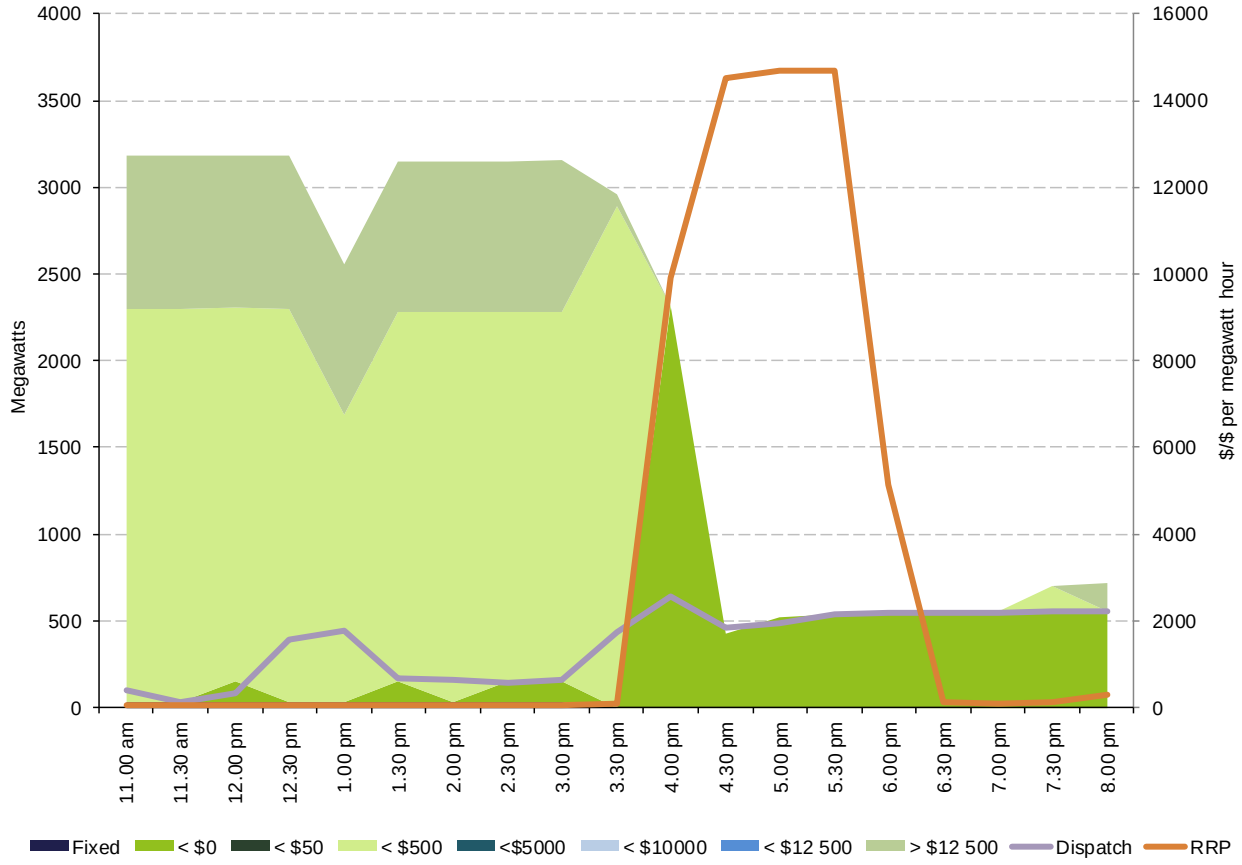
Despite 96 per cent of the available capacity (on average during the high price trading intervals) was priced below $5000/MWh, a number of factors combined that meant the price was set at the cap for a number of trading intervals. These factors included the network outages leading to reduced low-priced generation, energy and FCAS market trade-off and minor rebidding of capacity to prices above $5000/MWh.

3.3.2.1 Reduced low-priced generation

Actual availability dropped by around 2700 MW (the gap between the orange line and the top of the blue section in figure 3) between 3.30 pm to 5 pm. The drop in availability in New South Wales was largely due to Snowy Hydro's generators being significantly impacted by the network outages.

Figure 4 shows Snowy Hydro's availability dropped by over 2700 MW between the 3 pm and 4.30 pm trading intervals as the switching stations at Upper and Lower Tumut were out of service. As a result electricity generated at Upper Tumut and Lower Tumut power stations could not reach the market. Generator availability from Lower Tumut, Upper Tumut, Guthega and Blowering were all reduced to 0 MW from around 4 pm.

Figure 4: Snowy Hydro closing bids, dispatch and spot price in New South Wales



3.3.2.2 Rebidding

For the 5 pm and 5.30 pm trading intervals, rebidding contributed to high price outcomes as Boco Rock Wind Farm rebid all of its 110 MW of available capacity from the price floor to the price cap (see Figure A2 in Appendix A). The reason given related to a change in the price for global raise 6 second ancillary services. Boco Rock Wind Farm set price for two and four dispatch intervals respectively in the 5 pm and 5.30 pm trading intervals.

At 4.31 pm, for the 5 pm to 6 pm trading intervals Origin Energy rebid around 540 MW of capacity at Uranquinty from the price floor to the price cap. At 4.42 pm, around 135 MW was rebid back down to the price floor for the 5 pm and 5.30 pm trading intervals. For the 6 pm trading interval, the remaining 400 MW was rebid down to the floor at 5.29 pm. The reasons given all related to a constraint managing the separation of New South Wales from Victoria. However, due to constraints relating to the network outages Uranquinty could not get its generation to market during any of the above trading intervals.

Details of all significant rebids are contained in *Appendix B: Significant rebids*.

3.3.2.3 Energy FCAS trade-off

The market operator's dispatch engine optimises the eight FCAS markets and the energy market simultaneously every dispatch interval to determine the least cost outcome. This can lead to a trade-off between the FCAS and energy markets. For example, a generator may be reduced in

providing raise ancillary services so it can provide additional energy. This can impact on the prices within both FCAS and energy markets

Global prices[6] for raise regulation and contingency services were at the price cap of $14 700/MW at the same time as the high price trading intervals in the energy markets.

Though maximum availability of FCAS did not significantly change on the day, the effective availability (taking the trade-off into account) was impacted by the high output needed from New South Wales generators.

Effective availability dropped significantly in all raise services in New South Wales between 12 pm to 4 pm. In order for generators that were still online to provide additional megawatts of energy in New South Wales, additional megawatts of raise services had to be sourced from generators in Queensland which were priced at or close to the price cap. This resulted in the prices for global raise services being set at $14 700/MWh from 3.30 pm to 5.40 pm.

Around half of the high priced intervals were set by the co-optimisation between the Energy and the FCAS markets.

How that price was determined by the market systems are detailed in *Appendix C: Price setter*.

3.3.3 Lack of Reserve level 2

When demand and supply conditions are tight AEMO notifies the market, through Lack of Reserve (LOR) notices, to elicit a market response to increase generation or reduce demand. LORs have three levels – LOR 1, 2 and 3 with LOR 1 being the least severe and LOR 3 meaning there is not enough supply to meet demand. LOR 3 requires AEMO to shed load (commercial and industrial first then residential customers if required) in order to maintain power system security.

