

Electricity prices above \$5,000/MWh

Queensland,
8 & 9 March 2022

May 2022

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AER reference: AER22005126

Amendment record

Version	Date	Pages
1	12 May 2022	29

1 Summary

In 5 separate intervals, on 8 and 9 March 2022 the 30-minute price in the Queensland region was above \$5,000 per megawatt hour (\$/MWh). This report, as per the National Electricity Rules, covers the Australian Energy Regulator's (AER) review into these two events.

Specifically, on:

- 8 March 2022, from 6 pm to 7.30 pm, the 30-minute price in the Queensland region breached \$5,000/MWh on 4 separate but concurrent intervals. The forecast one hour price was above \$5,000/MWh for 2 of the 4 intervals, and the 4 hour forecast was above \$5,000/MWh for one of the intervals.
- 9 March 2022, at 3.30 am, the 30-minute price was \$5,097/MWh. This price was not forecast to be above \$5,000/MWh.

This report reviews the high prices on 8 and 9 March separately (at 3.1 and 3.2). While the intervals occurred on concurrent dates the drivers behind the prices are not common.

8 March

The main drivers of the high prices during 8 March were:

- Record breaking, higher than forecast demand, driven by high temperatures and high humidity. Record demand on 8 March was recorded (10,088 MW at 7pm) (see 3.1.2)
- A constraint managing a planned outage in NSW limited Queensland's access to lower priced capacity from the rest of the National Electricity Market (NEM), and
- 1,330 MW of capacity was unavailable due to outages during the high priced periods, compared to 1,230 MW offline in March 2021.

AEMO published forecast lack of reserve (LOR) notices for 8 March in order to seek a response from the market. Actual LOR1 and LOR2 were declared and incorporated the times of the high priced intervals.

Rebidding of capacity to higher prices did not contribute to the price outcomes.

9 March

The main drivers of the high price 9 March were:

- Wivenhoe Pump 1 was given a dispatch instruction to reduce its load, which resulted in a significant change in market conditions
- Due to ramping constraints, constrained generators were unable to set the price for the 3.15 am interval so the price was set at \$15,100/MWh, and
- AEMO reviewed the following 5-minute interval and determined there was incorrect input data. As per AEMO's procedures, the price was carried forward from the closest interval with correct inputs, which meant a second interval was priced at \$15,100/MWh.

Rebidding of capacity to higher prices did not contribute to the price outcomes.

2 Obligation

The 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.

The AER is required to publish a report whenever the electricity 30-minute price¹ 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 30-minute price exceeding \$5,000/MWh, including withdrawal of generation capacity and network availability
- assesses whether rebidding contributed to the 30-minute price exceeding \$5,000/MWh
- identifies the marginal scheduled generating units, and
- identifies all units with offers for the trading intervals 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.

¹ From 1 October 2021, clause 3.13.7 of the NER was amended for 5 minute settlement. Under 5 minute settlement, a trading interval is now comprised of a 5 minute period and the spot price is the price for a trading interval. The 30-minute price is the average of 6 trading intervals and is calculated the same way as previously under 30 minute settlement.

3 Overview of actual and expected conditions

In 5 separate intervals, on 8 and 9 March 2022 the 30-minute price in the Queensland region was above \$5,000 per megawatt hour (\$/MWh). This report, as per the National Electricity Rules, reports on the AER review into these intervals.

This report reviews the high prices on 8 and 9 March separately (at 3.1 and 3.2). While the intervals occurred on concurrent dates the drivers behind the prices are not common. The prices outcomes for both days are summarised here.

Table 1 and Table 2 compare the actual and forecast 30-minute spot prices, demand and available capacity in Queensland during the evening of 8 March and at 3.30 am on 9 March, respectively.

Table 1: 8 March Actual and forecast 30-minute price, demand and availability

30-minute period	Price (\$/MWh)			Demand (MW)			Availability (MW)		
	Actual	1 hr forecast	4 hr forecast	Actual	1 hr forecast	4 hr forecast	Actual	1 hr forecast	4 hr forecast
6.00 pm	11,879	300	350	10,020	9,660	9,320	10,645	10,740	10,672
6.30 pm	10,480	302	1,001	9,971	9,657	9,294	10,433	10,550	10,397
7.00 pm	15,100	15,100	9,798	10,088	9,790	9,316	10,274	10,465	10,380
7.30 pm	9,081	6,810	1,001	9,885	9,675	9,274	10,324	10,524	10,383

From Table 1 we observe that on 8 March 2022, from 6 pm to 7.30 pm:

- The 30-minute price in the Queensland region breached \$5,000/MWh on 4 separate but concurrent intervals
- The forecast one hour price was above \$5,000/MWh, on 2 of the 4 intervals, and the 4 hour forecast was above \$5,000/MWh on one of the 4 intervals. Price forecasts were volatile on the day fluctuating between \$300/MWh and \$15,1000/MWh
- Demand, driven by high temperatures, was higher than forecast by up to 360 MW, one hour prior, and
- Availability was between 95 MW and 200 MW lower than forecast one hour prior.

Table 2: 9 March Actual and forecast 30-minute price, demand and availability

30-minute period	Price (\$/MWh)			Demand (MW)			Availability (MW)		
	Actual	1 hr forecast	4 hr forecast	Actual	1 hr forecast	4 hr forecast	Actual	1 hr forecast	4 hr forecast
3.30 am	5,097	99	119	6,352	6,386	6,327	9,993	9,920	9,896

From Table 2 we observe on 9 March 2022, at 3.30 am:

- The 30-minute price was \$5,097/MWh
- The high price was not forecast
- Demand was 34 MW lower than forecast, one hour prior, and
- Availability was 73 MW higher than forecast, one hour prior.

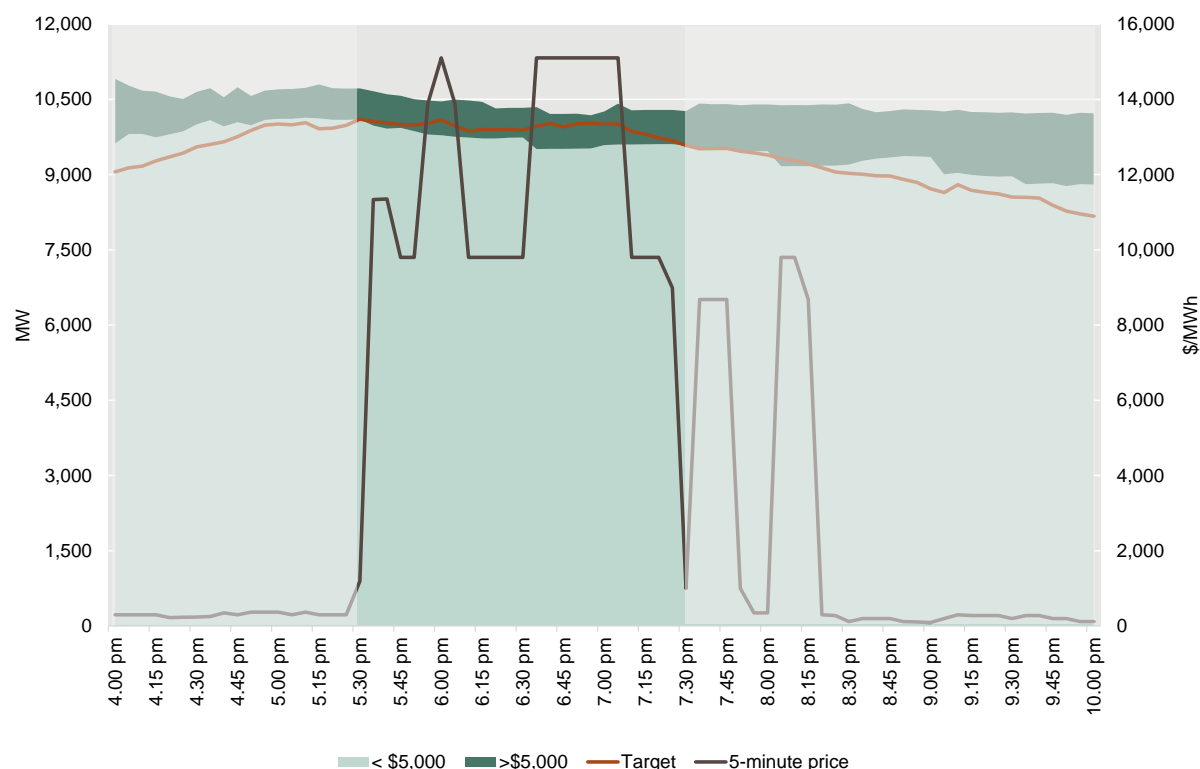
3.1 8 March

3.1.1 Sustained high prices for the early evening

On 8 March, between 5.35 pm and 8.15 pm there were 29 5-minute prices above \$5,000/MWh which led to 4 intervals of 30-minute prices to be above \$5,000/MWh between 6 pm and 7.30 pm.

Figure 1 shows the effective available capacity (stacked area) in the Queensland region, specifically available capacity priced above and below \$5,000/MWh, along with 5-minute prices (actual) and target.

Figure 1: Generation offered above and below \$5,000/MWh, target and 5-minute price



Source: AER analysis using NEM data

Note: The capacity priced less than \$5,000/MWh is adjusted to show effective availability, where ramp rate limited capacity could not make it to market.

Around 93% of the capacity offered was priced below \$5,000/MWh. However, up to 506 MW of high priced capacity was still needed to meet the high level of demand during the evening peak.

Prices were initially forecast to be above \$5,000/MWh from the previous day (not shown). Five 30-minute intervals were forecast to be above \$5,000/MWh and 4 of these intervals eventuated.

Participants did respond to the day ahead high price forecasts by rebidding some capacity to lower prices, and subsequent forecasts fell. Specifically, Stanwell shifted 185 MW of capacity at Stanwell power station and Tarong power station from \$15,100/MWh to below \$119/MWh. ERM Power shifted 156 MW at Oakey from \$15,100/MWh to below \$0/MWh. However, rebidding down by participants was not enough to offset the forecast demand error.

