AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

# Interim Forecasting Best Practice Guidelines Compliance Report

**August 2020**

Submitted with 2020 ESOO

# Executive summary

The AER's Interim Forecasting Best Practice Guidelines[1] (Interim FBPG) provide guidance for AEMO's forecasting practices and processes as they relate to the Retailer Reliability Obligations, having regard to the following principles[2]:

- Forecasts should be as accurate as possible, based on comprehensive information and prepared in an unbiased manner.
- The basic inputs, assumptions and methodology that underpin forecasts should be disclosed.
- Stakeholders should have as much opportunity to engage as is practicable, through effective consultation and access to documents and information.

This report describes how AEMO has, prepared its reliability forecast and indicative reliability forecast presented in the 2020 Electricity Statement of Opportunities[3] in accordance with the Interim FBPG.

AEMO has achieved a high level of compliance with the Interim FBPG requirements.

[1] See https://www.aer.gov.au/retail-markets/retail-guidelines-reviews/retailer-reliability-obligation-interim-forecasting-best-practice-guideline. The 2020 ESOO was developed under these Interim Guidelines. AEMO notes the Final FBPG was published on 25 August 2020; see https://www.aer.gov.au/networks-pipelines/guidelines-schemes-models-reviews/guidelines-to-make-the-integrated-system-plan-actionable/final-decision.

[2] Section 4A.B.5(b) of https://www.aemc.gov.au/sites/default/files/2020-08/NER%20-%20v148%20-%20Chapter%204A.pdf.

[3] Interim Forecasting Best Practice Guidelines at 2.3.

# Contents



# Tables

# Figures

# 1. Introduction

In July 2019, the Retailer Reliability Obligation (RRO) was introduced to support reliability in the National Electricity Market (NEM). AEMO is tasked with identifying forecast reliability gaps in each NEM region over a 10-year period and reporting on this in the NEM Electricity Statement of Opportunities (ESOO).

Under certain conditions, the RRO imposes obligations on liable entities. In recognition that AEMO's reliability forecasts, including associated demand forecasts, may financially impact liable entities, the Australian Energy Regulator's (AER's) Interim Forecasting Best Practice Guidelines (FBPG) provide guidance to AEMO to ensure the transparency and quality of AEMO's forecasts that contribute to the RRO.

## 1.1 AEMO's approach to demonstrating compliance

Where an Interim FBPG requirement has been fully addressed in another AEMO document, this report provides appropriate links. Where the requirement is not fully addressed in a particular document, this report provides explanation to supplement the content of the other AEMO documents.

## 1.2 Structure of this report

This document is structured as a checklist formed from the guidance set out in the Interim FBPG.

The table below summarises the guidance set out in the Interim FBPG and where it is addressed in this report.

**Table 1 Structure of this report**

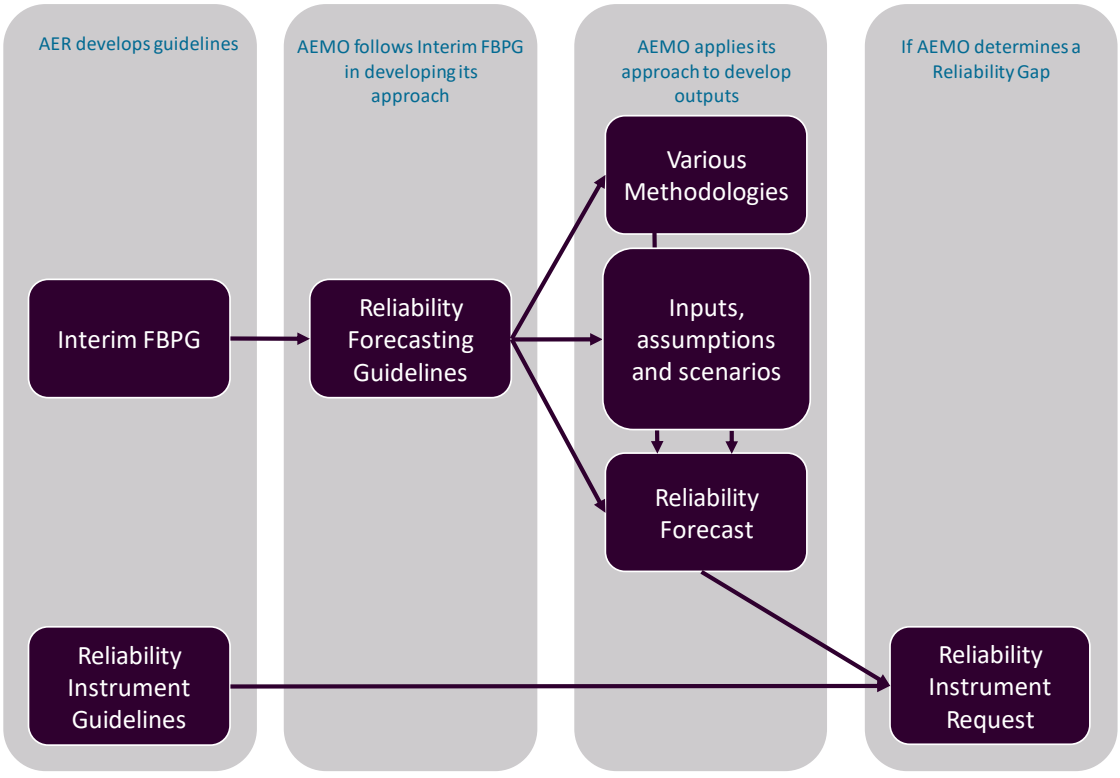
| Section of Interim FBPG | AER Interim FBPG Guidance | Where in this report AEMO addresses compliance |
|---|---|---|
| 2.2 Forecasting best practice consultation procedures | *The AER considers it best practice for AEMO to apply the Forecasting Best Practice Consultation Procedures when establishing its overall forecasting processes, including, but not limited to, the methodologies, assumptions, and the framework around the basic inputs that will underpin their forecasts.* | Section *2 Consultations* summarises compliance, with Appendix A1 Consultation History providing detail |
| 2.3 Forecasts should be accurate, unbiased and based on comprehensive information | *When publishing each electricity statement of opportunities, independent of whether the reliability forecast or indicative reliability forecast indicates a gap, AEMO will provide a report to the AER describing how it has, and where it has not, prepared the relevant forecasts in accordance with the Forecasting Best Practice Guidelines.* | This report provides additional information to help the AER assess AEMO's compliance against the Interim FBPG. The Annual Forecast Performance Review is addressed further below with reference to Interim FBPG Section 2.7. |
| 2.4 Forecasting methodologies, inputs, and assumptions to be disclosed | *The methodologies, assumptions and basic inputs that underpin AEMO's forecasting processes must be transparent, disclosed to stakeholders, and developed and prepared in accordance with the Forecasting Best Practice Guidelines and the Forecasting Best Practice Consultation Procedures.* | Section *3 Disclosure of methods, inputs and assumptions* is structured according to the headings within the Interim FBPG Section 2.4 |
| 2.5 Forecasts to be developed through effective consultation | *The AER considers that if AEMO follows the Forecasting Best Practice Consultation Procedures, this will provide a sound basis for effective stakeholder consultation.* | Section *4 Effective Consultation* |