Following the loss of availability from Snowy Hydro's generators, an actual LOR 2 was declared in New South Wales from 4 pm. The LOR 2 conditions resulted from unplanned network outages and generation that was unable to reach the major demand centres.[7]

On this day no load shedding was required to keep the system in a secure state.

3.3.4 Reliability and Emergency Reserve Trader (RERT)

Following the declaration of an LOR 2 in New South Wales, AEMO signalled its intent to commence negotiations for additional reserve under RERT contract arrangements at 4.18 pm. By 5.30 pm, AEMO had entered into a reserve contract and dispatched or activated reserves to be in effect from 6.20 pm.[8] Around 230 MW of reserve supply was delivered from the 6.30 pm to 10 pm trading intervals.[9]

Australian Energy Regulator

February 2020

[6] Global prices refers to prices for FCAS in New South Wales and Victoria and relating to mainland FCAS requirements.
[7] Market notice 72315.
[8] Market notices 72310, 72333, and 72334.
[9] AEMO RERT Activation report 4 January 2020

4 Appendix A: Closing bids

Figure A1 to Figure A7 highlight the half hour closing bids for participants in New South Wales with 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 A1: AGL Energy (Bayswater, Hunter Valley GT, Liddell, Nyngan) closing bids, dispatch and spot price

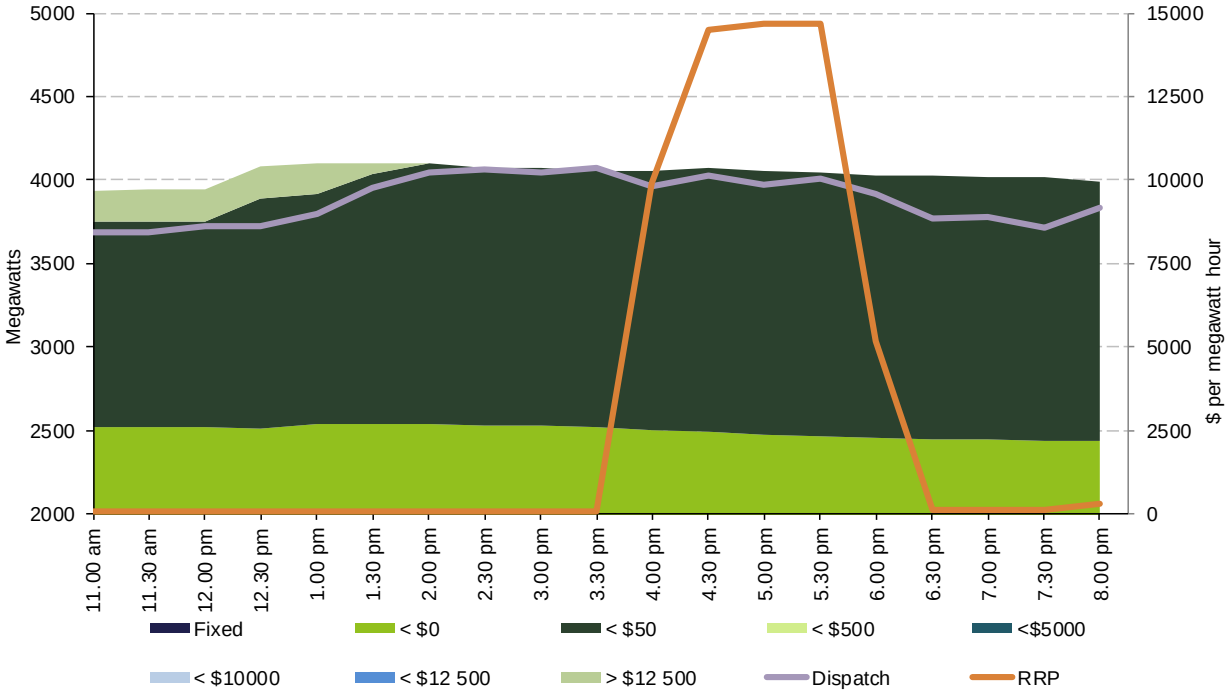


Figure A2: Boco Rock Wind Farm closing bids, dispatch and spot price

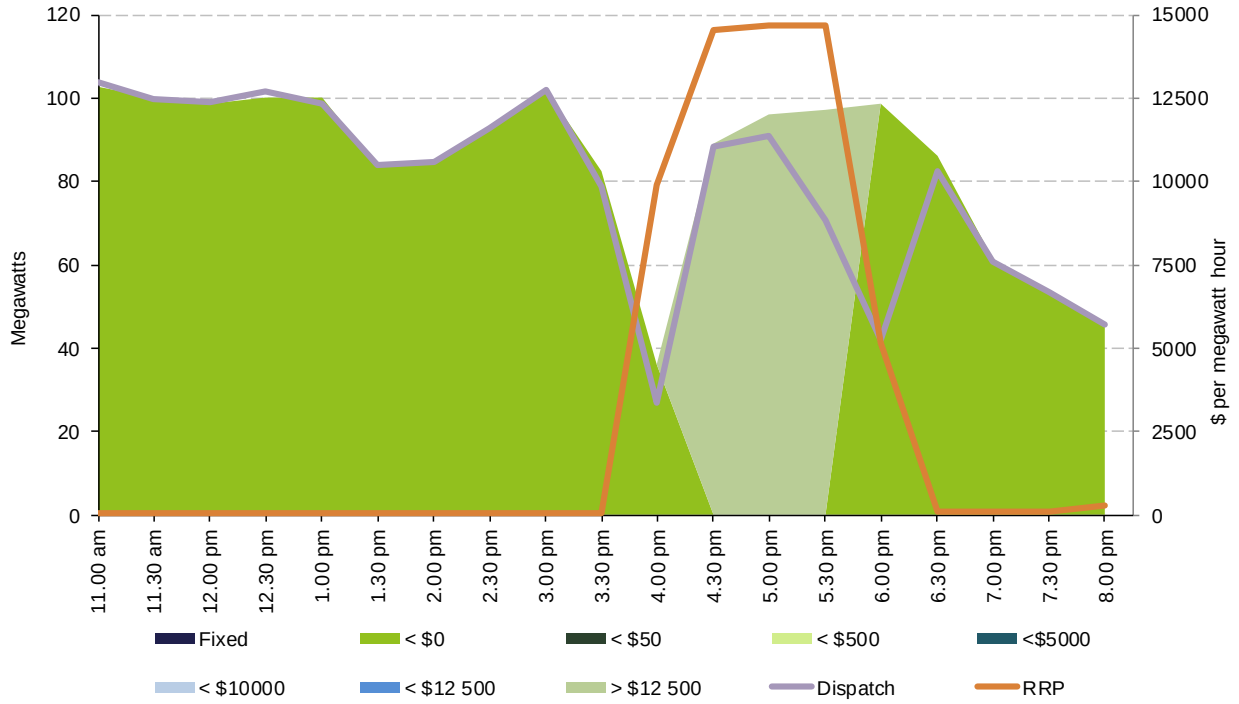


Figure A3: Delta Electricity (Vales Point) closing bids, dispatch and spot price

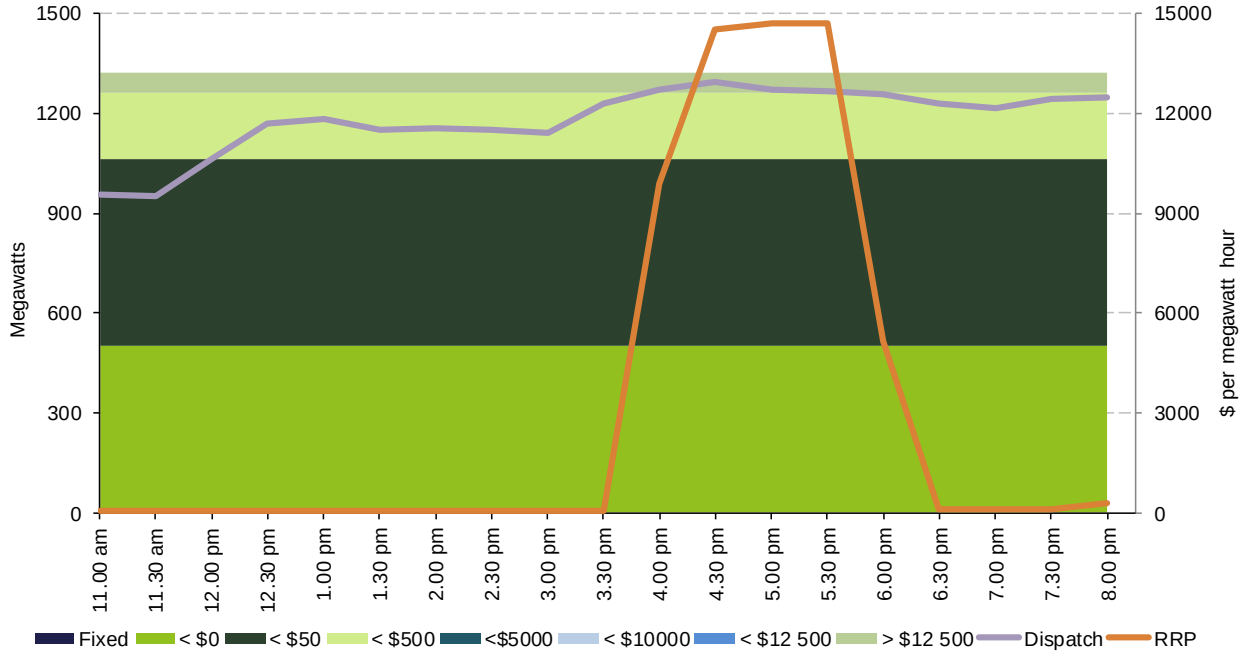


Figure A4: Energy Australia (Mt Piper and Tallawarra) closing bids, dispatch and spot price

