Report into market ancillary service prices above $5000/MW

South Australia, 30 March 2017

1 September 2017

AUSTRALIAN ENERGY REGULATOR

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Contents

1 Obligation

The Australian Energy Regulator regulates energy markets and networks under national legislation and rules in eastern and southern Australia, 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 energy markets, including the annual State of the energy market report, to assist participants and the wider community.

The AER is required to monitor significant variations between forecast and actual prices and publish a report where:

- prices for a market ancillary service over a period significantly exceed the relevant spot price for energy; and
- prices for a market ancillary service exceed $5000/MW for a number of trading intervals within that period.

In accordance with the clause 3.13.7(e) of the National Electricity Rules, the report must:

- describe the significant factors that contributed to the ancillary service prices exceeding $5000/MW;
- identify any linkages between spot prices in the energy market and ancillary service prices contributing to the occurrence; and
- assess whether rebidding pursuant to clause 3.8.22 contributed to prices exceeding $5000/MW.

These reports examine the reasons for the high price outcomes—they are not compliance reports. We deal separately with compliance issues that come to our attention during the preparation of these reports.

2 Summary

Lower and raise regulation frequency control ancillary services (regulation services) are used to manage small fluctuations in supply or demand.

On 30 March 2017 the local price for local regulation services in South Australia exceeded $11 400/MW for 54 consecutive dispatch intervals from 9.05 am to 1.30 pm. The wholesale (or spot) price for electricity in South Australia did not exceed $145/MWh over the same period.

At 6 am on 29 March there was a planned network outage on the Heywood 2 500 kV busbar in Victoria. This outage, which ended at 2.45 pm on 30 March, put South Australia on a single contingency, which created the risk of South Australia becoming electrically isolating from the National Electricity Market (NEM). To manage the risk, and in line with its procedures, the market operator (AEMO) notified the market that South Australia would be required to source 35 MW of raise and lower regulation services from within the region for the duration of the outage.

From 9.05 am on 30 March, AGL rebid 2 MW of raise and lower regulation services from low to high prices. This left only 34 MW of regulation services priced below $5000/MW, one megawatt less than the requirement. As a result, high priced regulation services were needed to meet the requirement.

Prices for raise and lower regulation services fell below $500/MW from 1.35 pm. The outage was over by 2.45 pm and AEMO removed the 35 MW requirement from 2.50 pm.

3 Analysis

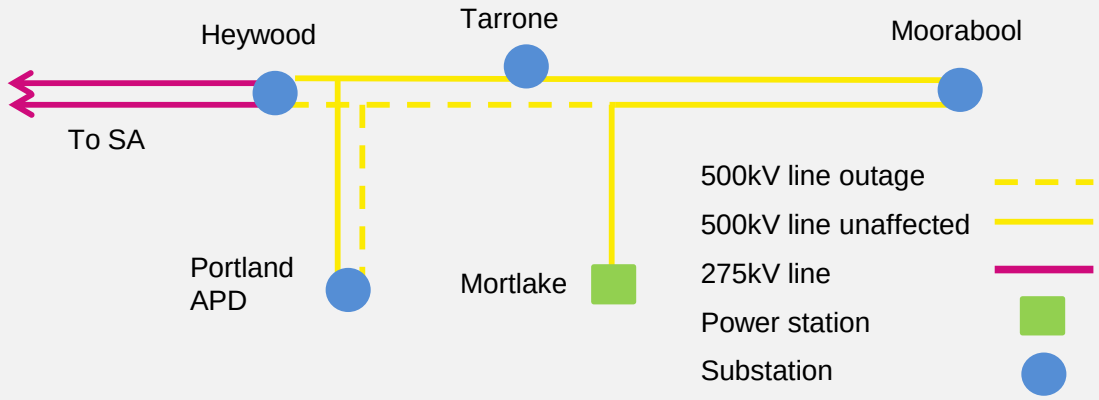
The following sections explain the reasons for the high regulation services prices. To summarise, in response to a planned network outage over two days in Victoria, AEMO imposed the requirement that 35 MW of regulation services be sourced locally in South Australia. A rebid by AGL at its Torrens Island power station shifted capacity for raise and lower regulation services from low prices to high prices, and, as a result, some high priced capacity was needed to meet the 35 MW requirement.

3.1 Planned network outage

Market notice 57972 (published on 13 March 2017 and replicated in Appendix E) announced to the market that there would be an outage in Victoria on the Heywood 2 500 kV busbar and the Heywood to Mortlake to APD No. 2 500kV line, from 6 am on 29 March to 4 pm on 30 March, putting South Australia on a single contingency. Under such conditions AEMO requires South Australia to source 35 MW of regulation services locally. Box 1 explains how AEMO manages outages on the Heywood interconnector.

Box 1: Heywood Interconnector and line outage management

South Australia is electrically connected to Victoria by the Heywood and Murraylink interconnectors. Murraylink is a direct current interconnector that cannot provide FCAS. The Heywood Interconnector is an alternating current high voltage transmission link which can transfer FCAS from the rest of the NEM. The figure below is a simplified representation of the network around the interconnector.



When any one of the four lines going through the Heywood substation is on an outage, the South Australian region is on a single contingency. This means that South Australia is at risk of being electrically isolated from the rest of the NEM as only one line is connecting South Australia to Victoria. When this occurs AEMO invokes constraints requiring 35 MW of local regulation services. This ensures adequate regulation services are immediately available to manage the frequency (around 50Hz) within South Australia if the remaining line trips.

Further details on the 35 MW requirement can be found in Appendix B.

3.2 Regulation FCAS availability, offer prices and price outcomes

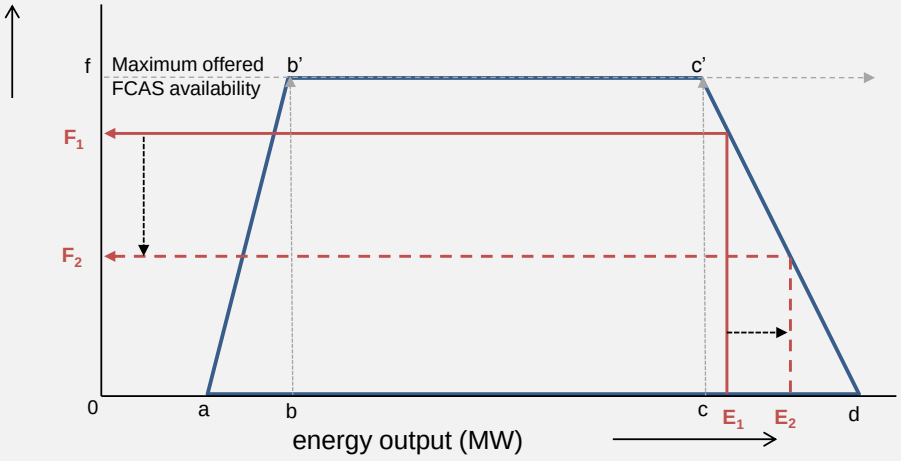
This section discusses participants' offers and resultant prices.

Box 2: Trade-off between generator FCAS and energy offers

Generators must register with AEMO to provide FCAS and offer FCAS capacity in a similar manner to energy into the market.

Participants offer the maximum amount of FCAS (f in the diagram below) and energy, in mega-watts (MW), they are willing to supply across ten price bands, ranging between -$1000 and $14 000 for a trading day. A trading day starts at 4 am each day. A participant also offers the limits by which they can be dispatched in FCAS (a, b, c, d in the diagram below). There can be a trade-off between a participant's provision of FCAS and energy, impacting the effective availability of FCAS. For example in the diagram below, if a generator's energy output is at E_1 then its FCAS effective availability is F_1, if its output in energy increases to E_2 then its effective FCAS availability drops to F_2.

For every dispatch interval the National Electricity Market Dispatch Engine (NEMDE) co-optimises market participants FCAS and energy offers to arrive at the least cost outcome while maintaining system security.



3.2.1 Registered maximum regulation FCAS capacity

Of the 26 power stations (including wind farms) in South Australia only four are registered to provide FCAS. Table 1 shows the power stations that were registered to provide raise and lower regulation FCAS in South Australia on the day and their maximum registered capacity. Table 1 shows each power station, if fully operational, was individually capable of providing the local requirement.

Table 1: Registered maximum regulation FCAS capacity by station

Power Station	Registered Capacity (MW)	
	Lower regulation	Raise regulation
Osborne (Origin Energy)	36	36
Quarantine (Origin Energy)	50	50
Pelican Point (Engie)	100	100
Torrens Island (AGL)	200	260
Total	**386**	**446**

On the day five units at Torrens Island power station and half of Pelican Point power station were unavailable. So, although the registered capacity is as shown in Table 1, only around 160 MW of lower regulation and around 200 MW of raise regulation was available.

Participant offers are reflected in Appendix D.

3.2.2 Rebidding and price outcomes

3.2.2.1 Rebidding

Although the main period of sustained high prices occurred in the afternoon of the second day of the outage, there were several price spikes at the price cap for both services on 29 March, and a continuous period of six dispatch intervals early in the morning on 30 March where the dispatch price for both services exceeded $5000/MW.

At the start of the outage at 6 am on 29 March, 36 MW of capacity was offered at prices below $5000/MW. The price spikes for regulation services throughout 29 March were caused by a reduction in regulation services availability (concept discussed in Box 2).

Rebidding by AGL caused the high price period on the morning of 30 March. At 12.25 pm on 29 March, effective for the 4.30 am trading interval on 30 March, AGL rebid 2 MW of raise and lower regulation services at Torrens Island from $300/MW to $11 500/MW and above. This left only 34 MW of regulation services available priced under $5000/MW, and as a result dispatch prices reached $11 500/MW in raise services and from $11 743/MW to $11 970/MW in lower services. Prices for both services dropped to below $500/MW at 4.35 am when the rebid was no longer effective.

