Electricity spot prices above $5,000/MWh

New South Wales, 21 May 2021

8 July 2021

AUSTRALIAN ENERGY REGULATOR

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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 (NEM)), as well as networks in the Northern Territory. Its functions include:

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

The AER is required to publish a report whenever the electricity spot price exceeds $5,000 per megawatt hour ($/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 21 May 2021 the spot price in New South Wales exceeded $5,000/MWh for the 5 pm and 5.30 pm trading intervals. These prices were forecast to be above $5,000/MWh from midday.

The main drivers were similar to price events earlier in the week, and related to reduced supply and increased demand.

- Planned and unplanned generator outages meant almost 2,800 MW of baseload generation in NSW was unavailable.
    - About 1,800 MW of this capacity was undergoing planned maintenance, as expected during the lower demand periods of spring and autumn.
    - This included limited capacity from AGL's Liddell unit 3 which experienced technical issues as it returned to service from an unplanned outage.
- There was little renewable generation, which mostly offers at lower prices, available grid solar had dropped off and wind output was very low at around 230 MW (out of almost 2,000 MW installed in New South Wales).
- There was limited supply from Victoria and Queensland.
    - Line outages in the Canberra area prevented generation from Victoria or southern New South Wales getting to load centres around Sydney.
    - Upgrades to the Queensland-New South Wales interconnector (QNI) limited flows from Queensland to 630 MW out of the 1,000 MW nominal limit.
- Demand was high during the evening peak, driven by cooler weather increasing heating requirements and rooftop solar tapering off as the sun went down.

Rebidding of capacity from low to high prices did not contribute to prices above $5,000/MWh.

Though up to 86% of capacity was offered below $5,000/MWh, as little as 3 MW of capacity priced over $5,000/MWh was required to meet demand.

3 Analysis

On 21 May 2021 the spot price in New South Wales exceeded $5,000/MWh for the 5 pm and 5.30 pm trading intervals.

3.1 Overview of actual and expected conditions

The spot price in New South Wales was $5,212/MWh and $7,652/MWh for the 5 pm and 5.30 pm trading intervals respectively.

Table 1 shows that:

- high spot prices over $1,000/MWh were forecast from at least 4 hours out.
- demand was 234 MW higher than forecast 4 hours prior for the 5 pm trading interval and close to forecast 4 hours prior for the 5.30 pm trading interval.
- availability was between 164 MW to 299 MW lower than forecast 4 hours prior.

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

Trading interval	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
5 pm	5,211.85	14,999.97	221.32	9,751	9,517	9,293	10,394	10,558	10,873
5.30 pm	7,651.80	1,190.46	299.99	10,059	10,080	9,714	10,337	10,636	10,832

3.2 Supply conditions

3.2.1 Generation

There was around 2,800 MW of generation on planned and unplanned outages, limiting the amount of low-priced capacity available (Table 2).

Liddell unit 3 was returning to service that day from an unplanned outage. Technical issues across the day meant the plant did not return to full output as quickly as anticipated. AGL Energy added and removed capacity during the day to reflect the conditions of the plant. As this capacity was priced at the floor, the forecast price outcomes were directly affected by the forecast availability of the unit. By the time the high prices occurred the unit was generating around 200 MW out of its 500 MW registered capacity, rather than the 420 MW previously forecast.

Table 2: Unavailable generation

Station	Unit	Registered capacity (MW)	Max Avail (MW)	Unavailable (MW)	Reason
Bayswater	BW02	660	0	-660	Offline since 5 March, planned outage
	BW03	660	0	-660	Offline from previous day 20 May due to tube leak, unplanned outage