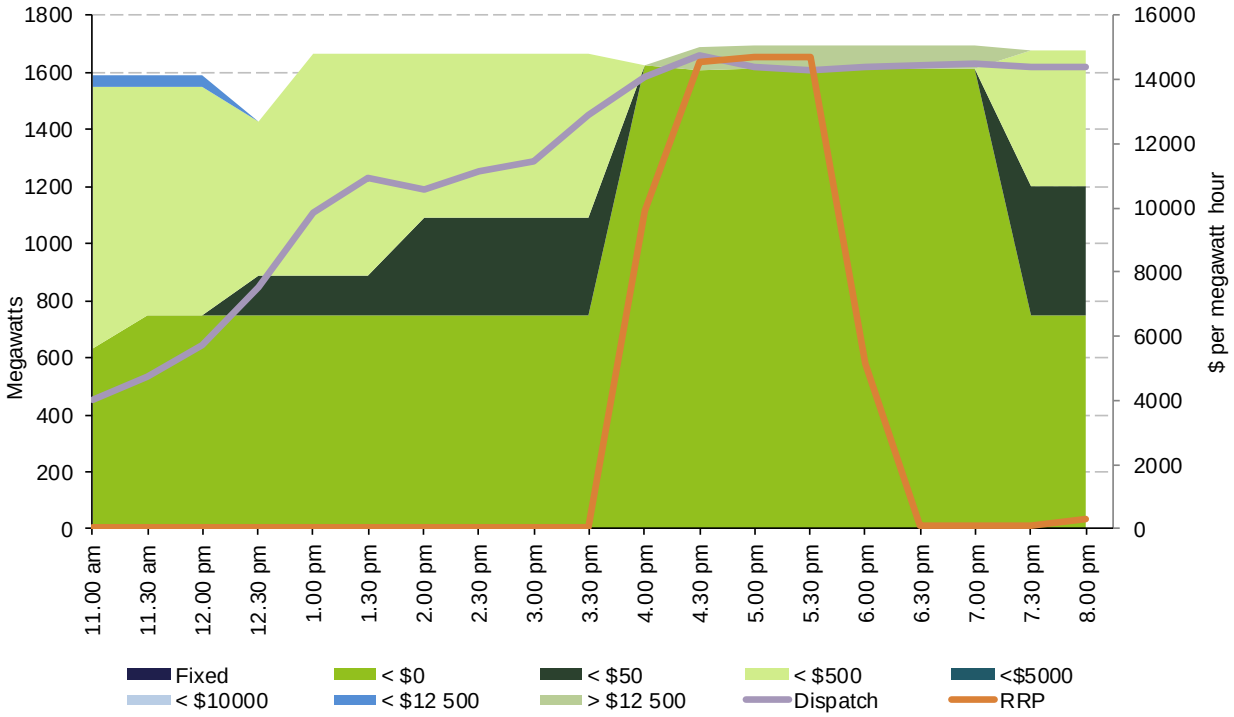


Figure A5: Finley Solar Farm closing bids, dispatch and spot price

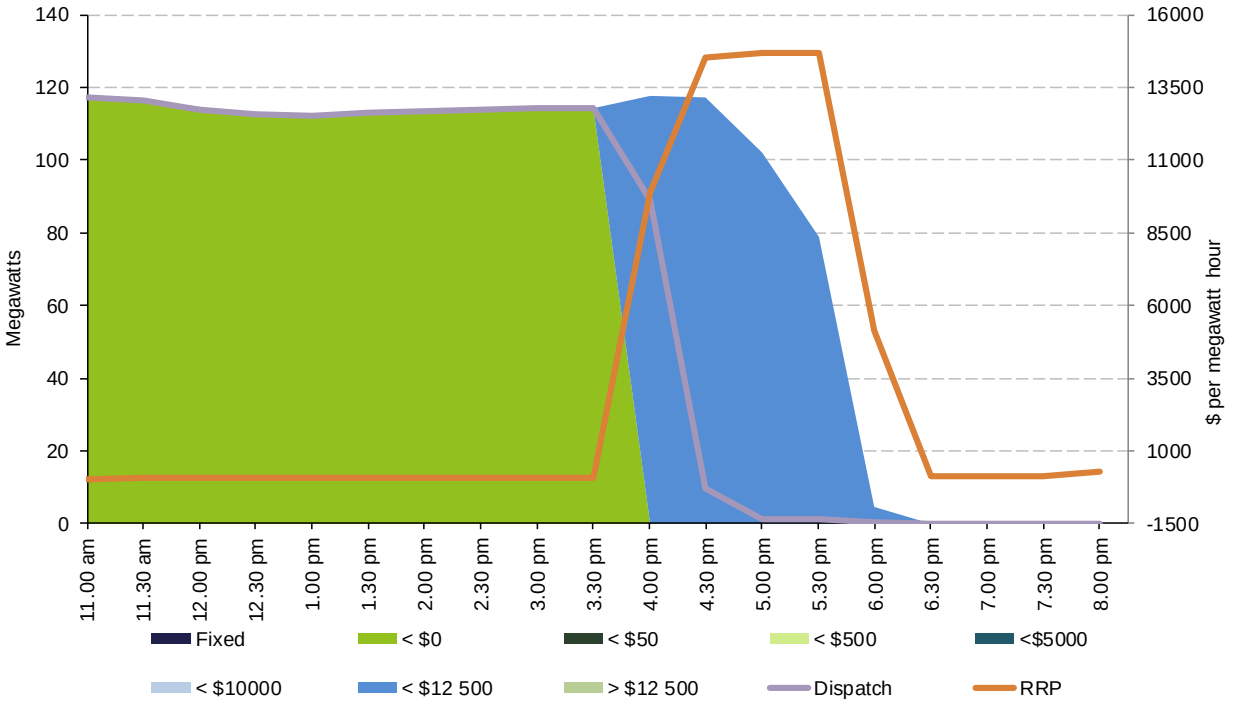


