Electricity spot prices above $5,000/MWh

Queensland and NSW, 25 May 2021

21 July 2021

AUSTRALIAN ENERGY REGULATOR

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Amendment Record

Version	Date	Pages
1	21/07/2021	28
Final Report	09/08/2021	28

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1 Obligation

The Australian Energy Regulator (AER) regulates energy markets and networks under national legislation and rules in eastern and southern Australia (known as the National Energy Market), 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, NSW, 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 $5,000 per megawatt hour ($/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 $5,000/MWh, including withdrawal of generation capacity and network availability;
- assesses whether rebidding contributed to the spot price exceeding $5,000/MWh;
- identifies the marginal scheduled generating units; and
- identifies all units with offers for the trading interval equal to or greater than $5,000/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 25 May 2021 the spot price in Queensland exceeded $5,000/MWh for the 4.30 pm to 6.30 pm trading intervals and in NSW for the 5.30 pm trading interval.

The main drivers of these prices were related to a reduction in or access to low priced capacity.

- At around 2 pm a catastrophic failure of Callide C unit 4 reduced the amount of low priced capacity available to the market
    - Callide B, Callide C, Stanwell and Gladstone Power Stations either went offline or had their output reduced. This effectively removed around 2,000 MW of capacity priced below $5,000/MWh at the time of high prices.
    - Multiple significant transmission lines around Callide tripped.
    - The loss of generation led AEMO to invoke system strength constraints backing off solar and wind generation which usually offers in capacity at negative prices. This mainly affected the 4.30 pm and 5 pm trading intervals
- There was already over 2,300 MW of baseload generation in Queensland and 2,600 MW in NSW unavailable, mainly due to planned outages.
- There was a planned outage of lines in NSW for the upgrade of the Queensland to NSW interconnector (QNI) which limited Queensland's ability to import cheaper generation from NSW.
- Imports into NSW across the Vic-NSW interconnector were limited to around 570 MW (nominally 1,400 MW) by planned outages around Canberra and South Morang in Victoria.

At the time of high prices around 13% of capacity in Queensland and 15% of capacity in NSW was priced above $5,000/MWh.

Rebidding of capacity from low to high prices did not significantly contribute to the price exceeding $5,000/MWh, except for in one dispatch interval in the 4.30 pm trading interval in Queensland.

The reduction in capacity and high demand led AEMO to invoke the Reliability and Emergency Reserve Trader (RERT) for 15 MW to ensure enough supply to meet demand from 5 pm to 7.30 pm.

This report is designed to examine market events and circumstances that contributed to wholesale market price outcomes and is not an indicator of potential compliance issues or enforcement action.

We are separately making enquiries around participant behaviour on the day. We will also review AEMO's final incident report for the Callide C Power Station event once it is completed, to determine whether any further investigation is required by the AER.

3 Analysis

On 25 May 2021 the spot price in Queensland exceeded $5,000/MWh 5 times between 4.30 pm and 6.30 pm and once in NSW at 5.30 pm.

3.1 Overview of actual and expected conditions

The spot price in Queensland ranged between $4,988/MWh and $15,000/MWh for the 4.30 pm to 7 pm trading intervals, and between $2,542/MWh and $6,848/MWh in NSW for the 5 pm to 6 pm trading intervals.

Table 1 shows that spot prices over $14,000/MWh were forecast 12 hours ahead (well before the Callide event) for the 6 pm, 6.30 pm and 7 pm trading intervals in Queensland.

- Demand was up to 1,162 MW lower than forecast 4 hours prior in Queensland due to load being shed to maintain the system in a secure state after the loss of generation.
- Demand in NSW was between 69 MW higher than forecast and 412 MW lower than forecast 4 hours prior.
- Availability was up to 2,122 MW lower than forecast in Queensland 4 hours prior, due mainly to the loss of generation at Callide, Stanwell and Gladstone.
- Availability in NSW was close to forecast 4 hours ahead.

Table 1: Actual and forecast spot price, demand and available capacity

Trading interval	Price ($/MWh)			Demand (MW)			Availability (MW)		
Qld	**Actual**	**4 hr forecast**	**12 hr forecast**	**Actual**	**4 hr forecast**	**12 hr forecast**	**Actual**	**4 hr forecast**	**12 hr forecast**
4.30 pm	**5,141**	**125**	**169**	**5,518**	**6,680**	**6,748**	**6,626**	**8,748**	**8,729**
5 pm	**15,000**	**46**	**297**	**6,128**	**6,966**	**7,016**	**6,583**	**8,621**	**8,611**
5.30 pm	**15,000**	**71**	**425**	**6,386**	**7,227**	**7,249**	**6,548**	**8,546**	**8,485**
6 pm	**15,000**	**14,946**	**15,000**	**6,602**	**7,462**	**7,426**	**6,505**	**8,524**	**8,459**
6.30 pm	**12,540**	**15,000**	**14,701**	**6,536**	**7,418**	**7,419**	**6,743**	**8,582**	**8,468**
7 pm	4,988	15,000	14,700	6,345	7,458	7,375	6,753	7,438	8,471
NSW	**Actual**	**4 hr forecast**	**12 hr forecast**	**Actual**	**4 hr forecast**	**12 hr forecast**	**Actual**	**4 hr forecast**	**12 hr forecast**
5 pm	2,542	43	300	8,761	8,692	8,920	10,822	10,818	11,067
5.30 pm	**6,848**	**69**	**407**	**9,073**	**9,294**	**9,461**	**10,799**	**10,855**	**11,078**
6 pm	4,622	15,000	15,000	9,320	9,732	9,856	10,903	10,876	11,117

3.2 Background

This section details conditions and events that occurred before the price exceeding $5,000/MWh.

3.2.1 Pre-existing outages

There was around 5,000 MW of capacity unavailable due to mainly planned generator outages in Queensland and NSW before Callide C tripped (Table 2). Planned maintenance for baseload generation is generally taken when there is less chance of them being required. This is usually when temperatures are not too extreme and demand is low. However, two units in Queensland and two units in NSW were unavailable or had reduced capacity due to unplanned plant issues.

Table 2: Baseload generator outages

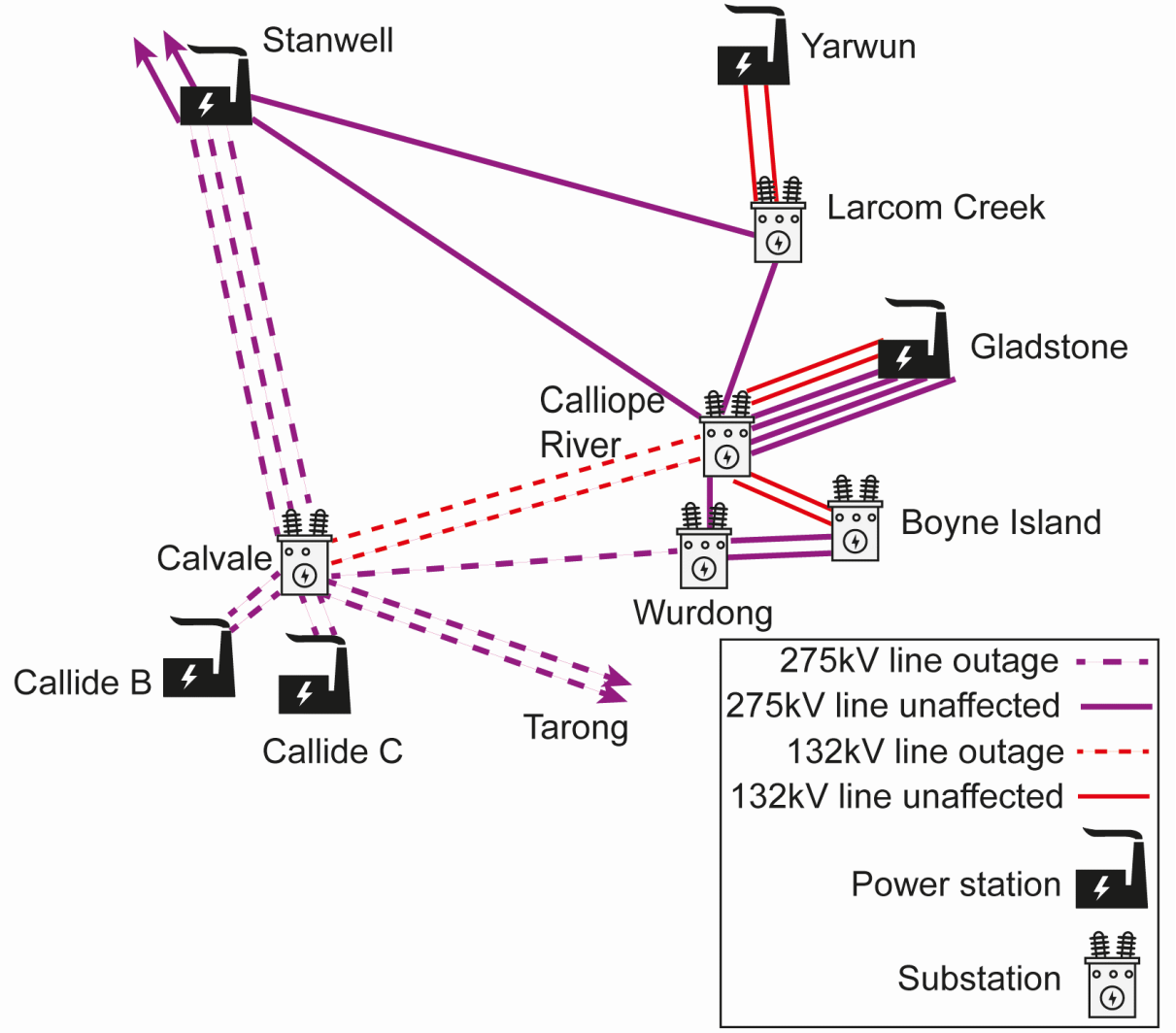
Participant	Unit	Unavailable Capacity (MW)	Outage type
Queensland			
Stanwell	Tarong unit 1	350	Planned
	Stanwell unit 2	365	Planned
InterGen	Millmerran unit 2	426	Planned
CS Energy	Callide B unit 1	350	Planned
CS Energy	Kogan Creek	564	Unplanned – boiler and tube leak issues saw them running at 180 MW (744 MW registered capacity)
CS Energy	Gladstone unit 2	280	Unplanned - Failed to come back online 7 May, following a planned outage since 8 April
	Total	**2,335**	
NSW			
AGL Energy	Bayswater unit 2	660	Planned
	Bayswater unit 3	660	Unplanned - due to ‘tube leak’ since 20 May
	Liddell unit 1	500	Planned
Infigen Energy	Smithfield	185	Unplanned – due to "change in plant availability, ambient conditions" since 12 May
Delta Electricity	Vales Point unit 6	660	Planned
	Total	**2,665**	

Upgrades to QNI meant lines were out in NSW, limiting flows to Queensland to 700 MW (nominally 1,000 MW) while system normal constraints were limiting imports across the Terranora interconnector to around 60 MW (nominally 107 MW).

