Real-Time Market Insights Forum

17 October 2023

Hosted by the WA Real-Time Market Monitoring Team

Please send questions, feedback and ideas to:
wa.rtm@aemo.com.au

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- The price or other terms at which Participants will supply
- Bids or tenders, including the nature of a bid that a Participant intends to make or whether the Participant will participate in the bid
- Which suppliers Participants will acquire from (or the price or other terms on which they acquire goods or services)
- Refusing to supply a person or company access to any products, services or inputs they require.

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Agenda

#	Time	Item	Speaker
1	13:05 – 13:20	In-Service vs Available Forecast	Douglas Birse
2	13:20 – 13:45	Cost Contribution Between Markets	Erika Canuti
3	13:45 – 13:55	Trapezia Change Outcomes	Adrian Pearce
4	13:55 – 14:10	Contingency Raise Shortfall Analysis	Damian Mugridge
5	14:10 – 14:20	Affected Dispatch Interval Review	Rachel Tandy
6	14:20 – 14:30	Questions, Feedback, Ideas	Rick Dolling

Content will be published on the AEMO website:
https://www.aemo.com.au/consultations/industry-forums-and-working-groups/list-of-industry-forums-and-working-groups/real-time-market-insights-forum

In-Service vs Available Forecast

Presenter	Douglas Birse
Purpose	Explain the different forecasts available to market participants
Driver	Inaccurate Available/In-Service bidding in the Pre-Dispatch Horizon
Outcome	Market Participants review In Service Capacity Only Forecast and modify bidding behaviour in Pre-Dispatch horizon

Forecast Types

Forecast Type	Dispatch	Pre-Dispatch	Description	Use Case	
Reference	✓	✓	Reference FOD Includes Available Quantities with Notice Time	Used for issuing Dispatch Instructions in the Primary Dispatch Interval Used for the calculation of NISC	Provides signal to commit facilities with available quantities that should be reviewed to become in-service
ForecastLow	✓	✓	Low FOD Includes Available Quantities with Notice Time	Low FOD signal	
ForecastHigh	✓	✓	High FOD Includes Available Quantities with Notice Time	High FOD signal	
inServiceCapacity Only	**X** Planned addition	✓	Reference forecast Only uses In Service Quantities	Current accurate forecast for state of prices and shortfalls AEMO review this to assess shortfalls current state of the market	Market Participants should review this to ensure Pre-Dispatch In-Service quantities are appropriate

FOD – Forecast Operational Demand
NISC – Not In Service Capacity

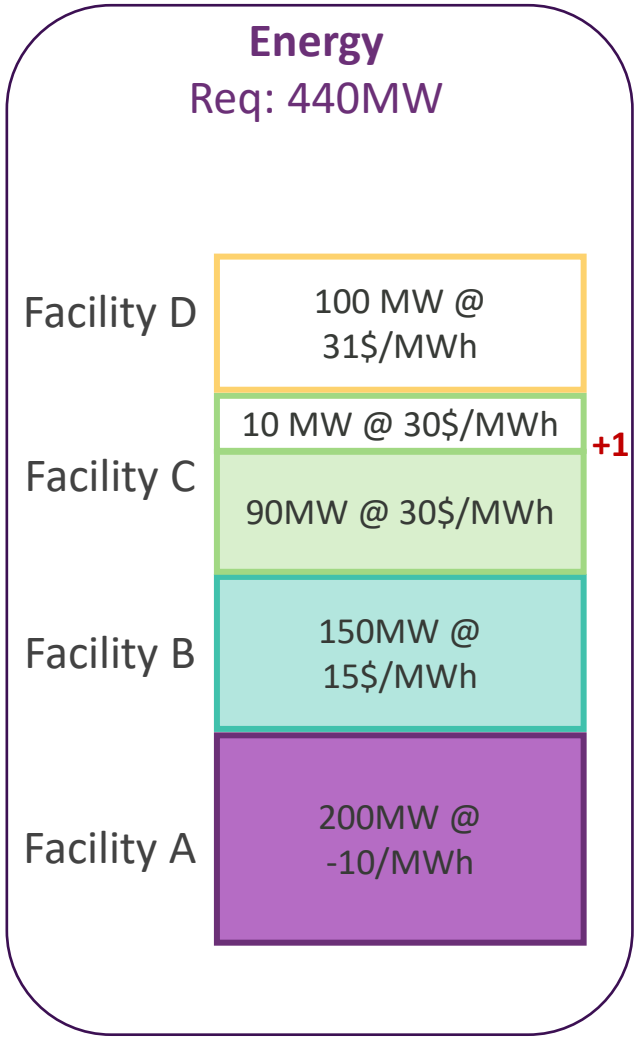
Cost Contribution Between Markets

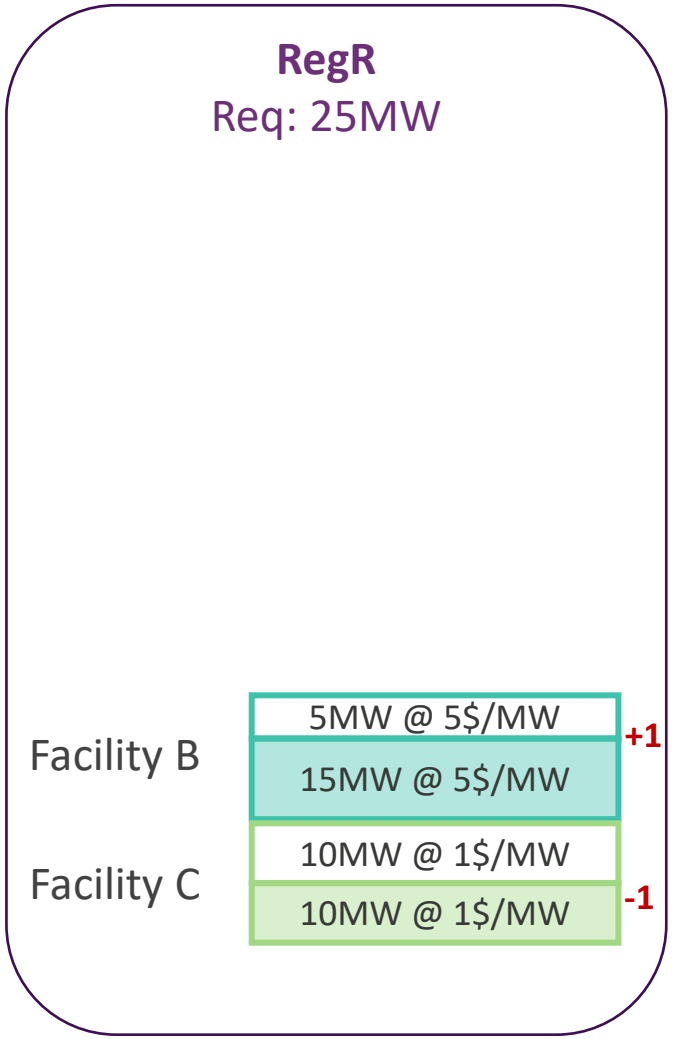
Presenter	Erika Canuti
Purpose	Explain inter-correlation of markets when determining Market Clearing Prices.
Driver	Price setting for Real Time Markets is different than Balancing and may be hard to understand.
Outcome	Understand price setting dynamics when there are contributions from other markets.