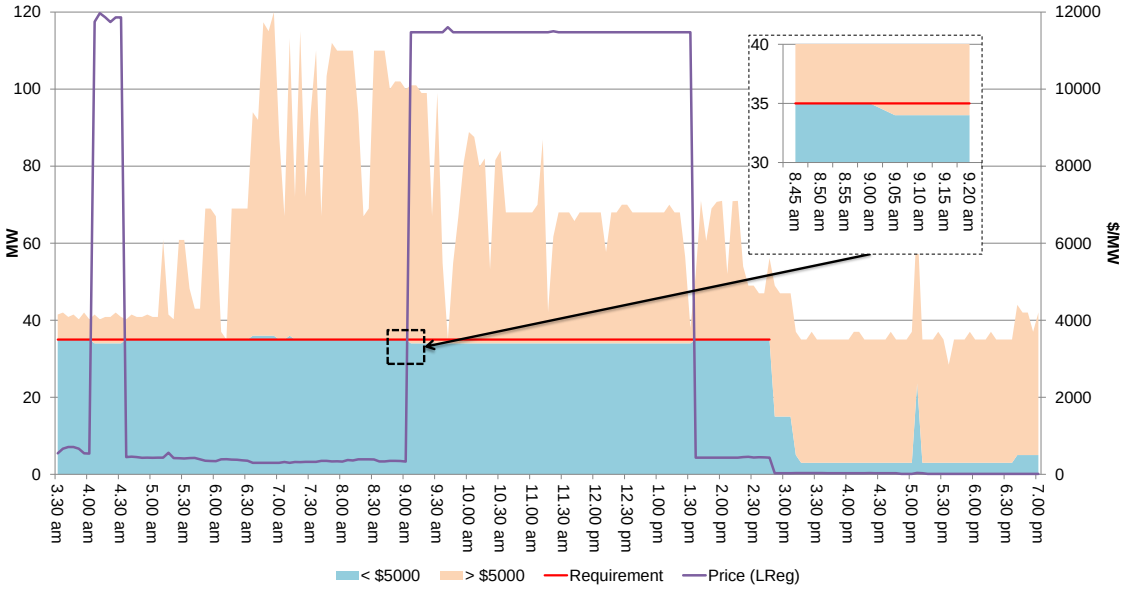
Rebidding by AGL also caused the sustained high prices from mid-morning to early afternoon on 30 March. At 8.06 am , effective from 9.05 am, AGL again rebid 2 MW of raise and lower regulation services at Torrens Island from $300/MW to $11 500/MW and above. The reason given related to a change in contract position due to counter price flows (see Appendix C). This left only 34 MW of regulation services available at under $5000/MW, and as a result prices for both regulation services increased to around $11 480/MW from 9.05 am and remained there until 1.35 pm, when the rebid was no longer in effect.

3.2.2.2 Price outcomes

Figure 1 and Figure 2 show actual price (purple line)[1] and effective available capacity over the high price period. The (constant) 35 MW requirement is shown as a red line. The blue shaded areas indicate effective available capacity below $5000/MW, while effective available capacity above $5000/MW is shaded light orange.

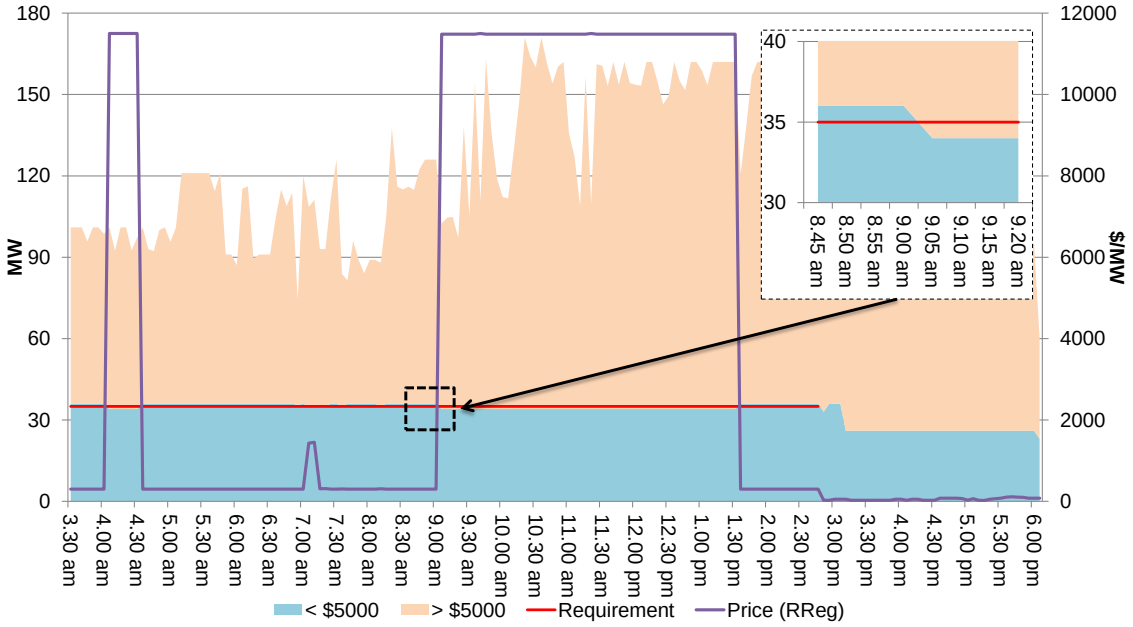
The inset graphs are designed to show the reduction in low priced capacity from 9.05 am. The inset graphs clearly show the red line just inside the orange shaded area, meaning that some high priced capacity was needed to meet the requirement. As a result, prices for regulation services increased from around $300/MW to around $11 500/MW.

Figure 1 Lower regulation effective offers, requirement and price



[1] Individual prices are contained in the Price Setter at Appendix F

Figure 2 Raise regulation effective offers, requirement and price



At 1.35 pm the price fell to $434/MW in lower regulation and $300/MW in raise regulation services after AGL's rebid was no longer in effect. The outage was completed over an hour earlier than scheduled and the requirement was removed at 2.50 pm.

Australian Energy Regulator

August 2017

Appendix A: Explanation of FCAS

Frequency control ancillary services (FCAS) are required to maintain the frequency of the power system within the frequency operating standards. The two general categories of FCAS are:

- Regulation services, which continuously adjust to small changes in demand or supply (changes that cause the frequency to move by only a small amount away from 50 Hz). There are regulation services to increase the frequency (raise regulation or RREG) and services to decrease the frequency (lower regulation or LREG).
- Contingency services, which manage large changes in demand or supply that occur relatively rarely and move the frequency by a large amount. There are three contingency services to increase the frequency and three contingency services to decrease the frequency. Raise contingency FCAS are required to be available to correct frequency excursions that have arisen from a credible contingency event that leads to a decrease in frequency. As these contingency events usually involve step reductions in supply side, the Electricity Rules stipulate that generators pay for these services. Lower contingency FCAS are the services required to be available to correct the frequency excursions that arise from a credible contingency event that leads to an increase in frequency. As these contingency events usually involve step reductions in customer demand, the Electricity Rules stipulate that customers pay for these services.

Participants providing regulation services receive adjusted dispatch targets every 5 minutes via their automatic generation control (AGC) signals from AEMO. Participants are paid through the FCAS markets in accordance with their offered volumes. Their energy production, which may be higher or lower depending on the AGC signals they receive, are settled in accordance with energy market prices.

There are three lower and three raise contingency services:

- fast services, which arrest a frequency deviation within the first six seconds of a contingent event (L6 and R6);
- slow services, which stabilise frequency deviations within sixty seconds of the event (L60/R60); and
- delayed services, which stabilise frequency deviations within five minutes of the event (L5/R5).

Participants offering to provide contingency services are enabled in accordance with the “trapezium” supplied in their offers. While participants will not necessarily be supplying these services until a contingency occurs they are paid in accordance with their enablement.

Frequency Control Ancillary Service Settlement

AEMO settles the FCAS markets on a weekly basis, as follows[2].

- Regulation FCAS: Cost recovery on a "causer pays" basis using the Causer Pays Procedure[3] developed by AEMO in accordance with the appropriate NER procedures.
- Contingency FCAS: Generators pay for Raise Services and customers pay for Lower Services.

The 'Causer Pays' Procedure allocates regulation FCAS costs to those market generators, customers and small generation aggregators with facilities that have the metering capable of determining their contribution to frequency deviations at any time.

Every four weeks based on historical data AEMO calculates a causer pays contribution factor for each generator. Broadly, the contribution factor is determined from historical 4 second generator output and frequency information and is a measure of how each generator contributed to managing changes in the system frequency. If a generators' output changes such that it supports maintaining the system frequency its contribution factor is positive. Conversely, if a generators' output changes such that it exacerbates a frequency deviation, its contribution factor will be negative. The causer pays contribution factors for a portfolio of generators effectively represent the aggregation of the individual performance of the generators in that portfolio.

Settlement is determined by allocating the FCAS costs incurred in the current period in accordance with the causer pays contribution factor for that portfolio from the preceding period. Thus cost allocation to a participant is not dependent on the amount of energy purchased or consumed in that period but by the performance of that participant in managing system frequency in the previous period.

Consequently a portfolio of generators with a negative factor in a particular period will still pay a share of FCAS costs irrespective of how much it generates in the current period.

Since not all of the costs will be recovered from generators, the residual costs are recovered from market customers (including retailers) in the relevant region, based on the amount of energy each market customer is purchasing.

2 For a full description go to https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Data/Ancillary-Services/Ancillary-Services-Payments-and-Recovery

3 For a full description go to https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Security-and-reliability/Ancillary-services/Ancillary-services-causer-pays-contribution-factors

Appendix B: Local Frequency Control Ancillary Services

AEMO sets the requirement for FCAS to ensure that the frequency standard (as set by the Reliability Panel) is maintained in the event of step changes in supply or demand that results from credible contingencies. Where a credible contingency results in the loss of an interconnector it is termed a “separation event”.

The standard states that in the event of a “separation event” the frequency must be contained within 49 to 51 Hz or a wider band notified to AEMO by a relevant JSSC. In the case of South Australia the JSSC notified AEMO that the frequency band for separation of the South Australian power system is 47 to 52 Hz and that under frequency relays will operate at frequency levels in the low end of this range.

When there is a potential separation event caused by the loss of an interconnector “local frequency control ancillary services” are usually required.

If the region was exporting at the time the interconnector fails, then as a consequence of the immediate over supply situation local contingency “lower” services are required in the islanded region to lower the frequency (typically generators offer to quickly reduce output to lower frequency). In other words, the loss of the Heywood interconnector when power is flowing from South Australia, results in an oversupply of generation, increasing the frequency in South Australia. Contingency lower services are sourced from registered suppliers in South Australia (typically generators) in proportion to the flow across the interconnector from South Australia to Victoria to quickly reduce that over frequency.

A similar situation exists for contingency “raise” services for all other regions except South Australia where, in accordance with the advice from the JSSC, the raise requirement is covered by under frequency load shedding. In other words, the loss of the Heywood interconnector when power is flowing into South Australia, results in an undersupply of generation decreasing the frequency in South Australia. Under frequency load shedding reduces demand in blocks to arrest the falling frequency until supply matches demand and the frequency is restored.

In either event, in the past, in the period immediately following the separation event AEMO would invoke local regulation services and establish a local regulation reference source to manage frequency until the region can be reconnected to the rest of the NEM. It is this aspect that has been recently changed by AEMO. AEMO will now impose a requirement for local lower and raise regulation services in South Australia prior to the failure of the interconnector so that frequency after an island is formed, and after the contingency services have operated, can be smoothly maintained.

Appendix C: 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.

