Electricity spot prices above $5,000/MWh

New South Wales, 14 July 2021

8 September 2021

AUSTRALIAN ENERGY REGULATOR

Inquiries about this publication should be addressed to:

Australian Energy Regulator
GPO Box 520
MELBOURNE VIC 3001

Tel: (03) 9290 1444
Fax: (03) 9290 1457

Email: AERInquiry@aer.gov.au
AER Reference: AER213099

Contents

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, 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 14 July 2021 the spot price in New South Wales reached $5,177/MWh for the 9 am trading interval. This price was only forecast 10 minutes before the end of the trading interval.

The main drivers were:

- Generator outages and reduced generator availability meant over 3,000 MW of baseload generation in New South Wales was unavailable, reducing the amount of low-priced capacity available.
    - 720 MW at Eraring was undergoing planned maintenance.
    - 660 MW at Bayswater had trouble returning to service and removed all its capacity by 8.35 am following a tube leak
    - Almost 1,700 MW was not offered by units that were online but not fully available to the market. All of the reasons provided related to coal or plant issues.
- There was limited access to low-priced capacity 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 less than 500 MW out of the 1,000 MW nominal limit.
- Actual demand was 500 MW higher than forecast 4 hours prior.

During the morning peak on 14 July, there was not enough available capacity in New South Wales able to come on in time to meet an increase in demand. As a result, demand was met by imports from Queensland and the price in New South Wales was set by generation in Queensland. Queensland was experiencing high ancillary service prices which were co-optimised with Queensland energy. This meant that for 2 dispatch intervals (10 minutes), the price in New South Wales was set at the cap of $15,100/MWh and the spot price for the 9 am trading interval exceeded $5,000/MWh.

At the time, 93% of capacity in New South Wales was offered below $5,000/MWh and rebidding capacity from low to high prices did not contribute to prices above $5,000/MWh.

3 Analysis

On 14 July 2021 the spot price in New South Wales reached $5,177/MWh for the 9 am trading interval.

3.1 Overview of actual and expected conditions

High prices were not expected because actual demand was higher and actual availability was lower than forecast. Table 1 compares actual and forecast prices, demand and availability:

- High spot prices were not forecast. In fact the first 4 dispatch intervals were priced close to forecast and the last 2 dispatch intervals were set at the cap.
- Demand was 500 MW higher than forecast 4 hours prior for the 9 am trading interval and over 720 MW higher than forecast 4 hours prior for the 9.30 am trading interval.
- Availability was between 520 MW to 630 MW lower than forecast 4 hours prior. Availability fell because over 450 MW of capacity was removed around 8 am due to operational issues.

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
9 am	**5,177**	**106**	**106**	**10,615**	**10,115**	**10,054**	**11,563**	**12,191**	**12,531**
9.30 am	2,058	106	106	10,666	9,943	9,877	11,559	12,082	12,467

3.2 There was reduced access to low-priced capacity

3.2.1 A large amount of baseload capacity in New South Wales was not fully available

Over 3,000 MW of baseload capacity in New South Wales was not offered to the market for the 9 am trading interval. Eraring unit 2 had been on a planned outage since 8 July, while Bayswater unit 2 suffered technical issues coming back from a planned outage and was unavailable by 8.40 am. The remaining MW were from units that were online but rebid reduced capacity due to coal or plant issues. This limited the amount of low-priced capacity available (Table 2). Any significant rebids are contained in *Appendix A: Significant rebids*.

Table 2: Unavailable generation

Participant	Station	Unit	Registered capacity (MW)	Max Avail (MW)	Unavailable (MW)	Reason
AGL	Bayswater	BW02	660	0	-660	Tube leak
		BW03	660	550	-110	Milling limits
		BW04	660	330	-330	Milling limits
	Liddell	LD01	500	350	-150	Plant limits
		LD02	500	373	-127	Plant limits
		LD03	500	300	-200	Milling limits

Participant	Station	Unit	Registered capacity (MW)	Max Avail (MW)	Unavailable (MW)	Reason
		LD04	500	300	-200	Plant limits
Origin	Eraring	ER02	720	0	-720	Planned outage since 8 July
		ER03	720	580	-140	Plant conditions
EnergyAustralia	Mount Piper	MP1	730	520	-210	Coal quality issues
		MP2	730	620	-80	Coal quality issues
Delta	Vales Point	VP6	660	520	-140	Heater limit
				Total	**-3,067**	

Participants with capacity priced above $5,000/MWh were Snowy Hydro (Colongra and Guthega power stations) and Delta Electricity (Vales Point power station) (Table 3). The offers for these participants are set out in *Appendix B: Offers greater than $5,000/MWh*.

