



# 2022 Forecasting Improvement Plan Consultation

Final Report

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## Executive summary

The publication of this final report concludes the single stage Forecasting Best Practice Guidelines (FPBG) Appendix B consultation procedure conducted by AEMO to finalise the 2022 Forecasting Improvement Plan.

AEMO thanks all stakeholders for their feedback on the draft 2022 Forecasting Improvement Plan, which was undertaken as required by National Electricity Rules (NER) 3.13.3A h(2), following the procedure in Appendix B of the AER's Forecasting Best Practise Guidelines.

The priority improvements proposed for 2023, outlined in Section 8 of the Forecast Accuracy Report (FAR), include:

1. Improve renewable generation and demand traces, including the quantity used, and their shape.
2. Improve visibility of sectoral consumption.
3. Review forecast maximum and minimum distribution of the initial year of the forecast horizon.
4. Review large industrial load and other non-scheduled generation forecast components.
5. Monitor data availability of uptake and usage of emerging technologies.
6. Monitor demand side participation.

AEMO received direct feedback only on item 3. Other stakeholder feedback received included:

- Suggestions on the need for annual independent reviews.
- Suggestions for the Demand Side Participation Methodology.
- Suggestions for the Forecast Accuracy Report Methodology.

While AEMO has addressed the substance of the above suggestions in most cases, AEMO will consult on the Forecast Accuracy Report Methodology and Demand Side Participation Forecast Methodology in 2023-24 followed by the Demand Forecast Methodology in 2024-25. Hence, AEMO will consult on these suggestions more comprehensively as part of that process.

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# 1. Stakeholder consultation process

As required by the National Electricity Rules (NER) 3.13.3A h(2), AEMO must publish any improvements made by AEMO or other relevant parties to the forecasting process that will apply to the next Electricity Statement Of Opportunities (ESOO) for the National Electricity Market (NEM), in accordance with the Reliability Forecast Guidelines<sup>1</sup>.

AEMO consulted on the 2022 Forecasting Improvement Plan, which outlines proposed forecasting improvements that may apply to the 2023 ES00, in accordance with the single stage consultation procedure in Forecasting Best Practice Guidelines Appendix B.

AEMO's process and timeline for this consultation are outlined below.

**Table 1 Consultation process and timeline**

Consultation steps	Dates
Presentation at Forecasting Reference Group	26 October 2022
Draft report and Forecast Accuracy Report published	16 December 2022
Submissions closed on draft report	27 January 2023
Final report published	13 June 2023

AEMO's consultation webpage at <https://aemo.com.au/consultations/current-and-closed-consultations/2022-forecast-improvement-plan-consultation> contains all published papers and reports, written submissions, and other consultation documents or reference material.

In response to its draft report, AEMO received two written submissions.

AEMO thanks all stakeholders for their feedback on the draft report through written submissions and discussion at the Forecasting Reference Group (FRG), which has been considered in preparing this final report.

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<sup>1</sup> Available at [https://aemo.com.au/-/media/files/electricity/nem/planning\\_and\\_forecasting/nem\\_esoo/2021/reliability-forecast-guidelines.pdf](https://aemo.com.au/-/media/files/electricity/nem/planning_and_forecasting/nem_esoo/2021/reliability-forecast-guidelines.pdf).

## 2. Background

### 2.1. Context for this consultation

As required by NER clause 3.13.3A(h) AEMO must, no less than annually, prepare and publish on its website information related to the accuracy of its demand and supply forecasts, and any other inputs determined by AEMO to be material to its reliability forecasts. This requirement is met by the publication of the 2022 Forecast Accuracy Report (FAR).

The FAR includes information related to proposed improvements to the forecasting processes that may apply to the next ESOO, with a particular focus on those arising from forecast deviations. In accordance with AEMO's Reliability Forecast Guidelines, AEMO consults on the Forecasting Improvement Plan part of the FAR using the single stage consultation process as outlined in Appendix B of the AER's Forecast Best Practice Guidelines. An FRG discussion on the topic was also held.

