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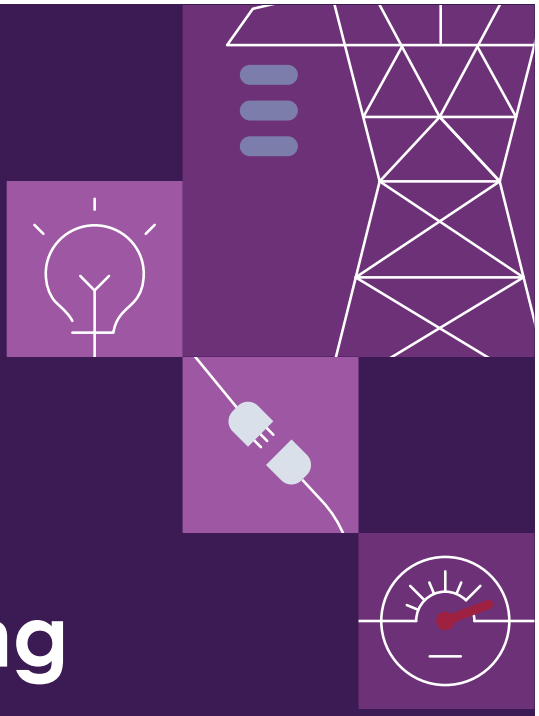

Reliability Forecasting guidelines and methodologies consultation

Draft Report – Standard consultation for the National Electricity Market

Published: 3 February 2023

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Australian Energy Market Operator Ltd ABN 94 072 010 327

Executive summary and consultation notice

The publication of this draft report commences the second stage of the standard consultation procedure conducted by AEMO to review a number of reliability forecasting guidelines and methodologies.

This consultation is intended to satisfy AEMO's requirements under:

- The 'Enhancing information on generator availability in MT PASA' rule change[1].
- AEMO's commitment to review processes used for projecting supply adequacy over the medium term, as specified in the market event and reviewable operating incident report for the National Electricity Market (NEM) market suspension and operational challenges in June 2022[2].
- The Australian Energy Regulator's (AER's) Forecasting Best Practice Guidelines, and AEMO's Reliability Forecast Guidelines (to review AEMO's forecasting methodologies at least once every four years).
- National Electricity Rules (NER) 3.9.3D(e) (to review the Reliability Standard Implementation Guidelines at least once every four years).

Further, AEMO will implement minor and administrative changes related to the 'Integrating energy storage systems into the NEM' rule change (IESS Rule Change)[3]. Administrative changes may also apply to other AEMO documents, such as the Spot Market Operations Timetable.

This draft report includes changes for the purposes of the National Electricity Amendment (Integrating energy storage systems into the NEM) Rule 2021 No. 13 (IESS Rule). The terms used in this draft report have the same meaning as the equivalent defined terms in NER Chapter 10, including changes to Chapter 10 as a result of the IESS Rule Change. These changes will be effective on 3 June 2024, however no material metholodgy changes should arise from their inclusion prior to this date.

The following guidelines and methodologies are subject to review in this consultation:

Guidelines and methodologies subject to consultation	Primary rule
Reliability Standard Implementation Guidelines (RSIG)[A]	NER 3.9.3C NER 3.9.3D
Energy Adequacy Assessment Projection (EAAP) Guidelines	NER 3.7C
Generation Information Guidelines	NER 3.7F
Medium Term Projection Assessment of System Adequacy (MT PASA) Process Description	NER 3.7.2
ESOO and Reliability Forecast Methodology	NER 3.13.3A NER 4A Parts A-C

A. AEMO intends to undertake targeted consultation required by the 'Updating Short Term PASA' rule change[4] in early 2023. RSIG elements specifically relating to ST PASA are therefore not be the focus of this consultation.

[1] See https://www.aemc.gov.au/rule-changes/enhancing-information-generator-availability-mt-pasa.

[2] See https://www.aemo.com.au/-/media/files/electricity/nem/market_notices_and_events/market_event_reports/2022/nem-market-suspension-and-operational-challenges-in-june-2022.pdf.

[3] See https://www.aemc.gov.au/rule-changes/integrating-energy-storage-systems-nem.

[4] See https://www.aemc.gov.au/rule-changes/updating-short-term-pasa.

Several key issues and requirements are addressed in this consultation, and are discussed below. For the purpose of this consultation, AEMO uses the term 'reliability forecasts' to collectively describe the Electricity Statement of Opportunities (ESOO), Energy Adequacy Assessment Projection (EAAP) and Medium Term Projected Assessment of System Adequacy (MT PASA) forecasts.

Consultation notice

AEMO invites written submissions from interested persons on the draft proposal and issues identified in this draft report to **energy.forecasting@aemo.com.au** by 5:00 pm (Melbourne time) on 3 March 2023.

Submissions may make alternative or additional proposals you consider may better meet the objectives of this consultation and the national electricity objective in section 7 of the National Electricity Law. Please include supporting reasons.

Please note the following important information about submissions:

- All submissions will be published on AEMO's website, other than confidential content.
- Please identify any parts of your submission that you wish to remain confidential, and explain why. AEMO may still publish that information if it does not consider it to be confidential, but will consult with you before doing so. Material identified as confidential may be given less weight in the decision-making process than material that is published.
- AEMO is not obliged to consider submissions received after the closing date and time. Any late submissions should explain the reason for lateness and the detriment to you if AEMO does not consider your submission.

Interested persons can request a meeting with AEMO to discuss any particularly complex, sensitive or confidential matters relating to the proposal. Meeting requests must be received by the end of the submission period and include reasons for the request. AEMO will try to accommodate reasonable meeting requests but, where appropriate, we may hold joint meetings with other stakeholders or convene a meeting with a broader industry group. Subject to confidentiality restrictions, AEMO will publish a summary of matters discussed at stakeholder meetings.

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1. Stakeholder consultation process

As required by the 'Enhancing information on generator availability in medium term projected assessment of system adequacy (MT PASA)' rule change[5], the Australian Energy Regulator's (AER's) Forecasting Best Practise Guidelines (to review forecasting methodologies at least once every four years), AEMO's Reliability Forecast Guidelines (to review at least once every four years), and National Electricity Rules (NER) 3.9.3D(e), AEMO is consulting on its reliability forecasting guidelines and methodologies.

Note that this consultation paper uses terms defined in the NER, which are intended to have the same meanings.

AEMO's timeline and stakeholder engagement activities for this consultation are outlined below. Future dates may be adjusted and additional activities may be included if necessary, as the consultation progresses.

Table 1 Consultation step timing

Consultation steps	Date
Consultation paper published	31 October 2022
Workshop on energy scenarios and energy limit modelling	7 November 2022
Workshop on commitment criteria	8 November 2022
Workshop on random outage parameters and MT PASA status codes	8 November 2022
Submissions due on consultation paper	28 November 2022
Draft report, methodologies and guidelines published	3 February 2023
Workshop on draft report	13 February 2023
Submissions due on draft report	3 March 2023
Final report, methodologies and guidelines published	30 April 2023

Proposed guideline and methodology drafting is released with this draft report.

AEMO's consultation webpage, at https://aemo.com.au/consultations/current-and-closed-consultations/2022-reliability-forecasting-guidelines-and-methodology, contains all previous published papers and reports, written submissions, and other consultation documents or reference material.

AEMO received seven written submissions in response to its consultation paper on the proposal.. AEMO also held three workshops dedicated to exploring specific consultation topics, and had several meetings with stakeholders to discuss topics that were submitted.

AEMO thanks all stakeholders for their feedback on the proposal to date, which has been considered in preparing this draft report.

[5] See https://www.aemc.gov.au/rule-changes/enhancing-information-generator-availability-mt-pasa.

2. Background

This draft report commences the second stage of consultation for AEMO to review and finalise changes to a number of reliability forecasting guidelines and methodologies.

This consultation is intended to satisfy AEMO's requirements under:

- The 'Enhancing information on generator availability in MT PASA' rule change[6].
- AEMO's commitment to review processes used for projecting supply adequacy over the medium term, as specified in the market event and reviewable operating incident report for the National Electricity Market (NEM) market suspension and operational challenges in June 2022[7].
- The AER's Forecasting Best Practise Guidelines, and AEMO's Reliability Forecast Guidelines (to review AEMO's forecasting methodologies at least once every four years).
- NER 3.9.3D(e) (to review the Reliability Standard Implementation Guidelines at least once every four years).

Further, AEMO will implement minor and administrative changes related to the 'Integrating energy storage systems into the NEM' rule change (IESS Rule Change)[8]. In doing so, this draft report includes changes for the purposes of the National Electricity Amendment (Integrating energy storage systems into the NEM) Rule 2021 No. 13 (IESS Rule). The terms used in this draft report have the same meaning as the equivalent defined terms in NER Chapter 10, including changes to Chapter 10 as a result of the IESS Rule Change. These changes will be effective on 3 June 2024, however no material methodolgy impacts should arise from their inclusion prior to this date.

Administrative changes may also apply to other AEMO documents, such as the Spot Market Operations Timetable.The guidelines and methodologies listed in Table 2 are subject to review in this consultation.

Table 2 National Electricity Rules associated with each Reliability Forecasting Guideline or Methodology

Guidelines and methodologies subject to consultation	Primary rule
Reliability Standard Implementation Guidelines (RSIG) [A]	NER 3.9.3C NER 3.9.3D
Energy Adequacy Assessment Projection (EAAP) Guidelines	NER 3.7C
Generation Information Guidelines	NER 3.7F
Medium Term Projection Assessment of System Adequacy (MT PASA) Process Description	NER 3.7.2
ESOO and Reliability Forecast Methodology	NER 3.13.3A NER 4A Parts A-C

A. AEMO intends to undertake targeted consultation required by the 'Updating Short Term PASA' rule change[9] in early 2023. RSIG elements specifically relating to ST PASA will therefore not be the focus of this consultation.

[6] See https://www.aemc.gov.au/rule-changes/enhancing-information-generator-availability-mt-pasa.

[7] See https://www.aemo.com.au/-/media/files/electricity/nem/market_notices_and_events/market_event_reports/2022/nem-market-suspension-and-operational-challenges-in-june-2022.pdf.

[8] See https://www.aemc.gov.au/rule-changes/integrating-energy-storage-systems-nem.

[9] See https://www.aemc.gov.au/rule-changes/updating-short-term-pasa.

2.1. Context for this consultation

In addition to the regulatory framework outlined above, AEMO is undertaking this consultation to address areas for potential improvement identified:

- following the June 2022 market event[10] which resulted in the temporary suspension of the wholesale market, and
- following the 2022 and earlier Electricity Statement of Opportunities publications (ESOO).

It is not the purpose of this consultation to review the events of June 2022, or the outcomes of the 2022 ESOO, but rather to consult on forecasting guidelines and methodologies to ensure they remain appropriate in future. The identified areas for potential improvement include:

- Better consideration of energy limitations, and the potential for greater thermal fuel information to improve reliability and energy adequacy forecasting. This includes potential refinement of energy limitation scenarios in current guidelines.
- Better representation of operational generation characteristics in current reliability forecasting models to support AEMO to more accurately and comprehensively identify supply adequacy issues should participants advise of significant energy limits.
- The inclusion in relevant methodologies of additional categories of generation outage that were key contributors to the June 2022 market event and other recent actual market events.
- Improved consistency in AEMO's commitment criteria affecting new generator, integrated resource system, aggregated distributed energy resources (DER) and/or transmission assets to improve timely identification of reliability risks considering the availability of these assets.
- Improvements in the methodology for calculating a reliability gap period, indicative trading intervals, and reliability gap size for the purposes of the Retailer Reliability Obligation (RRO).

2.2. The national electricity objective

Within the specific regulatory requirements applicable to this consultation, AEMO will seek to make a determination that is consistent with the national electricity objective (NEO) and, where considering options, to select the one best aligned with the NEO.