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

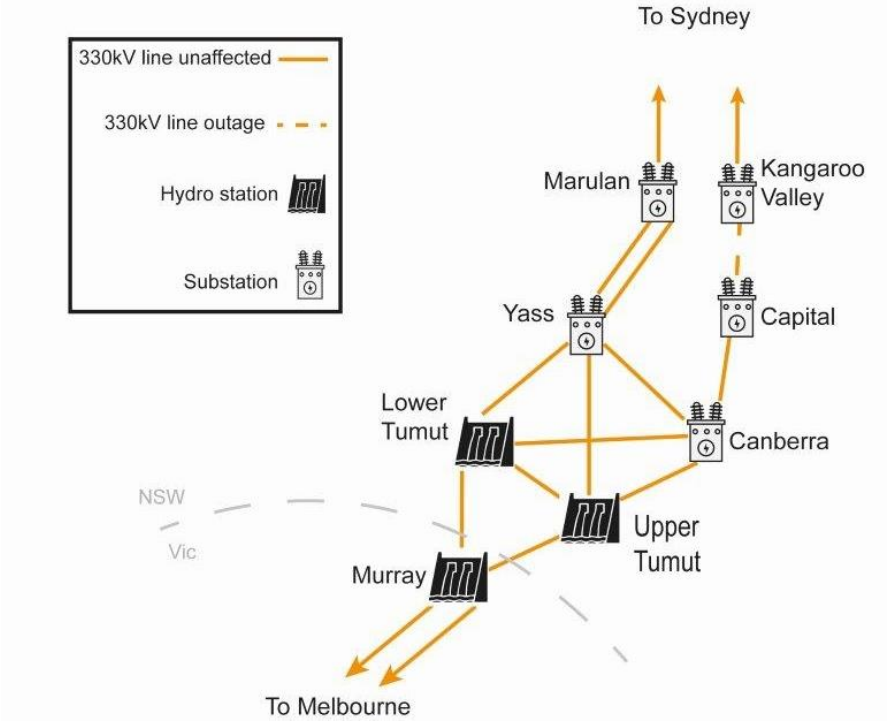
Participant	Station	Registered capacity (MW)	Fuel type	Capacity offered >$5,000/MWh	
				8.55 am (MW)	9 am (MW)
Snowy Hydro	Colongra	**724**	Gas	531	531
	Guthega	**68**	Hydro	68	0
Delta Electricity	Vales Point	**1,320**	Coal	170	170
			Total	**769**	**701**

3.2.2 Planned network outages reduced access to low-priced capacity from other regions

Planned network outages in New South Wales limited its ability to import cheaper generation from both Victoria and Queensland. There was a planned outage in southern New South Wales around Canberra which limited access to cheap generation from Victoria and southern New South Wales. There were also planned outages in northern New South Wales due to the upgrade of the QNI which limited access to cheap generation from Queensland.

In southern New South Wales, there were planned outages of the Capital to Kangaroo Valley 330 kV line, which began on 11 July. Figure 1 shows the affected network area, the significant generators, 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 1: Network diagram



What is a constraint?

In optimising economic generation dispatch and interconnector flows, the National Electricity Market Dispatch Engine (NEMDE) formulates the maximum network capability for every five minute dispatch interval. These capabilities are used to form constraints that describe the maximum capability of each network element and include generator and interconnector coefficients.

