



Electricity spot prices above \$5000/MWh

Queensland, 18 January 2015

March 2015

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1 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.

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

2 Summary

On Sunday 18 January 2015, the dispatch price reached the market price cap of \$13 500/MWh at 4.25 pm, 4.35 pm, 4.45 pm, 4.55 pm, 8 pm and 9 pm in Queensland. The spot price reached \$6626/MWh at 5 pm as a result of the dispatch prices at 4.35 pm, 4.45 pm and 4.55 pm. The forecast spot price for the 5 pm trading interval four and twelve hours ahead was \$35/MWh.

Sunday was the fifth day in a row of high temperatures in Brisbane and the temperature on the day reached 36.7 degrees. Despite being a Sunday, demand was high, exceeding 8000 MW from 4 pm and reaching 8204 MW² at 5.30 pm.

While high levels of demand contributed to the high prices, the key underlying driver was supply conditions brought about by participant rebidding (sometimes late in the trading interval). Prior to the trading intervals in question, around 7900 MW of capacity was offered at prices less than \$35/MWh and all capacity above 8000 MW was offered at prices above \$11 000/MWh. Given the supply and demand conditions, minor changes in availability, interconnector capability or demand had the potential to bring about large price variations.

² Based on total demand.

3 Analysis

Table 1 shows actual and forecast spot price, demand and availability for each high price³ trading interval. The spot price exceeded \$5000/MWh during the 5 pm trading interval following dispatch prices at the market price cap (\$13 500/MWh) at 4.35 pm, 4.45 pm and 4.55 pm.

The table shows that high prices were not forecast four or twelve hours ahead of dispatch. Actual demand was around 100 MW higher than forecast four hours ahead for all high price trading intervals, and up to 130 MW higher than forecast half an hour prior to dispatch for the 5.30 pm trading interval, as discussed in section 3.1.2. Availability was around 100 MW higher than forecast for all high price trading intervals with the exception of the 5.30 pm trading interval, when it was as forecast.

The analysis in section 3.1 shows that supply conditions were such that small variations in demand and interconnector flows had the potential to lead to large variations in price.

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

Time	Price (\$/MWh)			Demand (MW)			Availability (MW)		
	Actual	4 hr forecast	12 hr forecast	Actual	4 hr forecast	12 hr forecast	Actual	4 hr forecast	12 hr forecast
4 pm	397	35	30	8025	7900	7861	10 078	9995	10 300
4.30 pm	2262	34	31	8082	7982	7951	10 098	9965	10 300
5 pm	6626	35	35	8168	8075	8013	10 089	9977	10 325
5.30 pm	623	34	34	8204	8113	7998	10 094	10 094	10 327

³ The weekly report from 18 to 24 January 2015 stated that we would investigate all of these prices as part of this report.

3.1 Supply and Demand

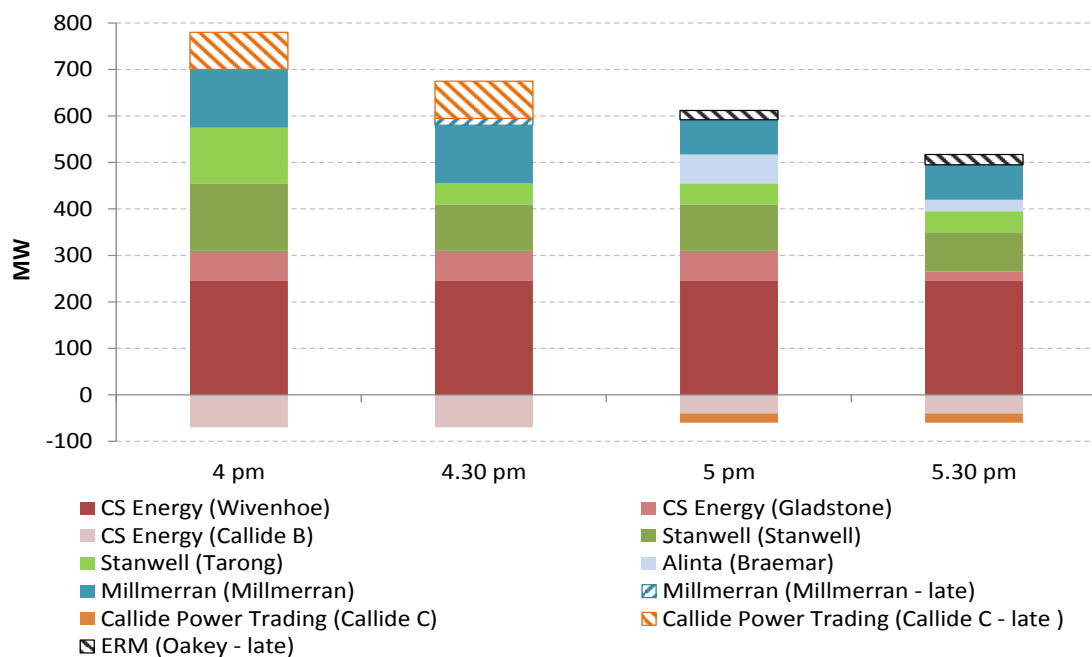
This section discusses changes to the offered prices and capacity and market demand conditions relevant to the high price periods.