The priority improvements proposed for 2023, outlined in Section 8 of the FAR, include:

1. Improve renewable generation and demand traces, including the quantity used, and their shape.
2. Improve visibility of sectoral consumption.
3. Review forecast maximum and minimum distribution of the initial year of the forecast horizon.
4. Review large industrial load and other non-scheduled generation forecast components.
5. Monitor data availability of uptake and usage of emerging technologies.
6. Monitor demand side participation.

Additionally, the Forecasting Research Plan includes research initiatives on:

- Sectoral modelling.
- Future load shape from:
  - Technology uptake and usage.
  - Behavioural change impacts on consumption profiles.

### 2.2. The national electricity objective

Within the specific requirements of the NER applicable to this proposal, AEMO has sought to make a determination that is consistent with the national electricity objective (NEO) and, where relevant, to select the option 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<sup>11</sup>, but has not informed AEMO's consideration in this report.

### 3. List of material issues

AEMO received two written submissions to the draft 2022 Forecasting Improvement Plan consultation, from Shell Energy and the Energy Users Association of Australia (EUAA). AEMO thanks both stakeholders for their considered submissions.

The issues raised in submissions to the draft report are listed in Table 2 in summary form.

**Table 2 List of material issues**

No.	Issue	Raised by
1.	Independent audit and review	Shell Energy & EUAA
2.	Adjusting the Maximum demand baseline rather than increasing the range	Shell Energy & EUAA
3.	Summer 10% POE is too high – AEMO should publish monthly forecast data	Shell Energy
4.	Data collection period and scope of demand side participation	Shell Energy
<b>Other issues (Section 5)</b>		
5.	Supply side graphs in Section 6 should show the full range of expected availability and show actual demand.	Shell Energy
6.	Section 7 – USE should be monthly and show actual v forecast USE from ESOO and MT PASA	Shell Energy

Each of the material issues in Table 2 is discussed in Section 4.

## 4. Discussion of material issues

### 4.1. Independent audit and review of forecast accuracy

#### 4.1.1. Issue summary and submissions

Both EUAA and Shell Energy submitted their recommendation to “*subject all future Forecasting Accuracy Reports and Improvement Plans, to an independent audit prior to publication with the independent audit published as an attachment to the report*”.

#### 4.1.2. AEMO’s assessment

In the 2020 Forecasting Improvement Plan consultation<sup>2</sup>, stakeholders requested an independent review of the annual FAR. In the submission response document, AEMO published:

*The AER reviews the reliability forecast and its components when a Reliability Instrument Request is issued by AEMO, so an independent evaluation of the forecast is undertaken when the reliability forecast has the potential to impact cost to industry and thus end consumers.*

*In addition, AEMO supports an independent review of the FAR methodology every four years as outlined in AEMO’s draft determination to its Reliability Forecast Guidelines consultation. However, AEMO considers an annual review to be excessive and not constituting value for energy consumers.*

*AEMO proposes to undertake an independent review of the methodology to assess forecast performance at least every four years ahead of the formal consultation of the Forecast Accuracy Report Methodology. AEMO then follows the documented methodology to assess forecast performance each year and transparently reports on its assessment. Such an assessment should be able to be replicated by external parties if they have access to all necessary data, which will be made available if not confidential.*

#### 4.1.3. AEMO’s conclusion

AEMO will continue with an external review of the Forecasting Accuracy Report Methodology once every four years, prior to stakeholder consultation. Given the AER reviews AEMO’s reliability forecasts when AEMO requests reliability instruments, additional reviews are likely to be of limited value and the additional costs that these reviews would incur are therefore likely to be inconsistent with the NEO.

The next independent review will be conducted in 2023, prior to consultation on the Forecasting Accuracy Report Methodology later in the year.