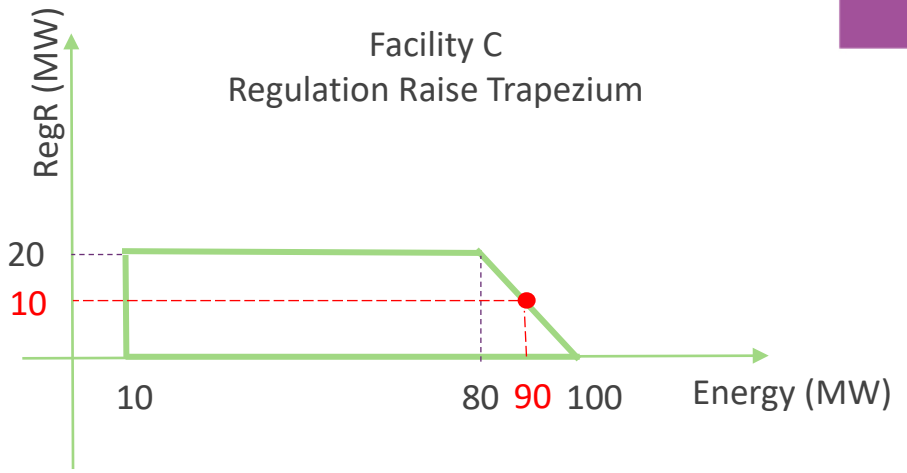
Introduction

- With WEMDE's co-optimisation, price determination for a market can have contributions and impact the price of another market (Energy or ESS Markets)
- We generally see this correlation from other markets when the marginal facility has a joint ESS capacity constraint binding or is the largest contingency.
- This may result in a Clearing Price for that market which is higher or lower than the marginal tranche price.
- The following slides contain a few simplified examples to explain this mechanism and a few real examples.