| Section of Interim FBPG | AER Interim FBPG Guidance | Where in this report AEMO addresses compliance |
|---|---|---|
| 2.6 Updating the reliability forecast | *The AER considers best practice would be, providing the change does not warrant a more fulsome review of the approach using the Forecasting Best Practice Consultation Procedures, for AEMO to update the reliability forecast to match the changed inputs in a form that is consistent with that used in the statement of opportunities.*<br>*Where that information makes a material change to the forecasting result, such as a significantly out of trend uptake of a new technology affecting the NEM, the AER considers it best practice for AEMO to use the Forecasting Best Practice Consultation Procedures for that new element or if the affect is more wide spread, on all input components, as set out in section 2.2 of these Guidelines.* | Section *5 Updating the Reliability Forecast* |
| 2.7 Annual forecast performance review | *The AER considers it best practice for AEMO to analyse, and publish, the performance of its reliability forecasts. At minimum, this performance analysis should include:*<br>• *an examination of the performance of each component;*<br>• *an explanation of any material deviation or trend in differences; and*<br>• *actions undertaken or to be undertaken to improve the accuracy of each component in the forecast.* | Section *6 Annual Forecast Performance Review* |

## 1.3 Application of the Interim FBPG

The Interim FBPG states that the AER considers it best practice for AEMO to apply the consultation procedures "when establishing its overall forecasting processes, including, but not limited to, the methodologies, assumptions, and the framework around the basic inputs". The flow-through of the Interim FBPG requirements is shown in the figure below.

**Figure 1 Application of the Interim FBPG**



This report consequently refers to the following AEMO documents:

- The Interim Reliability Forecast Guidelines (RFG) – these guidelines:
  - explain how a reliability forecast is prepared, and the underlying procedures, information requirements and methodologies that govern its preparation and operation; and
  - describe how AEMO will implement the Interim FBPG in preparing a reliability forecast.
- Various detailed methodologies – the forecast component methodologies identified within the RFG, including Electricity Demand Forecasting Methodology, ESOO and Reliability Forecast Methodology, and Demand Side Participation (DSP) Forecast Methodology.
- The 2020 Inputs, Assumptions and Scenarios report (IASR), which supports the Reliability Forecast.
- The Reliability Forecast (chapter 5 of the ESOO).

Additionally, the RFG describe how AEMO monitors and improves Reliability Forecasts via:

- The Forecasting Accuracy Report.
- The Forecasting Accuracy Report Methodology.
- The Forecasting Improvement Plan.

# 2. AEMO's consultations

## 2.1 Forecasting Best Practice Consultation Procedures

Appendix A of the Interim FBPG outlines Forecasting Best Practice Consultation Procedures which are modelled on section 8.9 of the National Electricity Rules (NER).

The requirements are for AEMO to:

> *apply the Forecasting Best Practice Consultation Procedures when establishing its overall forecasting processes, including, but not limited to, the methodologies, assumptions, and the framework around the basic inputs that will underpin their forecasts. The procedures apply to overall forecasting processes, methodologies, assumptions and the framework of basic inputs.*

Appendix A1 of this compliance report lists AEMO's methodologies under the RFG and related guidelines. The methodology consultations that were subject to the Forecasting Best Practice Consultation Procedures were:

- DSP Forecasting Methodology.
- Forecast Accuracy Report Methodology.

Not all methodologies have been formally consulted on in the first year under the Interim FBPG, due to the sheer volume of methodologies and limited capacity of both AEMO and industry to effectively engage on all methodologies in the same year in addition to consulting on a number of guidelines that needed to be updated. Unless there is a material change in circumstances, section 2.2 of the Interim FBPG permits up to four years between consultations. Methodology documents that were new, or requiring greater elaboration to improve transparency, were prioritised over others had been informally consulted on relatively frequently. In limiting consultations since the introduction of the Interim FBPG, AEMO has sought to balance the benefits of uplifting all methodologies and potential stakeholder 'consultation fatigue'.

Appendix A1 also includes some metrics indicative of the scale of stakeholder engagement for the methodologies and guidelines that were consulted on.

### 2.1.1 Compliance

While AEMO complied substantially with the consultation procedures set out in Appendix A of the Interim FBPG, due to the complexity of the issues, and competing resource pressures, AEMO was not able to publish a final report within the guidelines' time limit in all instances. This is described in Section 4 of this document.

# 3. Disclosure of methods, inputs and assumptions

The Interim FBPG states

> *The methodologies, assumptions and basic inputs that underpin AEMO's forecasting processes must be transparent, disclosed to stakeholders, and developed and prepared in accordance with the Forecasting Best Practice Guidelines and the Forecasting Best Practice Consultation Procedures.*

The following sections mirror the structure of the Interim FBPG.

## 3.1 Methodologies

The Interim FBPG and RFG identifies three overall streams involved in the process of producing a reliability forecast: demand forecasts, supply forecasts, and reliability forecast. For each component, following the FBPG consultation, the AER considers the final forecasting methodology report should detail:

- The suite of models to be used to perform the forecasting activities.
- The approach to the incorporation of data and its distribution or publication.
- How exogenous factors will be taken into account.
- The representation of resource constraints affecting energy delivery.
- How stakeholders can engage with the interim results, if appropriate, and the final results of the analytical stream.
- The process AEMO follows internally to verify the approach and its results.

The above items are addressed in the sections below, for the two methodology reports that were developed and prepared in accordance with the Interim FBPG and the Forecasting Best Practice Consultation Procedures: the DSP Forecasting methodology and the Forecasting Accuracy Report methodology.

### 3.1.1 Suite of models used

Section 3.2 of the RFG lists the component methodologies that make up the reliability forecast, being:

- Electricity Demand Forecasting Methodology Information Paper.
- DSP Forecasting Methodology.
- ESOO and Reliability Forecast Methodology.
- Forecast Accuracy Report Methodology.

Each of these methodologies explain the suite of models used to develop the component forecast. Consultations relating to these methodologies are listed in Appendix A1.

### 3.1.2 Approach to data and distribution or publication

AEMO's Interim RFG addresses the use and handling of confidential information. The document repeatedly notes that publication is subject to treatment of confidential data. Example sections include 4.1b, 3.3.1e, 3.4b, and 3.5.2a.