### 4.2. Maximum demand baseline

#### 4.2.1. Issue summary and submissions

Shell Energy and EUAA both noted that “*for a number of regions actual maximum demands during the extended summer period (November to March), fell either towards the lower end of AEMO forecast range of potential outcomes or in some instances below the implied 100% POE value.*”

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<sup>2</sup> Available at <https://aemo.com.au/consultations/current-and-closed-consultations/2020-forecast-improvement-plan-consultation>.

EUAA suggested that “*corrections should focus on the forecasting input assumptions to adjust the baseline rather than increasing the value range of expected outcomes*”. Shell Energy added that “*baselines should be adjusted similar to what would be done when actual outcomes sit towards the higher end of the forecast distribution*”.

Shell Energy also asked for AEMO to publish the monthly operational as generated maximum demand forecast for at least the first five years alongside each ESOO, rather than only in the annual FAR.

#### 4.2.2. AEMO's assessment

AEMO's medium- to longer-term reliability assessments rely on AEMO's seasonal demand forecasts and the translation of these forecasts into half-hourly demand traces, which are ultimately used in the modelling.

To reflect differences in weather and its impact on demand as well as the correlation between demand and generation from variable renewable generation, AEMO uses a number of different demand traces, reflecting different historical reference years and 10% and 50% probability of exceedance (POE) outcomes. Overall, 12 reference years were used for the 2022 ESOO, each modelled both for 10% and 50% POE conditions, resulting in 24 different demand traces being used in total for the reliability assessment.

The seasonal forecast accuracy have been assessed in all FARs published by AEMO to date.

Recently, AEMO has added an assessment of whether the demand traces generated on the basis of the forecasts sufficiently represent the seasonality at a monthly level. This is important to understand reliability risks not just in summer and winter, but also shoulder seasons when a lot of generators typically schedule planned outages.

An example of this assessment is Figure 16 of the 2022 FAR, which shows how well observed New South Wales monthly maximum demand values aligned with the maximum demand outcomes spanned by the 24 demand traces used in the modelling. The figure showed that the maximum demand outcomes for all months fell within the range of maximums formed by the demand traces used in the modelling. This was the case in most regions for the extended summer. There are cases where the actuals fell below the range formed by the traces, such as in January 2022 in South Australia. As the modelling does not include 90% POE traces, actual outcomes slightly below range formed by the traces are in line with expectations, in particular during La Niña summers.

The assessment suggests the accuracy of the methodology used to translate from seasonal maximum values to half-hourly demand traces is fit for purpose.

AEMO produces only seasonal maximum values (summer, winter and shoulder seasons) and not monthly values at this point. However, AEMO publishes the operational sent out demand traces used in the ESOO, so it is possible for stakeholders to look at the monthly range of demand traces for all forecast years similar to the assessment discussed above for the most recent historical year.

#### 4.2.3. AEMO's conclusion

Given the alignment shown for seasonal maximum demand forecasts for each region (beyond the issues already noted in the Forecast Improvement Plan) and the reasonable match at monthly level too, AEMO find the methods fit for purpose and has preferred not to add additional enhancements to the Forecast Improvement Plan at this time.

AEMO may start to produce monthly forecasts as part of its work on synthetic traces, which is already captured in the Forecast Improvement Plan (see improvement priority #1, regarding improving demand trace, including quantity and shape).



## 4.3. Relatively high summer 10% POE maximum demand forecasts

### 4.3.1. Issue summary and submissions

Shell Energy submitted concern regarding 10% POE forecasts for summer in several regions being considerably higher than actual outcomes, saying “*such an outcome may lead to unnecessary reliability concerns being raised resulting in increased costs to consumers.*”

### 4.3.2. AEMO's assessment

AEMO compares monthly maximum demand outcomes to monthly forecast data each year in the FAR. The comparison undertaken by Shell Energy has applied Medium Term Projected Assessment of System Adequacy (MT PASA) daily maximum and minimum daily peak loads published consistent with clause NER 3.7.2(f)(1A), which are not those applied by AEMO for the purposes of the MT PASA reliability forecast or loss of load probability (LOLP) run, the ESOO or Energy Adequacy Assessment Projection (EAAP). When developing the FAR, AEMO applies forecasts and history developed on the same demand definition basis.