The price outcomes were highly sensitive. For example, an hour before the start of the 6 pm interval, price forecasts were \$300/MWh, but a sensitivity analysis indicated that a demand increase (over forecast) of 200 MW would result in a price of \$15,100/MWh. As per Table 1, actual demand (10,020 MW) was 360 MW more than forecast (9,660 MW) resulting in a price of around \$11,900/MWh.

Constraints on the network managing a planned outage in NSW meant Queensland had limited access to lower priced generation from the rest of the NEM.

Details of participants who offered capacity priced greater than \$5,000/MWh is set out in *Appendix A: Closing Bids*.

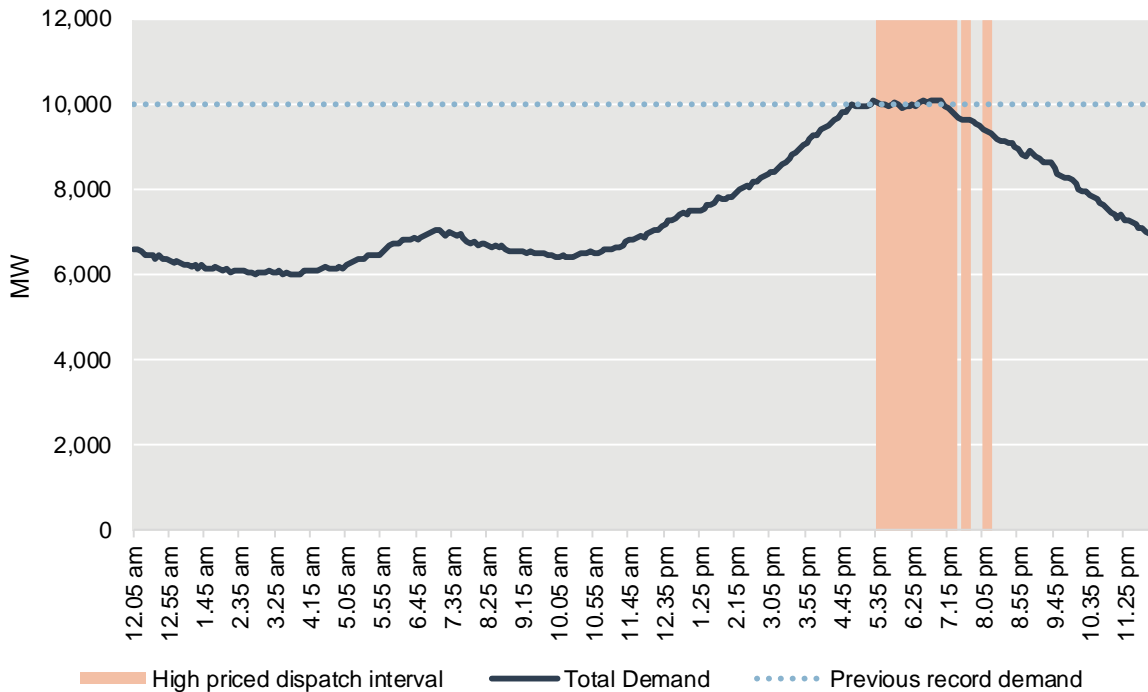
Further information on how the price was set is in *Appendix B: Price Setter*.

3.1.2 High temperatures drove record demand

Demand on 8 March reached 10,088 MW at 7 pm, setting a new total demand record for the region.² Hot days with high humidity drive high demand from air-conditioning units. The temperature on 8 March reached 34.4°C in Brisbane,³ with many areas in the Moreton South Coast districts reaching their highest March temperature on the day.⁴

Figure 2 shows demand across 8 March, by 5 minute intervals, and highlights the intervals priced above \$5,000/MWh.

Figure 2: High priced intervals coincide with record demand



Source: AER analysis using NEM data

Figure 2 illustrates that demand started to significantly increase from around 10.00 am, reaching its maximum levels around 4.45 pm and staying at this level until 7.15 pm. The majority of the high price intervals were during this period.

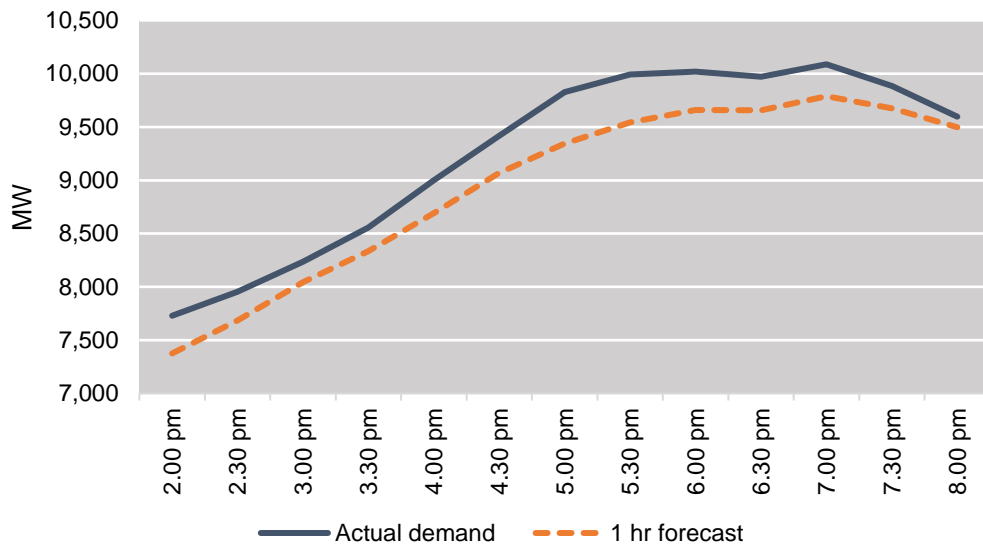
² Total demand is the demand met by scheduled and semi-scheduled generation and is used to determine the wholesale price of electricity. See https://www.aemo.com.au/-/media/files/electricity/nem/security_and_reliability/dispatch/policy_and_process/demand-terms-in-emms-data-model.pdf?la=en

³ <http://www.bom.gov.au/climate/current/month/qld/archive/202203.brisbane.shtml>

⁴ <http://www.bom.gov.au/climate/current/month/qld/archive/202203.summary.shtml>

Figure 3 shows the one hour forecast demand in comparison to actual demand across the evening of 8 March.

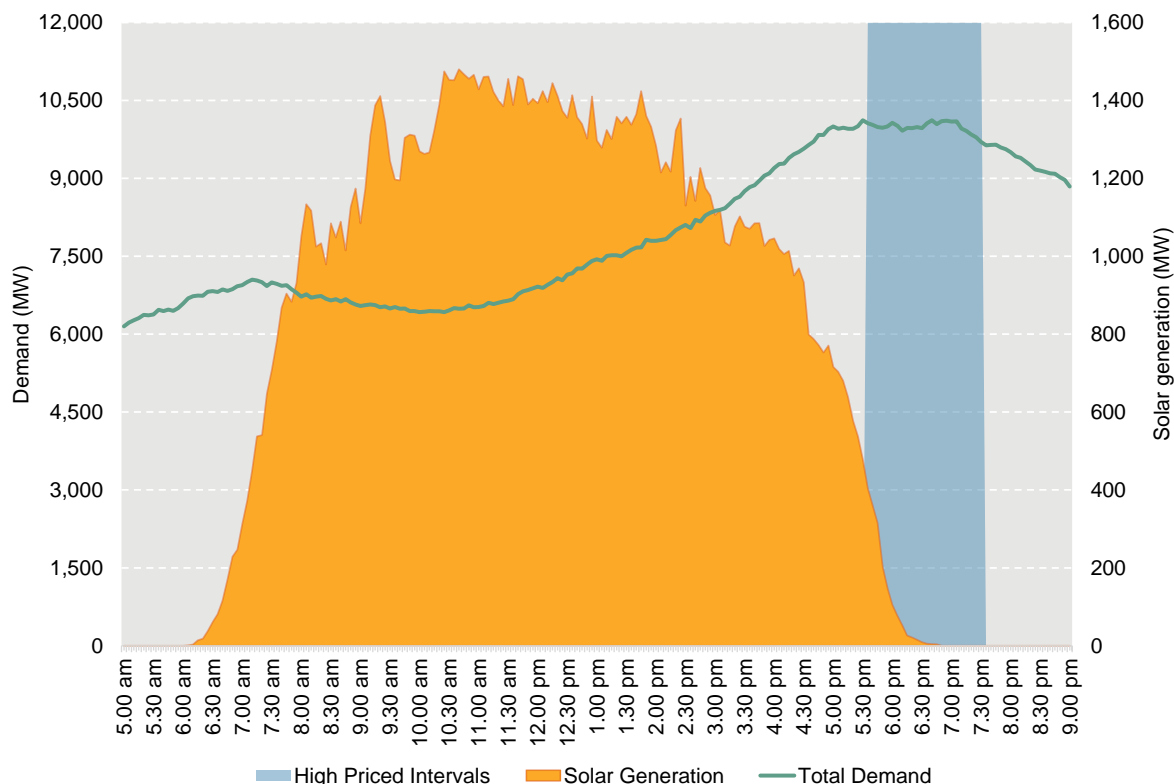
Figure 3: Actual versus 1 hour forecast demand



Source: AER analysis using NEM data

Figure 3 illustrates that demand was consistently underforecast across the day. This forecasting error started with initial forecasts published the previous day (not shown), up to and including the 1 hour forecast. Actual demand, at 6.00 pm was up to 360 MW higher than forecast (see Table 1).

Figure 4 shows solar generation across 8 March, by 5 minute intervals.

Figure 4: Queensland grid scale solar output, demand and 5-minute prices

Source: AER analysis using NEM data

Figure 4 illustrates that solar farm generation declined significantly in the late afternoon as the sun set. Coupled with reductions in rooftop PV output (not shown), demand on the grid increased until around 5.00 pm (see Figure 3).

3.1.2.1 Record high demand reduced reserves

For system security, AEMO always needs to have a buffer of spare capacity available in case there is an unexpected drop in the supply of electricity, either from a generator or an interconnector tripping.

