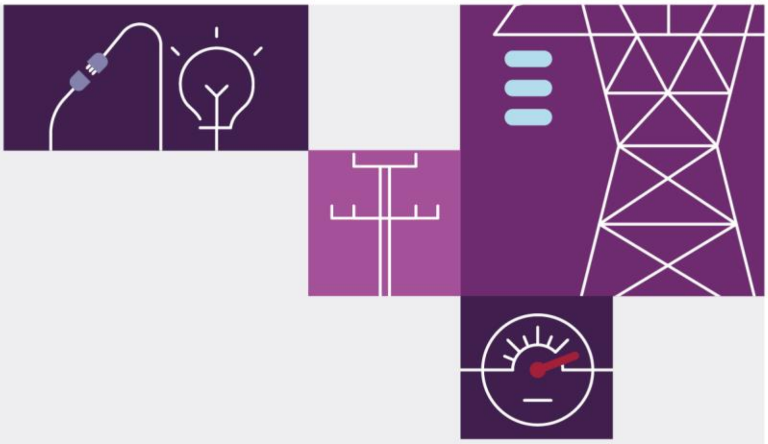
AEMO

AUSTRALIAN ENERGY MARKET OPERATOR

Draft demand side participation forecast methodology

October 2023



Important notice

Purpose

AEMO has prepared this document to provide a transparent forecasting methodology for demand side participation forecasts, which forms part of AEMO's overall Forecasting Approach. This methodology has been prepared in accordance with the AER's Forecasting Best Practice Guidelines.

Disclaimer

This document or the information in it may be subsequently updated or amended. This document does not constitute legal, business, engineering or technical advice. It should not be relied on as a substitute for obtaining detailed advice about the National Electricity Law, the National Electricity Rules, any other applicable laws, procedures or policies or the capability or performance of relevant equipment. AEMO has made reasonable efforts to ensure the quality of the information in this document but cannot guarantee its accuracy or completeness.

Accordingly, to the maximum extent permitted by law, AEMO and its officers, employees and consultants involved in the preparation of this document:

- make no representation or warranty, express or implied, as to the currency, accuracy, reliability or completeness of the information in this document; and
- are not liable (whether by reason of negligence or otherwise) for any statements or representations in this document, or any omissions from it, or for any use or reliance on the information in it.

Version control

Version	Release date	Changes
1	22/8/2019	Initial release
2	21/8/2020	Updates following 2020 consultation process
3	31/10/2023	Draft methodology for 2023 consultation

AEMO acknowledges the Traditional Owners of country throughout Australia and recognises their continuing connection to land, waters and culture. We pay respect to Elders past and present.

Contents

Figures

1 Introduction

Demand side participation (DSP) refers to activities performed by consumers to reduce demand due to various triggers. In light of trends in the transformation of the power system, with increasingly active consumers and enabling technologies, DSP resources are expected to grow over time, making forecasting DSP increasingly important in understanding the supply-demand balance.

AEMO publishes this document to describe the methodology for calculating DSP for use in its medium- to longer term reliability and planning studies. It also explains the extent to which, in general terms, DSP information received under National Electricity Rules (NER) rule 3.7D has informed AEMO's development or use of load forecasts for the purposes of the exercise of its functions under the NER.

This document is part of a portfolio of methodology documents set out in AEMO’s Interim Reliability Forecast Guidelines that explain AEMO’s core methodologies applied in preparing reliability forecasts and will be consulted on with industry at least every four years.

The document is structured into the following sections:

- Section 2 defines DSP in the context of how it is used by AEMO in its studies and AEMO’s overall DSP forecasting process.
- Section 3 explains AEMO’s methodology for estimating the current level of DSP in the NEM.
- Section 4 outlines AEMO’s approach to forecasting future levels of DSP in the NEM.

2 DSP in AEMO's reliability and planning process

2.1 What is DSP?

Contracted DSP is defined in clause 3.7D(a) of the NER as a contractual arrangement between a Registered Participant and a person, in which they agree to the adjustment of non-scheduled load or the provision of unscheduled generation in specified circumstances, as well as the provision of wholesale demand response (WDR) by a wholesale demand response unit approved under clause 2.3.6(a) of the NER[1].

In addition to contracted DSP, through clause 3.7D(e)(1)(ii), DSP includes adjustment of non-scheduled load or provision of unscheduled generation[2] in response to the demand for, or price of, electricity.

