Draft unplanned outage rate projections

For the 2023 NEM ESOO

14 June 2023

Forecasting Reference Group Meeting

Purpose and agenda

The purpose of this presentation is to *consult* with the FRG on the draft unplanned outage rates for generators and key inter-regional transmission flow paths, for the 2023 Electricity Statement of Opportunities (ESOO) for the National Electricity Market (NEM).

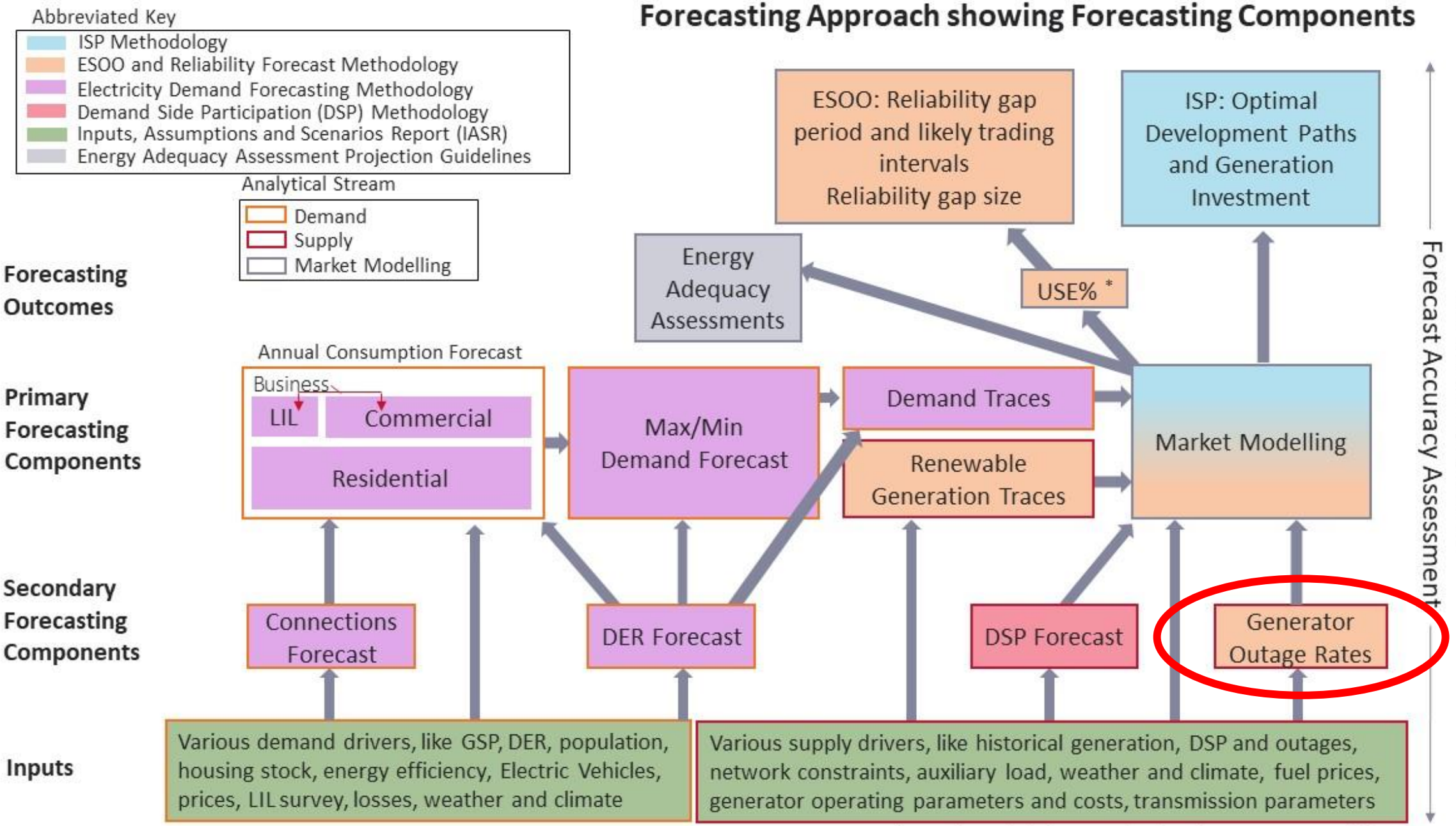
Today's Agenda includes:

- Review methodology changes
- Unplanned outage projections by technology
- Unplanned outage rates for key inter-regional transmission flow paths.
- Feedback and next steps

Relevant engagement includes:

Timing	Relevant topic	Responsible
Nov 22 – Apr 23	Reliability Forecasting Guideline and Methodology consultation revised the methodology for outage rates.	Stakeholders, AEMO
May 23	Historic and projected outage rates were submitted by generator participants consistent with updated methodology.	Generator participants, AEMO
Today	**FRG consultation on draft projections**	**AEMO, FRG**
End Aug	2023 ESOO publication	AEMO

Forecasting Approach showing Forecasting Components



See AEMO's Forecasting Approach

Methodology changes in 2023

- AEMO consulted on changes to the unplanned outage rate methodology between November 2022 and April 2023.
- The updated generator methodology now collects and applies all unplanned (non-discretionary) outages, regardless of whether they occurred in a committed, or non-committed state.

$$\text{Full Unplanned Outage Rate} = \frac{\text{Total hours in (full unplanned outage, committed state + failed start state)}}{\text{Total hours in (committed state + full unplanned outage, committed state + failed start state)}} + \frac{\text{Total hours in (full unplanned outage, available but not commited state + full planned outage extension state)}}{\text{Total hours in year}}$$

- The updated transmission methodology now applies separate constraint sets for single credible contingencies, and reclassification events.

Generator long duration generation outages are averaged over 13 years

Long duration generator outages include all unplanned generator outages greater than 5 months. Hydro and other gas and liquid generators are included for the first time.

Numerous long duration events were identified in 2022-23, many of which were located in Queensland.