3.2.2 Callide and subsequent events

At around 1.45 pm CS Energy's Callide C unit 4 suffered a catastrophic failure which tripped all other operating Callide units and all transmission lines from the Calvale substation (Figure 1). AEMO has released a preliminary power system incident report providing more details.[1]

Figure 1: Simplified network diagram of affected lines and generation

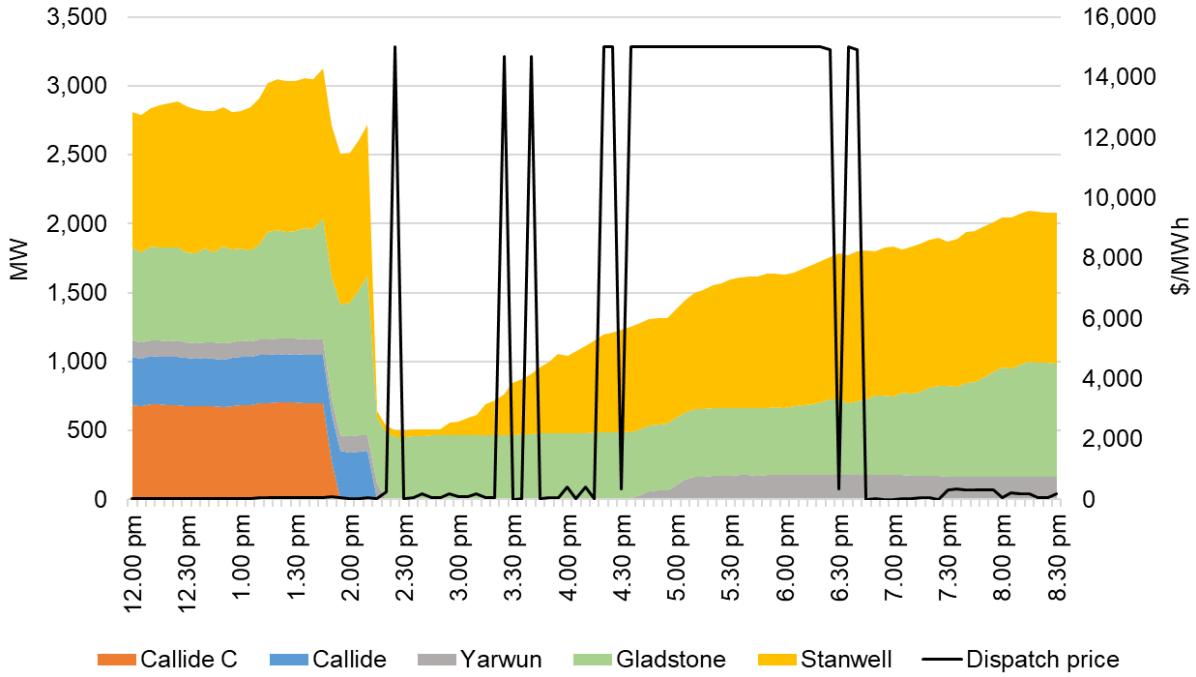


As a result Gladstone, Stanwell and Yarwun power stations either tripped or had their output reduced by around 2,500 MW in total, almost all of which was priced below $5,000/MWh. While they came back online throughout the day (Figure 2), capacity priced above $5,000/MWh was still required to be dispatched. None of the Callide units returned to service that day.[2]

[1] https://aemo.com.au/-/media/files/electricity/nem/market_notices_and_events/power_system_incident_reports/2021/preliminary-report--trip-of-multiple-generators-and-lines-in-queensland-and-associated-underfrequenc.pdf?la=en

[2] At time of publishing, Callide C unit 4 is not expected to return to service until December 2022 while the other Callide units returned to service during June 2021.

Figure 2: Output of affected generators



Following the incident, the spot price didn't exceed $5,000/MWh immediately as demand fell around 2,300 MW (Figure 4). The drop was due to protection systems that detected a significant fall in the frequency when generation was lost. These systems automatically reduce demand by turning off customer load which then helps increase the frequency back into its normal range.

Permission to restore load started around 2.10 pm and all transmission lines were returned to service at around 3.45 pm.

3.3 Queensland 4.30 pm to 6.30 pm trading intervals

For the times price exceeded $5,000/MWh there was still a reduction in capacity priced below $5,000/MWh compared to the 1.30 pm forecast in Queensland (Table 3). Both Callide stations were still out and Stanwell, Gladstone and Yarwun had not reached their full capacity resulting in around 2,200 MW being unavailable, almost all of which was priced below $5,000/MWh.

Table 3: Forecast and actual availability of affected generation

Station	Forecast offered capacity (MW)	Average offered capacity (MW)	Difference (MW)
Callide B	350	0	350
Callide C	833	0	833
Gladstone	1,380	566	814
Stanwell	1,095	939	156
Yarwun	115	31	84
			2,237

Thermal units provide technical characteristics to help manage minor voltage and frequency fluctuations. Generally, wind and solar units do not currently possess these technical characteristics. Due to the low amount of thermal capacity on in Queensland after the Callide incident, at around 2.15 pm constraints used to manage system strength reduced the output of

solar and wind farms in Queensland[3]. This generation was then replaced by more expensive thermal generation. This reduced solar capacity which was forecast to be there for 4.30 pm and 5 pm by 190 MW and 81 MW respectively (Figure 3) and wind by around 70 MW, both of which are normally priced below $5,000/MWh.

Figure 3: Actual and forecast solar output

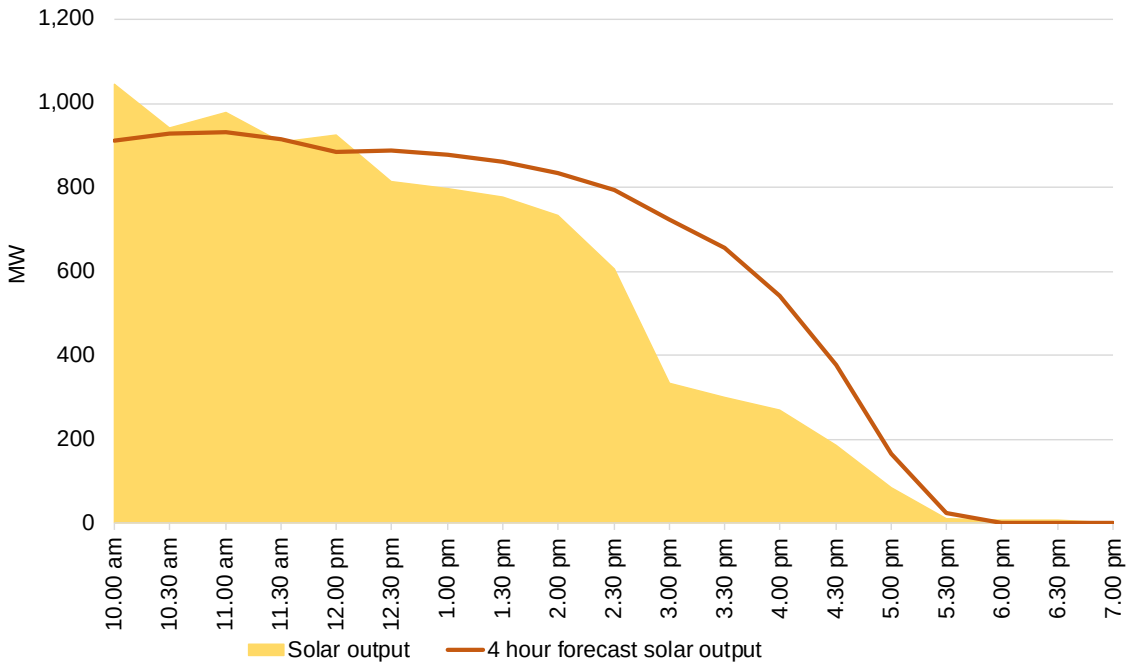
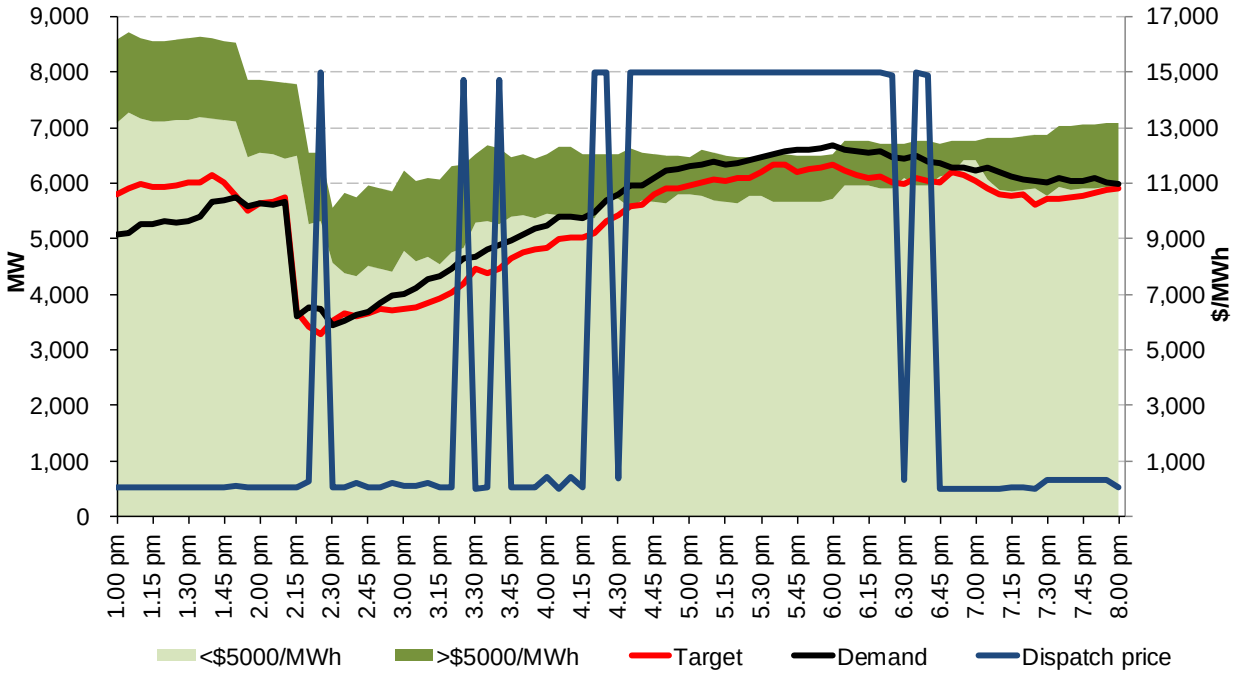