For practical application in electricity supply adequacy and market modelling studies, DSP may include:

- Market-driven responses:
  - This category includes residential, commercial, and industrial responses that are typically triggered in respect to the price of electricity.
  - Examples include industrial facilities that are exposed to the wholesale price and elect to reduce electric load at times of high prices, consumers that agree to let their battery be controlled by a third party or are incentivised to switch off air-conditioners, and small non-scheduled generators that have the ability to produce electricity at these times, offsetting local consumption.
- Reliability event responses:
  - This category includes responses that are called on when power system reliability requires support. They are most common under Lack of Reserve (LOR) conditions, although they often also coincide with high wholesale prices. These responses can be contracted.
  - Examples include load reductions under reserve contracts with AEMO utilising its Reliability and Emergency Reserve Trader (RERT) function[3]. Additionally, network event programs that may be aimed at distribution network demand management are included in the reliability event group; on a set maximum number of days per year, networks may call on agreements to reduce demand or incentivise reductions through temporary increases in electricity costs.

It is important to recognise that DSP is probabilistic in nature. The response of a particular site (or a program of sites as a whole) can vary significantly from time to time, even for similar levels of wholesale prices (if price-driven) or between two otherwise equal LOR events (if reliability-driven). This can be due to a number of reasons, such as:

- A site can only respond if it is operating. Certain loads are intermittent by nature, for example at mining sites or pumping water for irrigation. These can be on or off or operating at various levels depending on other processes on site, or, in the case of irrigation, on recent rainfall. Other sites may be limited in how long they can reduce consumption without damaging equipment, such as metal smelters.
- Where a retailer has both DSP and a generation portfolio, it may:

---

[1] The criteria for an application to be classified as a wholesale demand response unit are prescribed in NER clause 2.3.6.

[2] As per NER 3.7D(a), this reflects generation from transmission or distribution connected generating systems that are not scheduled or semi-scheduled, and integrated resource systems that are not scheduled.

[3] RERT is a function conferred on AEMO to maintain power system reliability using reserve contracts.

  - only operate the DSP when it is short in generation compared to its contracted retail sales (as it would have to source the rest at spot price), OR
  - not operate its DSP if its generation portfolio is generating in excess of its retail base, to keep up the price of the surplus generation supplied to the market.
- A site that is price-exposed and typically reducing consumption at higher price levels may at times have contractual obligations to deliver its products that make it more costly to reduce consumption in response to price than to pay penalties for late deliveries of its products.

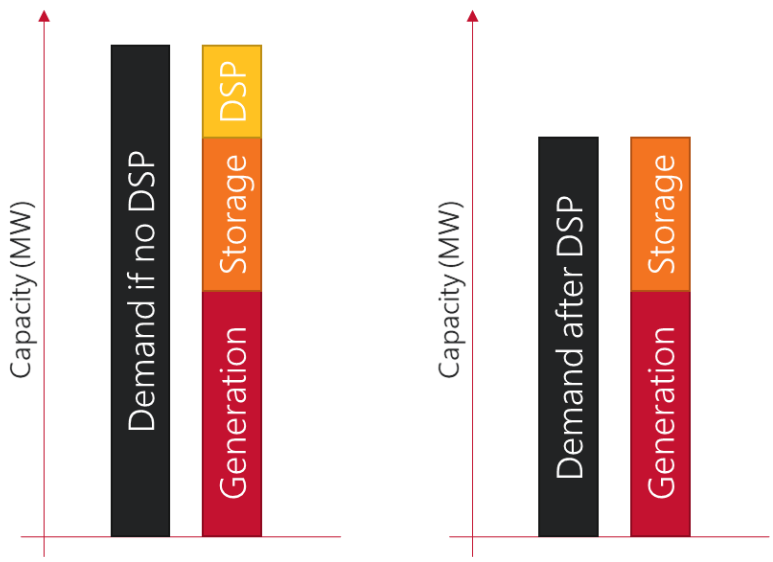
2.2 DSP in AEMO's demand and supply forecasts

In general, AEMO's estimation and forecasts of DSP aim to account for market-driven and reliability event responses by electricity consumers or generators. Because many types of DSP responses are already accounted for in AEMO's demand forecasts or supply models, the definition of DSP in this methodology is restricted to avoid double-counting.

DSP used for regular response (that is ongoing and of a predictable nature) is already included in the demand forecast, whereas this methodology focuses on DSP due to price or reliability triggers.

The forecast DSP is used as a dispatchable resource in AEMO's market modelling for the Electricity Statement of Opportunities (ESOO) and Integrated System Plan (ISP) for the NEM to balance supply and demand, as illustrated to the left in Figure 1. This best captures the functioning of the market and demand in the absence of high prices, as opposed to the illustration to the right, which assumes persistent DSP, which is not always the case as discussed above.

Figure 1 DSP modelled separately compared to including it in the demand forecast



AEMO recognises that price-responsive embedded (or small) generators behave in a similar manner to DSP load reductions. Their generation offsets demand at times of high prices and/or reliability events and thus they are included in the DSP forecast.

