NEM Lack of Reserve Framework Report 1 January to 31 March 2023

April 2023

A report for the National Electricity Market on the operation of the Lack of Reserve Framework

AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

Important notice

Purpose

AEMO has prepared this document under clause 4.8.4B of the National Electricity Rules to report on the operation of the NEM Lack of Reserve Framework for the period from 1 January to 31 March 2023.

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Version control

Version	Release date	Changes
1	26/04/2023	Initial release

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Executive summary

This report has been published in accordance with clause 4.8.4B of the National Electricity Rules (NER).

In the reporting period 1 January to 31 March (Quarter 1 2023), AEMO declared 65 individual Lack of Reserve (LOR) conditions in total in the National Electricity Market (NEM)[1].

Table 1 shows the number and type of LOR conditions declared in Quarter 1 2023.

Table 1   LOR conditions declared in Quarter 1 2023

LOR declarations		Total
LOR1	Actual	24
	Forecast	19
LOR2	Actual	4
	Forecast	18
LOR3	Actual	0
	Forecast	0
Total		**65**

This compares with 69 LOR conditions declared in the previous reporting period (Quarter 4 2022), and 35 LOR conditions declared for the same period last year (Quarter 1 2022)[2].

Quarter 1 2023 covered the mid-to-late summer months and the first month of autumn:

- Across the NEM, most of the LOR declarations in this quarter were due to decreased generation availability (including energy limitations) and increased forecast demand. Some of the LOR declarations in this quarter were due to reduced net import and increased forecast uncertainty measure (FUM) value.

- Many of the forecast LOR conditions did not eventuate into actual LOR conditions, mainly because additional generation was made available, or revised forecast demand meant the actual demand was not as high as previously forecast. Some of the forecast LOR conditions were cancelled when the FUM value decreased.

- The LOR conditions in New South Wales, Queensland and South Australia were mainly driven by decreased generation availability and high demand forecasts.

- The LOR conditions in Victoria was mainly due to decreased generation availability.

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[1] Forecast or actual LOR1, LOR2, or LOR3. LOR is described in clause 4.8.4 of the NER. AEMO's considerations and methodology, and the LOR levels, are outlined in AEMO's Reserve Level Declaration Guidelines, at https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Security-and-reliability/Power-system-operation.

[2] Previous quarterly reports are on AEMO's website at https://aemo.com.au/energy-systems/electricity/national-electricity-market-nem/system-operations/power-system-operation/nem-lack-of-reserve-framework-quarterly-reports.
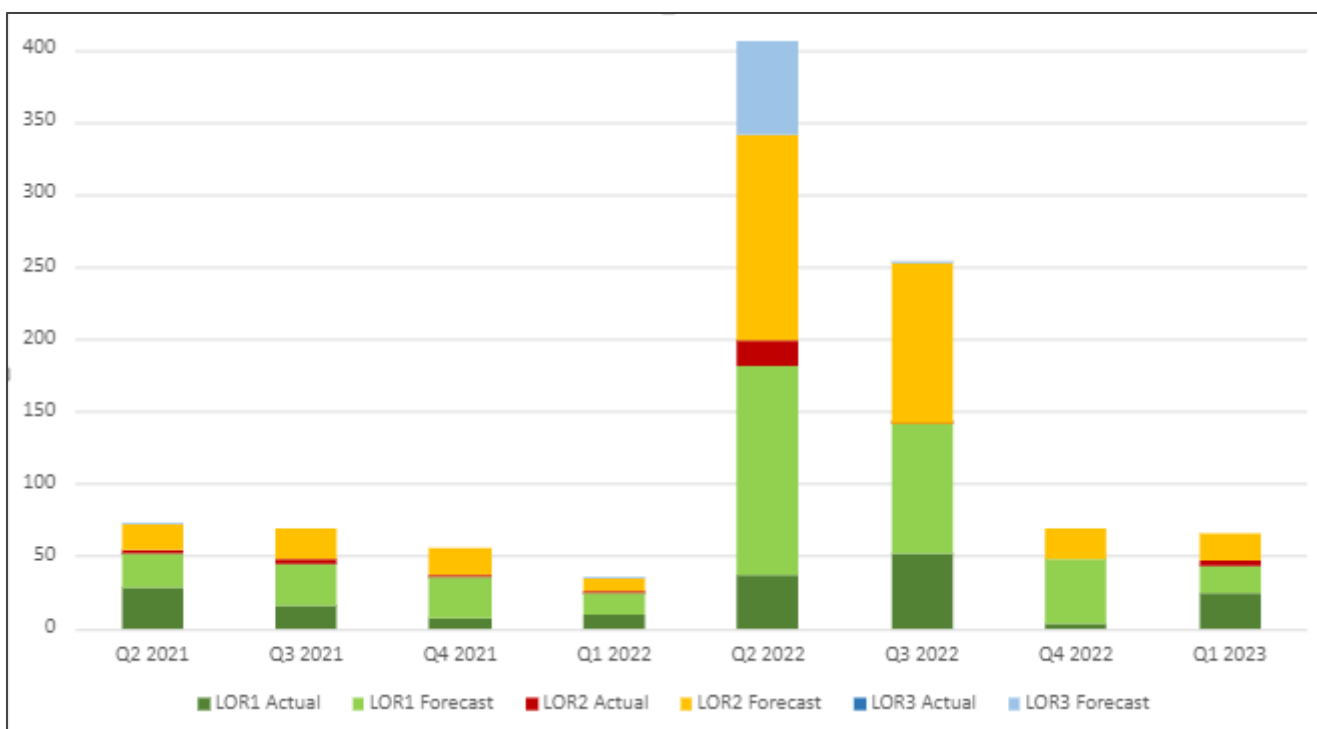
Of the 65 LOR declarations in Quarter 1 2023:

- For all 43 LOR1 declarations, the reserve requirement was set by the sum of the two largest credible risks (LCR2).

- There were 11 LOR2 declarations where the reserve requirement was set by the largest credible risk (LCR).

- There were 11 LOR2 declarations where the reserve requirement was set by the FUM.

This means 17% of LOR conditions were declared when the reserve requirement was set by the FUM. For comparison, in Quarter 4 2022, 15 of the 69 LOR declarations were set by the FUM (22%), and in Quarter 1 2022, nine of the 36 LOR declarations were set by the FUM (25%).

The graph below shows the historical trend of actual and forecast LOR conditions in past quarters from Quarter 2 2021 compared to the current quarter. The total number of LOR declarations in this reporting period decreased slightly compared to the last quarter but was moderately increased compared to the same period last year (Quarter 1 2022).

Figure 1   Quarterly comparison of actual and forecast LOR conditions, Q2 2021 to Q1 2023

The next report on the NEM Lack of Reserve Framework, for the reporting period 1 April 2023 to 30 June 2023, will be published by 31 July 2023.

Contents

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1 Introduction

This report has been published in accordance with clause 4.8.4B of the National Electricity Rules (NER), to provide a high-level analysis of how the Lack of Reserve (LOR) framework is operating. This report covers the period from 1 January to 31 March 2023 (Quarter 1 2023).

Unless otherwise noted, all times in this report are National Electricity Market (NEM) time (Australian Eastern Standard Time [AEST]).

The report is divided into three sections:

- **Reserve Level Declaration Guidelines** – a summary of changes to the Guidelines over the past quarter, and the retraining of the Bayesian Belief Network (BBN).

- **LOR conditions declared** – details of all LOR conditions declared or revised during the past quarter (based on market notices). For each condition declared, the report indicates the required reserve level and whether the requirement was set by the Forecast Uncertainty Measure (FUM), or the largest credible risk/s (LCR) in the region. The reserve requirement can be set by the largest credible risk (LCR, for LOR2 conditions) or the sum of the two largest credible risks (LCR2, for LOR1 thresholds). The FUM value for each relevant period is also provided.

- **Review of performance** – a review of the performance of the LOR framework and any observed trends, providing an assessment of FUM values compared to previous quarters, determinants of reserve level requirements, number of LOR declarations, and leading factors or causes of LOR declarations.

Please direct all LOR inquiries to www.aemo.com.au/Contact-us. In the inquiry form field '*What is your enquiry regarding?*', write "**LOR Framework Report**".

The next report on the NEM Lack of Reserve Framework, for the reporting period 1 April 2023 to 30 June 2023, will be published by 31 July 2023.

2   Reserve level declaration guidelines

2.1   Changes in the reporting period

During the reporting period, there were no changes to the Guidelines[3].

2.2   Retraining of the Bayesian Belief Network

The BBN is the algorithm which determines the FUM, which in turn can determine LOR levels. This process is summarised in the Guidelines. The intention of retraining the BBN is to update the network to include recent historical data since the last retraining. AEMO commenced the retraining in April 2023 to include data up to 31 March 2023. The retraining involves a three-stage process:

1. Extract-Transform-Load (ETL) stage, to extract historical data up to 31 March 2023, perform data validation and cleansing, and compile the data into the structured format required to incorporate into the network.

2. Analysis and modelling stage, to update the network and compile the network nodes.

3. Test and verification stage, to ensure the retrained network is suitable for production implementation.

AEMO is in the final stage of retraining and plans to implement the retrained BBN into production shortly, pending final verification and readiness checks in the pre-production environment.

2.2.1   Results from retraining

To verify the retraining, AEMO completed a backcast of all forecast intervals from October to December 2022, inclusive, using the existing BBN and the retrained BBN. The intention of the backcast is to provide an indication of the magnitude of changes to future FUM values.

Changes in 90th, 50th (median) and 10th percentiles FUM values between the existing and retrained BBN backcasts are listed below. Minor changes were identified for some other forecast horizons and distribution statistics but are not listed here. Maximum, mean, and minimum values are to still be included in visuals for review of actual FUM values in Section 4.1 of this report.

*   New South Wales - 90th percentile FUM values decreased by 42 megawatts (MW) for the 2 hours ahead forecast horizon. Median percentile FUM values decreased by 44 MW for the 60 hours ahead forecast horizon. 90th, median, and 10th percentile FUM values for all other forecast horizons were relatively unchanged.

*   Queensland - 90th percentile FUM values increased by 38 MW for the 24 hours ahead forecast horizon. Median percentile FUM values increased by 34 MW for the 24 hours ahead forecast horizon and by 26 MW in the 60 hours ahead forecast. 90th, median, and 10th percentile FUM values for all other forecast horizons remained relatively unchanged.

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[3] The Guidelines are at http://aemo.com.au/Electricity/National-Electricity-Market-NEM/Security-and-reliability/Power-system-operation.

- South Australia - 90th percentile FUM values decreased by 37 MW for the 60 hours ahead forecast horizon. Median percentile FUM values decreased by 22 MW for the 60 hours ahead forecast horizon. 90th, median and 10th percentile FUM values for all other forecast horizons remained relatively unchanged.

- Tasmania – 90th, median, and 10th percentile FUM values for all forecast horizons remained relatively unchanged (5MW or less).

- Victoria – 90th, median, and 10th percentile FUM values for all forecast horizons remained relatively unchanged (5MW or less).

3   Lack of Reserve conditions declared

Table 2 provides a high-level summary of the counts of forecast and actual LOR conditions for the reporting period (Quarter 1 2023) based on the declaration count principles.

Declaration count principles

For the reporting period, AEMO determined the total count for LOR conditions based on the following principles:

- All market notices making the initial declaration of a forecast or actual LOR condition with an effective date during the reporting period were counted.

- Any market notices which updated previously issued forecast or actual LORs at the same level for a given effective date (in relation to the reserve requirement, reserve capacity available, or effective period) were not counted, to prevent double-counting of a continuing condition.

- In cases where forecast LORs were cancelled but subsequently re-issued with approximately the same effective period, re-issues were not counted, to prevent double-counting of effective periods.

- Updates to existing LOR conditions where the LOR level changed were counted as separate LOR conditions.

- Any forecast LORs which were subsequently declared as actual LORs at the same LOR level were counted once. In Table 2, these are shown as actual conditions only. For example:

  – Where a forecast LOR1 was issued and later an actual LOR1 was declared for a similar period, only the actual LOR1 was counted.

  – If the initial forecast was for a forecast LOR2 condition and this was later declared as an actual LOR1, this would be counted as two LOR conditions, due to the differing LOR levels.