The NEO is expressed in section 7 of the National Electricity Law as:

> *to promote efficient investment in, and efficient operation and use of, electricity services for the long term interests of consumers of electricity with respect to:*
>
> *(a) price, quality, safety, reliability and security of supply of electricity; and*
>
> *(b) the reliability, safety and security of the national electricity system.*

Energy Ministers have proposed a change to the NEO to add a paragraph (c) in relation to Australia's greenhouse gas emissions. This proposal is currently being consulted on[11], but has not informed AEMOs consideration in this draft report.

[10] See https://www.aemo.com.au/-/media/files/electricity/nem/market_notices_and_events/market_event_reports/2022/nem-market-suspension-and-operational-challenges-in-june-2022.pdf.

[11] See https://www.energy.gov.au/government-priorities/energy-ministers/priorities/national-energy-transformation-partnership/incorporating-emissions-reduction-objective-national-energy-objectives.

3. List of material issues

AEMO received seven written submissions from the following stakeholders, all of which are published on AEMO's consultation webpage[12]:

1. The Australian Energy Council (AEC)
2. Origin Energy (Origin)
3. EnergyAustralia
4. Pacific Energy Trading (PET)
5. Shell Energy
6. Snowy Hydro
7. ENGIE.

Table 3 describes the key material issues arising from the proposal or raised in submissions or consultation meetings.

Table 3 List of material issues

No.	Issue	Raised by	Report section
1	Consultation timeline	AEC, Shell Energy	4.1
2	Analysis demonstrating impact of proposed methodology changes	Origin, AEC, EnergyAustralia, Shell Energy, Snowy Hydro	4.2
3	Reliance on June 2022 event	AEC, Snowy Hydro, EnergyAustralia, PET	4.3
4	Perceived conservatism in AEMO's reliability forecasts	ENGIE	4.4
5	EAAP scenarios	AEC, Origin, EnergyAustralia, Shell Energy, PET, ENGIE, Snowy Hydro	5.1
6	Generator Energy Limitations Framework (GELF)	AEC, Origin, Shell Energy, PET, ENGIE, Snowy Hydro	5.2
7	ESOO and EAAP model and publication alignment	Shell Energy, ENGIE, EnergyAustralia	5.3
8	Publication of energy limit information	PET, EnergyAustralia	5.4
9	Application of GELF and ISP parameters to reliability forecasts	Shell Energy	5.5
10	Hydro Modelling assumptions	Shell Energy	5.6
11	MT PASA LOLP modelling	Shell Energy	5.7
12	Generator and integrated resource system outage parameters	Shell Energy, AEC, ENGIE, Origin, EnergyAustralia,Snowy Hydro	6.1
13	Data analysis from stochastic modelling	Shell Energy	6.2
14	Transmission outages	AEC, Shell Energy	6.3
15	Outages at major loads	Shell Energy	6.4
16	Generating and integrated resource systems commitment criteria implementations	Snowy Hydro, Shell Energy, AEC, EnergyAustralia	7.1
17	Transmission projects commitment criteria implementations	AEC, Shell Energy, Snowy Hydro	7.2

[12] See https://aemo.com.au/consultations/current-and-closed-consultations/2022-reliability-forecasting-guidelines-and-methodology.

No.	Issue	Raised by	Report section
18	Aggregated DER developments commitment criteria implementations	AEC, ENGIE, Shell Energy	7.3
19	Large loads commitment criteria implementations	AEC, Shell Energy, ENGIE	7.4
20	Reliability gap in megawatts methodology	EnergyAustralia, Snowy Hydro, AEC, Shell Energy	8.1
21	Reliability gap period and trading intervals minimum percentage	AEC, Shell Energy, EnergyAustralia	8.2
22	Reliability gap period and trading intervals methodology	Shell Energy, Snowy Hydro, AEC, EnergyAustralia	8.3
23	The use of IEEE 762-2006 for reason code taxonomy	EnergyAustralia, PET, Origin, Snowy Hydro, EnergyAustralia	9.1
24	AEMO's usage of new information	EnergyAustralia	9.2
25	Use of single alphabetic input codes for submission	Shell Energy	9.3
26	PASA Availability recall period and implementation	ENGIE, Shell Energy, EnergyAustralia	9.4
27	Difficulties with long-term forecasting	Snowy Hydro	9.5

4. Discussion of general issues raised

4.1. Consultation timeline

4.1.1. Issue summary and submissions

The AEC raised a concern that, given the scope of the proposed changes to the guidelines, additional consultation time to the minimum rules requirements may have been appropriate. The AEC also raised concerns about some stakeholders being unaware of the consultation and that some may have been unable to attend related AEMO forums.

Shell Energy raised a concern about 'the minimal timeframe allocated to Stage 1 of this consultation' and encouraged AEMO to 'consider conducting additional workshops to allow further feedback on matters not directly raised prior to finalising the draft report.'

4.1.2. AEMO's assessment

When setting consultation dates AEMO considers many factors, including NER and AER Forecasting Best Practice Guidelines (FBPG) requirements. This consultation must be complete by 30 April 2023 to meet the requirement of the 'Increasing information on generation availability in MT PASA' rule change, and so that the guidelines and methodologies are in place for the 2023 ESOO and EAAP.The 30 April deadline, alongside the NER and FBPG requirements, does not allow AEMO to extend the consultation timeframe.

AEMO held workshops to complement the issues paper in November 2022. AEMO has also offered and scheduled meetings with all stakeholders who made submissions as part of Stage 1 to further discuss the topics of interest. Further, AEMO has scheduled an additional workshop on 13 February 2023 to ensure all stakeholders have the opportunity to contribute to the second stage consultation.

4.1.3. AEMO's conclusion

No extension to consultation timeframes can be offered, however the steps AEMO is taking ensures as much as practical the involvement of all interested stakeholders.

4.2. Analysis demonstrating impact of proposed methodology changes

4.2.1. Issue summary and submissions

Many participants requested more information on the impact of AEMO's proposed changes. Relevant comments from participants are listed below.

Regarding outage modelling:

- Origin further welcomed clarification and more information on how AEMO intended to implement the proposed additional outage categories. Origin also commented that 'more information is required on how MT PASA reason codes would work in practice. AEMO should provide clear guidance on the definitions of the proposed reason codes so that participants understand their intent, including clear descriptions of basic or extended outages.'

- The AEC and EnergyAustralia commented that it would have been helpful to provide an estimate of how the proposal would change outage rates.

Regarding forecast RRO outcomes:

- EnergyAustralia indicated that 'more analysis is needed to inform changes to reliability gap calculations.'
- Snowy Hydro and AEC both commented that the consultation paper does not contain enough material to understand whether the proposed changes in reliability gap period and trading intervals methodology will strike an appropriate balance between meeting the NEL and NER while not increasing costs for the market.

Regarding reliability forecasting consistency:

- EnergyAustralia also noted that some changes such as consistent operational assumptions across all reliability forecasts may materially impact measurement of unserved energy (USE) and this should be explicitly quantified by AEMO.
- Shell Energy also requested that 'AEMO provide the results of additional modelling which implements this proposed change to better understand its impact before considering the changes detailed as proposed.'

4.2.2. AEMO's assessment

In the first stage of the consultation AEMO did not provide draft versions of relevant guidelines and methodologies so that broader concepts could be considered prior to drafting proposed solutions. As suggested in the consultation paper, AEMO is providing draft versions of relevant guidelines and methodologies with this draft report which should assist in providing the additional level of detail requested in submissions. It should be noted that some of the guidelines under consultation are not designed to provide high levels of detail, where the details are often deferred to methodologies, data collection templates, or the publications themselves.

Where possible, AEMO will supplement the draft methodologies and decisions with worked examples and draft templates to assist participants in understanding and reviewing the draft proposals. In other cases, AEMO does not yet have the data required from participants to prepare indicative outcomes, or doing so would require a disproportionately large amount of work, hence AEMO must consult on methodology only.

AEMO notes that for MT PASA status and recall codes there are no modifications to the modelling approach so model outcomes will not change. The addition of reason codes is required by a rule change. The additional data collection and reporting will allow AEMO and participants to have more insight into generator outages.

For unplanned outage rates, AEMO is unable to provide an estimate of the impact of including the new categories as it does not have the data available from generators. AEMO will present the changes in unplanned outage rates applying both the old and new methodologies to the Forecasting Reference Group in June 2023.

For reliability gap calculations, AEMO has further clarified and revised the proposed reliability gap methodology via a more deterministic methodology. AEMO has also prepared a worked example to assist in interpretation of the draft ESOO and Reliability Forecast Methodology in sections 8.2 and 8.3.

4.2.3. AEMO's conclusion

AEMO has provided draft versions of the relevant methodologies and guidelines and will provide worked examples where possible and relevant.

4.3. Reliance on June 2022 event

In June 2022, a market event occurred which resulted in the temporary suspension of the wholesale market[13]. AEMO described this event as one of its considerations for undertaking this consultation on reliability forecasting guidelines and methodologies.

4.3.1. Issue summary and submissions

Stakeholders expressed concern that the changes in methodology were caused by the June 2022 market event. Comments received from participants are listed below:

- Shell noted that it was 'concerned by the focus on the consultation paper on the very unusual market conditions experienced in June 2022' and noted that this may have been an 'energy pricing' rather than an energy supply issue.
- The AEC noted that it was worthwhile for AEMO to explore alternative EAAP scenarios but rejected the presumption that this was required because of the June 2022 events. The AEC further stated 'overreliance on what appears to be at least a three-sigma event does not appear to be a sensible foundation for changing the equations for outage rates with the effect of increasing the rates'.
- Snowy Hydro noted that 'AEMO scenarios relating to energy adequacy would not predict what happened in the June energy crisis'.
- EnergyAustralia commented that 'the events of winter 2022 and the risk of recurrence have spurred various actions from market bodies and policy-makers. It is not clear, however, whether there was a failure of participants in providing necessary data on energy limits or in AEMO's current set of forecasting models'.
- Pacific Energy Trading commented that 'in order to avoid the scenario in winter 2022, generators should have to publicly disclose their forecast energy limits, much as they already disclose their forecast availability'.

4.3.2. AEMO's assessment

In the consultation paper AEMO referenced the June 2022 event as a catalyst for a review of reliability forecasting model performance, which consequently noted areas for improvement to ensure that energy adequacy issues are appropriately considered. AEMO confirms that it is not the purpose of this consultation to review the events of June 2022, or the outcomes of the 2022 ESOO, but rather to consult on forecasting guidelines and methodologies to ensure they remain appropriate in future, particularly in circumstances where participants may advise of significant energy supply issues.

The events in June 2022 shed light on the impact that energy constraints may have on supply adequacy. The changed EAAP scenarios are designed to better test these potential impacts, rather than focusing only on rainfall, and are aligned with the original purpose of the EAAP.

[13] See https://www.aemo.com.au/-/media/files/electricity/nem/market_notices_and_events/market_event_reports/2022/nem-market-suspension-and-operational-challenges-in-june-2022.pdf.

The proposed change in AEMO's methodology for calculation of unplanned outage rates was not due to events in June 2022, but rather based on AEMOs longer-term observations. AEMO has observed that the current methodology is excluding consideration for outages that are non-discretionary, and hence is likely under-estimating the rate of outages over the forecast horizon. AEMO has observed the exlusions of such outages over numerous years, before and after the June 2022 event and COVID-19 responses.

4.3.3. AEMO's conclusion

AEMO has proposed methodology changes to address potential deficiencies in the reliability forecast guidelines and methodologies. The methodology proposal is not tailored to any particular events in 2022.

4.4. Perceived conservatism in AEMO's reliability forecasts

4.4.1. Issue summary and submissions

ENGIE raised concern about AEMO's forecasting conservatism and associated costs to consumers, and suggested that there is an asymmetry between AEMO's supply forecasts (including use of commitment criteria) and demand forecasts (based on microeconomic models). ENGIE said that 'if processes such as EAAP are overly oriented to generating reliability concerns, AEMO may procure more long notice and multi-year reserves through the Reliability and Emergency Reserve Trader (RERT) process' and that consumers would have to pay for these RERT costs. ENGIE suggested that AEMO's forecasting approach should take a balanced view and include 'a high-level assessment of the costs that changes to its forecasting approach could trigger, such as increased RERT costs'.