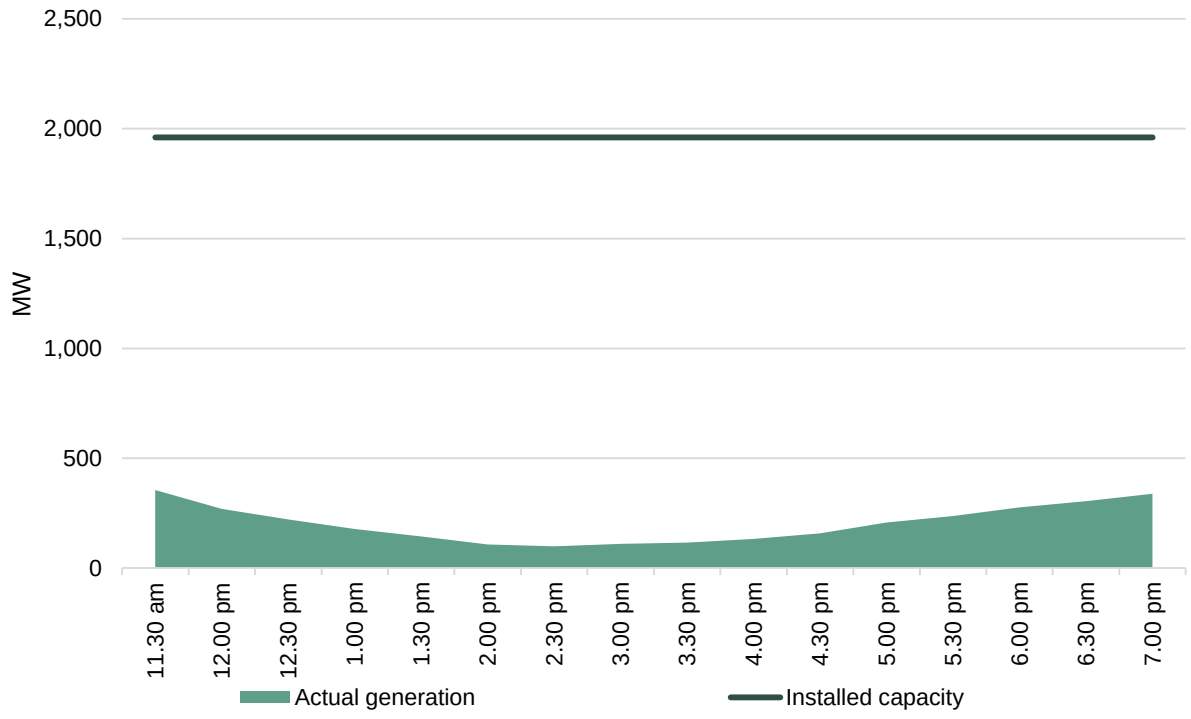
Station	Unit	Registered capacity (MW)	Max Avail (MW)	Unavailable (MW)	Reason
Liddell	LD01	500	0	-500	Offline from 6 May, planned outage
	LD03	500	215	-285	Had been offline since 16 May, unplanned outage Was returning to service that day
Vales Point	VP6	660	0	-660	Offline since 9 April, planned outage
			Total	**-2,765**	

At 11.30 am the forecast price for the 5 pm trading interval was $299/MWh and a greater than 200 MW change in demand or loss of supply would lead to prices over $5,000/MWh. By midday, forecast prices had changed to reflect the removal of capacity from Liddell unit 3 at 11.39 am and forecast changes to network flows (discussed in the next section).

Forecast prices for the 5.30 pm trading interval increased from 2 pm onwards, after AGL had removed further capacity from Liddell unit 3. In addition to the removal of capacity at Liddell unit 3, a number of minor rebids by other participants occurred which removed other low-priced capacity due to technical reasons. Any significant rebids are contained in *Appendix A: Significant rebids*.

Wind generation for the 5 pm and 5.30 pm trading intervals was around 208 MW to 237 MW, close to forecast. This is less than 12% of the approximately 2,000 MW installed capacity in New South Wales (Figure 1). As wind generation typically offers capacity at prices below $0/MWh, the lack of wind generation further limited the available capacity priced below $5,000/MWh.