Constraints contain a Left Hand Side (LHS) and a Right Hand Side (RHS). The RHS contains all of the inputs that cannot be varied by NEMDE. These inputs include demand and the rating of the relevant transmission line (i.e. how much energy the line can carry without damaging the line or causing unsafe conditions). The LHS contains all of the inputs that can be varied by NEMDE to deliver an outcome that satisfies the requirement of the RHS. These inputs include output from generators and flow on interconnectors. When the LHS equals the RHS then the constraint is binding.

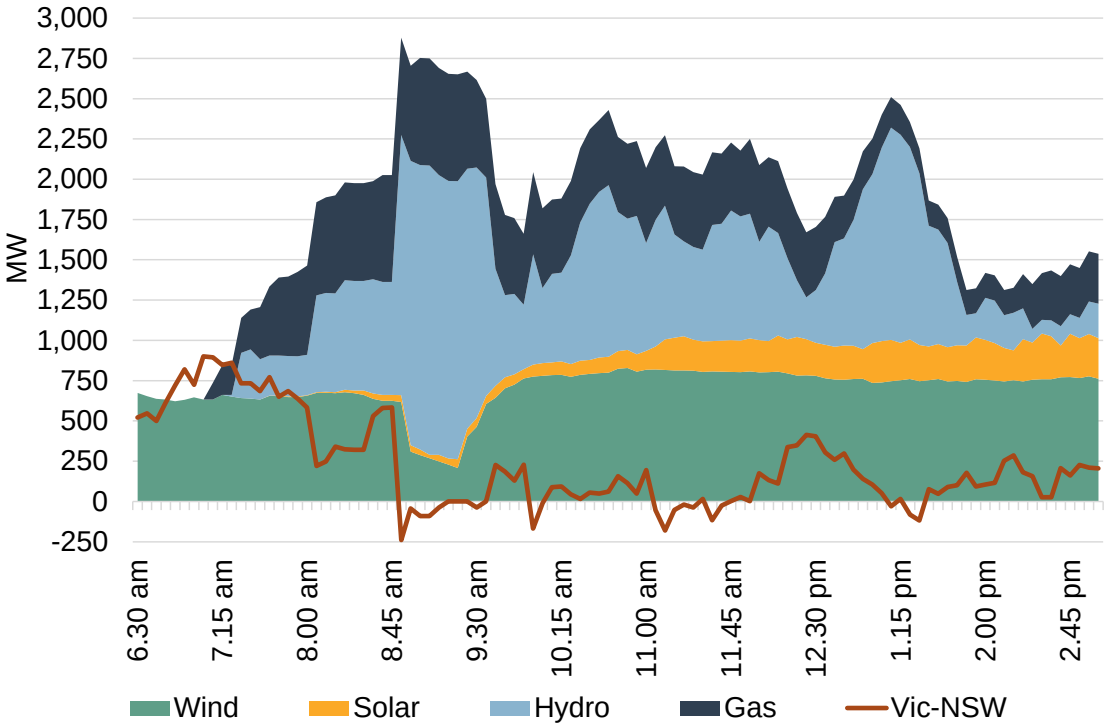
How a constraint leads to counter-priced flows

To minimise the dispatch price, NEMDE schedules the cheapest generation sources to meet demand and maintain interconnector flows within limits, so if generation in southern New South Wales is cheaper than the imports from Victoria, it is dispatched before imports and vice versa. In this situation, because of the location of the generators and the transmission outage, if the VIC-NSW interconnector is at its adjusted limit then any excess generation in that area is forced across the interconnector into Victoria, possibly counter-price (from a high to low priced region). The output of generators on the LHS of the constraint is co-optimised with interconnectors on the LHS. The participants with the largest generator capacity that affect this particular constraint are Snowy Hydro (2,256 MW) and Origin (664 MW). There are also a number of wind and solar farms, ranging from 10 MW to 324 MW that affect this constraint to a lesser degree.

At 8.50 pm a rebid by Snowy Hydro became effective that shifted 1,915 MW of capacity at Tumut and Upper Tumut from prices between $0/MWh and $450/MWh to the floor. This increased its dispatch by over 900 MW. As the constraint was already binding, the increased output from Upper Tumut effectively replaced imports on the Vic-NSW interconnector, which were priced at $4/MWh. As a result, flows went from 584 MW into New South Wales to 238 MW into Victoria (counter-price).