Simplified example 1



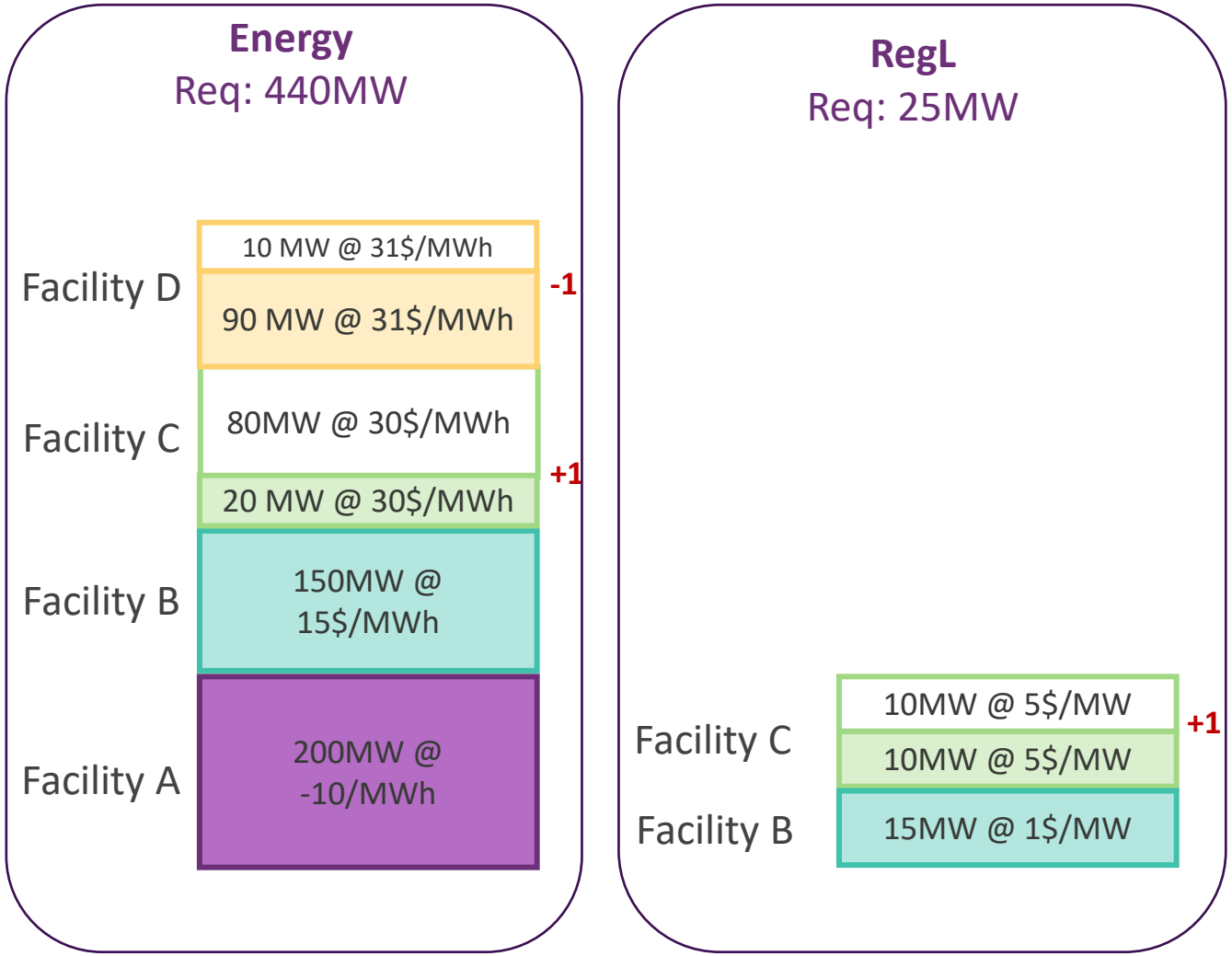


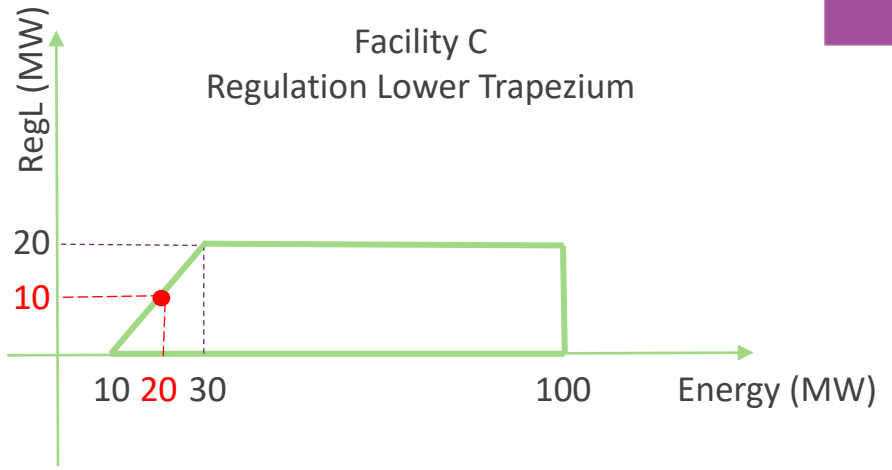


Energy Price Setting

Contribution	By How Much	Objective Coeff	
Facility C Energy T1	+1	30	+30
Facility C RegR T1	-1	1	-1
Facility B RegR T1	+1	5	+5
Energy Price			**34**

Simplified example 2

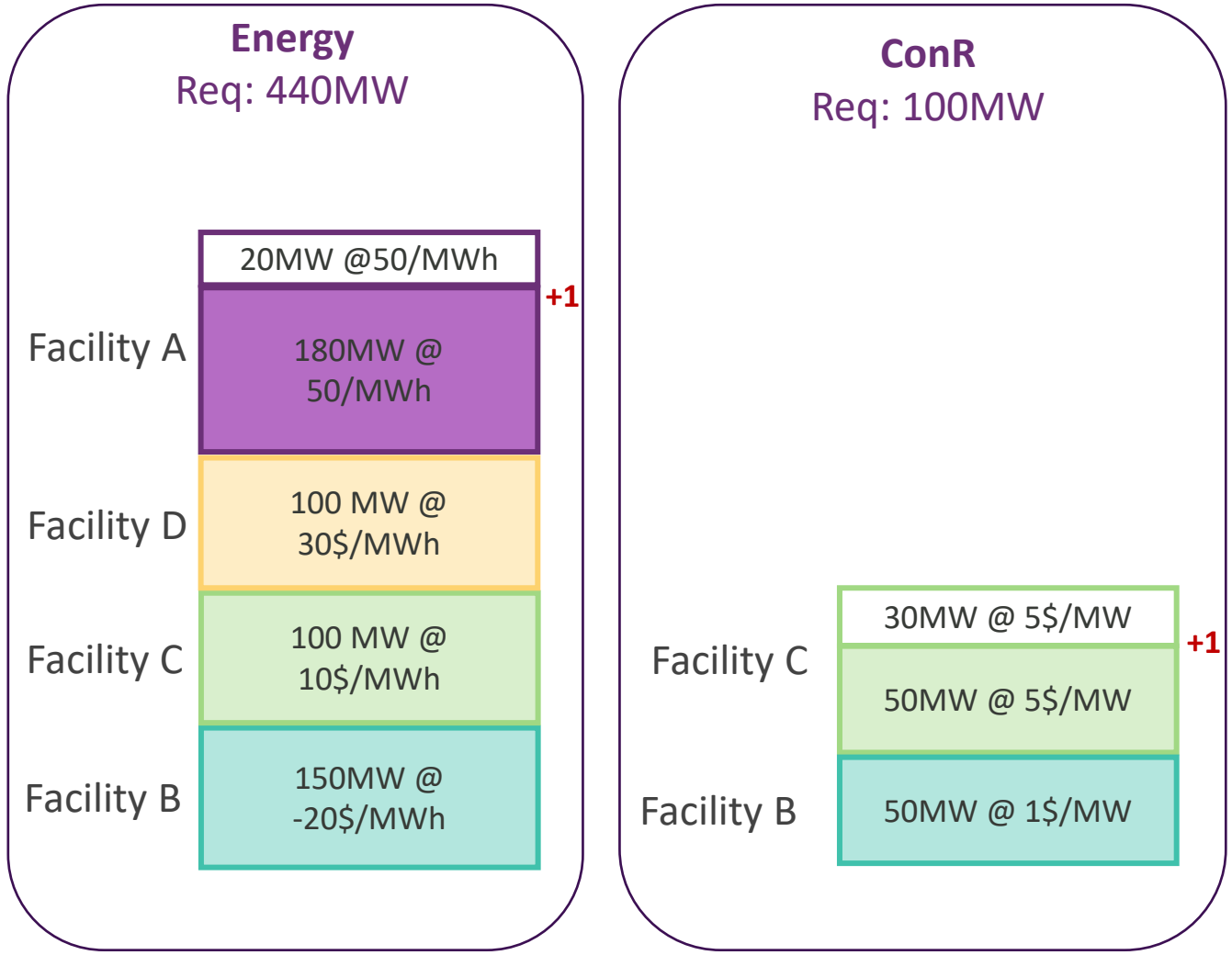




Regulation Lower Price Setting

Contribution	By How Much	Objective Coeff	
Facility C RegL T1	+1	5	+5
Facility C Energy T1	+1	30	+30
Facility D Energy T1	-1	31	-31
RegL Price			**4**