Figure 1: Installed and actual wind generation in New South Wales

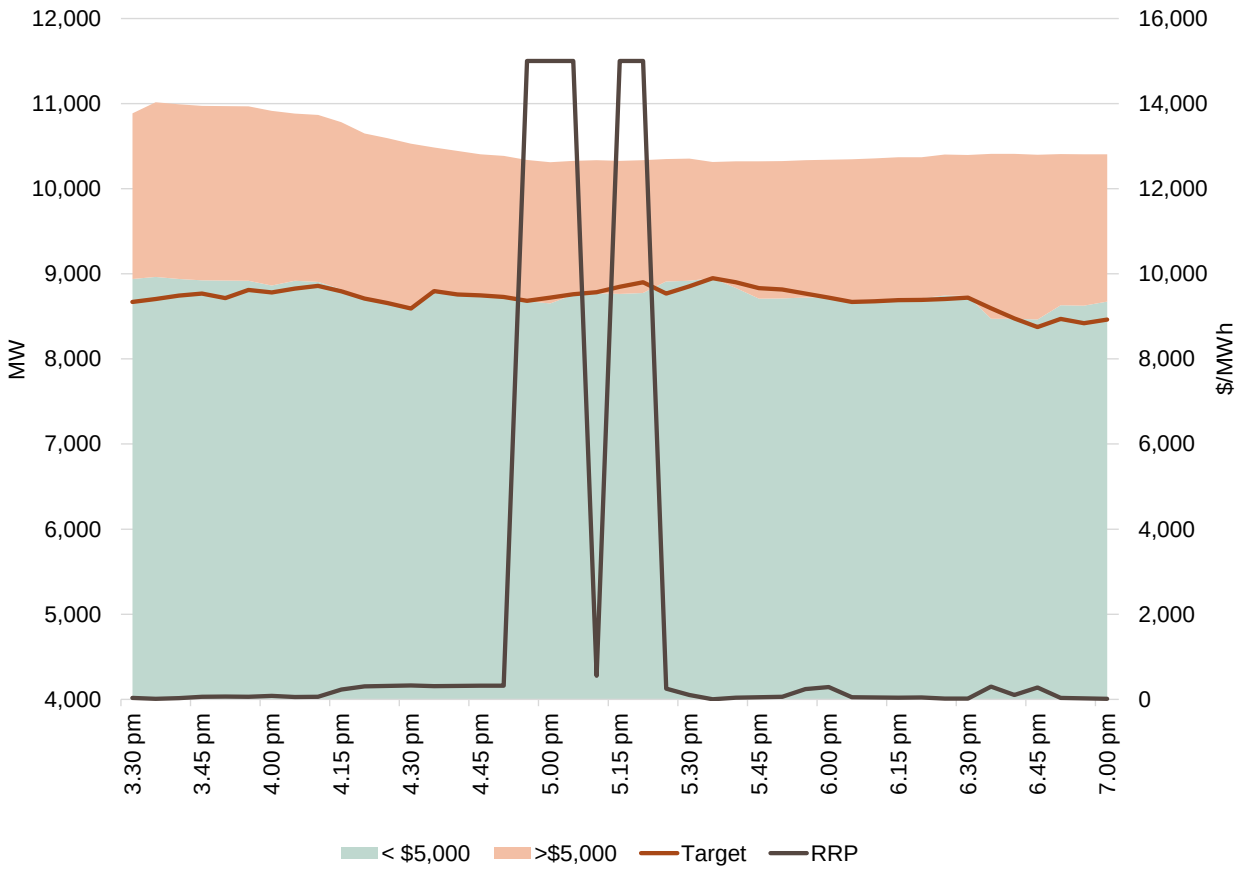


During the 5 pm and 5.30 pm trading intervals, there was no capacity offered between $0/MWh

and $14,999/MWh so small fluctuations in demand, availability, and network flows caused large variations in price.

Demand was high, driven by cooler weather increasing heating requirements and rooftop solar tapering off as the sun went down. The dispatch price hit the market cap of $15,000/MWh at 4.55 pm, 5 pm, 5.05 pm, 5.15 pm and 5.20 pm. Around 85% of capacity was offered below $5,000/MWh during the high priced intervals, almost all of this capacity was priced below $0/MWh. Despite this, between 3 MW and 127 MW of high-priced capacity was still required to meet demand (Figure 2).

Figure 2: New South Wales closing bids



Participants with capacity priced above $5,000/MWh were Origin Energy (Eraring and Uranquinty) and Snowy Hydro (Tumut and Colongra) (Table 3). Both Snowy Hydro and Origin Energy rebid capacity at Lower Tumut and Uranquinty respectively to lower prices from 1.30 pm, but the forecast price did not change. The closing bids for all participants in New South Wales with capacity priced at or above $5,000/MWh for the high-price periods are set out in *Appendix B: Closing bids*.