Figure 2 shows the target of all the units on the constraint. At 8.50 am, when Tumut's rebid came into effect, hydro generation increased, wind generation decreased and flows on the Vic-NSW interconnector changed direction from importing to exporting.

Figure 2: Generation and interconnector flows on Vic-NSW

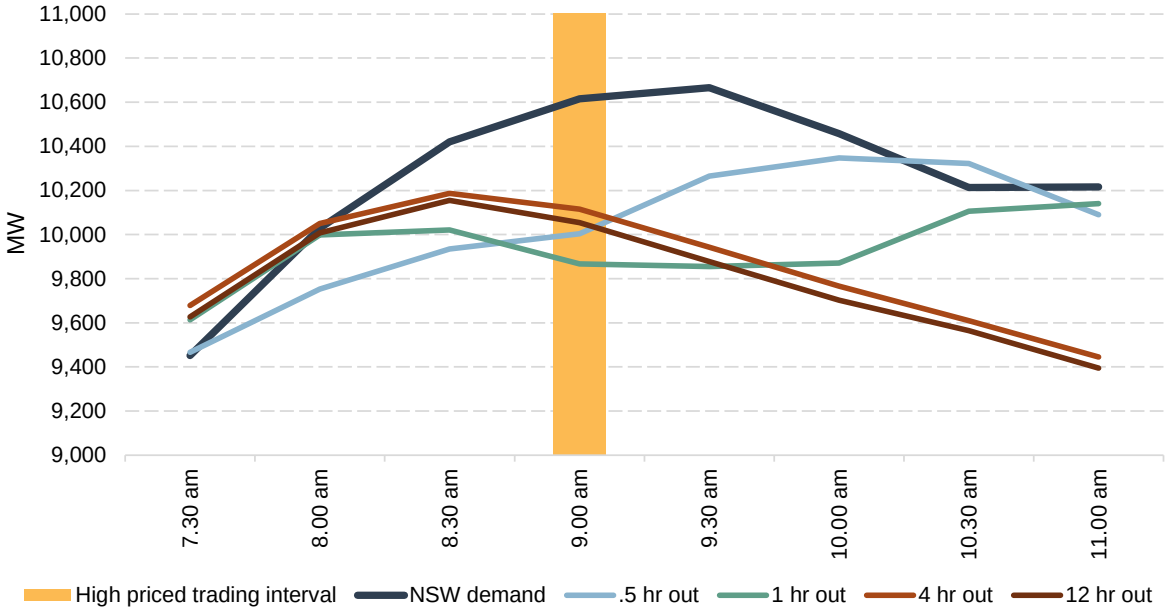


In northern New South Wales there was a planned outage of the Armidale to Tamworth 330 kV lines as part of the upgrade to the QNI interconnector. This outage limited imports from Queensland over the QNI interconnector to below 500 MW, out of the nominal 1,000 MW limit.

3.3 Demand

Morning demand peaked higher than forecast. Figure 3 shows that at around 8.30 am the demand forecast for 9 am (the light blue line) was around 600 MW below actual demand (dark blue line).