3.1.1 Rebidding

Appendix A contains all significant rebids that contributed to the high prices. Figure 1 graphically summarises significant rebids made within 12 hours of dispatch and which were effective during the high price period.

Areas above the horizontal axis represent capacity rebid from low prices to high prices for each trading interval, by participant and station. Areas below the horizontal axis represent (generally low-price) capacity withdrawn, for each trading interval. Hatched areas represent capacity rebid within the trading interval (i.e. late rebidding).

Figure 1: Rebidding to high prices and capacity withdrawn, by trading interval



To understand Figure 1, take the 5 pm trading interval as an example (i.e. when the spot price exceeded \$5000/MWh). The figure shows:

- CS Energy rebid 245 MW of the 500 MW available at Wivenhoe (dark red) and 65 MW of 1120 MW available at Gladstone (light red) from low prices to high prices.

- Stanwell Corporation rebid 45 MW of the 1235 MW available at Stanwell (dark green) and 45 MW of the 1095 MW available at Tarong (light green) from low prices to high prices.
- Millmerran Energy Trader rebid 75 MW of the 825 MW available at Millmerran (blue) from low prices to high prices.
- ERM Power (black hatched) rebid 20 MW of the 342 MW available at Oakey Power Station to the price cap at 4.45 pm (within the 5 pm trading interval).
- CS Energy and Callide Power Trading reduced the available capacity at their Callide B (light red with dots) and Callide C (orange) plants by 40 MW and 20 MW respectively.

Figure 1 shows that more capacity was shifted from low to high prices for the 4 pm and 4.30 pm trading intervals than for the 5 pm trading interval. However, the spot price was higher at 5 pm because demand was higher.

3.1.2 Supply curve

This section examines actual and forecast supply curves that existed as a result of the rebidding in 3.1.1 for the 5 pm trading interval when the spot price reached \$6626/MWh.

Figure 2 shows the actual supply curve for the 5 pm trading interval (denoted by the solid green line), the supply curve forecast 12 hours ahead (i.e. 5 am, denoted by the solid blue line), and the supply curve forecast 4 hours ahead (i.e. 1 pm, denoted by the solid red line). The supply curves were derived by summing the available capacity in each price band for all generators in Queensland.

Also shown is actual demand less imports, and forecast demand less forecast imports 12 and 4 hours ahead for the 5 pm trading interval. Represented as vertical dotted lines, they follow the same colour convention as the supply curves.

Figure 2: Forecast and actual supply curves

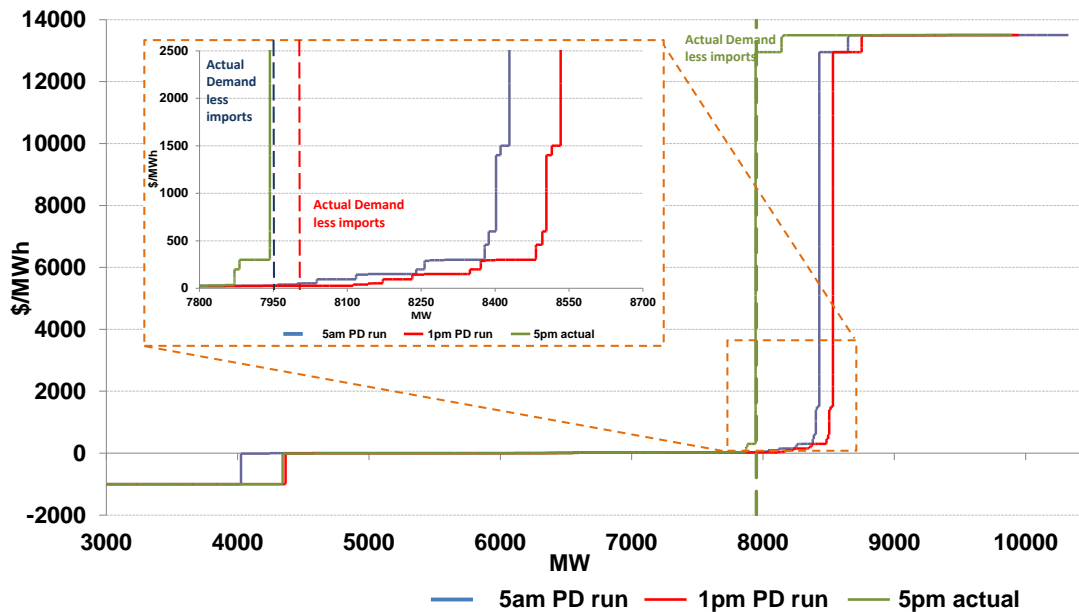


Figure 2 shows that from 12 hours ahead to 4 hours ahead rebidding caused the forecast supply curve to shift slightly to the right, however, as shown in Table 1, this did not result in an increase in forecast price.