The following table lists the publications whose analysis relied upon confidential data. Footnotes include links to the publications.

**Table 2 Treatment of confidential data**

| Publication/event | Treatment of confidential data |
|---|---|
| FRG presentation on Generator Outage Rates[4] | Data was presented at an aggregated level. |
| FRG discussion on SA Generator commissioning[5] | AEMO staff avoided any mention of confidential data. |
| FRG discussions on Large Industrial Load[6] | Did not reveal detailed survey results. |
| FRG presentation on DSP results[7] | Data was presented at an aggregated level. |
| ESOO datasets[8] | The spreadsheets and databases do not contain confidential data<br>The Large Industrial Loads are aggregated to a regional level.<br>Auxiliary loads collected through the generation information survey are also aggregated by technology. |
| ESOO report[8] | The ESOO report does not discuss confidential matters. The report does not mention individual sites, rather referring to 'LILS' (Large Industrial Loads). |

### 3.1.3 Exogenous factors

An exogenous variable is

> *Determined outside the model and is imposed on the model. In other words variables that affect a model without being affected by it.*[9]

Rather than a generalised treatment of exogenous factors, the RFG, and the subsequent methodologies it refers to, take into account exogenous factors on a case by case basis. To the extent that the exogenous factor is an important driver of forecast accuracy, it is also assessed as part of the Forecast Accuracy Report.

The following table lists exogenous factors material to the Reliability Forecast, and highlights where they are discussed in the 2020 IASR.

[4] 10 June presentation; see https://aemo.com.au/en/consultations/industry-forums-and-working-groups/list-of-industry-forums-and-working-groups/forecasting-reference-group-frg#:~:text=The%20Forecasting%20Reference%20Group%20(FRG,AEMO%20and%20industry's%20forecasting%20specialists.&text=It%20is%20an%20opportunity%20to,not%20a%20decision%20making%20body.

[5] Other Business during 29 July 2020 FRG.

[6] Discussed in September 2019, January 2020, March 2020, May 2020 (x2), June 2020 (x2) FRG meetings; see https://aemo.com.au/en/consultations/industry-forums-and-working-groups/list-of-industry-forums-and-working-groups/forecasting-reference-group-.

[7] 29 April 2020 FRG.

[8] At https://www.aemo.com.au/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/forecasting-and-reliability/nem-electricity-statement-of-opportunities-esoo.

[9] See https://towardsdatascience.com/time-series-forecasting-a-getting-started-guide-c435f9fa2216#:~:text=An%20exogenous%20variable%20is%20one,we'll%20be%20working%20with.

**Table 3 Exogenous factors**

| Methodology | Key exogenous factor(s) taken into account | Section reference to exogenous factor in IASR |
|---|---|---|
| **Electricity Demand Forecasting** | Economic and population forecasts | 1.2, 2.2, 3.1.2 |
| | Housing forecasts | 3.1.3 |
| | Appliance uptake | 3.1.5 |
| | Energy Efficiency forecast | 3.1.4 |
| | DER – EV, storage, Rooftop PV | 3.1.1 |
| | Network losses (transmission and distribution) | 3.7.3 |
| **ESOO Methodology / Market Modelling Methodology** | Demand and rooftop PV | 3.1.1 |
| | Generation technical parameters (heat rates etc, FOR, maintenance) | 3.3.1, 3.4 |
| | Hydro inflows | 3.3.2 |
| | Wind and solar traces | 3.7.1 |
| | Transmission network parameters | 3.5.1 |
| | Network constraints | 3.5.1, 3.7.3 |

### 3.1.4 Representation of resource constraints affecting energy delivery

Similarly to exogenous factors, AEMO addresses the representation of resource constraints in the methodology to which they belong. The following table summarises key resource constraints.

**Table 4 Representation of resource constraints**

| AEMO document | Representation of resource constraints | Section reference to resource constraint | |
|---|---|---|---|
| **Electricity Demand Forecasting** | Sunshine hours for PV | IASR 3.7.1 | |
| **ESOO / EAAP Guidelines / IASR** | Hydro water limits/inflows | IASR 3.1.7, 3.3.3 | ESOO 8.1 |
| | Wind production | IASR 3.7.1 | ESOO 8.1 |
| | Solar production | IASR 3.7.1 | ESOO 2.3.2, 7.2 |
| | Fuel / stockpile limits | IASR 3.4.3 | |
| **ESOO and Reliability Forecast Methodology** | Network constraints/capacity | IASR 3.5.1, 3.7.3 | ESOO 3.3, 7.2 |

### 3.1.5 Stakeholder engagement with results of each analytical stream

AEMO's framework for industry engagement is documented in Section 2 of the Interim RFG, and applies to all analytical streams (demand, supply and market modelling). It describes AEMO's industry engagement across a spectrum of inform, consult, involve, collaborate and empower. The following table provides evidence that AEMO executed on its plan.

**Table 5 Execution of stakeholder engagement commitments**

| Engagement cycle step listed in AEMO's RFG | Execution |
|---|---|
| **Overall stakeholder involvement in engagement strategy** | AEMO's strategy for industry engagement for forecasting was presented and discussed in the November 2019 FRG[10]. The FRG webpage[11] is regularly updated with the Forward Plan of FRG meetings, meeting presentation materials and meeting minutes/actions. |
| **AEMO will look for opportunities for improvements continually and engage with industry on these as early as practicable, when relevant** | AEMO, in recognising widespread industry interest in the effects of COVID-19 on the electricity industry, responded with three additional mid-month FRG sessions, including external experts presenting on updates to economic forecasts. |
| **Inform** | AEMO publishes information relevant to forecasting, including reports (quarterly generation information updates), and operational data such as electricity loads.<br>Post-Easter Industry briefings revealed the load patterns during COVID-19[12].<br>The 2019 ESOO was presented (post publication) at the 2 September 2019 NEM Wholesale Consultative Forum[13].<br>While the FRG generally discusses topics, it has also been used to inform participants of outcomes, such as Final distributed energy resources (DER), DSP and consumption forecasts. |
| **Consult** | Consulting encompasses both formal consultations on forecasting methodologies, and the informal stakeholder consultation via the FRG meetings. Since COVID-19, FRG meetings have been held virtually. Following feedback at the April 2020 FRG meeting, to facilitate greater discussion in the virtual format, AEMO have expanded discussion time following each presentation, typically such that the discussion time is twice that of the presentation time. This can be observed in the FRG agendas since then.<br>Section 3.2 of this compliance report addresses the consultation of assumptions (including scenarios). Section 3.3 of this compliance report addresses the consultation of inputs. |
| **Involve** | Stakeholders had the opportunity to contribute to the Forecast improvement plan. The Forecast Accuracy Report invited feedback, and it was the main topic of discussion in the 29 January 2020 FRG. |
| **Collaborate** | AEMO conducted four COVID-19 scenario modelling workshops with Energy Networks Australia (ENA) members, starting in April 2020. These workshops recognised and attempted to address the challenges facing forecasting professionals as the pandemic grew. The 11 invitees (and/or delegates) discussed scenarios, and sought consensus.<br>AEMO planned an Energy Efficiency Workshop for March 2020, but had to cancel as COVID-19 concerns made it inappropriate to continue with an in-person workshop.<br>AEMO continues to examine technology options to assist effective virtual workshop facilitation to enable suitable collaboration during COVID-19 restrictions. AEMO has planned two interactive virtual workshops for 2020, as seen in the FRG webpage[14]. |
| **Empower** | Industry participants are empowered to explore the dynamics of the various factors influencing reliability forecasts through AEMO's provision of the detailed spreadsheets that accompany the ESOO. AEMO's interactive Forecasting Portal also enables users to investigate demand forecast trends and use the forecasts as input to their own modelling. |