Table C 1: Significant rebids for 30 March– lower regulation

Submit time	Time effective	Participant	Station	Capacity rebid (MW)	Price from ($/MW)	Price to ($/MW)	Rebid reason
12.25 pm	4.05 am	AGL	Torrens Island	2	300	>11 500	1220~F~00 INITIAL BID~
8.06 am	9.05 am	AGL	Torrens Island	2	300	>11 500	0805~F~040 CHG IN CONTRACT POS~CPF SEE LOG

Table C 2: Significant rebids for 30 March – raise regulation

Submit time	Time effective	Participant	Station	Capacity rebid (MW)	Price from ($/MW)	Price to ($/MW)	Rebid reason
12.25 pm	4.05 am	AGL	Torrens Island	2	300	>11 500	1220~F~00 INITIAL BID~
8.06 am	9.05 am	AGL	Torrens Island	2	300	>11 500	0805~F~040 CHG IN CONTRACT POS~CPF SEE LOG

Appendix D: Closing bids

Figures D1a to D8b highlight for each dispatch interval the lower and raise regulation services closing bids for Origin, AGL and Engie (the participants in South Australia with ancillary service capability). It also shows the dispatch level of the respective services at each station and the dispatch price.

FCAS services are co-optimised with energy offers. For example a generator that is operating at its maximum capacity cannot provide raise services so their effective available capacity for raise services would be zero. Figures denoted with an "a" refer to the quantities offered while those with a "b" refer to the *effective* quantities available to the market after accounting for the interaction between energy and FCAS ("effective available capacity").

Lower Regulation

Figure D1a: Quarantine (Origin) lower regulation service closing bid prices, dispatch and dispatch price - maximum offers

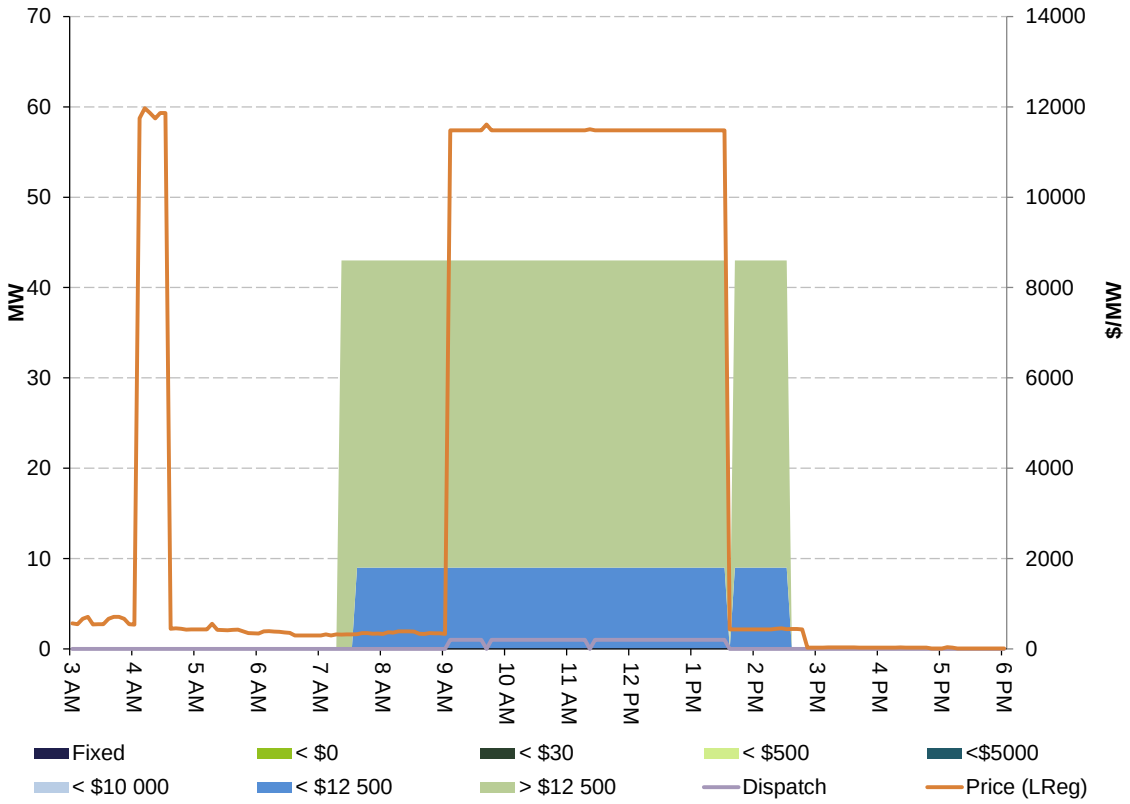


Figure D1b: Quarantine (Origin) lower regulation service closing bid prices, dispatch and dispatch price – effective offers

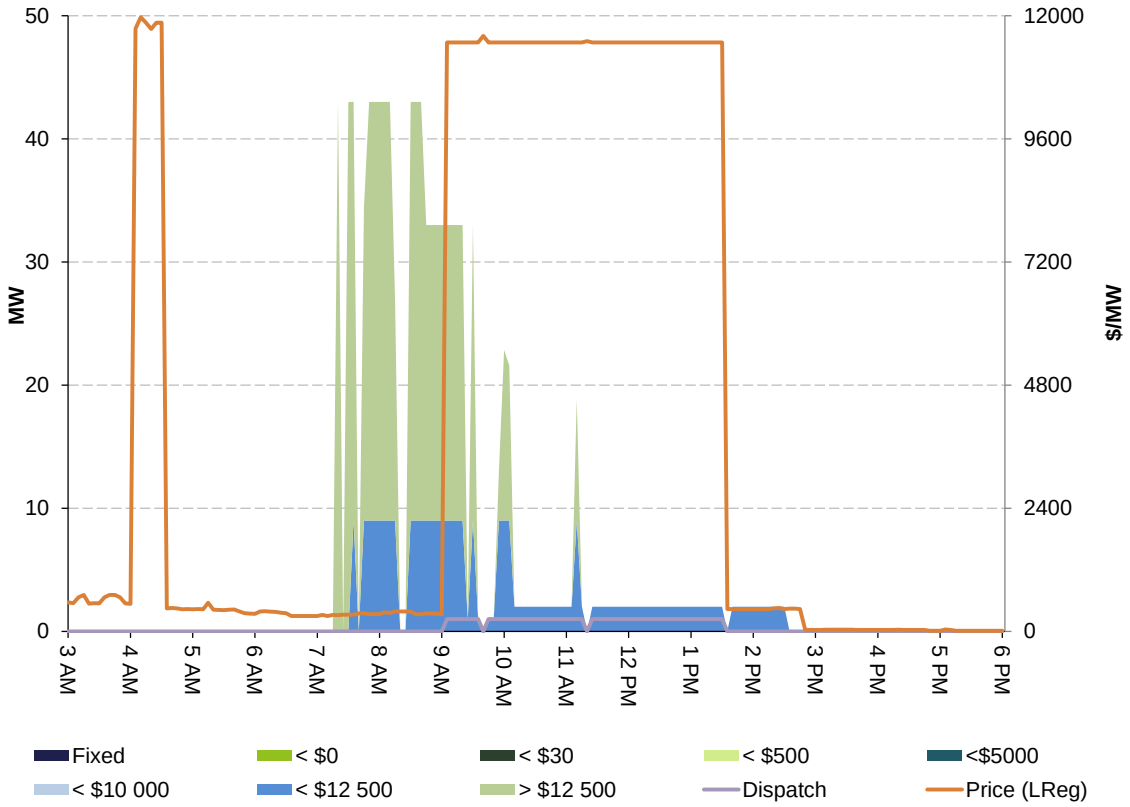


Figure D2a: Torrens Island (AGL) lower regulation service closing bid prices, dispatch and dispatch price – maximum offers

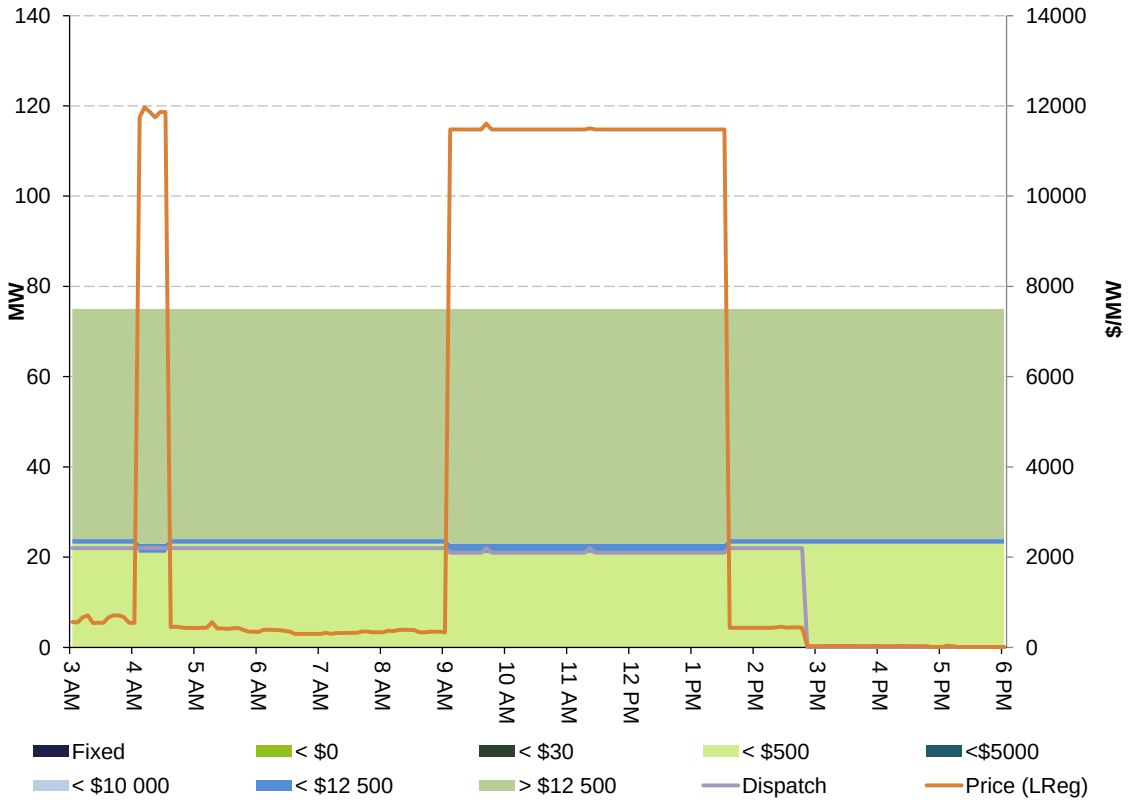


Figure D2b: Torrens Island (AGL) lower regulation service closing bid prices, dispatch and dispatch price – effective offers