These outages are removed from the calculation of station specific outage rates and are instead applied to all stations within the technology category.

The rates implemented are calculated by obtaining a 13 year average rate.

Technology	Long Duration Outage Rates (12 year average)	Mean Time to Repair (hours)
All Coal	0.90%	5,622
OCGT	0.77%	2,562
Hydro	0.10%	2,870
Other gas and liquids	0.49%	6,441

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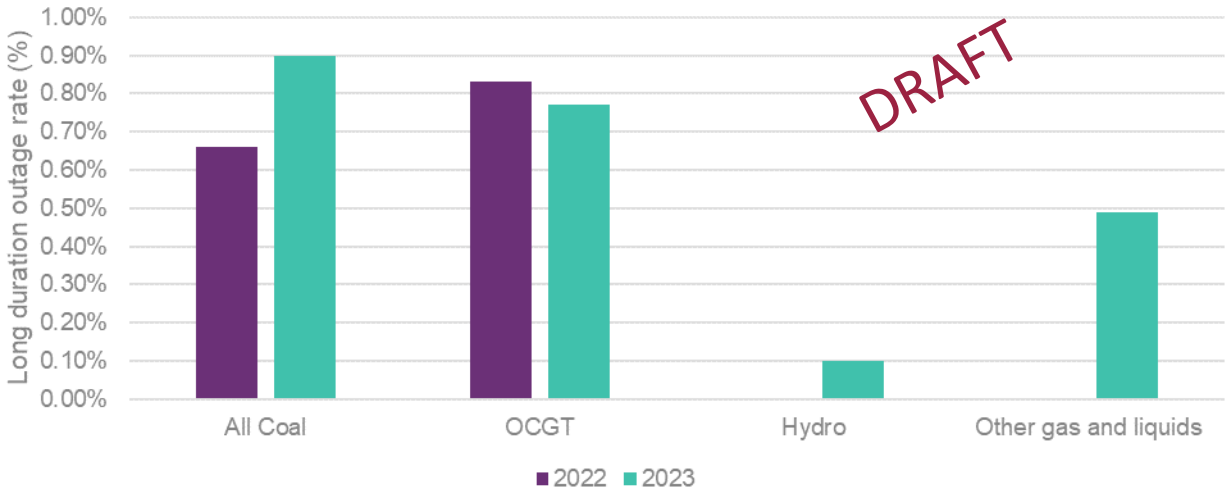
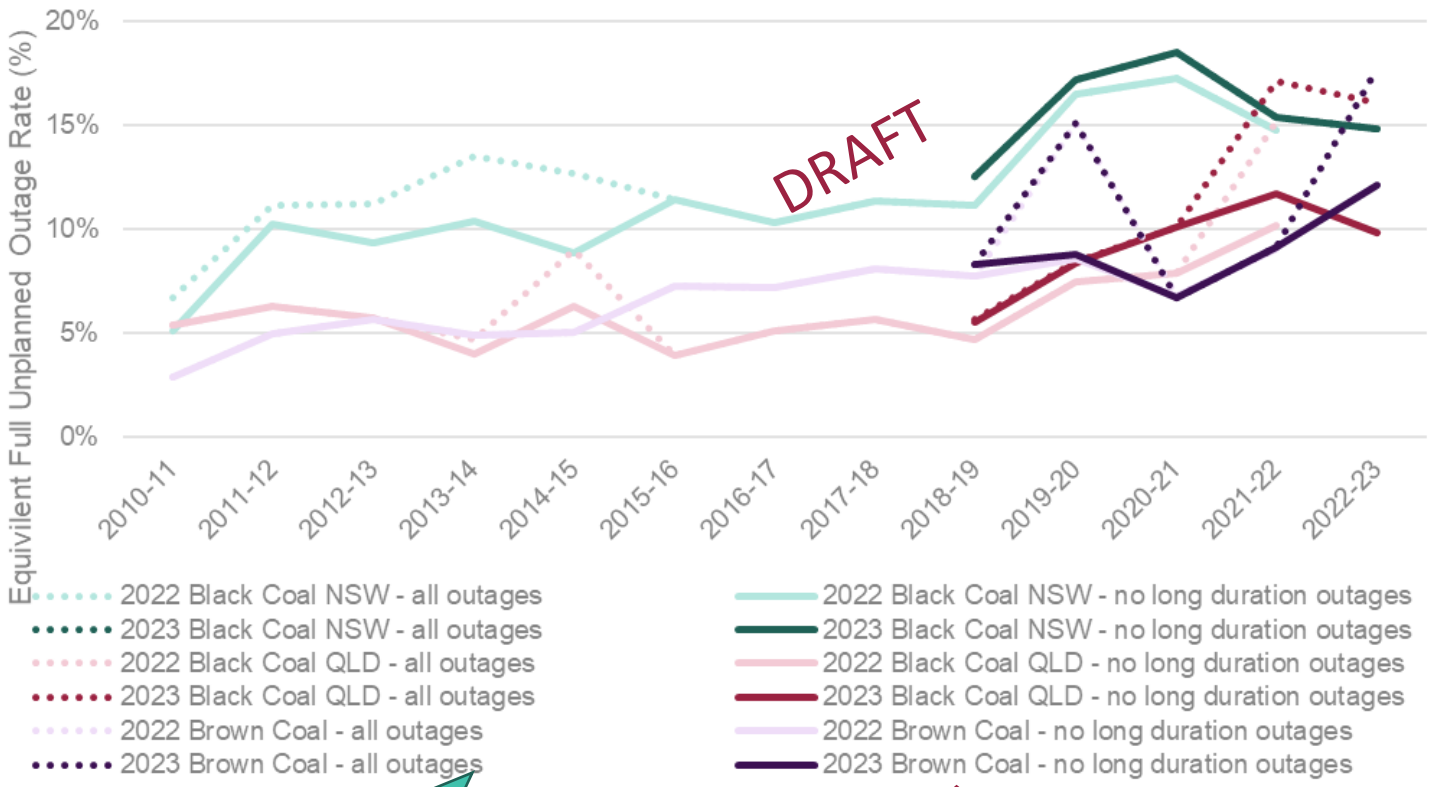


The updated methodology has resulted in revised history.