Table 3: Capacity offered above $5,000/MWh

Participant	Station	Registered Capacity (MW)	Fuel Type	Capacity offered >$5,000/MWh	
				5 pm (MW)	5.30 pm (MW)
Origin Energy	Eraring	**2,880**	Coal-Black	640	680
	Uranquinty	**664**	Gas	300	327
Snowy Hydro	Colongra	**724**	Gas	680	430
	Lower Tumut	**1,500**	Hydro	37	0
			Total	**1,657**	**1,437**

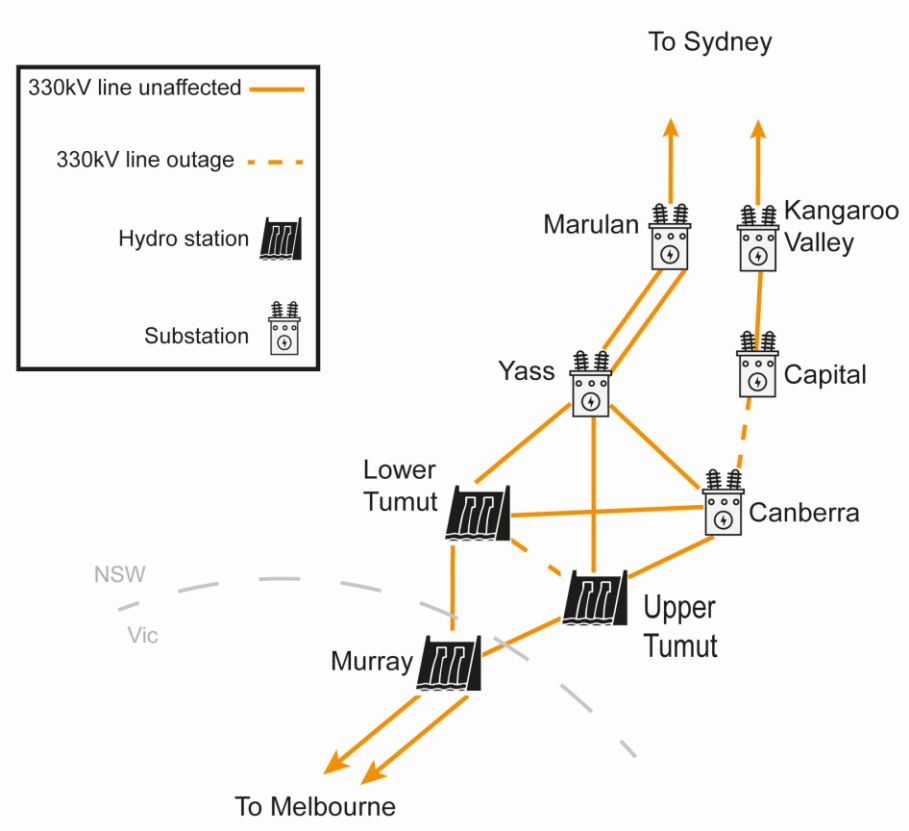
The generators involved in setting the price during the high-price periods and how that price was determined by the market systems are detailed in *Appendix C: Price Setter.*

3.2.2 Network

3.2.2.1 Network outages

There were planned outages of the Capital to Kangaroo Valley 330 kV line, which began on 17 May. There was also a planned outage of the 330 kV line between Lower and Upper Tumut. Figure 3 shows the affected network area, the significant generators, significant substations and the lines that were out (yellow dashed). There is a significant amount of generation in the area and with the outages, the main transmission pathway for generation to get through to load centres in Sydney was through the Yass – Marulan 330 kV line. To avoid overloading the line, AEMO invoked constraints affecting generation in southern New South Wales and flows on the VIC-NSW interconnector.

Figure 3: network diagram



The constraint limited the amount of low-priced capacity from southern New South Wales and imports from Victoria from reaching load centres in Sydney. To replace this generation, capacity priced above $5,000/MWh was dispatched to meet demand.

In addition, imports from Queensland over the QNI interconnector were limited to below 630 MW out of the nominal 1,000 MW limit. This was due to a planned outage of the Muswellbrook to Tamworth 330 kV lines in New South Wales as part of the upgrade to the QNI interconnector.

Australian Energy Regulator

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Appendix A: Significant rebids

The rebidding tables highlight the relevant rebids submitted by generators that impacted 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.