Figure A6: Origin Energy (Eraring and Uranquinty) closing bids, dispatch and spot price

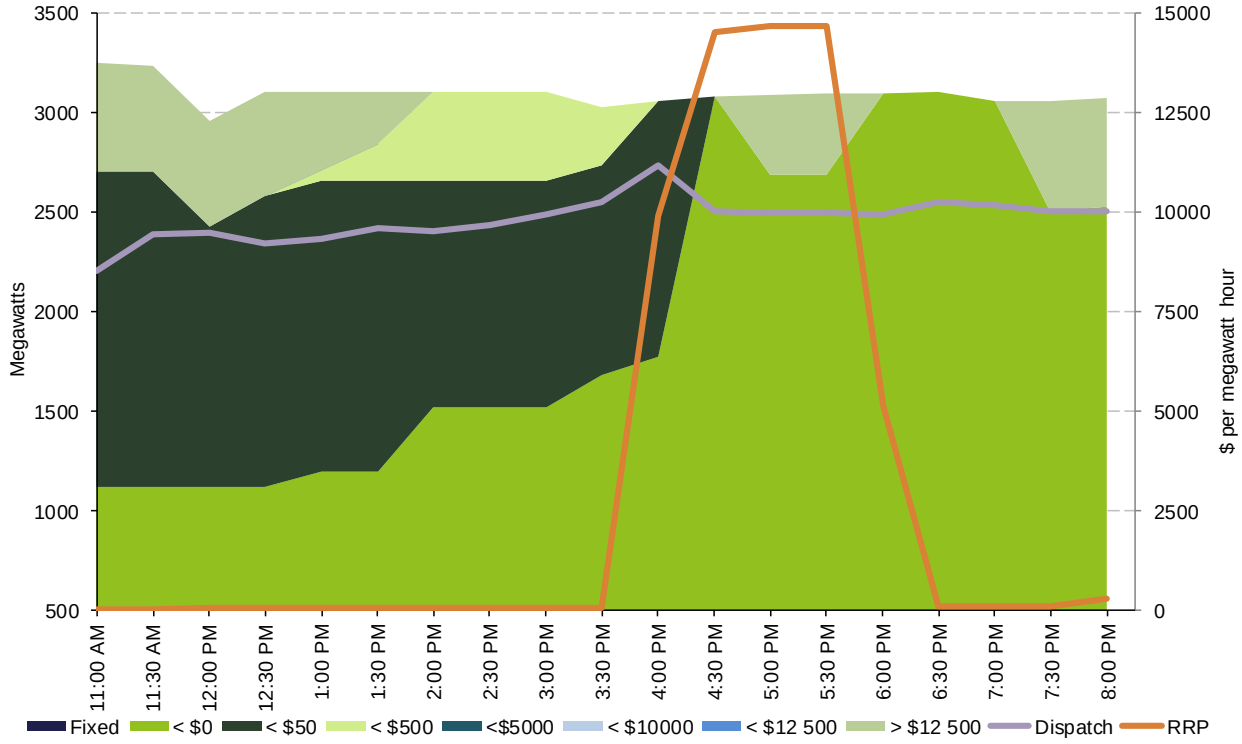
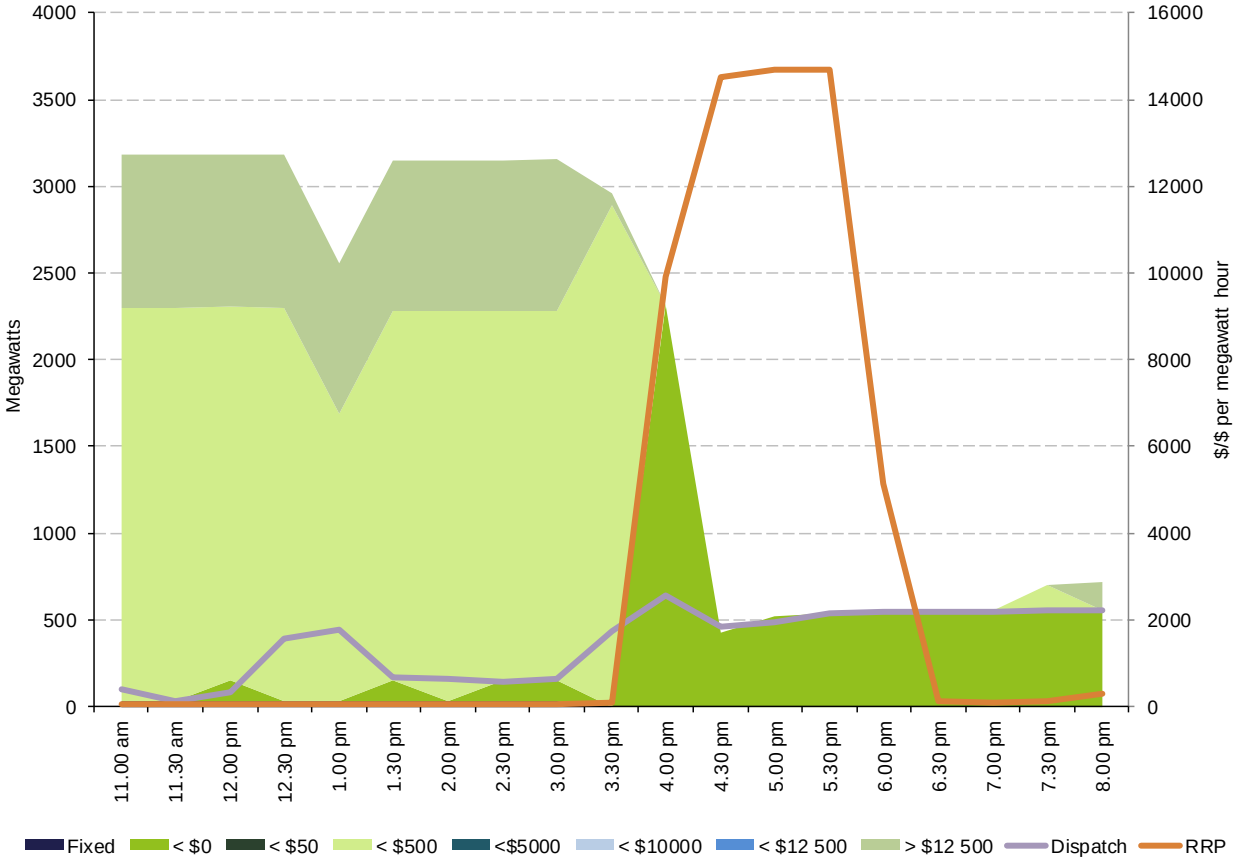