The 2022 outage rate history was driven predominantly by forced outages that occurred when the plant was committed (operating).

The 2023, updated outage rate history now captures all sources of unplanned outages, including those unplanned outages that occurred when the plant was uncommitted. It has been calculated for only the last 5 years.

The methodology continues to exclude planned outages, and any other outage that was taken at the discretion of the operator.



NSW black coal history has consistently been revised upwards.

QLD black coal history has consistently been revised upwards and has been subject to long duration outages.

Brown coal history has not varied significantly, and has also been subject to long duration outages.

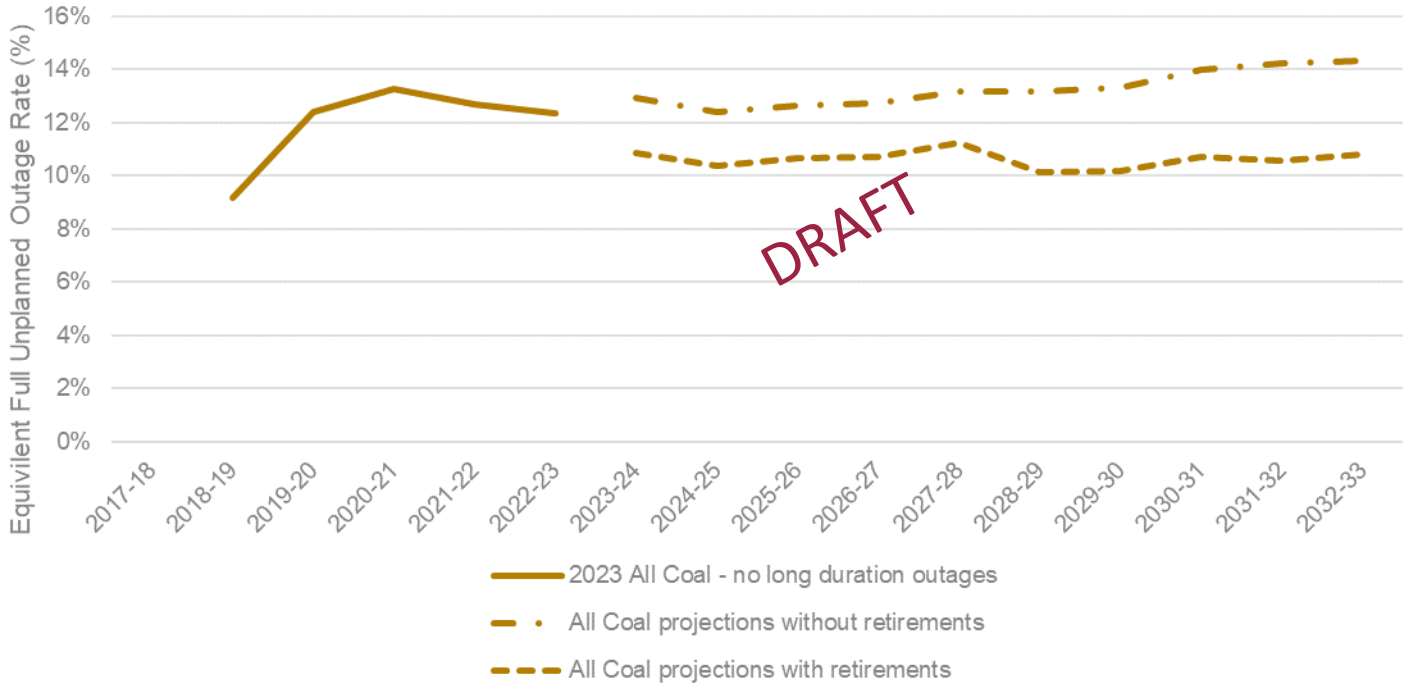
Outage rate projections are provided by participants for coal and large gas fired generators

- Responses were received by all requested participants.
- In some cases, upon review AEMO requested revisions or further justification.
- AEMO is still engaging with several participants regarding their provided submission.

- Flat projections that reflect the average of the last four years are applied to all other generators.