Simplified example 3



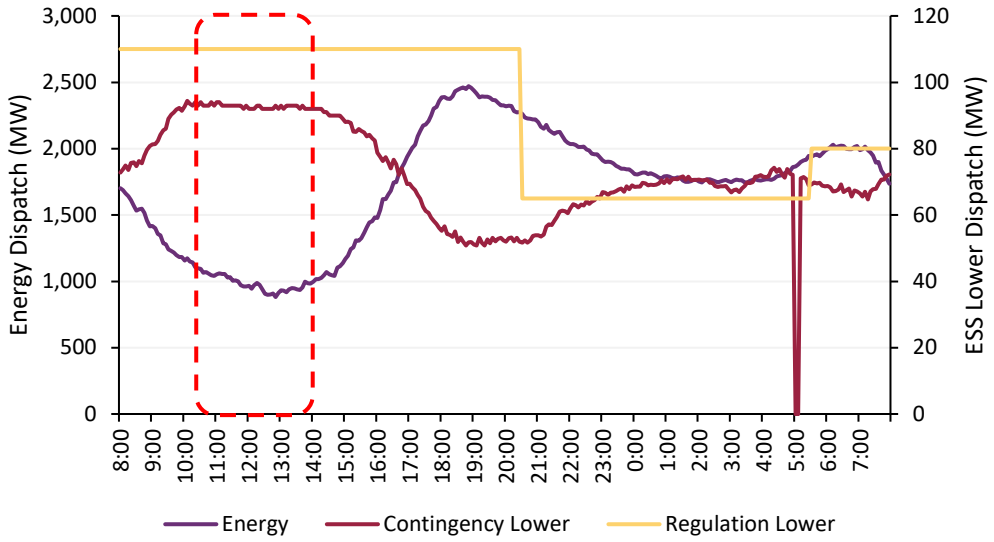
- Assumptions:
  - Facility A is the largest contingency
  - No binding ESS constraints
  - Contingency Raise Performance Factors all 1

Energy Price Setting

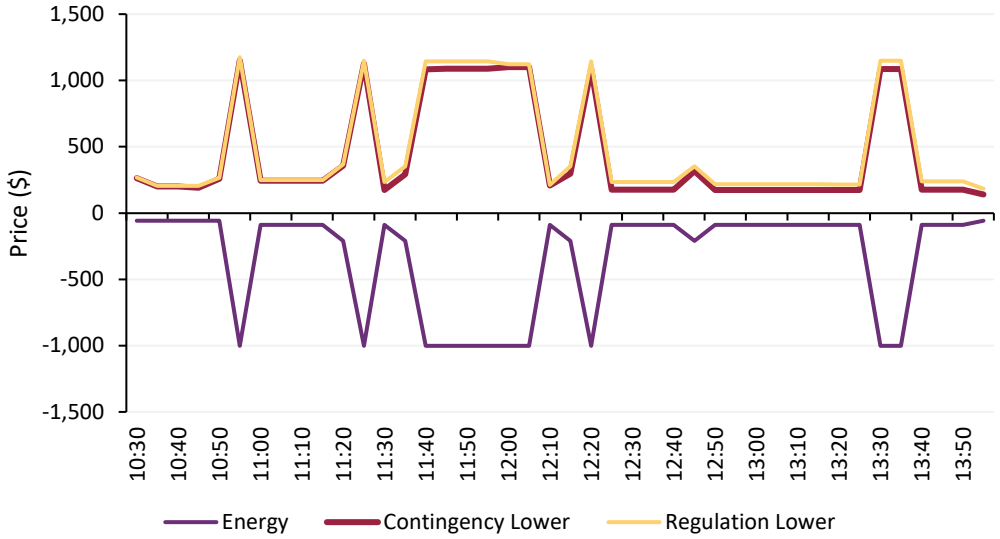
Contribution	By How Much	Objective Coeff	
Facility A Energy T1	+1	50	+50
Facility C ConR T1	+1	5	+5
Energy Price			**55**

Energy / ESS Lower price inversion

Market Service Requirements for TD 10/10/2023



Energy and ESS Lower Market prices 10:30 – 14:00, TD 10/10/2023



- Energy prices are hitting the floor due to low operational demand during the trough.
- Inversely, ESS Lower prices are high due to the negative correlation driven by ESS trapezia.
- An example of this behaviour is explained in the following slides