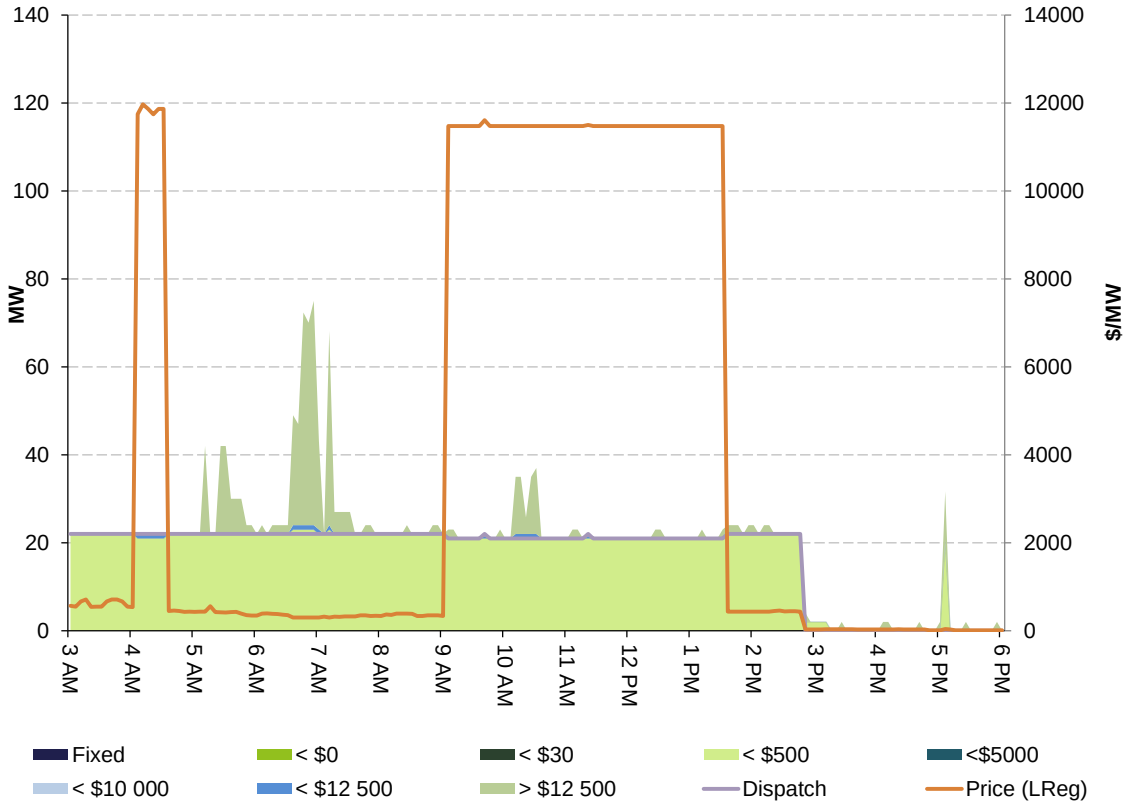


Figure D3a: Pelican Point (Engie) lower regulation service closing bid prices, dispatch and dispatch price – maximum offers

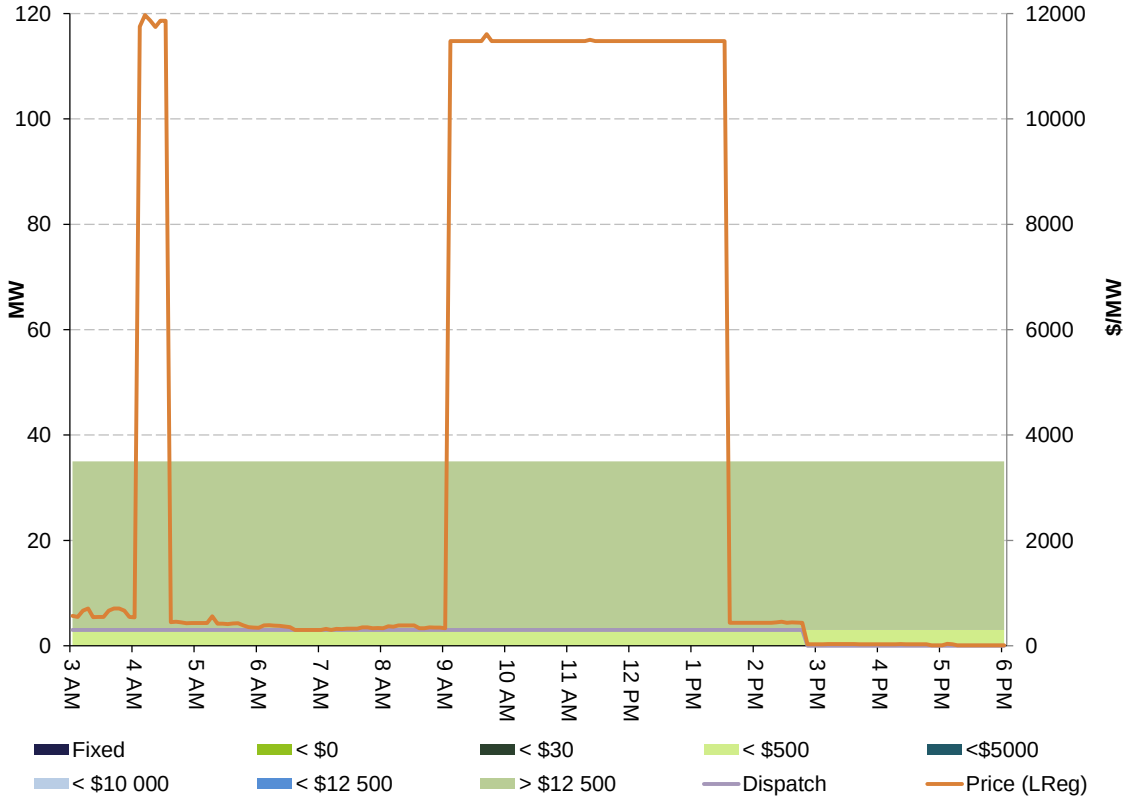


Figure D3b: Pelican Point (Engie) lower regulation service closing bid prices, dispatch and dispatch price – effective offers

Figure D4a: Osborne (Origin) lower regulation service closing bid prices, dispatch and dispatch price – maximum offers

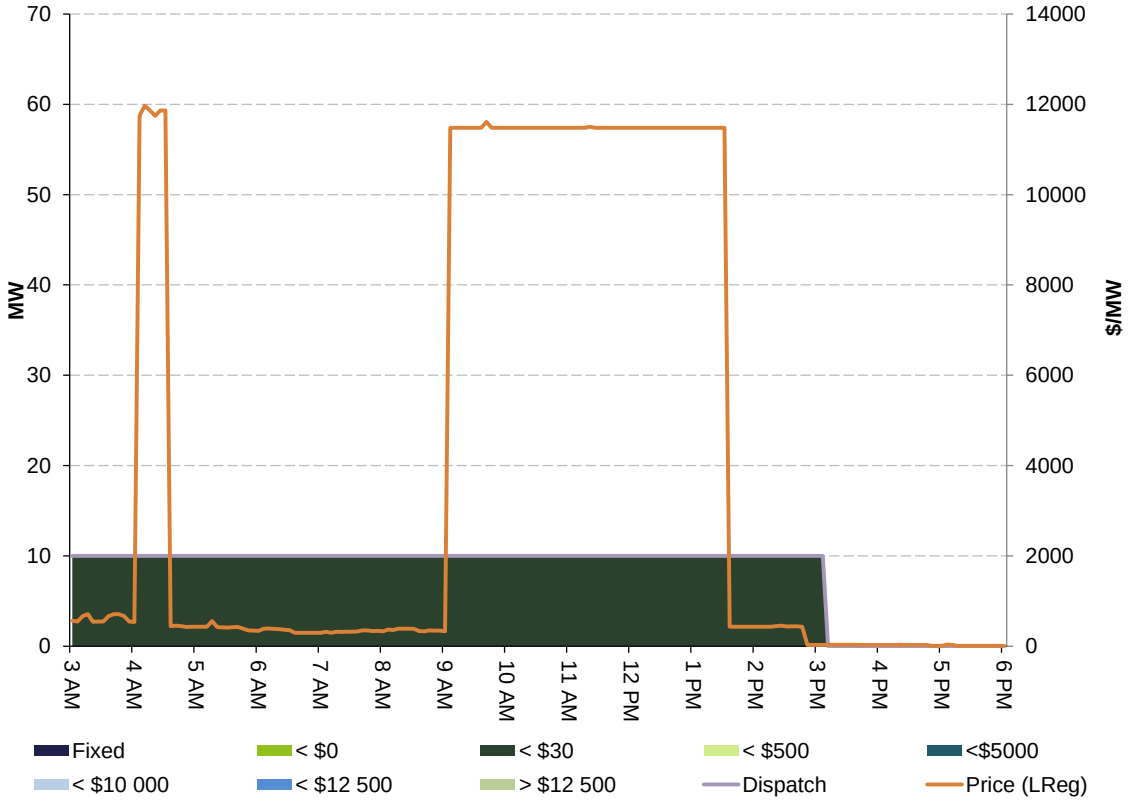
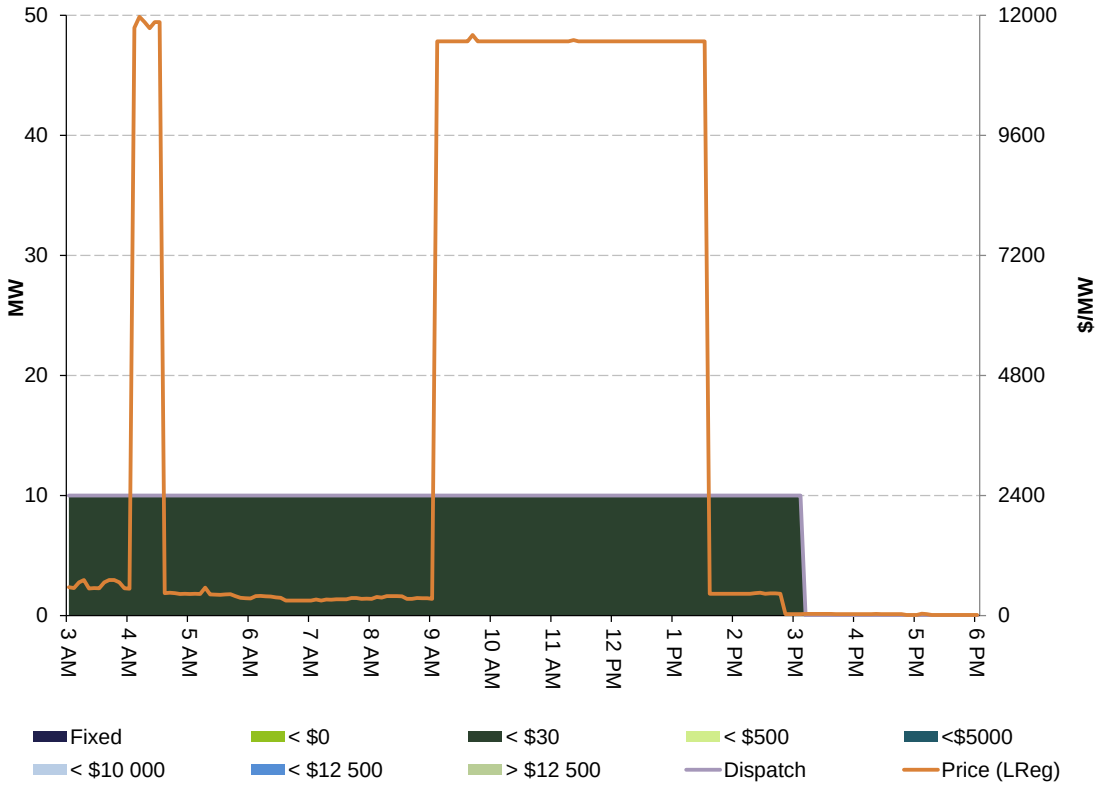