Outage rate projections often show a worsening outlook per station

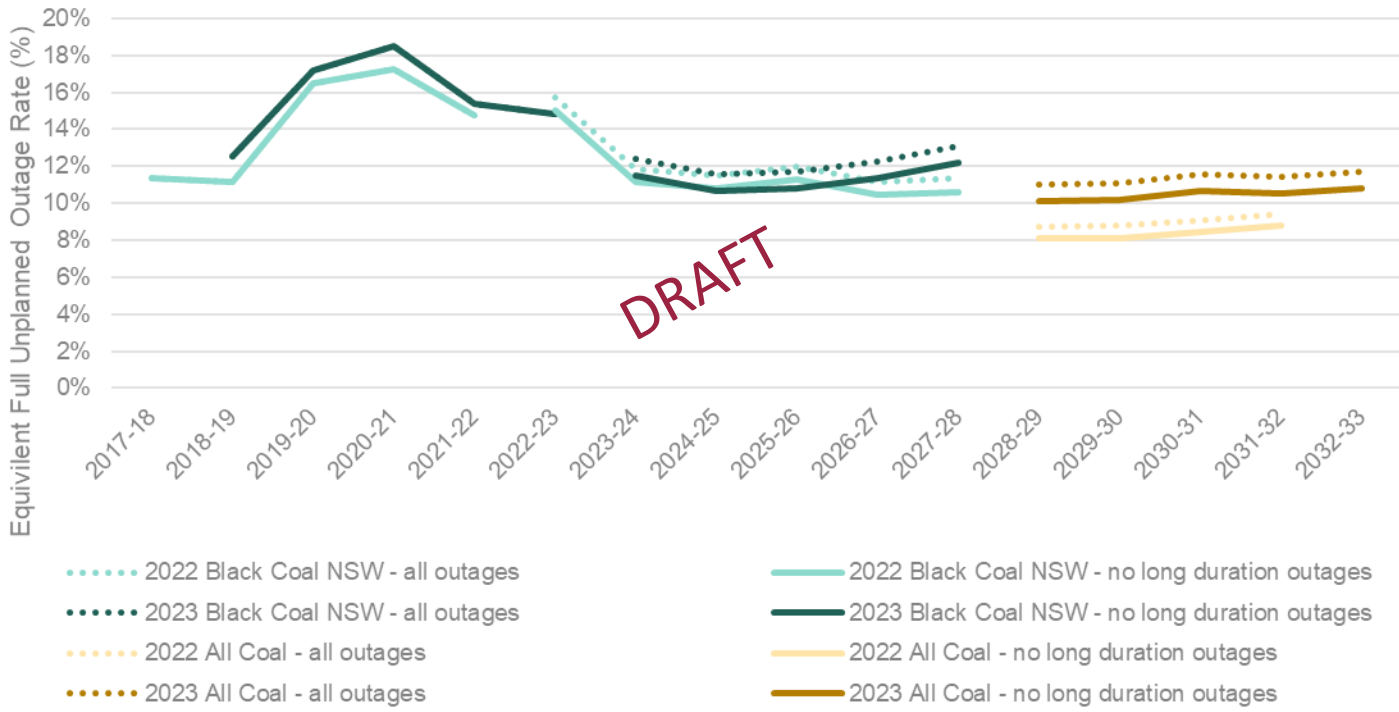
- Projections for outage rates at individual coal fired power stations typically show a worsening trend, reflecting expected degradation as the station ages, and potential changes to maintenance planning as the plant approaches retirement.
- However, once aggregated, the projections often show an improving trend.
- The difference in trajectory is driven by retirements, particularly the retirement of power stations with above average rates of unplanned outage.



For the purposes of this graph, the 'without retirements' series applies the last outage rate projection for the remainder of the horizon for retired generators.

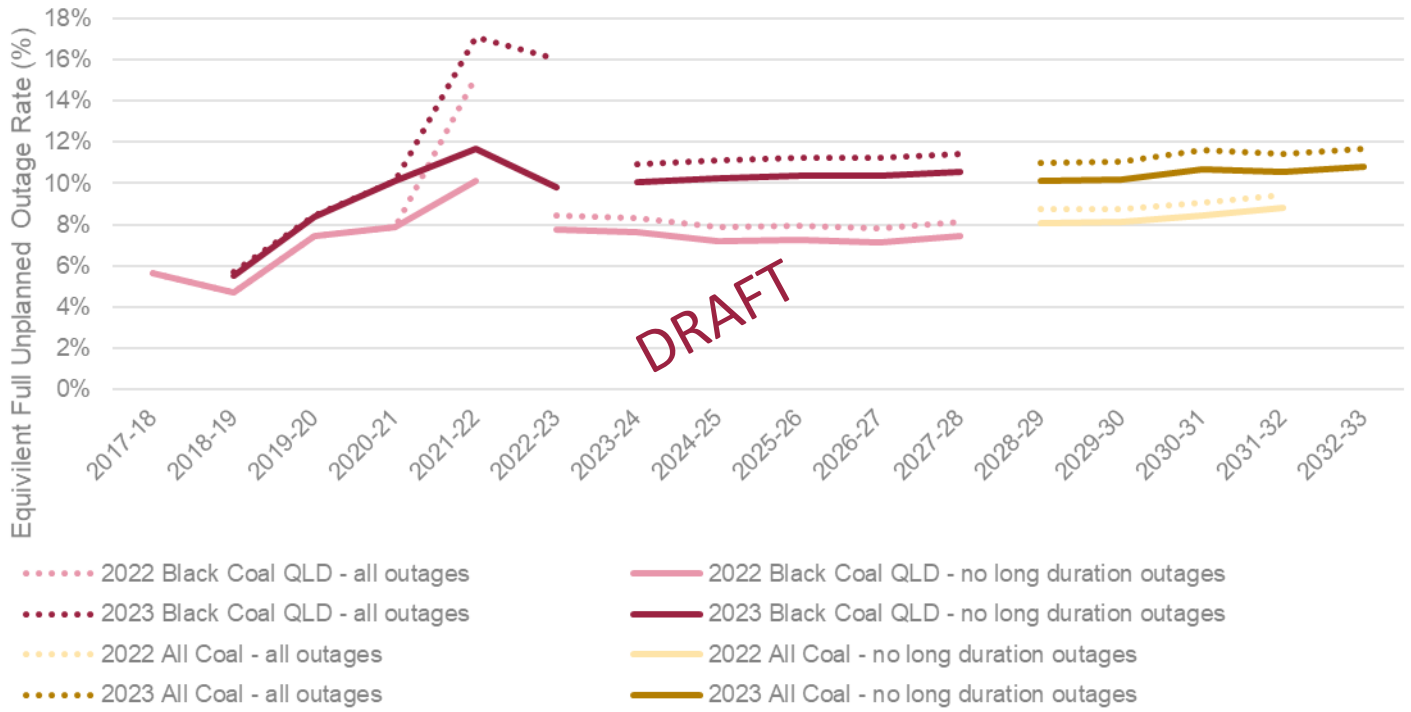
New South Wales black coal

- Projections for New South Wales black coal generators vary little from those applied in 2022 until 2026-27.
- Projections improve relative to recent history due to station retirements, and expected improvements that follow planned maintenance.
- From 2028-29 onwards, AEMO applies an All Coal aggregate to protect the confidentiality of participant submissions.