Particularly important to why the \$6626/MWh price for the 5 pm trading interval was much higher than the 4 hour forecast price of \$35/MWh is the shape of the actual supply curve. The inset in Figure 2 shows the effect rebidding within four hours of dispatch had on the shape of the supply curve. The rebidding repriced capacity such that there was no capacity left between \$300/MWh and \$12 500 MWh, leaving an almost vertical supply curve around the level of actual demand less imports.

With conditions as described above, had the following not occurred, prices may not have been quite so high:

- output at ERM Power’s Oakey Power station was limited during the high price periods by a system normal constraint (Q>NIL_MRTA_A, designed to prevent the thermal overload of a Middle Ridge to Tangkam 110 kV line for the trip of the parallel line).
- Callide Power Trading’s Callide C unit 3 was ramp up constrained.
- RTA Yarwun’s Yarwun Power Station was generating lower than its offer.

3.1.3 Demand

On 18 January 2015 the temperature in Brisbane was forecast to reach 36 degrees, and eventually reached 36.7 degrees. Figure 3 shows (as does Table 1) that demand for the 5 pm trading interval was forecast to reach 8013 MW four hours ahead (purple

dotted line) and 8075 MW twelve hours ahead (blue dotted line). Figure 3 also shows that demand for the 5 pm trading interval was forecast to be 8137 MW half an hour ahead of dispatch (green dotted line). Actual demand (red solid line) for the 5 pm trading interval reached 8168 MW, 36 MW below the maximum for the day of 8204 MW at 5.30 pm.⁴

According to data provided by AEMO, commercial and industrial customer demand reduced in response to the high prices by a total of approximately 50 MW from 2 pm and by a further 50 MW from 4 pm. The solid blue line in Figure 3 shows what demand would have been had the commercial and industrial demand not reduced in response to high prices. As these customers are non-scheduled their response at any point in time is not incorporated in AEMO's demand forecasts. The figure shows that had these customers not reduced their demand, the demand forecast error half an hour ahead would have been over 100 MW rather than 30 MW.

Figure 3: Actual and forecast demand

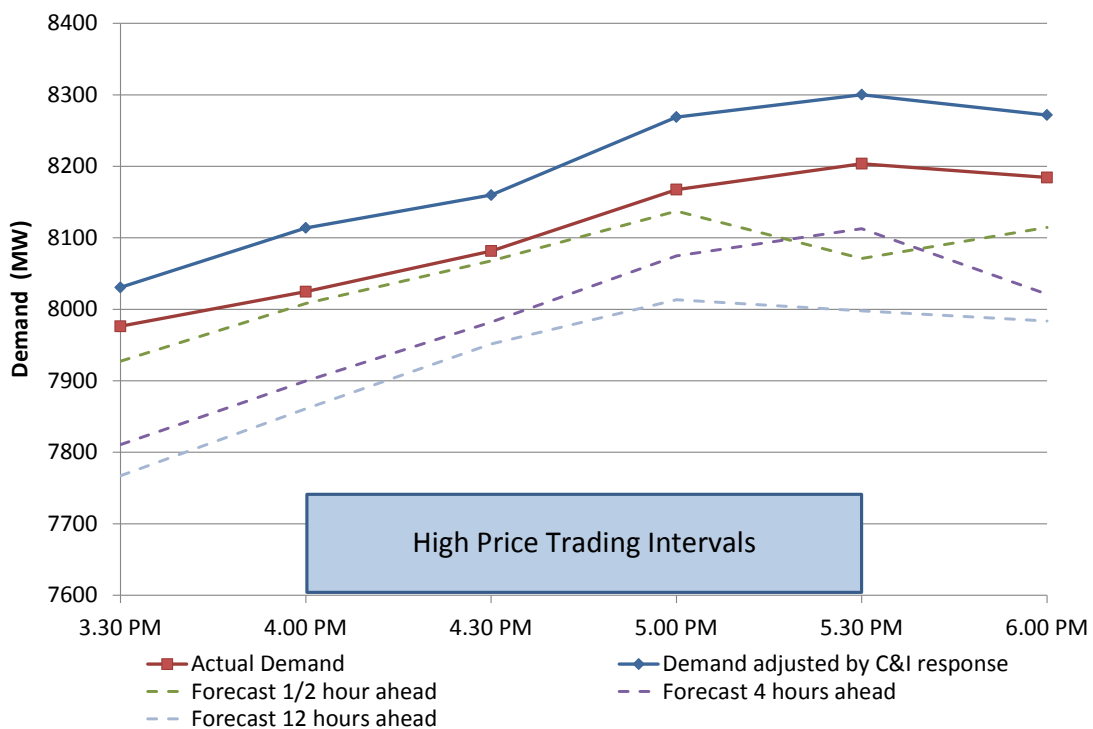
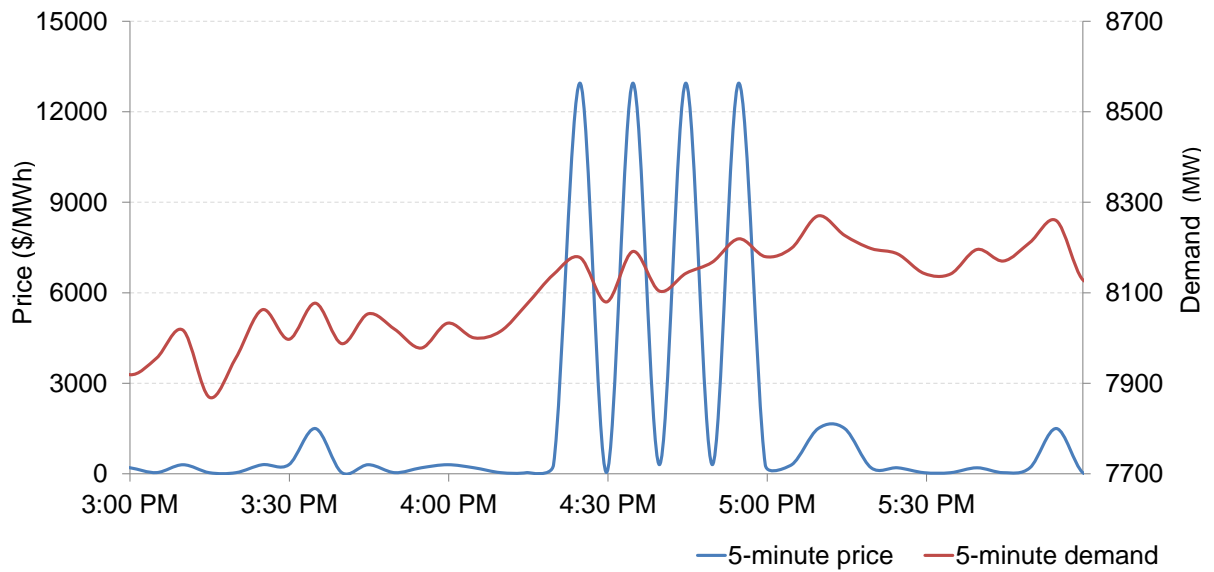