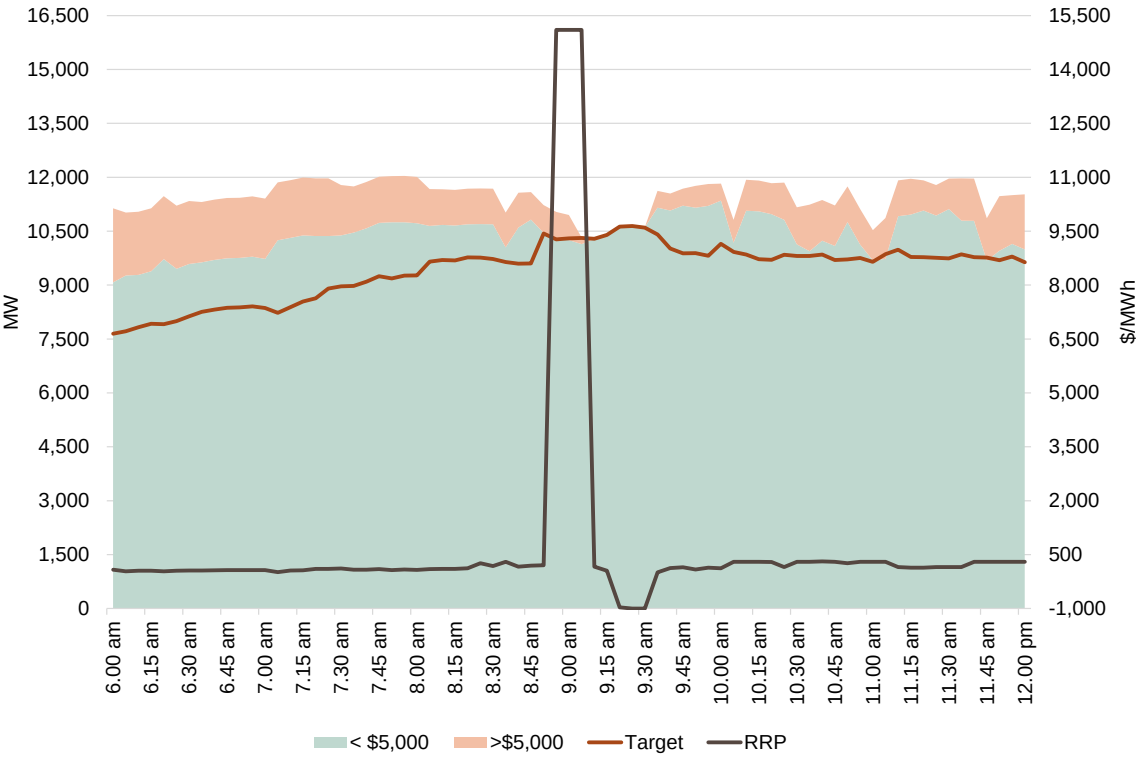
Figure 3: Forecast and actual demand



3.4 During the 8.55 am and 9 am dispatch intervals

Around 93% 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, as the morning demand peaked up to 46 MW of high-priced capacity was still required to meet demand but did not set price as it was ramp constrained (Figure 4).[1]

Figure 4: New South Wales capacity above and below $5,000/MWh



1 Ramp constrained capacity cannot set the price.

At 8.55 am demand increased by 157 MW and reached the morning peak of 10,757 MW. With around 520 MW of low priced capacity constrained down in southern New South Wales and limited imports from Queensland, some high priced capacity was dispatched. This high priced capacity was ramp up limited and unable to set price. The remaining high priced capacity was unable to start within 5 minutes or was being constrained down. As a result more supply had to come from Queensland.

Imports from Queensland increased by 120 MW and the requirement for lower ancillary services in Queensland also increased by up to 120 MW. The prices for the lower ancillary services in Queensland were set between $14,000/MW and the cap.

The dispatch price for energy in New South Wales was co-optimised by the FCAS and energy markets in Queensland, resulting in 2 dispatch intervals set at the cap. 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*.

3.5 Lack of Reserve

Following the rebids at Mount Piper and Bayswater after 7.30 am, supply conditions tightened. An actual Lack of Reserve (LOR) level 1 was declared in New South Wales from 8.10 am to 12.05 pm.

When demand and supply conditions are tight AEMO notifies the market, through 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.