AEMO publishes lack of reserve (LOR) market notices when forecast or actual reserve conditions are tight. The notices are tiered where LOR1 is the least severe but reserves are tight, up to LOR3 where there is no spare capacity and load shedding is required to return the system to a secure operating state.

As demand climbed in the evening peak, an actual LOR2 was declared between 5.30 pm and 7.30 pm, when the reserve shortfall was 129 MW. The low reserve level was not forecast on the day because the demand forecast error camouflaged the tight supply conditions.

In the 2 days leading up to 8 March AEMO published a series of forecast LOR notices which were cancelled and reinstated multiple times. See *Appendix D* for all market notices relating to lack of reserves on 8 March.

Record levels of demand combined with demand forecast errors and declining solar generation meant price outcomes and reserve capacity expectations varied significantly from what was forecast.

See *Appendix C* for a detailed explanation of low reserve conditions.

3.1.3 Reduced access to low priced capacity

3.1.3.1 Planned outages constrained the interconnectors

A constraint managing a planned outage in Lismore, NSW, limited imports from NSW on the Queensland-NSW interconnector (QNI) and actually forced exports on Terranora, from Queensland into NSW. Constrained interconnectors meant Queensland could only access a net amount of between 4 and 139 MW of capacity from NSW. The combined nominal capacity of both interconnectors is around 707 MW.

3.1.3.2 Baseload outages reduced the supply of low priced generation

Over 1,330 MW of baseload generation was offline during the high-price events due to technical issues. These outages reduced the supply of generation in the region. Table 3 identifies significant baseload generation that was unavailable on 8 March 2022.

Table 3: Baseload units unavailable in Queensland

Participant	Unit	Fuel type	Summer rating (MW)	Comment
CS Energy	Gladstone unit 1	Black coal	280	Offline since 24 Feb – “tube leak”
CS Energy	Gladstone unit 4	Black coal	280	Planned to be offline since 26 Feb
CS Energy	Callide C 4	Black coal	420	Offline since May 2021 following catastrophic failure
CleanCo	Swanbank E	Gas	350	Offline since 20 Dec 2021 due to technical issues
Total			1,330	

Some baseload generators are always offline as participants manage their portfolio. For context, around 1,230 MW of baseload capacity was not available during March 2021, indicating the outages on this day were slightly more than observed last year but not out of the ordinary.

3.2 9 March

3.2.1 Early morning prices

On 9 March, there were 2 5-minute prices at \$15,100/MWh during the 3.30 am 30-minute interval, which led to a 30-minute price of \$5,097/MWh. 30-minute prices are formed from the average of 6 5-minute prices.

Table 4 shows the prices set for each 5-minute interval. The high prices for 3.15 am and 3.20 am were not forecast.

Table 4: 5-minute prices

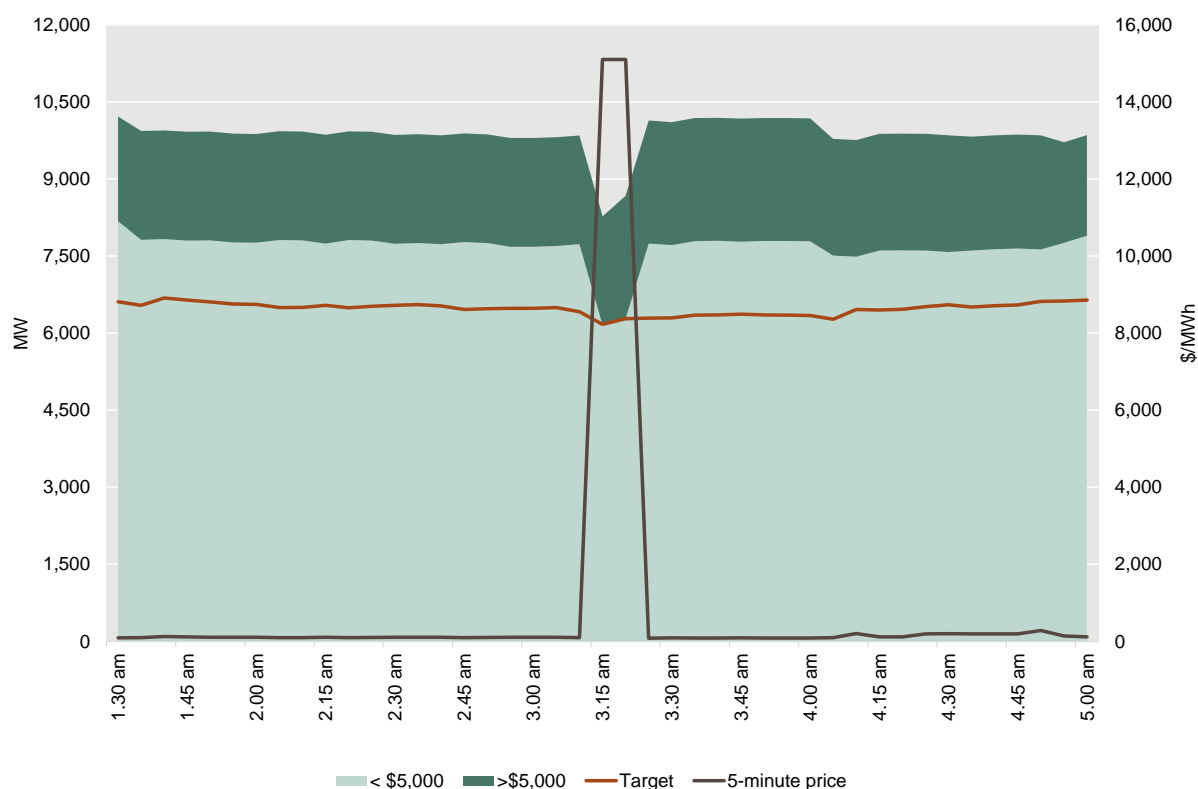
Time	5-minute price
3.05 am	\$109.73
3.10 am	\$97.78
3.15 am	\$15,100.00
3.20 am	\$15,100.00
3.25 am	\$82.10
3.30 am	\$90.73
30-minute price	\$5,097/MWh

Further information on how the price was set is in *Appendix B: Price Setter*.

3.2.2 Generators ramping down could not set price

Figure 5 shows available capacity priced above and below \$5,000/MWh, along with 5-minute prices (actual) and target.

Figure 5: Generation offered above and below \$5,000/MWh, target and 5-minute price



Source: AER analysis using NEM data

Note: The capacity priced less than \$5,000/MWh is adjusted to show effective availability, where ramp rate limited capacity could not make it to market.

3.15 am

At 3.15 am Wivenhoe Pump 1 was given a dispatch instruction to reduce it's load from 242 MW to 0 MW within 5 minutes. This is because Pump 1 offered to run as a load if the price was to be below \$300/MWh. 5 minutes before the start of the interval, the price forecast was \$315/MWh so as a result the load at

Pump 1 got a target of 0 MW. As load's consumption is offset by generation, 242 MW of NEM generation was no longer needed.

22 generators were backed off at their ramp down limit, meaning they could not set price. This effectively prevented these units from setting price as they were ramp-down constrained. All this constrained capacity was priced between the floor and \$100/MWh (see Figure 5).

Given the reduction of units that could set price, the price was set at \$15,100/MWh for this interval.

3.20 am

AEMO reviewed the 3.20 am price and determined it as having incorrect inputs (Market Notice 95189). As per AEMO's procedures,⁵ they carried the price forward from the closest interval with correct inputs, 3.15 am in this case. This meant the price for 3.20 am in Queensland was again set at \$15,100/MWh, overriding the price setter. AEMO publish a scheduling error declaration workbook which logs the intervals that have manifestly incorrect inputs and any rectification actions that have followed. The source of the erroneous data can often be down to bad SCADA data, constraint formulations or IT issues. In this instance an incorrect line rating was used. AEMO are investigating ways to improve their processes and review their default value inputs.⁶

Manifestly incorrect inputs, are not unusual but not frequent. For example, in 2021, 148 hours were affected, while in 2022 6.75 hours so far have been affected.

What are Manifestly Incorrect Inputs?

If flows on an interconnector and a 5 minute price change beyond pre-set thresholds, an interval price is flagged to be not firm and must be reviewed within 30 minutes. During the review process, if any of the inputs are deemed to be incorrect, AEMO must use the closest previous firm dispatch price.

Intervals that are flagged as not firm are communicated to the market via market notices and the findings of whether the inputs are correct or incorrect are communicated again via a market notice within 30 minutes.

⁵ https://www.aemo.com.au/-/media/Files/Electricity/NEM/Security_and_Reliability/Dispatch/Policy_and_Process/2017/Automated-Procedures-For-Identifying-Dispatch-Intervals-Subject-to-Review.docx

⁶ https://aemo.com.au/-/media/files/electricity/nem/market_notices_and_events/market_event_reports/scheduling-error-declaration.xlsx?la=en

Appendix A: Closing bids

Figure A1 to A8 highlight the 5-minute offers for participants in Queensland with capacity priced at or above \$5,000/MWh for 8 and 9 March 2022. They also show generation output and the 5-minute dispatch price.