Figure 4 shows 5-minute demand and price over the high price period. The figure shows that, with the almost vertical supply curve as discussed in section 3.1.2, small increases in 5-minute demand coincided with increases in price.

⁴ Maximum demand in Queensland was 8969 MW on 5 March 2015.

Figure 4: Queensland 5-minute price and demand graph



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

3.2 Network Availability

Table 2 shows the net import limit into Queensland from New South Wales was in the order of 350 MW lower than the nominal limit of 600 MW during the time of high prices.

Table 2: Actual and forecast network capability

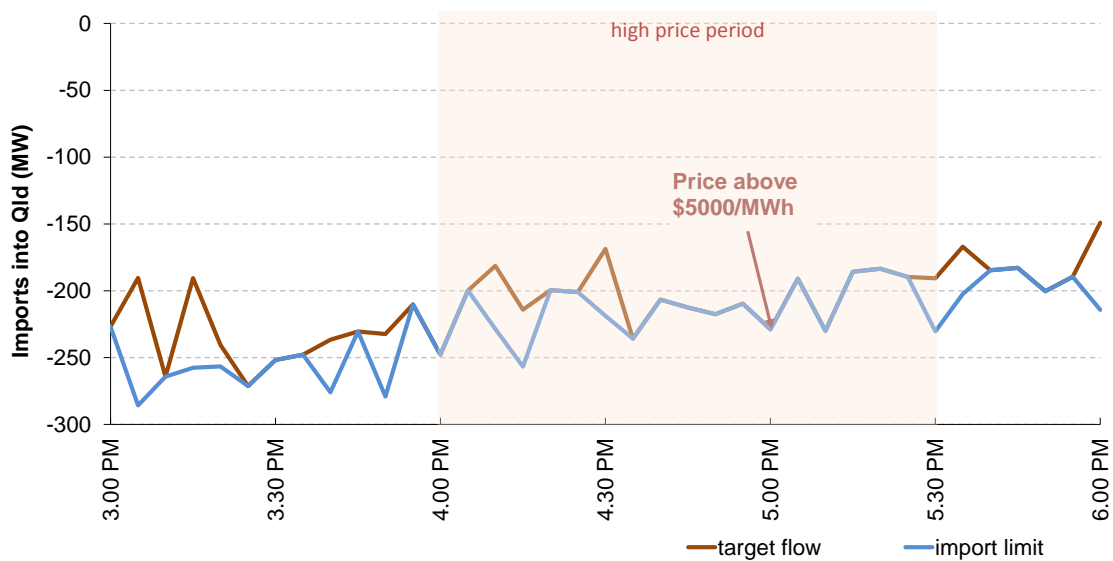
Time	Imports (MW)			Import limit (MW)		
	Actual	4 hr forecast	12 hr forecast	Actual	4 hr forecast	12 hr forecast
4 pm	-234	-70	62	-249	-243	-241
4.30 pm	-194	92	-32	-217	-305	-239
5 pm	-219	-77	-712	-218	-290	-232
5.30 pm	-195	15	53	-202	-288	-237

Imports across the Queensland to New South Wales interconnector (QNI) were limited to around 200 MW by a system normal constraint. This constraint manages the overloading of the Liddell to Muswellbrook line on the trip of the Liddell to Tamworth line.