Figure D4b: Osborne (Origin) lower regulation service closing bid prices, dispatch and dispatch price – effective offers



Raise Regulation

Figure D5a: Quarantine (Origin) raise regulation service closing bid prices, dispatch and dispatch price - maximum offers

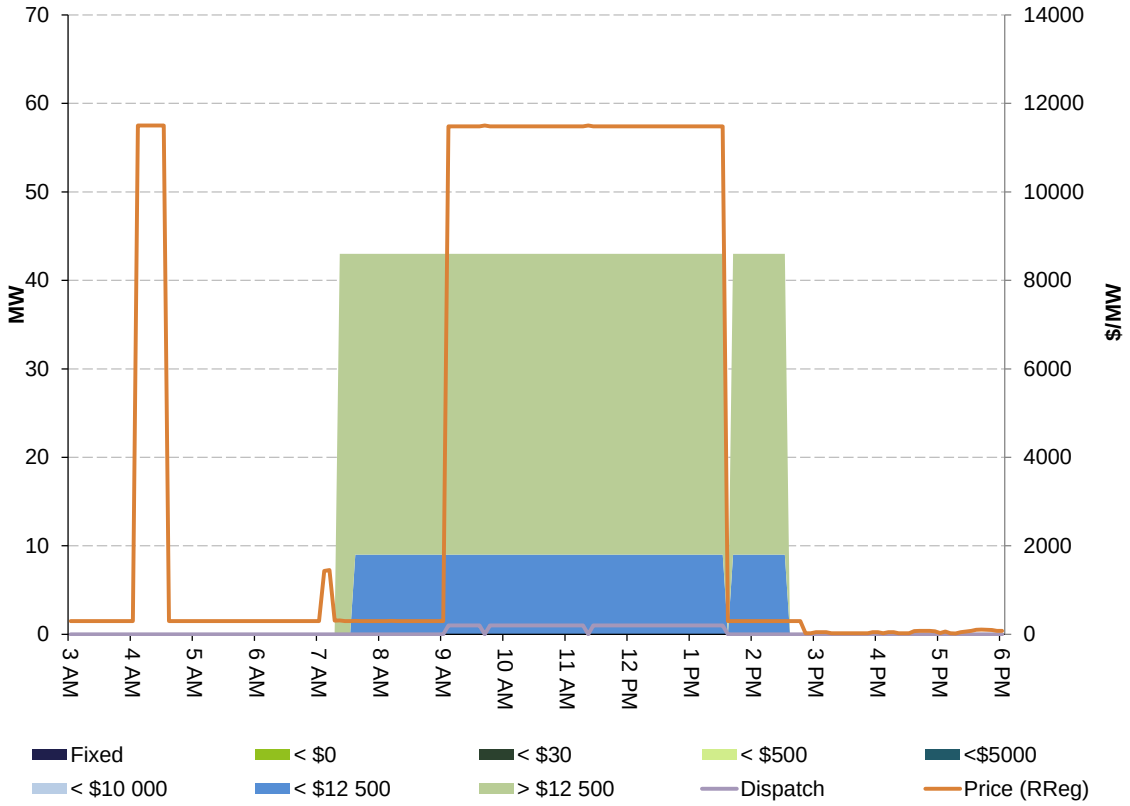


Figure D5b: Quarantine (Origin) raise regulation service closing bid prices, dispatch and dispatch price - effective offers

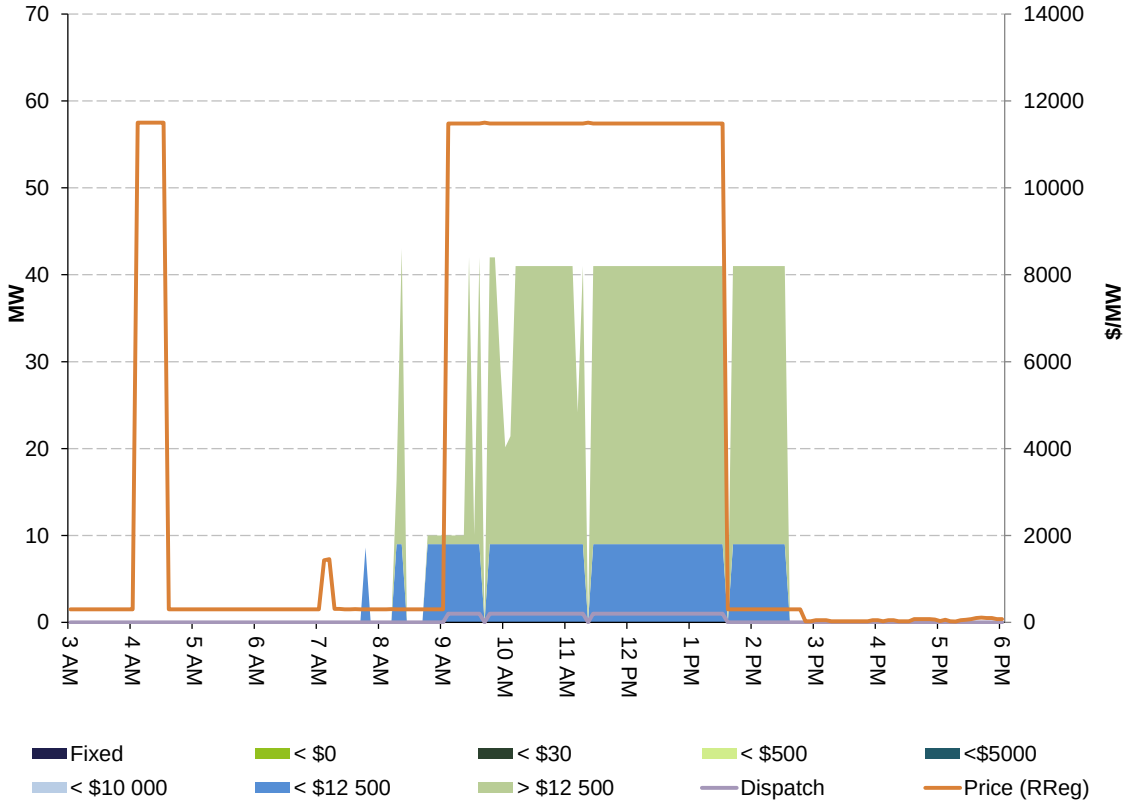


Figure D6a: Torrens Island (AGL) raise regulation service closing bid prices, dispatch and dispatch price – maximum offers

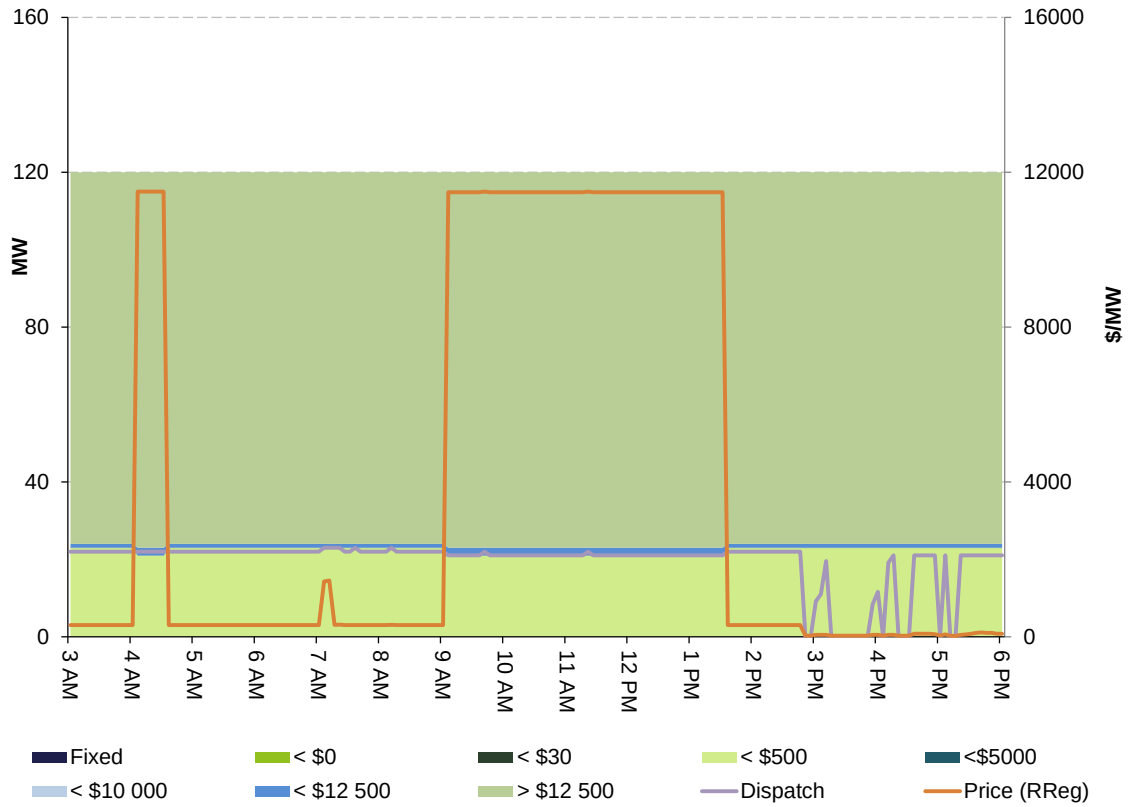


Figure D6b: Torrens Island (AGL) raise regulation service closing bid prices, dispatch and dispatch price – effective offers