Figure A7: Snowy Hydro (Colongra , Lower Tumut, Upper Tumut, Guthega, Blowering) closing bids, dispatch and spot price



5 Appendix B: Significant rebids

The rebidding table highlight the relevant rebids submitted by generators that impacted on market outcomes during the time of high prices. It details the time the rebid was submitted and used by the dispatch process, the capacity involved, the change in the price of the capacity being offered, and the rebid reason.

Table B 1: New South Wales significant rebids for 4 pm to 6 pm trading intervals

Submit time	TI effective	Participant	Station	Max capacity rebid (MW)	Price from ($/MWh)	Price to ($/MWh)	Rebid reason
1.42 pm	4 pm - 5.30 pm	Infigen Energy	Bodangora Wind Farm	-56	-1000	N/A	1345~P~change in plant availability - high temperature derating SL~
2.10 pm	4 pm – 6 pm	Infigen Energy	Bodangora Wind Farm	-15	-1000	N/A	1415~P~change in plant availability - wtg temp derating SL~
3.03 pm	5 pm, 5.30 pm	Snowy Hydro	Upper Tumut	-143	14 700	N/A	15:03:30 P update capability parameters for change to outage plan/plant conditions
3.08 pm	4 pm, 4.30 pm	Origin Energy	Eraring	-20	43	N/A	1505P change in avail - forced limitation SL
3.15 pm	4 pm – 6 pm	Snowy Hydro	Blowering	-34	-1000	N/A	15:14:23 P update capability parameters for change to outage plan/plant conditions
3.17 pm	4 pm, 4.30 pm	Origin Energy	Eraring	-50	49	N/A	1514P change in avail - forced limitation SL
3.21 pm	4 pm, 4.30 pm	Origin Energy	Eraring	-10	43	N/A	1519P change in avail - forced limitation SL
3.30 pm	4 pm – 6 pm	AGL PARF NSW Pty Ltd	Silverton Wind Farm	-75	-1000	N/A	1525~P~020 reduction in avail cap~units requested to come offline by transgrid
3.32 pm	4 pm	Snowy Hydro	Upper Tumut	-480	299	N/A	15:31:47 P update capability parameters for change to outage plan/plant conditions
3.36 pm	4 pm	Infigen	Smithfield	-106	-984	N/A	1535~E~operator error SL~

Submit time	TI effective	Participant	Station	Max capacity rebid (MW)	Price from ($/MWh)	Price to ($/MWh)	Rebid reason
3.38 pm	4 pm, 5 pm – 6 pm	Snowy Hydro	Upper Tumut	-341	14 700	N/A	15:38:30 P update capability parameters for change to outage plan/plant conditions
3.42 pm	4 pm, 5 pm	Snowy Hydro	Upper Tumut	-143	-1000	N/A	15:42:15 P update capability parameters for change to outage plan/plant conditions
3.43 pm	4 pm - 4.30 pm	Energy Australia	Tallawarra	-38	13 455	N/A	1540~P~adj avail due to ambient conditions~
3.53 pm	4 pm - 5.30 pm	Snowy Hydro	Colongra	-167	<435	N/A	15:53:30 P update capability parameters for change to outage plan/plant conditions
3.56 pm	4.30 pm - 6 pm	Snowy Hydro	Colongra	-18	-1000	N/A	15:56:24 P revised station capability due to changed ambient temperature
4.03 pm	4.30 pm - 5 pm	Snowy Hydro	Guthega	-67	-1000	N/A	16:03:30 P update capability parameters for change to outage plan/plant conditions
4.03 pm	5.30 pm	Snowy Hydro	Guthega	-67	14 700	N/A	16:03:30 P update capability parameters for change to outage plan/plant conditions
4.10 pm	4.30 pm - 6 pm	Snowy Hydro	Colongra	-22	-1000	N/A	16:09:51 P revised station capability due to changed ambient temperature
4.10 pm	4.30 pm - 6 pm	Snowy Hydro	Colongra	-7	-1000	N/A	16:10:13 P revised station capability due to changed ambient temperature
4.16 pm	4.30 pm - 6 pm	Snowy Hydro	Tumut	-1749	-1000	N/A	16:16:20 P update capability parameters for change to outage plan/plant conditions

Submit time	TI effective	Participant	Station	Max capacity rebid (MW)	Price from ($/MWh)	Price to ($/MWh)	Rebid reason
4.23 pm	5 pm – 6 pm	Boco Rock Wind Farm	Boco Rock Wind Farm	110	-1000	14 700	1621 F Revised offer as a result of R6raise price in NSW
4.27 pm	5.30 pm	Snowy Hydro	Upper Tumut	-143	299	N/A	16:27:36 P update capability parameters for change to outage plan/plant conditions
4.28 pm	5 pm – 6 pm	Snowy Hydro	Colongra	36	N/A	-1000	16:27:49 P update capability parameters for change to plant conditions
4.31 pm	6 pm	Origin Energy	Uranquinty	540	-1000	14 700	1630A constraint management - NQ_VST_ISLE_ASL
4.35 pm	5 pm	Snowy Hydro	Colongra	-166	-1000	N/A	16:34:58 P update capability parameters for change to outage plan/plant conditions
4.42 pm	6 pm	Origin Energy	Uranquinty	135	14700	-1000	1640A constraint management - NQ_VST_ISLE_ASL
5.08 pm	6 pm	Snowy Hydro	Colongra	-171	-1000	N/A	17:08:06 P update capability parameters for change to outage plan/plant conditions
5.29 pm	6 pm	Origin Energy	Uranquinty	405	14 700	-1000	1728A constraint management - NQ_VST_ISLE_ASL

6 Appendix C: Price setter

The following tables identify 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.[10] The 30-minute spot price is the average of the six dispatch interval prices. The dispatch prices that are in italics are capped at the price cap of $14 700/MWh when published by AEMO.