Flows into Queensland across the Terranora interconnector were limited to 10 MW during the time of high prices. Terranora has been partially out of service since August 2013 due to faulty cables, which has reduced its maximum import limit to around 30 MW. The interconnector is scheduled to return to service in mid-2015, which should return its nominal limit to around 110 MW.

Figure 5 shows the net import limit, and net target flows into Queensland. Interconnectors were operating close to, or at, their import limits at the time of high prices, from Figure 4 and Table 2. As shown in Table 2, the import limit was around 80 MW lower than forecast 4 hours ahead at the time of high prices except for the 4 pm trading interval where it was close to forecast.

Figure 5: Net import limit and target flows



Australian Energy Regulator

March 2015

A 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 capacity involved, the change in the price of the capacity was being offered and the rebid reason.

Significant Rebids for 4 pm Trading interval

Submit time	Participant	Station	Capacity rebid (MW)	Price from (\$/MWh)	Price to (\$/MWh)	Rebid reason
12.04 pm	Millmerran	Millmerran	65	7	Price cap	12:02A price above PD
12.35 pm	CS Energy	Callide B	-10	16	N/A	1235P condenser vacuum limit-SL
12.39 pm	CS Energy	Callide B	-20	16	N/A	1238P condenser vacuum limit-SL
1.07 pm	CS Energy	Callide B	-40	16	N/A	1305P condenser vacuum limit-SL
1.09 pm	Millmerran	Millmerran	20	7	Price cap	13:07 A significant change in PD price
1.14 pm	CS Energy	Wivenhoe	245	15	Price cap	1313P water management-SL
1.17 pm	CS Energy	Gladstone	15	<290	Price cap	1316P portfolio rearrangement due to-WPS fuel management-SL
2.32 pm	Millmerran	Millmerran	40	7	Price cap	14:31 A RRP below PD
2.45 pm	CS Energy	Gladstone	50	<290	Price cap	1441P portfolio rearrangement due to-GPS 6 availability_WPS WA
3.00 pm	Stanwell	Stanwell, Tarong	265	<26	13 499	1459A QLD 5min demand above 30min PD @ 1455HRS
3.47 pm (effective at 3.55 pm)	Callide	Callide C	80	-952	Price cap	1547A RRP above PD
Total capacity rebid from low to high prices			780			
Total capacity withdrawn			70			

Significant Rebids for 4.30 pm Trading interval

Submit time	Participant	Station	Capacity rebid (MW)	Price from (\$/MWh)	Price to (\$/MWh)	Rebid reason
12.04 pm	Millmerran	Millmerran	65	7	Price cap	12:02A price above PD
12.35 pm	CS Energy	Callide B	-10	16	N/A	1235P condenser vacuum limit-SL
12.39 pm	CS Energy	Callide B	-20	16	N/A	1238P condenser vacuum limit-SL
1.07 pm	CS Energy	Callide B	-40	16	N/A	1305P condenser vacuum limit-SL
1.09 pm	Millmerran	Millmerran	20	7	Price cap	13:07 A significant change in PD price
1.14 pm	CS Energy	Wivenhoe	245	15	Price cap	1313P water management-SL
1.17 pm	CS Energy	Gladstone	15	<290	13 239	1316P portfolio rearrangement due to-WPS fuel management-SL
2.32 pm	Millmerran	Millmerran	40	7	Price cap	14:31 A RRP below PD
2.45 pm	CS Energy	Gladstone	50	<290	Price cap	1441P portfolio rearrangement due to-GPS 6 availability_WPS WA
3.54 pm	Stanwell	Stanwell, Tarong	145	18	13 499	1553A manage QNI binding constraint
4.05 pm (effective at 4.15 pm)	Millmerran	Millmerran	15	7	Price cap	16:04 A RRP above PD
4.16 pm (effective at 4.25 pm)	Callide	Callide C	80	-952	Price cap	1610A RRP above PD ⁵
Total capacity rebid from low to high prices			675			
Total capacity withdrawn			70			

⁵ At 4.18 Callide submitted a rebid which reduced available capacity by 5 MW priced at the price cap.