4.4.2. AEMO's assessment

AEMO's reliability forecasts meet numerous NER requirements (3.13.3A, 4A, 3.7.2, 3.7C) to inform market and interested stakeholders about reliability risks, future capacity development requirements, and to identify potential developments and solutions that may address identified reliability risks.

In achieving these objectives, AEMO often pairs demand forecasts that reflect the most likely, or Central view, with supply forecasts that consider only those developments for which formal commitments have been made. These supply forecasts intentionally exclude developments for which formal commitments have not yet been made, so that reliability forecasts identify the risk of inaction and appropriately identify future capacity and/or intervention requirements. Developing a forecast that identifies the risk of inaction, and future capacity development needs, necessitates asymmetry in reliability forecasting approaches. This asymmetry typically applies different approaches to 'supply side' and 'demand side' inputs.

In developing reliability forecasting methodologies, AEMO endeavours to strike an appropriate balance when selecting methodologies and inputs such that reliability forecasts accurately and comprehensively identify supply adequacy issues based on participant advice and the assumptions of that forecast. AEMO agrees that the consultation should consider total costs, including potential costs to consumers of over- or under-forecasting reliability risks.

4.4.3. AEMO's conclusion

AEMO agrees that there is an asymmetry between AEMO's supply forecasts and demand forecasts, but argues this is a design feature, rather than an error requiring correction. AEMO thanks ENGIE for the feedback and will continue to improve the forecasting approach to accurately and comprehensively identify supply adequacy issues consistent with NEL and NER requirements in the context of the NEO.

5. Discussion of material issues on energy adequacy methodology and scenarios

In the consultation paper, AEMO identified opportunities to improve reliability forecasting models to consider the impact of energy limits more effectively and efficiently. AEMO proposed:

- alternate scenarios for consideration in the Energy Adequacy Assessment Projection (EAAP), which would be supported by new Generator Energy Limitations Framework (GELF) parameters to be provided by generator participants; and
- numerous changes to energy modelling assumptions to increase the alignment between reliability, energy adequacy and planning models – specifically the ESOO, EAAP, MT PASA and Integrated System Plan (ISP) modelling assumptions.

The use of market modelling (such as that used by AEMO for the ESOO, EAAP and MT PASA) to identify energy adequacy issues (as opposed to short-term capacity adequacy issues) is extremely challenging in practice. This is because market models optimise scarce available energy with perfect foresight to minimise the risk of USE. In practice, market participants bid and dispatch their scarce energy resources based on imperfect forecasts, without visibility of the whole-of-market impact. For this reason, market modelling is unlikely to identify USE arising from energy adequacy issues even if participants advise of highly scarce energy resources that could result in USE in reality.

While AEMO proposed changes to improve market modelling with regard to energy adequacy that will assist in identifying the risk of USE, additional metrics are also under consideration. Through the use of additional metrics, AEMO seeks to better inform industry decision-making with regard to the reliability risks arising from energy adequacy.

Further, the aim of the proposed changes was to ensure that reliability risks arising from fuel and water shortfalls that may occur for short periods of time (potentially due to supply chain or market disruptions, and the use of short duration storage) could be identified, as well as longer-term (monthly or annual) fuel availability limitations.

5.1. EAAP scenarios

AEMO proposed the following EAAP scenarios:

1. *Central* scenario (previously the *short-term average rainfall scenario*) – the most likely fuel availability from gas, coal, diesel, hydrogen and water resources (based on the average rainfall recorded over the past 10 years).
2. *Low Rainfall* scenario – based on the most likely fuel availability for thermal generators (as per the *Central* scenario) and considering water availability reflecting rainfall recorded in a specific historical period.
3. *Low Thermal Fuel* scenario – based on worst-case coal, gas, diesel and hydrogen availability for thermal generators and considering a high rainfall scenario reflecting the maximum rainfall recorded over the past 10 years, that may trigger water release challenges for hydro-electric generators.
4. Any other scenario that AEMO reasonably considers will have a material impact on the EAAP.

Through the use of the fourth scenario, AEMO proposed scenario flexibility to avoid the need for consultation should alternate risks emerge in future, allowing a more rapid response to future energy limitation issues, particularly in the case of supply chain or market disruption.

AEMO proposed to discontinue the *Long-term average rainfall* scenario, on the basis that no risks arising from low rainfall have been identified in any recent EAAP.

While AEMO proposed to include numerous scenarios which may be, or may not be immediately probable, it was proposed that the Reliability Standard Implementation Guidelines (RSIG) be updated to clarify that AEMO should declare Low Reserve Conditions (LRC) only for reasonably probable scenarios.

5.1.1. Issue summary and submissions

No stakeholder submission expressed concerns for the first two scenarios proposed by AEMO, which align with scenarios in the current EAAP guidelines. Further, no concerns were raised with the proposal to discontinue the *Long-term average rainfall* scenario.

While most submissions expressed in principle support for AEMO's proposal to include a scenario relating to low thermal fuel supplies, several stakeholders (the AEC, Origin, EnergyAustralia, Shell Energy, PET) noted some concerns:

- For example, ENGIE and Shell Energy indicated that the proposed *Low Thermal Fuel* scenario may be excessively conservative as it assumes energy availability challenges across all types of generation simultaneously. Shell Energy stated that key hydro power station outputs during winter 2022 events which had high rainfall did not support a scenario where extended high rainfall impacts both hydro and thermal plant simultaneously.
- EnergyAustralia said that AEMO's proposal to develop a 'worst case' scenario in the EAAP does not seem to address any needs arising in operational timeframes.
- Shell Energy suggested that Scenario 3 should be revised to examine a low fuel supply scenario with the same rainfall inputs as are applied to the central scenario and that an additional sensitivity conuld be considered by AEMO where it may have a material impact on the EAAP that explores high rainfall but low hydro output based on observed historical hydro plant output during such periods.
- Origin indicated that such a scenario would be inherently uncertain and could therefore increase the complexity of participant GELF submissions.

Stakeholder submissions were generally against AEMO's proposal to create any other scenarios that it reasonably considers would have a material impact on the EAAP without some form of stakeholder consultation. The AEC opposed the avoidance of consultation. ENGIE suggested that AEMO consider how it will engage with stakeholders prior to developing a new scenario. Shell Energy proposed that the Forecasting Reference Group be used to consult stakeholders in such a situation, and EnergyAustralia proposed using the Reliability Panel for this purpose. EnergyAustralia also expressed concern about possible interventions relating to an additional scenario that may be low probability.

The proposed ability for AEMO to create any other scenario was of concern due to circumstances where AEMO may also be able to trigger LRC and/or instigate market intervention for improbable scenarios. Shell Energy and ENGIE requested further clarification regarding which circumstances would trigger LRC.

5.1.2. AEMO's assessment

Given the preliminary nature of the changes proposed in the consultation paper, it is reasonable that participants requested further clarification; the draft Guidelines and Methodologies published alongside this draft report provide the requested clarification. AEMO considers that the concerns raised by stakeholders regarding scenario specification can be addressed by modifying and clarifying the proposed scenarios.

For the *Low Thermal Fuel scenario*, AEMO proposes some modifications and clarifications that seek to address stakeholder concerns:

- To address concerns with the uncertainty in developing the participant submission, AEMO proposes clarifications to participant provided energy limits for non-hydro participants, such that they should represent 90% POE energy availability (an estimate that is expected to be exceeded nine out of 10 years) that should consider applicable limitations for each site, including the potential impacts of wet coal, longwall moves, train and truck deliveries, loader outages, likely market limitations and water limitations. The provided limit should not reflect a disaster situation, only a low estimate based on limitations that apply to each site from time to time. While this scenario still requires some degree of stakeholder judgement, AEMO considers the specification should be clear enough for each generator participant to represent relevant downside risks for their site. For this scenario, hydro participants are requested to provide energy limits consistent with the EAAP Central scenario.
- With regard to the improbability of such a scenario, AEMO notes several factors that should not drive this scenario to be unduly improbable or pessimistic:
  - The unavailability of multiple fuels can and does occur simultaneously from time to time.
  - The use of historical generation as an EAAP input does not always give an idea of how tight limits were and does not provide insight regarding potential coincident supply issues in the future.
  - The 90% POE specification proposed is not intended to reflect disaster situations, and participants should not submit extreme or unrealistic limits.

For the proposed ability to create any other scenario that AEMO reasonably considers will have a material impact on the EAAP, including associated reliability standard implementation, AEMO proposes modifications that seek to address stakeholder concerns:

- AEMO proposes updated wording to clarify that LRC will only be declared for *the EAAP Central scenario*, unless AEMO has evidence to suggest that an alternate EAAP scenario is instead the most likely scenario. As an example, AEMO may declare LRC for the coming summer should the *Low Rainfall scenario* forecast USE above the reliability standard and strong El Niño conditions be also forecast for the coming summer that align with Low Rainfall conditions submitted by participants.
- In cases where differences in USE have occurred in the model due to energy limitations, AEMO will provide as much commentary about these as possible in the EAAP, alongside a high level qualitative assessment of the potential likelihood of the scenario.
- Regarding the fourth scenario that was intended to provide scenario flexibility, AEMO no longer proposes to to include any other scenario that it reasonably considers will have an impact on the EAAP. This scenario flexibility is unlikely to be required, on the basis that:

- AEMO has clarified that LRC will only be declared on the EAAP Central scenario, or the scenario that it considers most likely,
- AEMO is able to publish additional sensitivities to the three scenarios that it considers will provide additional and important information to stakeholders,
- AEMO is able to specify the proposed GELF parameters in the EAAP Guidelines.

5.1.3. AEMO's conclusion

AEMO has reflected the proposed modifications to the scenarios and clarified LRC requirements in the draft guidelines and methodologies.

5.2. Generator Energy Limitations Framework (GELF)

In the consultation paper, AEMO proposed GELF parameters that scheduled generator participants would be required to provide, that would be specified in the EAAP Guidelines for the proposed scenarios:

- For hydro power schemes:
  - Reservoir storage and projected inflows (per scenario).
  - Operational parameters including minimum and maximum levels, limits on continuous operation, seasonal parameters, and outflow requirements or restrictions.
- For non-hydro power stations:
  - Current and most likely projected onsite storage of primary and secondary fuels (where applicable) (in joules).
  - Most likely projected inflows of primary and secondary fuels (where applicable).
  - Currently contracted inflows of primary and secondary fuels (where applicable).
  - Cooling water and demineralised water storage availability and limits.
  - Energy output limits per scenario (in megawatt hours [MWh]).
  - Operational parameters including minimum and maximum storage levels per fuel type, limits on continuous operation, seasonal parameters, and requirements or restrictions to operate.

AEMO proposed that additional GELF information would allow it to understand and model energy adequacy risks more appropriately, including site-specific and multi-site risks relating to fuel supply, supply chains, and fuel market scarcity as anticipated by NER 3.7C.

5.2.1. Issue summary and submissions

In response to the proposed GELF parameters, stakeholders suggested that only relevant and required parameters be added, to reduce the burden on market participants:

- Shell Energy considered that 'the proposed expanded GELF parameters appear overly intrusive and onerous for market participants'.
- Shell Energy further added that due to the information frequency, some additional parameters would not add value, submitting: 'both stored fuel and demineralised water storage levels change frequently. Provisions of this information once a year or more frequently is of little value and it is

questionable whether a model incorporating such levels would provide any additional insights into energy adequacy of the supply system. If questions are to be asked regarding fuel supplies, it must include information regarding the ability to access additional fuel supplies as required for ensuring reliability purposes'. Shell Energy also submitted that 'we consider that weekly energy limit data provided should not be adjusted by this additional artificial limit. For similar reasons we do not support the application of artificial modelling limits on the thermal generator fuel supplies'.