- Continuous LOR conditions which spanned multiple periods throughout a day are counted as individual LOR declarations for each period covered. For this purpose, a NEM trading day is split into four 6-hour periods: morning peak covers 0400 hrs to 1000 hrs, mid-day covers 1000 hrs to 1600 hrs, evening peak covers 1600 hrs to 2200 hrs, and overnight covers 2200 hrs to 0400 hrs on the next day[4]. The maximum count allocated to each trading day is four.

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[4] This is due to **trading day rather than calendar day to prevent double-counting of a continuous condition.**

Table 2   Summary of forecast and actual LOR conditions, with causing factors

Effective date[A]	Region	LOR1		LOR2		LOR3		Cause and resolution
		Actual	**Forecast**	**Actual**	**Forecast**	**Actual**	**Forecast**	
18/01/2023	NSW		1					With 22 hour lead time, a forecast LOR1 condition was declared, updated, and cancelled several times, due to changing effective period and forecast reserve level. The effective period ranged 16:00 – 18:00. The forecast LOR condition worsened or improved due to changes in generation availability, net import and forecast operational demand (MN 105045, MN 105052, MN 105063, MN 105066, MN 105080).
29/01/2023	NSW	2			1			**Midday:** An actual LOR1 was declared, updated twice with effective period ranged 14:30 – 18:30 due to decreased generation availability, decreased net import and increased forecast operational demand (MN 105348, MN 105352, MN 105359). The actual LOR1 condition was cancelled when the effective period elapsed (MN 105361). **Evening Peak:** With one hour lead time, forecast LOR1 and LOR2 conditions were declared, updated, and cancelled several times, due to changing effective period and forecast reserve level. The effective period ranged 15:00 – 19:30. The forecast LOR conditions worsened or improved due to changes in generation availability, forecast operational demand and net import (MN 105343, MN 105344, MN 105349, MN 105353, MN 105357). An actual LOR1 was present with effective period 19:00 – 19:30 due to increased forecast operational demand, decreased generation availability and decreased net import (MN 105368). The actual LOR1 condition was cancelled when the effective period elapsed (MN 105369).
02/02/2023	NSW	1			1			With 16 hour lead time, forecast LOR1 and LOR2 conditions were declared, updated, and cancelled several times, due to changing effective period and forecast reserve level. The effective period ranged 15:30 – 19:30. The forecast LOR conditions worsened or improved due to changes in generation availability and forecast operational demand (MN 105470, MN 105473, MN 105475, MN 105476, MN 105509). An actual LOR1 condition was present between 17:15 – 19:30 due to increased forecast operational demand and decreased generation availability (MN 105532). The actual LOR1 condition was cancelled when the effective period elapsed (MN 105538).
11/02/2023	NSW	1						A forecast LOR1 was declared and cancelled twice with effective period ranged 17:30 – 19:30 (28 hour lead time). The reserve condition changed with changes in net import, generation availability and forecast operational demand (MN 105759, MN 105770, MN105773, MN 105793). An actual LOR1 was present with effective period 18:00 – 18:30 due to increased forecast operational demand (MN 105795). The actual LOR1 condition was cancelled when the effective period elapsed (MN 105797).

Effective date[A]	Region	LOR1		LOR2		LOR3		Cause and resolution
		Actual	Forecast	Actual	Forecast	Actual	Forecast	
06/03/2023	NSW	1		1				With five day lead time, forecast LOR1 conditions were declared, updated, and cancelled several times, due to changing effective period and forecast reserve level. The effective period ranged 15:30 – 20:00. The forecast LOR conditions worsened or improved due to changes in generation availability, forecast operational demand and net import (MN 106183, MN 106239, MN 106286, MN 106289, MN 106294).
								An actual LOR1 was present with effective period 16:00 – 19:00 due to increased forecast operational demand (MN 106308).
								The actual LOR1 condition was cancelled when the effective period elapsed (MN 106323).
								With three day lead time, forecast LOR2 conditions were declared, updated, and cancelled several times, due to changing effective period and forecast reserve level. The effective period ranged 15:30 – 19:00. The forecast LOR conditions worsened or improved due to changes in FUM level, generation availability, forecast operational demand and net import demand (MN 106233, MN 106235, MN 106245, MN 106247, MN 106259, MN 106279, MN 106280, MN 106285, MN 106287, MN 106288).
								An actual LOR2 condition was present between 17:00 – 17:30 due to increased forecast operational demand and decreased generation availability (MN 106310).
								The actual LOR2 condition was cancelled when the effective period elapsed (MN 106312).
07/03/2023	NSW		1		1			A forecast LOR2 was declared with effective period 17:00 – 19:00 (56 hours lead time) due to increased FUM level and increased operational forecast demand (MN 106279).
								Several updates to the forecast LOR2 conditions were issued due to changing effective period and forecast reserve level. The effective period ranged 16:30 – 19:00. The forecast LOR conditions worsened or improved due to changes in FUM level, forecast operational demand and net import (MN 106281, MN 106293, MN 106298, MN 106299, MN 106300).
								The forecast LOR2 condition was cancelled due to decreased FUM level and increased net import (MN 106302).
								A forecast LOR1 was declared with effective period 18:30 – 19:00 (30 hours lead time) due to increased forecast operational demand (MN 106301).
								The forecast LOR1 condition was cancelled due to increased net import (MN 106303).
16/03/2023	NSW	1		1				With six day lead time, forecast LOR1 conditions were declared and updated several times, due to changing effective period and forecast reserve level. The effective period ranged 15:30 – 19:00. The forecast LOR conditions worsened or improved due to changes in forecast operational demand, generation availability and net import (MN 106419, MN 106438, MN 106477, MN 106606, MN 106644, MN 106673, MN 106674, MN 106693).
								An actual LOR1 was present with effective period 16:00 – 19:00 due to increased forecast operational demand and decreased net import (MN 106700).
								The actual LOR1 condition was cancelled when the effective period elapsed (MN 106729).
								With five day lead time, forecast LOR2 conditions were declared, updated, and cancelled several times, due to changing effective period and forecast reserve level. The effective

Effective date[A]	Region	LOR1		LOR2		LOR3		Cause and resolution
		Actual	**Forecast**	**Actual**	**Forecast**	**Actual**	**Forecast**	
								period ranged 15:00 – 19:30. The forecast LOR conditions worsened or improved due to changes in FUM level, generation availability, forecast operational demand and net import. (MN 106458, MN 106462, MN 106464, MN 106497, MN 106528, MN 106570, MN 106577, MN 106580, MN 106598, MN 106623, MN 106630, MN 106635, MN 106706).
								An actual LOR2 condition was present between 17:50 – 18:30 due to increased forecast operational demand and decreased net import (MN 106716).
								The actual LOR2 condition was cancelled when the effective period elapsed (MN 106726).
17/03/2023	NSW	1			1			With seven day lead time, forecast LOR1 conditions were declared and updated several times, due to changing effective period and forecast reserve level. The effective period ranged 15:00 – 18:30. The forecast LOR conditions worsened or improved due to changes in forecast operational demand and generation availability (MN 106420, MN 106438, MN 106478, MN 106604, MN 106734, MN 106738, MN 106742).
								An actual LOR1 was present with effective period 17:50 – 18:30 due to increased forecast operational demand and decreased generation availability (MN 106766).
								The actual LOR1 condition was cancelled when the effective period elapsed (MN 106781).
								A forecast LOR2 was declared and cancelled twice with effective period ranged 17:30 – 18:30 (five day lead time) due to changed forecast operational demand (MN 106465, MN 106471, MN 106480, MN 106485).
18/03/2023	NSW	1			1			With five day lead time, forecast LOR1 and LOR2 conditions were declared and cancelled several times, due to changing effective period and forecast reserve level. The effective period ranged 17:00 – 18:30. The forecast LOR conditions worsened or improved due to changes in forecast operational demand and net import (MN 106550, MN 106605, MN 106745, MN 106751, MN 106752).
								An actual LOR1 was present with effective period 17:50 – 18:00 due to increased forecast operational demand (MN 106816).
								The actual LOR1 condition was cancelled when the effective period elapsed (MN 106817).
19/03/2023	NSW	1			1			With four day lead time, forecast LOR1 and LOR2 conditions were declared, updated, and cancelled several times, due to changing effective period and forecast reserve level. The effective period ranged 15:20 – 19:00. The forecast LOR conditions worsened or improved due to changes in forecast operational demand, generation availability and FUM level (MN 106655, MN 106733, MN 106744, MN 106748, MN 106791, MN 106792, MN 106793, MN 106794, MN 106818, MN 106819, MN 106830).
								An actual LOR1 was present with effective period 17:00 – 17:30 due to decreased generation availability (MN 106832).
								The actual LOR1 condition was cancelled when the effective period elapsed (MN 106834).
21/03/2023	NSW		1					A forecast LOR1 was declared with effective period 16:30 – 17:00 (seven day lead time) due to decreased generation availability (MN 106607).
								The forecast LOR1 condition was cancelled due to decreased forecast operational demand

Effective date[A]	Region	LOR1		LOR2		LOR3		Cause and resolution
		Actual	**Forecast**	**Actual**	**Forecast**	**Actual**	**Forecast**	
								(MN 106654).
23/03/2023	NSW		1					A forecast LOR1 was declared with effective period 16:30 – 17:00 (four day lead time) due to increased forecast operational demand (MN 106829).
								The forecast LOR1 condition was cancelled due to decreased forecast operational demand (MN 106897).
04/01/2023	QLD		1					A forecast LOR1 was declared with effective period 18:30 – 19:00 (three day lead time) due to increased forecast operational demand (MN 104782) and updated with effective period 17:30 – 20:30 (two day lead time) due to decreased generation availability and decreased net import (MN 104799). The forecast LOR1 condition was cancelled due to increased generation availability (MN 104813).
								A forecast LOR1 was redeclared with similar effective period 17:30 – 20:30 (three hour lead time) due to decreased generation availability (MN 104841) and updated with effective period 18:30 – 20:00 (one hour lead time) due to increased forecast demand (MN 104843), and later cancelled due to decreased forecast demand and increased generation availability and net import (MN 104846).
09/01/2023	QLD	1						An actual LOR1 was declared with effective period 18:30 – 19:00 due to decreased generator availability (MN 104906).
								The actual LOR1 condition was cancelled due to increased generator availability (MN 104907)
25/01/2023	QLD		1					A forecast LOR1 was declared and cancelled twice with effective period 18:30 – 19:00 (seven hour lead time and two hour lead time) due to changed generation availability (MN 105226, MN 105228, MN 105241, MN 105243).
26/01/2023	QLD	1						An actual LOR1 condition was present between 18:00 – 19:15 due to decreased generation availability (MN 105267).
								The actual LOR1 condition was cancelled due to increased generation availability (MN 105269).
31/01/2023	QLD	1		1				An actual LOR1 condition was present between 18:00 – 19:00 and 19:30 – 20:40 due to increased demand and decreased generation availability (MN 105418, MN 105424).
								An actual LOR2 condition was present between 19:00 – 19:30 due to increased demand and decreased generation availability (MN 105421).
								The actual LOR1 and LOR2 conditions were cancelled after the period had elapsed (MN 105423, MN 105426).
01/02/2023	QLD	1						A forecast LOR1 was declared with effective period 17:30 – 20:00 (three day lead time) due to increased forecast demand (MN 105351) and later cancelled due to decreased forecast operational demand and increased net import (MN 105356).
								An actual LOR1 condition was present between 18:45 – 19:20 due to increased demand (MN

Effective date[A]	Region	LOR1		LOR2		LOR3		Cause and resolution
		Actual	**Forecast**	**Actual**	**Forecast**	**Actual**	**Forecast**	
								105458).
								The actual LOR1 condition was cancelled due to increased generation availability and decreased demand (MN 105460).
02/02/2023	QLD		1		1			A forecast LOR1 was declared with effective period 18:00 – 20:00 (three day lead time) due to increased forecast demand (MN 105351) later cancelled due to decreased forecast operational demand and increased net import (MN 105356).
								The forecast LOR1 condition was declared with effective period 17:30 – 18:00 and 19:30 – 20:00 (17 hour lead time) due to decreased net imports (MN 105472).
								A forecast LOR2 was declared with effective period 18:00 – 19:30 (17 hour lead time) due to decreased net imports (MN 105471).
								The forecast LOR1 and LOR2 conditions were cancelled due to increased net imports (MN 105477, MN 105478).
								A forecast LOR1 condition was redeclared with effective period 18:30 – 19:00 (two hour lead time) due to increased forecast demand and decreased generation availability, and later cancelled due to decreased forecast demand (MN 105515, MN 105533).
03/02/2023	QLD	1	1		2			**Midday:**
								With three day lead time, forecast LOR1 and LOR2 conditions were declared, updated, and cancelled twice, due to changing effective period and forecast reserve level. The effective period ranged 14:30 – 16:00. The forecast LOR conditions worsened or improved due to changes in generation availability and forecast demand.
								(MN 105410, MN 105434, MN 105436, MN 105446, MN 105461, MN 105467, MN 105480)
								Evening Peak:
								With five day lead time, forecast LOR1 and LOR2 conditions were declared, updated, and cancelled several times, due to changing effective period and forecast reserve level. The effective period ranged 16:00 – 22:00. The forecast LOR conditions worsened or improved due to changes in generation availability and forecast demand.
								(MN 105351, MN 105386, MN 105397, MN 105398, MN 105399, MN 105408, MN 105410, MN 105413, MN 105417, MN 105428, MN 105433, MN 105484, MN 105486, MN 105536, MN 105537, MN 105539, MN 105540, MN 105544, MN 105545, MN 105559, MN 105560, MN 105576, MN 105577, MN 105593)
								An actual LOR1 condition was present between 16:00 – 17:45 and 18:15 – 21:00 due to high operational demand (MN 105591, MN 105599, MN 105602, MN 105608).
12/02/2023	QLD	1						An actual LOR1 condition was present between 18:30 – 19:00 due to increased demand (MN 105809).
								The actual LOR1 condition was cancelled due to decreased demand (MN 105811).
13/02/2023	QLD	1						An actual LOR1 condition was present between 18:30 – 19:20 due to increased demand (MN 105829).