Figure A1: Alinta Energy (Braemar A, Collinsville SF and Rugby Run SF) offers, dispatch and Qld regional reference price (RRP)

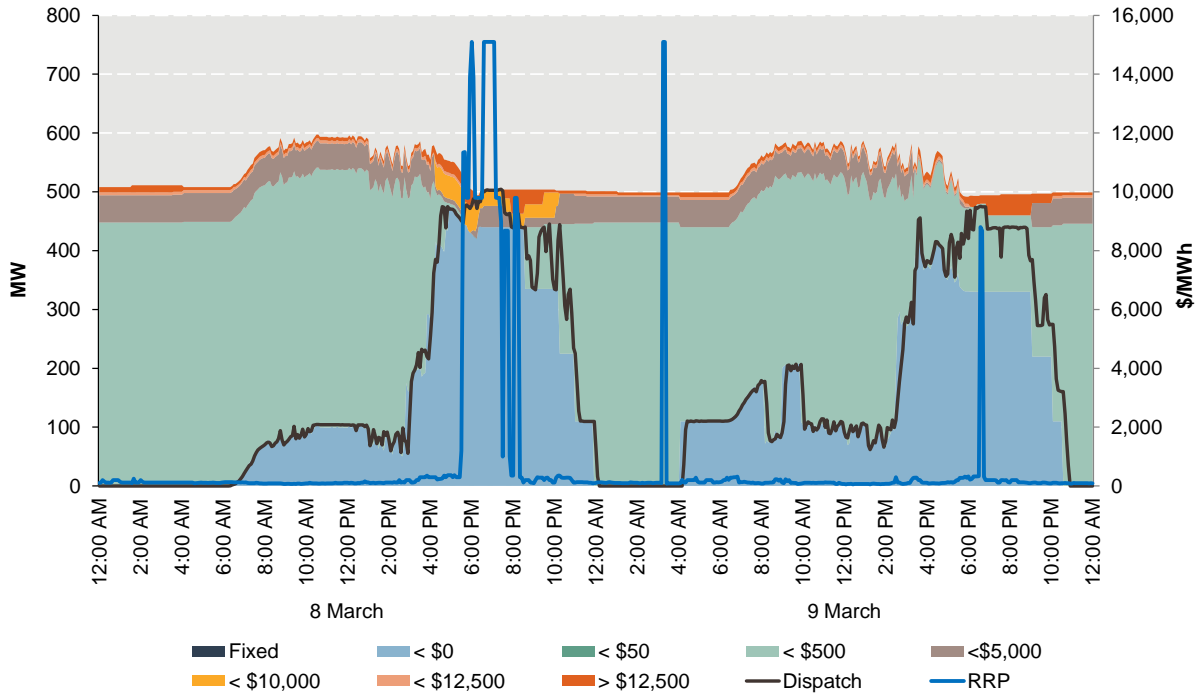


Figure A2: Arrow Energy (Braemar 2) offers, dispatch and Qld regional reference price (RRP)

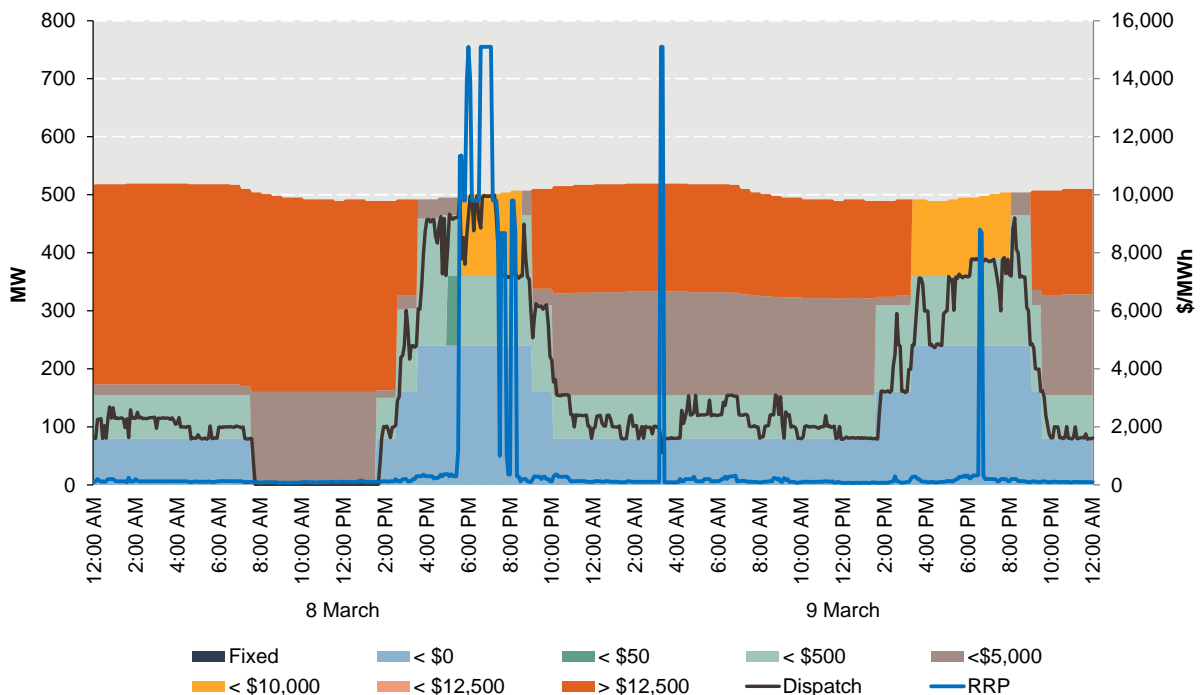


Figure A3: CleanCo (Barron Gorge, Kareeya, Swanbank and Wivenhoe) offers, dispatch and Qld regional reference price (RRP)

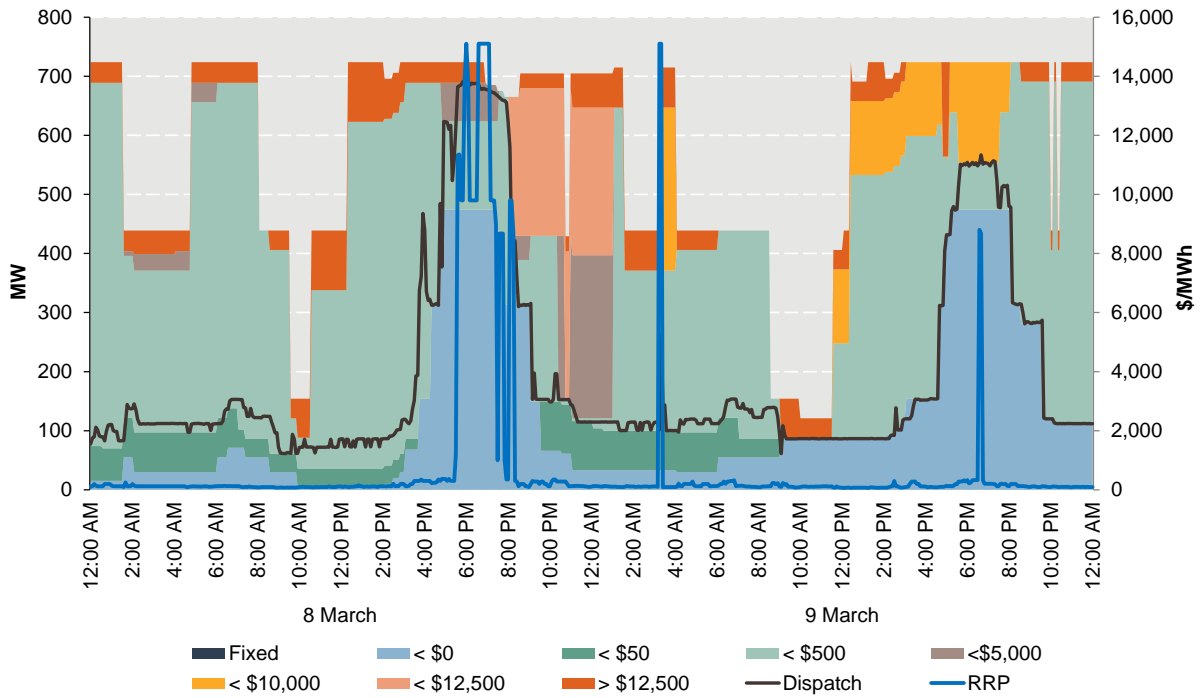


Figure A4: CS Energy (Callide B, Gladstone, Kogan Creek) offers, dispatch and Qld regional reference price (RRP)

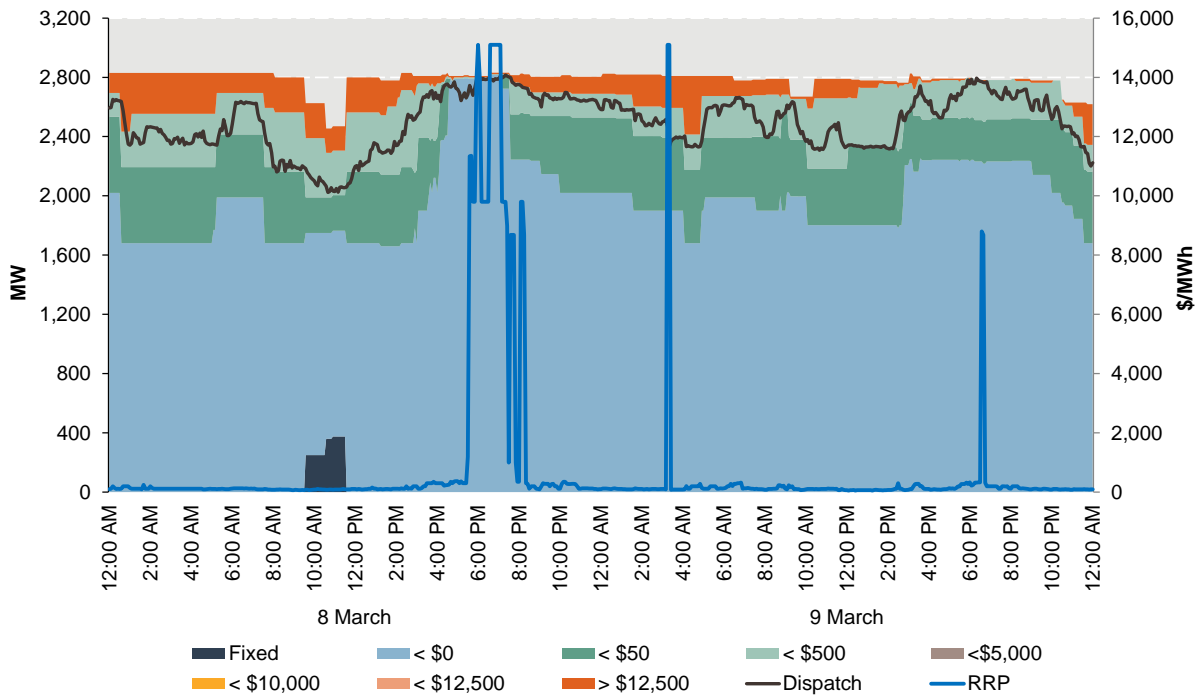


Figure A5: ERM Power (Oakey) offers, dispatch and Qld regional reference price (RRP)