- Shell Energy noted it was unclear how the EAAP model would benefit from the inclusion of contracted fuel supply in addition to 'most likely' fuel supply.
- Origin also submitted concern with the additional parameters: 'the proposed GELF parameters would be difficult for generators to provide with a degree of certainty. In addition to the uncertainty around contractual positions and expected generation levels, market participants do not typically have comprehensive knowledge of the entire fuel supply chain and visibility of competition for fuel supply. This would limit the accuracy of fuel supply estimates. It is also unclear if the proposed parameter, "energy output limits per scenario in MWh", is intended to be provided as monthly or weekly energy limit. It is also not clear how useful the proposed parameter, "cooling water and demineralised water storage availability and limits" would be, given that a point-in-time estimate of availability and limits may not appropriately capture whether a unit is affected by a water limitation'. Origin suggested that 'more information and consultation is needed to develop the proposed additions or identify more useful parameters and scenarios to improve AEMO's understanding of energy adequacy risks'.
- Snowy Hydro suggested that 'AEMO clarify the additional GELF information requested, since this analysis is an important part of participants' assessment of their potential liabilities and opportunities from the changes in input that AEMO is assessing. AEMO should always be mindful of the burden the process could have on one group of market participants in providing this information. This will be an extra requirement on generators'.
- ENGIE also asked for further clarification of additional information required, submitting that 'more information provision typically results in additional costs to participants, and sometimes creates avoidable compliance risks'.

5.2.2. AEMO's assessment

AEMO is aware of the burden on participants from additional data requests and aims to make this request as simple and streamlined as possible while providing AEMO enough detail to be able to reveal important insights to market participants and interested parties, consistent with the purpose of the EAAP described in NER 3.7C(a).

In the consultation paper, AEMO proposed a level of detail that allowed consideration for broader concepts prior to drafting fine details. To provide the additional insight on the proposed GELF information requested by participants, AEMO has provided a draft GELF template for comment alongside this draft report, and draft guidelines and methodologies. AEMO understands the complexities of some of these fuel supplies, and proposes a simplified approach that can be applied to all power stations and reservoirs. AEMO will work with generators to discuss any parameters or scenarios that may be problematic for them and welcomes specific feedback on the draft GELF template as part of Stage 2 of this consultation.

AEMO proposes to retain the proposed variables related to expected and contracted fuel quantities, which will be requested based on a monthly projection, rather than a single point in time snapshot. It is

proposed that these variables will be used for the development of EAAP sensitivities that describe the implications of potential supply chain and fuel market shortfalls on energy adequacy.

For example, the 2022 Gas Statement of Opportunities identified potential gas supply shortfalls in southern Australia. When gas shortfalls occur, one of the few options available to reduce gas demand is to restrict gas powered generation. The provision of the proposed GELF data will be necessary for AEMO to accurately understand the potential implications of peak day and general gas shortfalls on electricity market outcomes. Other ongoing risk factors such as hazards arising from climate change, and the degree to which electricity, gas and liquid fuel markets are now tightly coupled, highlight the necessity of the proposed GELF data to accuratey inform market participants and governments of energy adequacy risks.

AEMO appreciates that contracted quantities, expected storage levels and expected fuel inflows will change over time and will have most relevance to the next season/s and not the full EAAP horizon.

While provision of this data will have a cost to participants, AEMO argues that the value of the analysis outweighs the costs to participants given the potential for supply chain and fuel market shortfalls, and the desire for policy and market responses that may mitigate such risks.

5.2.3. AEMO's conclusion

AEMO will include more detail of the required GELF parameters and will release a proposed GELF template with this draft report, including a draft GELF template. AEMO will include the proposed methodology in relevant draft guideline and methodology documents.

5.3. EAAP and ESOO model and publication alignment

In the consultation paper, AEMO proposed changes to increase the alignment between the EAAP and the ESOO, notably:

- EAAP analysis to be published within the ESOO, which is published by the end of August each year.
- EAAP methodology and model to predominantly align with the ESOO, where GELF parameters will be added to the ESOO model, instead of the most recent MT PASA run model.
- Instead of requiring participants to specify in the GELF which MT PASA outages were inflexible, AEMO proposed that the EAAP only apply material outages submitted to MT PASA that are not recallable.

5.3.1. Issue summary and submissions

Regarding the proposals to incorporate the EAAP as a section within the ESOO that would be published in August each year, and to align the EAAP with ESOO methodologies:

- EnergyAustralia supported AEMO's proposal to align the EAAP with the ESOO model.
- Shell Energy raised a concern that it was not clear from the consultation paper how the EAAP assessment would be incorporated in the ESOO, suggesting that there is value in them being separate reports.
- Regarding the timing of the EAAP, ENGIE submitted that 'the proposal to collect GELF information around the same time as other data requests' (as would occur due to aligning the EAAP with the ESOO) 'could help save costs for participants if they can integrate and streamline their information provision into a single process. However, the Consultation includes the caveat "unless an update is

required". AEMO will need to be clear about the circumstances under which an update is required so that there is no ambiguity for participants as to whether or not they need to provide updated information'.

5.3.2. AEMO's assessment

AEMO thanks EnergyAustralia and ENGIE for their support of the proposed approach to incorporate the EAAP within the ESOO, thereby revising the publication timing to August each year, and GELF data collection to April each year.

Regarding Shell Energy's concern about the independence of the two reports, AEMO clarifies that EAAP analysis will remain independent to ESOO analysis and will be published within a section of the ESOO, and that AEMO does not intend to merge ESOO and EAAP analysis. AEMO will continue to assess the requirement to publish ESOO and EAAP publications annually, or more frequently consistent with NER 3.13.3A and NER 3.7C respectively. Specifically, AEMO does not forsee that a material change that requires the publication of an update to one report would require the update of the other.

Regarding the proposed GELF data collection planned for April every year, AEMO anticipates that this will happen once a year only but may be requested out of cycle if AEMO consider energy adequacy has changed materially. AEMO will only consider requesting updated data from certain participants where it considers GELF parameters have changed materially, and AEMO is obligated under NER 3.7C(d)(2) to produce another EAAP. While AEMO will only request updated GELF data under certain circumstances, participants should be aware of their NER 3.7(i) obligations; it requires revision and re-submission of GELF data in circumstances where there has been a material change which has an impact on the energy constraints associated with that GELF submission. AEMO will clarify in the EAAP Guidelines that the materiality of a change should be assessed against the energy limits provided for the EAAP Central scenario only.

5.3.3. AEMO's conclusion

AEMO will update the relevant guidelines and methodolgoies to reflect the clarifications and methodologies proposed.

5.4. Publication on energy limit information

AEMO made no proposal to publish additional information on participant provided energy limits.

5.4.1. Issue summary and submissions

Both PET and EnergyAustralia suggested that AEMO should publish additional information on participant provided energy limits:

- PET proposed that AEMO publish generators forecast energy limits similar to the PASA availability already published. PET suggested that energy limits should take into account fuel supply contracting and availability, as well as any other energy constraints on the plant, including rail and pipeline access, water license requirements, stockpile and storage levels. Submissions should indicate whether generators have contracted access to fuel or whether they intend to purchase supplies from spot markets on an ad hoc basis.
- EnergyAustralia suggested that regular publication of fuel limits would be valuable.

- EnergyAustralia also argued that that new measures that better highlight fuel supply challenges may be more valuable than deterministic 'worst case' scenario modelling in the EAAP publication.

5.4.2. AEMO's assessment

AEMO notes that it is not clear that AEMO can publish individual data under current NER provisions.

AEMO does however publish aggregated energy limits as submitted by participants to MT PASA, consistent with NER 3.7.2(f)(5B). AEMO will clarify the description of these published values in the MT PASA process description as requested by PET.

AEMO strongly supports EnergyAustralia's recommendation to incorporate additional metrics that describe energy adequacy. AEMO is currently prototyping additional sensitivities and output metrics that may better describe potential energy supply/demand imbalances with more insight than expected USE. These developments are not proposed to feature in the draft guidelines and methodologies at this stage.

5.4.3. AEMO's conclusion

No changes are proposed to the guidelines and methodolgoies at this stage based on the suggestions from PET and EnergyAustralia.

5.5. Application of GELF and ISP operational parameters to reliability forecasts

In the consultation paper, AEMO proposed that the EAAP and all reliability forecasts should apply ISP operational assumptions – as documented in AEMO's Inputs, Assumptions and Scenarios Report (IASR) – as relevant and appropriate for each scenario. Minimum stable level, ramp rates, and/or minimum operational timeframes were specifically noted for consideration.

Further, AEMO proposed that reliability forecasting methodologies reflect that relevant GELF parameters may be applied to all reliability forecasts where relevant.

5.5.1. Issue summary and submissions

Shell Energy expressed concern about the use of ISP assumptions in the EAAP process, in particular minimum stable loads for thermal generators. It argued that these parameters should not be used as a process to force thermal generators out of service based soley on not achieving minimum stable levels in the modelling, particularly if this results in a reliability shortfall. Shell Energy indicated that 'when a generator is indicated as available in the MT PASA, the EAAP modelling should assume the unit is in-service and operating at or above minimum stable load'.

Shell Energy was also concerned that 'the inclusion of GELF parameters in the ESOO beyond the short term horizon covered by the EAAP assessment should not be considered. The potential responses of market participants to short term outcomes must be assumed in the ESOO modelling to ensure that it serves its purpose as a long term supply assessment'.

No other stakeholder concerns were noted.

5.5.2. AEMO's assessment

AEMO's current methodology does not include consideration for operational characteristics at all, hence simulated generator dispatch is able to follow patterns that may not be operable. Patterns that have

been observed from the simulated dispatch of current models, that may not actually be operable in practice, include:

- Meeting energy limits by starting and stopping coal and gas units multiple times a day
- Meeting energy limits by running below the minimum stable level during daytime periods.
- Meeting energy limits by ramping to and from 100% of capacity within one interval.

AEMO agrees with Shell Energy that EAAP modelling should assume units (particularly coal units) are operating at or above minimum stable levels when submitted as available. AEMO argues that consideration of operational parameters such as minimum stable levels is critical to understand the impact of energy limits, else a simulated dispatch will meet submitted energy limits in ways that are inoperable in practise. Including consideration for operational parameters will only lead to USE in circumstances where provided energy limits are extremely tight. Their inclusion will not force generators out of service based on not achiving minimum stable load exclusively.

AEMO also clarifies that it does not intend to include all GELF parameters across the entire ESOO horizon, however seeks flexibility to include relevant parameters such as reservoir parameters, and other static operational parameters, and not the scenario specific energy limits. As clarified earlier, ESOO and EAAP analysis will remain independent, however relevant parameters advised by participants should be included if relevant and appropriate across the entire ESOO timeframe.

5.5.3. AEMO's conclusion

AEMO has updated the relevant guidelines and methodolgoies to reflect the clarifications proposed.

5.6. Hydro modelling assumptions

AEMO's hydro modelling methodology assumes that reservoir levels must return to starting levels by the end of the financial year, thereby not allowing for the sharing of water reserves between forecast years. Given that AEMO models each year in isolation, and does not optimise between forecast year, AEMO proposed no changes to this methodology.

5.6.1. Issue summary and submissions

Shell Energy suggested that the allocation of water resources for hydro plant in the methodology used in MT PASA and EAAP is overly conservative, as it requires reservoirs to return to original quantities by the end of the year which fails to recognise the historically observed fluctuations in hydro storage levels between years.

5.6.2. AEMO's assessment

AEMO recognises that hydro storage levels do fluctuate from year to year, however notes that AEMO's methodologies do not allow optimisation of water resources between forecast years and that including such consideration would come at a great cost of compute and complexity. While hydro generators may have greater flexibility than the current methodology suggests, allowing the model to deplete all storages would over-state that flexibility because it could be depleted in each forecast year with no consequence. Further, AEMO notes that no recent EAAP has identified any additional USE due to low water inflows, indicating that this assumption has not impacted energy adequacy outcomes.