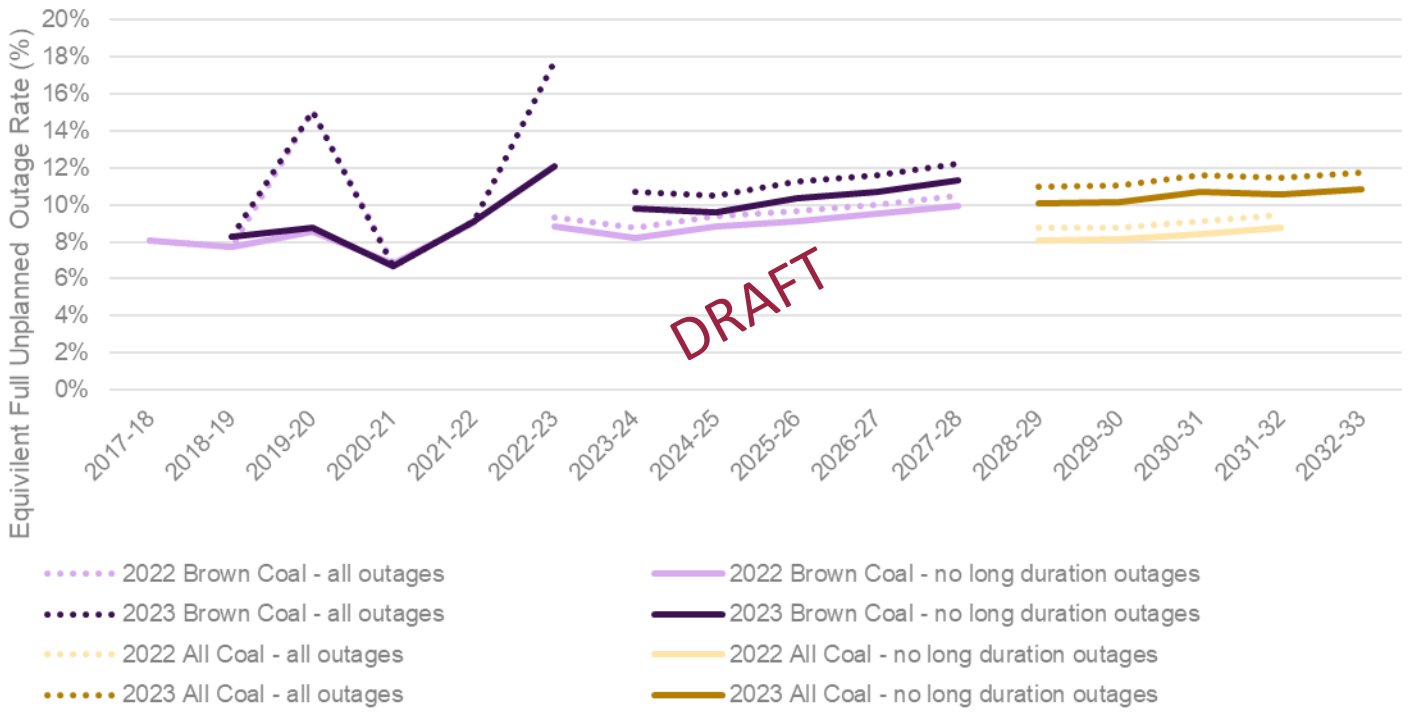
Queensland black coal

- Projections for Queensland black coal generators have increased relative to those provided in 2022, following the revised history and recent performance.
- Projections show a slight upward trend.
- From 2028-29 onwards, AEMO applies an All Coal aggregate to protect the confidentiality of participant submissions.