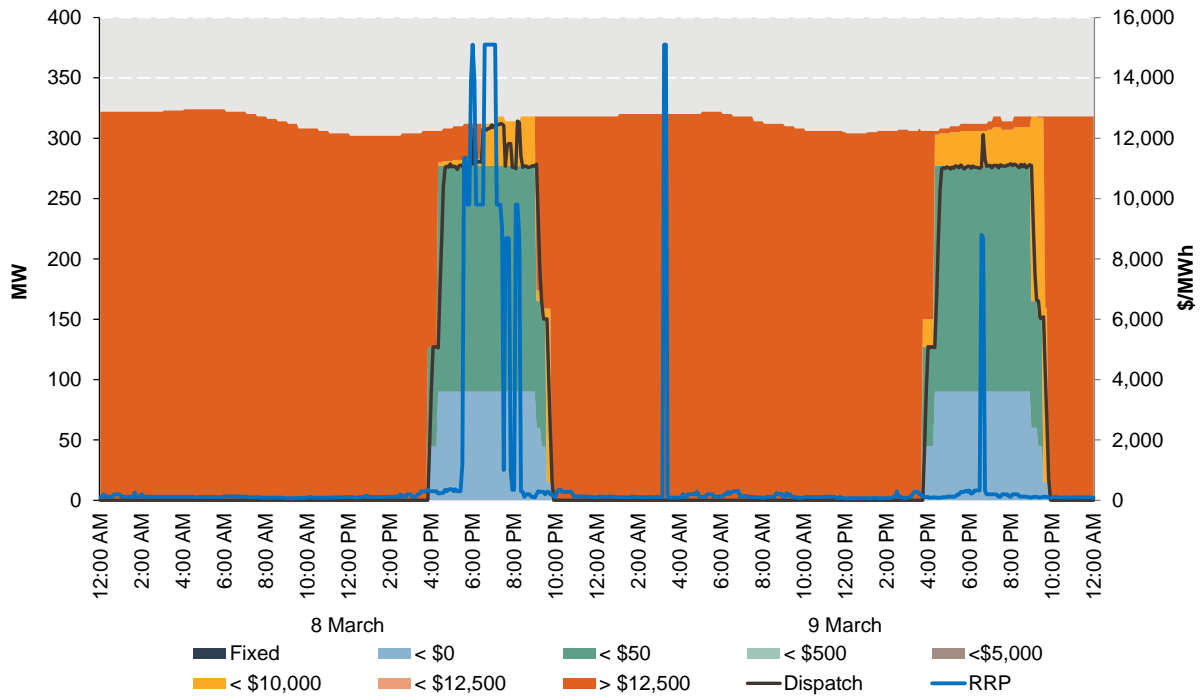


Figure A6: InterGen (Millmerran) offers, dispatch and Qld regional reference price (RRP)

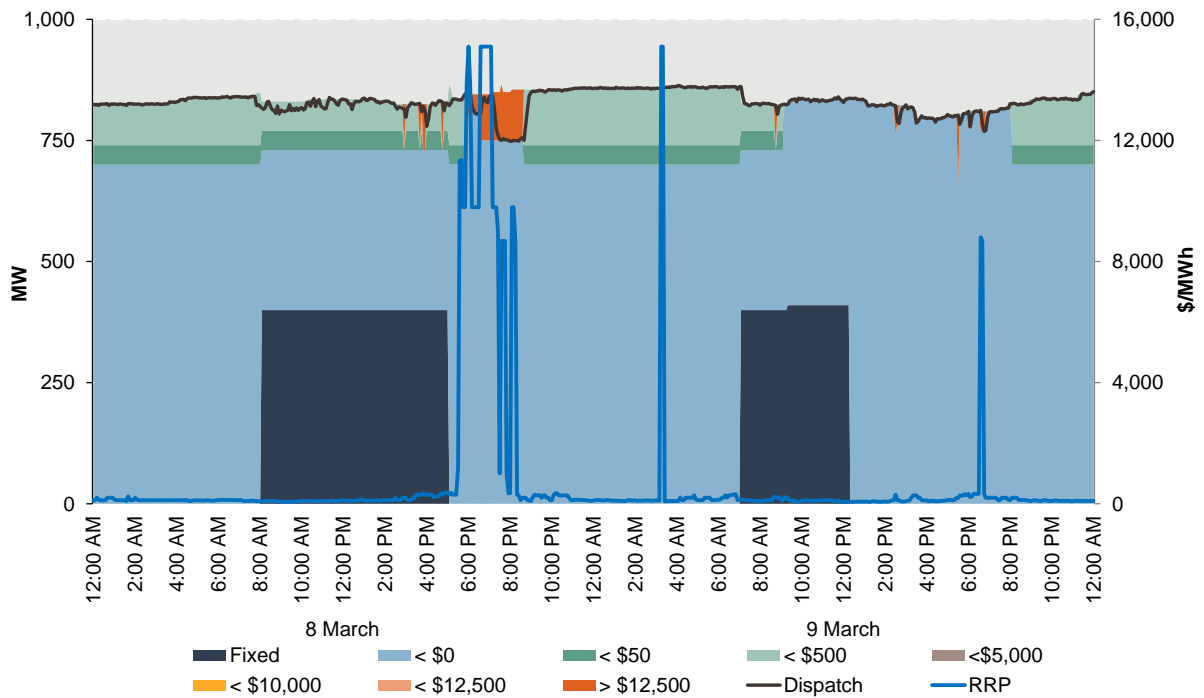


Figure A7: Origin Energy (Darling Downs, Mt Stuart and Roma) offers, dispatch and Qld regional reference price (RRP)

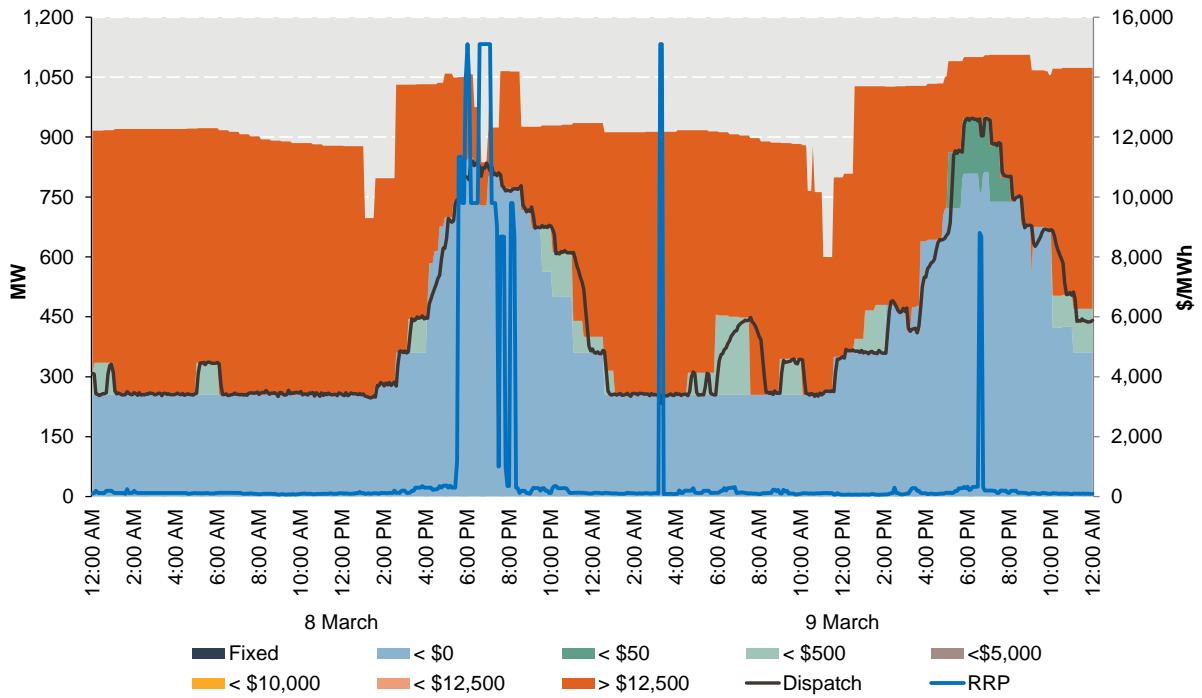
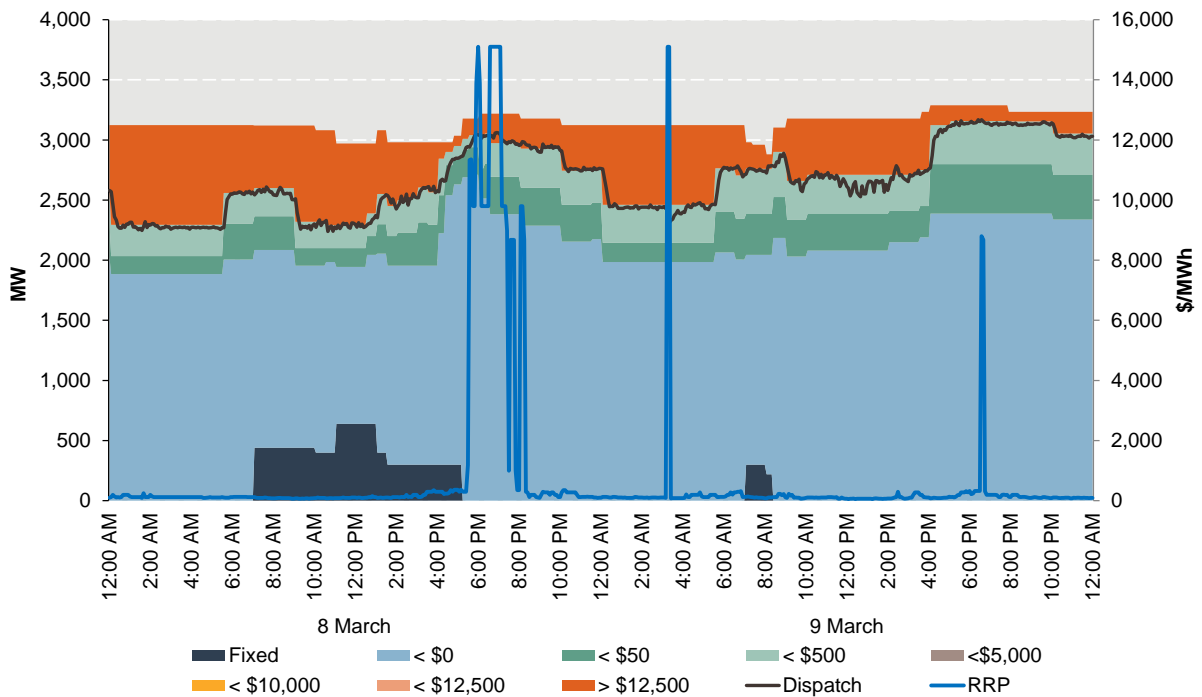


Figure A8: Stanwell Co (Stanwell, Tarong, Tarong North) offers, dispatch and Qld regional reference price (RRP)



Appendix B: Price Setter

The following table identifies the units involved in setting the price for each 5-minute interval for the 30-minute trading intervals above \$5,000/MWh. This information is published by AEMO⁷.