For MT PASA, AEMO applies load forecasts based on operational sent-out demand, consistent with the approach used for the ESOO and the EAAP. The AEMO 10% POE and 50% POE calculations of maximum and minimum daily peak loads published consistent with clause 3.7.2(f)(1A) are similar, but different to the range of daily maximum demands considered across the demand traces for use in reliability modelling, with differences being:

- The MT PASA published values assume an expected annual auxiliary load and an auxiliary load at time of peak to convert from sent-out to as-generated, for better comparison with demand published by AEMO after each trading period, whereas the demand inputs to the reliability run are sent-out.
- The MT PASA published values are net of all non-scheduled generation based on the assumed profiles of large non-scheduled generation within each region in each reference year, whereas in the reliability run, large non-scheduled generation (and associated demand) is modelled explicitly.

Further, the abstract demand traces used for the LOLP run in MT PASA are not directly comparable to 10% POE daily demand met by scheduled and semi-scheduled generators due to a different treatment of variable renewable energy.

### 4.3.3. AEMO's conclusion

AEMO continues to monitor maximum and minimum demand forecasting performance against historical outcomes which are measured on a consistent basis in the FAR. AEMO will make appropriate improvements to its forecasting methodologies to increase their accuracy based on the results of these assessments.

Operational sent-out demand traces that are published with the ESOO model remain the best source of data for participants to analyse AEMO's demand forecasts.

## 4.4. Demand side participation data

### 4.4.1. Issue summary and submissions

Shell Energy recommended that AEMO consider if the observation period from demand side participation (DSP) needs to be extended to ensure higher spot price outcomes remain within the analysed period. Shell suggested that the level of DSP in the NEM based on observed and reported

DSP dispatch is being underforecast across all regions. Shell also recommended including a question about DSP in annual Large Industrial Load (LIL) surveys.

#### 4.4.2. AEMO's assessment

AEMO's methodology allows the use of more than three years of history to observe the level of DSP in the NEM if warranted. Specifically, the DSP Forecast Methodology<sup>3</sup> states:

*Typically, a three-year time series is used, because this is short enough to capture recent customer behaviour, yet long enough to capture a useful number of DSP events. AEMO may choose to use a different time period, to ensure sufficient DSP events or to avoid unrepresentative periods.*

Going back further than three years can reduce the relevance to the current DSP fleet, but may be necessary if prices generally have been low for several years, leaving few observation points for any potential DSP response at higher price levels. AEMO will make the most relevant decision when developing the forecast and ensure that transparency is provided if a different period than three years has been used.

AEMO's assessment of DSP forecast performance in recent years has shown a reasonably good alignment between median estimated observed responses and the median of the forecast response, taking into account some years have had very few observations of extreme prices. AEMO is aware that on certain occasions DSP responses will be higher than the median, but the median is what is being assumed available in AEMO's forecast.

The assessment is supplemented with a review of DSP during maximum demand events, and in general aligns well with the forecast when considering the market price or lack of reserve (LOR) conditions during these events.

DSP is an evolving area and AEMO is monitoring how it is changing, including assessments of the uptake and use of Wholesale Demand Response (WDR)<sup>4</sup>.

AEMO does include a question about DSP in its surveys to LILs, but as this survey is voluntary it does not receive many responses. Instead, insights primarily arise through the collection of data from the annual and mandatory DSP Information survey for all registered participants.

#### 4.4.3. AEMO's conclusion

AEMO's methodology does provide flexibility in terms of the assessment horizon suggested by Shell Energy, and AEMO will utilise this flexibility where appropriate to ensure the quality of the forecast.

AEMO finds no need to change the methodology through this year's Forecasting Improvement Plan based on the accuracy assessment in recent years.

AEMO will, as noted in the improvement plan, monitor DSP for changes, including observing the uptake and use of WDR.

It should be noted that AEMO will consult on the DSP methodology later in 2023, as it is due for its four-yearly review.