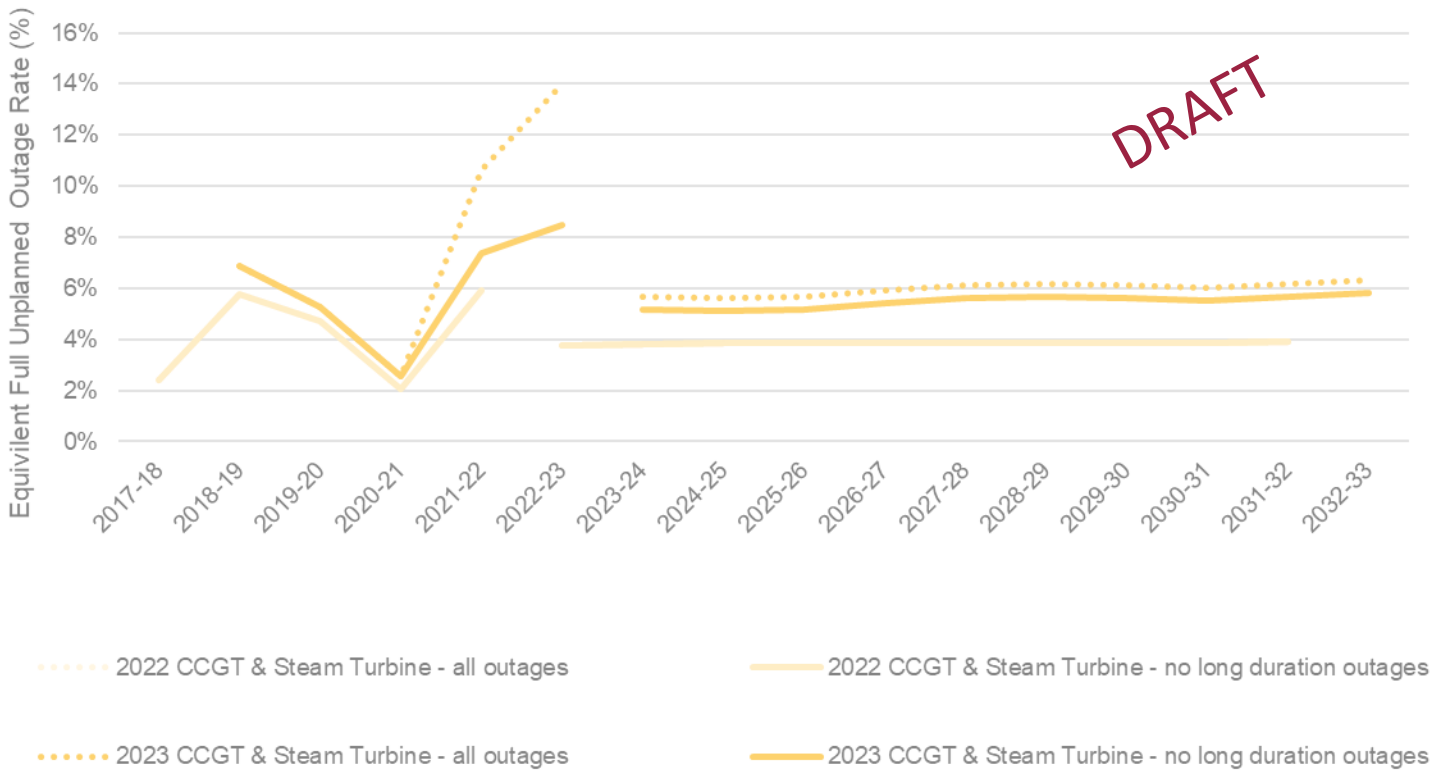
Victorian Brown Coal

- Projections for Victorian brown coal generators have increased slightly relative to those provided in 2022, following recent performance.
- Projections show an upward trend.
- From 2028-29 onwards, AEMO applies an All Coal aggregate to protect the confidentiality of participant submissions.



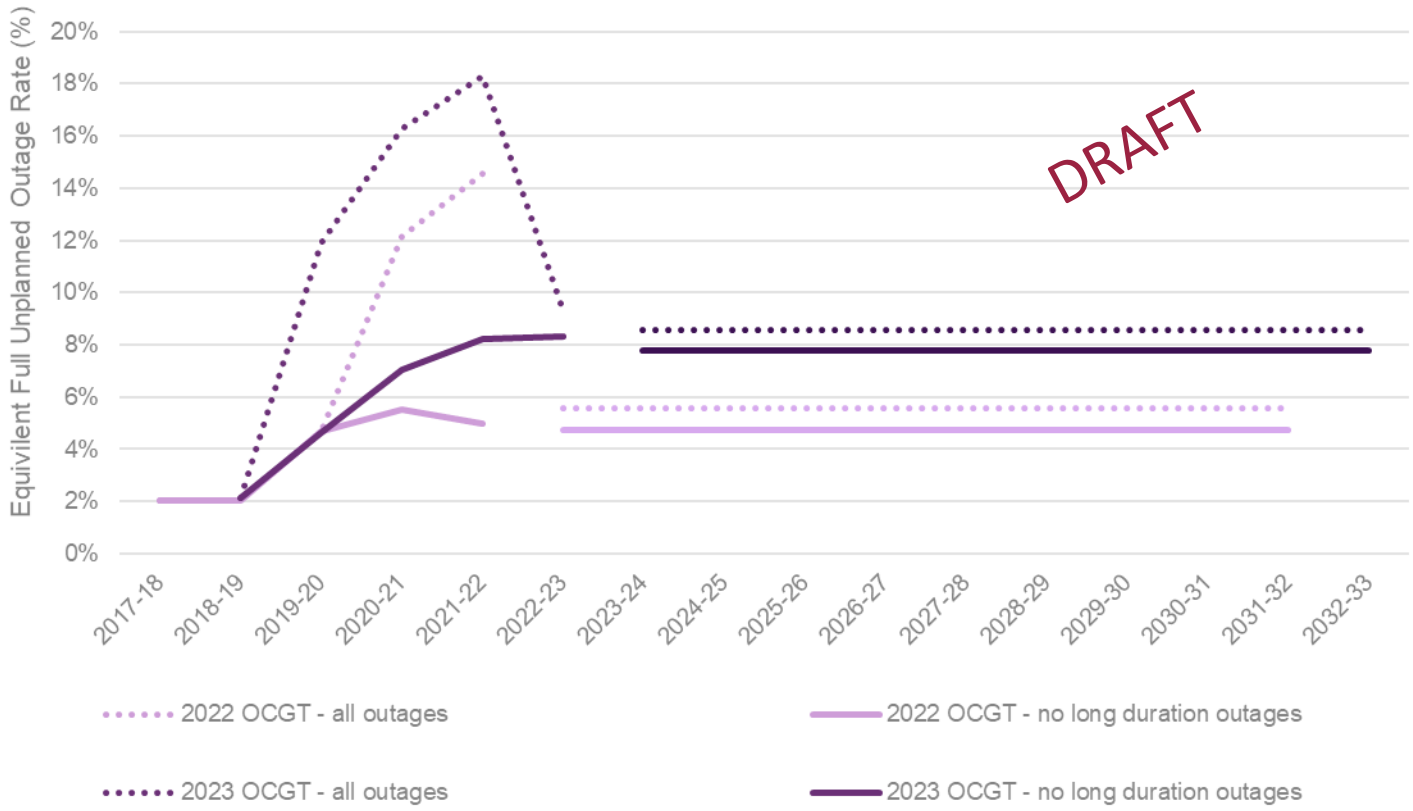
Closed Cycle Gas Turbines (CCGT) and Steam Turbines

- CCGT's and Steam Turbines are aggregated together to protect participant confidentiality.
- Increasing outage rates are observed in the history, which has been subject to revision.
- CCGT's apply a mixture of participant provided forecasts, and flat projections, which reflects recent performance.
- Long duration outage rates are applied to this category for the first time in 2023.



Open Cycle Gas Turbines (OCGT)

- This category includes large (non-peaking) OCGT's only.
- Increasing outage rates are observed in the history, which has been subject to revision.
- OCGT's apply a flat projection, which reflects recent performance.