[10] See presentation titled 'FRG engagement in 2020' in https://aemo.com.au/en/consultations/industry-forums-and-working-groups/list-of-industry-forums-and-working-groups/forecasting-reference-group-frg.

[11] See https://aemo.com.au/en/consultations/industry-forums-and-working-groups/list-of-industry-forums-and-working-groups/forecasting-reference-group-frg.

[12] Meeting Pack 29 https://www.aemo.com.au/consultations/industry-forums-and-working-groups/list-of-industry-forums-and-working-groups/forecasting-reference-group-frg.

[13] Meeting 35 https://aemo.com.au/consultations/industry-forums-and-working-groups/list-of-industry-forums-and-working-groups/nem-wholesale-consultative-forum.

[14] See https://aemo.com.au/en/consultations/industry-forums-and-working-groups/list-of-industry-forums-and-working-groups/forecasting-reference-group-frg.

The RFG also list specific engagement types, with the understanding that AEMO utilises the engagement type which is fit for purpose. They are listed in the table below.

**Table 6 Execution of stakeholder engagement actions**

| AEMO action outlined in RFG | Execution |
|---|---|
| **Technical working group** | COVID-19 scenario modelling workshops with ENA members |
| **Methodology workshop** | A methodology workshop was conducted on 15 November 2019, Melbourne. Networks, Generators and Retailers came together to share techniques and best practices. Multiple parties presented, and participants were surveyed to determine preferences for further workshops. |
| **Advisory** | Not implemented. During the workshop to consult on AEMO's Interim Reliability Forecast Guidelines[15], stakeholders advised that they would prefer not to delegate aspects of the reliability forecasting engagement to representatives in an Advisory Group. |
| **One-on-one** | AEMO has conducted one on one discussions with:<br>• Generators regarding outage rates.<br>• LILs regarding expansions/contractions.<br>• FRG participants as follow up to FRG discussions. To the extent these are facilitated by email, AEMO's energy.forecasting@aemo.com.au inbox holds a record of these interactions.<br>• Jurisdictions regarding energy efficiency policies.<br>The results of one-on-one discussions are not published directly, as they typically contain confidential data. |
| **Written** | AEMO's main form of written engagement is via formal consultations. See Appendix A1. |

### 3.1.6 AEMO's verification process

AEMO's quality assurance process is described in Section 3.5 of the RFG. The RFG describes AEMO's processes before, during and after the reliability forecasting process, encompassing both verification and validation[16]. Each stage is addressed below:

#### Consult on planned changes

The guidance is:

> (a) Before the reliability forecasting process, AEMO must consult on planned changes to assumptions and methodologies (typically driven by the forecast improvement plan, as outlined in Section 4.2) using FRG consultation or written consultation.

AEMO has conducted a number of consultations, as listed in Appendix A1. The consultations were driven by various rules requirements, the forecast improvement plan detailed in Section 6.2, and (as stated in Section 2.1) to increase transparency regarding AEMO's forecasting processes.

#### Undertake validation

The guidance is:

> (b) Throughout the reliability forecasting process, AEMO will:

[15] Workshop material is available at https://aemo.com.au/en/consultations/current-and-closed-consultations/interim-reliability-forecast-guidelines.

[16] See https://en.wikipedia.org/wiki/Verification_and_validation.

(i) undertake validation of data and assumptions, for example through the use of reputable sources, validation against other available sources and explaining changes from previous versions.

AEMO, as the market operator, has access to all meter data and thus the methodologies (where relevant) utilise actual meter data, ensuring that forward projections are consistent with historical trends.

Incoming data (weather data, solar photovoltaic [PV] data from the Clean Energy Regulator) is reviewed to ensure it is free of gaps and errors. This is achieved through use of defined business rules and data visualisations.

AEMO also utilises consultants to provide expert forecasts. Consultants bidding for such work are asked to explain their own quality assurance processes. AEMO experts review the consultants' deliverables during development and at completion. The consultants are typically invited to attend and/or present at the FRG, to engage directly with stakeholders, address their questions, consider feedback in finalising forecasts, and explain why any feedback has not been incorporated.

The FRG meetings are a further form of validation to test the plausibility of the inputs. It is well attended by key AEMO forecasting staff and stakeholders from a broad cross-section of industry. Where issues are recognised, they are recorded in the FRG actions register.

### Undertake verification

The guidance is:

(ii) undertake verification of model implementations underpinning each subprocess;

In general, AEMO's forecasting verification processes are conducted as bespoke processes for each forecast component.

AEMO has developed a bespoke quality assurance support tool, "the Forecasting Hub", which helps with basic data and quality assurance checks and data model handover validation between forecasting components.

Each forecasting component has fit for purpose tools:

- **Demand forecasting** – for consumption forecasting, verification of forecast inputs and outputs is performed by various methods including unit testing, benchmarking, peer review, use of software development tools, versioning (creating a forecasting input-to-output lineage), and bug tracking. The combined effect of these methods is to maximise scrutiny and assurance in the quality of the forecast.

  For **minimum and maximum demand forecasting** – quality assurance is provided by various processes including quality assurance of inputs, models and their outputs, and handover to downstream processes. In detail:

  - Input data – data is verified through the use of tools which automatically alert forecasters of data quality issues. This is supplemented by data visualisations, designed to highlight data deficiencies. A weekly meeting occurs to discuss and resolve any data issues.
  - Models and their outputs – these are checked through the use of model diagnostic processes, which include well established methodologies such as the examination of residual plots. In-house dashboards have been developed to present the range of diagnostic measures, ensuring their consistent application.
  - Handover – AEMO performs unit tests of model implementations following any changes. AEMO currently has an initiative underway to further improve and formalise model management. Quality assurance/model management is a key job responsibility for nominated forecasting staff.
- **DSP forecasting** – verification steps are outlined in the DSP methodology document
- **ESOO and reliability forecasting** – an internal wiki page lists tasks, manages versions, defines ownership, and records who has independently checked each item of work. This page also records, where appropriate, the source of all inputs used and the location of any conversion of that input data.