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 9 am trading interval

Submit time	Time effective	Participant	Station	Capacity rebid (MW)	Price from ($/MWh)	Price to ($/MWh)	Rebid reason
7.28 am		Origin Energy	Uranquinty	166	15,100	<450	0726A inc NSW dem 5PD 10003MW > 30PD 9752MW @ 0800 SL
7.30 am		Energy Australia	Mt Piper	-140	35	N/A	0725~P~adj avail due to coal quality issues sl~~
7.49 am		AGL Energy	Bayswater	-150	-1,000	N/A	0745~P~020 reduction in avail cap~tube leak / roc-down adjusted~
7.54 am		Energy Australia	Mt Piper	-100	<35	N/A	0750~P~adj avail due to mill issue~~
8.17 am		Origin Energy	Shoalhaven	40	15,100	-1,000	0816A inc NSW dem 5PD 10284MW > 30PD 10004MW @ 0900 SL
8.30 am	8.40 am	Origin Energy	Uranquinty	56	450	76	0830A material change in nsw dem sl
8.42 am	8.50 am	Snowy Hydro	Tumut	765	300	-1,000	08:34:00 A NSW 30min PD +200 Sensitivity $14,164.76 higher than 30min PD 09:00@08:04 ($14,288.00) SL
8.42 am	8.50 am	Snowy Hydro	Upper Tumut	450	450	-1,000	08:34:00 A NSW 30min PD +200 Sensitivity $14,164.76 higher than 30min PD 09:00@08:04 ($14,288.00) SL

Appendix B: Closing bids

Figures B1 and B2 highlight the 5 minute offers 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 dispatch price.