2023-10-10 11:50 – Regulation Lower Price

```
,,
"prices": {
    "energy": -1000.0,
    "contingencyLower": 1086.82,
    "regulationRaise": 21.98,
    "regulationLower": 1142.4,
    "rocof": 0.0,
    "contingencyRaise": 48.84
},
```

```
"marketService": "regulationLower",
"isMarketServiceCapped": false,
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    },
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    },
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    },
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    },
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        "objectiveCoefficient": 0.0
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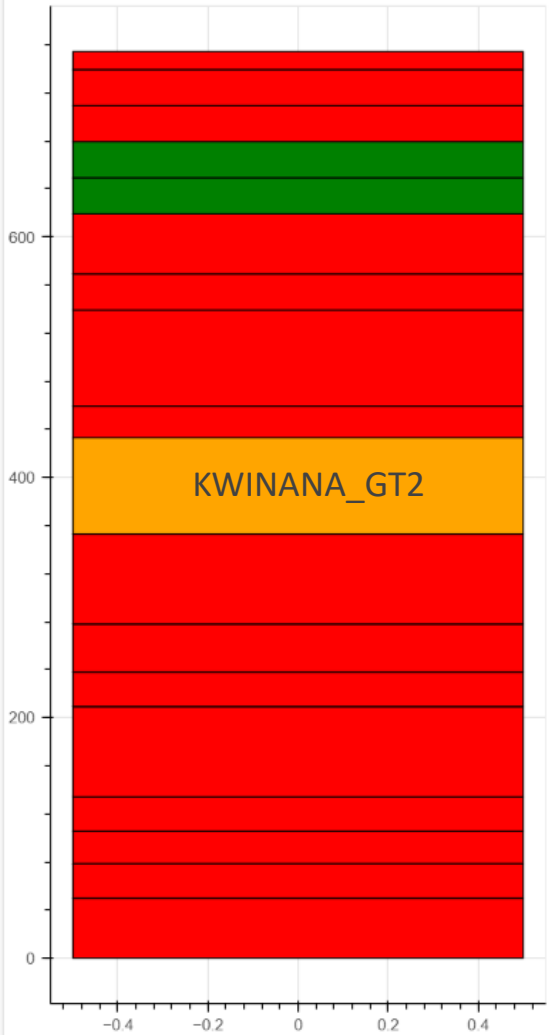
5 3 5 1 4 2 3

2023-10-10 11:50 – Regulation Lower Price

1

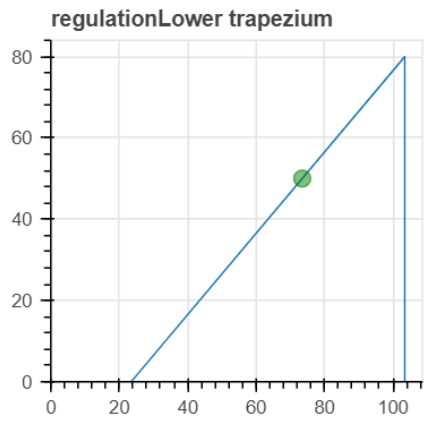
Regulation Lower Offer Stack

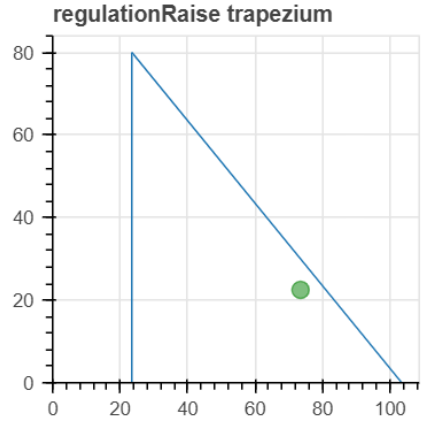


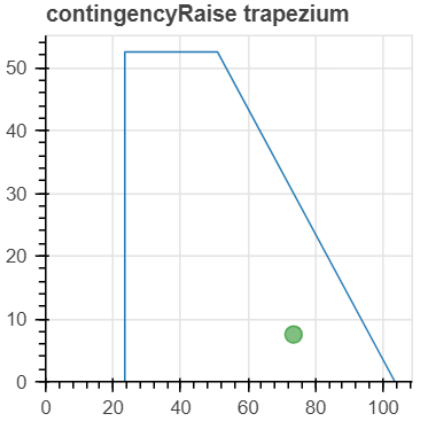
- KWINANA_GT2 is the only Regulation Lower tranche with spare capacity for this market.


```
{
    "contributingVariable": "KWINANA_GT2_regulationLower_Tranche_01",
    "byHowMuch": 1.0,
    "objectiveCoefficient": 0.0
```


- The facility has ESS constraints binding, hence a marginal increase from this tranche has to come as a trade-off with other markets.





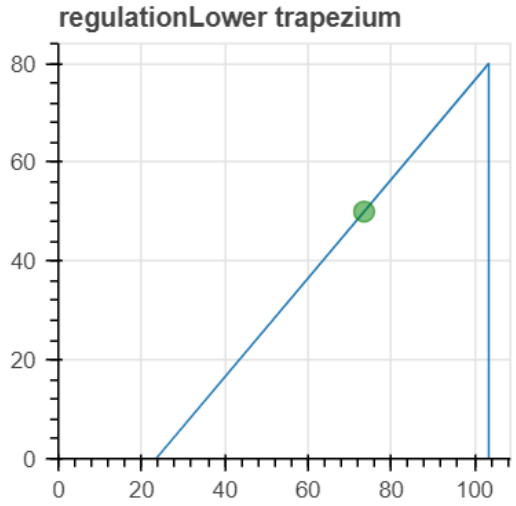


id	leftHandSideValue	rightHandSideValue	operator	*bindingConstraintFla*
ESSEnergyRegulationConstraint2_KWINANA_GT2_regulationLower	23.5	23.5	GreaterThanOrEqua	true
ESSJointCapacityConstraint1_KWINANA_GT2_contingencyRaise	103.5	103.5	LessThanOrEqualTo	true

2023-10-10 11:50 – Regulation Lower Price

2

- KWINANA_GT2 has an ESS Energy and Regulation constraint 2 binding.
- Because of the inclination of the lower slope of its Regulation Lower trapezium, for each MW increase in Regulation Lower there needs to be 1MW increase in Energy.

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{
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```


3

- To make the Energy market even, the 1MW increase needs to be taken out from the marginal tranche.
- There are 2 marginal tranches in Energy in this case due to tie-breaking and their *By How Much* value depends on the tie-breaking proportion


```
{
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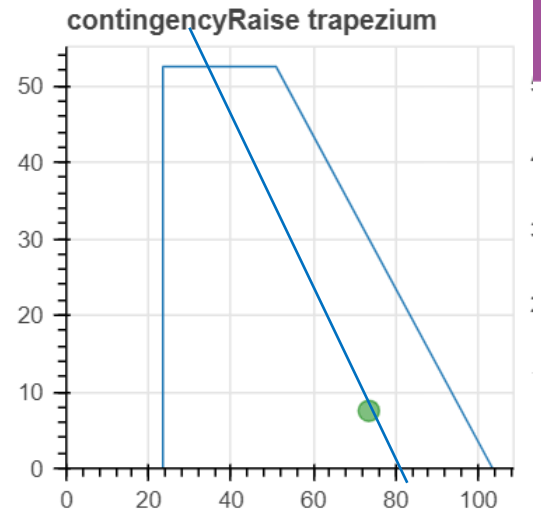
    "contributingVariable": "PINJAR_GT11_energy_Tranche_01",
    "byHowMuch": -0.8,
    "objectiveCoefficient": -1000.0
```

2023-10-10 11:50 – Regulation Lower Price

4

- KWINANA_GT2 has also an ESS Joint Capacity constraint 1 binding on Contingency Raise.
- The marginal increase in its energy tranche (step 2) requires a marginal decrease in its Regulation Raise or Contingency Raise tranches to avoid violation of this constraint. The first option is the cheapest in this case.