For key input assumptions and more involved data processes, independent staff members perform reviews.

Internal meetings regularly emphasise the importance of verification; there is a strong culture of verification at AEMO.

### Engage with industry on interim results

The guidance is:

> (iii) engage with industry on interim results, both by individual component and demand and supply forecasts overall, though FRG discussion and FRG consultation.

Appendix A2 lists the topics covered during FRG meetings.

### Publish methodology and supporting material

The guidance is:

> (c) After the reliability forecasting process, AEMO will publish final methodology documents and supporting material as defined in Section 3.5.2.

The AEMO website is up to date with the latest versions of AEMO methodology documents. The ESOO report contains links to relevant methodologies and supporting material.

## 3.2 Assumptions, scenarios and sensitivities

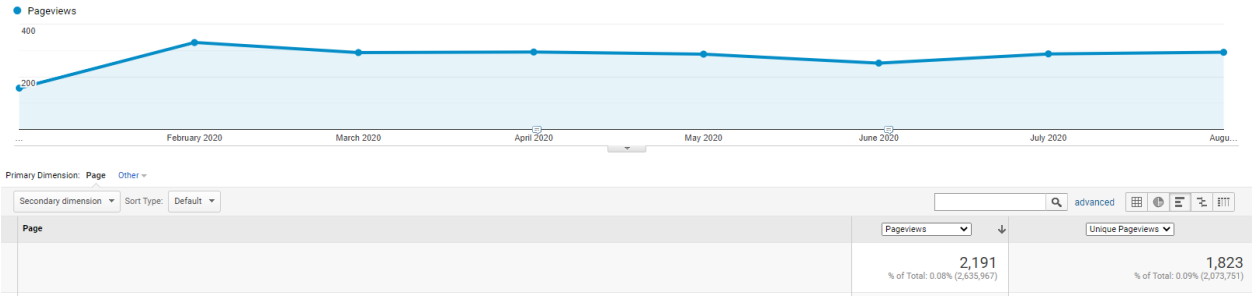
The Interim FBPG notes that the AER considers best practice involves:

> *…development of the scenarios and sensitivities, where appropriate, and the supporting narratives, will follow the (consultation) procedures set out in section 2.2 and Appendix A of (the Interim FBPG).*

- AEMO has undertaken an extensive consultation on Inputs, Assumptions and Scenarios[17].
- AEMO's Inputs, Assumption and Scenarios Report (IASR)[18] includes the high-level consultation process (including consultation milestones), and the submissions received as a result of the IASR consultation.

At all times throughout the IASR consultation, AEMO's IASR webpage was available to keep participants aware of the consultation and engaged. Data was uploaded to the page as it was finalised, for example PV data. The number of monthly views of the IASR webpage is shown in the figure below.

**Figure 2 Monthly visits to IASR webpage (excluding visits from within AEMO)**




Note: data is from 1 January 2020 to 25 August 2020.

[17] See https://aemo.com.au/consultations/current-and-closed-consultations/2020-planning-and-forecasting-consultation-on-scenarios-inputs-and-assumptions.

[18] See https://aemo.com.au/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/scenarios-inputs-assumptions-methodologies-and-guidelines.

Participants had further opportunities to contribute or raise concerns through FRG discussion (during a relevant presentation or as 'other business'), or at any time making an informal submission to AEMO[19]. Appendix A2 lists all the FRG meeting topics, many of which discussed relevant assumptions.

## 3.3 Inputs

The Interim FBPG guidance for Inputs is:

> *AEMO to use the (consultation) procedures set out in section 2.2 and Appendix A of these Guidelines to determine the components that will feed into the models used to determine the demand and supply forecasts on which reliability forecasts will be produced.*

Forecasting inputs are defined in AEMO's RFG, and are addressed at length in AEMO's 2020 IASR which is outlined in the above Section 3.2.

The Interim FBPG also provides additional guidance for inputs:

> *AEMO to use accurate confidential data provided for this purpose; however, AEMO should also determine the most appropriate aggregation approach such that non-confidential representative information may be published.*

Both the use and aggregation of confidential data are addressed in this compliance report's Section 3.1.2.

To facilitate the accuracy of the ESOO, including the reliability forecast, AEMO has authority to request information from Registered Participants[20] in accordance with NER clause 3.13.3A(d)-(e). These information requests (standing or ad hoc) are used for the primary purpose of facilitating the forecast, and also serve to verify and validate elements of the forecasts.

The use of standing information requests was included for discussion in the November 2019 FRG.

In January 2020, AEMO issued such a standing information request, covering large loads, forced outage information, and generating unit auxiliary loads. AEMO did not issue any ad hoc information requests.

Participants had further opportunities to contribute or raise concerns regarding key inputs through FRG discussion, or at any time making an informal submission to AEMO. Appendix A2 lists all the FRG meeting topics, many of which discussed relevant inputs.

[19] During FRG meetings, the email address energy.forecasting@aemo.com.au is promoted as a means of providing informal submissions.

[20] See https://aemo.com.au/-/media/files/electricity/nem/planning_and_forecasting/nem_esoo/2020/aemo---standing-information-request-for-2020.pdf.

# 4. Effective consultation

Appendix A1 lists 11 forecasting consultations conducted by AEMO in the last 12 months, and two that are planned for. The consultations were conducted under a number of frameworks including the NER, the Interim FBPG, and the consulting procedures described in AEMO's Interim RFG.

AEMO has included in the table a number of 'consultation metrics'[21] that are not required under the Interim FBPG, but are indicative of the level of stakeholder interest in each consultation. Given the highly specialist nature of the content, AEMO believes the metrics overall indicate a suitable level of stakeholder engagement.

Key items of note in Appendix A1 are:

- AEMO's high-level forecasting approach is described in its Interim RFG. AEMO ran a formal consultation[22], presented the approach in October 2019 and accepted feedback in an industry workshop[23].
- A key result of AEMO's consultations is Appendix A3, which lists improvements to the 2020 ESOO resulting from stakeholder input on the Forecast Improvement Plan consultation.