Significant Rebids for 5 pm Trading interval

Submit time	Participant	Station	Capacity rebid (MW)	Price from (\$/MWh)	Price to (\$/MWh)	Rebid reason
1.07 pm	CS Energy	Callide B	-40	16	N/A	1305P condenser vacuum limit-SL
1.09 pm	Millmerran	Millmerran	20	7	Price cap	13:07 A significant change in PD price
1.14 pm	CS Energy	Wivenhoe	245	15	Price cap	1313P water management-SL
1.16 pm	Alinta	Braemar	26	<568	Price cap	1310A QLD price \$199 VS 5MIN PD \$35@13:15
1.17 pm	CS Energy	Gladstone	15	<290	Price cap	1316P portfolio rearrangement due to-WPS fuel management-SL
2.32 pm	Millmerran	Millmerran	40	7	Price cap	14:31 A RRP below PD
2.45 pm	CS Energy	Gladstone	50	<290	Price cap	1441P portfolio rearrangement due to-GPS 6 availability_WPS WA
3.54 pm	Stanwell	Stanwell, Tarong	145	18	13 499	1553A manage QNI binding constraint
4.05 pm	Millmerran	Millmerran	15	7	Price cap	16:04 A RRP above PD
4.18 pm and 4.24 pm (effective at 4.35 pm)	Callide	Callide C	-20	<13	N/A	1617P CC4 – low coal CV – emission nearing limit and 1624P CC4 – low coal CV – emission nearing limit
4.24 pm (effective at 4.35 pm)	Arrow	Braemar	36	<1423	Price cap	1620A change in 5MIN PD: QLD price increase SL
4.37 pm (became effective at 4.45 pm)	ERM	Oakey	20	287	Price cap	1635P ambient conditions::change MW distrib.
Total capacity rebid from low to high prices			612			
Total capacity withdrawn			60			

Significant Rebids for 5.30 pm Trading interval

Submit time	Participant	Station	Capacity rebid (MW)	Price from (\$/MWh)	Price to (\$/MWh)	Rebid reason
1.07 pm	CS Energy	Callide B	-40	16	N/A	1305P condenser vacuum limit-SL
1.09 pm	Millmerran	Millmerran	20	7	Price cap	13:07 A significant change in PD price
1.16 pm	Alinta	Braemar	25	<568	Price cap	1310A QLD price \$199 VS 5MIN PD \$35@13:15
2.32 pm	Millmerran	Millmerran	40	7	Price cap	14:31 A RRP below PD
2.33 pm	CS Energy	Wivenhoe	245	15	Price cap	1433P water maN/Agement-SL
2.45 pm	CS Energy	Gladstone	20	<290	Price cap	1441P portfolio rearrangement due to-GPS 6 availability_WPS WA
4.05 pm	Millmerran	Millmerran	15	7	Price cap	16:04 A RRP above PD
4.18 pm and 4.24 pm	Callide	Callide C	-20	<13	N/A	1617P CC4 – low coal CV – emission nearing limit and 1624P CC4 – low coal CV – emission nearing limit
4.51 pm	Stanwell	Tarong and Stanwell	130	19	13 499	1649A QLD 5min demand above 30min PD @ 1650HRS
5.08 pm (effective at 5.15 pm)	AGL	Oakey	22	<287	13 499	1707F change in PD: FCAST price INC::change MW DISTRIB.
Total capacity rebid from low to high prices			517			
Total capacity withdrawn			60			

B Price setter

The following table identifies for the trading interval in which the spot price exceeded \$5000/MWh, each five minute dispatch interval price and the generating units involved in setting the energy price. This information is published by AEMO.⁶ The 30-minute spot price is the average of the six dispatch interval prices.

Queensland - 5 pm

Time	Dispatch Price	Participant	Unit	Service	Marginal change	Contribution
16:35	\$12 949.99	Stanwell	STAN-2	Energy	0.13	\$12 949.99
		Stanwell	STAN-3	Energy	0.13	\$12 949.99
		Stanwell	STAN-4	Energy	0.13	\$12 949.99
		Stanwell	TARONG#1	Energy	0.20	\$12 949.99
		Stanwell	TARONG#3	Energy	0.20	\$12 949.99
		Stanwell	TARONG#4	Energy	0.20	\$12 949.99
16:40	\$301.50		OAKEY1	Energy	0.66	\$301.50
			OAKEY2	Energy	0.34	\$301.50
16:45	\$12 949.99	Stanwell	STAN-2	Energy	0.13	\$12 949.99
		Stanwell	STAN-3	Energy	0.13	\$12 949.99
		Stanwell	STAN-4	Energy	0.13	\$12 949.99
		Stanwell	TARONG#1	Energy	0.20	\$12 949.99
		Stanwell	TARONG#3	Energy	0.20	\$12 949.99
		Stanwell	TARONG#4	Energy	0.20	\$12 949.99
16:50	\$301.50		OAKEY1	Energy	1.00	\$301.50
16:55	\$12 949.99	Stanwell	STAN-2	Energy	0.13	\$12 949.99
		Stanwell	STAN-3	Energy	0.13	\$12 949.99
		Stanwell	STAN-4	Energy	0.13	\$12 949.99

⁶ Details on how the price is determined can be found at www.aemo.com.au

Time	Dispatch Price	Participant	Unit	Service	Marginal change	Contribution
		Stanwell	TARONG#1	Energy	0.20	\$12 949.99
		Stanwell	TARONG#3	Energy	0.20	\$12 949.99
		Stanwell	TARONG#4	Energy	0.20	\$12 949.99
17:00	\$301.50		OAKEY1	Energy	1.00	\$301.50
	Spot Price	\$6626/MWh				

C Closing bids

Figures C1 to C5 highlight the half hour closing bids for participants in Queensland with significant capacity priced at or above \$5000/MWh during the periods in which the spot price exceeded \$5000/MWh. They also show generation output and the spot price.