Effective date[A]	Region	LOR1		LOR2		LOR3		Cause and resolution
		Actual	**Forecast**	**Actual**	**Forecast**	**Actual**	**Forecast**	
								The actual LOR1 condition was cancelled after the period elapsed (MN 105830).
16/03/2023	QLD	1		1				With five day lead time, forecast LOR1 and LOR2 conditions were declared, updated, and cancelled several times, due to changing effective period and forecast reserve level. The effective period ranged 17:00 – 19:00. The forecast LOR conditions worsened or improved due to changes in net import, generation availability and forecast operational demand. (MN 106459, MN 106463, MN 106466, MN 106475, MN 106498, MN106529, MN 106571, MN 106575, MN 106578, MN 106579, MN 106603, MN 106675, MN 106677, MN 106704) An actual LOR2 condition was present between 17:30 – 18:00 due to high operational demand, decreased generation availability and net import (MN 106719). The actual LOR2 condition was cancelled when the effective period elapsed (MN 106725). An actual LOR1 condition was present between 18:30 – 19:00 due to high operational demand (MN 106727). The actual LOR1 condition was cancelled when the effective period elapsed (MN 106728).
17/03/2023	QLD	1			1			A forecast LOR2 was declared twice with effective period 17:30 – 18:30 (five day lead time) due to increased forecast operational demand and decreased net import (MN 106467, MN 106479) and cancelled twice due to increased generation availability and net import (MN 106472, MN 106486). A forecast LOR1 was declared with effective period 17:00 – 17:30 and 18:30 - 19:00 (five day lead time) due to increased forecast operational demand (MN 106476) and later cancelled due to increased generation availability (MN 106553). A forecast LOR1 was declared with effective period 17:30 - 19:00 (six hour lead time) due to increased forecast operational demand (MN 106743). An actual LOR1 condition was present between 17:50 – 19:15 due to high operational demand (MN 106767). The actual LOR1 condition was cancelled when the effective period elapsed (MN 106782).
18/03/2023	QLD		1					A forecast LOR1 was declared with effective period 18:00 – 18:30 (one hour lead time) due to decreased generation availability and net import (MN 106802). The forecast LOR1 condition was cancelled due to decreased demand and increased net import (MN 106806).
22/03/2023	QLD				1			A forecast LOR2 was declared with effective period 07:00 – 07:30 (21 hour lead time) due to decreased generator availability and increased forecast operational demand (MN 106856). The forecast LOR2 condition was cancelled due to increased generation availability and net import (MN 106857).
27/03/2023	QLD	1						A forecast LOR1 was declared and updated with effective period 17:30 - 18:30 (two hour lead time) due to increased forecast operational demand, decreased generation availability and net import (MN 107031) and later cancelled due to increased generation availability and net import (MN 107034).

Effective date[A]	Region	LOR1		LOR2		LOR3		Cause and resolution
		Actual	**Forecast**	**Actual**	**Forecast**	**Actual**	**Forecast**	
								An actual LOR1 condition was present between 18:00 – 18:46 due to decreased generation availability and net import (MN 107035). The actual LOR1 condition was cancelled when the effective period elapsed (MN 107036).
28/03/2023	QLD	1						With four day lead time, forecast LOR1 conditions were declared, updated, and cancelled several times, due to changing effective period and forecast reserve level. The effective period ranged 17:00 – 20:30. The forecast LOR conditions worsened or improved due to changes in net import, generation availability and forecast operational demand.
								(MN 106949, MN 106974, MN 106993, MN 107013, MN 107037, MN 107038, MN 107044, MN 107048, MN 107050, MN 107053)
								An actual LOR1 condition was present between 18:30 – 19:15 due to decreased generation availability and increased demand (MN 107055). The actual LOR1 condition was cancelled when the effective period elapsed (MN 107056).
29/03/2023	QLD		1					A forecast LOR1 was declared and updated with effective period 17:30 - 18:00 (four day lead time) due to increased forecast operational demand (MN 106974) and later cancelled due to increased generation availability and decreased forecast operational demand (MN 106993).
30/03/2023	QLD		1					A forecast LOR1 was declared twice with effective period 13:30 – 14:30 (four day lead time) due to increased forecast operational demand (MN 106974, MN 106992) and later cancelled twice due to decreased forecast operational demand, increased generation availability and net import (MN 106993, MN 107029).
13/01/2023	SA		1		1			A forecast LOR1 was declared and cancelled with an effective period 18:00 – 19:30 (four day lead time) due to changed generation availability (MN 104901, MN 104952), it was redeclared with a similar effective period 18:30 – 19:00 (eight hour lead time) due to decreased generation availability and later cancelled due to increased generation availability and decreased forecast demand (MN 104979, MN 104988).
								A forecast LOR2 was declared with effective period 18:30 – 19:00 (four day lead time) due to decreased generation availability (MN 104924).
								The forecast LOR2 condition was cancelled due to increased generation availability (MN 104925)
16/01/2023	SA		1		1			A forecast LOR2 was declared with effective period 18:00 – 19:30 (five day lead time) due to decreased generator availability and increased forecast demand (MN 104957).
								The forecast LOR2 condition was cancelled due to increased generation availability (MN 104962).
								A forecast LOR1 was declared with effective period 18:00 – 19:30 (four day lead time) due to decreased generator availability and increased forecast demand (MN 104970).
								The forecast LOR1 condition was cancelled due to increased generator availability and decreased forecast demand (MN 104984)
17/01/2023	SA		1		1			Forecast LOR1 conditions were declared with effective periods 18:00 – 18:30, 20:00 – 22:00

Effective date[A]	Region	LOR1		LOR2		LOR3		Cause and resolution
		Actual	**Forecast**	**Actual**	**Forecast**	**Actual**	**Forecast**	
								(seven day lead time) as well as a forecast LOR2 condition with effective period 18:30 – 20:00 (seven day lead time) due to decreased generation availability (MN 104932, MN 104931, MN 104941).
								The forecast LOR2 condition was cancelled due to increased generation availability (MN 104942).
								The forecast LOR1 condition updated with similar effective periods: 18:00 – 20:30, 21:00 - 21:30 (six day lead time) due to decreased generation availability (MN 104953).
27/01/2023	SA		1					A forecast LOR1 condition was declared with effective period 18:30 – 19:30 (20 hour lead time) due to decreased generation availability (MN 105274).
								An update to the forecast LOR1 was issued due to change in effective period 18:00 - 20:00 (10 hour lead time) and forecast reserve level. The forecast LOR1 condition worsened due to reduced generation availability (MN 105282)
								The forecast LOR1 condition was cancelled due to increased generation availability (MN 105284).
09/02/2023	SA	1						An actual LOR1 condition was present between 19:00 – 20:30 due to increased demand, reduced net import and reduced generation availability (MN 105351).
								The actual LOR1 condition was cancelled when the effective period elapsed (MN 105352).
16/02/2023	SA	1						A forecast LOR1 was declared, updated, and cancelled several times (5 day lead time), due to changing effective period and forecast reserve level. The effective period ranged 18:30 - 20:00. The reserve condition worsened or improved due to changes in net import, generation availability and forecast operational demand (MN 105790, MN 105810, MN105865, MN 105868, MN 105887, MN 105903).
								An actual LOR1 was declared with effective period 19:00 – 19:30 due to decreased generation availability and increased demand (MN 105907).
								The actual LOR1 condition was cancelled when the effective period elapsed (MN 105908).
22/02/2023	SA		1					A forecast LOR1 was declared with effective period 18:00 – 19:30 (29 hour lead time) due to decreased generation availability (MN 106046).
								The forecast LOR1 condition was cancelled due to increased generation availability (MN 106048)
23/02/2023	SA	1			2			A forecast LOR2 conditions were declared with effective periods 13:30 – 14:30 (50 hour lead time) and 17:30 - 19:30 (54 hour lead time) (MN 106042, MN 106044, MN 106050) due to decreased generation availability and increased FUM value. These conditions were later cancelled due to increased generation availability and decreased FUM value.
								A forecast LOR1 was declared and cancelled several times (30 hour lead time), due to changing effective period and forecast reserve level. The effective period ranged 18:00 – 19:00. The reserve condition worsened or improved due to changes in net import, generation availability and forecast operational demand (MN 106072, MN 106074, MN 106076, MN

Effective date[A]	Region	LOR1		LOR2		LOR3		Cause and resolution
		Actual	**Forecast**	**Actual**	**Forecast**	**Actual**	**Forecast**	
								106077, MN 106078, MN 106079).
								An actual LOR1 was declared with effective period 18:30 – 19:30 due to increased operational demand (MN 106087).
								The actual LOR1 condition was cancelled when the effective period elapsed (MN 106089).
24/02/2023	SA		1					A forecast LOR1 was declared with effective period 18:30 – 19:00 (five day lead time) due to decreased generator availability (MN 106011).
								The forecast LOR1 condition was cancelled due to increased generator availability (MN 106036)
17/01/2023	VIC		2		1			**Midday:**
								A forecast LOR1 was declared with effective period 15:00 – 16:30 (46 hour lead time) due to decreased generator availability (MN 105011) and later cancelled due to increased generation availability (MN 105024).
								Evening Peak:
								A forecast LOR1 was declared with effective period 17:00 – 19:30 (seven day lead time) due to decreased net import (MN 104933).
								The forecast LOR1 condition was updated to effective period 16:00 – 17:30 and 18:30 – 19:30 due to increased forecast operational demand, decreased generation availability and net import (MN 104951).
								With six day lead time, forecast LOR2 condition was declared, updated, and cancelled several times, due to changing effective period and forecast reserve level. The effective period ranged 17:00 – 19:30. The forecast LOR conditions worsened or improved due to changes in generation availability and demand (MN 104943, MN 104949, MN 104950, MN 104954, MN 104958, MN 104960, MN 104961, MN 104963, MN 104964, MN 104966, MN 104974, MN 104977).
								A forecast LOR2 was declared with effective period 16:30 – 17:00 (47 hour lead time) due to increased forecast operational demand and decreased generator availability (MN 105009).
								The forecast LOR2 condition was cancelled due to increased generation availability (MN 105018).
								A forecast LOR1 was declared with effective period 16:00 – 16:30 and 17:00 – 18:30 (46 hour lead time) due to decreased generator availability (MN 105011).
								The forecast LOR1 condition was cancelled due to increased generation availability (MN 105024).
16/02/2023	VIC	1			1			A forecast LOR2 was declared with effective period 16:30 – 17:00 (58 hour lead time) due to increased FUM and decreased generator availability (MN 105835).
								The forecast LOR2 condition was cancelled due to increased generation availability (MN 105837).
								With three day lead time, forecast LOR1 condition was declared, updated, and cancelled

Effective dateA	Region	LOR1		LOR2		LOR3		Cause and resolution
		Actual	**Forecast**	**Actual**	**Forecast**	**Actual**	**Forecast**	
								several times, due to changing effective period and forecast reserve level. The effective period ranged 18:00 – 19:30. The forecast LOR conditions worsened or improved due to changes in generation availability (MN 105821, MN 105846, MN 105866, MN 105869, MN 105889, MN 105901, MN 105902).
								An actual LOR1 was declared with effective period 18:00 – 18:55 due to increased forecast operational demand (MN 105905).
								The actual LOR1 condition was cancelled due to increased generator availability and net import (MN 105906).
Total		**24**	**19**	**4**	**18**	**0**	**0**	

A. Effective date is the date on which the condition occurred or was expected to occur and may differ from the date on which a market notice advising of the forecast or actual condition was issued.