Conceptually, there is an advantage in having all sources of DSP within the one forecast, which provides stakeholders with a holistic view of the total DSP that is predicted to be available. Practically, there are challenges involved in removing the DSP embedded within existing demand and supply forecasts. Examples that illustrate these challenges include:

- Customers on time-of-use tariffs (TOU, e.g. peak/off-peak) are likely to adjust their demand in response to the price of electricity and therefore fall under the definition of DSP as contemplated by NER 3.7D. However, estimating the magnitude of the customer response to TOU tariffs based on the available data is not currently practical and therefore the response is embedded in the data used to train the forecast models and, by extension, in the forecasts produced by those models.
- Embedded storage (e.g. virtual power plants, or VPP, or 'vehicle-to-grid' electric vehicles) is currently modelled within AEMO's supply dispatch models for the ESOO. These and other supply sources are optimised within the model and therefore removing VPP and V2G from those models and including them in the DSP forecast may affect the optimisation results.

More details of specific inclusions and exclusions are provided in Section 3.1.

2.3 AEMO's DSP forecasting and planning processes

2.3.1 Requirements under the National Electricity Rules

AEMO's work in relation to DSP is governed by the NER, in particular clause 3.7D:

- Registered Participants must provide demand side participation information to AEMO in accordance with the demand side participation information guidelines[4].
- AEMO also must publish details, no less than annually, on the extent to which, in general terms, demand side participation information received under rule 3.7D has informed AEMO's development or use of load forecasts for the purposes of the exercise of its functions under the NER.

2.3.2 Including DSP in AEMO's reliability and planning processes

AEMO estimates the current level of, committed changes to, and forecast future growth for DSP.

The current estimated level of DSP (see Section 3.3) plus any committed new DSP (see Section 4.1) will be used in the following AEMO reliability studies for the duration of each assessment period (or until DSP contract expiry if earlier) to ensure supply adequacy includes only existing and already committed sources of supply (including DSP) to meet peak demand:

- ESOO for the NEM.
- Energy Adequacy Assessment Projection (EAAP).
- Medium Term Projected Assessment of System Adequacy (MT PASA).

AEMO's ISP also uses DSP forecasts. The ISP DSP forecasts may vary from the estimated DSP for reliability studies, because they include scenario-specific assumptions around year-on-year growth (explained in Section 4.2).

2.3.3 Annual DSP forecasting cycle

AEMO's annual DSP forecasting cycle consists of three key steps, explained below.

[4] At https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/Demand-Side-Participation-Information-Guidelines.

Demand Side Participation Information process

Within a calendar year, the starting point of AEMO's DSP forecast is the process of collecting DSP information from market participants through the Demand Side Participation Information Portal (DSP IP). A formal annual submission process runs through the month of April, as set out in the DSPI Guidelines[5], to ensure the data reflects the DSP used in the previous summer. The data submitted by the end of April will be used as the basis for the DSP forecast for the ESOO published in August of the same year.

Should any changes in DSP arise during the year, these can be entered into the DSP IP in the months outside the formal submission window in April. Any information submitted outside this formal reporting window may be considered in any subsequent analysis, for example, within an updated ESOO[6].

DSP forecast publication

The collected data is the key input into developing AEMO's DSP forecast, which must be published no later than the ESOO[7] and will from day of publication be included in published ESOO, MT PASA, and EAAP studies (as discussed in Section 2.3.2). The ISP is published every second year and will use the most recent DSP forecast available as a starting point for consultation.

AEMO's DSP forecast publication, which may be appended to the ESOO, will include statistics on DSP as set out in the NER (including network tariff information relevant to DSP and analysis of trends) and explain the use of information received under NER clause 3.7D in creating these forecasts.

DSP forecast accuracy assessment

Following publication of an ESOO, AEMO will assess the accuracy of the different components of the previous year's forecasts. The outcome is presented in AEMO's annual Forecast Accuracy Report (FAR)[8], which will also outline any key improvements identified to AEMO's forecasting processes.

The accuracy of the previous year's DSP forecast is assessed as part of this process, with the approach being explained in the FAR methodology[9].

[5] Further information on the DSP IP is at https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/Demand-Side-Participation-Information-Guidelines.

[6] Refer NER 3.13.3A(b).

[7] In accordance with the NER, the NEM ESOO must be published by the end of August each year.

[8] See https://aemo.com.au/en/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/forecasting-and-reliability/forecasting-accuracy-reporting.