On balance, AEMO considers that the existing methodology is fit for purpose, and that should low water inflows be associated with higher energy adequacy risks, the beneficial impact of depleting storages would be best tested as a sensitivity.

5.6.3. AEMO's conclusion

AEMO proposes no update to the relevant guidelines and methodolgoies.

5.7. MT PASA Loss of Load Probability (LOLP) modelling

AEMO proposed to adjust the methodology used in the MT PASA Loss of Load Probability (LOLP) run, to incorporate submitted weekly energy limits, which have not previously been considered. The MT PASA LOLP run output data is used by AEMO and market participants to understand potential reliability risks should high demand coincide with low variable renewable energy (VRE) output, on a daily basis over the 2 year MT PASA horizon.

5.7.1. Issue summary and submissions

Shell Energy submitted that it did not support this proposal, and raised that adding energy limits would result in an 'all worst-case' scenario, as the run already assumes 10% probability of exceedance (POE) demand outcomes alongside worst-case variable renewable energy (VRE) outcomes. Shell Energy suggested that the proposal failed to consider the flexibility that exists in the allocation of available energy during high demand and high priced periods.

5.7.2. AEMO's assessment

AEMO considers that although this proposal imposes an extra constraint to a worst-scenario, it is an important metric to include in the LOLP run, noting that the current weekly limits in MT PASA are normally quite generous (allowing for flexibility and often overstating fuel if maximum energy was generated for more than one week). The MT PASA model is also able to schedule scarce available energy more optimally than observed in reality and does not model all 'actual' operating parameters (such as minimum stable levels and minimum up and down times), which leads to an over optimisation of energy.

As the LOLP run is not used in the reliability standard assessment, it will have no impact on expected USE outcomes, but has the potential to highlight tight operating conditions that may arise due to submitted energy limits.

AEMO expects that adding weekly energy limits in the LOLP run will have no material impact on LOLP outcomes in the majority of weeks, but may highlight periods of energy supply/demand imbalance infrequently, providing market insight not currently available.

5.7.3. AEMO's conclusion

AEMO will update the MTPASA process description to reflect the proposed methodology.

6. Discussion of material issues on random outage parameters

AEMO's reliability forecasting models use random outage parameters to simulate a variety of outage categories for scheduled generators, integrated resource systems, and key inter-regional transmission flow paths. AEMO is aware of numerous large outages that have not previously been considered in AEMO's reliability forecasts were observed to have affected supply availability. To more accurately forecast reliability risks, AEMO proposed to include these outage categories in its reliability forecasts, and collect additional outage parameters from participants to enable this inclusion.

6.1. Generator and integrated resource system outage parameters

AEMO proposed two new categories for inclusion in generator and integrated resource system outage parameter calculations. These include:

- Unplanned outages, which have occurred while the unit was available, but not committed. This may include maintenance outages as defined by IEEE 762-2006.
- Planned outages that have extended beyond their original timeframes due to complications and unexpected issues.

AEMO proposed that planned outages that proceed as planned should be excluded from ESOO and EAAP forecasts, as is current practice, on the basis that participants predominantly plan such outages outside periods of supply scarcity. AEMO sought to include new outage categories on the assumption that most outages (by capacity and time) within these new categories are not discretionary, and therefore have the potential to occur during periods of supply scarcity.

6.1.1. Issue summary and submissions

Participant submissions generally raised concern with the proposed methodology suggested by AEMO. Shell Energy, the AEC and ENGIE raised a particular concern that some extended planned outages and maintenance outages are actually discretionary. It was suggested that by including such discretionary outages in its forecasts, AEMO would inappropriately overestimate its unplanned outage rates. Similarly, EnergyAustralia and the AEC raised concerns regarding the potential magnitude of the change on reliability forecast outcomes.

To overcome potential bias, the AEC suggested that the second term in the proposed equation, which relates to maintenance outages and planned outage extensions that were initiated while the plant was uncommitted, be multiplied by 0.25. The AEC alternatively proposed that the AER could develop a guideline for generators to incorporate appropriate contingency in their planned outage return dates to remove bias rather than what is proposed.

Shell Energy proposed the use of the term 'non-discretionary' when developing the methodology and requesting historical data, suggesting that this will more effectively differentiate between the types of events that are appropriate to include in random outage modelling from those that are not appropriate.

Shell Energy suggested that outcomes where a planned outage returns to service early should also be allowed in the provision of data and allowed for in the model. The AEC also noted that there was no mention of plants that return to service prior to their forecast dates in the proposed methodology.

Origin expressed concern that more information on the outage categories is needed and it was unclear what would be categorised as unplanned outage extensions.

EnergyAustralia and Snowy Hydro submitted a concern that by adding more categories the process would become more complex and that the detail may not be appropriate in cases where generators have small unit sizes or are extended for short amounts of time. It was argued that in cases where small units are aggregated to a single connection point, the obligation would be particularly onerous, as many records may now need to be supplied.

Snowy Hydro expressed concerns that the new outage categories do not add much insight and would not add value.

6.1.2. AEMO's assessment

AEMO proposed the additional outage categories on the assumption that most outages (by capacity and time) within these categories were not discretionary, and therefore have the potential to occur during periods of supply scarcity. Feedback received in participant submissions suggested that outages in these categories are instead often discretionary; for example, a generator may choose to extend an outage, or take a maintenance outage, only on the basis that conditions associated with supply scarcity are unlikely to occur. AEMO however notes instances exist where outages in these categories have been non-discretionary, and hence should be included in forecast outage rates.

AEMO accepts participant suggestions to use the term 'non-discretionary' in its methodology and data request, rather than the IEEE 762-2006 definitions specifically. This will ensure that participants only need to provide the 'non-discretionary' outages that AEMO seeks to include in outage parameters, avoids the need for unjustified multipliers, and avoids concerns about inappropriate overestimation.

In ESOO and EAAP modelling, planned outages are not included, and AEMO proposes to only include planned outage extensions which are considered non-discretionary by the operator. As such, including early return service would not be relevant or appropriate. For the same reasons, the AEC proposal for the AER guidelines to incorporate appropriate contingency in their planned outage submissions to MT PASA would not affect the methodology for forced outage rates used in the ESOO and EAAP.

Although planned outages are included in MT PASA, it is proposed that the same rates will be used. These outages change regularly based on participant submissions to reflect the latest expectations of generators. The reduction in early return to service is assumed to have minor impact, as the purpose of MT PASA differs from ESOO and it is assumed more appropriate to rely on participants' estimates for outage planning. While updated AER guidelines may be useful for some participants when determining their MT PASA submissions, this suggestion is best considered by the AER.

AEMO agrees with stakeholder feedback that more details are needed to confirm the outage data participants would be required to provide each year for the new outage categories. AEMO proposes the following materiality thresholds that aim to minimise the burden for aggregated and small units:

- Full planned outage extension should be submitted for any extension to full planned outage which is non-discretionary and is extended by three days or more and the unit is larger than 30 MW. Only the non-discretionary proportion on any extension should be included in this category. It is assumed that participants would consider the supply demand balance during the period of the extended outage and would schedule discretionary outages outside tight supply periods.
- Partial planned outage extension should be submitted for any extension to a partial planned outage which is non-discretionary, is extended by three days or more, and unit capacity reduction is larger than 10 MW or 5% of summer capacity. Only the non-discretionary proportion of any extension should be included in this category. It is assumed that participants would consider the supply demand balance during the period of the extended outage and would schedule discretionary outages outside tight supply periods.

AEMO does not agree that the second term in the two outage equation should be scaled back by a factor (for example, multiplied by 0.25). AEMO considers that there is no reason to dilute this term given the clarified specification and that the proposed equation reflects the most accurate representation of unplanned outages.

6.1.3. AEMO's conclusion

AEMO will reflect the proposed updated methodology in the draft ESOO and Reliability Forecast Methodology.

Although AEMO is not able to assess the magnitude that this change will have without having collected the data, it is not expected to be large. When outage rates are calculated for the next ESOO, AEMO will provide a comparison of old and new methodology in pre-publication stakeholder engagement.

6.2. Data analysis from stochastic modelling

AEMO proposed no changes to the reporting of outage rates and their impact on the reliability forecasts.

6.2.1. Issue summary and submissions

Shell Energy submitted that AEMO should provide extra analysis on stochastic outage variables, stating that:

- Electricity market stakeholders need to understand the impact of stochastic outage variables on the modelling outcomes.
- The distribution of the results obtained from modelling many different outage scenarios should be individually reported on to highlight the range of expected outcomes and the materiality of outage rate assumptions.
- Sensitivity analysis should be undertaken on stochastic variables with impact on unserved energy reported on as part of EAAP.

6.2.2. AEMO's assessment

Currently unplanned outage rates are the only stochastic parameter in reliability forecast modelling (although a number of weather patterns [or 'reference years'] reflecting demand and renewable generation patterns are also modelled). In the 2022 ESOO, AEMO provided probability density charts for forecast USE for the first forecast year, to depict the variability due to stochastic modelling, and expected USE per reference year to depict the variability due to weather patterns. In previous consultations, AEMO has received feedback asking that its publications be less complicated. AEMO considers the analysis provided in 2022 is an appropriate overview of stochastic outcomes from the model and further analysis would make report overly complex for most readers.

6.2.3. AEMO's conclusion

AEMO will continue to provide expected USE per reference year and USE probability density charts in the ESOO.

6.3. Transmission outages

In January 2022, AEMO consulted on its methodology for modelling inter-regional transmission unplanned outages in the ESOO[14]. As part of the AER's consultation on a T-1 instrument, in response to the 2022 ESOO and associated RRO requests published in August 2022, some stakeholders suggested that the model simplifications in the methodology used by AEMO overstated the risks and magnitudes of USE[15].

AEMO argued in the consultation paper that the impact of transmission outages that were impacted by model simplifications were immaterial and that adding further granularity to the methodology would increase ESOO production costs.

AEMO instead proposed to include provision in the ESOO methodology that would require AEMO to apply full granularity (both single credible contingency and reclassification constraint sets) to its ESOO and EAAP simulations only in circumstances where the outage rates forecast are likely to have a material impact on expected USE.

6.3.1. Issue summary and submissions

The AEC accepted AEMO's assessment and agreed with the proposal.

Shell Energy disagreed with AEMO's assessment, suggesting that transmission outages should be modelled explicitly at all times, and that any prejudgement of the materiality of the impact on modelling results should be avoided.

No other participant submissions expressed concerns with AEMO's proposal.

6.3.2. AEMO's assessment

AEMO notes concerns from Shell Energy regarding the desire for model granularity, however, reiterates that in this case, the additional granularity gained comes at a cost that is disproportionate to the forecast accuracy gained. It is estimated that developing the additional outage constraint sets would approximately double the time required to develop outage constraint sets. Given the extremely low materiality documented for this input, AEMO asserts that adding additional granularity would increase costs to participants for limited benefit, and is therefore inconsistent with the NEO.

6.3.3. AEMO's conclusion

AEMO proposes no further changes to the proposed methodology.

6.4. Outages of major loads

AEMO considered that the treatment of outages of major loads was already captured in the methodology and proposed no changes.

[14] See https://aemo.com.au/-/media/files/stakeholder_consultation/working_groups/other_meetings/frg/consultations/2022/frg-consultation---unplanned-transmission-outage-rates.zip?la=en.

[15] See https://www.aer.gov.au/retail-markets/retailer-reliability-obligation/register-of-reliability-instruments/south-australia-january-february-2024/t-1.

6.4.1. Issue summary and submissions

Shell Energy suggested improvements to evaluate outages at major loads and incorporating these explicitly in the modelling. Shell Energy said it is likely that large energy users will increasingly align plant shutdowns with high energy prices.