The Interim FBPG notes that the AER considers it best practice:

> *for [the report arising out of a consultation] to detail:*
>
> - *a description of AEMO's forecasting approach;*
> - *the procedures AEMO has followed in considering relevant matters; and*
> - *summaries of each issue raised during the consultation process, and AEMO's considered response to each issue.*

The two consultations conducted under the Forecasting Best Practice Consultation Procedures were the DSP Forecasting Methodology and the Forecasting Accuracy Report Methodology. At time of writing this compliance report, the DSP Forecasting Methodology has completed, while the Forecasting Accuracy Report Methodology final determination is due to be published soon.

In each of the two consultations, the determinations and methodology documents describe the forecasting approach of the relevant methodology. Appendix A1 includes the column *Content requirements* which documents that the forecasting approach has been described.

The determinations of the two consultations reference the principles followed in considering the submissions, as well as broader input from the FRG.

The determinations of the two consultations also summarise the material issues raised and AEMO's response. The material issues raised and AEMO's response for the IASR is included as an appendix to the report.

The two consultations have not strictly adhered to the timing requirements for consultation, due to resource constraints and the complexity of the subject matter. In most instances, stakeholder requests for extensions to submission time periods were accepted, understanding the heavy consultation workload for industry. AEMO's time to complete the determinations was also delayed. The timings for AEMO to complete its determinations are detailed below.

[21] Website views are filtered to exclude any views that occurred from within AEMO's IT systems.

[22] See https://aemo.com.au/en/consultations/current-and-closed-consultations/interim-reliability-forecast-guidelines.

[23] See https://aemo.com.au/-/media/files/stakeholder_consultation/consultations/nem-consultations/2019/interim-reliability-forecast-guidelines/draft-interim-reliability-forecast-guidelines-consultation-workshop.pdf.

**Table 7 Timings of consultation stages under Interim FBPG**

| Consultation, stage, and timing | Maximum duration under Appendix A of the Interim FBPG (business days) | Actual duration (business days)[24] |
|---|---|---|
| **DSP Forecasting Methodology, round 1, AEMO's publication of draft determination following completion of submissions period** | 20 | 44<br>from 2 April 2020 (the day after submissions were received) to 4 June 2020 (day prior to publication) |
| **DSP Forecasting Methodology, round 2, AEMO's publication of final determination following completion of submission period** | 30 | 34<br>From 7 July 2020 (the day after submissions were received) to 20 August 2020 (day prior to publication) |
| **FAR Methodology, round 1, AEMO's publication of draft determination following completion of submissions period** | 20 | 25<br>From 6 June 2020 (the day after submissions were received[25]) to 13 July 2020 (day prior to publication) |
| **FAR Methodology, round 2, AEMO's publication of final determination following completion of submission period** | 30 | 13<br>From 12 August 2020 (the day after submissions due) to 30 August 2020 (day before expected publication date) |

[24] Actual business days may vary depending on which state's public holidays are referenced.

[25] An extension was granted beyond the published date, for stakeholder submissions to 5 June 2020.

# 5. Updating the Reliability Forecast

## 5.1 Background

Under the NER[26], AEMO is required to update the reliability forecast annually, in line with the existing statement of opportunities process. If there has been a change in market circumstances, such as the announcement of a generator closure, AEMO has typically published an update to the annual ESOO if practicable to do so without interfering with the timely preparation of the next annual ESOO report.

However, more frequent 'out of cycle' updates to reliability forecasts may be required. This could be needed due to a material change to the supply-demand outlook, such as a change in government policy, the commitment to build a significant new generator or transmission element, or significant changes in forecast demand.

The current NER provide that if, after the publication of the ESOO, AEMO becomes aware of significant new information as specified in the NER, it must publish that information as soon as practicable. The NER enhance the triggers for 'out of cycle' updates in which new information is to be included in the statement of opportunities and accompanying reliability forecasts.

## 5.2 Provision for compliance with updating the Reliability Forecast

There have been no updates issued for the 2019 ESOO. AEMO constantly monitors the environment in which it operates to understand existing and emerging issues that may affect the AEMO's mission and deliverables, including the need to update a Reliability Forecast.

### 5.2.1 Emergence of COVID-19

Mainstream recognition of COVID-19 occurred in March 2020, and AEMO quickly demonstrated leadership through the stakeholder engagement described in Section 0. While AEMO was quick to highlight scenarios and possibilities, it was impractical for AEMO to update the 2019 ESOO because:

- Robust forecasts of exogenous variables (such as economic impacts) were not available.
- The little data existing was from the autumn shoulder season, so could not be applied to summer/winter.
- Significant policy changes with respect to economic resilience and recovery were being made frequently.
- The timing of COVID-19 (post summer) was such that the AEMO team was already working on the 2020 ESOO, and publishing an updated Reliability Forecast would not have resulted in a new Reliability Forecast any sooner than the 2020 ESOO.

For the above reasons, and in ongoing consultations with stakeholders, it was evident to AEMO that it was impractical to issue an ESOO update in response to COVID-19.

### 5.2.2 Readiness for updating the Reliability Forecast

AEMO's RFG acknowledges the possibility of updates to the ESOO and outlines the process and stakeholder engagement to occur in such a situation. AEMO's forecasting methodologies typically have sections that relate to update processes. These sections have received stakeholder submissions, so it is clear that stakeholders are aware of the possibility of updates.

[26] NER 4A.B.1

# 6. Annual Forecast Performance Review

The NER[27] require AEMO, no less than annually, to prepare and publish on its website information related to (1) the accuracy of its demand and supply forecasts, and any other inputs determined by AEMO to be material to its reliability forecasts; and (2) any improvements made by AEMO or other relevant parties to the forecasting process that will apply to the next statement of opportunities

Consistent with this requirement, the Interim FBPG notes that the AER considers it best practice for AEMO to:

> *analyse, and publish, the performance of its reliability forecasts. At minimum, this performance analysis should include:*
>
> - *an examination of the performance of each component;*
> - *an explanation of any material deviation or trend in differences; and*
> - *actions undertaken or to be undertaken to improve the accuracy of each component in the forecast.*

The above guidance is addressed in the following sections:

## 6.1 2019 Forecast Accuracy Report

The 2019 Forecast Accuracy Report was published in December 2019[28].

The report provides detailed analysis of forecast performance across the range of forecasting components, with commentary and explanation on drivers. The report assessed the accuracy of the following forecasts by region:

- Drivers of demand:
  - Macro-economic forecast, including population.
  - Rooftop PV uptake.
  - Weather and climate.
- Energy consumption.
- Maximum and minimum demand.
- DSP.
- Completion of generation and storage capacity (including large-scale solar).
- Cost of generation technologies.
- Generation availability (including variable renewable generation).

AEMO commenced the Forecast Accuracy Report methodology consultation[29] in April 2020 to provide transparency around its current approach and better understand stakeholder expectations regarding how AEMO assesses performance of its forecasts.