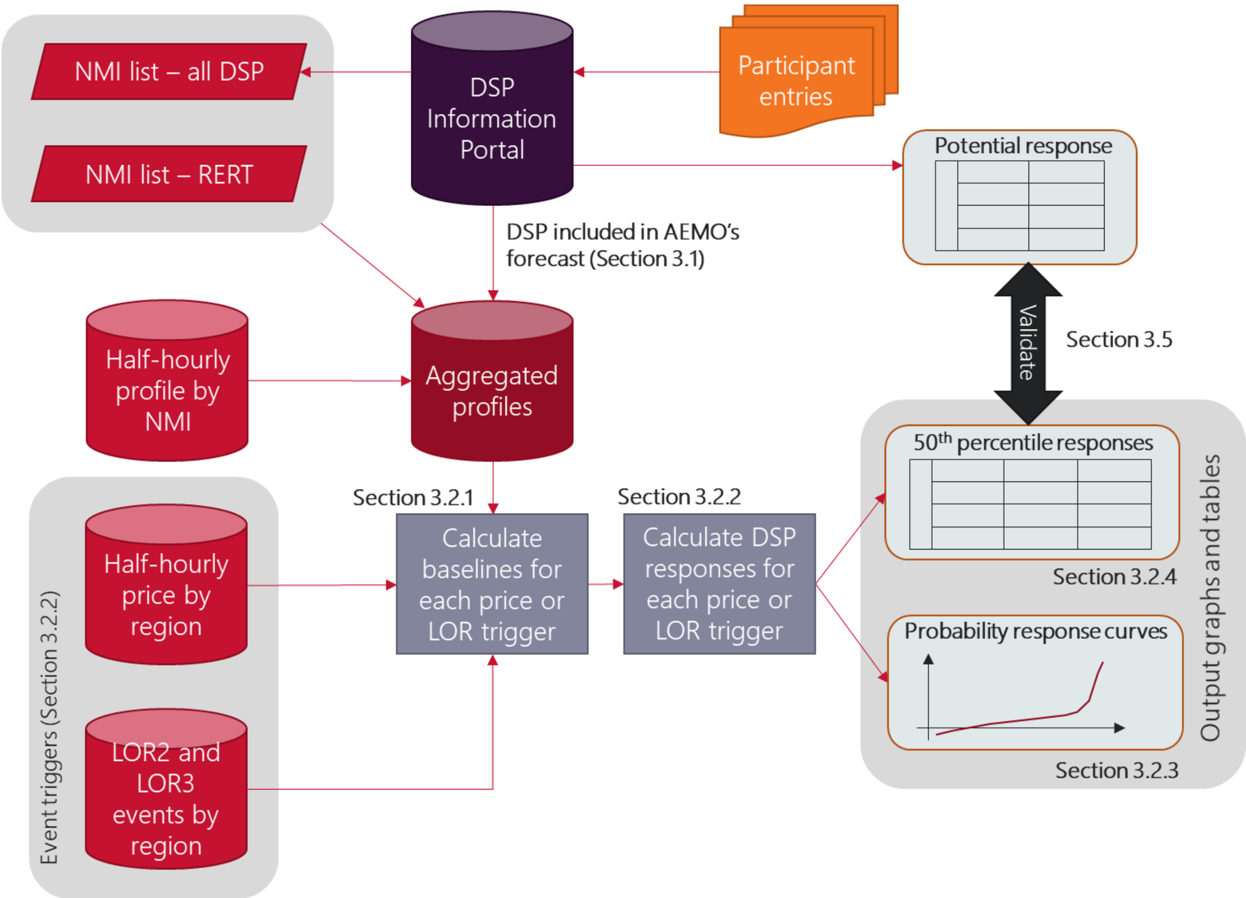
[9] See https://aemo.com.au/consultations/current-and-closed-consultations/forecast-accuracy-report-methodology.

3 Estimating the current level of DSP

Section 3 outlines AEMO's approach to estimating the current level of DSP in the market. This is used as the starting point for the forecast.

Figure 2 summarises the information flow, beginning with Participant Entries to the DSP IP. The flow ends with the estimation of historical market-driven or reliability event responses. The process steps are explained in the following sections.

Figure 2 Overview of DSP forecast process



3.1 Definition of current DSP

As outlined above in Section 2.2, the overarching principle is to ensure DSP resources included in the DSP forecast are:

- Mutually exclusive with any DSP resources already included in demand or supply forecasts, and
- Collectively exhaustive with reference to the demand and supply forecasts – that is, there are no DSP resources that are not taken account of anywhere.

Data sources

AEMO's DSP forecast utilises information submitted through the DSP IP. Key information submitted from market participants to the DSP IP includes National Meter Identifiers (NMIs) for each customer that meet the criteria of the DSP information guidelines, demand response program information, and potential customer response amounts (in megawatts) where relevant. A NMI may belong to one or more demand response programs.

The NMI data is validated against AEMO's own lists of large industrial customers and larger peaking[10] Other Non-Scheduled Generators (ONSG). The large industrial customer list is maintained through AEMO's other forecasting processes, and surveys of network service providers. The ONSG list is sourced from the distributed energy resources (DER) register and AEMO's Generation Information Page updates.