Figure 4 shows how much available capacity was offered above and below $5,000/MWh and how much local generation was targeted to meet demand in Queensland. Even though only 13% of capacity offered in Queensland was priced above $5,000/MWh, some of it needed to be dispatched.

[3] https://aemo.com.au/-/media/files/electricity/nem/system-strength-explained.pdf

Figure 4: Generation availability above and below $5,000/MWh, target and dispatch price in Queensland



Participants offered up to 967 MW of capacity priced above $5,000/MWh when the spot price exceeded $5,000/MWh (Table 4). Arrow Energy at Braemar 2 and CleanCo at Wivenhoe rebid capacity to above $5,000/MWh for part of the 4.30 pm trading interval which contributed to a high price at 4.20 pm before Arrow Energy rebid capacity back down to the price floor.

Any significant rebids are contained in *Appendix B: Significant rebids*.

Table 4: Capacity offered > $5,000/MWh during the high priced trading intervals

Participant	Station	Reg. Cap (MW)	Fuel type	Capacity offered >$5,000/MWh (MW)				
				4.30 pm	5 pm	5.30 pm	6 pm	6.30 pm
Arrow Energy	Braemar 2	**519**	Gas	168	168	168	168	168
CleanCo	Barron Gorge	**60**	Hydro	33	8			
	Wivenhoe	**570**	Hydro	530	400	400	376	361
ERM Power	Oakey	**288**	Gas	188	196			
Origin Energy	Mt Stuart	**419**	Liquid	201	276	276	276	276
Sun Metals	Sun Metals	**143**	Solar	29	15			
Total				**967**	**857**	**844**	**808**	**801**

Note: Capacity offered >$5,000/MWh is calculated by using average offered capacity above $5,000/MWh when the dispatch price in the trading interval is >$5,000/MWh

As load was restored the demand for generation increased and capacity priced above $5,000/MWh needed to be dispatched. For all but 2 dispatch intervals from 4.20 pm to 6.40 pm the price was at or close to the price cap.

3.4 NSW 5.30 pm trading interval

The NSW price exceeded $5,000/MWh for the 5.30 pm dispatch interval. Price sensitivities published 30 minutes before the trading interval showed a 100 MW increase in demand or loss of supply would lead to prices close to the cap.

Imports from Victoria over the VIC-NSW interconnector were around 570 MW, about a third of its nominal limit, due to planned network outages in NSW and Victoria. This meant NSW could not access any more low priced capacity from Victoria. As demand continued to increase over the evening peak, it was cheaper for capacity in Queensland to set the price in NSW rather than dispatching local higher priced generation. See *Appendix C: Price Setter* to see what units set price during each dispatch interval.

Around 15% of capacity in NSW was priced above $5,000/MWh and as the evening peak demand increased a small amount of this capacity needed to be dispatched (Figure 5).

Figure 5: Generation availability above and below $5,000/MWh, target and dispatch price in NSW

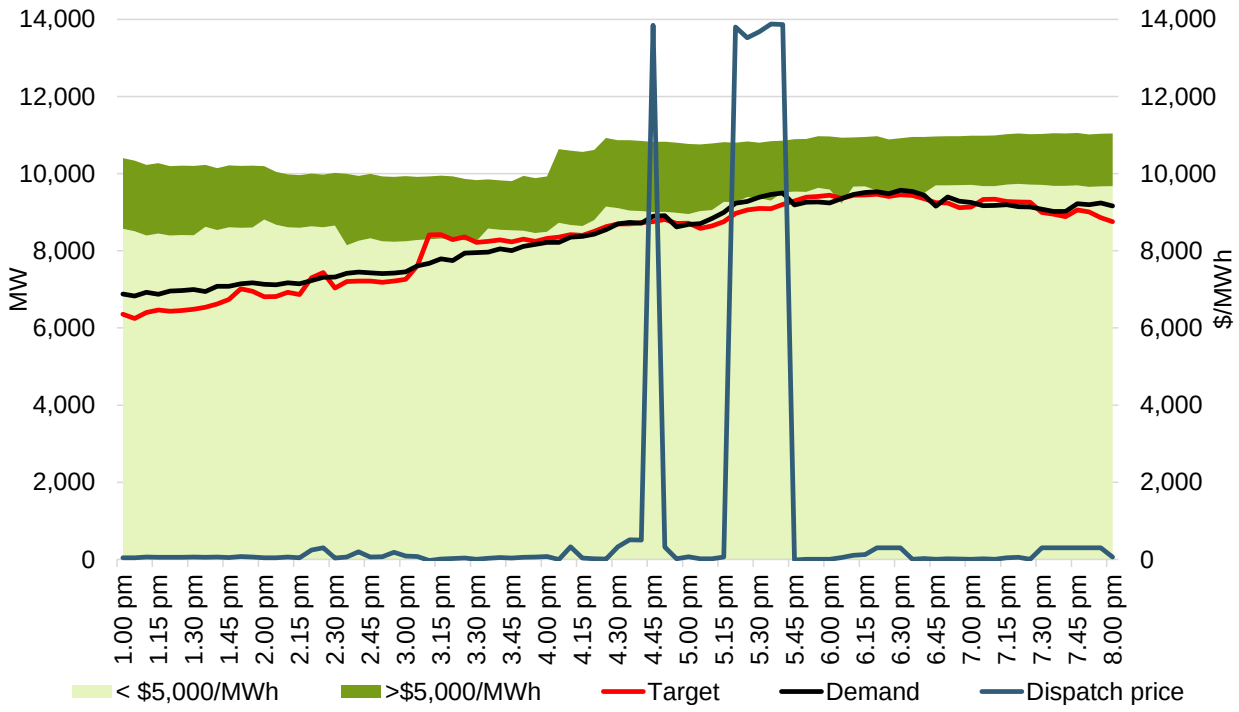


Table 5 shows the units in NSW that offered capacity greater than $5,000/MWh when the spot price was above $5,000/MWh.

Table 5: Capacity offered > $5,000/MWh during the high priced intervals

Participant	Station	Reg. Cap (MW)	Fuel type	Capacity offered >$5,000/MWh (MW) 5.30pm
Origin Energy	Eraring	**2,880**	Coal-Black	133
	Uranquinty	**664**	Gas	627
Snowy Hydro	Colongra	**724**	Gas	708
Total				**1,435**

Note: Capacity offered >$5,000/MWh is calculated by using average offered capacity above $5,000/MWh when the dispatch price in the trading interval is >$5,000/MWh

The closing bids for all participants in Queensland and NSW with capacity priced at or above $5,000/MWh for the high-price periods are set out in *Appendix A: Closing bids*.

3.5 Reserves and RERT

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. An actual LOR 3 requires AEMO to shed load in order to maintain power system security.

Due to the loss of generation in Queensland AEMO issued a series of LOR market notices for Queensland and NSW (Table 6) with an actual LOR 2 occurring in Queensland and an actual LOR 1 in NSW.

Table 6: Forecast and actual availability of affected generation

Time issued	Details	LOR Time
3.12 pm	Forecast LOR1 in NSW	5.30 pm to 7.30 pm
3.21 pm	Forecast LOR2 in QLD	5.30 pm to 7.30 pm
3.29 pm	Forecast LOR 1 in QLD	3.30 pm to 9.30 pm
3.48 pm	Forecast LOR2 in NSW	5.30 pm to 6.30 pm
4.44 pm	Actual LOR2 in QLD	4.40 pm to 9.30 pm
5.07 pm	Forecast LOR3 in QLD	5 pm to 9 pm
5.21 pm	Cancel forecast LOR2 in NSW	Cancelled at 5.15 pm
6.13 pm	Actual LOR1 in NSW	6 pm to 8 pm
6.41 pm	Cancel actual LOR1 condition in NSW	Cancelled at 6.40 pm
6.49 pm	Cancel forecast LOR1 in NSW	Cancelled from 6.45 pm
7.13 pm	Cancel actual LOR2 condition in QLD	Cancelled at 7.10 pm
7.23 pm	Cancel forecast LOR3 condition in QLD	Cancelled at 7.10 pm
7.24 pm	Cancel forecast LOR1 condition in QLD	Cancelled at 7.10 pm

Following the forecast LOR 2 in Queensland at 3.21 pm, AEMO signalled its intent to commence negotiations for additional reserves under Reliability and Emergency Reserve Trader (RERT) contract arrangements. This was to apply between 5.30 pm and 8 pm. Then at 5 pm AEMO activated 15 MW of RERT to maintain the system in a reliable state. This was forecast to apply until 9.30 pm but ended at 7.30 pm.