6.4.2. AEMO's assessment

AEMO surveys large industrial load (LIL) customers each year, requesting forecast annual electricity consumption by site, taking into account major and minor planned outages. As these surveys inform AEMO's energy forecast, AEMO considers this factor to be sufficiently included in AEMO's energy forecasts. Further, outages on major loads that have occurred in the past are included in the demand traces that input to reliability forecasts. In most cases, AEMO considers that applying further outages would result in double-counting. In limited circumstances, however, AEMO can, and has, adjusted demand traces used in MT PASA where a major outage on a load has been advised and AEMO considers that it has not been captured in the energy forecast and existing demand trace.

6.4.3. AEMO's conclusion

AEMO has made no changes to the treatment of outages at major loads in the methodology.

7. Discussion of material issues on commitment criteria

In the consultation paper, AEMO identified opportunities to improve the consistency of the commitment criteria implementation for new generator, integrated resource system, aggregated DER and/or transmission developments to improve timely identification of reliability risks considering the forecast availability of these assets. AEMO proposed:

- numerous changes to generator and integrated resource systems, including the date of committed and committed* projects to be included in reliability forecasts, and anticipated projects to be included in the reliability forecast; and
- commitment criteria change for transmission projects to be consistent with ISP methodology and the CBA Guidelines; and
- inclusion of only those aggregated DER developments that can be identified as having committed in the ESOO and EAAP forecasts.

7.1. Generating and integrated resource systems commitment criteria implementations

AEMO proposed the following implementation for assessing generation and integrated resource system developments in reliability forecasts. No changes were proposed to the process for identifying generator and integrated resource system project commitment.

- Committed projects that have met the commissioning requirements of their first hold point to be included in reliability forecasts at:
  - The Full Commercial Use Date (FCUD) submitted by the developer.
- Committed projects that have not met the commissioning requirements of their first hold point to be included in reliability forecasts at:
  - Six months after the FCUD submitted by the developer.
- Committed* projects to be included in reliability forecasts at the furthest date of either:
  - The first day after the T-1 year for RRO purposes, or
  - The FCUD submitted by the developer.
- Anticipated projects to be included in the reliability forecast at the furthest date of either:
  - the first day after the T-1 year for RRO purposes, or
  - One year after the FCUD submitted by the developer.

7.1.1. Issue summary and submissions

Participant submissions were generally in support of the proposed commitment criteria implementation for generation and integrated resource systems:

- Snowy Hydro supported ‘the ongoing refinement of the criteria based on its demonstrated accuracy for the commitment criteria’.

- Shell Energy agreed that 'the current commitment criteria for supply side resources, transmission augmentation and proposed large industrial or commercial loads requires revision such that a consistent commitment basis is applied to all projects'.
- The AEC was supportive of revising the commitment criteria.

Suggestions to improve the proposal were also received:

- Shell Energy suggested the Committed* commitment criteria be amended to 'fully meet at least three of the above criteria but may only partially meet two of the finance, contracts or planning criteria and under the finance criteria must have achieved Financial Investment approval' and to include Committed* projects in reliability forecasts from their submitted FCUD plus six months. Shell Energy also suggested more details be provided on commissioning delay reasons.
- EnergyAustralia suggested more accurate data be obtained from participants instead of adjusting collected data. EnergyAustralia also suggested AEMO consider sensitivity analysis for commissioning delays by saying 'the prospects and consequences of delays in commissioning large infrastructure are now likely to be material enough to justify sensitivity analyses in AEMO's forecasts'.

7.1.2. AEMO's assessment

AEMO thanks stakeholders for their positive feedback on the proposed generation and integrated resource system commitment criteria implementation.

AEMO agrees with Shell Energy and EnergyAustralia that there is a need to obtain more accurate data from participants and intends to work with developers to improve their submissions. Currently committed projects were found to complete commissioning on average more than one year after the date they had provided, while AEMO had proposed to subject such projects to only a six-month delay in reliability forecasts. AEMO considers the use of the six-month delay appropriately balances the multiple paths AEMO is pursuing to improve accuracy, and to reflects the ongoing challenges in commissioning and in obtaining accurate project information.

AEMO considers Shell Energy's proposal regarding Committed* worthwhile, because the category typically represents projects that are very well advanced. AEMO, however, does not propose to adopt a three criteria definition for this category, on the basis that the category would be too similar to AEMO's current Anticipated project commitment criteria and would offer little benefit. Given AEMO now proposes to include Anticipated projects in reliability forecasts, revising Committed* commitment criteria is considered unnecessary. AEMO appreciates Shell Energy's suggestion to implement Committed* projects in reliability forecasts at the FCUD provided by the developer plus six months, and considers that this change will better balance project development risks for Committed* projects.

7.1.3. AEMO's conclusion

AEMO has updated the draft ESOO and Reliability Forecast Methodology document with the updated proposed methodology, and has also proposed discretion may apply to projects in circumstances where AEMO has sufficient evidence to suggest a delay is extremely unlikely. AEMO would welcome whether the detail of the draft methodology that incorporates delays to Committed* projects, and inclusion of Anticipated projects provides appropriate balance of these risks of under- and over-forecasting of available capacity appropriate for AEMO's reliability forecasting.

AEMO will consider sensitivity analysis on generator and integrated resource system developments in future reliability forecasting publications consistent with relevant market intelligence to inform the market as appropriate.

7.2. Transmission projects commitment criteria implementations

AEMO proposed the following application of commitment criteria for transmission developments:

- Committed projects to be included in the ESOO and EAAP reliability assessments at the commissioning dates provided by the developer.
- Anticipated projects to be included in the ESOO and EAAP reliability assessments at one year after the commissioning dates provided by the developer.

AEMO proposed no change to the treatment of transmission projects in MT PASA, in that transmission projects are included in MT PASA only to the degree that constraints used operationally, in NEMDE for example, capture such projects. Operational constraints are typically only updated following the provision of detailed operational specifications by the proponent – which is usually in the weeks prior to energisation.

7.2.1. Issue summary and submissions

The AEC, Shell Energy, and Snowy Hydro expressed support for the proposed approach for transmission project treatment in the ESOO and EAAP, while other stakeholder submissions expressed no concern for AEMO's proposal.

Shell Energy noted concern for the timely delivery of current transmission projects, suggesting that 'sensitivity analysis on committed project delays may be appropriate'. Further, Shell Energy suggested that the commitment criteria for 'committed' transmission projects should be based on a project receiving project funding approval, rather than just the completion of a regulatory investment test for transmission (RIT-T).

Regarding the treatment of transmission developments in MT PASA, Shell Energy did not support AEMO's proposal to not change the existing process. Shell Energy indicated that all transmission projects should be included in MT PASA, suggesting that the constraint sets used between ESOO, EAAP and MT PASA were the same.

7.2.2. AEMO's assessment

AEMO thanks stakeholders for their positive feedback on the proposed transmission commitment criteria implementation. To support further transparency on transmission augmentations in the NEM, AEMO has now launched a Transmission Augmentation Information page[16], that will be kept up to date based on information provided by project proponents.

The treatment of transmission commitment on the transmission augmentation information page matches that proposed by Shell Energy, in that transmission projects are only considered committed

[16] See https://aemo.com.au/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/forecasting-and-planning-data/transmission-augmentation-information.

once project funding approval is achieved. This varies from the criteria previously used by AEMO in the ESOO. [17]

Transmission developments are currently considered in MT PASA only to the degree that constraints used operationally, in the NEM Dispatch Engine (NEMDE) for example, capture such projects. Operational constraints are typically only updated following the provision of detailed operational specifications by the proponent – which is usually in the weeks prior to energisation. Because MT PASA uses operational constraints, rather than constraints developed for planning purposes, the incorporation of longer-term transmission projects that do not yet have detailed operational design characteristics is extremely challenging to incorporate. AEMO proposes that the ESOO and EAAP remain the most appropriate place for such consideration, and not MT PASA, which is designed for more operational purposes.

7.2.3. AEMO's conclusion

AEMO will update the draft ESOO and Reliability Forecast methodology to incorporate the proposed methodology. AEMO will consider sensitivity analysis on transmission developments in future publications consistent with relevant market intelligence to inform the market as appropriate.

7.3. Aggregated DER developments commitment criteria implementations

AEMO proposed changes to the treatment of forecast aggregated DER in reliability forecasts, such that only those aggregated DER developments that can be identified as having met appropriate commitment criteria would be included in the ESOO and EAAP forecasts. AEMO proposed that while all DER forecasts would remain included in reliability forecasts, aggregated DER (such as virtual power plants or coordinated vehicle to grid) would be treated as non-aggregated (uncoordinated behind the meter batteries, or uncoordinated vehicle charging) until such aggregation was identified as having been sufficiently committed. All other DER, such as photovoltaics (PV), electric vehicles (EVs) and batteries, were to remain included in the forecast as per AEMO's current methodology.

7.3.1. Issue summary and submissions

Both the AEC and Shell Energy expressed support for the proposed approach for aggregated DER treatment.

ENGIE suggested an inconsistency between AEMO's forecasting approach for supply and demand, indicating that only the largest DER developments are at all likely to be able to provide 'commitment even though it is implausible that rooftop PV installations will suddenly cease'.

Shell Energy suggested that more details were required in the consultation report to distinguish the treatment of DER, aggregated DER and demand response.

7.3.2. AEMO's assessment

AEMO notes potential confusion regarding the proposal to include only 'committed' aggregated DER. The proposal was to retain the inclusion of all forecast DER uptake, including PV, batteries and EV's, but that the aggregation of such DER would only be included in reliability forecasts to the degree that

[17] At current, the Transmission Augmentation Page includes additional information on project status that aligns with the current ESOO methodology. Following completion of this consultation, that additional consideration will be removed, and committed transmission projects will require completion of all five commitment criteria, consistent with the ISP.

the aggregation was considered 'committed'. In cases where the aggregation is not considered 'committed', AEMO proposed to include the DER forecast without aggregation. AEMO agrees with ENGIE that the exclusion of DER growth from reliability forecasts would be inconsistent, and ignore a key forecasting component, hence does not propose such an approach.

AEMO thanks stakeholders for their positive feedback on the proposed aggregated DER commitment criteria implementation.

7.3.3. AEMO's conclusion

AEMO will update the draft ESOO and Reliability Forecast Methodology to include the proposed methodology and clarifications and is interested in whether additional detail is required to avoid further confusion.

7.4. Large loads commitment criteria implementations

AEMO did not propose any commitment criteria implementations for large loads, as AEMO's demand forecasting methodologies were not the subject of this consultation.

7.4.1. Issue summary and submissions

The AEC commented the consultation ignored the demand side and suggested large loads commitment criteria by saying future new large loads should be assessed with the same rigour as that of supply. Shell Energy suggested large loads (greater than 10 MW) should also have commitment criteria for alignment. ENGIE suggested a consistent approach to forecasting supply and load by saying 'Large-scale load will still be included based on AEMO's survey data rather than when the proponents have committed to the project that will result in the new load'.

7.4.2. AEMO's assessment

The existing demand forecasting methodology[18] specifies how AEMO considers new large industrial loads that are surveyed, where a project is only considered in the 'best estimate'/Central scenario where:

- The project has obtained the required environmental approvals.
- The project has obtained approvals from the network service provider to connect to their system.
- The project proponent has publicly announced that it has taken a positive final investment decision and/or the project has commenced construction.

AEMO considers that this methodology is fit for purpose, and meets the intent of participant submissions.

7.4.3. AEMO's conclusion

AEMO has not made changes to the relevant methodologies and guidelines.

[18] See https://aemo.com.au/-/media/files/electricity/nem/planning_and_forecasting/nem_esoo/2022/forecasting-approach-electricity-demand-forecasting-methodology.pdf?la=en.