Demand flexibility as distinct from DSP

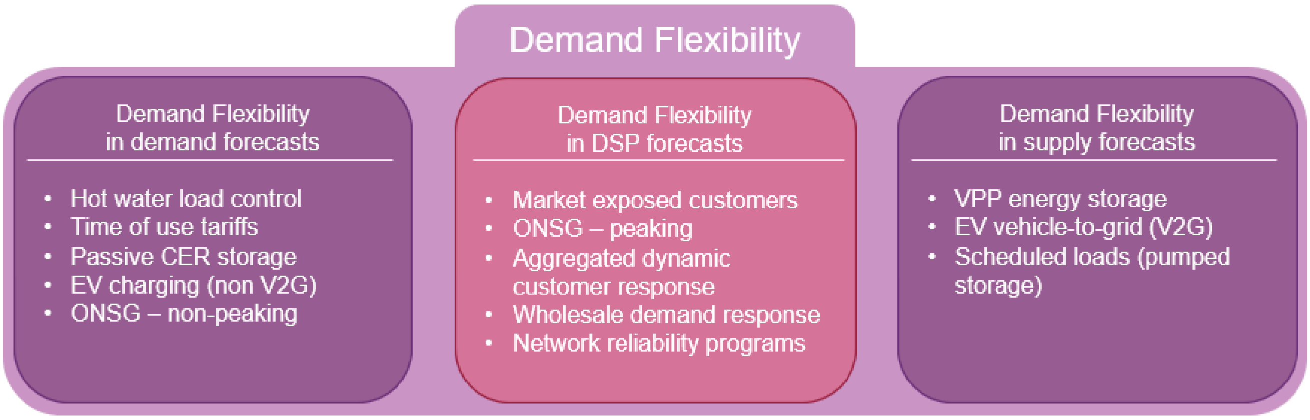
AEMO uses the following logical structure to determine which of the NMIs reported in the DSP IP are included in the definition of DSP (note, the specific factors are detailed further below in Figure 3): In this context, DSP is a sub-set of a broader category that can be referred to as 'demand flexibility', which recognises that a NMI may be part of a program or contract that targets demand side response, but may be represented elsewhere in AEMO's forecasting components.

As discussed in section 2.2:

- A NMI is excluded from DSP forecasts if it is contracted to RERT.[11]
- A NMI is excluded from DSP forecasts if the NMI's demand flexibility is already reflected in AEMO's demand or supply forecasts,
- If the NMI is not contracted to RERT and its demand flexibility is not reflected in AEMO's demand or supply forecasts, it is captured in AEMO's DSP forecasts.

Figure 3 below summarises the allocation of NMI load into DSP.

Figure 3 Allocation of NMI load into DSP



[10] 'Peaking' refers to generators that operate a few hours a year during high price events.

[11] In rare cases, AEMO may need to 'split' a RERT-contracted NMI's load into contracted RERT and DSP eligible components, despite the above logical structure (see discussion on additional adjustments in Section 3.3). As an indication, AEMO would only do this for sites with a non-RERT response of at least 10 megawatts (MW).

RERT

AEMO uses the DSP forecast in its reliability forecast. The reliability forecast provides an assessment of the reliability gap that helps AEMO to determine whether there is a requirement for RERT (including interim reliability reserves). The DSP forecast therefore needs to include DSP that is not contracted as RERT. In terms of RERT status:

- RERT participants that have entered into a RERT contract cannot provide the same capacity to the market in the trading intervals covered by the RERT contract, nor – in the case of scheduled reserves – the 12 months prior to being contracted[12]. They are therefore excluded from the DSP forecast.
- RERT panel members will be included in the DSP forecast if AEMO deems their historical behaviour provides sufficient confidence in their future response, excluding RERT contracted periods in this assessment.
- AEMO also considers special cases, where only part of the potential response at a site is contracted for RERT (see Section 3.3).

3.2 Historical time series data

AEMO aggregates the meter data by region according to the two response categories described in Section 2.1. In this process, to avoid double counting, a NMI will only be included once across the categories to ensure these can be summed to a combined estimate of regional DSP response. If a NMI has factors pertaining to both a market-driven response and reliability event driven response, it is included in the market category only.

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. For example, a consecutive three-year period of mild weather conditions may not be a good indicator of how DSP may respond in a more extreme weather year, so a longer, or different, time series may be analysed.

Time series of wholesale price and periods where actual LOR events have occurred are also collated and used to identify DSP trigger events.

3.2.1 Calculate the baseline

For each identified trigger event (typically a price event), a baseline is required to estimate the DSP response for the duration of the period the trigger conditions are met. A baseline is an estimate of a consumer's demand in the absence of DSP response. This baseline is consistent with AEMO's demand forecasts, which reflect demand in the absence of DSP and load shedding events.