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Appendix A: Closing bids

Figure A1 to A7 highlight the half hour closing bids for participants in Queensland and NSW with capacity priced at or above $5,000/MWh by the end of the trading intervals in which the spot price exceeded $5,000/MWh. They also show generation output and the spot price.

Queensland

Figure A1: Arrow Energy (Braemar 2) closing bids, dispatch and spot price

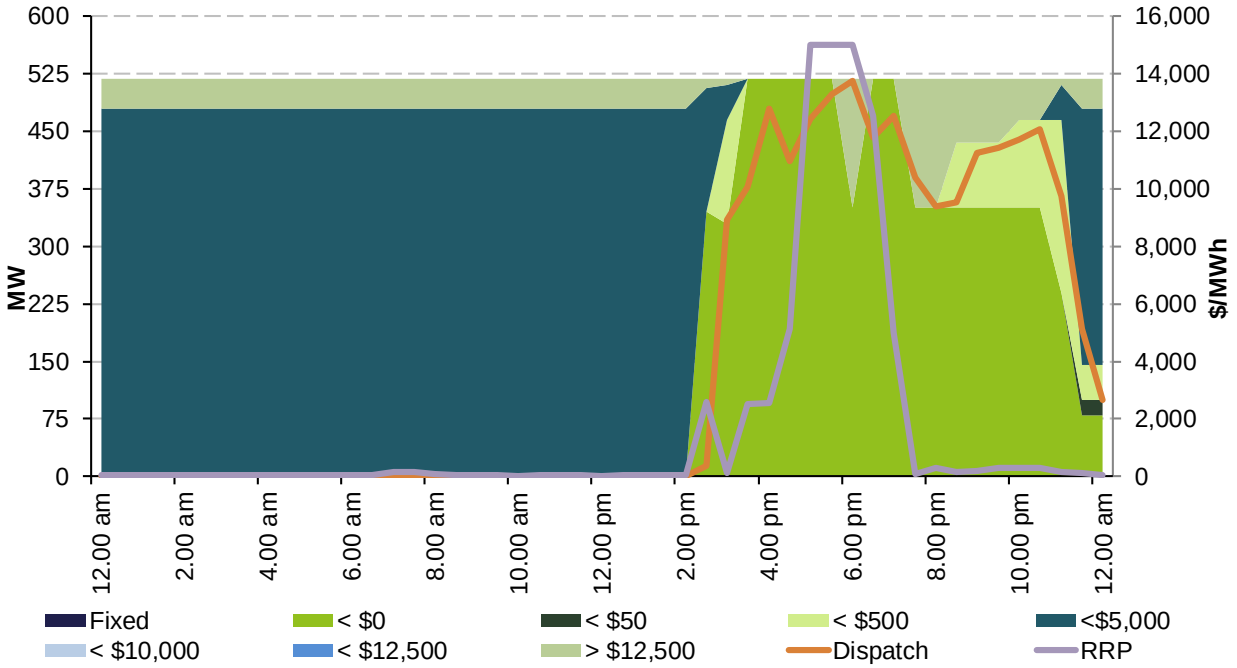


Figure A2: CleanCo (Wivenhoe, Swanbank E, Barron Gorge and Kareeya) closing bids, dispatch and spot price

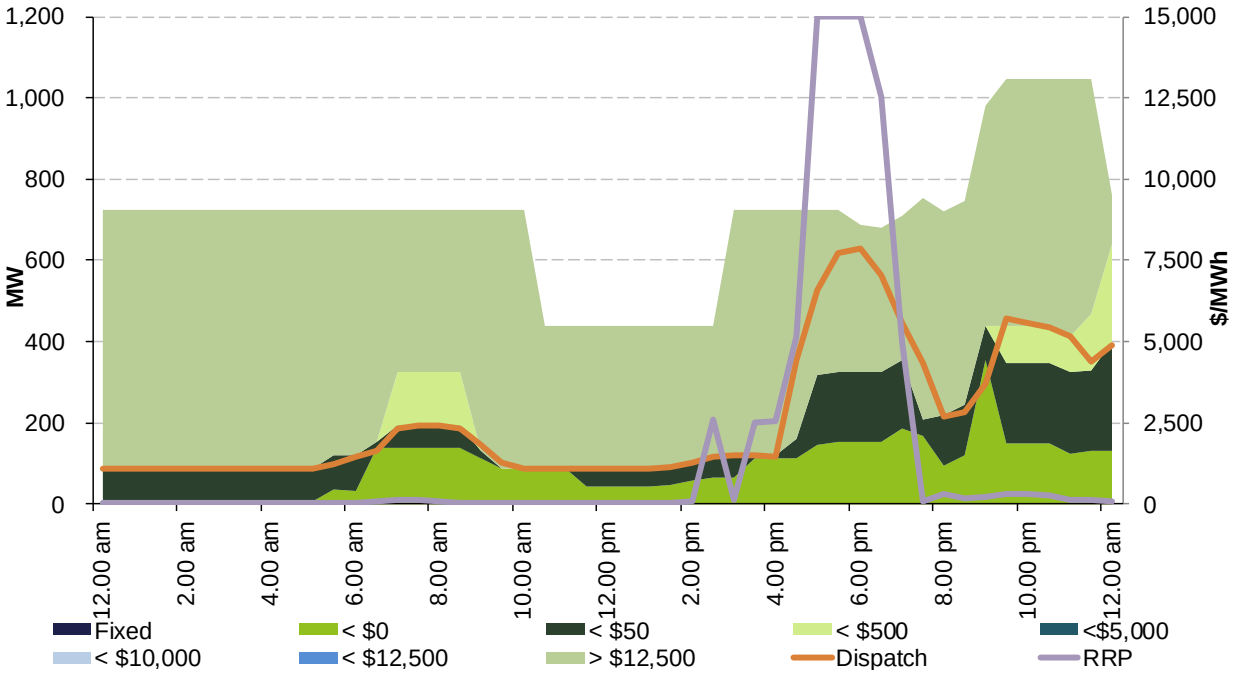


Figure A3: Origin (Darling Downs, Mt Stuart and Roma) closing bids, dispatch and spot price

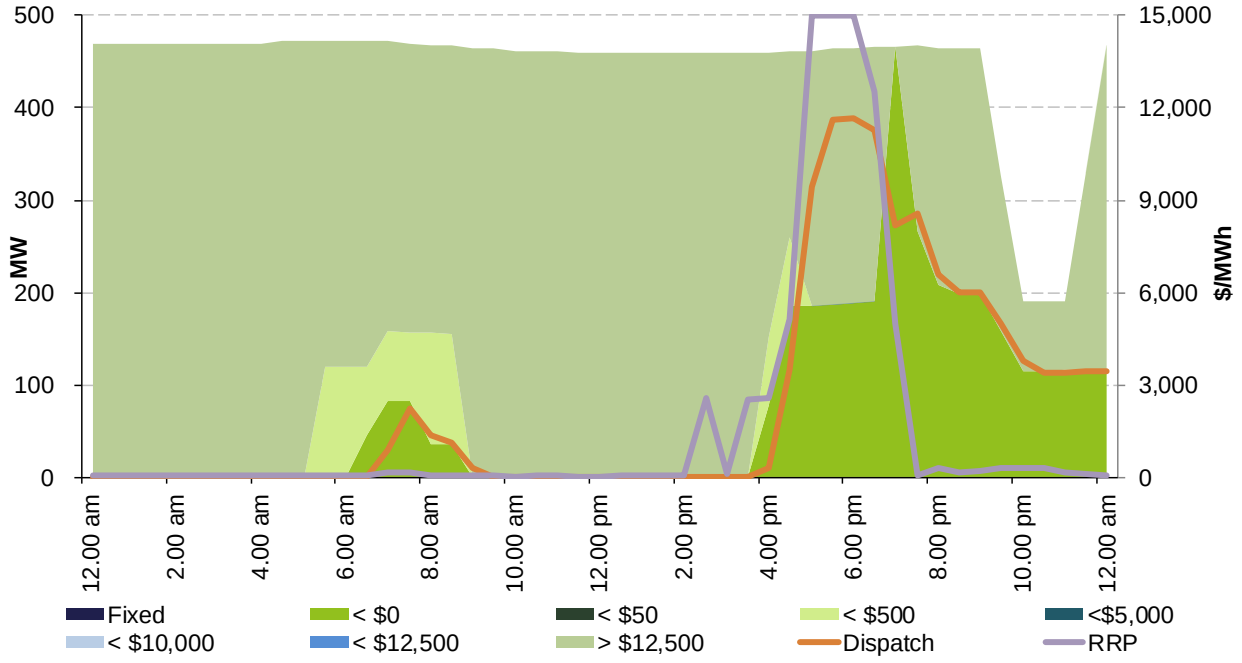
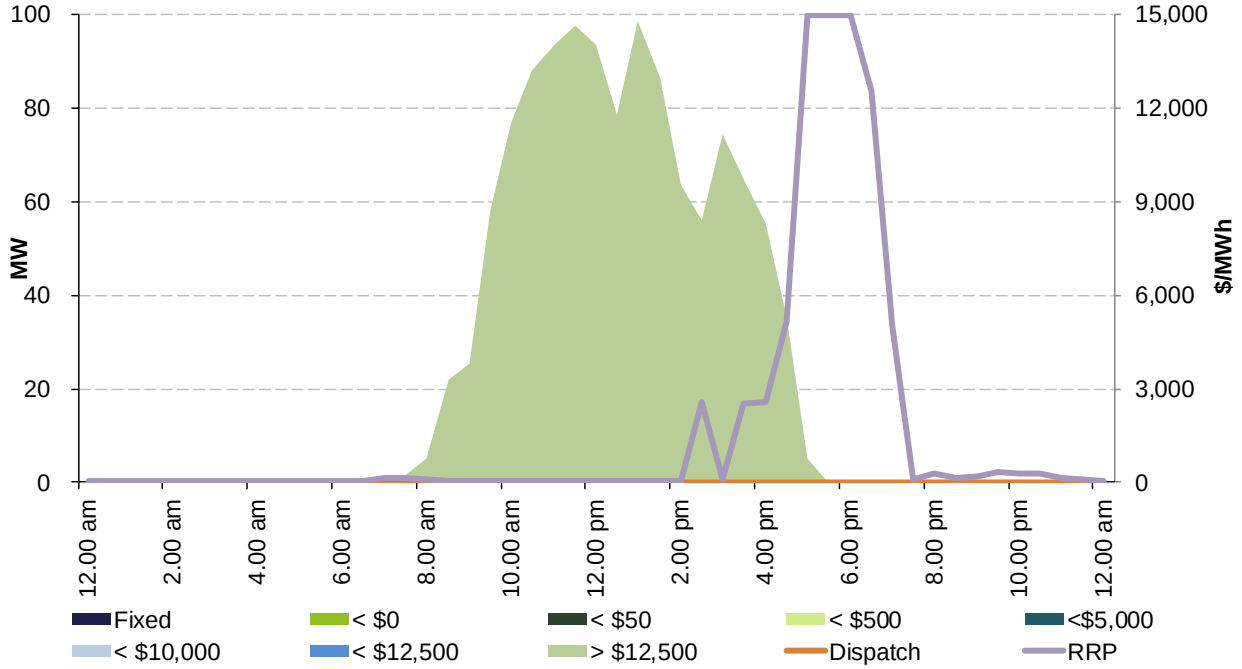