8. Discussion of material issues on Reliability Gap Calculation

In the consultation paper, AEMO proposed an updated reliability gap calculation methodology to address numerous identified deficiencies with the current methodology in the 2022 ESOO. Identified deficiencies included:

- The indicative trading intervals of the reliability gap periods did not always capture the majority of forecast USE.
- The limited sampling of 12 reference years resulted in bias amongst forecast USE. For example, maximum demand forecasts for South Australia in 2023-24 indicated the possibility of maximum demand events between December and March, whereas the reliability risks identified from the limited sample of 12 reference years predominantly arose in January. AEMO considers it prudent that a greater gap period, to cover forecast maximum demand projections would have been more appropriate.
- The calculated reliability gap in megawatts was not reflective of the true capacity requirement given the methodology of identifying the gap as the capacity required to reduce the reliability forecast to within the relevant reliability standard through reduced reliability risks within the reliability gap period only. Extending this reliability gap period revealed a much lower reliability gap, commensurate with the size of capacity required if available throughout the year (as could be expected of a new development, or a newly flexible customer load).

Stakeholder submissions generally agreed that the reliability gap calculation needs to change, with some suggestions and issues discussed below.

8.1. Reliability gap in megawatts methodology

AEMO proposed to calculate the reliability gap in megawatts as the capacity required to reduce expected USE to the relevant reliability standard, assuming the capacity is available in all periods of the year (rather than in a narrower reliability gap period).

8.1.1. Issue summary and submissions

Submissions from EnergyAustralia, Snowy Hydro, the AEC, and Shell Energy were in favour of the proposed methodology change with no objections noted from other participants.

8.1.2. AEMO's assessment

AEMO thanks participants for their feedback.

8.1.3. AEMO's conclusion

AEMO has updated the draft ESOO and Reliability Forecast Methodology with this updated methodology.

8.2. Reliability gap period and trading intervals minimum percentage

AEMO proposed to calculate the likely trading intervals and the reliability gap period such that the likely trading intervals of the reliability gap period contain a minimum of 90% of USE forecast over the financial year.

8.2.1. Issue summary and submissions

The AEC said 'the requirement that the reliability gap period must contain at least 90 per cent of forecast USE appears high'. The AEC further commented that as more VRE enters the market, it would become increasingly likely that attaining 90 per cent may require the reliability gap to be triggered for the majority of the year, which would invalidate the purpose of the RRO to focus attention on at risk periods. Hence, AEC suggested the value should be from 60% - 70%.

Shell Energy commented that a minimum of 90% forecast USE is conservative, saying 'the current requirement set out in proposed change 2 to require the reliability gap period to capture a minimum of 90% of all forecast USE periods to be overly conservative'. Shell Energy commented that the threshold should not exceed 70%.

EnergyAustralia commented 'setting a threshold of capturing at least 90% of forecast USE would have altered the dimensions of reliability gaps declared for NSW in the most recent ESOO, and it is not clear that this would have been AEMO's intention', hence suggested more analysis was needed to inform changes to reliability gap calculations.

8.2.2. AEMO's assessment

The proposal to set a minimum percentage of annual forecast USE that falls within the likely trading intervals of the reliability gap period is based on an interpretation of the following NEL and NER definitions:

Part 2A of the National Electricity Law (NEL) requires AEMO to forecast the occurrence of reliability gaps in future years, where:

- NEL14G(1) – A *forecast reliability gap* occurs when the amount of electricity forecast for a region, in accordance with the Rules, does not meet the reliability standard to an extent that, in accordance with the Rules, is material.
- NEL14G(2) – A *forecast reliability gap period* is the period during which a forecast reliability gap is forecast to occur.

Further, NER 4A.B.2(c) states that AEMO's reliability forecast must include 'the trading intervals during the forecast reliability gap period in which the forecast unserved energy observed during the forecast reliability gap is likely to occur'.

Given the probabilistic nature of the reliability assessment deployed by AEMO, a methodology is required for identifying the likely trading intervals of the reliability gap period, and reliability gap in megawatts. AEMO argues that if too little of the forecast USE falls within the likely trading intervals of the reliability gap period, then it is not 'the period during which a forecast reliability gap is forecast to occur'.

Should this methodology be indiscriminate in identifying gaps, it has the potential to increase costs to retailers. Conversely, should this methodology be too narrow in identifying gaps, it will not capture the

periods where reliability risks to consumers are likely to occur, and will therefore not meet the requirements of the NEL and NER.

Contrary to the suggestions from the AEC, the evidence from South Australia, which was used as an example in the consultation paper, indicates that increasing penetration of VRE is associated with less frequent, high magnitude forecast USE events that are clustered in peak seasons. Should the minimum percentage be too low, there is a risk that only one or two single forecast events are used to identify a very narrow period inappropriately.

AEMO accepts participant objections that a 90% minimum requirement may result in a wider reliability gap period that could, in some circumstances be burdensome for participants, however, argues that the minimum percentage requirement must remain reasonably high to ensure that NEL and NER requirements are met. For example, applying a minimum percentage of 60-70% as suggested, would have resulted in a reliability gap for the South Australian T-1 in the 2022 ESOO that would have been very narrow, would have excluded many of the periods where reliability risks were forecast to occur, and hence may not have meet requirements.

AEMO proposes to update the minimum percentage requirement to 80%, which AEMO considers more appropriately balances the NEO by minimising costs to participants and ensuring the identification of an appropriate reliability gap period. The updated minimum percentage would not have changed the dimensions of the reliability gaps declared in New South Wales in the 2022 ESOO as raised by EnergyAustralia, but would result in a narrower reliability gap period than declared in South Australia as identified in the 2022 ESOO.

8.2.3. AEMO's conclusion

AEMO will update the draft ESOO and Reliability Forecast Methodology with the updated proposed methodology.

8.3. Reliability gap period and trading intervals methodology

AEMO proposed a flexible methodology, whereby AEMO must have regard to the following items when identifying the likely trading intervals and reliability gap period:

(a) Periods within the year that have a high LOLP in reliability forecast modelling (monthly and hourly analysis similar to existing processes).

(b) Periods within the year in which maximum demand is forecast to approach (for example, 99th percentile demand) the one-in-two year (50% POE) peak demand forecast (monthly and hourly analysis to complement LOLP analysis, in cases where limited sampling is biasing modelled results)

(c) The availability of standard contract periods on a suitably liquid and transparent futures market, for example contracts available on the ASX Electricity Futures Market. This may include contract periods that exclude non-working weekdays and/or periods that fall outside available standard contract periods where feasible.

8.3.1. Issue summary and submissions

Participant feedback was mixed regarding the proposed methodology, with all submissions requesting additional analysis to quantify the change.

Shell Energy considered that 'the NER and NEL requirements could be achieved by implementing the change regarding the minimum percentage (discussed in Section 8.2) and are not convinced that the

changes set out as proposed in this section (Section 8.3) are required.' Hence, Shell Energy suggested AEMO should provide 'the results of additional modelling which implements this proposed change to better understand its impact in this area.' Shell Energy was worried that the proposed changes discussed in this section may 'materially increase costs for retailers with flow on impacts to consumers by extending the duration of a reliability gap period without materially impacting the forecast USE'.

Snowy Hydro supported the methodology revision and commented 'the consultation paper however does not contain enough material to understand whether the proposed changes will strike the right balance between meeting the NEL and NER while not increasing costs for the market'.

AEC was in favour of the reliability gap methodology revision and expressed similar concern with Snowy Hydro. AEC said, 'the consultation does not contain enough material for AEC to ascertain whether the proposed changes will strike the right balance between satisfying the NEL and NER while not unduly increasing costs for retailers'. The AEC noted that 'the proposed changes do give AEMO more discretion whereas the AEC's preference is generally for a prescribed process. With respect to the proposed changes, the AEC agrees with the subjective items (a), (b) and (c) which "AEMO must have regard to"'.

EnergyAustralia suggested further analysis should be presented to identify 'how loss of load probabilities are expected to change over time and in different regions with different types and rates of technology uptake'. EnergyAustralia also encouraged AEMO to explore whether the resources procured to address any declared reliability gap were not available for other trading intervals.

8.3.2. AEMO's assessment

AEMO notes stakeholder support for the three items that AEMO proposed to have regard for, but also notes concerns that a reliability gap period that is too wide may unduly increase costs for retailers. To address concerns with ambiguity regarding the process, AEMO proposes to describe the process in a more deterministic manner so that participants can have confidence in the repeatability and detail of the process. As this methodology differs from the existing methodology, only to the degree that it captures the items AEMO proposed to have regard for, AEMO does not believe it unduely increases costs for retailers.

AEMO instead proposes the following process description:

- AEMO to consider standard contract periods on a suitably liquid and transparent futures market, for example contracts available on the ASX Electricity Futures Market. This may include contract periods that exclude non-working weekdays and/or periods that fall outside available standard contract periods where feasible.
- Monthly – a forecast reliability gap is declared to exist in a month if the LOLP in that month exceeds 10%[A]. The months identified are then used to determine the start and end date of the forecast reliability gap period.
    a. AEMO applies a 'sense test' that could widen the months included, only in circumstances where the limited sampling of reference years leads to a potentially biased outcome. For example, when USE is concentrated in less than half of the reference years and is unduly narrowing the reliability gap period. In such a case, AEMO will consider the forecast timing of maximum demand to include other months in which supply scarcity risks are also likely to occur.

b. AEMO applies a second 'sense test' that could tighten the start and end dates of the forecast reliability gap period within the month, if all the risk is forecast to occur in, say, the first or last week of the month.

- Day-of-the-week – within each month identified, day categories consistent with the standard contract periods (for example, working weekday and non-working weekday) are assessed and declared as being within the forecast reliability gap period if the LOLP exceeds 10%[A]. The day-of-the-week classification is used to describe the likely trading intervals of a shortfall.
- Time-of-day – a consistent time-of-day is applied across all periods within a forecast reliability gap period. The range of trading intervals is identified by determining the earliest and latest time-of-day where the LOLP exceeds 10%[A]. All periods between these trading intervals are included.

A 10% or a lower percentage, decreased in 2% increments as required to achieve the minimum required USE percentage as discussed in Section 8.2.

8.3.3. AEMO's conclusion

AEMO has included the proposed updated methodology in the draft ESOO and Reliability Forecast Methodology, alongside a worked example to assist in its interpretation.

9. Discussion of material issues on MT PASA unit status and recall times

The 'Enhancing information on generator availability in MT PASA' rule change was one of the Energy Security Board's (ESB's) post-2025 recommendations to improve resource adequacy outcomes in the NEM. The final rule was published by the Australian Energy Market Commission (AEMC) on 18 August 2022. The rule builds on existing MT PASA requirements, which require scheduled generators and other market participants to indicate how many megawatts they could make available each day over the medium-term horizon (between seven days and 36 months into the future). In addition to providing the megawatt availability, the final rule requires scheduled generators and integrated resource systems to also provide current intentions and best estimates of a:

- Unit state – that is, a scheduled generating or integrated resource system's availability or unavailability and the reason for its availability or unavailability. The unit state must distinguish between a physical and economic reason for unavailability.
- Unit recall time – to indicate the period in which the plant could be made available under normal conditions after a period of unavailability.

AEMO is required to consult with stakeholders to identify the process for, and the form of, reason code and recall time information.

AEMO proposed a solution that utilises IEEE 762-2006, as shown in the following table.

Table 4 Proposed MT PASA reason codes and recall time requirements

Reason code category	Reason code	Economic or physical	Recall time requirements
Deactivated shutdown	Inactive reserve	Economic	Mandatory
Deactivated shutdown	Mothballed	Economic	Mandatory
Deactivated shutdown	Retired	Economic	None
Available	No deratings	Not applicable	None
Available	Basic planned deratings	Physical	Mandatory if available
Available	Extended planned deratings	Physical	Mandatory if available
Available	Unplanned forced deratings	Physical	Mandatory if available
Available	Unplanned maintenance deratings	Physical	Mandatory if available
Unavailable	Basic planned outage	Physical	Mandatory if available
Unavailable	Extended planned outage	Physical	Mandatory if available
Unavailable	Unplanned forced outage	Physical	Mandatory if available
Unavailable	Unplanned maintenance outage	Physical	Mandatory if available

AEMO proposed that all definitions from IEEE 762-2006 apply to the proposed reason codes, and clarified that the 'No deratings' category should be used when submitted PASA availability represents 'Dependable capacity' not just 'Maximum capacity' as defined in the standard, which would therefore include 'Seasonal derating'.