[27] NER 3.13.3A(h)(1)

[28] At https://www.aemo.com.au/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/forecasting-and-reliability/forecasting-accuracy-reporting.

[29] See https://aemo.com.au/en/consultations/current-and-closed-consultations/forecast-accuracy-report-methodology.

## 6.2 2019 Forecast Improvement Plan

AEMO's most recent Forecast Improvement Plan is contained in Chapter 9 of the 2019 Forecast Accuracy Report[30], and is an integral part of executing on Principle 1[31]:

> *…forecasts should be as accurate as possible, based on comprehensive information and prepared in an unbiased manner.*

The Forecast Improvement Plan lists specific actions for AEMO to deliver improved forecasts. Stakeholder feedback on the improvement plan was accepted at multiple stages:

- In July 2019, stakeholders were surveyed on understanding and perceived accuracy of AEMO forecasts. The results were presented in November 2019[32]. The survey results, along with insights from the 2019 Forecast Accuracy Report, were considered in formulating the Forecast Improvement Plan.
- AEMO included an invitation for written submissions in the Forecast Accuracy Report.
- AEMO requested written submissions to define and validate the Forecast Improvement Plan. This was conducted through a short-form written consultation, as detailed in AEMO's interim RFG.
- The Forecast Improvement Plan was presented during the 29 January 2020 FRG.

Appendix A3 details AEMO's progress of executing the 2019 Forecast Improvement Plan.

[30] At https://www.aemo.com.au/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/forecasting-and-reliability/forecasting-accuracy-reporting.

[31] NER 4A.B.5(b)(1)

[32] See 'FRG engagement in 2020' presentation in November 2019, at https://aemo.com.au/en/consultations/industry-forums-and-working-groups/list-of-industry-forums-and-working-groups/forecasting-reference-group-frg.

# A1. Consultation history

| Consultation Title (link) Commencement Date | Compliance Requirement | Compliance with Appendix A of Interim FBPG (parts of the Appendix) | | | | Consultation Metrics | |
|---|---|---|---|---|---|---|---|
| | | Notice and invitation to Consulted Persons (a,b) | Meets timing requirements (d,f,g,h,j,k) | Content requirements (e,i) and description (Section Error! Reference source not found.) | # meetings requested/ held | # formal submissions | # times webpage viewed since Jan 2020 (ex AEMO) |
| Interim Reliability Forecasting Guidelines<br>Oct 19 | Per Chapter 11, Interim RFG doesn't require 8.9 rules consultation. AEMO conducted a single round consultation. The Interim RFG replaces the Reliability Forecast Methodology (July 2019).<br>These will be consulted on again in late 2020. | N/A | N/A | N/A | N/A | 6 | 152 |
| **Forecasting methodologies** | | | | | | | |
| Market Modelling Methodology | To be consulted on in first half of 2021 as part of the ISP methodology consultation. | N/A | N/A | N/A | N/A | N/A | N/A |
| Electricity Demand Forecasting Methodology Information Paper<br>Aug 19 | No formal consultation has occurred on this methodology in this first year under the Interim FBPG. This is planned for 2020-21.<br>However, a consultation on the effectiveness of the communication within this document was conducted in November 2018. | N/A | N/A | N/A | N/A | N/A | 12 |
| ESOO and Reliability Forecast Methodology<br>Aug 19 | Completed as part of interim RFG consultation (see above). | N/A | N/A | N/A | N/A | N/A | 152 |
| DSP Forecasting Methodology<br>Feb 20 | Forecasting Best Practice Consultation Procedures | Yes | Substantial* | Yes | 0/0 | 3 | 372 |

| Consultation Title (link) Commencement Date | Compliance Requirement | Compliance with Appendix A of Interim FBPG (parts of the Appendix) | | | | Consultation Metrics | |
|---|---|---|---|---|---|---|---|
| | | Notice and invitation to Consulted Persons (a,b) | Meets timing requirements (d,f,g,h,j,k) | Content requirements (e,i) and description (Section Error! Reference source not found.) | # meetings requested/ held | # formal submissions | # times webpage viewed since Jan 2020 (ex AEMO) |
| RSIG, MT PASA and EAAP<br>June 20 | 8.9 of NER | N/A | N/A | N/A | N/A | 3 | 127 |
| **Input collection** | | | | | | | |
| Standing Information Request (2020)<br>Nov 19 | FRG consultation as per Interim RFG (Appendix A). | | | | | N/A | Unavailable |
| IASR<br>(2020 Planning and forecasting consultation on scenarios, inputs and assumptions)<br>Dec 19 | AEMO conducted a written consultation and received written feedback. A summary of the submissions and AEMO's responses are published in the 2020 IASR. | N/A | N/A | N/A | N/A | 21 | 2035 |
| Generation Information Guidelines<br>Feb 20 | 8.9 of NER | N/A | N/A | N/A | N/A | 5 | 602 |
| DSP Information Guidelines<br>Aug 20 | 8.9 of NER | N/A | N/A | N/A | N/A | N/A (just started) | N/A (just started) |
| **Forecast performance** | | | | | | | |
| Forecast Improvement Plan<br>Jan 20 | Conducted in accordance with the short form written consultation as outlined in the Interim RFG.<br>The Forecast Improvement Plan is published within the 2019 Forecast Accuracy Report. | N/A | N/A | N/A | N/A | See Appendix A3 | 148 |
| Forecast Accuracy Report Methodology | Interim Forecasting Best Practice Guidelines | Yes | Substantial* | Yes | 0/0 | 1 | 251 |

| Consultation Title (link) Commencement Date | Compliance Requirement | Compliance with Appendix A of Interim FBPG (parts of the Appendix) | | | | Consultation Metrics | |
|---|---|---|---|---|---|---|---|
| | | Notice and invitation to Consulted Persons (a,b) | Meets timing requirements (d,f,g,h,j,k) | Content requirements (e,i) and description (Section Error! Reference source not found.) | # meetings requested/ held | # formal submissions | # times webpage viewed since Jan 2020 (ex AEMO) |
| **April 20** | | | | | | | |

* AEMO followed the Interim FBPG guidance for the duration submissions were accepted (open) but did not complete one or more stages of the consultation according to the overall timeline.

# A2. Forecasting Reference Group history

The following table lists relevant FRG meetings since August 2019, organised by topic. The agenda, presentations and minutes are available on the FRG website[33].