Figure A4: Sun Metals (Sun Metals SF) closing bids, dispatch and spot price



NSW

Figure A5: AGL (Bayswater, Broken Hill solar, Hunter Valley GT, Liddell, Nyngan solar, Silverton wind farm) closing bids, dispatch and spot price

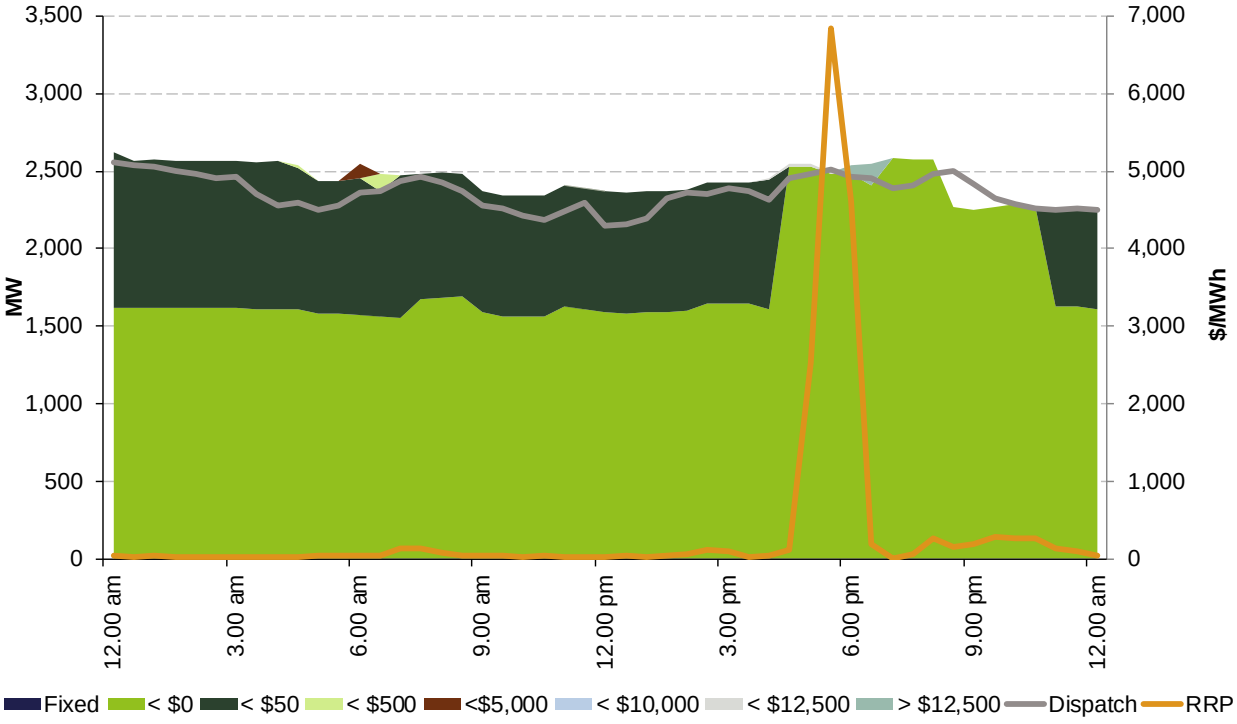


Figure A6: Origin (Eraring, Shoalhaven, Uranquinty) closing bids, dispatch and spot price

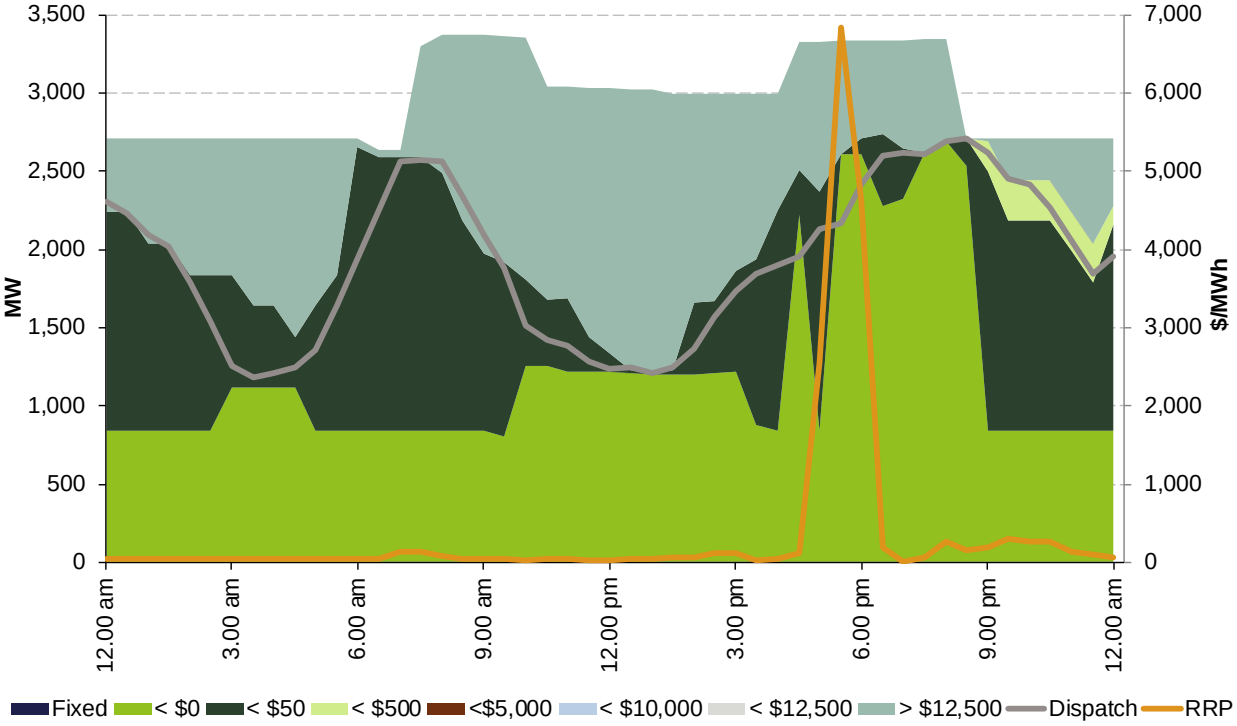
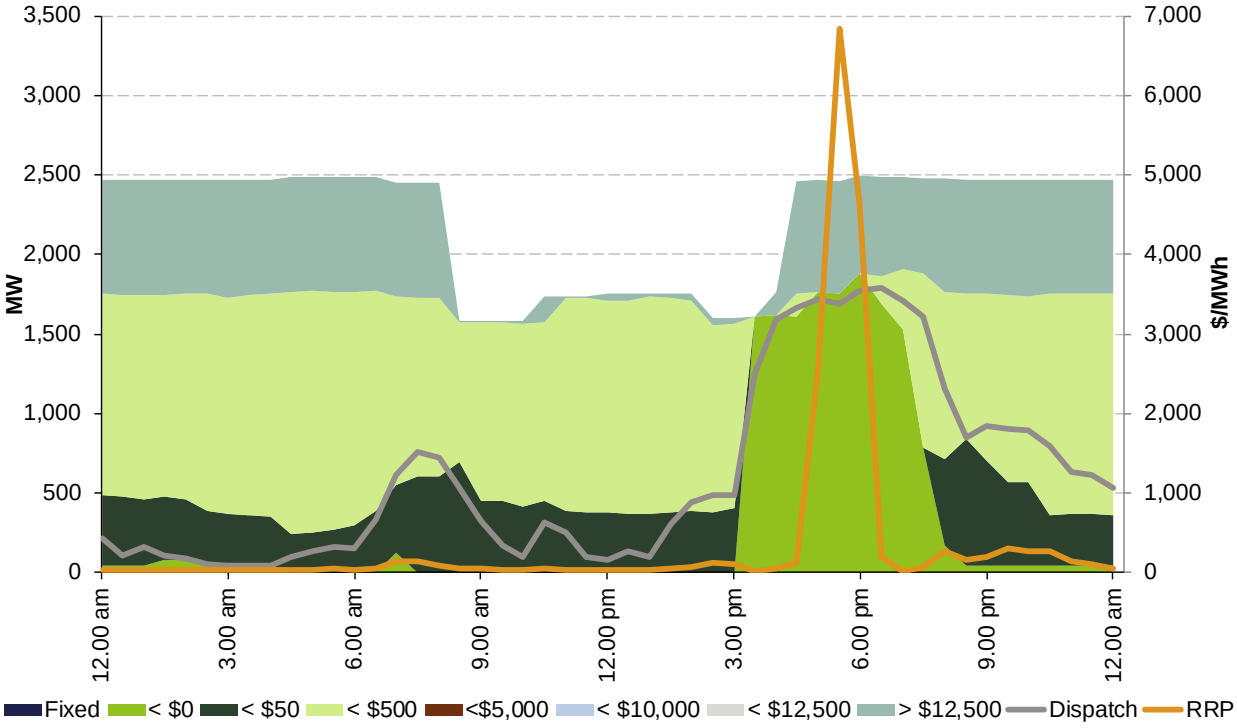