In cases where a recall time does not apply, for example when a unit is unavailable for maintenance that is not recallable, AEMO proposed that a recall time would not be required, but would be mandatory if a recall time did apply. As such, the recall time field would accept NULL submissions for many reason codes.

9.1. The use of IEEE 762-2006 for reason code taxonomy

AEMO has proposed status codes consistent with IEEE 762-2006.

9.1.1. Issue summary and submissions

Participants generally expressed support for the use of IEEE 762-2006 as proposed, with EnergyAustralia saying they 'seem reasonable', Origin, PET and Shell Energy 'supporting' these codes and AEC expressing they had 'no issues with what is proposed'.

Comments generally asked for clarification of the codes or suggestions of adding additional codes to those in the standard:

- EnergyAustralia suggested 'further granularity of data associated with unit unavailability linked to fuel limits', and suggested this may be useful in signalling these types of risks more often than in annual EAAP publications.
- PET suggested an additional code for generators withdrawn at late notice as a result of fuel supply restrictions as well as reasons for switching availability between unconstrained and constrained capacity.
- Origin requested clear definitions of these codes, including the differentiation between basic and extended outages.
- Snowy Hydro requested clarification of the recall time requirements category that is labelled 'mandatory if available'.
- EnergyAustralia noted that the example provided was unrealistic and requested further information on the use of economic reasons, including when and why participants might change availability status between PASA submissions.

9.1.2. AEMO's assessment

AEMO proposes the use of IEEE 762-2006 as it is an industry standard that is typically understood and used in practise. Participant feedback suggests this proposal is reasonable.

AEMO will ensure that the MT PASA Process Description includes relevant definitions for participant clarification. For example, IEEE 762-2006 defines a basic and extended outage as follows:

- Basic outage: the basic planned outage state is the planned outage as originally scheduled and with a predetermined duration
- Extended outage: the extended planned outage state is the extension of the basic planned outage beyond its predetermined duration.

The difference between a basic and extended outage is that the basic outage is as originally scheduled and the extended outage is beyond the predetermined duration. AEMO has included a table in the draft MT PASA process description that includes definitions of each status code. Further detail is available in the IEEE 762-2006 standard.

The proposed requirement for recall times to be 'Mandatory if available' was proposed such that a recall time must be provided if one is available; i.e., if the unit is recallable. In the case of an inactive reserve and mothballed unit, in many instances the unit may be brought back to normal service by definition so a recall time must be provided. In the case of an outage or derating, a recall time only needs to be provided if the unit is recallable; if physical constraints prevent the recall of the unit, then no recall time

is required. For example, once an outage has begun it may not be possible to return the unit to service until the outage is complete.

EnergyAustralia and PET suggested the introduction of codes relating to fuel availability. Such codes are not included in the standard; a unit that is fully available, but does not have access to fuel would presumably be defined as 'no derating' in the standard. Similarly, the rule change final determination indicated that the recall times were intended to comment on PASA availability which is defined as being energy unconstrained, rather than energy limited.

While AEMO understands that EnergyAustralia and PET would appreciate additional insight on energy limit information, such unit level information is not prescribed to be published by the NER, hence is confidential.

9.1.3. AEMO's conclusion

AEMO has included the proposed reason codes and recall time requirements, including examples in the MT PASA process description and RSIG.

9.2. AEMO's usage of new information

AEMO will collect and publish new information on recall reason and recall periods, including information on economic shutdowns.

9.2.1. Issue summary and submissions

EnergyAustralia queried 'how AEMO intends to use this information'.

9.2.2. AEMO's assessment

As specified in the AEMC's final determination, the purpose of the 'Enhancing information on generator availability in MT PASA' rule change is consistent with the main purpose of the PASA, which is to ensure that "…participants are properly informed to enable them to make decisions about supply, demand and outages of transmission networks..."[19] and supports other PASA outcomes such as the publication of "sufficient information to allow the market to operate effectively with a minimal amount of intervention by AEMO"[20]. The rule change specifically states 'reason codes and recall times will be published alongside the MT PASA reliability assessment, and not be an input to the modelling'[21].

9.2.3. AEMO's conclusion

Consistent with the rule change, AEMO does not intend to make any modifications to its MT PASA modelling process to incorporate recall reasons or recall times. This information will be published to market and will be used as a reliable source of information for informing market participant and market body decision-making.

[19] NER cl. 3.7.1(b)

[20] NER cl. 3.7.1(d)

[21] Rule determination: National Electricity Amendment (Enhancing Information on generator availability in MT PASA) Rule 2022 at https://www.aemc.gov.au/sites/default/files/2022-08/ERC0338%20-%20Final%20Determination%20-%20Enhancing%20information%20on%20generator%20availability%20in%20MT%20PASA%20-%2018%20August%202022.pdf.

9.3. Use of single alphabetic input codes for submission

AEMO proposed reason codes that were full text descriptions.

9.3.1. Issue summary and submissions

Shell Energy suggested the long form reason codes should be replaced with a single alphabetic input code for submissions.

9.3.2. AEMO's assessment

AEMO agrees that the full reason codes are long and may be unwieldy. The use of a single alphabetic numeric code may be confusing as the letter may not correspond to the reason code. AEMO considers that a simple string representation of the code (rather than a single letter, or a long form description) would deliver the intent of Shell Energy's suggestion.

Participants can use a variety of methods to input MT PASA bids, including the web UI as well as the API. For consistency, AEMO will use the same alphabetic input string representations across all input methods.

9.3.3. AEMO's conclusion

AEMO has proposed shortened strings to represent each reason code. These strings will be consistent across all input methods and have been documented in the draft MT PASA process description.

9.4. PASA Availability recall period and implementation

AEMO did not propose any change to the definition of PASA availability, which specifies that PASA availability is the capacity that can be made available within 24 hours notice. Neither the AEMC's rule change, nor AEMO's consultation paper, made a determination on what capacity the recall period was recalling to.

AEMO did not propose any clarification to the recall time requirements of the definition of 'scheduled capacity' as submitted to Generation Information.

9.4.1. Issue summary and submissions

ENGIE and Shell Energy both suggested the 24-hour recall period used to define PASA availability is too rigid, and that it should be extended to say 72 hours.

Shell Energy queried what capacity the new data field 'recall period' was recalling to. Shell Energy submitted 'PASA availability should reflect the availability the resource can achieve in the recall period (may not return to full capability within recall time)'.

EnergyAustralia noted that this could raise 'potential inconsistencies' whereby if a participant specifies a unit recall time of greater than 24 hours for a discretionary economic outage it could be treated as "PASA unavailable".

9.4.2. AEMO's assessment

PASA availability is defined in the NER glossary as follows:

> The physical plant capability (taking ambient weather conditions into account in the manner described in the procedure prepared under clause 3.7.2(g)) of a scheduled generating unit,

> scheduled load or scheduled network service available in a particular period, including any physical plant capability that can be made available during that period, on 24 hours' notice.[22]

It was also clarified in the determination to the 'Enhancing information on generator availability in MT PASA' rule that:

> Reason codes and recall times will be published alongside the MT PASA reliability assessment, and not be an input to the modelling. AEMO would continue to analyse reliability over a 24 month period using the PASA availability that participants can make available given 24 hours' notice.[23]

The NER definition is subject to change as part of the 'National Electricity Amendment (Updating Short Term PASA) Rule 2022 No. 4', which will defer the definition of the recall period to the RSIG. This rule change commences operation in 31 July 2025. AEMO will consult on the definition of recall period closer to the commencement of this rule change. Until then, it is beyond the scope of AEMO's consultation to make any adjustments to the NER.

The definition of recall time included within the Enhancing information on generator availability in MT PASA rule as:

> unit recall time means, for a scheduled generating unit or scheduled bidirectional unit, the period in which the plant can be made available under normal conditions after a period of unavailability as determined in accordance with the reliability standard implementation guidelines.[24]

This is further clarified in the determination to the Enhancing information on generator availability in MT PASA rule that:

> The unit recall time will: represent the period in which the plant could be made available under normal conditions after a period of unavailability, and not under direction from AEMO.[25]

AEMO does not expect that inconsistencies will arise as suggested by EnergyAustralia. For example, in the case where a unit is 'normally' recallable in 36 hours but is recallable in 24 hours under direction, the PASA availability value would override and the submission should most likely declare 'no deratings'.

In some cases, the recall time may differ depending on whether the unit is brought back to partial operations, or brought back in full. To avoid ambiguity, AEMO proposes to clarify that the recall time should refer to the time taken to restore the unit to 'normal' operations (i.e., not a partial restoration). This would mean that in cases where restoration to 'normal' operations is not possible, the recall time should be submitted as NULL, indicating it is not recallable.

AEMO accepts that 72 hour recall is a valid recall period for longer-term planning including the EAAP and ESOO. As such, AEMO proposes to clarify this in the recall time requirements of the definition of

[22] National Electricity Rules. At https://energy-rules.aemc.gov.au/ner/431.

[23] Rule determination: National Electricity Amendment (Enhancing Information on generator availability in MT PASA) Rule 2022 at https://www.aemc.gov.au/sites/default/files/2022-08/ERC0338%20-%20Final%20Determination%20-%20Enhancing%20information%20on%20generator%20availability%20in%20MT%20PASA%20-%2018%20August%202022.pdf.

[24] Indicative changes to the National Electricity Rules showing changes made by the National Electricity Amendment (Enhancing information on generator availability in MT PASA) Rule 2022. At https://www.aemc.gov.au/sites/default/files/2022-08/ERC0338%20-%20Final%20Rule%20-%20Enhancing%20information%20on%20generator%20availability%20in%20MT%20PASA%20-%20markup%20format.pdf.

[25] Rule determination: National Electricity Amendment (Enhancing Information on generator availability in MT PASA) Rule 2022 at https://www.aemc.gov.au/sites/default/files/2022-08/ERC0338%20-%20Final%20Determination%20-%20Enhancing%20information%20on%20generator%20availability%20in%20MT%20PASA%20-%2018%20August%202022.pdf.

'scheduled capacity' as submitted to Generation Information, which is the source of capacity information for ESOO and EAAP.

9.4.3. AEMO's conclusion

AEMO has not made any updates to the recall period at this time. AEMO may consider further changes to the 24-hour recall period in future consultations closer to 31 July 2025, once the definition of PASA availability is deferred to the RSIG.

AEMO has modified the draft RSIG to clarify that the unit recall time is the period to restore the unit to 'normal operations'.

AEMO has updated the Generation Information guidelines to clarify a 72-hour recall time requirement for the definition of 'scheduled capacity' as submitted to Generation Information.

9.5. Difficulties with long-term forecasting

9.5.1. Issue summary and submissions

Snowy Hydro submitted that 'any unit status greater than one year is likely to be inaccurate and unhelpful'.

9.5.2. AEMO's assessment

The requirement to provide recall times for a 36-month period for scheduled generating units is included within the 'Enhancing information on generator availability in MT PASA' rule change and AEMO is obliged to collect this information. Per clause 3.7.2(d) of the NER, participants are obliged to submit this information based on their 'current intentions and best estimates'.

All PASA availability information is based on long-term expectations about plant utilisation and maintenance which may vary from time to time.

9.5.3. AEMO's conclusion

Participants are required to provide recall reason codes and recall times for a period of 36 months that represent 'current intentions and best estimates' consistent with NER requirements. AEMO has included examples in the MT PASA Process Description to aid participants in meeting their obligations.

10. Draft determination on proposal

AEMO has proposed draft versions of each relevant guideline and methodology which are published alongside this draft report.