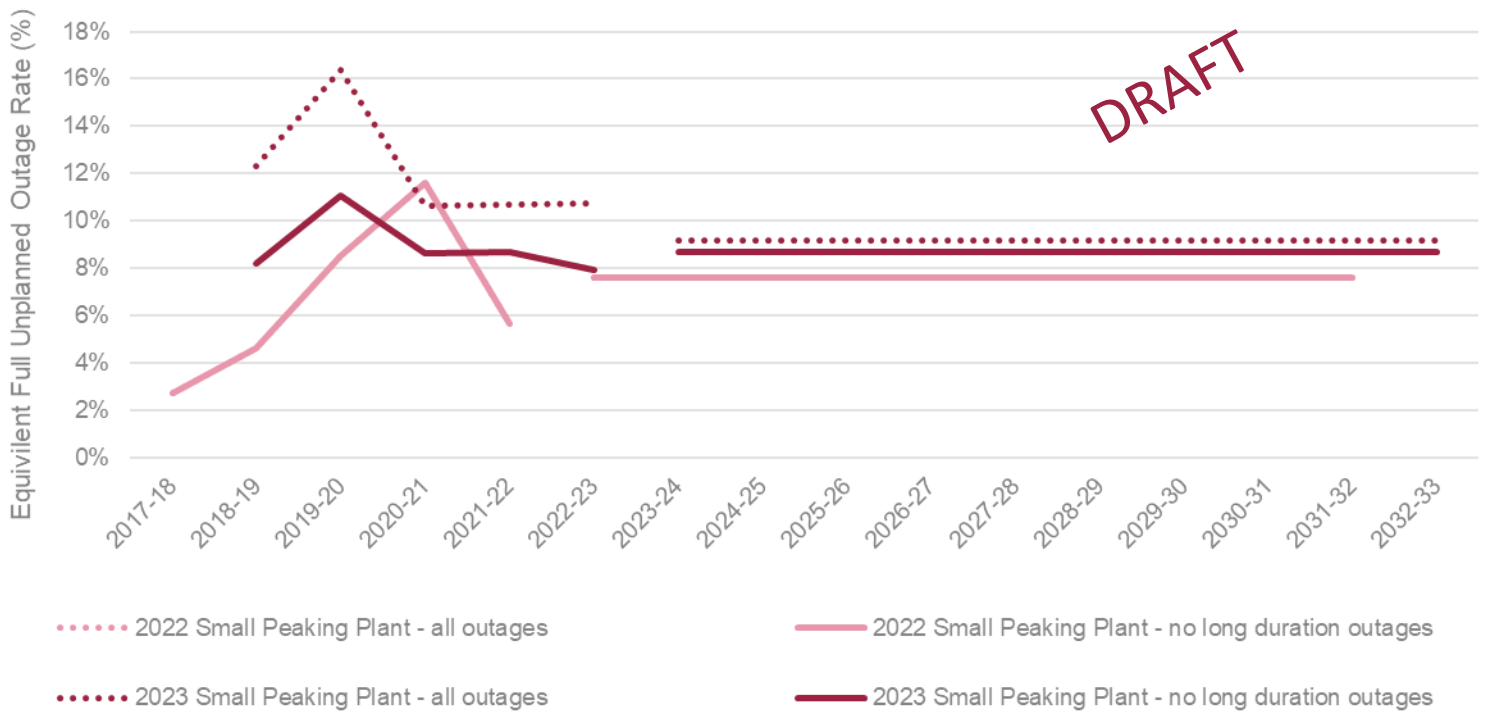


Hydro

- History has been subject to substantial revision, reflecting a large number of outages that have occurred in a non-committed state.
- A flat projection is applied for hydro generators, which reflects recent performance.
- Long duration outage rates are applied to this category for the first time in 2023.