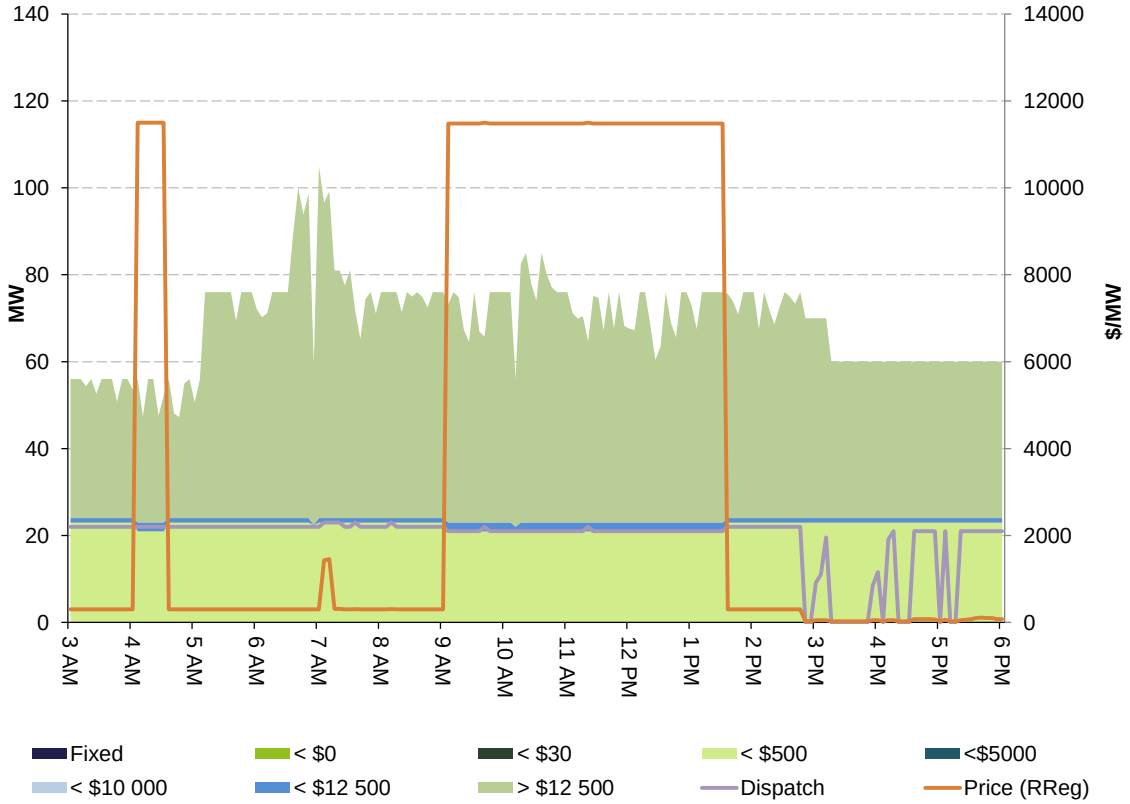


Figure D7a: Pelican Point (Engie) raise regulation service closing bid prices, dispatch and dispatch price – maximum offers

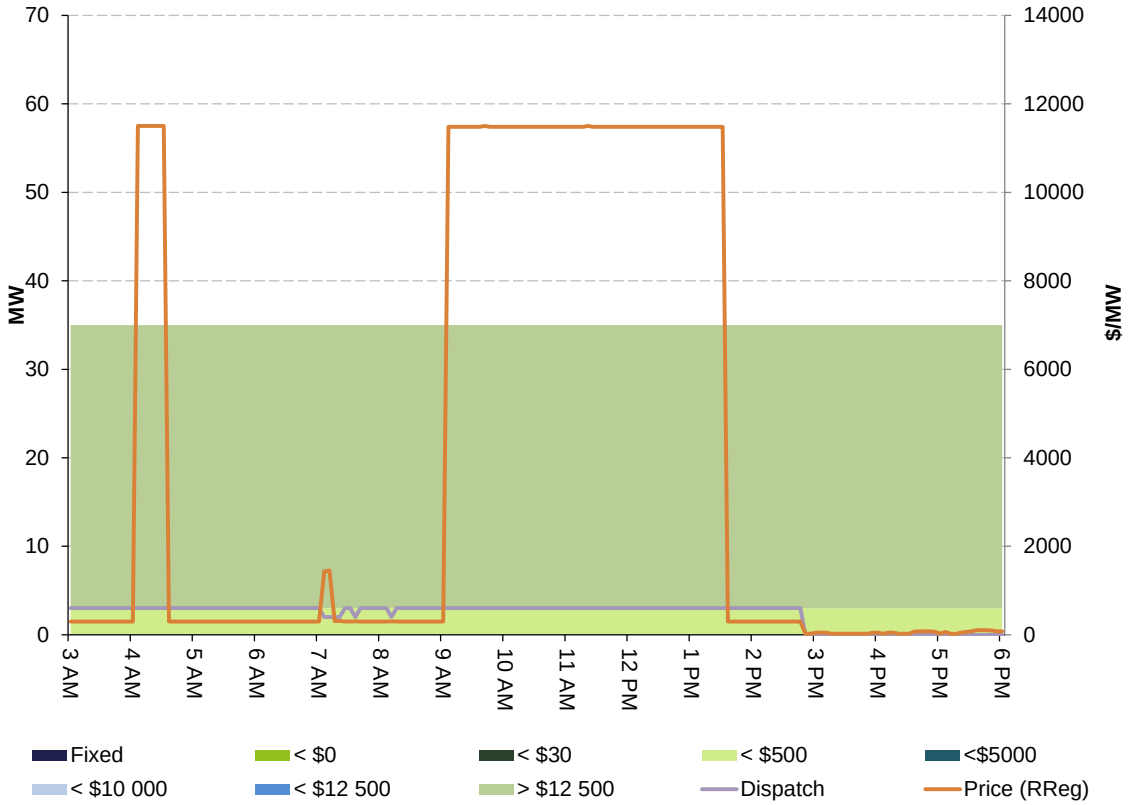


Figure D7b: Pelican Point (Engie) raise regulation service closing bid prices, dispatch and dispatch price – effective offers

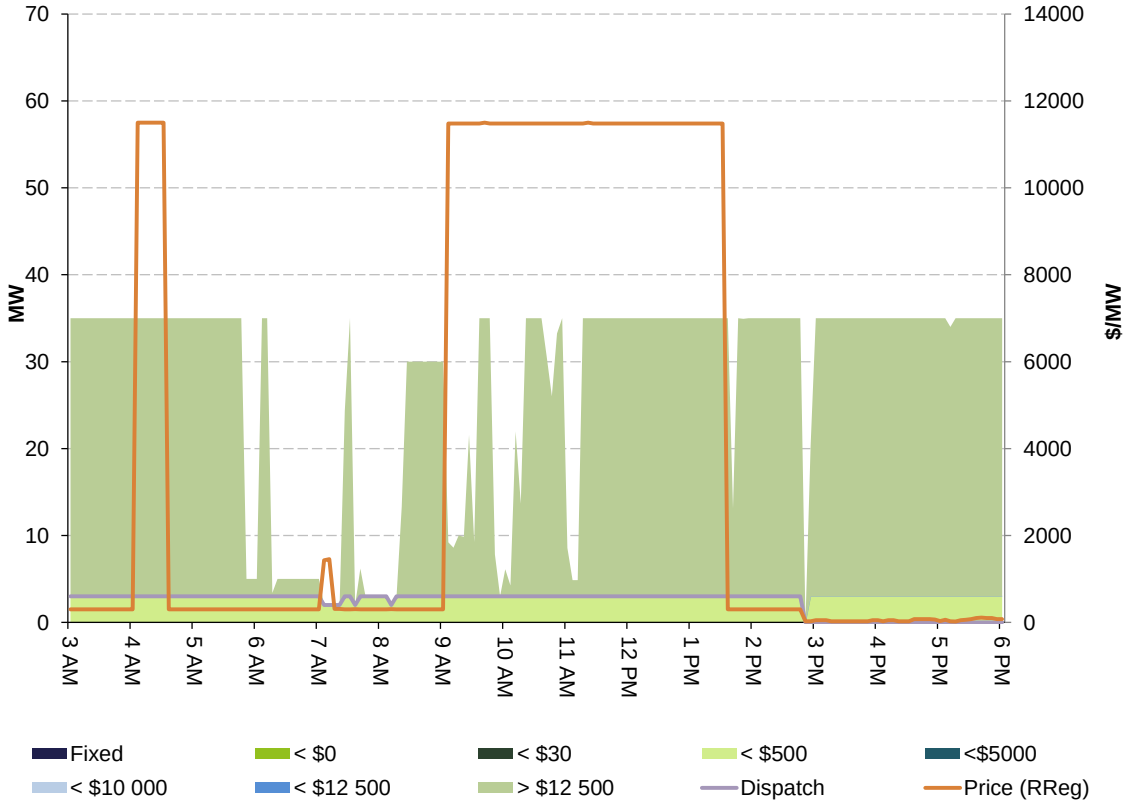


Figure D8a: Osborne (Origin) raise regulation service closing bid prices, dispatch and dispatch price – maximum offers