Figure A7: Snowy Hydro (Colongra, Tumut, Upper Tumut, Guthega, Blowering) closing bids, dispatch and spot price



Appendix B: Significant rebids

The rebidding tables 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 maximum capacity involved, the change in the price of the capacity being offered, and the rebid reason.

Queensland

Table 7: Queensland significant rebids for 4.30 pm trading interval

Submit time	Time effective	Participant	Station	Capacity rebid (MW)	Price from ($/MWh)	Price to ($/MWh)	Rebid reason
1.46 pm		Callide Power Trading	Callide C	-424	<25	N/A	1345P unit trip
1.46 pm		Callide Power Trading	Callide C	-406	<25	N/A	1346P unit trip
2.09 pm		CS Energy	Callide B	-350	<30	N/A	1408P unit trip-sl
2.10 pm		CS Energy	Gladstone	-840	<51	N/A	1410P unit trip-sl
2.38 pm		AGL Energy	Yabulu	15	N/A	36	1435~P~030 increase in avail cap~304 st sync earlier than expected~
3.01 pm		AGL Energy	Yabulu	60	N/A	-1,000	1458~P~010 unexpected/plant limits~108 load/ramp variation during run up~
3.11 pm		CS Energy	Gladstone	-70	<51	N/A	1511P plant not following target rebid to match load-sl
3.41 pm		Arrow Energy	Braemar 2	159	<1,000	15,000	1541E correct error in previous bid sl
3.41 pm		CS Energy	Gladstone	10	N/A	-1,000	1541P plant not following target rebid to match load-sl
3.43 pm		Stanwell Corporation	Stanwell	-125	<19	N/A	1541P revised unit availability - increase load profile
3.44 pm		CleanCo	Wivenhoe	210	<291	15,000	1542A unforecast unique system conditions: manage syc water usage - sl
3.54 pm	4.05 pm	Stanwell Corporation	Stanwell	-205	<19	N/A	1553P revised unit loading capability - a id fan delay on rts
4.06 pm	4.15 pm	Origin Energy	Mt Stuart	75	15,000	-1,000	1601P plant conditions - avoid intermittent dispatch sl
4.15 pm	4.25 pm	Arrow Energy	Braemar 2	168	15,000	-1,000	1615A qld price higher than forecast sl

Table 8: Queensland significant rebids for 5 pm trading interval

Submit time	Time effective	Participant	Station	Capacity rebid (MW)	Price from ($/MWh)	Price to ($/MWh)	Rebid reason
1.46 pm		Callide Power Trading	Callide C	-424	<25	N/A	1345P unit trip

Submit time	Time effective	Participant	Station	Capacity rebid (MW)	Price from ($/MWh)	Price to ($/MWh)	Rebid reason
1.46 pm		Callide Power Trading	Callide C	-406	<25	N/A	1346P unit trip
2.09 pm		CS Energy	Callide B	-350	<30	N/A	1408P unit trip-sl
2.10 pm		CS Energy	Gladstone	-840	<51	N/A	1410P unit trip-sl
3.11 pm		CS Energy	Gladstone	-70	<51	N/A	1511P plant not following target rebid to match load-sl
3.41 pm		Arrow Energy	Braemar 2	159	<1,000	15,000	1541E correct error in previous bid sl
3.41 pm		CS Energy	Gladstone	10	N/A	-1,000	1541P plant not following target rebid to match load-sl
4.09 pm		CS Energy	Gladstone	30	N/A	-1,000	1608P unit rts revised-sl
4.26 pm	4.35 pm	Stanwell Corporation	Stanwell	-205	<19	N/A	1626P revised unit loading capability - a id fan delay on rts
4.34 pm	4.45 pm	CS Energy	Gladstone	-30	-1,000	N/A	1632P unit rts revised-sl
4.39 pm	4.50 pm	Stanwell Corporation	Stanwell	5	N/A	-1,000	1638P revised unit loading capability - a id fan delay on rts
4.47 pm	4.55 pm	CS Energy	Gladstone	10	N/A	-1,000	1647P unit ramping rebid to match-sl

Table 9: Queensland significant rebids for 5.30 pm trading interval

Submit time	Time effective	Participant	Station	Capacity rebid (MW)	Price from ($/MWh)	Price to ($/MWh)	Rebid reason
2.09 pm		CS Energy	Callide B	-350	<30	N/A	1408P unit trip-sl
2.10 pm		CS Energy	Gladstone	-840	<236	N/A	1410P unit trip-sl
2.57 pm		CS Energy	Gladstone	30	N/A	-1,000	1455P unit rts revised-sl
3.00 pm		Callide Power Trading	Callide C	-466	<25	N/A	1458P unit offline
3.07 pm		Callide Power Trading	Callide C	-420	<25	N/A	1504P unit offline
4.09 pm		CS Energy	Gladstone	80	N/A	-1,000	1608P unit rts revised-sl
4.26 pm		Stanwell Corporation	Stanwell	-205	<19	N/A	1626P revised unit loading capability - a id fan delay on rts
4.34 pm		CS Energy	Gladstone	-80	-1,000	N/A	1632P unit rts revised-sl
4.39 pm		Stanwell Corporation	Stanwell	5	N/A	-1,000	1638P revised unit loading capability - a id fan delay on rts
4.47 pm		CS Energy	Gladstone	-15	<51	N/A	1647P unit ramping rebid to match-sl
4.55 pm	5.05 pm	Stanwell Corporation	Stanwell	75	N/A	-1,000	1655P revised unit loading capability - id fan rts; roc ti 1700-1730;
4.56 pm	5.05 pm	RTA Yarwun	Yarwun	50	N/A	-989	alumina refinery constraints
5.02 pm	5.10 pm	CS Energy	Gladstone	-35	<51	N/A	1702P plant not following target rebid to match load-sl

Table 10: Queensland significant rebids for 6 pm trading interval

Submit time	Time effective	Participant	Station	Capacity rebid (MW)	Price from ($/MWh)	Price to ($/MWh)	Rebid reason
2.09 pm		CS Energy	Callide B	-350	<30	N/A	1408P unit trip-sl
2.10 pm		CS Energy	Gladstone	-840	<236	N/A	1410P unit trip-sl
2.57 pm		CS Energy	Gladstone	110	N/A	-1,000	1455P unit rts revised-sl
3.00 pm		Callide Power Trading	Callide C	-466	<25	N/A	1458P unit offline
3.07 pm		Callide Power Trading	Callide C	-420	<25	N/A	1504P unit offline
3.28 pm		CS Energy	Gladstone	30	N/A	-1,000	1527P unit rts revised-sl
3.44 pm		CleanCo	Wivenhoe	80	<291	14,902	1542A unforecast unique system conditions: manage syc water usage - sl
3.57 pm		CS Energy	Gladstone	-30	-1,000	N/A	1556P unit rts revised-sl 1555P unit rts revised-sl
4.26 pm		Stanwell Corporation	Stanwell	-205	<19	N/A	1626P revised unit loading capability - a id fan delay on rts
4.34 pm		CS Energy	Gladstone	30	N/A	-1,000	1633P unit rts revised-sl
4.39 pm		Stanwell Corporation	Stanwell	5	N/A	-1,000	1638P revised unit loading capability - a id fan delay on rts
4.47 pm		CS Energy	Gladstone	-15	-<51	N/A	1647P unit ramping rebid to match-sl
4.55 pm		Stanwell Corporation	Stanwell	75	N/A	-1,000	1655P revised unit loading capability - id fan rts; roc ti 1700-1730;
4.56 pm		RTA Yarwun	Yarwun	50	N/A	-989	alumina refinery constraints
5.02 pm		CS Energy	Gladstone	-35	<51	N/A	1702P plant not following target rebid to match load-sl
5.18 pm		CS Energy	Gladstone	-30	-1,000	N/A	1717P unit rts revised-sl
5.32 pm	5.40 pm	CS Energy	Gladstone	-50	<36	N/A	1732P plant not following target rebid to match load-sl
5.51 pm	6.00 pm	CS Energy	Gladstone	30	N/A	-1,000	1750P unit rts revised-sl