Table C1: New South Wales price setter 4 pm

DI	Dispatch Price ($/MWh)	Participant	Unit	Service	Offer price ($/MWh)	Marginal change	Contribution
3.35 pm	$300	Snowy Hydro	UPPTUMUT	Energy	$300	1.00	$300
3.40 pm	$300	Snowy Hydro	TUMUT3	Energy	$300	1.00	$300
3.45 pm	*$14 700*	AGL Energy	BW01	Energy	$38	2.65	$102
		Origin Energy	ER04	Energy	$43	-1.65	-$70
		AGL Energy	BW01	Raise 60 sec	$100	-1.65	-$165
		Origin Energy	ER03	Raise 60 sec	$12 490	1.65	$20 608
		AGL Energy	BW01	Raise 6 sec	$100	-1.65	-$165
		Origin Energy	ER04	Raise 6 sec	$12 200	1.65	$20 130
3.50 pm	*$14 700*	Delta Electricity	VP6	Energy	$14 300	1.00	$14 300
		Delta Electricity	VP6	Raise 5 min	$1	-1.00	-$1
		Origin Energy	ER03	Raise 5 min	$14 700	1.00	$14 700
		Delta Electricity	VP6	Raise 60 sec	$2	-1.00	-$2
		Origin Energy	ER03	Raise 60 sec	$14 700	1.00	$14 700
		Delta Electricity	VP6	Raise 6 sec	$2	-1.00	-$2
		Stanwell	STAN-1	Raise 6 sec	$14 700	1.00	$14 700
3.55 pm	*$14 700*	Delta Electricity	VP6	Energy	$14 300	1.00	$14 300
		Delta Electricity	VP6	Raise 5 min	$1	-1.00	-$1
		Origin Energy	ER03	Raise 5 min	$14 700	1.00	$14 700
		Delta Electricity	VP6	Raise 60 sec	$1	-1.00	-$1
		Origin Energy	ER03	Raise 60 sec	$14 700	1.00	$14 700
		Delta Electricity	VP6	Raise 6 sec	$1	-1.00	-$1
		Stanwell	STAN-1	Raise 6 sec	$14 700	1.00	$14 700
4 pm	*$14 700*	Snowy Hydro	GUTHEGA	Energy	-$1000	1.00	-$1000
Spot Price		**$9900/MWh**					

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

Table C2: New South Wales price setter 4.30 pm

DI	Dispatch Price ($/MWh)	Participant	Unit	Service	Offer price ($/MWh)	Marginal change	Contribution
4.05 pm	*$14 700*		NSW1,ENOF	Generation deficit constraint	$2 205 000	1.00	$2 205 000
4.10 pm	*$14 700*		NSW1,ENOF	Generation deficit constraint	$2 205 000	1.00	$2 205 000
4.15 pm	*$14 700*		NSW1,ENOF	Generation deficit constraint	$2 205 000	1.00	$2 205 000
4.20 pm	$13 654	Origin Energy	ER02	Energy	-$1000	1.00	-$1000
		Origin Energy	ER02	Raise 6 sec	$46	-1.00	-$46
		Stanwell	TARONG#2	Raise 6 sec	$14 700	1.00	$14 700
4.25 pm	*$14 700*	CS Energy	CALL_B_2	Energy	-$1000	-2.61	$2610
		Stanwell	STAN-1	Energy	$48	0.65	$31
		Stanwell	STAN-2	Energy	$48	0.65	$31
		Stanwell	STAN-3	Energy	$48	0.65	$31
		Stanwell	STAN-4	Energy	$48	0.65	$31
		Delta Electricity	VP6	Energy	$14 300	1.00	$14 300
		CS Energy	CALL_B_2	Lower reg	$5	-2.61	-$13
		Delta Electricity	VP5	Lower reg	$25	2.61	$65
		Delta Electricity	VP6	Raise 6 sec	$50	-1.00	-$50
		CS Energy	CALL_B_2	Raise 6 sec	$14 500	1.00	$14 500
4.30 pm	*$14 700*	CS Energy	CALL_B_1	Energy	-$1000	-12.13	$12 130
		CS Energy	CALL_B_2	Energy	-$1000	-12.13	$12 130
		Origin Energy	ER01	Energy	-$1000	9.30	-$9300
		Stanwell	STAN-1	Energy	$48	8.09	$386
		Stanwell	STAN-2	Energy	$48	8.09	$386
		Stanwell	STAN-3	Energy	$48	8.09	$386
		Stanwell	TARONG#1	Energy	$77	-2.52	-$194
		Stanwell	TARONG#2	Energy	$77	-2.52	-$194
		Stanwell	TARONG#3	Energy	$77	-2.52	-$194
		Stanwell	TARONG#4	Energy	$77	-2.52	-$194
		CleanCo Qld Ltd	W/HOE#2	Raise 5 min	$2	9.30	$21
		Origin Energy	ER01	Raise 5 min	$3	-9.30	-$26
		Origin Energy	ER01	Raise 60 sec	$3	-9.30	-$26
		CS Energy	GSTONE1	Raise 60 sec	$34	9.30	$314
		Origin Energy	ER01	Raise 6 sec	$2	-9.30	-$16
		CS Energy	CALL_B_1	Raise 6 sec	$14 500	4.65	$67 425
		CS Energy	CALL_B_2	Raise 6 sec	$14 500	4.65	$67 425
Spot Price		**$14 526/MWh**					

Table C3: New South Wales price setter 5 pm

DI	Dispatch Price ($/MWh)	Participant	Unit	Service	Offer price ($/MWh)	Marginal change	Contribution
4.35 pm	*$14 700*	Stanwell	STAN-1	Energy	$68	0.30	$20
		Stanwell	STAN-2	Energy	$68	0.30	$20
		Stanwell	STAN-3	Energy	$68	0.30	$20
		Stanwell	STAN-4	Energy	$68	0.30	$20
		Delta Electricity	VP6	Raise reg	$100	1.12	$112
		Stanwell	STAN-1	Raise reg	$116	-1.12	-$130
		Delta Electricity	VP6	Raise 60 sec	$50	-1.12	-$56
		Stanwell	TARONG#2	Raise 60 sec	$55	1.12	$62
		Delta Electricity	VP6	Raise 6 sec	$50	-1.12	-$56
		Stanwell	TARONG#2	Raise 6 sec	$14 700	1.12	$16 464
4.40 pm	$14 700	Boco Rock Wind Farm	BOCORWF 1	Energy	$14 700	1.00	$14 700
4.45 pm	*$14 700*	EnergyAustralia	MP2	Energy	-$1000	-15.97	$15 970
		AGL Energy	BW01	Energy	$38	25.65	$985
		Braemar Power Projects	BRAEMAR2	Energy	$76	-10.47	-$794
		Stanwell	TARONG#2	Raise 5 min	$12	9.68	$116
		AGL Energy	BW01	Raise 5 min	$100	-25.65	-$2565
		EnergyAustralia	MP2	Raise 5 min	$249	15.97	$3977
		AGL Energy	BW01	Raise 60 sec	$30	-15.97	-$479
		Stanwell	TARONG#2	Raise 60 sec	$34	9.68	$329
		EnergyAustralia	MP2	Raise 60 sec	$150	6.29	$944
		AGL Energy	BW01	Raise 6 sec	$30	-15.97	-$479
		EnergyAustralia	MP2	Raise 6 sec	$1100	15.97	$17 567
4.50 pm	$14 700	Boco Rock Wind Farm	BOCORWF 1	Energy	$14 700	1.00	$14 700
4.55 pm	*$14 700*	CS Energy	CALL_B_1	Energy	-$1000	-12.28	$12 280
		CS Energy	CALL_B_2	Energy	-$1000	-12.28	$12 280
		EnergyAustralia	MP2	Energy	-$1000	9.38	-$9380
		CleanCo Qld Ltd	W/HOE#2	Energy	$61	-16.71	-$1026
		Stanwell	STAN-1	Energy	$68	6.14	$416
		Stanwell	STAN-2	Energy	$68	6.14	$416
		Stanwell	STAN-3	Energy	$68	6.14	$416
		Stanwell	STAN-4	Energy	$68	6.14	$416
		ERMPower and Arrow	BRAEMAR5	Energy	$118	3.27	$386
		ERMPower and Arrow	BRAEMAR7	Energy	$118	3.27	$386
		CS Energy	CALL_B_1	Lower reg	$5	-12.28	-$61
		CS Energy	CALL_B_2	Lower reg	$5	-12.28	-$61
		EnergyAustralia	MP2	Lower reg	$32	24.56	$781
		CleanCo Qld Ltd	W/HOE#2	Raise 5 min	$2	9.38	$21
		EnergyAustralia	MP2	Raise 5 min	$249	-9.38	-$2336
		CS Energy	CALL_B_1	Raise 60 sec	$101	4.69	$472
		CS Energy	CALL_B_2	Raise 60 sec	$101	4.69	$472