3.1 LOR declarations during the reporting period – Gantt chart

This section shows the LOR declarations during the reporting period 1 January to 31 March 2023 for each region using Gantt charts. Each Gantt chart covers a four-day period. Periods with no LOR declarations were omitted and not graphed.

Forecast and actual LOR1, LOR2 and LOR3 conditions including updates are shaded according to the legend at the bottom of each page for the corresponding effective periods based on the market notices.

3.1.1 New South Wales

There were no LOR declarations in the period from 1 January to 16 January 2023.

17 January - 20 January 2023
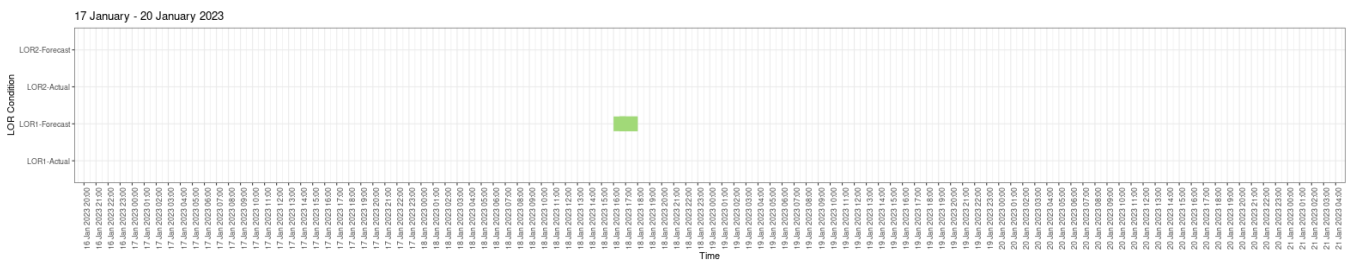
There were no LOR declarations in the period from 21 January to 28 January 2023.
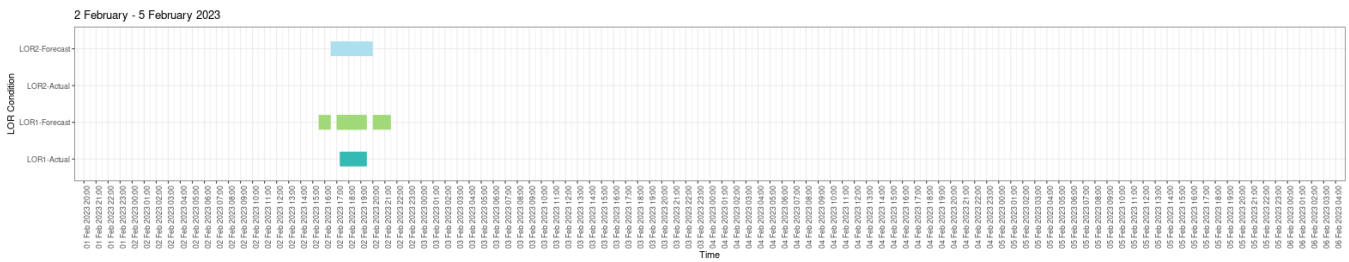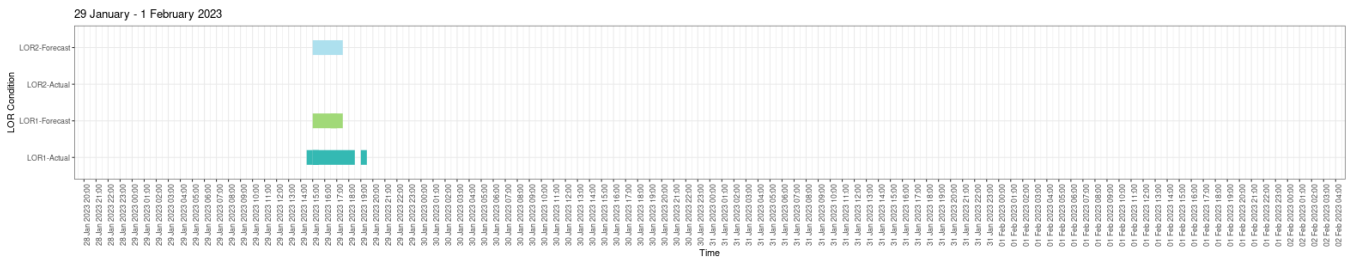
29 January - 1 February 2023

2 February - 5 February 2023

There were no LOR declarations in the period from 6 February to 9 February 2023.

10 February - 13 February 2023
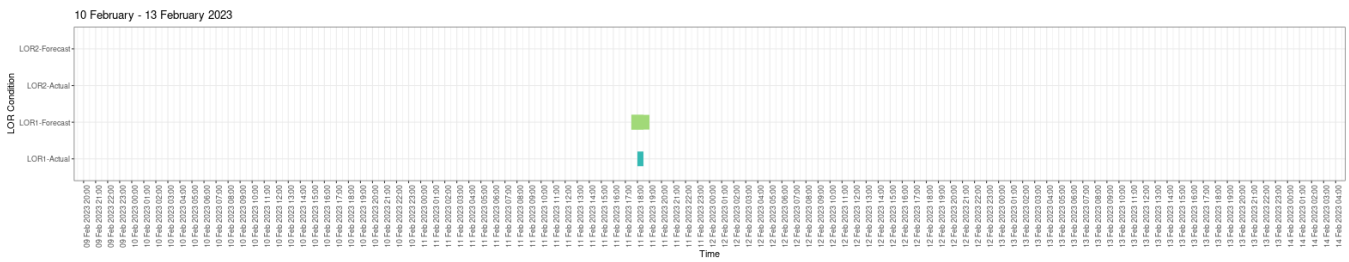
There were no LOR declarations in the period from 14 February to 5 March 2023.

Legend:
LOR1-Forecast, LOR2-Forecast, LOR3-Forecast
LOR1-Actual, LOR2-Actual, LOR3-Actual
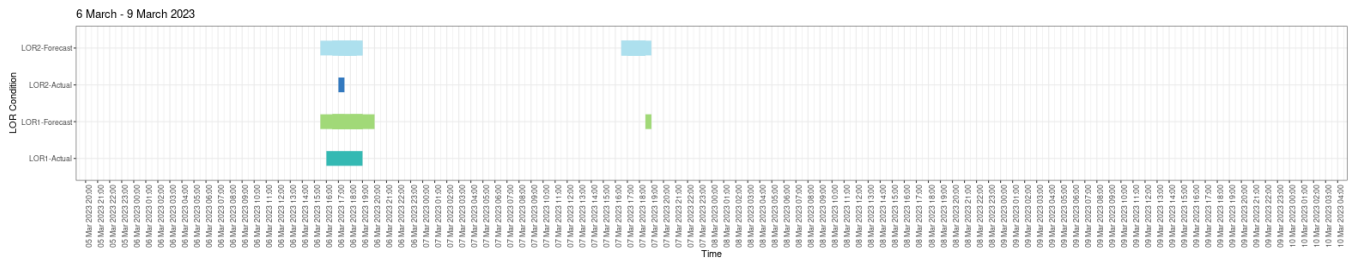
6 March - 9 March 2023

There were no LOR declarations in the period from 10 March to 13 March 2023.

14 March - 17 March 2023

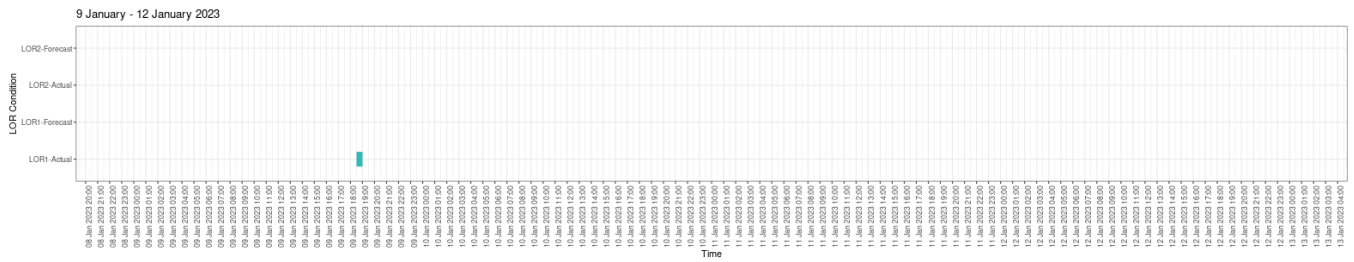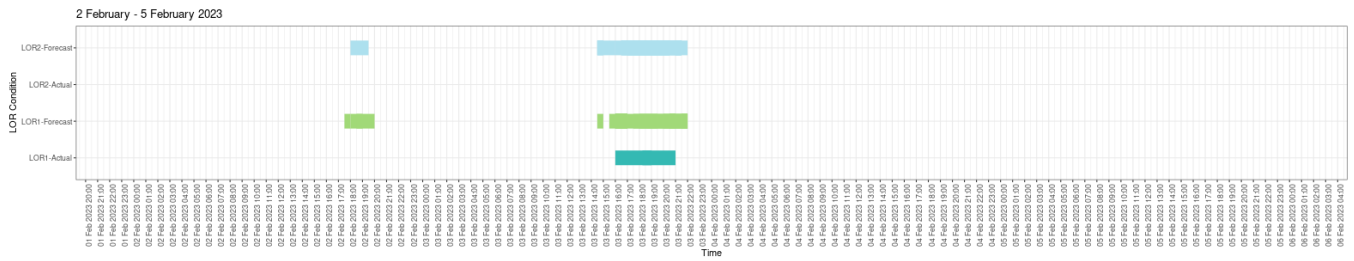**18 March - 21 March 2023**

22 March - 25 March 2023
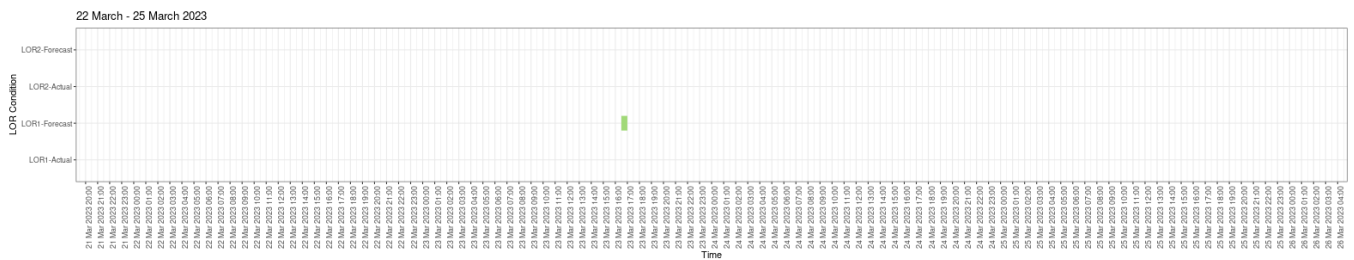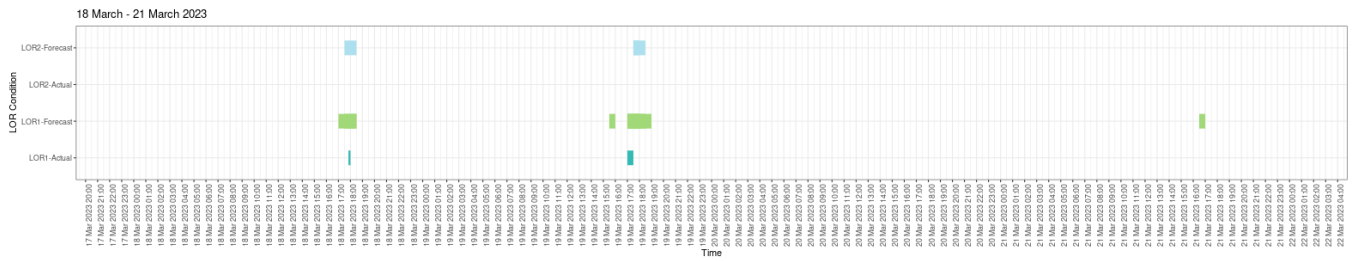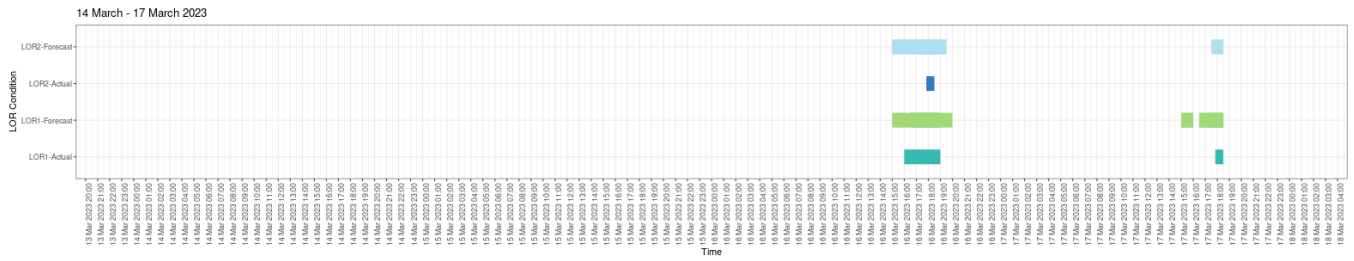
There were no LOR declarations in the period from 26 March to 31 March 2023.

