AEMO Price Responsive Reporting Guidelines

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Q1. Is there additional content that the Guidelines should cover?

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Current version release details

Version	Effective date	Summary of changes
1.0	10 April 2025	Initial Draft of Price Responsive Reporting Guidelines

1. Introduction

1.1. Purpose and scope

These are the AEMO Price Responsive Reporting Guidelines (**Guidelines**) made under clause 3.10C.2 of the National Electricity Rules (**NER**). The Guidelines have been implemented as part of the Integrating price-responsive resources (**IPRR**) into the National Electricity Market (**NEM**) reform project[1].

The Guidelines must be developed and published in accordance with the Rules consultation procedures outlined in NER 8.9.

The purpose of the Guidelines is to:

(a) explain to interested parties the information about unscheduled price-responsive resources (**PRR**) in the NEM and trends in operational forecast accuracy that AEMO will publish to meet the:

  (i) Quarterly reporting requirements set out in NER 3.10C.2(c), and

  (ii) Annual reporting requirement set out in NER 3.10C.2(b); and

(b) describe how AEMO will update and maintain these guidelines.

These Guidelines have effect only for the purposes set out in the NER. The NER and the National Electricity Law (**NEL**) prevail over these Guidelines to the extent of any inconsistency.

1.2. Definitions and interpretation

1.2.1. Glossary

Terms defined in the NEL, and the NER have the same meanings in these Guidelines unless otherwise specified in this clause.

Terms defined in the NER are intended to be identified in these Guidelines by italicising them, but failure to italicise a defined term does not affect its meaning.

In addition, the words, phrases and abbreviations in the table below have the meanings set out opposite them when used in these Guidelines.

Term	Definition
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
CER	Consumer Energy Resources
DER	Distributed Energy Resources
DPV	Distributed Photovoltaics
DSP	Demand Side Participation

[1] See https://aemo.com.au/initiatives/major-programs/nem-reform-program/nem-reform-program-initiatives/integrating-price-responsive-resources-into-the-nem.

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Term	Definition
DSPI	Demand Side Participation Information
EMMS	Electricity Market Management System
IPRR	Integrating Price Responsive Resources
kW	Kilowatts
MBE	Mean Bias Error
MW	Megawatts
NEL	National Electricity Law
NEM	National Electricity Market
NER	National Electricity Rules
PRR	Price-Responsive Resources
PVNSG	Photovoltaics Non-Scheduled Generation
RSME	Root Mean Square Error
SCADA	Supervisory Control and Data Acquisition
VPP	Virtual Power Plant
VSR	Voluntarily Scheduled Resources
VSRP	Voluntarily Scheduled Resource Provider
WDR	Wholesale Demand Response

1.2.2. Interpretation

The following principles of interpretation apply to these Guidelines unless otherwise expressly indicated:

(a) These Guidelines are subject to the principles of interpretation set out in Schedule 2 of the NEL.

(b) Demand definitions follow those described in Demand Terms in the EMMS Data Model[2].

1.3. Monitoring and reporting framework for unscheduled price -responsive resources

On 19 December 2024, the Australian Energy Market Commission (**AEMC**) made the National Electricity Amendment (Integrating price-responsive resources into the NEM) Rule 2024[3], which establishes a framework, called "dispatch mode", that allows for aggregated resources, such as virtual power plants (**VPPs**), small stand-alone generators or energy storage systems, community batteries, flexible loads and other PRR to participate in NEM dispatch. Many PRR will not be capable of participating, or choose to participate, in dispatch mode.

As the magnitude of these resources grows, AEMO will face further challenges forecasting demand in the NEM. To help understand the magnitude of this issue, the final rule introduces a

[2] See https://aemo.com.au/-/media/files/electricity/nem/security_and_reliability/dispatch/policy_and_process/demand-terms-in-emms-data-model.pdf.

[3] See https://www.aemc.gov.au/rule-changes/integrating-price-responsive-resources-nem.

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monitoring and reporting framework for AEMO and the Australian Energy Regulator (**AER**). The key features of the framework are:

- Monitoring and reporting by AEMO to identify the presence and issues created by increased unscheduled PRR. This requires AEMO to report annually on the impact of this response on its operational forecasting and the measures it takes to improve it to account for unscheduled PRR.
- Monitoring and reporting by the AER to assess the estimated efficiency implications and costs associated with actual demand deviating from forecasts due to unscheduled PRR.