DI	Dispatch Price ($/MWh)	Participant	Unit	Service	Offer price ($/MWh)	Marginal change	Contribution
		EnergyAustralia	MP2	Raise 60 sec	$301	-9.38	-$2823
		EnergyAustralia	MP2	Raise 6 sec	$1100	-9.38	-$10 318
		CS Energy	CALL_B_1	Raise 6 sec	$14 500	4.71	$68 295
		CS Energy	CALL_B_2	Raise 6 sec	$14 500	4.71	$68 295
		Stanwell	TARONG#2	Raise 6 sec	$14 700	-0.03	-$441
5 pm	*$14 700*	CS Energy	CALL_B_1	Energy	-$1000	-12.30	$12 300
		CS Energy	CALL_B_2	Energy	-$1000	-12.30	$12 300
		Origin Energy	ER03	Energy	-$1000	9.40	-$9400
		CleanCo Qld Ltd	W/HOE#2	Energy	$299	-16.74	-$5005
		ERMPower and Arrow	BRAEMAR5	Energy	$591	31.17	$18 435
		CleanCo Qld Ltd	W/HOE#2	Raise 5 min	$2	9.40	$21
		Origin Energy	ER03	Raise 5 min	$3	-9.40	-$26
		Origin Energy	ER03	Raise 60 sec	$3	-9.40	-$26
		CS Energy	CALL_B_1	Raise 60 sec	$101	4.70	$473
		CS Energy	CALL_B_2	Raise 60 sec	$101	4.70	$473
		Origin Energy	ER03	Raise 6 sec	$2	-9.40	-$16
		Stanwell	TARONG#2	Raise 6 sec	$14 700	9.40	$138 180
Spot Price		**$14 700/MWh**					

Table C4: New South Wales price setter 5.30 pm

DI	Dispatch Price ($/MWh)	Participant	Unit	Service	Offer price ($/MWh)	Marginal change	Contribution
5.05 pm	*$14 700*	Millmerran	MPP_2	Energy	-$1000	5.71	-$5710
		CleanCo Qld Ltd	W/HOE#2	Energy	$0	-26.97	$0
		AGL Energy	BW01	Energy	$38	8.06	$309
		AGL Energy	BW03	Energy	$38	7.08	$272
		Stanwell	STAN-4	Energy	$77	-9.43	-$724
		ERM Power	OAKEY1	Energy	$289	10.24	$2956
		ERM Power	OAKEY2	Energy	$289	10.24	$2956
		Delta Electricity	VP5	Energy	$14 300	-5.71	-$81 653
		Millmerran	MPP_2	Lower reg	$19	5.71	$108
		Delta Electricity	VP5	Lower reg	$25	-5.71	-$143
		AGL Energy	BW01	Raise 5 min	$1	-8.06	-$8
		AGL Energy	BW03	Raise 5 min	$1	-7.08	-$7
		CleanCo Qld Ltd	W/HOE#2	Raise 5 min	$2	15.14	$35
		Millmerran	MPP_2	Raise reg	$0	-5.71	$0
		Delta Electricity	VP5	Raise reg	$100	5.71	$571
		AGL Energy	BW01	Raise 60 sec	$0	-5.02	-$2
		AGL Energy	BW03	Raise 60 sec	$0	-4.41	-$2
		Stanwell	STAN-4	Raise 60 sec	$55	9.43	$519
		AGL Energy	BW01	Raise 6 sec	$0	-5.02	-$2

DI	Dispatch Price ($/MWh)	Participant	Unit	Service	Offer price ($/MWh)	Marginal change	Contribution
		AGL Energy	BW03	Raise 6 sec	$0	-4.41	-$2
		Stanwell	STAN-4	Raise 6 sec	$14 700	9.43	$138 621
5.10 pm	$14 700	Boco Rock Wind Farm	BOCOR WF1	Energy	$14 700	1.00	$14 700
5.15 pm	$14 700	Boco Rock Wind Farm	BOCOR WF1	Energy	$14 700	1.00	$14 700
5.20 pm	$14 700	Boco Rock Wind Farm	BOCOR WF1	Energy	$14 700	1.00	$14 700
5.25 pm	*$14 700*	EnergyAustralia	MP2	Energy	-$1000	-16.07	$16 070
		AGL Energy	LYA1	Energy	$0	3.37	$0
		AGL Energy	LYA3	Energy	$0	3.37	$0
		AGL Energy	LYA4	Energy	$0	3.00	$0
		EnergyAustralia	YWPS1	Energy	$16	-9.74	-$155
		AGL Energy	BW01	Energy	$38	9.26	$355
		AGL Energy	BW02	Energy	$38	8.41	$323
		AGL Energy	BW03	Energy	$38	8.13	$312
		CleanCo Qld Ltd	SWAN_E	Energy	$46	-9.74	-$448
		ERMPower and Arrow	BRAEMAR7	Energy	$593	-0.79	-$469
		AGL Energy	BW01	Raise 5 min	$1	-9.26	-$9
		AGL Energy	BW02	Raise 5 min	$1	-8.41	-$8
		AGL Energy	BW03	Raise 5 min	$1	-8.13	-$8
		Hydro Tasmania	GORDON	Raise 5 min	$19	9.74	$185
		EnergyAustralia	MP2	Raise 5 min	$249	16.07	$4001
		AGL Energy	LYA1	Raise reg	$100	-3.37	-$337
		AGL Energy	LYA3	Raise reg	$100	-3.37	-$337
		AGL Energy	LYA4	Raise reg	$100	-3.00	-$300
		CleanCo Qld Ltd	SWAN_E	Raise reg	$380	9.74	$3701
		AGL Energy	BW01	Raise 60 sec	$0	-5.76	-$3
		AGL Energy	BW02	Raise 60 sec	$0	-5.24	-$2
		AGL Energy	BW03	Raise 60 sec	$0	-5.06	-$2
		Stanwell	TARONG #2	Raise 60 sec	$55	9.74	$536
		EnergyAustralia	MP2	Raise 60 sec	$301	6.33	$1905
		AGL Energy	BW01	Raise 6 sec	$0	-5.76	-$3
		AGL Energy	BW02	Raise 6 sec	$0	-5.24	-$2
		AGL Energy	BW03	Raise 6 sec	$0	-5.06	-$2
		EnergyAustralia	MP2	Raise 6 sec	$1100	16.07	$17 677
5.30 pm	$14 700	Boco Rock Wind Farm	BOCOR WF1	Energy	$14 700	1.00	$14 700
Spot Price		**$14 700/MWh**					