3.1.2 Queensland

1 January - 4 January 2023
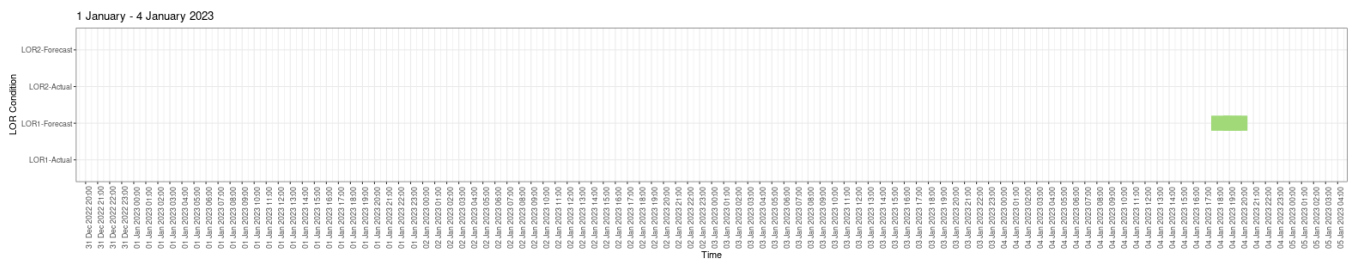
There were no LOR declarations in the period from 5 January to 8 January 2023.

Legend: LOR1-Forecast, LOR2-Forecast, LOR3-Forecast, LOR1-Actual, LOR2-Actual, LOR3-Actual
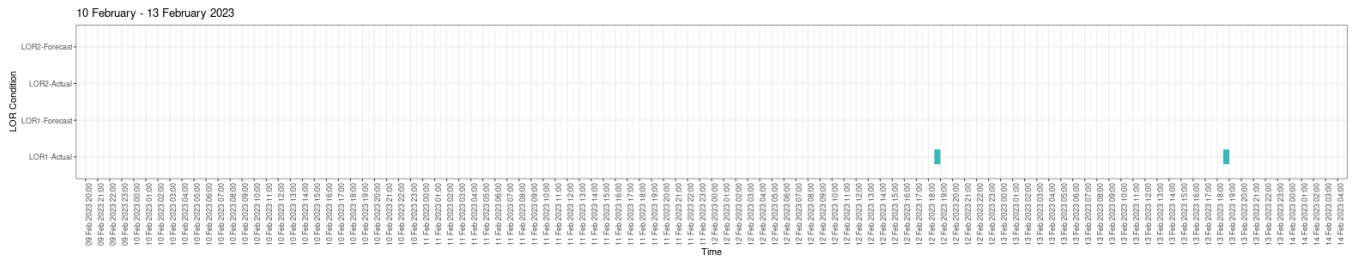
9 January - 12 January 2023

There were no LOR declarations in the period from 13 January to 24 January 2023.
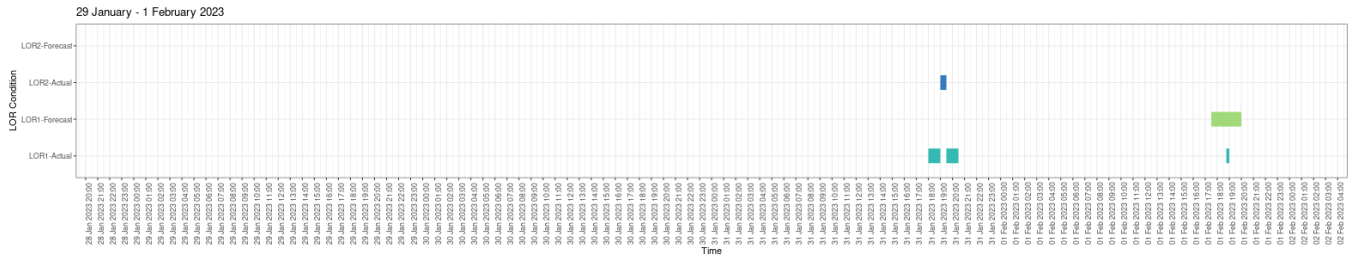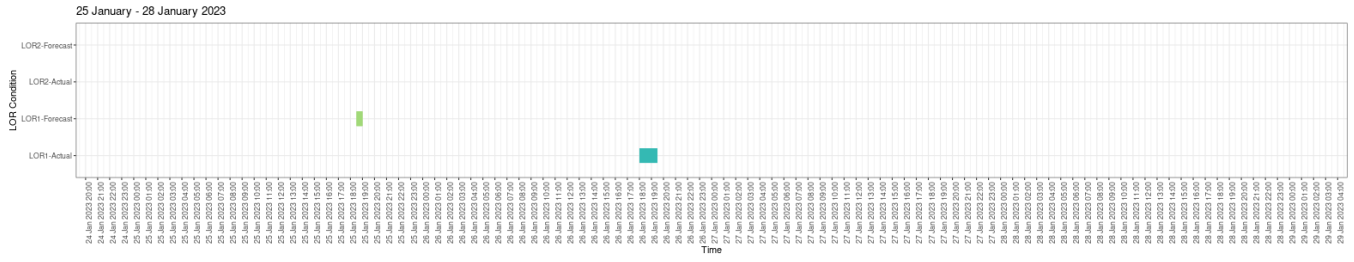
25 January - 28 January 2023

29 January - 1 February 2023

2 February - 5 February 2023

There were no LOR declarations in the period from 6 February to 9 February 2023.

10 February - 13 February 2023

There were no LOR declarations in the period from 14 February to 13 March 2023.

Legend

LOR1-Forecast	LOR2-Forecast	LOR3-Forecast
LOR1-Actual	LOR2-Actual	LOR3-Actual

14 March - 17 March 2023

18 March - 21 March 2023

22 March - 25 March 2023

26 March - 29 March 2023

30 March - 31 March 2023
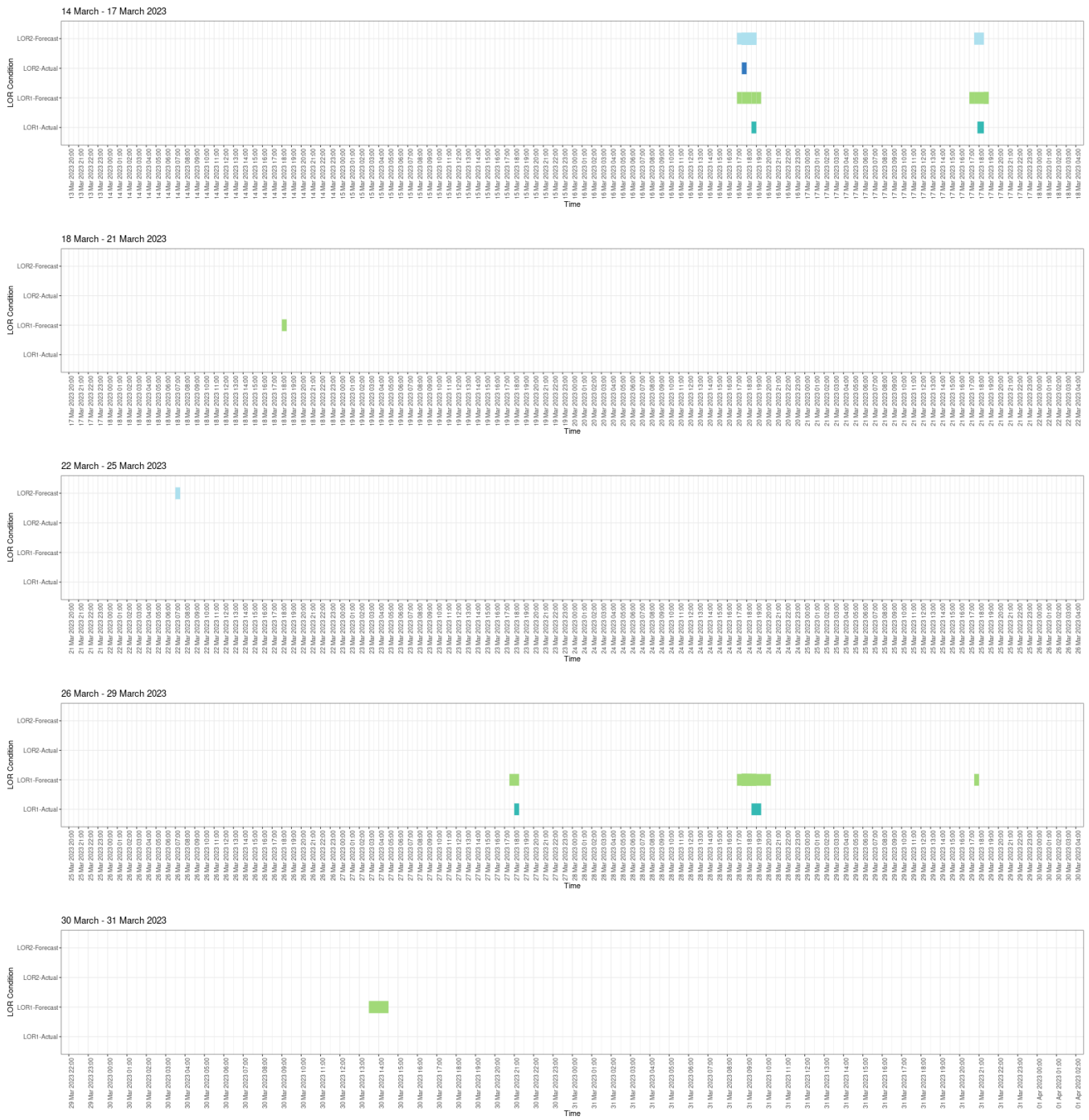
3.1.3   South Australia

There were no LOR declarations in the period from 1 January to 12 January 2023.

Legend

| LOR1-Forecast | LOR2-Forecast | LOR3-Forecast |
| LOR1-Actual | LOR2-Actual | LOR3-Actual |

13 January - 16 January 2023

17 January - 20 January 2023

There were no LOR declarations in the period from 21 January to 24 January 2023.