Figure B1: Delta Electricity (Vales Point) offers, dispatch and dispatch price

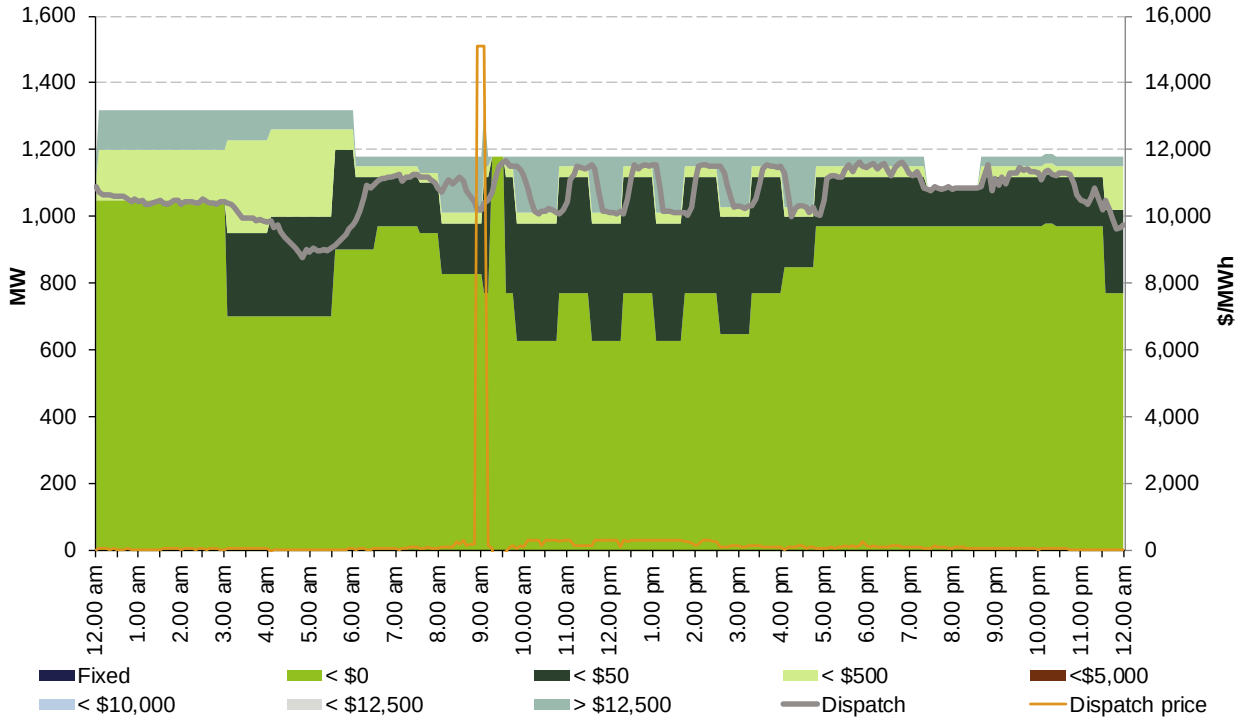
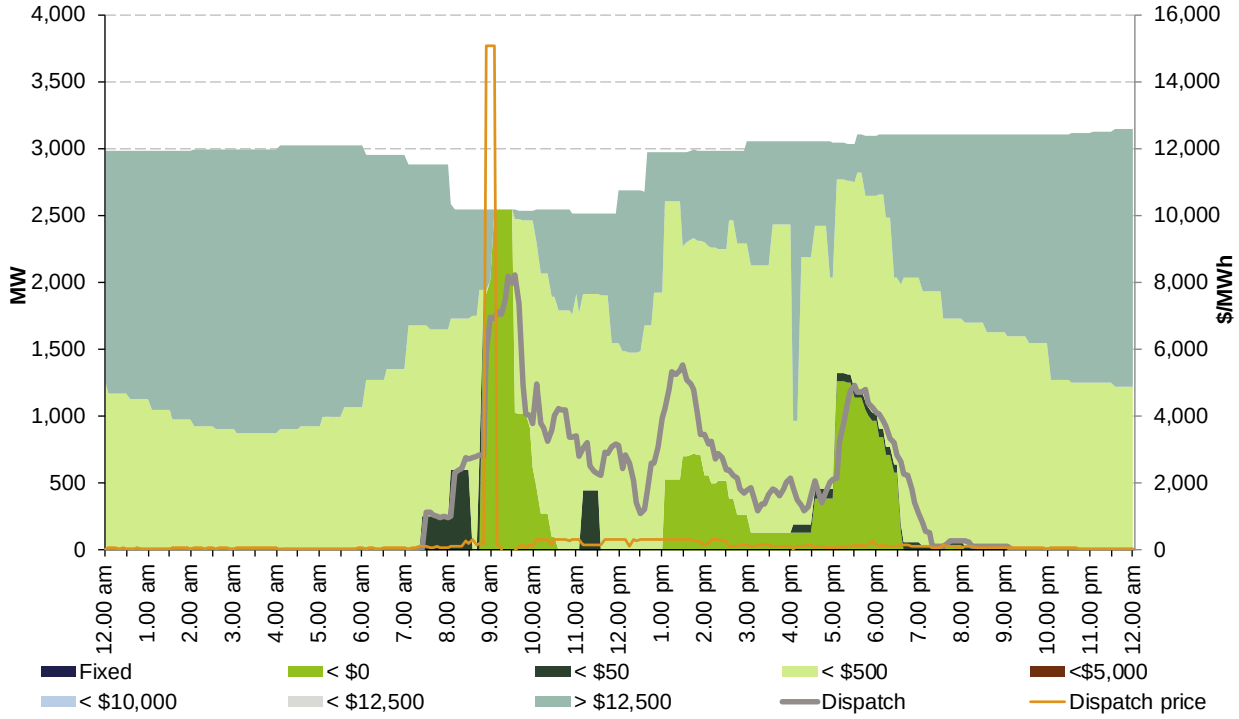


Figure B2: Snowy Hydro (Colongra, Tumut, Upper Tumut, Guthega, Blowering) offers, dispatch and dispatch price



Appendix C: Price setter

The following table identifies 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.[2] The 30-minute spot price is the average of the 6 dispatch interval prices. The dispatch prices that are in italics are capped at the price cap of $15,100/MWh when published by AEMO.