Figure C1 - CS Energy (Callide B, Gladstone, Kogan Creek, Wivenhoe) closing bid prices, dispatch and spot price

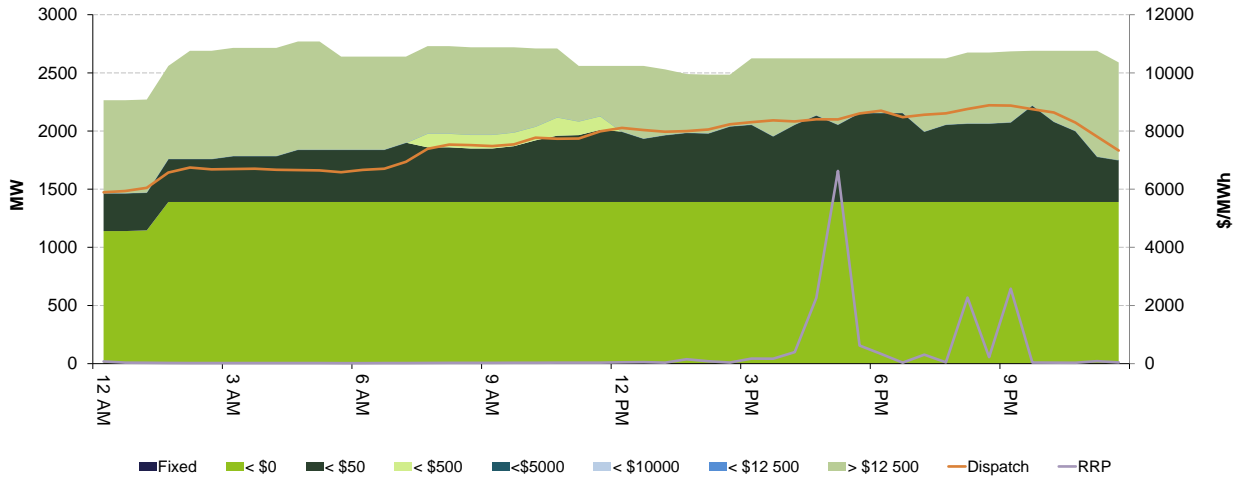


Figure C2 - Stanwell (Barron Gorge, Kareeya, Mackay, Stanwell, Tarong, Tarong North) closing bid prices, dispatch and spot price