Table 4: New South Wales significant rebids for 5 pm trading interval

Submit time	Time effective	Participant	Station	Capacity rebid (MW)	Price from ($/MWh)	Price to ($/MWh)	Rebid reason
11.39 am		AGL Energy	Liddell	-100	-1,000	N/A	1135~P~010 unexpected/plant limits~101 oil cooler issues~
1.42 pm		AGL Energy	Liddell	-90	-1,000	N/A	1340~P~010 unexpected/plant limits~108 load/ramp variation during rts~
4.02 pm		AGL Energy	Liddell	30	N/A	-1,000	1600~P~010 unexpected/plant limits~108 load/ramp variation during rts~
4.06 pm		AGL Energy	Liddell	-20	-1,000	N/A	1600~P~010 unexpected/plant limits~101 milling limits~
4.07 pm		Snowy Hydro	Upper Tumut	-10	-1,000	N/A	16:07:49 P revised station capability due to changed peak mode setting
4.13 pm		Energy Australia	Mt Piper	-40	-1,000	N/A	1610~P~coal quality and mill limit sl~~
4.28 pm	4.35 pm	AGL Energy	Liddell	15	N/A	-1,000	1625~P~010 unexpected/plant limits~108 load/ramp variation during rts~
4.41 pm	4.50 pm	AGL Energy	Liddell	20	N/A	-1,000	1640~P~010 unexpected/plant limits~108 load/ramp variation during rts~

Table 5: New South Wales 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
11.39 am		AGL Energy	Liddell	-110	-1,000	N/A	1135~P~010 unexpected/plant limits~101 oil cooler issues~
1.42 pm		AGL Energy	Liddell	-90	-1,000	N/A	1340~P~010 unexpected/plant limits~108 load/ramp variation during rts~
4.28 pm		AGL Energy	Liddell	15	N/A	-1,000	1625~P~010 unexpected/plant limits~108 load/ramp variation during rts~
4.41 pm		AGL Energy	Liddell	20	N/A	-1,000	1640~P~010 unexpected/plant limits~108 load/ramp variation during rts~
5.03 pm	5.10 pm	AGL Energy	Liddell	25	N/A	-1,000	1700~P~010 unexpected/plant limits~108 load/ramp variation during rts~
5.16 pm	5.25 pm	AGL Energy	Liddell	-10	-1,000	N/A	1715~P~010 unexpected/plant limits~108 load/ramp variation during rts~

Submit time	Time effective	Participant	Station	Capacity rebid (MW)	Price from ($/MWh)	Price to ($/MWh)	Rebid reason
5.21 pm	5.30 pm	Energy Australia	Mt Piper	-20	-1,000	N/A	1720~P~coal quality and mill limit sl~~
5.22 pm	5.30 pm	AGL Energy	Liddell	15	N/A	-1,000	1720~P~010 unexpected/plant limits~108 load/ramp variation during rts~

Appendix B: Closing bids

Figures A1 and A2 highlight the half hour closing bids for participants in New South Wales with capacity priced at or above $5,000/MWh during the periods in which the spot price exceeded $5,000/MWh. They also show generation output and the spot price.

Figure A1: Origin (Eraring, Shoalhaven, Uranquinty) closing bids, dispatch and spot price