The reporting framework will position the market bodies and participants to evaluate the impact of unscheduled price-responsive resources on AEMO's forecasts.

1.4. NER requirements

In accordance with NER 3.10C.2(e)-(g), these Guidelines include the components listed below, which can be found in the section indicated to the right.

Table 1 NER requirements

NER clause	Requirement	Guidelines section
3.10C.2	**Quarterly reporting** (c) AEMO must develop, publish and maintain a single source of information for unscheduled price responsive resources that presents the information and metrics specified by the AEMO price responsive reporting guidelines. (d) AEMO must update the information published under paragraph (c) when new information becomes available and at least once each calendar quarter.	3.1 3.2
3.10C.2	**Annual reporting** (b) By 30 September each year, AEMO must prepare and publish, in accordance with the AEMO price responsive reporting guidelines, a report which includes the following information in respect of the previous financial year: (1) an analysis of the statistics and trends of: (i) the volumes and types of unscheduled price responsive resources reported by Registered Participants, using the DER register information and demand side participation information; and (ii) patterns in forecast deviations, including to the extent identifiable, the approximate contribution of unscheduled price responsive resources to forecast deviations, in response to forecast and actual spot prices; (2) AEMO's best estimate of the impact of unscheduled price responsive resources on forecast deviations in relation to additional amounts paid to: (i) Ancillary Service Providers for additional ancillary services that are enabled; and (ii) Cost Recovery Market Participants for ancillary service transaction payments under clause 3.15.6AA; (3) an assessment of the degree of forecast deviations in regional demand across a range of market conditions, as well as the factors contributing to the size of forecast deviations; (4) analysis of impacts of unscheduled price responsive resources on the load forecast used by AEMO for pre-dispatch and dispatch, including in comparison with outcomes published in	3.3

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NER clause	Requirement	Guidelines section
	previous reports prepared in accordance with this clause (as applicable); (5) identification of additional information or inputs required to improve or account for unscheduled price responsive resources in load forecasts; (6) a description of any actions taken by AEMO to reduce forecast deviations by accounting for unscheduled price responsive resources, where those actions have resulted in improved market outcomes; (7) a description of: (i) the methodologies used by AEMO to consider and manage the impacts of unscheduled price responsive resources on load forecasts for pre-dispatch and dispatch; and (ii) any barriers to AEMO using those methodologies to improve forecasting; and (8) any other relevant information AEMO considers necessary or convenient to include in the report.	
3.10C.2	**AEMO price responsive reporting guidelines** (e) AEMO must develop and publish, and may amend, the AEMO price responsive reporting guidelines in accordance with the Rules consultation procedures. (f) The AEMO price responsive reporting guidelines must specify: (1) how AEMO will meet its reporting obligations under paragraph (b); and (2) the information and metrics that AEMO will include in the reporting required pursuant to paragraph (c). (g) In satisfying its obligations under paragraphs (b) and (c), AEMO may: (1) utilise existing AEMO monitoring and reporting frameworks under the Rules; (2) utilise data, reports and systems otherwise available to AEMO; and (3) take into account or include any other information that AEMO reasonably considers relevant to meet the objective set out in paragraph (a).	4

1.5. Related documents

The following table include documents of relevance to these Guidelines.

Table 2 Related documents

Title	Location
Demand Terms in the EMMS Data Model	https://aemo.com.au/-/media/files/electricity/nem/security_and_reliability/dispatch/policy_and_process/demand-terms-in-emms-data-model.pdf
VSR Guidelines	https://aemo.com.au/consultations/current-and-closed-consultations/voluntarily-scheduled-resources-guidelines-consultation
AER price responsive reporting guidelines	TBA
DSP Information Guidelines	https://aemo.com.au/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/forecasting-approach/forecasting-and-planning-guidelines/demand-side-participation-information-guidelines
DER Register Information Guidelines	https://aemo.com.au/energy-systems/electricity/der-register/der-register-reference-information
Load Forecasting Procedure	https://aemo.com.au/-/media/files/electricity/nem/security_and_reliability/power_system_ops/procedures/so_op_3710-load-forecasting.pdf

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2. Objectives of AEMO price-responsive reporting

Operational demand in the NEM represents the demand to be met by scheduled, -semi scheduled and significant non-scheduled resources[4].