Table 11: Queensland significant rebids for 6.30 pm trading interval

Submit time	Time effective	Participant	Station	Capacity rebid (MW)	Price from ($/MWh)	Price to ($/MWh)	Rebid reason
2.09 pm		CS Energy	Callide B	-350	<30	N/A	1408P unit trip-sl
2.10 pm		CS Energy	Gladstone	-840	<236	N/A	1410P unit trip-sl
2.57 pm		CS Energy	Gladstone	140	N/A	-1,000	1455P unit rts revised-sl 1456P unit rts revised-sl

Submit time	Time effective	Participant	Station	Capacity rebid (MW)	Price from ($/MWh)	Price to ($/MWh)	Rebid reason
3.00 pm		Callide Power Trading	Callide C	-466	<25	N/A	1458P unit offline
3.07 pm		Callide Power Trading	Callide C	-420	<25	N/A	1504P unit offline
3.28 pm		CS Energy	Gladstone	80	N/A	-1,000	1527P unit rts revised-sl
3.44 pm		CleanCo	Wivenhoe	80	<291	14,902	1542A unforecast unique system conditions: manage syc water usage - sl
3.57 pm		CS Energy	Gladstone	-80	-1,000	N/A	1555P unit rts revised-sl
4.26 pm		Stanwell Corporation	Stanwell	-205	<19	N/A	1626P revised unit loading capability - a id fan delay on rts
4.34 pm		CS Energy	Gladstone	80	N/A	-1,000	1633P unit rts revised-sl
4.39 pm		Stanwell Corporation	Stanwell	5	N/A	-1,000	1638P revised unit loading capability - a id fan delay on rts
4.47 pm		CS Energy	Gladstone	-15	<51	N/A	1647P unit ramping rebid to match-sl
4.55 pm		Stanwell Corporation	Stanwell	200	N/A	<19	1655p revised unit loading capability - id fan rts; roc ti 1700-1730;
4.56 pm		RTA Yarwun	Yarwun	50	N/A	-989	alumina refinery constraints
5.02 pm		CS Energy	Gladstone	-35	<51	N/A	1702P plant not following target rebid to match load-sl
5.18 pm		CS Energy	Gladstone	-80	-1,000	N/A	1717P unit rts revised-sl
5.30 pm		ERM Power	Oakey	190	14,700	-1,000	P 1728 1725 ambient conditions - match bid to expected unit output
5.32 pm		CS Energy	Gladstone	35	N/A	-1,000	1732P plant not following target rebid to match load-sl
5.51 pm		CS Energy	Gladstone	80	N/A	-1,000	1750P unit rts revised-sl
6.11 pm	6.20 pm	CS Energy	Gladstone	-35	-1,000	N/A	1811P plant not following target rebid to match load-sl
6.23 pm	6.30 pm	Arrow Energy	Braemar 2	168	15,000	-1,000	1820A qld price lower than forecast sl

NSW

Table 12: NSW significant rebids for 5.30 pm trading interval

Submit time	Time effective	Participant	Station	Capacity rebid (MW)	Price from ($/MWh)	Price to ($/MWh)	Rebid reason
4.43 pm		Snowy Hydro	Guthega	-40	-1,000	N/A	16:43:33 P update capability parameters for change to outage plan/plant conditions

Submit time	Time effective	Participant	Station	Capacity rebid (MW)	Price from ($/MWh)	Price to ($/MWh)	Rebid reason
4.44 pm		AGL Energy	Liddell	-20	-1,000	N/A	1642~P~010 unexpected/plant limits~101 feeder limit~
5.06 pm	5.15 pm	Origin Energy	Eraring	190	15,000	13	1700A constraint management - V>>V_DDSM_1 SL
5.12 pm	5.20 pm	EnergyAustralia	Mt Piper	-30	-1,000	N/A	1710~P~ADJ avail revised mill limit sl~~
5.18 pm	5.25 pm	Origin Energy	Eraring	100	15,000	-1,000	1715A unforecast dispatch volatility sl
5.19 pm	5.30 pm	AGL Energy	Liddell	-40	-1,000	N/A	1717~P~020 reduction in avail cap~203 feeder failure 40mw~

Appendix C: Price setter

The following tables identify for the trading interval in which the spot price exceeded $5,000/MWh, each 5 minute dispatch interval price and the generating units involved in setting the energy price. This information is published by AEMO.[4] The 30-minute spot price is the average of the 6 dispatch interval prices.

Queensland

Table 13: Queensland price setter 4.30 pm

DI	Dispatch Price ($/MWh)	Participant	Unit	Service	Offer price ($/MWh)	Marginal change	Contribution
16:05	$19.15	Stanwell	TARONG#2	Energy	$19.15	0.50	$9.58
		Stanwell	TARONG#4	Energy	$19.15	0.50	$9.58
16:10	$425.44	Origin Energy	MSTUART3	Energy	$425.44	1.00	$425.44
16:15	$41.88	Origin Energy	ER01	Energy	$12.59	1.12	$14.10
		Hornsdale Power Reserve	HPRG1	Raise reg	$24.90	1.12	$27.89
		Origin Energy	ER01	Raise reg	$0.00	-1.12	$0.00
16:20	$15,000.00	ERMPower and Arrow	BRAEMAR5	Energy	$15,000.00	0.08	$1,200.00
		ERMPower and Arrow	BRAEMAR6	Energy	$15,000.00	0.08	$1,200.00
		ERMPower and Arrow	BRAEMAR7	Energy	$15,000.00	0.08	$1,200.00
		CleanCo	W/HOE#1	Energy	$15,000.00	0.41	$6,150.00
		CleanCo	W/HOE#2	Energy	$15,000.00	0.35	$5,250.00
16:25	$14,999.00	CleanCo	BARRON-1	Energy	$14,999.00	1.00	$14,999.00
16:30	$361.82	AGL Hydro	MCKAY1	Energy	$290.99	1.24	$360.83
		Berrybank	BRYB1WF1	Energy	-$31.64	-0.07	$2.21
Spot Price		**$5,141/MWh**					

Table 14: Queensland price setter 5 pm

DI	Dispatch Price ($/MWh)	Participant	Unit	Service	Offer price ($/MWh)	Marginal change	Contribution
16:35	$15,000.00	ERMPower and Arrow	BRAEMAR6	Energy	$15,000.00	0.12	$1,800.00
		ERMPower and Arrow	BRAEMAR7	Energy	$15,000.00	0.12	$1,800.00
		Origin Energy	MSTUART1	Energy	$15,000.00	0.26	$3,900.00
		Origin Energy	MSTUART2	Energy	$15,000.00	0.23	$3,450.00
		Origin Energy	MSTUART3	Energy	$15,000.00	0.20	$3,000.00
		CleanCo	W/HOE#2	Energy	$15,000.00	0.07	$1,050.00
16:40	$15,000.00	ERMPower and Arrow	BRAEMAR5	Energy	$15,000.00	0.11	$1,650.00
		ERMPower and Arrow	BRAEMAR6	Energy	$15,000.00	0.11	$1,650.00
		ERMPower and Arrow	BRAEMAR7	Energy	$15,000.00	0.11	$1,650.00
		Origin Energy	MSTUART1	Energy	$15,000.00	0.23	$3,450.00
		Origin Energy	MSTUART2	Energy	$15,000.00	0.20	$3,000.00

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

DI	Dispatch Price ($/MWh)	Participant	Unit	Service	Offer price ($/MWh)	Marginal change	Contribution
		Origin Energy	MSTUART3	Energy	$15,000.00	0.18	$2,700.00
		CleanCo	W/HOE#2	Energy	$15,000.00	0.07	$1,050.00
16:45	$15,000.00	ERMPower and Arrow	BRAEMAR5	Energy	$15,000.00	0.28	$4,200.00
		ERMPower and Arrow	BRAEMAR6	Energy	$15,000.00	0.28	$4,200.00
		ERMPower and Arrow	BRAEMAR7	Energy	$15,000.00	0.28	$4,200.00
		CleanCo	W/HOE#2	Energy	$15,000.00	0.17	$2,550.00
16:50	$15,000.00	CleanCo	W/HOE#1	Energy	$15,000.00	1.00	$15,000.00
		Hydro Tasmania	TREVALLN	Raise 5	$0.90	0.56	$0.50
		CleanCo	W/HOE#1	Raise 5	$0.80	-0.56	-$0.45
		Hydro Tasmania	REECE1	Raise	$25.00	0.56	$14.00
		Hydro Tasmania	TREVALLN	Raise	$25.00	-0.56	-$14.00
16:55	$15,000.00	CleanCo	W/HOE#1	Energy	$15,000.00	0.89	$13,350.00
		CleanCo	W/HOE#2	Energy	$15,000.00	0.11	$1,650.00
17:00	$15,000.00	CleanCo	W/HOE#1	Energy	$15,000.00	0.89	$13,350.00
		CleanCo	W/HOE#2	Energy	$15,000.00	0.11	$1,650.00
Spot Price		**$15,000/MWh**					