Table C5: New South Wales price setter 6 pm

DI	Dispatch Price ($/MWh)	Participant	Unit	Service	Offer price ($/MWh)	Marginal change	Contribution
5.35 pm	*$14 700*	Origin Energy	ER03	Energy	-$1000	9.39	-$9390
		Stanwell	STAN-4	Energy	$77	-9.39	-$721
		ERMPower and Arrow	BRAEMAR5	Energy	$591	-0.79	-$467
		Origin Energy	ER03	Raise 5 min	$45	-9.39	-$422
		Stanwell	TARONG#2	Raise 5 min	$300	9.39	$2817
		Origin Energy	ER03	Raise 60 sec	$3	-9.39	-$26
		ERM Power	OAKEY2	Raise 60 sec	$24	9.39	$222
		Origin Energy	ER03	Raise 6 sec	$2	-9.39	-$16
		Stanwell	STAN-4	Raise 6 sec	$14 700	9.39	$138 033
5.40 pm	*$14 700*	AGL Energy	BW01	Energy	$38	8.05	$309
		AGL Energy	BW03	Energy	$38	7.08	$272
		CleanCo Qld Ltd	SWAN_E	Energy	$65	5.71	$371
		CleanCo Qld Ltd	W/HOE#2	Energy	$299	-26.95	-$8058
		ERMPower and Arrow	BRAEMAR5	Energy	$591	11.03	$6523
		Delta Electricity	VP6	Energy	$14 300	-5.71	-$81 653
		AGL Energy	BW01	Raise 5 min	$0	-8.05	-$4
		AGL Energy	BW03	Raise 5 min	$0	-7.08	-$3
		CleanCo Qld Ltd	W/HOE#2	Raise 5 min	$1	15.13	$13
		Delta Electricity	VP6	Raise reg	$100	5.71	$571
		CleanCo Qld Ltd	SWAN_E	Raise reg	$380	-5.71	-$2170
		AGL Energy	BW01	Raise 60 sec	$0	-5.01	-$2
		AGL Energy	BW03	Raise 60 sec	$0	-4.41	-$2
		ERM Power	OAKEY2	Raise 60 sec	$24	9.42	$223
		AGL Energy	BW01	Raise 6 sec	$0	-5.01	-$2
		AGL Energy	BW03	Raise 6 sec	$0	-4.41	-$2
		Stanwell	STAN-1	Raise 6 sec	$14 700	9.42	$138 474
5.45 pm	$472	CS Energy	GSTONE3	Energy	-$1000	-0.40	$400
		AGL Energy	LD03	Energy	$0	0.29	$0
		AGL Energy	LD04	Energy	$0	0.71	$0
		Stanwell	TARONG#2	Energy	$91	0.20	$18
		Stanwell	TARONG#3	Energy	$91	0.20	$18
		AGL Energy	LD03	Raise 60 sec	$0	-0.12	$0
		AGL Energy	LD04	Raise 60 sec	$0	-0.28	$0
		CS Energy	GSTONE3	Raise 60 sec	$1	0.40	$0
		ERM Power	OAKEY2	Raise 60 sec	$13	-0.40	-$5
		Delta Electricity	VP5	Raise 60 sec	$100	0.40	$40
		AGL Energy	LD03	Raise 6 sec	$0	-0.12	$0
		AGL Energy	LD04	Raise 6 sec	$0	-0.28	$0
		CS Energy	GSTONE3	Raise 6 sec	$1	0.40	$0
5.50 pm	$471	CS Energy	GSTONE2	Energy	-$1000	-0.13	$130
		CS Energy	GSTONE5	Energy	-$1000	-0.13	$130
		CS Energy	GSTONE6	Energy	-$1000	-0.13	$130
		AGL Energy	LD03	Energy	$0	0.29	$0
		AGL Energy	LD04	Energy	$0	0.71	$0
		Stanwell	TARONG#1	Energy	$77	0.18	$14
		Stanwell	TARONG#3	Energy	$77	0.04	$3
		Stanwell	TARONG#4	Energy	$77	0.18	$14
		AGL Energy	LD03	Raise 60 sec	$0	-0.12	$0
		AGL Energy	LD04	Raise 60 sec	$0	-0.28	$0

DI	Dispatch Price ($/MWh)	Participant	Unit	Service	Offer price ($/MWh)	Marginal change	Contribution
		AGL Energy	BW03	Raise 60 sec	$100	0.40	$40
		AGL Energy	LD03	Raise 6 sec	$0	-0.12	$0
		AGL Energy	LD04	Raise 6 sec	$0	-0.28	$0
		CS Energy	GSTONE2	Raise 6 sec	$1	0.13	$0
		CS Energy	GSTONE5	Raise 6 sec	$1	0.13	$0
		CS Energy	GSTONE6	Raise 6 sec	$1	0.13	$0
5.55 pm	$459	CS Energy	GSTONE2	Energy	-$1000	-0.13	$130
		CS Energy	GSTONE5	Energy	-$1000	-0.13	$130
		CS Energy	GSTONE6	Energy	-$1000	-0.13	$130
		AGL Energy	LD01	Energy	$0	1.00	$0
		Stanwell	STAN-1	Energy	$77	0.10	$8
		Stanwell	STAN-2	Energy	$77	0.10	$8
		Stanwell	STAN-3	Energy	$77	0.10	$8
		Stanwell	STAN-4	Energy	$77	0.10	$8
		AGL Energy	LD01	Raise 60 sec	$15	-0.40	-$6
		AGL Energy	BW01	Raise 60 sec	$100	0.40	$40
		CS Energy	GSTONE2	Raise 6 sec	$1	0.13	$0
		CS Energy	GSTONE5	Raise 6 sec	$1	0.13	$0
		CS Energy	GSTONE6	Raise 6 sec	$1	0.13	$0
		AGL Energy	LD01	Raise 6 sec	$15	-0.40	-$6
6 pm	$91	Stanwell	TARONG#3	Energy	$68	1.35	$92
Spot price		**$5149/MWh**					