Table 5: NSW price setter 9 am

DI	Dispatch Price ($/MWh)		Participant	Unit	Service	Offer price ($/MWh)	Marginal change	Contribution
08:35	$	299.99	Snowy Hydro	TUMUT3	Energy	$299.99	1.00	$299.99
08:40	$	162.68	Delta Electricity	VP5	Energy	$110.00	1.00	$110.00
			Delta Electricity	VP5	Raise reg	$48.00	-1.00	-$48.00
			Stanwell	TARONG#3	Raise reg	$100.68	1.00	$100.68
08:45	$	191.94	Arrow	BRAEMAR6	Energy	$69.80	1.04	$72.59
			CS Energy	CALL_B_2	Lower reg	$0.01	1.02	$0.01
			CS Energy	CALL_B_2	Lower 60	$0.61	-1.02	-$0.62
			CS Energy	CALL_B_2	Lower 6	$0.61	-1.02	-$0.62
			NEOEN	HPRL1	Lower reg	$13.70	-1.02	-$13.97
			Stanwell	STAN-1	Lower 6	$16.68	2.04	$34.03
			Stanwell	STAN-3	Lower 60	$49.25	2.04	$100.47
			EnergyAustralia	MP1	Lower 60	$0.15	-1.02	-$0.15
08:50	$	204.60	AGL Energy	DALNTHL1	Lower 6	$0.00	-1.03	$0.00
			NEOEN	HPRL1	Lower reg	$13.70	-1.03	-$14.11
			AGL Energy	LD04	Lower 60	$0.03	-1.03	-$0.03
			Stanwell	STAN-1	Lower reg	$74.99	1.03	$77.24
			Stanwell	STAN-3	Lower 6	$49.25	1.03	$50.73
			Stanwell	TARONG#1	Energy	$38.95	0.26	$10.13
			Stanwell	TARONG#2	Energy	$38.95	0.26	$10.13
			Stanwell	TARONG#3	Energy	$38.95	0.26	$10.13
			Stanwell	TARONG#3	Lower 60	$49.25	1.03	$50.73
			Stanwell	TARONG#4	Energy	$38.95	0.26	$10.13
08:55	*$*	*15,100*	Arrow	BRAEMAR6	Energy	$41.86	-1.00	-$41.86
			EnergyAustralia	BALBL1	Lower reg	$7.65	-1.04	-$7.96
			CS Energy	GSTONE1	Energy	$235.73	0.52	$122.58
			CS Energy	GSTONE1	Lower reg	$14,500.00	0.52	$7,540.00
			CS Energy	GSTONE2	Energy	$235.73	0.52	$122.58
			CS Energy	GSTONE2	Lower reg	$14,500.00	0.52	$7,540.00
			CS Energy	GSTONE3	Energy	$235.73	0.52	$122.58
			CS Energy	GSTONE3	Lower reg	$14,500.00	0.52	$7,540.00
			CS Energy	GSTONE4	Energy	$235.73	0.52	$122.58
			CS Energy	GSTONE4	Lower reg	$14,500.00	-0.52	-$7,540.00

[2] 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
			CS Energy	GSTONE4	Lower 60	$15,000.00	1.04	$15,600.00
			CS Energy	GSTONE4	Lower 6	$15,000.00	1.04	$15,600.00
09:00	*$*	*15,100*	CS Energy	GSTONE1	Energy	$85.73	0.26	$22.29
			CS Energy	GSTONE1	Lower 60	$15,000.00	0.26	$3,900.00
			CS Energy	GSTONE1	Lower 6	$15,000.00	0.26	$3,900.00
			CS Energy	GSTONE2	Energy	$85.73	0.26	$22.29
			CS Energy	GSTONE2	Lower 60	$15,000.00	0.26	$3,900.00
			CS Energy	GSTONE2	Lower 6	$15,000.00	0.26	$3,900.00
			CS Energy	GSTONE3	Energy	$85.73	0.26	$22.29
			CS Energy	GSTONE3	Lower 60	$15,000.00	0.26	$3,900.00
			CS Energy	GSTONE3	Lower 6	$15,000.00	0.26	$3,900.00
			CS Energy	GSTONE4	Energy	$85.73	0.26	$22.29
			CS Energy	GSTONE4	Lower 60	$15,000.00	0.26	$3,900.00
			CS Energy	GSTONE4	Lower 6	$15,000.00	0.26	$3,900.00
			NEOEN	HPRL1	Lower 60	$0.00	-1.03	$0.00
			Stanwell	TARONG#4	Lower 5	$14,000.00	1.03	$14,420.00
			EnergyAustralia	MP2	Lower 5	$0.07	-1.03	-$0.07
			Yarranlea Solar	YARANSF1	Energy	-$31.63	0.03	-$0.95
Spot Price			**$5,177/MWh**					