25 January - 28 January 2023
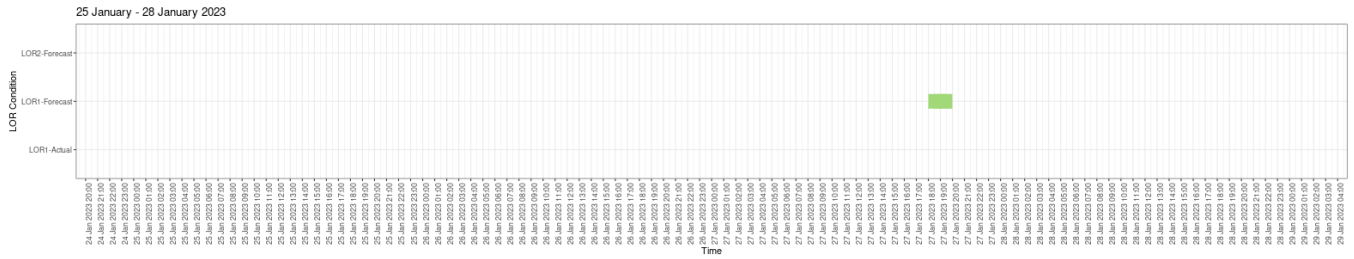
There were no LOR declarations in the period from 29 January to 5 February 2023.

6 February - 9 February 2023
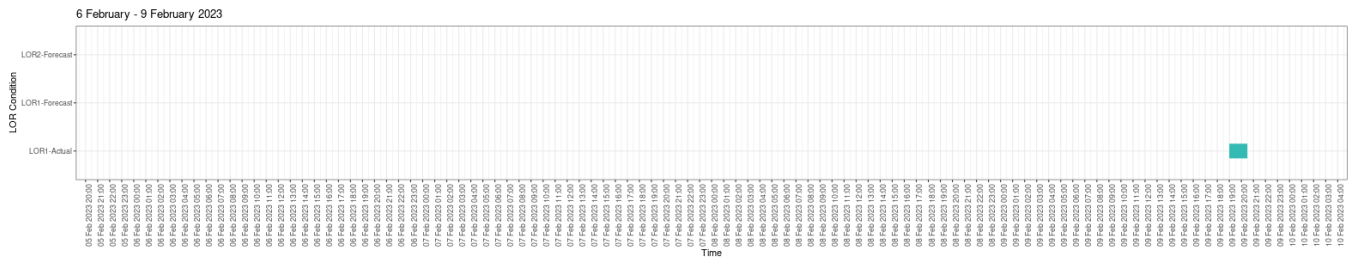
There were no LOR declarations in the period from 10 February to 13 February 2023.

14 February - 17 February 2023
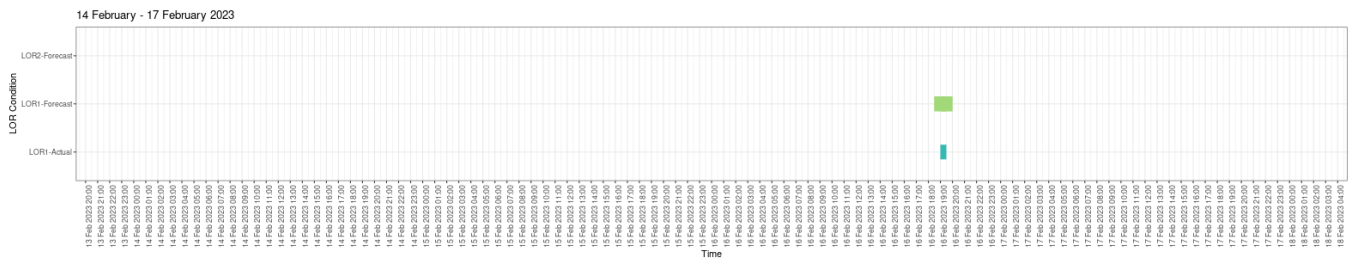
There were no LOR declarations in the period from 18 February to 21 February 2023.

Legend

■ LOR1-Forecast	■ LOR2-Forecast	■ LOR3-Forecast
■ LOR1-Actual	■ LOR2-Actual	■ LOR3-Actual

There were no LOR declarations in the period from 26 February to 31 March 2023.

3.1.4   Victoria

There were no LOR declarations in the period from 1 January to 16 January 2023.

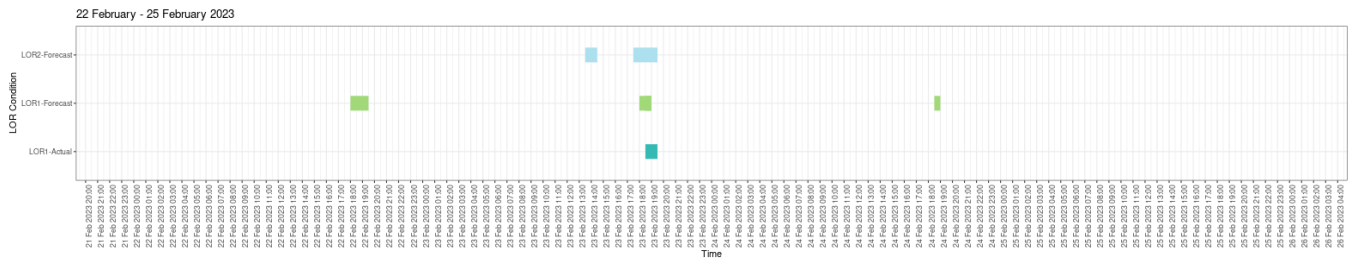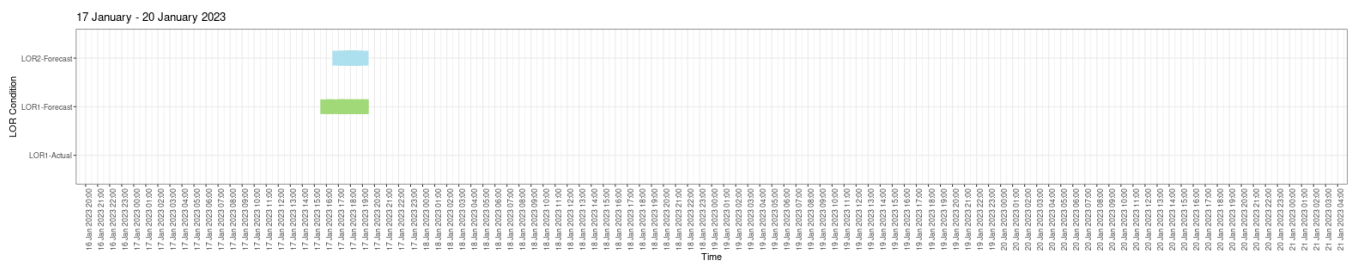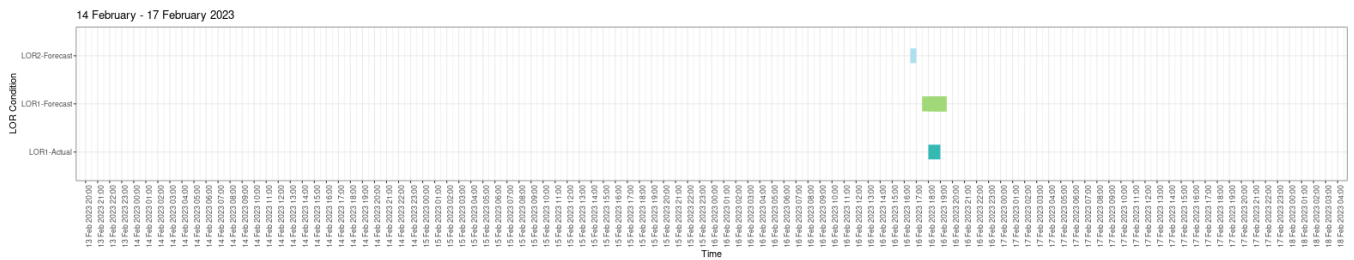There were no LOR declarations in the period from 21 January to 13 February 2023.

There were no LOR declarations in the period from 18 February to 31 March 2023.

3.1.5   Tasmania

There were no LOR declarations in the period from 1 January to 31 March 2022.

Legend
LOR1-Forecast   LOR2-Forecast   LOR3-Forecast
LOR1-Actual   LOR2-Actual   LOR3-Actual

4 Review of performance

4.1 Forecast Uncertainty Measure values

As in Section 2.1, this section will compare the 10th, 50th (median) and 90th percentile FUM values for this reporting period to those for each quarter from Quarter 1 2022 to Quarter 1 2023 (Figure 2 to Figure 6). FUM values decreasing is indicative of the distribution tightening with decreasing forecast uncertainty.

The most material changes in FUM values between Quarter 1 2022 and Quarter 1 2023 are summarised in this section. For forecast horizons not mentioned in this section, the changes from Quarter 1 2023 were minor:

- New South Wales – 10th, median and 90th percentile FUM values decreased for the 2, 6, 12, 24 and 48 hours ahead forecast horizons, and increased for the 60 hours ahead forecast horizon.

- Queensland – 10th percentile FUM values increased for the 2, 6, 12, 48 and 60 hours ahead forecast horizon. The median FUM values increased for the 2, 6, 12, 48 and 60 hours ahead forecast horizon. 90th percentile FUM values increased across all time forecast horizons.

- South Australia – 10th percentile FUM values increased across all forecast horizons. Median FUM values decreased for the 60 hours ahead forecast horizon. 90th percentile FUM values decreased for the 48 and 60 hours ahead forecast horizon.

- Tasmania – 10th percentile FUM values increased for the 2, 6, 12 and 60 hours ahead forecast horizon, and decreased for the 24 and 48 hours ahead forecast horizons. The median FUM values decreased across all but the 2 hours ahead forecast horizons. 90th percentile FUM values decreased for the 2, 6 and 60 hours ahead forecast horizons.

- Victoria – 10th percentile FUM values decreased for the 6, 12, 24, 48 and 60 hours ahead forecast horizon, and was the same for the 2 hours ahead forecast horizons. The median and 90th percentile FUM values decreased across all the forecast horizons.

Figure 2   New South Wales region: FUM values for the reporting period, and compared to previous four quarters
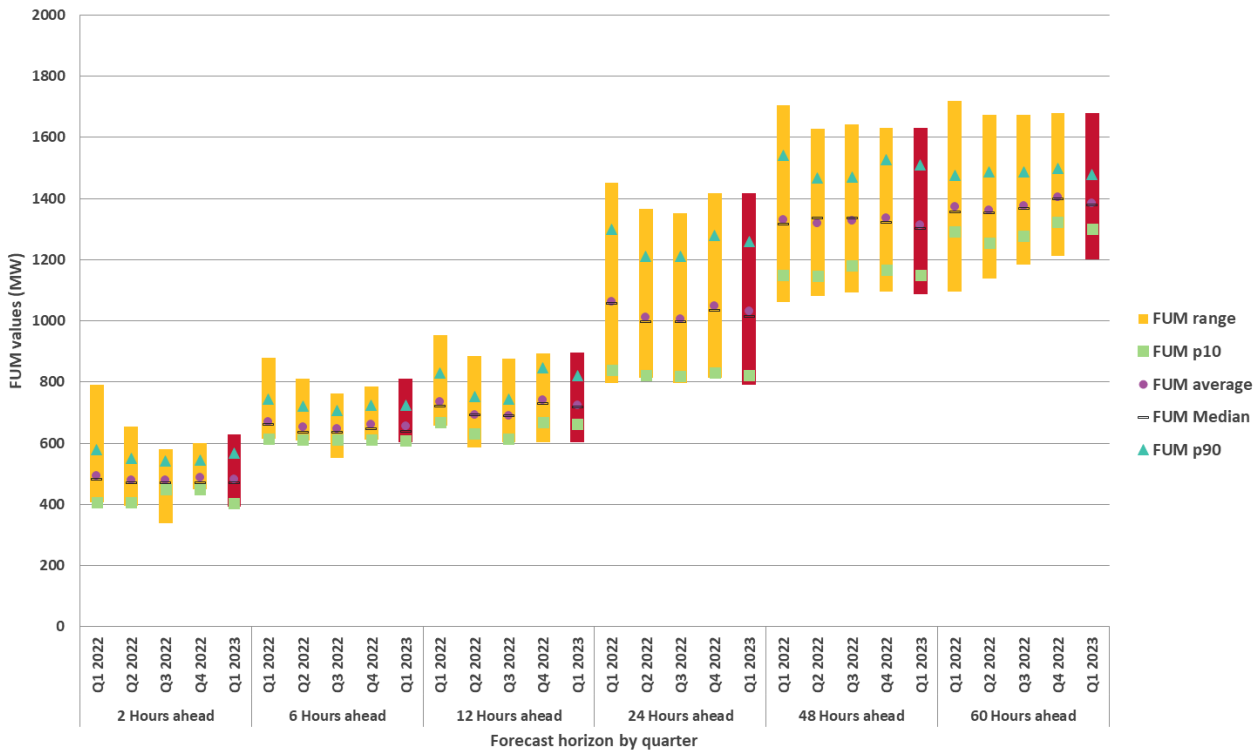