In contrast to large industrial loads which are stable and easy to calculate baselines for, smaller aggregated loads can vary significantly. This makes baseline calculations challenging, particularly for events of long duration, events with fluctuating prices as a trigger, or combined price and reliability events.

The subtraction of actual observed demand from the baseline results in the estimate of DSP at a given market interval. This calculation is performed at the category level.

[12] See NER 3.20.3(g)-(i)

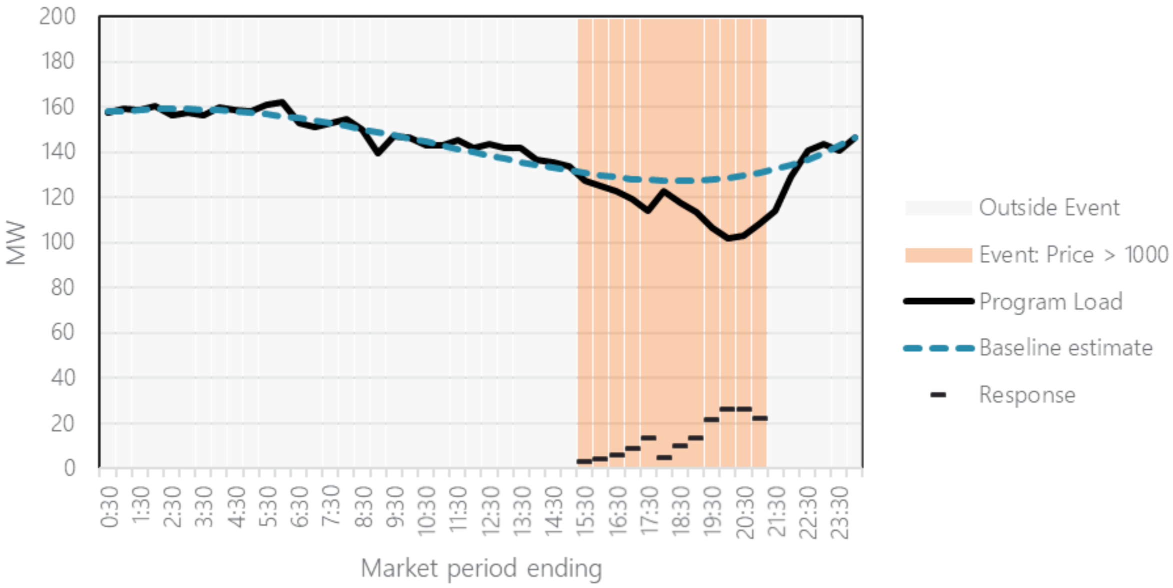
AEMO's approach to calculating baselines from time series of programs or aggregation of DSP programs is to fit one of three models to the time series for each event period[13]:

- A quadratic polynomial, using market period as the explanatory variable, is applied to load aggregates where demand changes smoothly from one period to the next during the day. For example, it is used for residential demand or consumer demand in aggregate. A piecewise polynomial (spline) may be used instead if model verification suggests it fits demand and interpolates across event periods better.
- A constant model (flat demand) is applied when it fits demand better than the polynomial. This is typically useful for individual or smaller groups of industrial facilities, which usually consume a steady rate of energy. Individual site responses are generally only assessed to calculate additional adjustments as outlined in Section 3.3, or to validate the DSP forecast against.
- A model based on historical similar days with DSP events. This is in particularly useful for managing complex consumption patterns, and/or multiple triggers; for example, the combined response from controlled air-conditioners where the majority of the households have coincident electric hot water system response. The similar day model helps separate the air-conditioner response (included in DSP) and hot water system response (excluded from DSP).

For each event day, the half-hourly demand used to fit the model excludes the half-hours of the event period. The 'event day' is permitted to extend over more than one day to ensure enough data is present for fitting the baseline model.

An illustrative example of an estimated baseline using the polynomial model approach, relative to actual demand, is presented in Figure 4. The figure also indicates the 'event period', which is the time range where a DSP trigger is determined to have occurred (outlined in Section 3.2.2).

Figure 4 Example of baseline estimation and calculated response



Any baseline methodology is an approximation and inherently assumes customers follow a particular trend, such as a similar day in the past. In reality, any load (aggregate or individual) will either be over or under this in the

[13] AEMO's approach for estimating baselines was informed by findings reported in Jazaeri, J., Alpcan, T., Gordon, R.L., Brandão, M.F., Hoban, T., and Seeling, C. (2016), "Baseline methodologies for small scale residential demand response". 2016 IEEE Innovative Smart Grid Technologies - Asia (ISGT-Asia), 747-752.

absence of any DSP response (with a perfect baseline, the split would be 50/50). This can be seen on Figure 4 above, before the response starting at 15:00.