```
{
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    "byHowMuch": -1.0,
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}
```


5

- To make the Regulation Raise market even following the marginal decrease from step 4, a marginal increase is needed from the marginal tranche.
- There are 2 marginal tranches in Regulation Raise in this case due to tie-breaking and their *By How Much* value depends on the tie-breaking proportion


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    "byHowMuch": 0.5,
    "objectiveCoefficient": 21.98
```

2023-10-10 11:50 – Regulation Lower Price

- The 2 contributions from Energy market with a negative *byHowMuch* and floor price (-1000) caused the high Clearing Price for Regulation Raise

Contribution	By How Much	Objective Coeff	
KWINANA_GT2 Regulation Lower T1	+1	0	0
KWINANA_GT2 Energy T1	+1	120.42	+120.42
TIWEST_COG1 Energy T1	-0.2	-1000	+200
PINJAR_GT11 Energy T1	-0.8	-1000	+800
KWINANA_GT2 Regulation Raise T1	-1	0	0
ALINTA_PNJ_U1 Regulation Raise T2	+0.5	21.98	+10.99
ALINTA_PNJ_U2 Regulation Raise T2	+0.5	21.98	+10.99
Reg Lower Price			**1142.4**

Trapezia Change Outcomes

Presenter	Chris Wilson
Purpose	Information on rebidding ESS Trapezia
Driver	Observed behaviour
Outcome	Participants are aware of how to change ESS Trapezia without accidently leaving the trapezia.

Background

- AEMO has observed several instances where a Facility is inadvertently causing shortfalls or re-dispatch in primary and forecast intervals due to rebidding in such a way to eject themselves from their ESS Trapezia.
- This occurs when a Facility changes their Enablement Minima / Enablement Maxima by more than their maximum ramp rate in the relevant Dispatch Interval.
- This means that in the forecast schedule, the Initial MW value is outside the new ESS Trapezium, and so ESS Pre-Processing fails for that forecast Dispatch Interval.

Events of 11 October

Dispatch Schedule as at 22:10

Facility	Initial MW	22:20	22:25	22:30	22:35	22:40
FACILITY_A	91	91	91	121	151	170

Selected Case File items for 22:30 as at 22:10

Submission Data (RoCOF)	RoCoF
Schedule	2015.56 (MWs)
Enablement Minimum Value Used	81
Low Breakpoint Value Used	81
High Breakpoint Value Used	101
Enablement Maximum Value Used	101
Downwards Ramp Rate Value Used	6
Upwards Ramp Rate Value Used	6

Events of 11 October

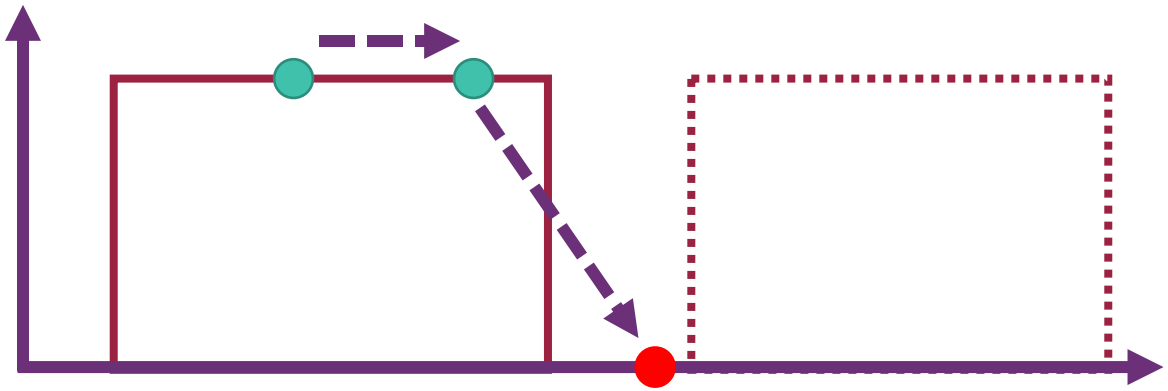
Dispatch Schedule as at 22:15

Facility	Initial MW	22:20	22:25	22:30	22:35	22:40
FACILITY_A	90	91	91	121	151	170

Selected Case File items for 22:30 as at 22:15

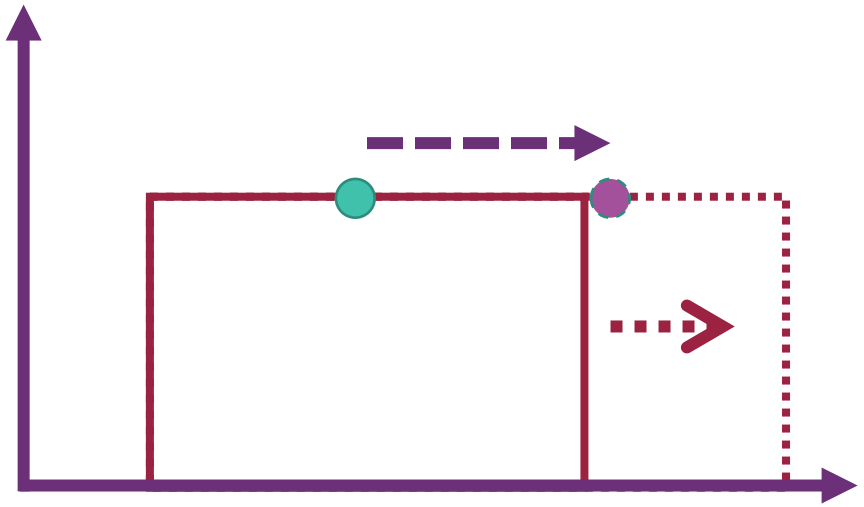
Submission Data (RoCOF)	RoCoF
Schedule	0 (MWs)
Enablement Minimum Value Used	111
Low Breakpoint Value Used	111
High Breakpoint Value Used	131
Enablement Maximum Value Used	131
Downwards Ramp Rate Value Used	6
Upwards Ramp Rate Value Used	6

- In the forward schedule, the energy schedule determined in the previous Dispatch Interval is used as the Initial MW value for the next Dispatch Interval
- 91 < 111, and so Facility fails ESS Pre-Processing check for RoCoF.