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<sup>3</sup> At [https://aemo.com.au/-/media/files/stakeholder\\_consultation/consultations/nem-consultations/2022/2022-forecast-improvement-plan-consultation/2022-forecast-accuracy-report-final.pdf](https://aemo.com.au/-/media/files/stakeholder_consultation/consultations/nem-consultations/2022/2022-forecast-improvement-plan-consultation/2022-forecast-accuracy-report-final.pdf).

<sup>4</sup> The 2022 assessment is available at <https://aemo.com.au/-/media/files/initiatives/wdr/2022-wdr-annual-report.pdf>.

## 5. Other matters

In addition to topics relating to the 2022 Forecasting Improvement Plan consultation, Shell Energy's submission also included topics relating to the Forecast Accuracy Report Methodology. This methodology, and potential improvements, will be subject to stakeholder consultation later in 2023.

### 5.1. Supply side availability

#### 5.1.1. Issue summary and submissions

Regarding Section 6 of the FAR, "Supply forecasts", Shell Energy submitted that *"truncating the forecast of expected availability across the top ten demand days but then graphically comparing this to actual outcomes provides an inaccurate understanding of the full range of forecast availability included in the modelling. We recommend that these graphs be amended to show the full range of expected availability outcomes as included in the modelling. We also consider that the graphs would benefit from the addition of actual demand outcomes during the analysis period shown."*

#### 5.1.2. AEMO's assessment

Given enough simulations, the full range of simulated supply availability extends from zero to full capacity, providing little insight. As evidence of this, prior to the 2019 Forecast Accuracy Report Methodology independent review<sup>5</sup>, AEMO presented the supply availability curves with the full range of availability that occurred across the simulations. Stakeholders at the time noted that showing the full range was not a good representation of the simulated outcomes, because the minimum availability observed across all simulations is, by definition, an outlier event and would be a highly volatile measure.

AEMO agreed with this feedback and reverted to a more standard statistical approach, which is to show the equivalent of a 95% confidence interval. If the historical outcomes fall outside this range, it indicates that the input assumptions used (being capacities and outage rates) could be incorrect, but AEMO also understands there is also a chance that the historical performance itself could be an outlier event.

AEMO remains of the view that the 95% approach is superior to an approach that shows the full range of simulated outcomes.

#### 5.1.3. AEMO's conclusion

AEMO will consider the suggestion to include actual demand outcomes during the analysis period, noting though that the additional data may make the charts harder to interpret and increase confusion.

AEMO will consult on the Forecast Accuracy Report Methodology later in 2023.

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<sup>5</sup> [https://aemo.com.au/-/media/files/electricity/nem/planning\\_and\\_forecasting/inputs-assumptions-methodologies/2021/forecast-accuracy-report-methodology-independent-review.pdf](https://aemo.com.au/-/media/files/electricity/nem/planning_and_forecasting/inputs-assumptions-methodologies/2021/forecast-accuracy-report-methodology-independent-review.pdf)

## 5.2. Unserved energy forecast accuracy

### 5.2.1. Issue summary and submissions

Shell Energy asked for AEMO to publish summer unserved energy (USE) data on a monthly basis and set out actual USE compared to USE forecasts from both the relevant ESOO and latest MT PASA reliability assessment update.

### 5.2.2. AEMO's assessment and conclusion

AEMO will make clearer the source and horizon of forecast USE compared in the FAR.

AEMO notes that monthly USE is reported in both MT PASA and EAAP, although currently not in ESOO. As the EAAP will be published within the ESOO in 2023, these values will now be available to readers.

AEMO currently measures the accuracy of USE based on an annual level. AEMO will consult on the Forecast Accuracy Report Methodology later in 2023.

## 6. Final determination on the Forecasting Improvement Plan

Having considered the matters raised in submissions to the draft report, AEMO's determination is to make the 2022 Forecasting Improvement Plan in the form published with this final report, in accordance with NER 3.13.3A h(2).

### **Effective date**

The effective date of this determination is 13 June 2023.