For any event where a response for some reason does not occur, the observed program load for some half-hours can show as an increase relative to the baseline (negative DSP response). This basically represents a random drift in consumption around an average baseline at times where there is no response. A similar number of half-hours would see a reduction in consumption (positive DSP response).

The treatment of negative DSP responses is discussed further in Section 3.2.3.

3.2.2 Response by event

Responses are estimated by subtracting baseline demand (Section 3.2.1) from actual demand, for any period where event trigger conditions are met:

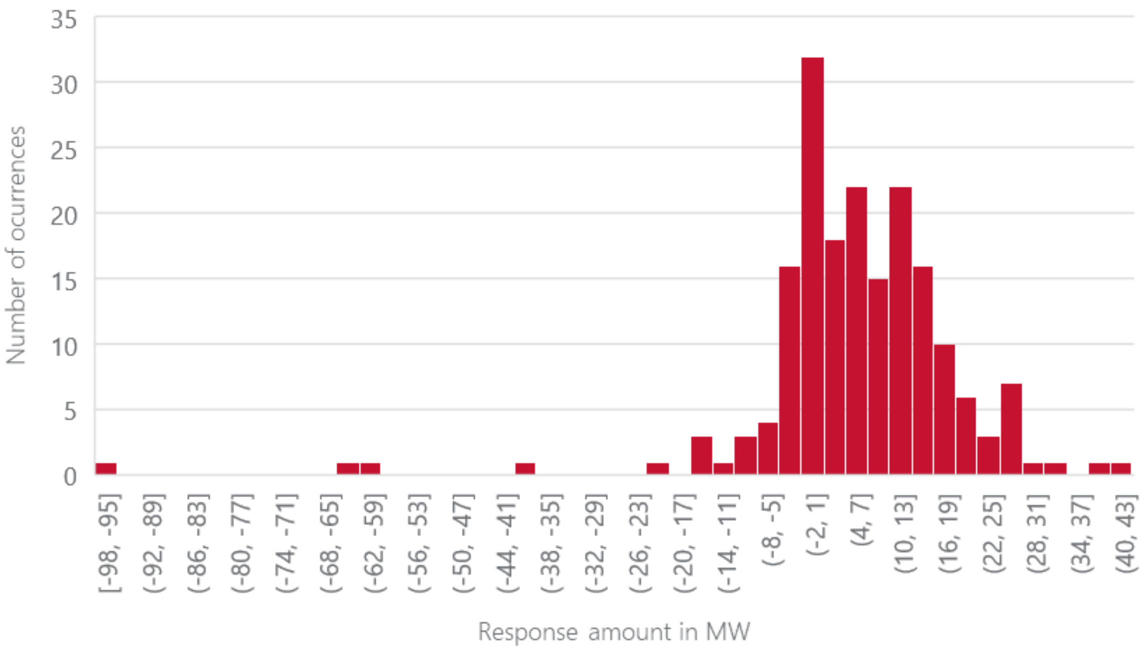
- **Price triggers** – to cover a reasonable range of different DSP initiatives, AEMO estimates DSP for wholesale electricity prices between the following ranges:
  - $300 per megawatt hour (MWh) to less than $1,000 per MWh
  - $1,000 per MWh to less than $7,500 per MWh.
  - $7,500 per MWh up to the prevailing wholesale market price cap (MPC).
- **Reliability triggers** – the responses are estimated for periods with:
  - Actual LOR 2 and LOR 3 events[14].
- WDR – the response of NMIs enrolled in WDR programs
- **Load-on trigger** – this response measures the estimated increase in demand for periods where prices are less than $0/MWh.

3.2.3 DSP Response probability curve

For a portfolio of DSP resources, responses vary even for the same trigger value, as shown in Figure 5.

[14] See AEMO's reserve level declaration guidelines, at https://www.aemo.com.au/-/media/files/electricity/nem/security_and_reliability/power_system_ops/reserve-level-declaration-guidelines.pdf?la=en&hash=C6BAAC5CFAED22495C92C7C418885F43.

Figure 5 Example DSP response distribution as a histogram for a specific trigger



For each trigger, AEMO forms a DSP response probability curve from historical DSP responses.

For multiple trigger levels, the data can be presented as a family of probability distribution curves. An example family of derived probability distribution curves is presented in Figure 6.