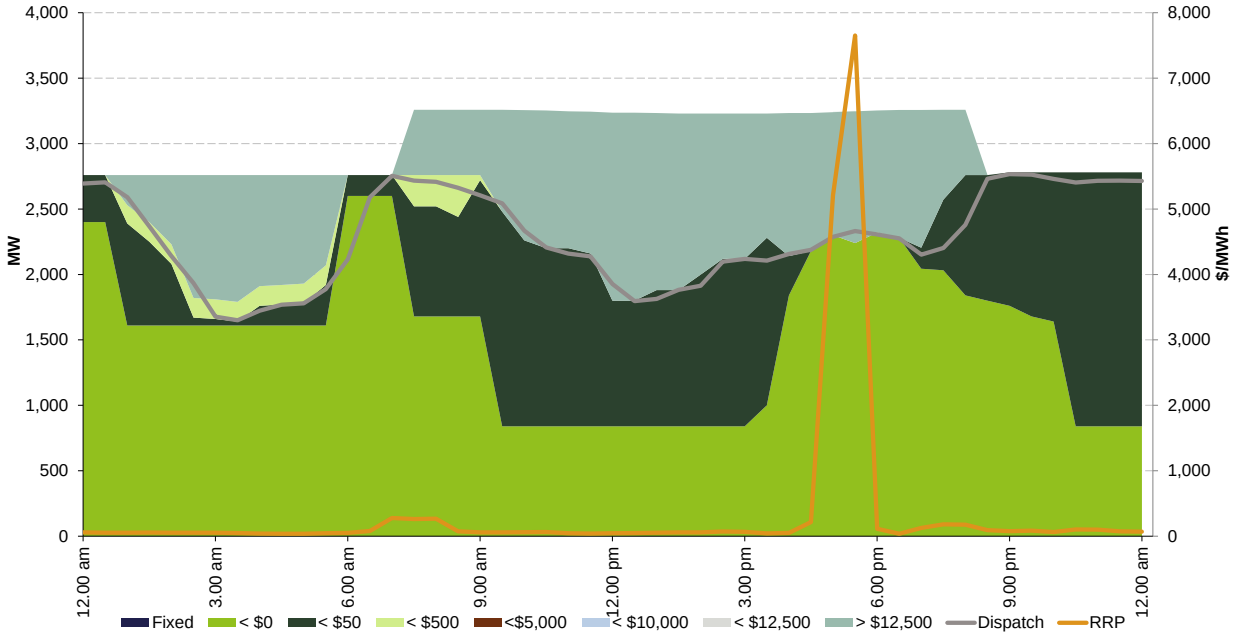
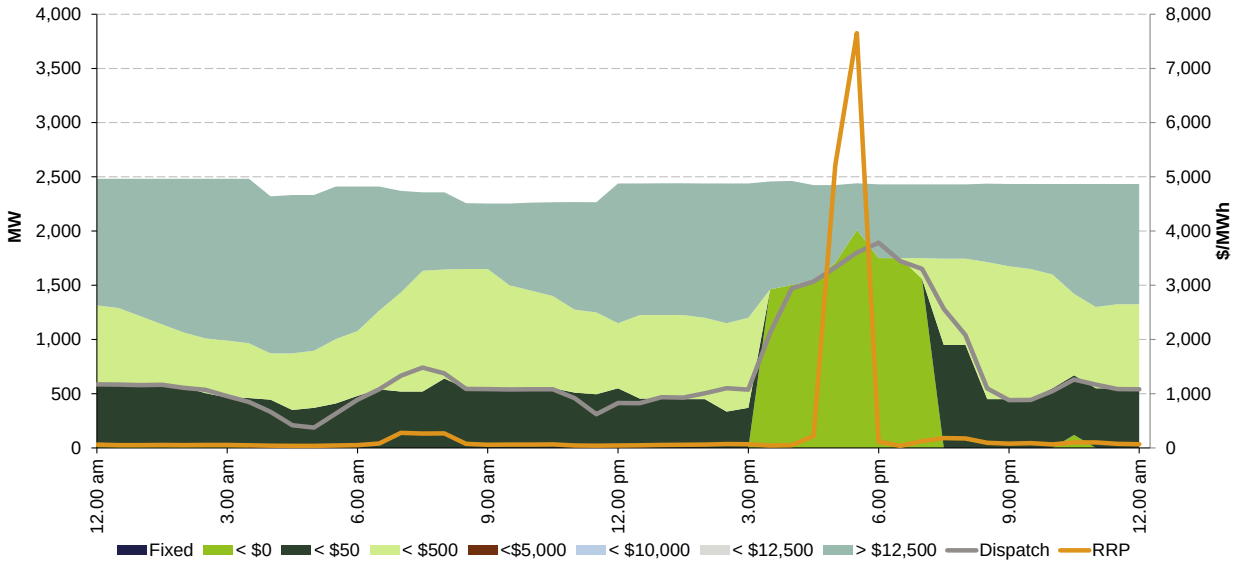


Figure A2: Snowy Hydro (Colongra, Tumut, Upper Tumut, Guthega, Blowering) closing bids, dispatch and spot price



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.[1] The 30-minute spot price is the average of the 6 dispatch interval prices.

Table 6: 21 May 2021 - NSW price setter 5 pm

DI	Dispatch Price ($/MWh)	Participant	Unit	Service	Offer price ($/MWh)	Marginal change	Contribution
16:35	$311.99	Snowy Hydro	MURRAY	Energy	$299.50	1.04	$311.48
16:40	$317.46	Snowy Hydro	MURRAY	Energy	$299.50	1.06	$317.47
16:45	$319.61	Snowy Hydro	MURRAY	Energy	$299.50	1.07	$320.47
16:50	$322.02	Snowy Hydro	MURRAY	Energy	$299.50	1.08	$323.46
16:55	$15,000.00	Origin Energy	ER01	Energy	$15,000.00	0.25	$3,750.00
		Origin Energy	ER02	Energy	$15,000.00	0.25	$3,750.00
		Origin Energy	ER03	Energy	$15,000.00	0.25	$3,750.00
		Origin Energy	ER04	Energy	$15,000.00	0.25	$3,750.00
17:00	*$15,000*	Origin Energy	ER01	Energy	$15,000.00	0.25	$3,750.00
		Origin Energy	ER02	Energy	$15,000.00	0.25	$3,750.00
		Origin Energy	ER03	Energy	$15,000.00	0.25	$3,750.00
		Origin Energy	ER04	Energy	$15,000.00	0.25	$3,750.00
		AGL (SA)	TORRB2	Raise reg	$32.00	1.00	$32.00
		Origin Energy	ER01	Raise reg	$30.30	-0.25	-$7.58
		Origin Energy	ER02	Raise reg	$30.30	-0.25	-$7.58
		Origin Energy	ER03	Raise reg	$30.30	-0.25	-$7.58
		Origin Energy	ER04	Raise reg	$30.30	-0.25	-$7.58
Spot Price		**$5,212/MWh**					