**Table 8 Forecasting Reference Group history, by topic**

| Topic | Presentation topic | FRG date |
|---|---|---|
| **Consumption and Demand Forecasts** | Consumption Forecasts | May 2020 |
| | Maximum and Minimum Demand Forecasts | Jun 2020 |
| | Connection Point Forecasts | Jul 2020 |
| **COVID -19** | COVID-19 Update | Mar 2020 |
| | COVID-19 Impacts | May 2020 |
| | COVID-19 Impacts and adjustments to maximum and minimum demand | Jun 2020 |
| **DER** | DER Register | Sep 2019 |
| | DER Register in Forecasting | Sep 2019 |
| | DER Trends – CER | Feb 2020 |
| | DER forecasts and methodology – CSIRO | Feb 2020 |
| | DER forecasts and methodology – GEM | Feb 2020 |
| | AEMO DER Forecasts | Mar 2020 |
| | DER – CSIRO | Apr 2020 |
| | DER – GEM | Apr 2020 |
| **DSP** | DSP Update | Sep 2019 |
| | DSP Methodology | Apr 2020 |
| | DSP Forecasts | Jun 2020 |
| **Economic Forecasts** | Macroeconomic Long-Term Forecasts | Jan 2020 |

[33] At https://aemo.com.au/en/consultations/industry-forums-and-working-groups/list-of-industry-forums-and-working-groups/forecasting-reference-group-frg.

| Topic | Presentation topic | FRG date |
|---|---|---|
| | COVID-19 Economic forecast update | Apr 2020 |
| ESOO | ESOO Recap | Aug 2019 |
| | IASR Update | Mar 2020 |
| EV | Electric Vehicle Modelling Roadmap | Sep 2019 |
| Forecast Accuracy | Forecast Accuracy Report Summary | Jan 2020 |
| | Forecast Improvement Program | Jan 2020 |
| | Forecast Accuracy Report Methodology | Apr 2020 |
| FRG | FRG Engagement | Nov 2019 |
| Generation | Seasonal Generator Ratings | Aug 2019 |
| | Thermal Power Station Retirement and Revenue Sufficiency | Aug 2019 |
| | Standing Data Request | Nov 2019 |
| | Forward looking outages – AEP Elical | Jun 2020 |
| | AEMO Forced Outage Rates Forecasts | Jun 2020 |
| GSOO | GSOO Scenarios | Oct 2019 |
| | GSOO Consumption Methodology | Oct 2019 |
| | CORE Gas Price Outlook | Oct 2019 |
| | GSOO Commitment Classification | Oct 2019 |
| | Gas model improvements & forecast performance | Jan 2020 |
| | Draft GSOO Consumption & Peak Day Gas Forecast | Jan 2020 |
| | GPG Forecasts | Jan 2020 |
| | Gas Supply Forecasts | Jan 2020 |
| Weather | NEAR Project | Nov 2019 |
| | Extreme weather and climate | Jul 2020 |

# A3. Improvements for the 2020 ESOO

AEMO's forecasts are assessed at least annually through the Forecast Accuracy Report[34], which assesses the accuracy of inputs, consumer demand and supply availability forecasts. Based on the report's findings, AEMO addresses identified issues by developing and implementing a data and methodology improvements workplan.

The 2019 Forecast Improvement Plan was published within the 2019 Forecast Accuracy Report[35]. It proposed a number of improvements, which were presented at AEMO's monthly Forecasting Reference Group (FRG) and were the subject of a short form written consultation as outlined in the Interim RFG. AEMO acknowledges the ongoing contributions made by the FRG to assist AEMO in improving the forecasting process. The consultation received two written responses. Each improvement is listed below with a summary of feedback and the implementation status.

The following table constitutes the determination for the short form written consultation.

**Table 9 Proposed improvements relevant to the 2020 ESOO**

| Improvement | Stakeholder feedback | Status |
|---|---|---|
| **Operational energy consumption forecast methodology**<br>Develop multi-model ensembles of energy consumption per region considering both the existing component based model and shorter-term monthly time-series models. | This proposed improvement was discussed at the January 2020 FRG. Written feedback suggested broad support but requested clarity as to how time-series models would be incorporated or merged alongside component based models to reflect customer segments or total energy consumption trends. | **Implemented**. Improvements have been implemented and demand methodology documents have been updated to provide requested clarity. |
| **PV forecasts**<br>Use the DER register and work more closely with the Clean Energy Regulator (CER) to ensure insights from historical installations are captured in short-term trends, possibly at more detailed spatial granularity. | This proposed improvement was discussed at the January 2020 FRG. | **Partially implemented**. Delayed implementation of the DER register precluded its use in underpinning these forecasts, however AEMO's DER forecasts considered the most up-to-date information on historical uptake from the CER, and CSIRO's forecast methodology improved to incorporate this trend. Green Energy Markets (GEM) was engaged as a second consultant to complement the forecasts provided by CSIRO. |

[34] At https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/Forecasting-Accuracy-Reporting.

[35] AEMO. 2019. Forecast Accuracy Report 2019, at https://www.aemo.com.au/-/media/files/electricity/nem/planning_and_forecasting/accuracy-report/forecast_accuracy_report_2019.pdf

| Improvement | Stakeholder feedback | Status |
|---|---|---|
| **Generator derating in response to summer heat**<br>AEMO will apply two summer capacity ratings to better capture available capacity at different temperatures. | This proposed improvement was discussed at the November 2019 and January 2020 FRG. | **Implemented.** The 2020 ESOO and Reliability Forecasting Methodology document has been updated. |
| **Customer connection forecast methodology**<br>AEMO now has over five years of connections history for all regions, so a new connections model is being developed that incorporates greater visibility and consideration of the history and dwelling type characteristics. | This proposed improvement was discussed at the January 2020 FRG. | **Implemented**. Demand forecasting methodology document has been updated to reflect the changes to the connection model that better capture short-term trends. |
| **Forecasting portal** [36]<br>Publish shoulder seasonal minimums in addition to summer/winter | This proposed improvement was discussed at the January 2020 FRG. | **Implemented**. Shoulder demand forecasts are now available on the portal. |
| **Demand side participation**<br>Include responses from peaking type non-scheduled generators in DSP forecast. | This proposed improvement was discussed at the January 2020 FRG. | **Implemented**. DSP methodology documents have been updated. |
| **Auxiliary load**<br>Estimations of auxiliary load will be requested from generators directly through the Generation Information data collection process. | This proposed improvement was discussed at the January 2020 FRG. | **Implemented**. Market modelling has been updated with generator provided auxiliary rates. |

In addition to the above improvements, AEMO conducted several investigations, and completed numerous minor methodological improvements including:

- Monitoring the performance of generator new entrant connections to ensure actual rates of connection match forecast.
- Implementing forward-looking forced outage rate projections (discussed in the June 2020 FRG).
- Improving data cleansing of historical weather and demand data.
- Developing a dynamic EV charge profile to reflect controlled EV charging that is optimised around minimum demand (most relevant beyond the 10-year ESOO planning horizon).

[36] The AEMO forecasting portal can be found at http://forecasting.aemo.com.au.