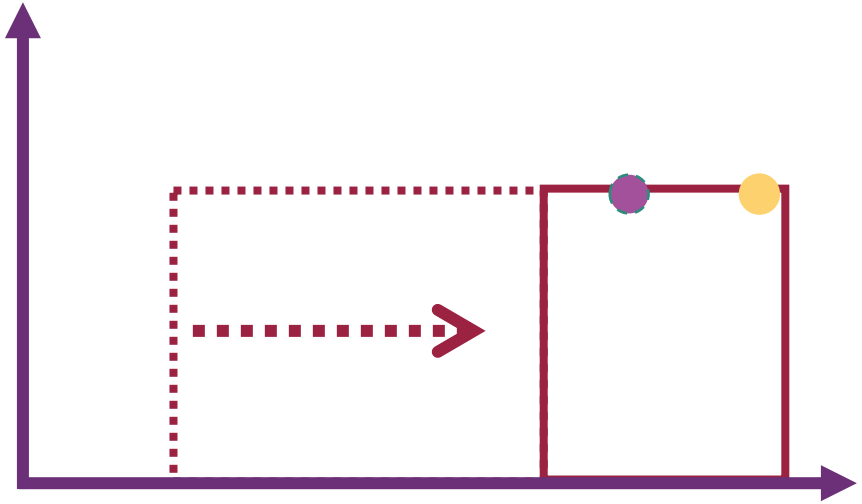


How to resolve?

- The ESS Trapezium needs to ‘shuffle’ with the energy schedule quantity to ensure it remains within the relevant area while changing operating modes.
- This could be achieved by changing the Enablement Maximum first, and then the Enablement Minimum in following intervals.
- Multiple possibilities, as long as the Initial MW stays within the trapezium.



Interval 1



Interval 2

Contingency Raise Shortfall Analysis

Unexpected Dispatch Outcome

Presenter	Damian Mugridge
Purpose	To provide Market Participants with a recent example of a dispatch outcome that differed to the desired or expected outcome and to explain why WEMDE dispatched in this way.
Driver	Question raised to AEMO regarding a recent dispatch outcome
Outcome	Provide participants an example on how to work through dispatch outcomes from available data.

Unexpected Dispatch Outcome

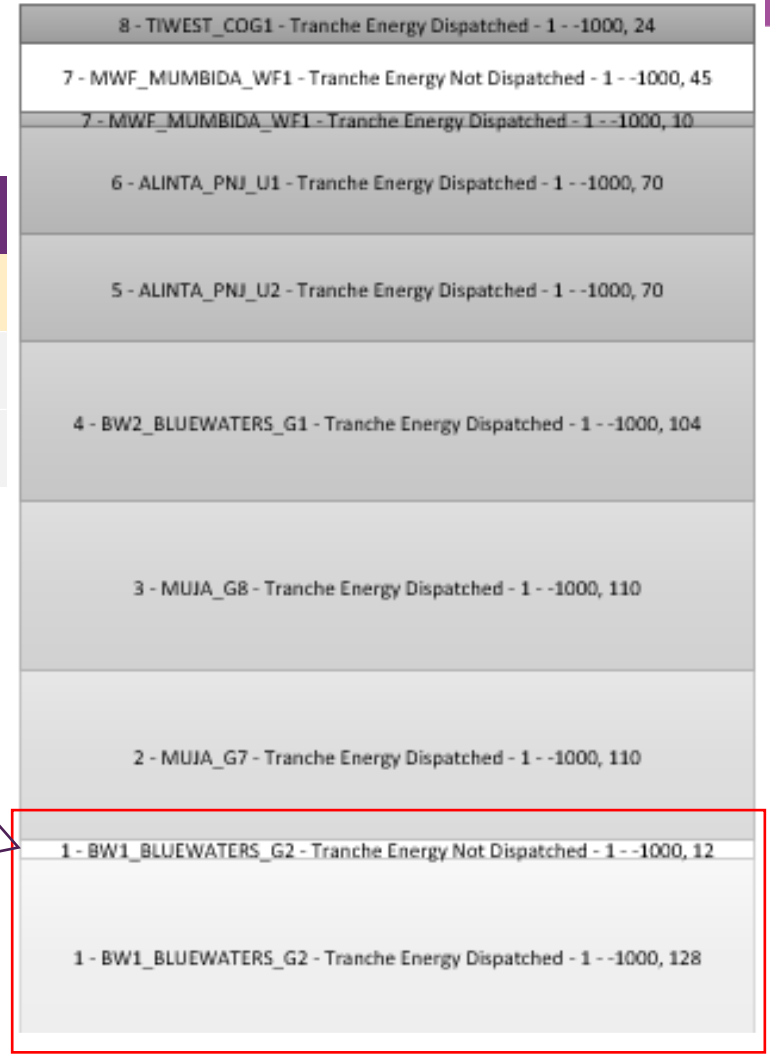
Offered at the price floor of -$1,000MW and more expensive facilities dispatched in full, why was BW1_BLUEWATERS_G2 not fully dispatched to 140MW?

Service submissions

Service	facilityCode	tranche	fuelType	quantity	submittedPrice	capacityType
Energy	BW1_BLUEWATERS_G2	1	NON-LIQUID	140 MW	-$1,000	IN-SERVICE
Energy	BW1_BLUEWATERS_G2	2	NON-LIQUID	77 MW	$738	IN-SERVICE
Rocof	BW1_BLUEWATERS_G2	1	NON-LIQUID	1077 MWs	$0	IN-SERVICE