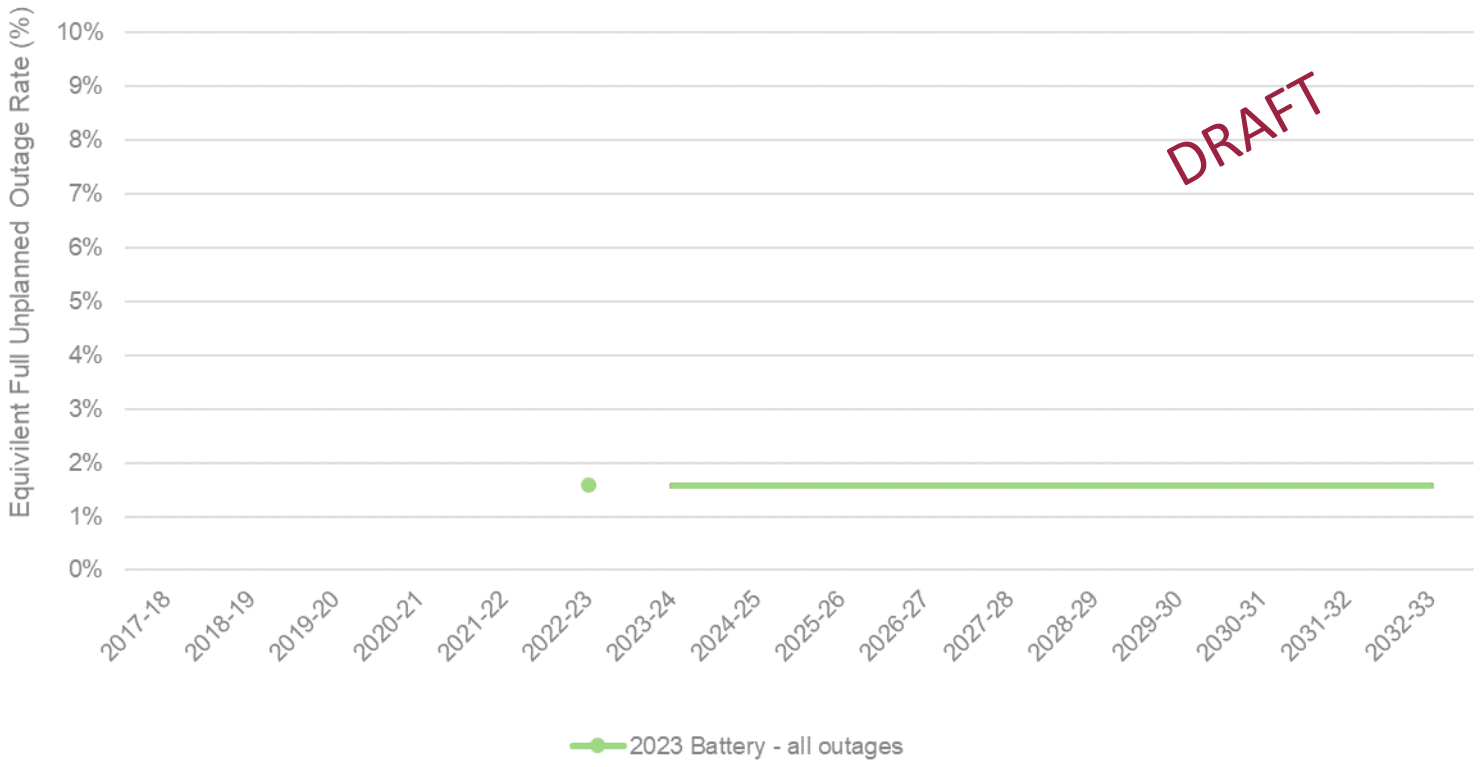
Peaking plant

- This category includes all gas and diesel generators that are subject to infrequent dispatch.
- History has been subject to substantial revision, reflecting a large number of outages that have occurred in a non-committed state.
- A flat projection is applied for peaking plant, which reflects recent performance.
- Long duration outage rates are applied to this category for the first time in 2023.



Batteries

- This category has been newly calculated in 2023, incorporating several in-service batteries.
- AEMO proposes to apply the one year of history to the 10 year projection.



Transmission flow paths considered in 2023

AEMO models some outages on a limited selection of transmission flow paths that are required for inter-regional power transfer.

- Liddell – Muswellbrook – Tamworth – Armidale – Dumaresq – Bulli Creek
- Murraylink
- Mortlake – Heywood – South East
- Basslink

Transmission unplanned outage rates

AEMO projects the occurrence of both single credible contingencies and reclassification events, on the key flow paths identified. Multiple and non-credible events are not considered.

Historical data is collected from AEMO sources and is filtered to remove any events that could be identified as having occurred in response to a multiple or non-credible contingency event.

Long duration events are included in the historic dataset.

Rates were developed using at least ten years of history for each flow path.

Flow path	Outage rate	Mean Time to Repair (hours)
Liddell – Bulli Creek (QNI) Credible Contingency	0.21%	9.9
Liddell – Bulli Creek (QNI) Reclassification	2.28%	9.9
Murraylink – Credible Contingency	0.07%	12.4
Basslink – Credible Contingency	5.35%	206.9
Mortlake – South East (VSA) Credible Contingency	0.09%	20.1
Mortlake – South East (VSA) Reclassification	0.19%	20.1

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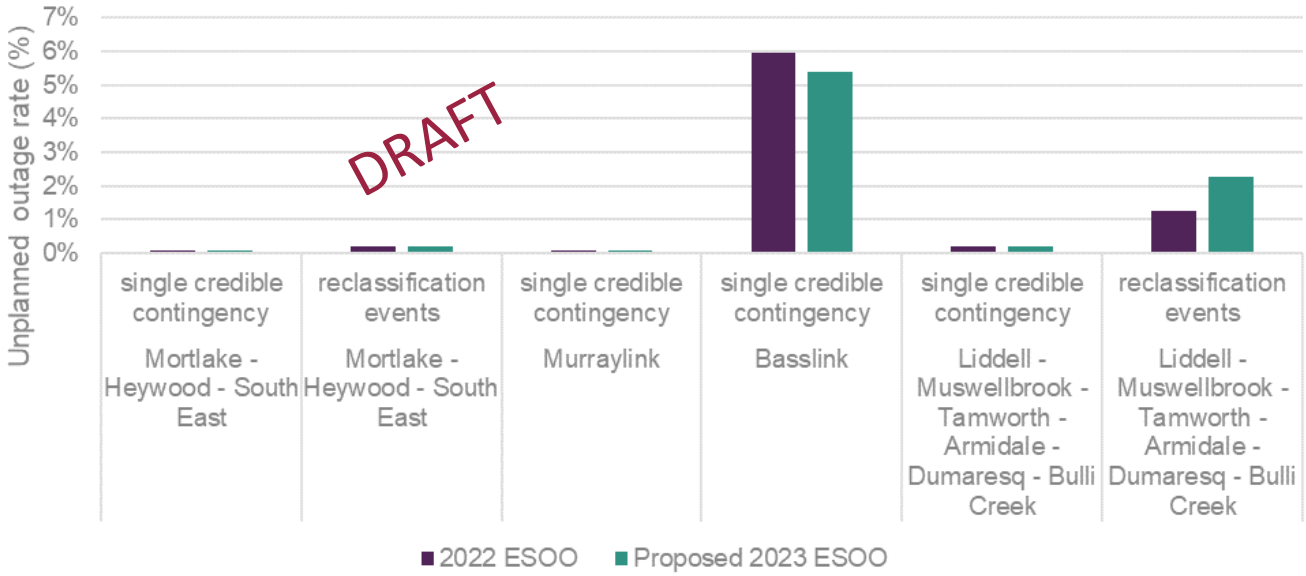

Questions for consultation

- Has AEMO correctly applied its generation unplanned outage rate methodology?
- Has AEMO correctly applied its transmission unplanned outage rate methodology?
- Are there any other factors or technologies AEMO should consider in future assessments?