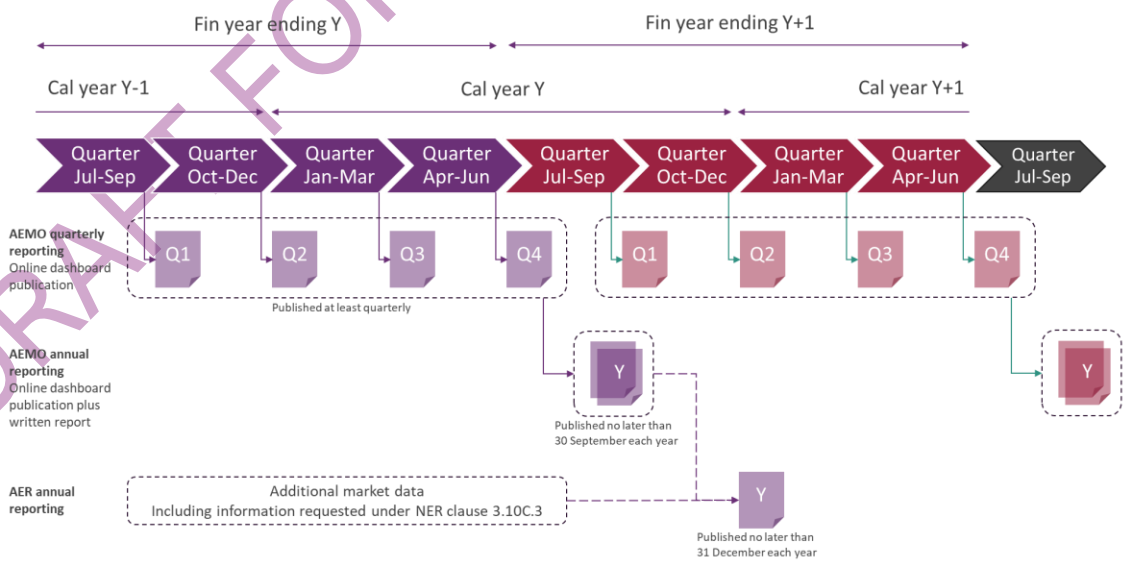
In a broad sense, NEM market participants and its users of electricity are either active or passive. In the past, the market generators were active and end-users passive, but with the emergence of consumer energy resources (**CER**), the rollout of smart meters, and the introduction of tariff offerings that incentivise (or disincentivise) generation or consumption at particular times, end-users are increasingly becoming active.

Some will be active through aggregation (like wholesale demand response [**WDR**]) and function in the market as any other scheduled resource, being available to meet operational demand.

But a significant proportion of active end-user demand (including their generation and injection from storages where available) is likely to remain outside formal scheduling processes by not becoming part of WDR or the voluntarily scheduled resources (**VSR**) introduced under the IPRR framework. As result, their operation in response to market signals will be affecting the magnitude of operational demand, making it relatively lower (through lower consumption or higher local unscheduled generation) during high-price events, and relatively higher (through higher consumption or backing-off local unscheduled generation) when prices are very low, including negative.

AEMO's price-responsive reporting is part of a monitoring and reporting framework, outlined in Figure 1, put in place to ensure visibility of whether the forecasting processes adequately capture the operation of the active unscheduled PRR.

Figure 1 Timeline of AEMO and AER's reporting requirements



Actions to improve forecast accuracy in response to deteriorating forecast performance will be proposed in the annual reporting. These actions may include AEMO seeking access to

[4] For the exact definition, see the *Demand Terms in the EMMS Data Model* document: https://aemo.com.au/-/media/files/electricity/nem/security_and_reliability/dispatch/policy_and_process/demand-terms-in-emms-data-model.pdf

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additional data sources, improving forecasting processes/techniques or, in extreme cases, flagging that market design changes are required to ensure forecast accuracy is maintained at levels required for efficient power system and market operation.

AEMO's reporting feeds into a subsequent reporting role undertaken by the AER under NER 3.10C.3.