Table 7: 21 May 2021 - NSW price setter 5.30 pm

DI	Dispatch Price ($/MWh)	Participant	Unit	Service	Offer price ($/MWh)	Marginal change	Contribution
17:05	*$15,000*	Origin Energy	ER01	Energy	$15,000.00	0.25	$3,750.00
		Origin Energy	ER02	Energy	$15,000.00	0.25	$3,750.00
		Origin Energy	ER03	Energy	$15,000.00	0.25	$3,750.00
		Origin Energy	ER04	Energy	$15,000.00	0.25	$3,750.00
		NEON	HPRG1	Raisereg	$18.40	1.00	$18.40
		Origin Energy	ER01	Raisereg	$0.00	-0.25	$0.00
		Origin Energy	ER02	Raisereg	$0.00	-0.25	$0.00
		Origin Energy	ER03	Raisereg	$0.00	-0.25	$0.00

[1] 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	ER04	Raisereg	$0.00	-0.25	$0.00
17:10	$557.28	Stanwell	TARONG#2	Energy	$19.15	0.55	$10.53
		Stanwell	TARONG#4	Energy	$19.15	0.55	$10.53
		Stanwell	TARONG#2	Lowerreg	$74.99	0.55	$41.24
		Stanwell	TARONG#4	Lowerreg	$74.99	0.55	$41.24
		CS Energy	GSTONE3	Lowerreg	$14.73	-0.06	-$0.88
		Engie	PPCCGT	Lowerreg	$10.88	-1.04	-$11.32
		CS Energy	CALL_B_2	Lower60sec	$146.61	0.99	$145.14
		CS Energy	GSTONE3	Lower60sec	$27.73	0.06	$1.66
		Engie	PPCCGT	Lower60sec	$0.03	-1.04	-$0.03
		CS Energy	GSTONE3	Lower6sec	$299.73	1.04	$311.72
		NEON	HPRL1	Lower6sec	$0.00	-1.04	$0.00
		CS Energy	GSTONE5	Raise60sec	$23.37	0.47	$10.98
		Stanwell	TARONG#2	Raise60sec	$8.68	-0.24	-$2.08
		Stanwell	TARONG#4	Raise60sec	$8.68	-0.24	-$2.08
17:15	$15,000.00	Origin Energy	ER01	Energy	$15,000.00	0.25	$3,750.00
		Origin Energy	ER02	Energy	$15,000.00	0.25	$3,750.00
		Origin Energy	ER03	Energy	$15,000.00	0.25	$3,750.00
		Origin Energy	ER04	Energy	$15,000.00	0.25	$3,750.00
17:20	$15,000.00	Origin Energy	ER01	Energy	$15,000.00	0.25	$3,750.00
		Origin Energy	ER02	Energy	$15,000.00	0.25	$3,750.00
		Origin Energy	ER03	Energy	$15,000.00	0.25	$3,750.00
		Origin Energy	ER04	Energy	$15,000.00	0.25	$3,750.00
17:25	$251.64	Infigen	SATGS1	Energy	$245.00	1.03	$252.35
17:30	$101.88	CleanCo	SWAN_E	Energy	$70.00	1.09	$76.30
		Stanwell	TARONG#4	Lower60sec	$8.68	-0.05	-$0.43
		CleanCo	SWAN_E	Lower60sec	$7.88	1.09	$8.59
		AGL Energy	LYA4	Lower60sec	$0.03	-1.04	-$0.03
		Stanwell	STAN-4	Lower6sec	$16.68	1.04	$17.35
Spot Price		**$7,652/MWh**					