Figure 3   Queensland region: FUM values for the reporting period, and compared to previous four quarters
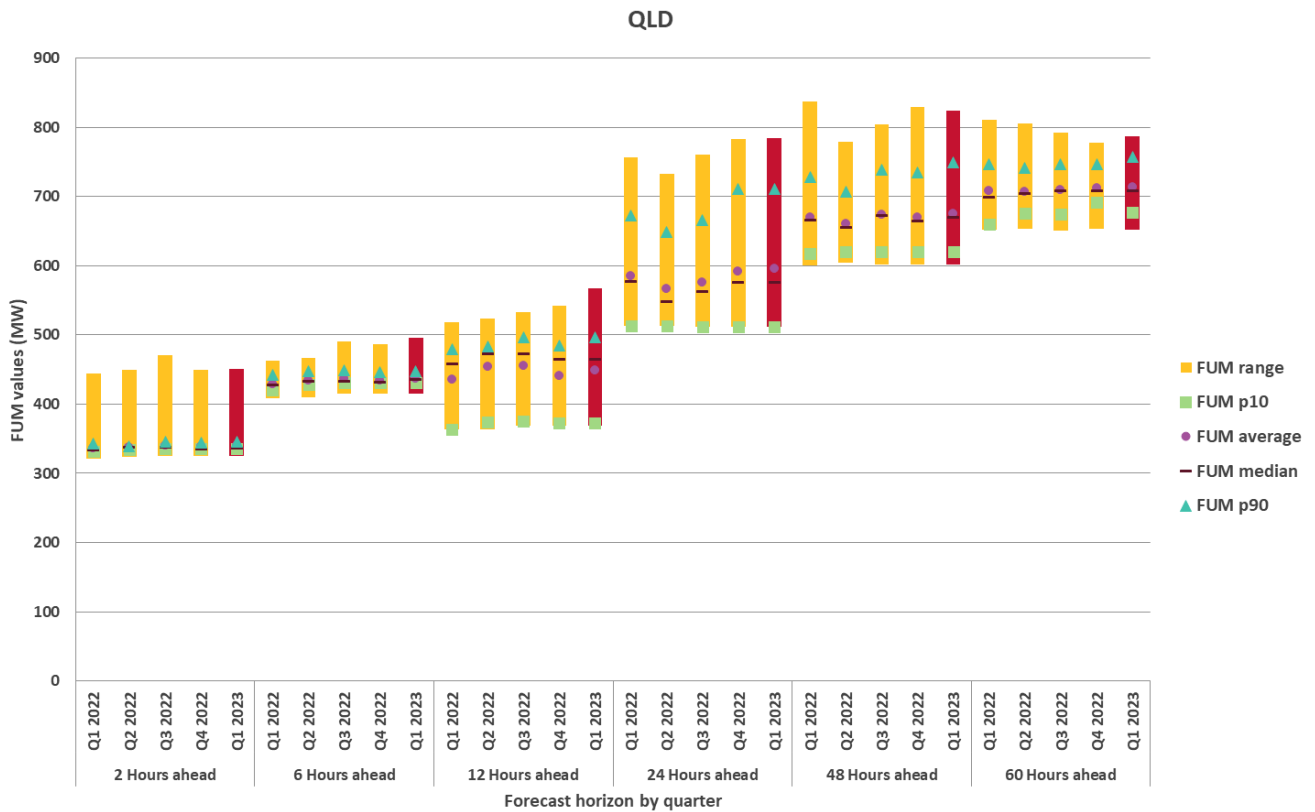
Figure 4   South Australia region: FUM values for the reporting period, and compared to previous four quarters
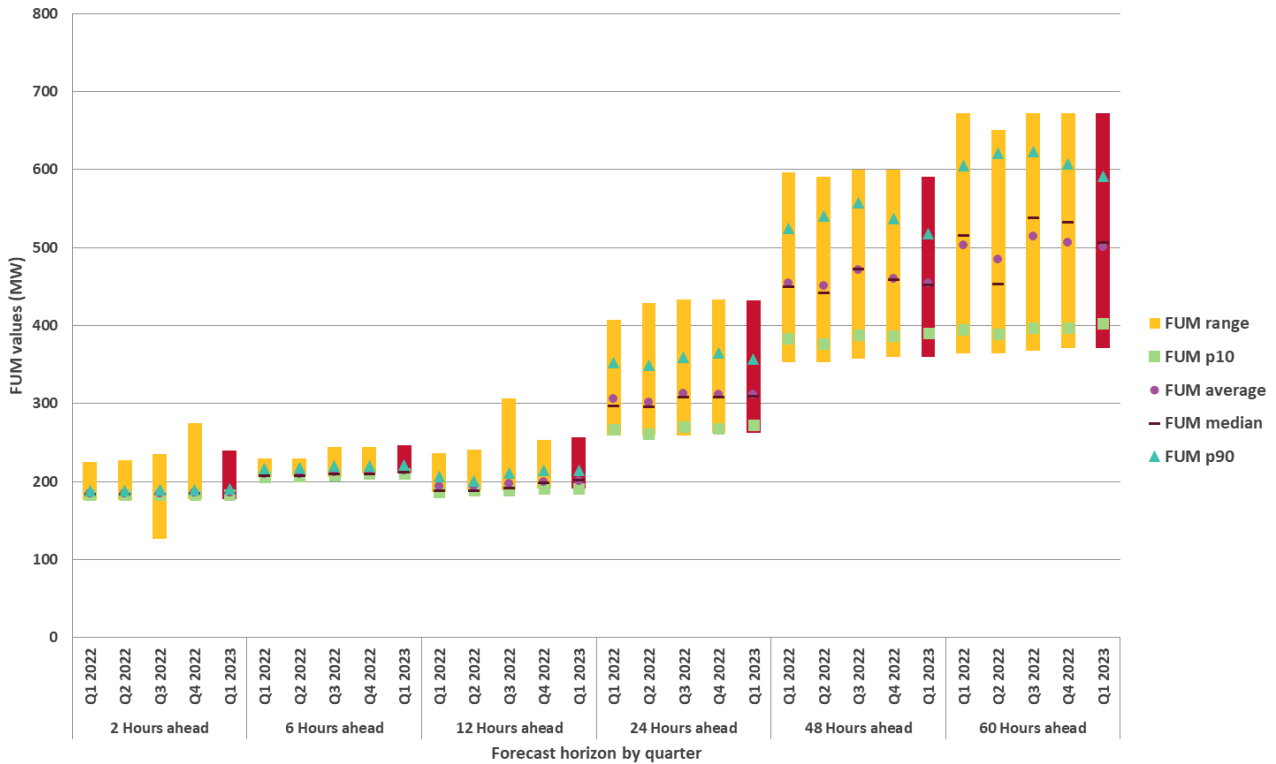

Figure 5   Tasmania region: FUM values for the reporting period, and compared to previous four quarters
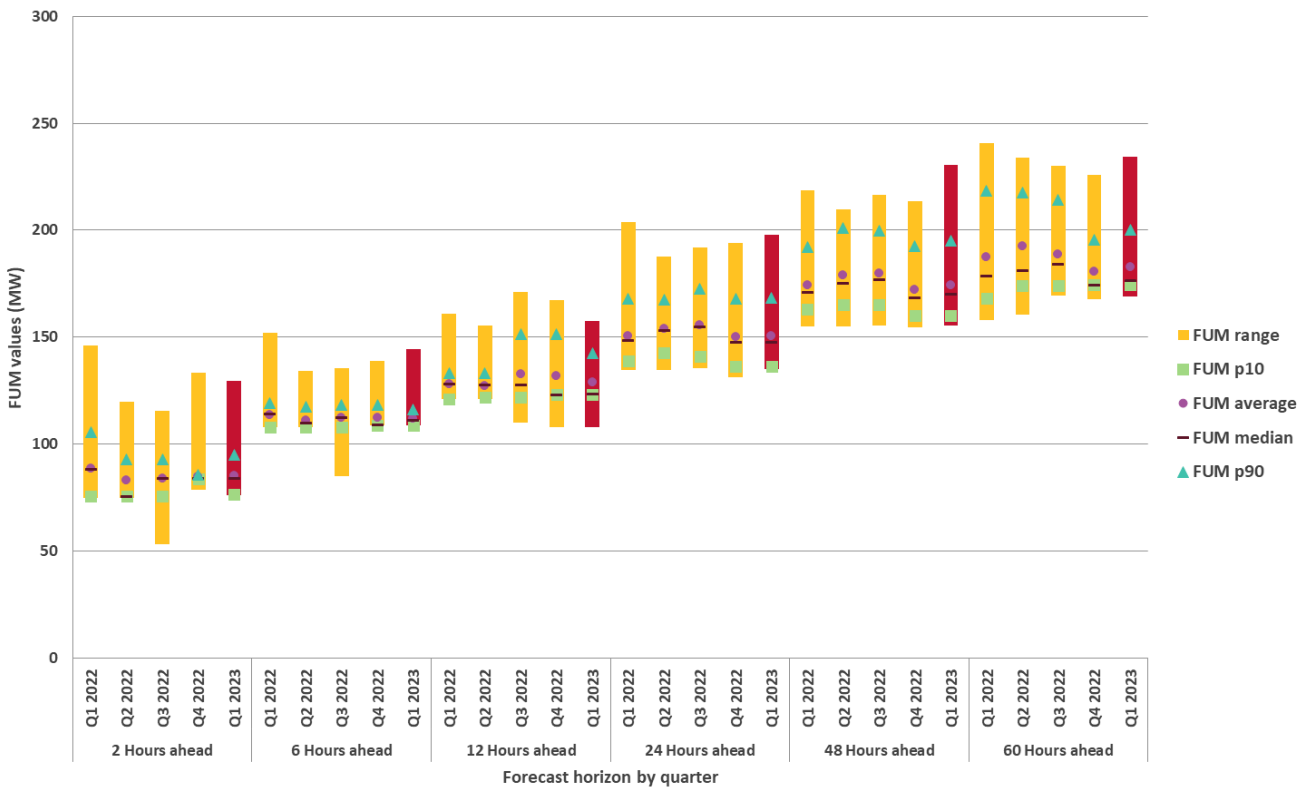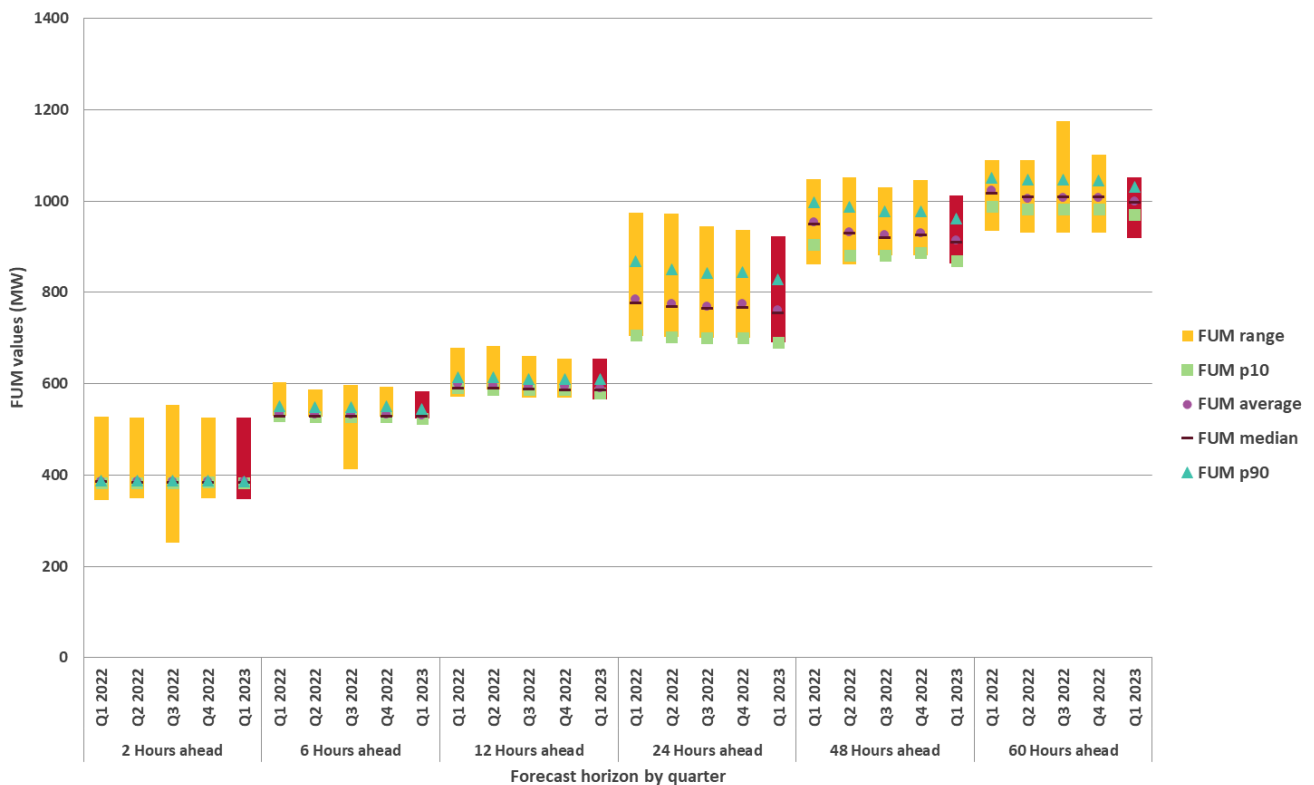
Figure 6   Victoria region: FUM values for the reporting period, and compared to previous four quarters

4.2   Forecast and actual LOR declarations

A summary of the count and causes of declared forecast and actual LOR conditions can be found in Table 2 in Section 3 of this report.