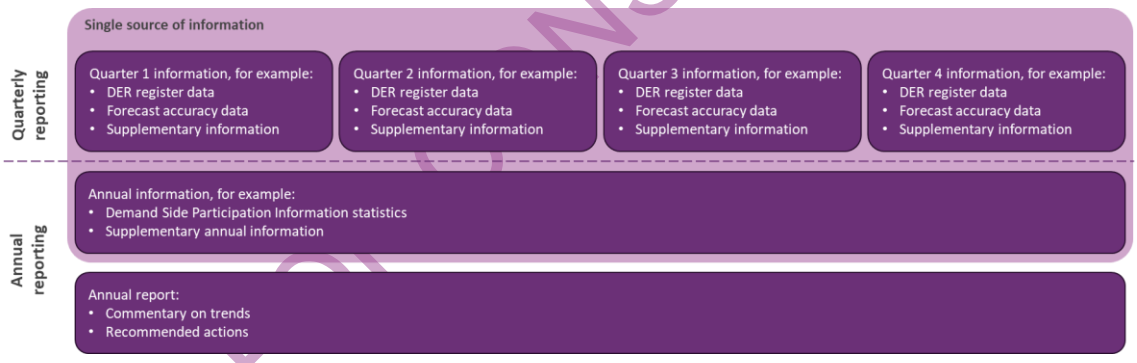
3. Quarterly and annual reporting

To meet the requirements outlined in Table 1, AEMO will establish a single source of information and undertake the reporting outlined in Sections 3.2 and 3.3.

3.1. Single source of information

AEMO's single source of information as outlined in NER 3.10C.2(c) is a compilation of several resources, building on AEMO's DER Register and DSP information (**DSPI**) survey processes, supplemented with forecast accuracy information (see Section 3.2.2) and supplementary information (see Sections 3.2.3 and 3.3.3). Figure 2 summarises the content of this information source, which will be accessible from a single location.

Figure 2 AEMO's single source of information



Q2. Do you agree with the composition of the single source of information?

3.2. Quarterly reporting

For the quarterly reporting, where possible, AEMO will seek to make at least three years of data available. For a particular quarter, for example Q1, that means the corresponding three previous Q1 quarters will also be presented.

The quarterly reporting, as per Figure 1, will report on calendar quarters (January-March, April-June, July-September and October-December).

The quarterly reporting will cover two separate areas:

- uptake trends for CER technologies; and
- forecast accuracy trends.

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Q3. Do you agree that three years of data is sufficient?

Q4. Do you agree that calendar quarters as proposed is appropriate for quarterly reporting?

3.2.1. CER trends by quarter

Based on the Distributed Energy Resources (**DER**) Register, AEMO will make available the current and historical uptake of certain CER technologies based on the following groupings:

- installed capacity of distributed photovoltaics (**DPV**) in megawatts (**MW**) split into:
  - rooftop PV (<100 kilowatts [**kW**] installed capacity);
  - smaller PV non-scheduled generation (**PVNSG**) (100 kW to 1 MW); and
  - larger PVNSG (1 MW to 30 MW[5]);
- installed capacity of distributed battery storage systems in MW split into:
  - smaller distributed batteries (<100 kW installed capacity); and
  - larger distributed batteries (100 kW to 5 MW); and
- other CER technologies than those above reported to the DER Register.

Q5. Do you agree the proposed DER Register groupings provide a reasonable breakdown on CER technologies?

3.2.2. Forecast accuracy trend by quarter

Each quarter, AEMO will assess forecast accuracy. This will be done for each region across all half-hours in the quarter, plus at least for the following three time slices (using local time):

- 5:30pm to 7:30pm – typical peak demand period;
- 11:00am to 1:00pm – typical minimum demand period; and
- 1:00am – 5:00am – typical overnight demand period.

Q6. Do you agree the proposed time slices are the most relevant to consider forecast accuracy for?

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[5] Certain systems <30 MW will be excluded if part of operational demand, with those exceptions outlined in the *Demand Terms in the EMMS Data Model* document: https://aemo.com.au/-/media/files/electricity/nem/security_and_reliability/dispatch/policy_and_process/demand-terms-in-emms-data-model.pdf.

Overall forecast performance metrices

As part of NER 3.10C, AEMO is required to report on load forecast deviations for *pre-dispatch* and *dispatch*. A forecast deviation, sometimes referred to as a residual, is defined as the difference between forecast load and actual load (forecast – actual) for a particular trading interval.

AEMO will use two performance metrics to measure the long-term performance of load forecasts: root mean square error (**RMSE**) and mean bias error (**MBE**). These two metrics are typically used to capture the key performance characteristics of forecasts.