Situation

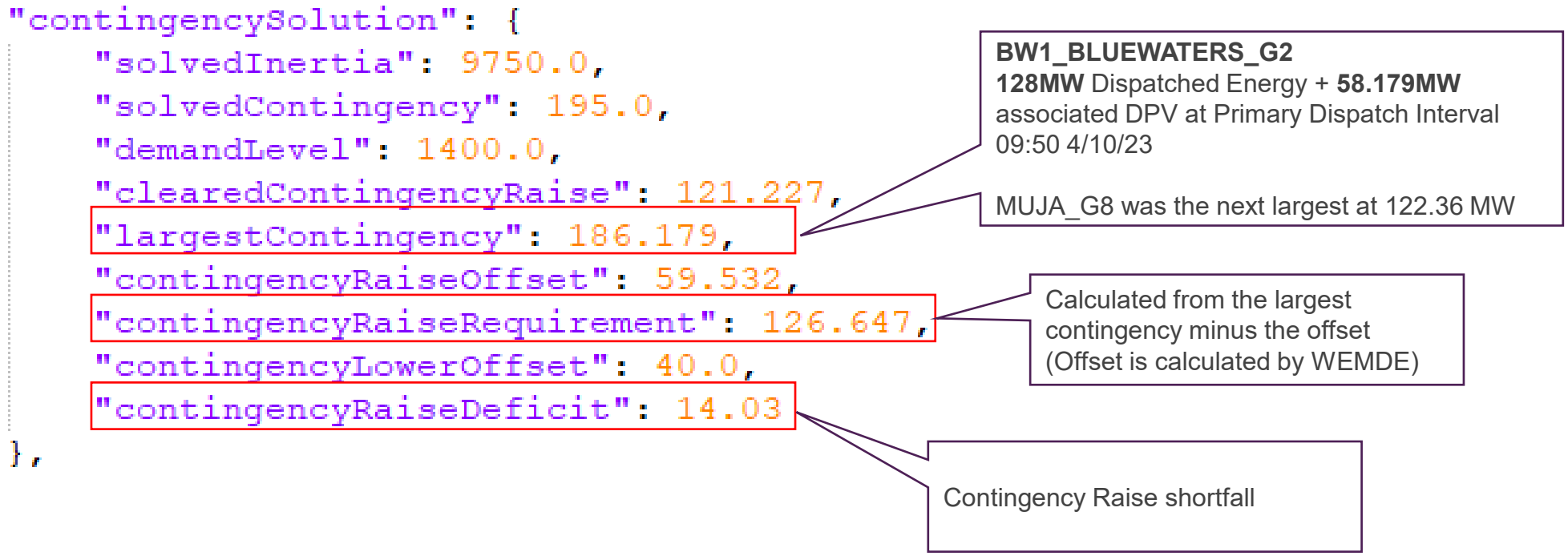
- Facility BW1_BLUEWATERS_G2 was offered into the energy market for 140MW Tranche 1 at -$1,000MW.
- The facility was generating 138MW at the start of the interval
- The next dispatch instruction dispatched the facility to 128MW.
- With a 2MW/min ramp rate this is the minimum dispatchable value.



Tranche 1
12 MW has not been dispatched

Unexpected Dispatch Outcome

Contingency Solution – Solution file



Unexpected Dispatch Outcomes

Contingency Raise – Offers and Dispatch

FacilityCode	Bid Quantity	Dispatch Quantity (Performance Adjusted)	Note
SIMCOA_IPT_LD_01	63.00	63.00	Fully Dispatch
PINJAR_GT9	45.60	43.82	Fully Dispatch with a Performance Factor of 0.96
KWINANA_GT2	52.50	5.80	Providing maximum potential Contingency Raise of 12.63 MW *Binding Joint Capacity Constraint and* a Performance Factor of 0.46
KWINANA_GT3	52.50	0	Saturated with Energy/Regulation *Binding Joint Capacity Constraint*
ALINTA_WGP_GT	55.00	0	Not running due to offer price in energy market
ALINTA_WGP_U2	60.00	0	Not running (Energy tranche is AVAILABLE, **not 'IN-SERVICE'**) If Energy is AVAILABLE, ESS tranches **MUST** be also set to AVAILABLE
Total	**328.60 MW**	**112.62 MW**	

In this example - The **only outcome** was to reduce the largest contingency – The largest contingency was BW1_BLUEWATERS_G2 and although the offer price was -$1,000 WEMDE took this action for system security

Market Signal is either:

- More Contingency Raise should be bid in
- Largest Contingency must be reduced

Affected Dispatch Interval Review

Presenter	Rachel Tandy
Purpose	Provide participants with further details of the Affected Dispatch Interval process and current status.
Driver	Questions raised related to the progress of AEMO's review.
Outcome	Provide clarity and seek feedback on the current process and status.

Operational Process Overview

AEMO will determine and publish replacement information for Affected Dispatch Intervals using the last available Market Schedule.	•AEMO will also Republish the Reference Trading Price, as well as the Trading Day Report. •Once complete, AEMO will issue a Market Advisory, e.g. #210093 for 1-4 October. •AEMO will publish a report detailing the reasons for determining a Dispatch Interval to be an Affected Dispatch Interval as soon as reasonably practicable. In the long term we intend to do this for each Trading Week.
AEMO are still maturing its operational processes around identification and determination of Affected Dispatch Intervals.	•In the long term we intend to meet the timeline defined in 7.11C.2, i.e. determination by noon on the business day following the end of the Trading Day. •As the new market is still stabilising AEMO reserve the option to review Dispatch Intervals and determine they are Affected Dispatch Intervals if required. •At this point, the intention is that for Trading Days already reviewed and replaced no further changes will be made. If further review will be undertaken AEMO will advise Market Participants as soon as possible.
AEMO will actively provide information to Market Participants as it becomes available.	•The intention is to publish CSV files of the Affected Dispatch Intervals in the interim to the AEMO website - https://www.aemo.com.au/energy-systems/electricity/wholesale-electricity-market-wem/data-wem/affected-dispatch-interval-report

Any feedback on this processes or in general can be sent to wa.rtm@aemo.com.au.

Investigations: 1 – 8 October

Trading Day	Number of intervals investigated	Number of intervals deemed Affected	Main drivers of Affected intervals	Status
1 October 2023	29	16	• Contingency Raise shortfalls were driven by facility trapezium drift. • For 4 intervals, RoCoF shortfalls were driven by erroneous RoCoF requirements	Published
2 October 2023	29	24	• Contingency Raise shortfalls were driven by facility trapezium drift.	Published
3 October 2023	0	NA	• No market shortfalls were observed	Published
4 October 2023	8	3	• Trapezium drift resulted in RoCoF shortfalls in 3 intervals	Published
5 October 2023	29	25	• Contingency Raise shortfalls were driven by incorrect ramp rate limits.	**Publication pending**
6 October 2023	47	6 (36 still under investigation)	• Contingency Raise shortfalls were driven by facility trapezium drift. • 36 intervals are still under investigation.	**Investigation in progress**
7 October 2023	25	3	• Contingency Raise shortfalls were driven by facility trapezium drift.	**Publication pending**
8 October 2023	24	13	• Contingency Raise shortfalls were driven by facility trapezium drift.	**Publication pending**

Investigations: 9-16 October

Trading Day	Number of intervals investigated	Number of intervals deemed Affected	Main drivers of Affected intervals	Status
9 October 2023	26			
10 October 2023	22			
11 October 2023	26			
12 October 2023	15			
13 October 2023	10			
14 October 2023	5			
15 October 2023	2			
16 October 2023	Pending			

Trapezium drift fix implemented 12 October, PM

TBD

Investigations in progress

Questions, Feedback, Ideas

For more information visit

aemo.com.au