8 March 2022

Table B1: Price Setter 8 March 6 pm Queensland

Time	Dispatch price	Participant	Unit	Service	Offer price	Marginal change	Contrib.
5:35 pm	\$11,336.31	Arrow	BRAEMAR5	Energy	\$9,797.97	0.38	\$3,723.23
		Arrow	BRAEMAR6	Energy	\$9,797.97	0.38	\$3,723.23
		Arrow	BRAEMAR7	Energy	\$9,797.97	0.38	\$3,723.23
		CS Energy	GSTONE2	Energy	-\$1,000.00	-0.05	\$50.00
		CS Energy	GSTONE5	Energy	-\$1,000.00	-0.05	\$50.00
		CS Energy	GSTONE6	Energy	-\$1,000.00	-0.05	\$50.00
5:40 pm	\$11,352.27	Arrow	BRAEMAR5	Energy	\$9,797.97	0.38	\$3,723.23
		Arrow	BRAEMAR6	Energy	\$9,797.97	0.38	\$3,723.23
		Arrow	BRAEMAR7	Energy	\$9,797.97	0.38	\$3,723.23
		CS Energy	GSTONE3	Energy	-\$1,000.00	-0.14	\$140.00
		CS Energy	GSTONE3	Raise 60 sec	\$1.73	0.14	\$0.24
		CS Energy	GSTONE3	Raise 6 sec	\$1.73	0.14	\$0.24
		AGL Energy	LYA4	Raise 6 sec	\$21.00	-0.14	-\$2.94
		Neoen	VBBG1	Raise 60 sec	\$20.00	-0.14	-\$2.80
5:45 pm	\$9,797.97	Arrow	BRAEMAR5	Energy	\$9,797.97	0.33	\$3,233.33
		Arrow	BRAEMAR6	Energy	\$9,797.97	0.33	\$3,233.33
		Arrow	BRAEMAR7	Energy	\$9,797.97	0.33	\$3,233.33
5:50 pm	\$9,797.97	Arrow	BRAEMAR5	Energy	\$9,797.97	0.33	\$3,233.33
		Arrow	BRAEMAR6	Energy	\$9,797.97	0.33	\$3,233.33
		Arrow	BRAEMAR7	Energy	\$9,797.97	0.33	\$3,233.33
5:55 pm	\$13,888.88	InterGen	MPP_1	Energy	\$13,888.88	0.50	\$6,944.44
		InterGen	MPP_2	Energy	\$13,888.88	0.50	\$6,944.44
6:00 pm	\$15,100.00	CleanCo	W/HOE#2	Energy	\$15,100.00	0.20	\$3,020.00
		Alinta Energy	BRAEMAR2	Energy	\$15,100.00	0.17	\$2,567.00
		Alinta Energy	BRAEMAR3	Energy	\$15,100.00	0.17	\$2,567.00
		Stanwell	TNPS1	Energy	\$15,100.00	0.46	\$6,946.00
30-minute price						\$11,879/MWh	

⁷ Details on how the price is determined can be found at www.aemo.com.au.

Electricity 30-minute price above \$5,000/MWh

Table B2 Price Setter 8 March 6.30 pm Queensland

Time	Dispatch price	Participant	Unit	Service	Offer price	Marginal change	Contrib.
6:05 pm	\$13,888.88	InterGen	MPP_1	Energy	\$13,888.88	1.00	\$13,888.88
6:10 pm	\$9,797.97	Arrow	BRAEMAR5	Energy	\$9,797.97	0.33	\$3,233.33
		Arrow	BRAEMAR6	Energy	\$9,797.97	0.33	\$3,233.33
		Arrow	BRAEMAR7	Energy	\$9,797.97	0.33	\$3,233.33
6:15 pm	\$9,797.97	Arrow	BRAEMAR5	Energy	\$9,797.97	0.33	\$3,233.33
		Arrow	BRAEMAR6	Energy	\$9,797.97	0.33	\$3,233.33
		Arrow	BRAEMAR7	Energy	\$9,797.97	0.33	\$3,233.33
6:20 pm	\$9,797.97	Arrow	BRAEMAR6	Energy	\$9,797.97	1.00	\$9,797.97
6:25 pm	\$9,797.97	Arrow	BRAEMAR5	Energy	\$9,797.97	0.33	\$3,233.33
		Arrow	BRAEMAR6	Energy	\$9,797.97	0.33	\$3,233.33
		Arrow	BRAEMAR7	Energy	\$9,797.97	0.33	\$3,233.33
6:30 pm	\$9,797.97	Arrow	BRAEMAR5	Energy	\$9,797.97	0.33	\$3,233.33
		Arrow	BRAEMAR6	Energy	\$9,797.97	0.33	\$3,233.33
		Arrow	BRAEMAR7	Energy	\$9,797.97	0.33	\$3,233.33
30-minute price							\$10,480/MWh

Table B3 Price Setter 8 March 7 pm Queensland

Time	Dispatch price	Participant	Unit	Service	Offer price	Marginal change	Contrib.
6:35 pm	\$15,100.00	Origin Energy	MSTUART1	Energy	\$15,100.00	0.78	\$11,778.00
		CleanCo	W/HOE#2	Energy	\$15,100.00	0.22	\$3,322.00
6:40 pm	\$15,100.00	CleanCo	W/HOE#2	Energy	\$15,100.00	1.00	\$15,100.00
6:45 pm	\$15,100.00	Origin Energy	MSTUART1	Energy	\$15,100.00	0.78	\$11,778.00
		CleanCo	W/HOE#2	Energy	\$15,100.00	0.22	\$3,322.00
6:50 pm	\$15,104.79	NEON	HPRG1	Raise reg	\$24.79	1.00	\$24.79
		InterGen	MPP_1	Energy	\$15,100.00	0.50	\$7,550.00
		InterGen	MPP_1	Raise reg	\$20.00	-0.50	-\$10.00
		InterGen	MPP_2	Energy	\$15,100.00	0.50	\$7,550.00
		InterGen	MPP_2	Raise reg	\$20.00	-0.50	-\$10.00
6:55 pm	\$15,111.32	NEON	HPRG1	Raise 6 sec	\$20.00	1.00	\$20.00
		Stanwell	TARONG#1	Energy	\$15,100.00	0.50	\$7,550.00
		Stanwell	TARONG#1	Raise 6 sec	\$8.68	-0.50	-\$4.34
		Stanwell	TARONG#4	Energy	\$15,100.00	0.50	\$7,550.00
		Stanwell	TARONG#4	Raise 6 sec	\$8.68	-0.50	-\$4.34
7:00 pm	\$15,100.00	Origin Energy	MSTUART1	Energy	\$15,100.00	0.35	\$5,285.00
		Stanwell	TARONG#3	Energy	\$15,100.00	0.65	\$9,815.00
30-minute price							\$15,100/MWh

Table B4 Price Setter 8 March 7.30 pm Queensland

Time	Dispatch price	Participant	Unit	Service	Offer price	Marginal change	Contrib.
7:05 pm	\$15,100.00	Origin Energy	MSTUART1	Energy	\$15,100.00	0.20	\$3,020.00
		Origin Energy	MSTUART2	Energy	\$15,100.00	0.49	\$7,399.00
		Origin Energy	MSTUART3	Energy	\$15,100.00	0.31	\$4,681.00
7:10 pm	\$9,797.97	Arrow	BRAEMAR5	Energy	\$9,797.97	0.33	\$3,233.33
		Arrow	BRAEMAR6	Energy	\$9,797.97	0.33	\$3,233.33
		Arrow	BRAEMAR7	Energy	\$9,797.97	0.33	\$3,233.33
7:15 pm	\$9,797.97	Arrow	BRAEMAR5	Energy	\$9,797.97	0.33	\$3,233.33
		Arrow	BRAEMAR6	Energy	\$9,797.97	0.33	\$3,233.33
		Arrow	BRAEMAR7	Energy	\$9,797.97	0.33	\$3,233.33
7:20 pm	\$9,797.97	Arrow	BRAEMAR5	Energy	\$9,797.97	0.33	\$3,233.33
		Arrow	BRAEMAR6	Energy	\$9,797.97	0.33	\$3,233.33
		Arrow	BRAEMAR7	Energy	\$9,797.97	0.33	\$3,233.33
7:25 pm	\$8,988.88	Alinta Energy	BRAEMAR1	Energy	\$8,988.88	1.00	\$8,988.88
7:30 pm	\$1,001.02	Alinta Energy	BRAEMAR2	Energy	\$1,001.02	1.00	\$1,001.02
30-minute price							\$9,081/MWh