The RMSE metric is used to measure the *accuracy* of a forecast by examining how spread out/dispersed the forecast deviations are. This metric reflects the magnitude of the forecast deviation with larger deviations contributing more to the metric. RMSE is given by:

$$RMSE = \sqrt{\frac{\sum_{t=1}^{N}\left(\hat{y}_{t,i} - y_t\right)^2}{N}}$$

where $\hat{y}_{t,i}$ is the forecast of load at interval *t* made at forecast lead time *i*, y_t is the actual load at interval *t,* and *N* is the number of intervals over the relevant period of time, for example calendar quarter or peak hours within the calendar quarter. A lower RMSE indicates better accuracy.

The MBE metric is used to measure the *bias* in a forecast. A *positive* bias indicates the forecast is typically over forecasting load, while a negative bias indicates the forecast is underestimating load. MBE is given by:

$$MBE = \frac{\sum_{t=1}^{N}\left(\hat{y}_{t,i} - y_t\right)}{N} \times 100$$

where $\hat{y}_t$ is the forecast of load at interval *t* made at forecast lead time *i*, y_t is the actual load at interval *t,* and *N* is the number of intervals over the relevant period of time.

Q7. Relative to the proposed RMSE and MBE, are there better forecast performance metrices to consider – and if so, why?

AEMO will be determining the above performance metrics for each NEM region for the following lead times:

- Dispatch.
- One-hour ahead pre-dispatch.
- Four-hour ahead pre-dispatch.

AEMO will – where possible – include at least three years of data to allow trends to be identified.

Q8. For the pre-dispatch forecast accuracy, would any other lead times be more relevant than one-hour ahead and four-hour ahead – and if so, why?

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For dispatch, the analysis will be done for actual spot price and the forecast price made five minutes before dispatch. For the forecast deviations one-hour ahead and four-hour ahead, the analysis will be done using the one-hour ahead and four-hour ahead pre-dispatch prices respectively.

Q9. Would any other forecast price than the five minutes ahead pre-dispatch price be more relevant – and if so, why?

Unscheduled price-responsive resource impacts on forecast deviations

To the extent possible, AEMO will examine the relationship between unscheduled PRR and forecast deviation[6]. To assist this examination, AEMO will use the statistical measure correlation. Correlation measures the relationship between two variables. It is important to note that correlation does not assign a causal relationship – *correlation does not mean causation*. Discussion of the identified correlation will happen in the annual report (see Section 3.3.4).

AEMO will, where possible, examine the relationship between forecast deviations with various variables such as:

- Price buckets.
- Uptake of DPV.
- Estimated DPV generation.
- Estimated DPV forecast error.

Where possible, AEMO will include at least three years of data to allow trends to be identified.

Q10. Can you suggest any better methods for identifying impacts of PRR on forecast deviations?

Unscheduled price-responsive resource impacts on ancillary service payments

To the extent possible, AEMO will estimate the impact of unscheduled PRR on forecast deviations in relation to payments made to Ancillary Service Providers or to Cost Recovery Market Participants for ancillary service transaction payments.

As with the impacts of unscheduled PRR on forecast deviation alone, AEMO will use correlation as a potential indicator, noting again that correlation does not necessarily mean there is a causal relationship. Specifically, AEMO will show the correlation between forecast deviation, such as MBE, and the volumes and costs in ancillary service payments.

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[6] AEMO continually improves and retrains the load forecasting models. While the explanatory variables of the models may not explicitly capture impacts from unscheduled price responsive resources, some impacts may be implicitly captured through other explanatory variables such as time of day and temperature.

Q11. Can you suggest any better methods for identifying impacts of unscheduled PRR on forecast deviations in relation to Ancillary Service payments?

Changes to reported forecast accuracy data

From time to time, due to backfilling missing or bad quality SCADA data, revisions of settlement data, or other adjustments made to AEMO's data, the calculated accuracy metrices may change from what has been reported in a quarterly report. Unless the change is substantial, this will be reflected in the next quarterly report upload. Only significant changes may lead to a republishing of data within a particular quarter.

3.2.3. Supplementary information by quarter

While not a requirement of NER 3.10C.2, AEMO may include additional resources as supplementary information, where this data is available and potentially relevant.

Q12. Do you support the concept of supplementary information resources?

3.3. Annual reporting

The annual reporting will summarise the quarterly data and look and the historical year-on-year trends overall.