Of the 65 LOR declarations in the reporting period, 37 were for forecast LOR conditions:

- 19 forecast LOR1 conditions were declared.

- 18 forecast LOR2 conditions were declared.

- No forecast LOR3 conditions were declared.

- None of the forecast LOR1 conditions were set by the FUM.

- 11 forecast LOR2 conditions were set by the FUM.

- A total of 24 actual LOR1 conditions were declared. Of these, 16 were observed as forecast LOR1 prior to being declared as an actual, therefore not counted as a forecast declaration based on the declaration count principles outlined in Section 3. Eight were declared as actual LOR1 conditions without prior forecast.

- There were four actual LOR2 conditions declared. Three were observed as forecast LOR2 prior to being declared as an actual. One was declared as actual LOR2 conditions without prior forecast.

Table 3   Summary of LOR conditions during reporting period, 1 January to 31 March 2023

Region	LOR1		LOR2		LOR3	
	Actual	Forecast	Actual	Forecast	Actual	Forecast
NSW	9	4	2	6	0	0
QLD	11	7	2	5	0	0
SA	3	6	0	5	0	0
TAS	0	0	0	0	0	0
VIC	1	2	0	2	0	0
Total	**24**	**19**	**4**	**18**	**0**	**0**

Reliability and Emergency Reserve Trader (RERT) activations

During the reporting period, RERT services were activated on 3 February (Queensland). RERT services were contracted on 16 March (New South Wales) but not activated[5].

Table 4   LORs declared during the reporting period by trigger (FUM or LCR)

Effective period	LOR1	LOR2	LOR3
New South Wales (NSW)			
18/01/2023	Forecast		
29/01/2023	Actual	Forecast	
	Forecast then Actual		
02/02/2023	Forecast then Actual	Forecast	
11/02/2023	Forecast then Actual		
06/03/2023	Forecast then Actual	Forecast then Actual	
07/03/2023	Forecast	Forecast	
16/03/2023	Forecast then Actual	Forecast then Actual	
17/03/2023	Forecast then Actual	Forecast	
18/03/2023	Forecast then Actual	Forecast	
19/03/2023	Forecast then Actual	Forecast	
21/03/2023	Forecast		
23/03/2023	Forecast		
Queensland (QLD)			
04/01/2023	Forecast		
09/01/2023	Actual		
25/01/2023	Forecast		
26/01/2023	Actual		
31/01/2023	Actual	Actual	
01/02/2023	Forecast then Actual		
02/02/2023	Forecast	Forecast	

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[5] RERT reporting can be found at https://aemo.com.au/energy-systems/electricity/emergency-management/reliability-and-emergency-reserve-trader-rert/rert-reporting.

Effective period	LOR1	LOR2	LOR3
03/02/2023	Forecast	Forecast	
	Forecast then Actual	Forecast	
12/02/2023	Actual		
13/02/2023	Actual		
16/03/2023	Forecast then Actual	Forecast then Actual	
17/03/2023	Forecast then Actual	Forecast	
18/03/2023	Forecast		
22/03/2023		Forecast	
27/03/2023	Forecast then Actual		
28/03/2023	Forecast then Actual		
29/03/2023	Forecast		
30/03/2023	Forecast		
South Australia (SA)			
13/01/2023	Forecast	Forecast	
16/01/2023	Forecast	Forecast	
17/01/2023	Forecast	Forecast	
27/01/2023	Forecast		
09/02/2023	Actual		
16/02/2023	Actual		
22/02/2023	Forecast		
23/02/2023	Forecast then Actual	Forecast	
		Forecast	
24/02/2023	Forecast		
Tasmania (TAS)			
NIL			
Victoria (VIC)			
17/01/2023	Forecast	Forecast	
	Forecast		
16/02/2023	Forecast then Actual	Forecast	

Note. Yellow shading indicates the requirement was set by the LCR or LCR2, and orange indicates the requirement was set by the FUM.

4.3   Causes of LOR declarations

As summarised in Table 2, a total of 65 LOR conditions were declared during the reporting period: 37 forecast and 28 actual LOR conditions.

Based on Table 2:

- Of the 35 forecast LOR1 conditions declared, 16 resulted in actual LOR1 conditions. These were counted as actual LOR1 conditions based on the declaration count principles outlined in Section 3.

- Of the 21 forecast LOR2 conditions declared, three resulted in an actual LOR2 condition. It was counted as an actual LOR2 condition based on the declaration count principles outlined in Section 3.

- There were 19 forecast LOR1 conditions that did not develop into actual LOR1 conditions, and 18 forecast LOR2 conditions that did not develop into actual LOR2 conditions. The reasons were either a market response following the issue of the forecast market notice, or changes to the net import or changes in forecast demand. The market response generally took the form of increased available generation or transmission network service providers (TNSPs) rescheduling planned transmission outages. Some of the forecast LOR conditions were cancelled when the FUM value decreased.

As Table 4 above shows, during the reporting period there were nine instances where actual LOR conditions occurred with no prior forecast.

- The LOR conditions in New South Wales, Queensland and South Australia were mainly driven by decreased generation availability and high demand forecasts.

- The LOR conditions in Victoria was mainly due to decreased generation availability.

- There were no LOR conditions declared in Tasmania.

4.4   Number of LOR declarations compared to previous quarters

Quarter 1 2023 covered the mid-to late summer months and the first month of autumn.

A total of 65 LOR conditions were declared during Quarter 1 2023: 37 forecast and 28 actual LOR conditions. This is slightly lower than the 69 LOR declarations recorded in the previous reporting period (1 October 2022 to 31 December 2022), but higher than the 36 LOR conditions declared for the same period last year (Quarter 1 2022).

Figure 7 shows the historical trend of actual and forecast LOR conditions in past quarters from Quarter 2 2021 compared to the Quarter 1 2023.

Figure 7   Quarterly comparison of actual and forecast LOR conditions, Q2 2021 to Q1 2023
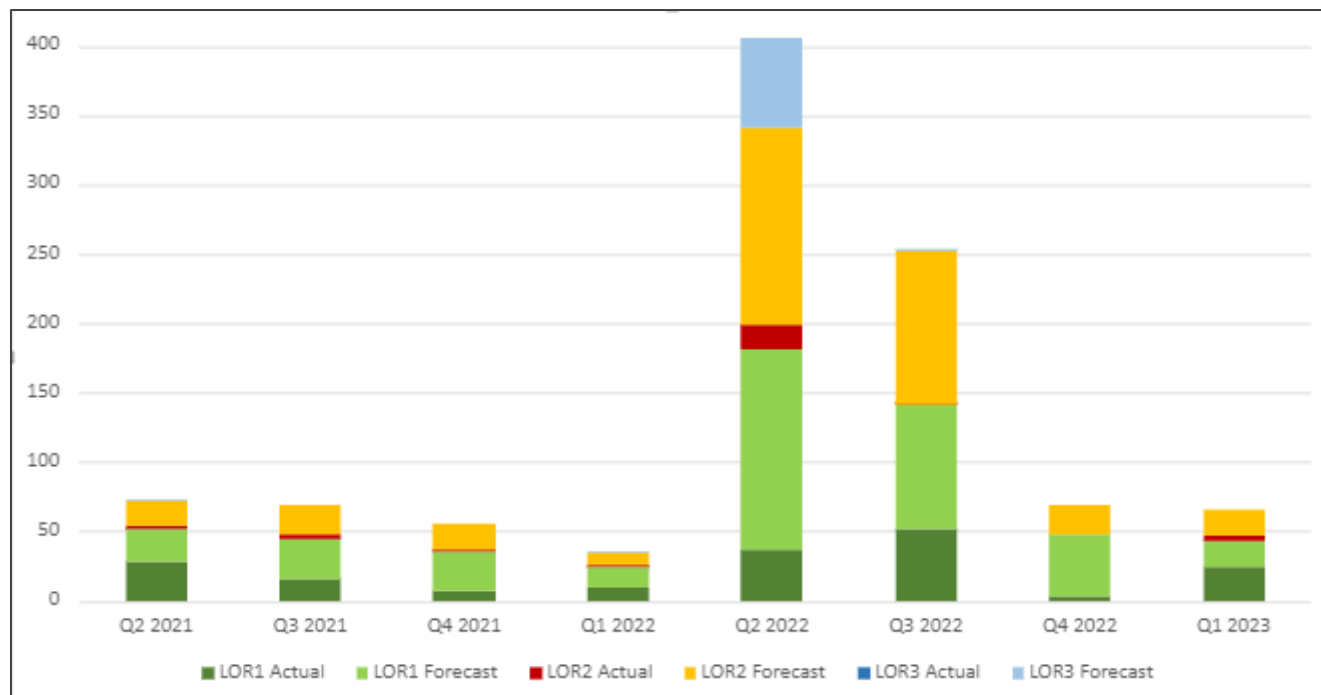
Glossary

This document uses many terms that have meanings defined in the NER. The NER meanings are adopted unless otherwise specified.

For each of the terms below, refer to the Reserve Level Declaration Guidelines[6] for further information.

Term	Definition
AEST	Australian Eastern Standard Time
BBN	Bayesian Belief Network[7]
ETL	Extract-Transform-Load
FUM	Forecast Uncertainty Measure (the number of MW representing the level of forecasting uncertainty)
Guidelines	The Reserve Level Declaration Guidelines published by AEMO under clause 4.8.4A of the NER
LCR	Largest Credible Risk – the single largest credible risk in the region
LCR2	Largest Credible Risk 2 – the sum of the two largest credible risks in the region
LOR1	Lack of Reserve level 1. The threshold for an LOR1 is determined by the larger value of either the FUM or the sum of the two largest credible risks in the region (LCR2).
LOR2	Lack of Reserve level 2. The threshold for an LOR2 is determined by the larger value of either the FUM or the largest credible risk in the region (LCR).
LOR3	Lack of Reserve level 3. The threshold for an LOR3 condition is when the forecast reserve for a region is at or below zero.
PASA	Projected Assessment of System Adequacy[8]
RERT	Reliability and Emergency Reserve Trader[9]
TNSP	Transmission network service provider

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[6] See AEMO's reserve level declaration guidelines, at https://www.aemo.com.au/-/media/files/electricity/nem/security_and_reliability/power_system_ops/reserve-level-declaration-guidelines.pdf.

[7] More detail regarding Bayesian Belief Networks is available in the Appendix of AEMO's reserve level declaration guidelines document in the link above.

[8] See AEMO's Projected Assessment of System Adequacy (PASA) principles, at https://aemo.com.au/en/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/forecasting-and-reliability/projected-assessment-of-system-adequacy.

[9] See AEMO's Reliability and Emergency Reserve Trader (RERT) guidelines, at https://aemo.com.au/en/energy-systems/electricity/emergency-management/reliability-and-emergency-reserve-trader-rert.