9 March 2022**Table B5 Price Setter 9 March 3.30 am Queensland**

Time	Dispatch price	Participant	Unit	Service	Offer price	Marginal change	Contrib.
3:05 am	\$109.73	CS Energy	GSTONE2	Energy	\$109.73	0.25	\$27.43
		CS Energy	GSTONE3	Energy	\$109.73	0.25	\$27.43
		CS Energy	GSTONE5	Energy	\$109.73	0.25	\$27.43
		CS Energy	GSTONE6	Energy	\$109.73	0.25	\$27.43
3:10 am	\$97.78	Snowy Hydro	UPPTUMUT	Energy	\$89.97	1.09	\$98.07
3:15 am	*\$17,689 (\$15,100)	Snowy Hydro	UPPTUMUT	Energy	\$89.97	18.63	\$1,676.14
		Stanwell	TNPS1	Energy	-\$1,000.00	-16.01	\$16,010.00
3:20 am	*\$68.10 (\$15,100)	Stanwell	TARONG#1	Energy	\$68.10	0.17	\$11.58
		Stanwell	TARONG#2	Energy	\$68.10	0.33	\$22.47
		Stanwell	TARONG#3	Energy	\$68.10	0.33	\$22.47
		Stanwell	TARONG#4	Energy	\$68.10	0.17	\$11.58
3:25 am	\$82.10	EnergyAustralia	TALWA1	Energy	\$78.96	1.04	\$82.12
3:30 am	\$90.73	CS Energy	GSTONE2	Energy	\$90.73	0.25	\$22.68
		CS Energy	GSTONE3	Energy	\$90.73	0.25	\$22.68
		CS Energy	GSTONE5	Energy	\$90.73	0.25	\$22.68
		CS Energy	GSTONE6	Energy	\$90.73	0.25	\$22.68
30-minute price						\$5,097/MWh	

*The final price for 3.15 am was capped at the market price cap at \$15,100/MWh. Even through the 3.20 am price was set at \$68/MWh, manifestly incorrect inputs meant the closest dispatch price with correct inputs had to be used, \$15,100/MWh in this case. The 30-minute price in this instance was set using the final price in the brackets.

Appendix C: Lack of reserve explained

AEMO is required to monitor the level of reserve, or spare capacity, within each region of the NEM. Reserves are defined as the difference between the volume of electricity that can be made available to consumers, either by local generation or through the network from other regions of the NEM, and the regional customer demand at that time.

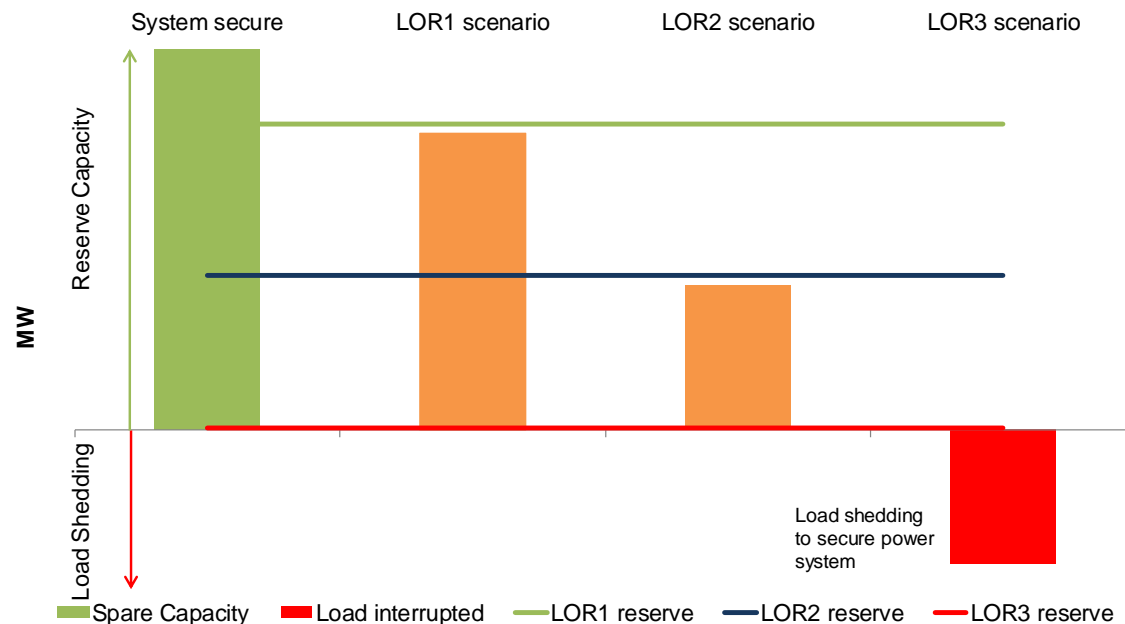
Reserves are an indicator of the supply demand balance and an important tool to communicate with the market potential and actual shortfalls. This is achieved through the release of lack of reserve (LOR) notices by AEMO. Forecast LOR notices are designed to elicit a market response from generators to increase their declared available capacity or retailers to reduce demand to address any forecast reserve shortfalls. Actual LOR notices are also issued when the thresholds are actually triggered.

There are 3 reserve thresholds, which relate to managing power system security following a defined number of unplanned failures of either transmission or generating equipment (credible contingencies). An example of a credible contingency would be the failure of a large generator or the failure of a transmission line that would reduce interconnector capacity.

The 3 LOR levels are broadly categorised as follows:⁸

- LOR1: declared when the minimum level of reserves are low enough that load shedding is likely to occur in the event of the two largest credible contingencies in a region.
- LOR2: declared when the minimum level of reserves are low enough that load shedding is likely to occur in the event of the single largest credible contingency in a region.
- LOR3: declared when the minimum level of reserves are at (or below) zero, where customer(s) load would be, or is, shed in order to maintain power system security.

Figure 6: Spare capacity and lack of reserve



⁸ <https://aemo.com.au/learn/energy-explained/energy-101/aemo-market-notifications-explained>

Figure 6 shows the four possible reserve scenarios graphically. Assuming that the horizontal axis line represents a situation when supply equals demand, then excess generating capacity (above the x axis) amounts to spare or reserve capacity. As discussed above, the 3 reserve levels are shown as 3 horizontal lines, reserve requirements for LOR1 in green, for LOR2 in blue and where there are no reserves and all capacity is being used to meet demand, LOR3, in red. The solid green and amber blocks represent spare capacity. As the spare capacity drops below a reserve line (the horizontal lines) either by a reduction in available capacity or an increase in demand, a new reserve condition exists. AEMO monitors this situation continuously and issues LOR notices to inform participants. When there is insufficient capacity to meet demand load must be shed for load other than non-interruptible load (including commercial, industrial and residential customers) and an LOR3 is issued.

Appendix D: Market Notices

The following relevant AEMO market notices notified the market of the lack of reserves in the lead up to the day and on 8 March as they unfolded.

Market Notice	Type	Date of issue	Last Changed
95084	Reserve Notice	6/03/2022 10:27	6/03/2022 10:27
External Reference			
STPASA - Forecast Lack Of Reserve Level 2 (LOR2) in the QLD Region on 08/03/2022			
Reason			
AEMO ELECTRICITY MARKET NOTICE			

AEMO declares a Forecast LOR2 condition under clause 4.8.4(b) of the National Electricity Rules for the QLD region for the following period:

[1.] From 1830 hrs 08/03/2022 to 1900 hrs 08/03/2022.

The forecast capacity reserve requirement is 651 MW.

The minimum capacity reserve available is 600 MW.

AEMO is seeking a market response.

AEMO has not yet estimated the latest time it would need to intervene through an AEMO intervention event.

Manager NEM Real Time Operations

Market Notice	Type	Date of issue	Last Changed
95085	Reserve Notice	6/03/2022 11:29	6/03/2022 11:29
External Reference			
STPASA - Cancellation of the Forecast Lack Of Reserve Level 2 (LOR2) in the QLD Region on 08/03/2022			
Reason			
AEMO ELECTRICITY MARKET NOTICE			

The Forecast LOR2 condition in the QLD region advised in AEMO ELECTRICITY MARKET NOTICE

No. 95084 is cancelled at 1130 hrs 06/03/2022.

Manager NEM Real Time Operations

Electricity 30-minute price above \$5,000/MWh

Market Notice	Type	Date of issue	Last Changed
95092	Reserve Notice	6/03/2022 14:47	6/03/2022 14:47

External Reference

STPASA - Forecast Lack Of Reserve Level 2 (LOR2) in the QLD Region on 08/03/2022

Reason

AEMO ELECTRICITY MARKET NOTICE

AEMO declares a Forecast LOR2 condition under clause 4.8.4(b) of the National Electricity Rules for the QLD region for the following period:

[1.] From 1830 hrs 08/03/2022 to 1900 hrs 08/03/2022.

The forecast capacity reserve requirement is 668 MW.

The minimum capacity reserve available is 655 MW.

AEMO is seeking a market response.

AEMO has not yet estimated the latest time it would need to intervene through an AEMO intervention event.

Manager NEM Real Time Operations

Market Notice	Type	Date of issue	Last Changed
95093	Reserve Notice	6/03/2022 14:48	6/03/2022 14:48

External Reference

STPASA - Forecast Lack Of Reserve Level 1 (LOR1) in the QLD Region on 08/03/2022

Reason

AEMO ELECTRICITY MARKET NOTICE

AEMO declares a Forecast LOR1 condition under clause 4.8.4(b) of the National Electricity Rules for the QLD region for the following periods:

[1.] From 1800 hrs 08/03/2022 to 1830 hrs 08/03/2022.

The forecast capacity reserve requirement is 868 MW.

The minimum capacity reserve available is 704 MW.

[2.] From 1900 hrs 08/03/2022 to 1930 hrs 08/03/2022.

The forecast capacity reserve requirement is 868 MW.

The minimum capacity reserve available is 796 MW.

Manager NEM Real Time Operations

Market Notice	Type	Date of issue	Last Changed
95094	Reserve Notice	6/03/2022 15:18	6/03/2022 15:18

External Reference

STPASA - Cancellation of the Forecast Lack Of Reserve Level 2 (LOR2) in the QLD Region on 08/03/2022

Reason

AEMO ELECTRICITY MARKET NOTICE

The Forecast LOR2 condition in the QLD region advised in AEMO ELECTRICITY MARKET NOTICE

No. 95092 is cancelled at 1515 hrs 06/03/2022.