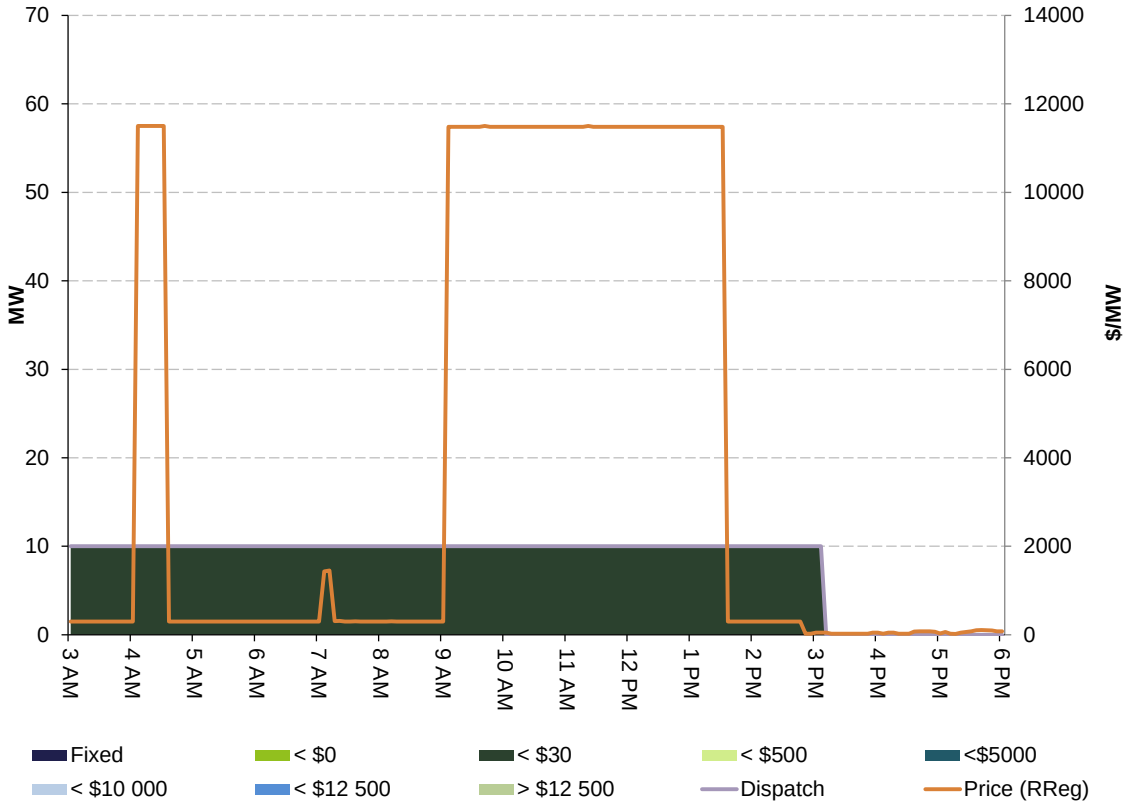
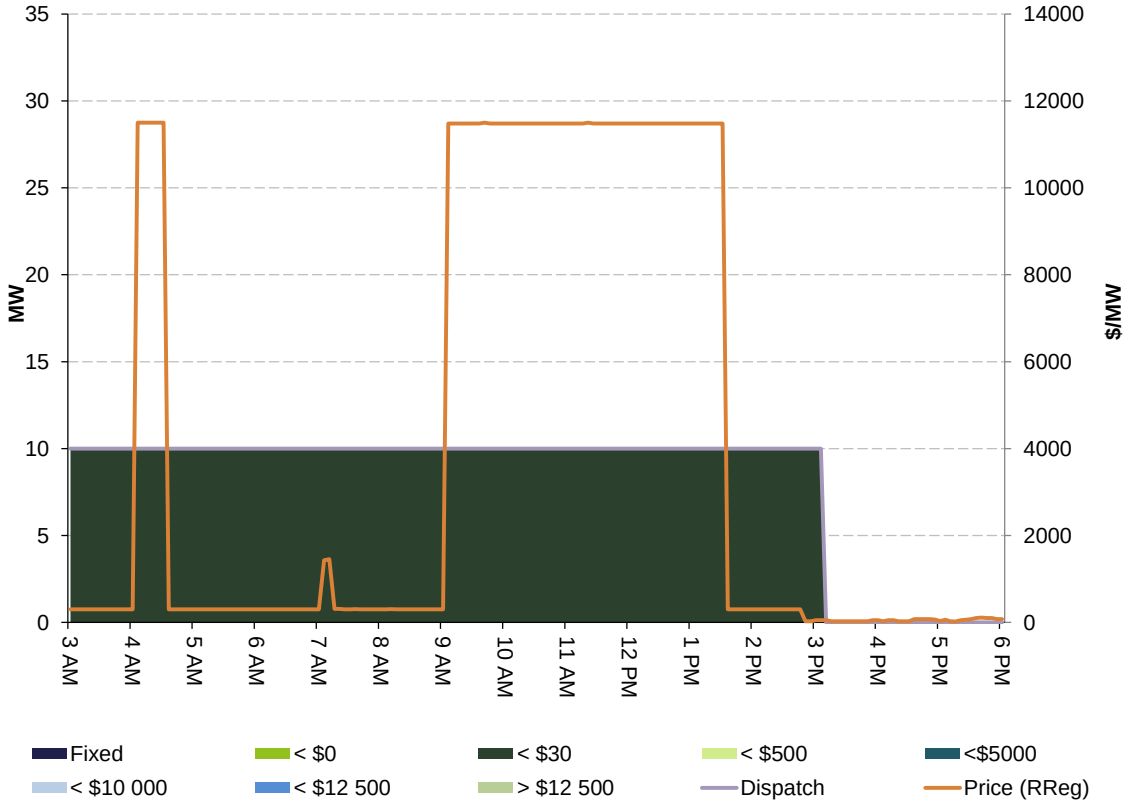


Figure D8b: Osborne (Origin) raise regulation service closing bid prices, dispatch and dispatch price – effective offers



Appendix E: Relevant Market Notices

AEMO issued the following market notices relating to events on the day.

Market Notice	Type	Date of issue	Last Changed
57972	GENERAL NOTICE	13/03/2017 10:10:48	13/03/2017 10:10:48

Reason

AEMO ELECTRICITY MARKET NOTICE.

This market notice is FOR INFORMATION ONLY.

The Heywood No.2 500 kV busbar in Victoria Region is planned out of service from 29/03/2017 0600 hrs to 30/03/2017 1600 hrs. During this outage, Heywood 500/275 kV M2 transformer will be off-loaded and Heywood - Mortlake - Alcoa Portland No.2 500 kV line will be opened at Heywood.

During this outage, a credible contingency can separate South Australia region from the rest of the NEM.

Under these circumstances, 35 MW of Raise and Lower regulation FCAS will be sourced from South Australia for the duration of this outage. In addition, consistent with AEMO existing procedures, adequate contingency FCAS lower requirements will also be sourced from South Australia at times when power transfer is from South Australia to Victoria.

The following constraint sets have been invoked for this outage:

F-I_HYSE (includes F-S_LREG_0035 and F-S_RREG_0035)

S-X_BC_CP

V-HYTX_M12

V-HY_500BUS

Refer AEMO Network Outage Schedule (NOS) for further details.

AEMO will continue monitoring this proposed outage and will update the Market accordingly.

Diyoni Hoole

AEMO Operations

Appendix F: Price setter

The following tables identify for each five-minute dispatch interval where regulation dispatch prices were above $5000/MW, the price and the generating units involved in setting the price for each of the lower and raise regulation services in South Australia. This information is published by AEMO.[4] Also shown are the offer prices involved in determining the dispatch price, together with the quantity of that service and the contribution to the total price. AEMO reports an increase as a negative marginal change in FCAS price setter. Generator offers which contributed zero to the price have been removed for clarity.

Lower regulation 30 March

DI	Dispatch Price ($/MW)	Participant	Unit	Service	Offer price ($/MW)	Marginal change	Contribution
04:05	$11 750.37	AGL (SA)	TORRB1	Lower reg	$11 499.99	-1	-$11 499.99
		AGL (SA)	TORRB1	Energy	$319.99	-1	-$319.99
		AGL Energy	BW02	Energy	$105.96	0.25	$26.49
		AGL Energy	BW03	Energy	$105.96	0.16	$16.95
		AGL Energy	BW04	Energy	$105.96	0.25	$26.49
04:10	$11 970.70	AGL (SA)	TORRB1	Lower reg	$11 499.99	-1	-$11 499.99
		AGL (SA)	TORRB1	Energy	$319.99	-1	-$319.99
			HDWF2	Energy	-$150.72	1	-$150.72
04:15	$11 865.51	AGL (SA)	TORRB3	Lower reg	$11 499.99	-1	-$11 499.99
		AGL (SA)	TORRB3	Energy	$319.99	-1	-$319.99
		Infigen	LKBONNY2	Energy	-$45.53	1	$45.5
04:20	$11 743.69	AGL (SA)	TORRB1	Lower reg	$11 499.99	-1	-$11 499.99
		AGL (SA)	TORRB1	Energy	$319.99	-1	-$319.99
		Stanwell	TARONG#1	Energy	$98.93	0.19	$18.80
		Stanwell	TARONG#2	Energy	$98.93	0.19	$18.80
		Stanwell	TARONG#3	Energy	$98.93	0.19	$18.80
		Stanwell	TARONG#4	Energy	$98.93	0.19	$18.80
04:25	$11 864.98	AGL (SA)	TORRB1	Lower reg	$11 499.99	-1	-$11 499.99
		AGL (SA)	TORRB1	Energy	$319.99	-1	-$319.99
		Roaring 40s	WATERLWF	Energy	-$45	1	-$45
04:30	$11 864.98	AGL (SA)	TORRB1	Lower reg	$11 499.99	-1	-$11 499.99
		AGL (SA)	TORRB1	Energy	$319.99	-1	-$319.99
		Roaring 40s	WATERLWF	Energy	-$45	1	-$45
09:35	$11 478.36	Origin Energy	QPS5	Lower reg	$11 478.02	-1	-$11 478.02
		Origin Energy	QPS5	Energy	$125.03	-1	-$125.03

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

DI	Dispatch Price ($/MW)	Participant	Unit	Service	Offer price ($/MW)	Marginal change	Contribution
		Engie	PPCCGT	Energy	$124.69	1	$124.69
09:40	$11 607.95	AGL (SA)	TORRB1	Lower reg	$11 499.99	-1	-$11 499.99
		AGL (SA)	TORRB1	Energy	$212.99	-1	-$212.99
		Hydro Tasmania	POAT220	Energy	$11 9.25	0.88	$104.94
			T-V-	Energy	$0.01	0.86	$0.01
09:45	$11 478.36	Origin Energy	QPS5	Lower reg	$11 478.02	-1	-$11 478.02
		Origin Energy	QPS5	Energy	$125.03	-1	-$125.03
		Engie	PPCCGT	Energy	$124.69	1	$124.69
09:50	$11 478.36	Origin Energy	QPS5	Lower reg	$11 478.02	-1	-$11 478.02
		Origin Energy	QPS5	Energy	$125.03	-1	-$125.03
		Engie	PPCCGT	Energy	$124.69	1	$124.69
09:55	$11 478.02	Origin Energy	QPS5	Lower reg	$11 478.02	-1	-$11 478.02
10:00	$11 478.02	Origin Energy	QPS5	Lower reg	$11 478.02	-1	-$11 478.02
10:05	$11 478.02	Origin Energy	QPS5	Lower reg	$11 478.02	-1	-$11 478.02
10:10	$11 478.02	Origin Energy	QPS5	Lower reg	$11 478.02	-1	-$11 478.02
10:15	$11 478.02	Origin Energy	QPS5	Lower reg	$11 478.02	-1	-$11 478.02
10:20	$11 478.02	Origin Energy	QPS5	Lower reg	$11 478.02	-1	-$11 478.02
10:25	$11 478.02	Origin Energy	QPS5	Lower reg	$11 478.02	-1	-$11 478.02
10:30	$11 478.02	Origin Energy	QPS5	Lower reg	$11 478.02	-1	-$11 478.02
10:35	$11 478.02	Origin Energy	QPS5	Lower reg	$11 478.02	-1	-$11 478.02
10:40	$11 478.02	Origin Energy	QPS5	Lower reg	$11 478.02	-1	-$11 478.02
10:45	$11 478.02	Origin Energy	QPS5	Lower reg	$11 478.02	-1	-$11 478.02
10:50	$11 478.02	Origin Energy	QPS5	Lower reg	$11 478.02	-1	-$11 478.02
10:55	$11 478.02	Origin Energy	QPS5	Lower reg	$11 478.02	-1	-$11 478.02
11:00	$11 478.02	Origin Energy	QPS5	Lower reg	$11 478.02	-1	-$11 478.02
11:05	$11 478.02	Origin Energy	QPS5	Lower reg	$11 478.02	-1	-$11 478.02
11:10	$11 478.02	Origin Energy	QPS5	Lower reg	$11 478.02	-1	-$11 478.02
11:15	$11 478.02	Origin Energy	QPS5	Lower reg	$11 478.02	-1	-$11 478.02
11:20	$11 503.39	AGL (SA)	TORRB1	Lower reg	$11 499.99	-1	-$11 499.99
		Snowy Hydro	UPPTUMUT	Energy	$132	-0.94	-$124.08
		Hydro Tasmania	POAT220	Energy	$119.25	1.04	$124.02
		AGL Energy	LD03	Raise 6 sec	$6.80	-0.63	-$4.28
		AGL (SA)	TORRB1	Raise 6 sec	$2.60	0.63	$1.64
		Hydro Tasmania	GORDON	Raise 60 sec	$2.39	-1.03	-$2.46
		Hydro Tasmania	GORDON	Raise 5 min	$2.10	-1.03	-$2.16
		CS Energy	W/HOE#2	Raise 5 min	$2.09	1.03	$2.15
		AGL (SA)	TORRB1	Raise 60 sec	$1.48	1.03	$1.52
		Engie	LOYYB2	Lower 5 min	$0.19	-1.03	-$0.20