Table 15: Queensland price setter 5.30 pm

DI	Dispatch Price ($/MWh)	Participant	Unit	Service	Offer price ($/MWh)	Marginal change	Contribution
17:05	$15,000.00	ERMPower and Arrow	BRAEMAR5	Energy	$15,000.00	0.11	$1,650.00
		ERMPower and Arrow	BRAEMAR6	Energy	$15,000.00	0.11	$1,650.00
		ERMPower and Arrow	BRAEMAR7	Energy	$15,000.00	0.11	$1,650.00
		CleanCo	W/HOE#1	Energy	$15,000.00	0.58	$8,700.00
		CleanCo	W/HOE#2	Energy	$15,000.00	0.07	$1,050.00
17:10	$15,000.00	ERMPower and Arrow	BRAEMAR5	Energy	$15,000.00	0.11	$1,650.00
		ERMPower and Arrow	BRAEMAR6	Energy	$15,000.00	0.11	$1,650.00
		ERMPower and Arrow	BRAEMAR7	Energy	$15,000.00	0.11	$1,650.00
		CleanCo	W/HOE#1	Energy	$15,000.00	0.58	$8,700.00
		CleanCo	W/HOE#2	Energy	$15,000.00	0.07	$1,050.00
17:15	$15,000.00	ERMPower and Arrow	BRAEMAR5	Energy	$15,000.00	0.28	$4,200.00
		ERMPower and Arrow	BRAEMAR6	Energy	$15,000.00	0.28	$4,200.00
		ERMPower and Arrow	BRAEMAR7	Energy	$15,000.00	0.28	$4,200.00
		CleanCo	W/HOE#2	Energy	$15,000.00	0.17	$2,550.00
17:20	$15,000.00	CleanCo	W/HOE#1	Energy	$15,000.00	1.00	$15,000.00
		EnergyAustralia	BALBG1	Raise 5	$0.89	0.56	$0.50
		CleanCo	W/HOE#1	Raise 5	$0.80	-0.56	-$0.45
17:25	$15,000.00	Origin Energy	MSTUART1	Energy	$15,000.00	0.19	$2,850.00
		Origin Energy	MSTUART2	Energy	$15,000.00	0.17	$2,550.00
		Origin Energy	MSTUART3	Energy	$15,000.00	0.15	$2,250.00
		CleanCo	W/HOE#1	Energy	$15,000.00	0.44	$6,600.00

DI	Dispatch Price ($/MWh)	Participant	Unit	Service	Offer price ($/MWh)	Marginal change	Contribution
		CleanCo	W/HOE#2	Energy	$15,000.00	0.05	$750.00
17:30	$15,000.00	Origin Energy	MSTUART1	Energy	$15,000.00	0.19	$2,850.00
		Origin Energy	MSTUART2	Energy	$15,000.00	0.17	$2,550.00
		Origin Energy	MSTUART3	Energy	$15,000.00	0.15	$2,250.00
		CleanCo	W/HOE#1	Energy	$15,000.00	0.44	$6,600.00
		CleanCo	W/HOE#2	Energy	$15,000.00	0.05	$750.00
Spot Price		**$15,000/MWh**					

Table 16: Queensland price setter 6 pm

DI	Dispatch Price ($/MWh)	Participant	Unit	Service	Offer price ($/MWh)	Marginal change	Contribution
17:35	$15,000.00	CleanCo	W/HOE#1	Energy	$15,000.00	1.00	$15,000.00
		Hydro Tasmania	GORDON	Raise 5 min	$0.90	0.56	$0.50
		CleanCo	W/HOE#1	Raise 5 min	$0.80	-0.56	-$0.45
17:40	$15,000.00	CleanCo	W/HOE#1	Energy	$15,000.00	1.00	$15,000.00
		Hydro Tasmania	FISHER	Raise 5 min	$0.90	0.56	$0.50
		CleanCo	W/HOE#1	Raise 5 min	$0.80	-0.56	-$0.45
17:45	$15,000.00	CleanCo	W/HOE#1	Energy	$15,000.00	1.00	$15,000.00
		Hydro Tasmania	POAT110	Raise 5 min	$0.90	0.56	$0.50
		CleanCo	W/HOE#1	Raise 5 min	$0.80	-0.56	-$0.45
17:50	$15,000.00	CleanCo	W/HOE#1	Energy	$15,000.00	1.00	$15,000.00
		Hydro Tasmania	GORDON	Raise 5 min	$0.90	0.56	$0.50
		CleanCo	W/HOE#1	Raise 5 min	$0.80	-0.56	-$0.45
17:55	$15,000.00	CleanCo	W/HOE#1	Energy	$15,000.00	1.00	$15,000.00
		Hydro Tasmania	FISHER	Raise 5 min	$0.90	0.56	$0.50
		CleanCo	W/HOE#1	Raise 5 min	$0.80	-0.56	-$0.45
18:00	$15,000.00	CleanCo	W/HOE#1	Energy	$15,000.00	1.00	$15,000.00
		Hydro Tasmania	TREVALLN	Raise 5 min	$0.90	0.56	$0.50
		CleanCo	W/HOE#1	Raise 5 min	$0.80	-0.56	-$0.45
		Hydro Tasmania	DEVILS_G	Raise reg	$45.00	0.56	$25.20
		Hydro Tasmania	TREVALLN	Raise reg	$45.00	-0.56	-$25.20
		Hydro Tasmania	DEVILS_G	Raise 6 sec	$200.00	-0.12	-$24.00
		Hydro Tasmania	REECE2	Raise 6 sec	$200.00	0.04	$8.00
		Hydro Tasmania	TREVALLN	Raise 6 sec	$200.00	0.08	$16.00
Spot Price		**$15,000/MWh**					

Table 17: Queensland price setter 6.30 pm

DI	Dispatch Price ($/MWh)	Participant	Unit	Service	Offer price ($/MWh)	Marginal change	Contribution
18:05	$15,000.01	ERMPower and Arrow	BRAEMAR5	Energy	$15,000.00	0.33	$4,950.00

DI	Dispatch Price ($/MWh)	Participant	Unit	Service	Offer price ($/MWh)	Marginal change	Contribution
		ERMPower and Arrow	BRAEMAR6	Energy	$15,000.00	0.33	$4,950.00
		ERMPower and Arrow	BRAEMAR7	Energy	$15,000.00	0.33	$4,950.00
18:10	$15,000.00	ERMPower and Arrow	BRAEMAR5	Energy	$15,000.00	0.11	$1,650.00
		ERMPower and Arrow	BRAEMAR6	Energy	$15,000.00	0.11	$1,650.00
		ERMPower and Arrow	BRAEMAR7	Energy	$15,000.00	0.11	$1,650.00
		Origin Energy	MSTUART1	Energy	$15,000.00	0.25	$3,750.00
		Origin Energy	MSTUART2	Energy	$15,000.00	0.22	$3,300.00
		Origin Energy	MSTUART3	Energy	$15,000.00	0.19	$2,850.00
18:15	$15,000.00	ERMPower and Arrow	BRAEMAR5	Energy	$15,000.00	0.07	$1,050.00
		ERMPower and Arrow	BRAEMAR6	Energy	$15,000.00	0.07	$1,050.00
		ERMPower and Arrow	BRAEMAR7	Energy	$15,000.00	0.07	$1,050.00
		Origin Energy	MSTUART1	Energy	$15,000.00	0.16	$2,400.00
		Origin Energy	MSTUART2	Energy	$15,000.00	0.14	$2,100.00
		Origin Energy	MSTUART3	Energy	$15,000.00	0.12	$1,800.00
		CleanCo	W/HOE#1	Energy	$15,000.00	0.37	$5,550.00
18:20	$15,000.00	ERMPower and Arrow	BRAEMAR5	Energy	$15,000.00	0.12	$1,800.00
		ERMPower and Arrow	BRAEMAR6	Energy	$15,000.00	0.12	$1,800.00
		ERMPower and Arrow	BRAEMAR7	Energy	$15,000.00	0.12	$1,800.00
		CleanCo	W/HOE#1	Energy	$15,000.00	0.63	$9,450.00
18:25	$14,901.00	CleanCo	W/HOE#1	Energy	$14,901.00	1.00	$14,901.00
18:30	$336.71	Snowy Hydro	TUMUT3	Energy	$299.99	1.12	$335.99
Spot Price		**$12,540/MWh**					

NSW

Table 18: NSW price setter 5.30 pm

DI	Dispatch Price ($/MWh)	Participant	Unit	Service	Offer price ($/MWh)	Marginal change	Contribution
17:05	$12.59	Origin Energy	ER01	Energy	$12.59	1.00	$12.59
17:10	$12.59	Origin Energy	ER01	Energy	$12.59	0.50	$6.30
		Origin Energy	ER02	Energy	$12.59	0.50	$6.30
17:15	$58.42	Alinta Energy	LOYYB1	Energy	$9.21	0.67	$6.17
		Alinta Energy	LOYYB2	Energy	$9.21	0.67	$6.17
		Alinta Energy	LOYYB1	Raise 60	$4.50	-0.67	-$3.02
		Alinta Energy	LOYYB2	Raise 60	$4.50	-0.67	-$3.02
		EnergyAustralia	YWPS2	Raise 60	$39.00	1.34	$52.26
17:20	$13,801.15	CleanCo	W/HOE#1	Energy	$15,000.00	0.92	$13,800.00
		EnergyAustralia	BALBG1	Raise 5	$0.89	0.52	$0.46
		CleanCo	W/HOE#1	Raise 5	$0.80	-0.52	-$0.42
17:25	$13,523.47	Origin Energy	MSTUART1	Energy	$15,000.00	0.17	$2,550.00
		Origin Energy	MSTUART2	Energy	$15,000.00	0.15	$2,250.00

DI	Dispatch Price ($/MWh)	Participant	Unit	Service	Offer price ($/MWh)	Marginal change	Contribution
		Origin Energy	MSTUART3	Energy	$15,000.00	0.13	$1,950.00
		CleanCo	W/HOE#1	Energy	$15,000.00	0.40	$6,000.00
		CleanCo	W/HOE#2	Energy	$15,000.00	0.05	$750.00
17:30	$13,677.71	Origin Energy	MSTUART1	Energy	$15,000.00	0.17	$2,550.00
		Origin Energy	MSTUART2	Energy	$15,000.00	0.15	$2,250.00
		Origin Energy	MSTUART3	Energy	$15,000.00	0.13	$1,950.00
		CleanCo	W/HOE#1	Energy	$15,000.00	0.40	$6,000.00
		CleanCo	W/HOE#2	Energy	$15,000.00	0.05	$750.00
Spot Price		**$6,848/MWh**					