The annual reporting will also include:

- Additional data that is available to AEMO only at annual level, such as commercial arrangements for demand side participation (**DSP**) obtained through AEMO's DSPI survey.
- Commentary to trend, including potential reasons, and proposed initiatives to improve forecast accuracy, where problems have been identified.

As with the quarterly reporting, where possible AEMO will seek to include at least three historical years of data for the trend analysis.

3.3.1. CER trends by year

CER technologies can impact demand in two ways.

- As passive participants, that is where their operation does not take into account market signals, their impact can be calculated through traditional forecasting techniques, taking into account, for example solar, irradiance to calculate the impact of DPV generation on demand[7].

[7] With the introduction of flexible export limits, this becomes more complicated, as DPV generation in that case also will depend on distribution network congestion. That creates a more dynamic and challenging generation profile to forecast, and it may have a larger impact on forecast deviation than for example prices.

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- As active participants, their operation will – at least at times – be driven by market signals, and their impact cannot be accurately predicted without consideration of market drivers.

The quarterly reporting based on the DER Register reflects the stock of CER technologies covered by that, but not the commercial arrangements in place, indicating whether active or passive.

AEMO's DSPI survey is an annual process[8], which provides information about market-exposed resources, and the annual price-responsive reporting will – in addition to the DER Register information provided as part of the quarterly reporting – also include relevant statistics from the DSPI survey.

The DSPI statistics have been created to meet the requirements of NER 3.7D(c) and are governed by AEMO's DSPI Guidelines[9].

The statistics provide data on the number of customers on particular tariffs, whether related to market-driven factors, network operation or static time-of-use. It is not limited to DER but will cover any market customer regardless of size.

Also, where MW estimates have been provided through the annual survey by market participants, annual reporting will include reporting in MW (noting that it is not a requirement to provide estimated MW capacity for all DSP categories).

Where the provided DSPI statistics include data on whether customers are part of VSRs, a further breakdown of the data above into VSR and non-VSR customers will be provided.

Q13. Are there any other DSP statistics that should be provided?

Q14. Is there any other annual data on CER that AEMO should provide?

3.3.2. Forecast accuracy trend by year

The annual reporting of forecast performance will be equivalent to the quarterly reporting (see Section 3.2.2), but with supporting commentary as outlined in Section 3.3.4 below.

3.3.3. Supplementary information by year

While it is not a requirement of NER 3.10C.2, AEMO may include additional resources as supplementary information, where this data is available and potentially relevant.

3.3.4. Annual report content

In addition to the numerical information provided as per Sections 3.3.1-3.3.3, AEMO will produce an annual report to meet the requirements in NER 3.10C.2(b). This report will include:

[8] For further information, see https://aemo.com.au/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/forecasting-approach/forecasting-and-planning-guidelines/demand-side-participation-information-guidelines.

[9] At https://aemo.com.au/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/forecasting-approach/forecasting-and-planning-guidelines/demand-side-participation-information-guidelines.

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- Analysis and discussion of:
  - the volumes and types of reported unscheduled price responsive resources as per Section 3.3.1;
  - patterns and trends in identified forecast deviations, including, to the extent identifiable, the approximate contribution of unscheduled PRR to:
    - forecast deviations overall (both pre-dispatch and dispatch time-frames); and
    - additional amounts paid to Ancillary Service Providers and Cost Recovery Market Participants; and
  - the degree of forecast deviations in regional demand across a range of market conditions, as well as the factors contributing to the size of forecast deviations.
- Based on issues highlighted above, the report will describe:
  - Actions planned or already taken by AEMO to reduce forecast deviations by improved accounting for unscheduled price responsive resources (directly or indirectly)[10].
  - Any barriers to AEMO using those methodologies to improve forecasting, including additional information or inputs required to improve or account for unscheduled price responsive resources in load forecasts.

Q15. Apart from what has been outlined, is there any further information that should be included in the annual report?

4. Maintaining the Guidelines

AEMO will review and consult on these Guidelines in accordance with the rules consultation procedures outlined in NER 8.9.

AEMO will communicate the commencement of such reviews through its normal channels, including relevant stakeholder forums, and seek input into changes that should be considered.

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[10] AEMO's Load Forecasting procedure (SO OP 3710) will be updated accordingly. This is as available at https://aemo.com.au/-/media/files/electricity/nem/security_and_reliability/power_system_ops/procedures/so_op_3710-load-forecasting.pdf.