DI	Dispatch Price ($/MW)	Participant	Unit	Service	Offer price ($/MW)	Marginal change	Contribution
		Hydro Tasmania	TRIBUTE	Lower 5 min	$0.17	1.03	$0.18
		Engie	LOYYB2	Lower 6 sec	$0.02	-1.03	-$0.02
		Engie	LOYYB2	Lower 60 sec	$0.02	-1.03	-$0.02
			T-V-	Energy	$0.01	1.03	$0.01
11:25	$11 478.02	Origin Energy	QPS5	Lower reg	$11 478.02	-1	-$11 478.02
11:30	$11 478.02	Origin Energy	QPS5	Lower reg	$11 478.02	-1	-$11 478.02
11:35	$11 478.02	Origin Energy	QPS5	Lower reg	$11 478.02	-1	-$11 478.02
11:40	$11 478.02	Origin Energy	QPS5	Lower reg	$11 478.02	-1	-$11 478.02
11:45	$11 478.02	Origin Energy	QPS5	Lower reg	$11 478.02	-1	-$11 478.02
11:50	$11 478.02	Origin Energy	QPS5	Lower reg	$11 478.02	-1	-$11 478.02
11:55	$11 478.02	Origin Energy	QPS5	Lower reg	$11 478.02	-1	-$11 478.02
12:00	$11 478.02	Origin Energy	QPS5	Lower reg	$11 478.02	-1	-$11 478.02
12:05	$11 478.02	Origin Energy	QPS5	Lower reg	$11 478.02	-1	-$11 478.02
12:10	$11 478.02	Origin Energy	QPS5	Lower reg	$11 478.02	-1	-$11 478.02
12:15	$11 478.02	Origin Energy	QPS5	Lower reg	$11 478.02	-1	-$11 478.02
12:20	$11 478.02	Origin Energy	QPS5	Lower reg	$11 478.02	-1	-$11 478.02
12:25	$11 478.02	Origin Energy	QPS5	Lower reg	$11 478.02	-1	-$11 478.02
12:30	$11 478.02	Origin Energy	QPS5	Lower reg	$11 478.02	-1	-$11 478.02
12:35	$11 478.02	Origin Energy	QPS5	Lower reg	$11 478.02	-1	-$11 478.02
12:40	$11 478.02	Origin Energy	QPS5	Lower reg	$11 478.02	-1	-$11 478.02
12:45	$11 478.02	Origin Energy	QPS5	Lower reg	$11 478.02	-1	-$11 478.02
12:50	$11 478.02	Origin Energy	QPS5	Lower reg	$11 478.02	-1	-$11 478.02
12:55	$11 478.02	Origin Energy	QPS5	Lower reg	$11 478.02	-1	-$11 478.02
13:00	$11 478.02	Origin Energy	QPS5	Lower reg	$11 478.02	-1	-$11 478.02
13:05	$11 478.02	Origin Energy	QPS5	Lower reg	$11 478.02	-1	-$11 478.02
13:10	$11 478.02	Origin Energy	QPS5	Lower reg	$11 478.02	-1	-$11 478.02
13:15	$11 478.02	Origin Energy	QPS5	Lower reg	$11 478.02	-1	-$11 478.02
13:20	$11 478.02	Origin Energy	QPS5	Lower reg	$11 478.02	-1	-$11 478.02
13:25	$11 478.02	Origin Energy	QPS5	Lower reg	$11 478.02	-1	-$11 478.02
13:30	$11 478.02	Origin Energy	QPS5	Lower reg	$11 478.02	-1	-$11 478.02

Raise regulation 30 March

DI	Dispatch Price ($/MW)	Participant	Unit	Service	Offer price ($/MW)	Marginal change	Contribution
04:05	$11 499.99	AGL (SA)	TORRB3	Raise reg	$11 499.99	-1	-$11 499.99
04:10	$11 499.99	AGL (SA)	TORRB1	Raise reg	$11 499.99	-1	-$11 499.99
04:15	$11 499.99	AGL (SA)	TORRB1	Raise reg	$11 499.99	-1	-$11 499.99

DI	Dispatch Price ($/MW)	Participant	Unit	Service	Offer price ($/MW)	Marginal change	Contribution
04:20	$11 499.99	AGL (SA)	TORRB1	Raise reg	$11 499.99	-1	-$11 499.99
04:25	$11 499.99	AGL (SA)	TORRB3	Raise reg	$11 499.99	-1	-$11 499.99
04:30	$11 499.99	AGL (SA)	TORRB3	Raise reg	$11 499.99	-1	-$11 499.99
09:05	$11 482	Origin Energy	QPS5	Raise reg	$11 482	-1	-$11 482
09:10	$11 482	Origin Energy	QPS5	Raise reg	$11 482	-1	-$11 482
09:15	$11 482	Origin Energy	QPS5	Raise reg	$11 482	-1	-$11 482
09:20	$11 482	Origin Energy	QPS5	Raise reg	$11 482	-1	-$11 482
09:25	$11 482	Origin Energy	QPS5	Raise reg	$11 482	-1	-$11 482
09:30	$11 482	Origin Energy	QPS5	Raise reg	$11 482	-1	-$11 482
09:35	$11 482	Origin Energy	QPS5	Raise reg	$11 482	-1	-$11 482
09:40	$11 499.99	AGL (SA)	TORRB1	Raise reg	$11 499.99	-1	-$11 499.99
09:45	$11 482	Origin Energy	QPS5	Raise reg	$11 482	-1	-$11 482
09:50	$11 482	Origin Energy	QPS5	Raise reg	$11 482	-1	-$11 482
09:55	$11 482	Origin Energy	QPS5	Raise reg	$11 482	-1	-$11 482
10:00	$11 482	Origin Energy	QPS5	Raise reg	$11 482	-1	-$11 482
10:05	$11 482	Origin Energy	QPS5	Raise reg	$11 482	-1	-$11 482
10:10	$11 482	Origin Energy	QPS5	Raise reg	$11 482	-1	-$11 482
10:15	$11 482	Origin Energy	QPS5	Raise reg	$11 482	-1	-$11 482
10:20	$11 482	Origin Energy	QPS5	Raise reg	$11 482	-1	-$11 482
10:25	$11 482	Origin Energy	QPS5	Raise reg	$11 482	-1	-$11 482
10:30	$11 482	Origin Energy	QPS5	Raise reg	$11 482	-1	-$11 482
10:35	$11 482	Origin Energy	QPS5	Raise reg	$11 482	-1	-$11 482
10:40	$11 482	Origin Energy	QPS5	Raise reg	$11 482	-1	-$11 482
10:45	$11 482	Origin Energy	QPS5	Raise reg	$11 482	-1	-$11 482
10:50	$11 482	Origin Energy	QPS5	Raise reg	$11 482	-1	-$11 482
10:55	$11 482	Origin Energy	QPS5	Raise reg	$11 482	-1	-$11 482
11:00	$11 482	Origin Energy	QPS5	Raise reg	$11 482	-1	-$11 482
11:05	$11 482	Origin Energy	QPS5	Raise reg	$11 482	-1	-$11 482
11:10	$11 482	Origin Energy	QPS5	Raise reg	$11 482	-1	-$11 482
11:15	$11 482	Origin Energy	QPS5	Raise reg	$11 482	-1	-$11 482
11:20	$11 499.99	AGL (SA)	TORRB1	Raise reg	$11 499.99	-1	-$11 499.99
11:25	$11 482	Origin Energy	QPS5	Raise reg	$11 482	-1	-$11 482
11:30	$11 482	Origin Energy	QPS5	Raise reg	$11 482	-1	-$11 482
11:35	$11 482	Origin Energy	QPS5	Raise reg	$11 482	-1	-$11 482
11:40	$11 482	Origin Energy	QPS5	Raise reg	$11 482	-1	-$11 482
11:45	$11 482	Origin Energy	QPS5	Raise reg	$11 482	-1	-$11 482
11:50	$11 482	Origin Energy	QPS5	Raise reg	$11 482	-1	-$11 482
11:55	$11 482	Origin Energy	QPS5	Raise reg	$11 482	-1	-$11 482

DI	Dispatch Price ($/MW)	Participant	Unit	Service	Offer price ($/MW)	Marginal change	Contribution
12:00	$11 482	Origin Energy	QPS5	Raise reg	$11 482	-1	-$11 482
12:05	$11 482	Origin Energy	QPS5	Raise reg	$11 482	-1	-$11 482
12:10	$11 482	Origin Energy	QPS5	Raise reg	$11 482	-1	-$11 482
12:15	$11 482	Origin Energy	QPS5	Raise reg	$11 482	-1	-$11 482
12:20	$11 482	Origin Energy	QPS5	Raise reg	$11 482	-1	-$11 482
12:25	$11 482	Origin Energy	QPS5	Raise reg	$11 482	-1	-$11 482
12:30	$11 482	Origin Energy	QPS5	Raise reg	$11 482	-1	-$11 482
12:35	$11 482	Origin Energy	QPS5	Raise reg	$11 482	-1	-$11 482
12:40	$11 482	Origin Energy	QPS5	Raise reg	$11 482	-1	-$11 482
12:45	$11 482	Origin Energy	QPS5	Raise reg	$11 482	-1	-$11 482
12:50	$11 482	Origin Energy	QPS5	Raise reg	$11 482	-1	-$11 482
12:55	$11 482	Origin Energy	QPS5	Raise reg	$11 482	-1	-$11 482
13:00	$11 482	Origin Energy	QPS5	Raise reg	$11 482	-1	-$11 482
13:05	$11 482	Origin Energy	QPS5	Raise reg	$11 482	-1	-$11 482
13:10	$11 482	Origin Energy	QPS5	Raise reg	$11 482	-1	-$11 482
13:15	$11 482	Origin Energy	QPS5	Raise reg	$11 482	-1	-$11 482
13:20	$11 482	Origin Energy	QPS5	Raise reg	$11 482	-1	-$11 482
13:25	$11 482	Origin Energy	QPS5	Raise reg	$11 482	-1	-$11 482
13:30	$11 482	Origin Energy	QPS5	Raise reg	$11 482	-1	-$11 482