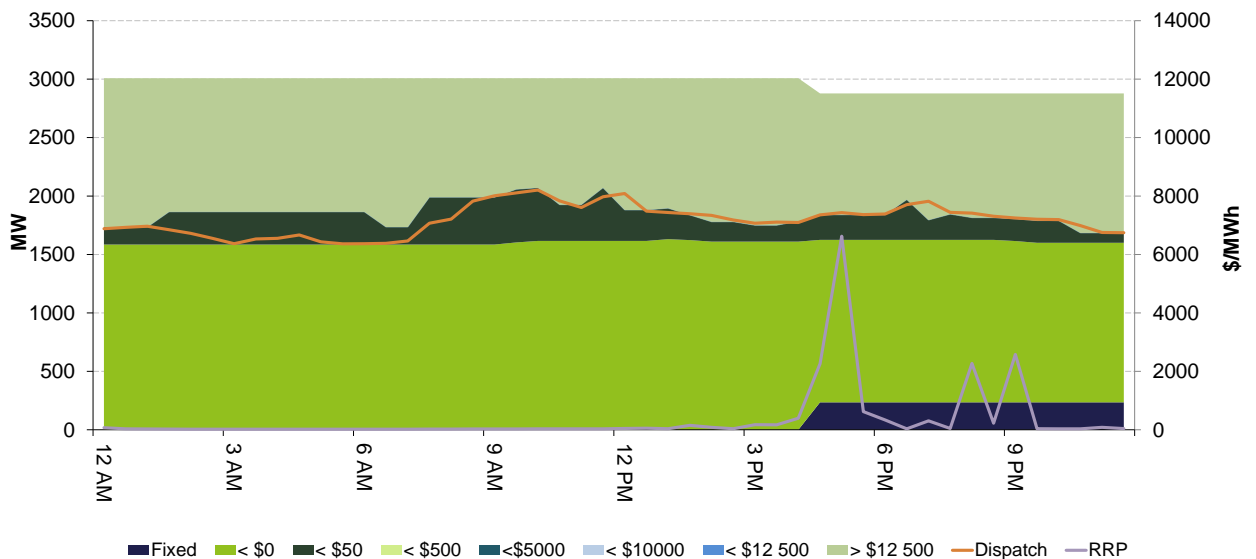


Figure C3 - Alinta (Braemar A) closing bid prices, dispatch and spot price

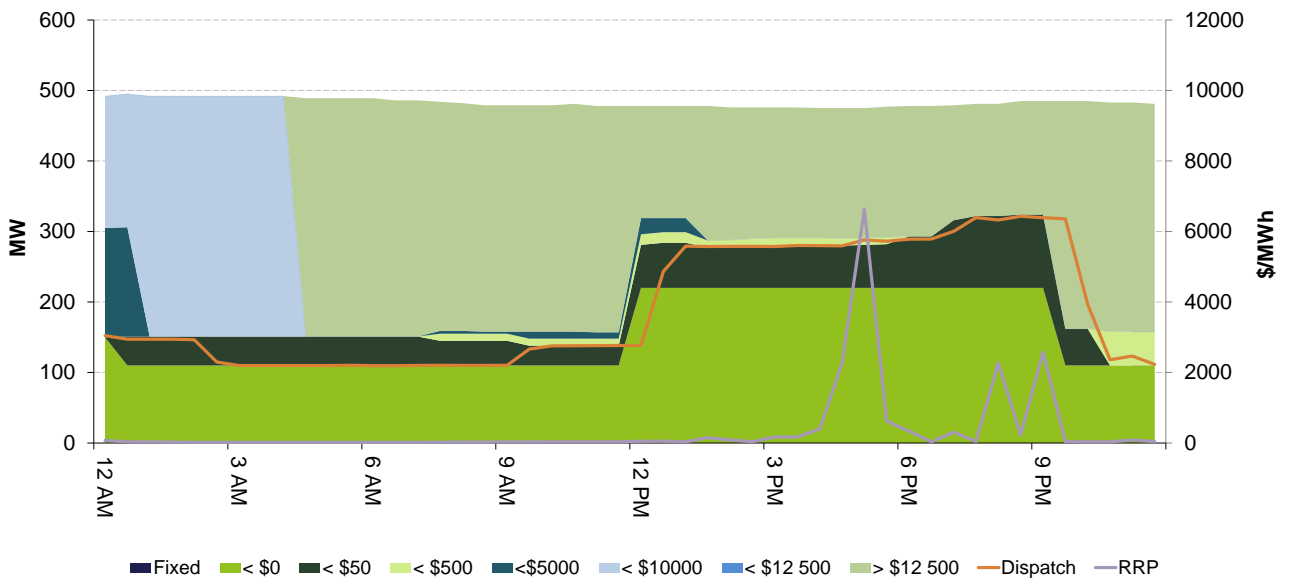


Figure C4 - Millmerran Energy Trader (Millmerran) closing bid prices, dispatch and spot price

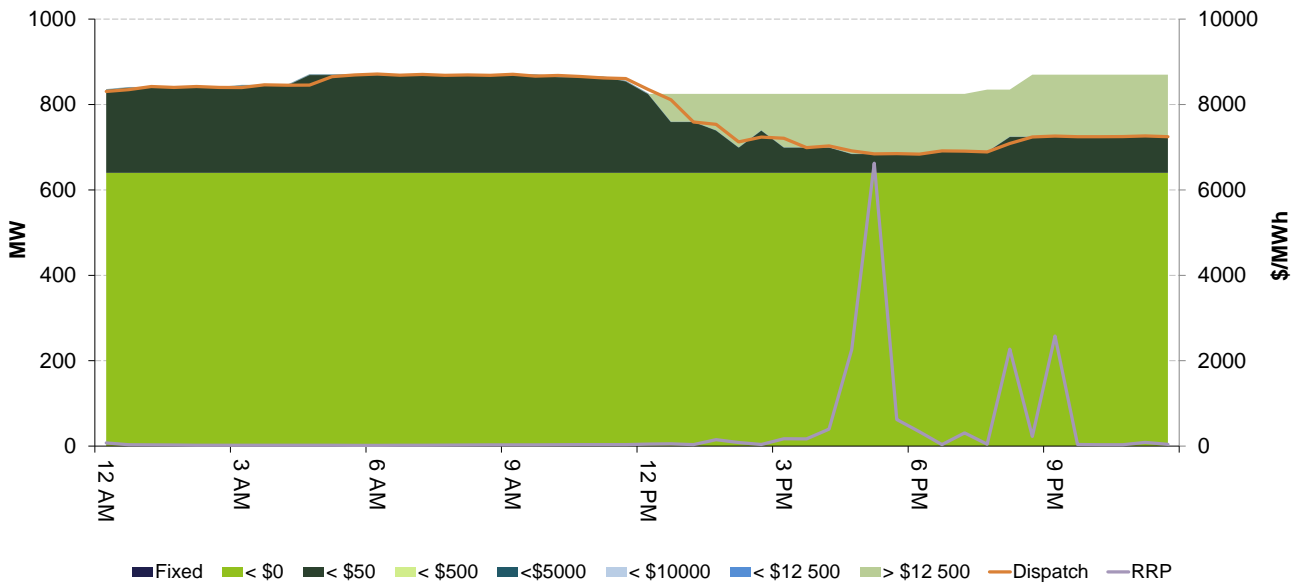


Figure C5 - ERM (Oakey) closing bid prices, dispatch and spot price