Manager NEM Real Time Operations

Electricity 30-minute price above \$5,000/MWh

Market Notice	Type	Date of issue	Last Changed
95098	Reserve Notice	6/03/2022 17:24	6/03/2022 17:24

External Reference

STPASA - Forecast Lack Of Reserve Level 2 (LOR2) in the QLD Region on 08/03/2022

Reason

AEMO ELECTRICITY MARKET NOTICE

AEMO declares a Forecast LOR2 condition under clause 4.8.4(b) of the National Electricity Rules for the QLD region for the following period:

[1.] From 1830 hrs 08/03/2022 to 1900 hrs 08/03/2022.

The forecast capacity reserve requirement is 708 MW.

The minimum capacity reserve available is 681 MW.

AEMO is seeking a market response.

AEMO has not yet estimated the latest time it would need to intervene through an AEMO intervention event.

Manager NEM Real Time Operations

Market Notice	Type	Date of issue	Last Changed
95098	Reserve Notice	6/03/2022 17:24	6/03/2022 17:24

External Reference

STPASA - Forecast Lack Of Reserve Level 2 (LOR2) in the QLD Region on 08/03/2022

Reason

AEMO ELECTRICITY MARKET NOTICE

AEMO declares a Forecast LOR2 condition under clause 4.8.4(b) of the National Electricity Rules for the QLD region for the following period:

[1.] From 1830 hrs 08/03/2022 to 1900 hrs 08/03/2022.

The forecast capacity reserve requirement is 708 MW.

The minimum capacity reserve available is 681 MW.

AEMO is seeking a market response.

AEMO has not yet estimated the latest time it would need to intervene through an AEMO intervention event.

Manager NEM Real Time Operations

Electricity 30-minute price above \$5,000/MWh

Market Notice	Type	Date of issue	Last Changed
95104	Reserve Notice	7/03/2022 5:41	7/03/2022 5:41

External Reference

STPASA - Cancellation of the Forecast Lack Of Reserve Level 2 (LOR2) in the QLD Region on 08/03/2022

Reason

AEMO ELECTRICITY MARKET NOTICE

The Forecast LOR2 condition in the QLD region advised in AEMO ELECTRICITY MARKET NOTICE

No. 95098 is cancelled at 0540 hrs 07/03/2022.

Manager NEM Real Time Operations

Market Notice	Type	Date of issue	Last Changed
95105	Reserve Notice	7/03/2022 6:02	7/03/2022 6:02

External Reference

STPASA - Update of the Forecast Lack Of Reserve Level 1 (LOR1) in the Qld Region on 08/02/2022

Reason

AEMO ELECTRICITY MARKET NOTICE

The Forecast LOR1 condition in the Qld region advised in AEMO ELECTRICITY MARKET NOTICE

No. 95093 has been updated at 0600 hrs 07/02/2022 to the following:

[1.] From 1800 hrs 08/03/2022 to 1900 hrs 08/03/2022.

The forecast capacity reserve requirement is 868 MW.

The minimum capacity reserve available is 734 MW.

Manager NEM Real Time Operations

Market Notice	Type	Date of issue	Last Changed
95119	Reserve Notice	7/03/2022 15:29	7/03/2022 15:29

External Reference

STPASA - Cancellation of the Forecast Lack Of Reserve Level 1 (LOR1) in the QLD Region on 08/02/2022

Reason

AEMO ELECTRICITY MARKET NOTICE

The Forecast LOR1 condition in the QLD region advised in AEMO ELECTRICITY MARKET NOTICE

No. 95105 is cancelled at 1500 hrs 07/03/2022.

No LOR condition is currently forecast in the STPASA period.

AEMO Operations

Electricity 30-minute price above \$5,000/MWh

Market Notice	Type	Date of issue	Last Changed
95129	Reserve Notice	7/03/2022 22:18	7/03/2022 22:18

External Reference

PDPASA - Forecast Lack Of Reserve Level 1 (LOR1) in the QLD Region on 08/03/2022

Reason

AEMO ELECTRICITY MARKET NOTICE

AEMO declares a Forecast LOR1 condition under clause 4.8.4(b) of the National Electricity Rules for the QLD region for the following period:

[1.] From 1800 hrs 08/03/2022 to 1900 hrs 08/03/2022.

The forecast capacity reserve requirement is 868 MW.

The minimum capacity reserve available is 793 MW.

Manager NEM Real Time Operations

Market Notice	Type	Date of issue	Last Changed
95131	Reserve Notice	8/03/2022 0:18	8/03/2022 0:18

External Reference

PDPASA - Cancellation of the Forecast Lack Of Reserve Level 1 (LOR1) in the QLD Region on 08/02/2022

Reason

AEMO ELECTRICITY MARKET NOTICE

The Forecast LOR1 condition in the QLD region advised in AEMO ELECTRICITY MARKET NOTICE

No. 95129 is cancelled at 0030 hrs 08/03/2022.

No LOR condition is currently forecast in the PDPASA period.

AEMO Operations

Market Notice	Type	Date of issue	Last Changed
95144	Reserve Notice	8/03/2022 14:53	8/03/2022 14:53

External Reference

PDPASA - Forecast Lack Of Reserve Level 1 (LOR1) in the QLD Region on 08/03/2022

Reason

AEMO ELECTRICITY MARKET NOTICE

AEMO declares a Forecast LOR1 condition under clause 4.8.4(b) of the National Electricity Rules for the QLD region for the following period:

[1.] From 1830 hrs 08/03/2022 to 1900 hrs 08/03/2022.

The forecast capacity reserve requirement is 868 MW.

The minimum capacity reserve available is 857 MW.

Manager NEM Real Time Operations

Electricity 30-minute price above \$5,000/MWh

Market Notice	Type	Date of issue	Last Changed
95161	Reserve Notice	8/03/2022 16:06	8/03/2022 16:06

External Reference

Update - PDPASA - Forecast Lack Of Reserve Level 1 (LOR1) in the QLD Region on 08/03/2022

Reason

AEMO ELECTRICITY MARKET NOTICE

AEMO declares a Forecast LOR1 condition under clause 4.8.4(b) of the National Electricity Rules for the QLD region for the following period:

[1.] From 1800 hrs 08/03/2022 to 1900 hrs 08/03/2022.

The forecast capacity reserve requirement is 868 MW.

The minimum capacity reserve available is 708 MW.

Manager NEM Real Time Operations

Market Notice	Type	Date of issue	Last Changed
95163	Reserve Notice	8/03/2022 17:14	8/03/2022 17:14

External Reference

Actual Lack Of Reserve Level 1 (LOR1) in the QLD Region on 08/03/2022

Reason

AEMO ELECTRICITY MARKET NOTICE

Actual Lack Of Reserve Level 1 (LOR1) in the QLD region - 08/03/2022

An Actual LOR1 condition has been declared under clause 4.8.4(b) of the National Electricity Rules for the QLD region from 1700 hrs.

The Actual LOR1 condition is forecast to exist until 1930 hrs.

The forecast capacity reserve requirement is 868 MW.

The minimum capacity reserve available is 601 MW.

Manager NEM Real Time Operations

Market Notice	Type	Date of issue	Last Changed
95166	Reserve Notice	8/03/2022 17:43	8/03/2022 17:43

External Reference

Actual Lack Of Reserve Level 2 (LOR2) in the QLD Region on 08/03/2022

Reason

AEMO ELECTRICITY MARKET NOTICE

Actual Lack Of Reserve Level 2 (LOR2) in the QLD region - 08/03/2022

An Actual LOR2 condition has been declared under clause 4.8.4(b) of the National Electricity Rules for the QLD region from 1730 hrs.

The Actual LOR2 condition is forecast to exist until 1900 hrs.

The forecast capacity reserve requirement is 443 MW.

The minimum capacity reserve available is 314 MW.

AEMO is seeking an immediate market response.

An insufficient market response may require AEMO to implement an AEMO intervention event.

Manager NEM Real Time Operations

Electricity 30-minute price above \$5,000/MWh

Market Notice	Type	Date of issue	Last Changed
95169	Reserve Notice	8/03/2022 19:32	8/03/2022 19:32

External Reference

Cancellation of Actual (LOR2) in the QLD region - 08/03/2022

Reason

AEMO ELECTRICITY MARKET NOTICE

Cancellation of Actual (LOR2) in the QLD region - 08/03/2022

The Actual LOR2 Condition in the QLD Region advised in AEMO ELECTRICITY MARKET NOTICE

No. 95166 is cancelled at 1930 hrs 08/03/2022.

Manager NEM Real Time Operations

Market Notice	Type	Date of issue	Last Changed
95170	Reserve Notice	8/03/2022 19:42	8/03/2022 19:42

External Reference

Update - Actual Lack Of Reserve Level 1 (LOR1) in the QLD Region on 08/03/2022

Reason

AEMO ELECTRICITY MARKET NOTICE

Update - Actual Lack Of Reserve Level 1 (LOR1) in the QLD region - 08/03/2022

The Actual LOR1 condition in the QLD region advised in AEMO ELECTRICITY MARKET NOTICE

No. 95163 has been updated at 1930 hrs 08/03/2022 to the following:

The Actual LOR1 condition is forecast to exist until 2030 hrs.

The forecast capacity reserve requirement is 886 MW.

The minimum capacity reserve available is 579 MW.

Manager NEM Real Time Operations

Market Notice	Type	Date of issue	Last Changed
95171	Reserve Notice	8/03/2022 20:42	8/03/2022 20:42

External Reference

Cancellation of Actual (LOR1) in the QLD region - 08/03/2022

Reason

AEMO ELECTRICITY MARKET NOTICE

Cancellation of Actual (LOR1) in the QLD region - 08/03/2022

The Actual LOR1 Condition in the QLD Region advised in AEMO ELECTRICITY MARKET NOTICE

No. 95163 is cancelled at 2030 hrs 08/03/2022.

Manager NEM Real Time Operations