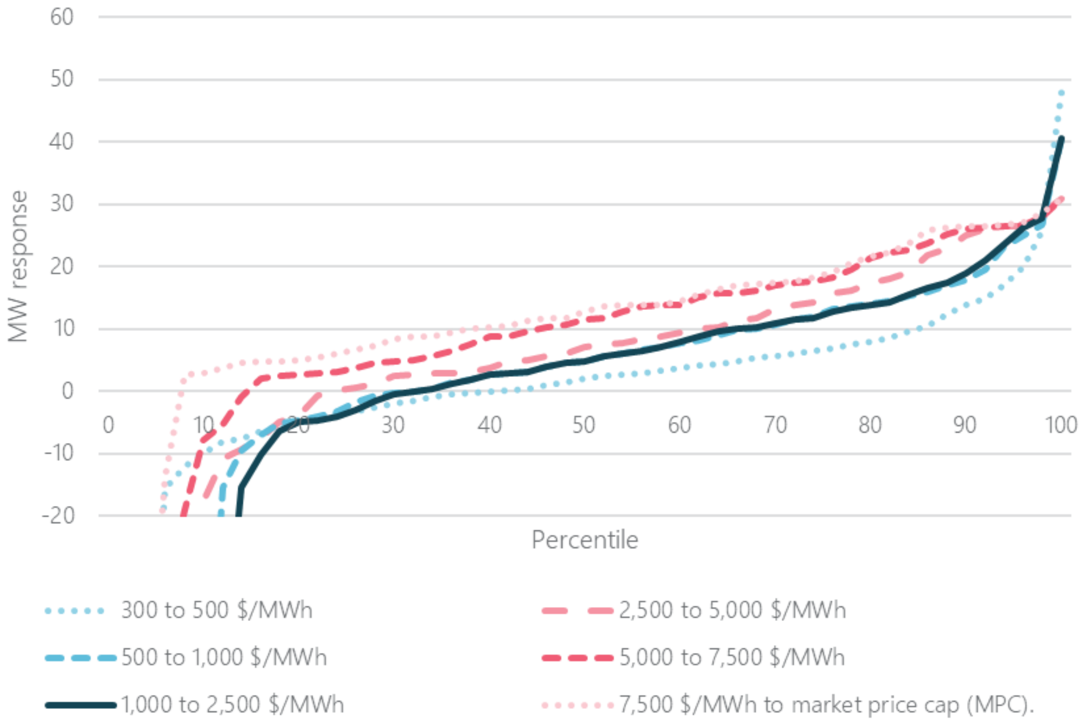
3.2.4 50th percentile response

AEMO uses the 50th percentile of DSP response at each price trigger as the most reasonable estimate of the response distribution for future DSP.

At the extreme ends of the percentile range, response estimates vary widely, due to atypical behaviour of the load and the baseline calculation approach. In particular, the negative values seen in 10-30% of the cases represent random drift in consumption during an event period where there was no response (as discussed in Section 3.2.1). Removing negative values creates a bias towards over-forecasting DSP unless a similar amount of upwards random drift is removed.

As AEMO uses the 50th percentile of responses at each price trigger, any bias will be negligible, and no adjustments are required. AEMO may present additional percentiles for information about the shape of the response probability distribution, but care must be taken to remove the biases from the drift to lower consumption for percentiles lower than 50th and remove the drift towards higher consumption for percentiles higher than 50th.

Figure 6 Response probability distribution by price bands



3.3 Wholesale demand response

The WDR mechanism[15] allows for DSP in the wholesale electricity market at any time in accordance with the NER. However, this is most likely to occur at times of high electricity prices and electricity supply scarcity. Demand Response Service Providers (DRSPs) must apply to AEMO to classify the qualifying load as a wholesale demand response unit under NER 2.3.6. DRSPs aggregate the demand response capability of large market loads for dispatch through the NEM's standard bidding and scheduling processes under NER 3.8.2A. DRSPs receive payment for the dispatched response, measured in megawatt hours (MWh) against a baseline estimate at the electricity spot price.

WDR is therefore a type of DSP and it must be included in AEMO's DSP forecasts. To establish the current level of WDR, AEMO analyses historical WDR activity to determine:

- the proportion of trading intervals within AEMO's price trigger bands in which WDR was activated. For example, if there were 3,000 trading intervals between $1,000/MWh and $7,500/MWh and WDR was deployed in 300 of these intervals, there was a 10% likelihood (or 'response rate') of WDR in that price band
- The mean response in megawatts (MW) for WDR events.

The mean response is multiplied by the response rates for each of AEMO's price trigger bands to calculate the forecast WDR. To the extent that a trend in WDR emerges, AEMO may adjust its forecast WDR to take account of this trend.

[15] Refer NER 2.3.6

Where practicable, AEMO may also engage with DRSPs to gain their insights about how future WDR may compare to historical WDR.

3.4 DSP during reliability events

LOR 2 and LOR 3 events occur very rarely, so there are very few data points on which to estimate a distribution of DSP response. Consequently, AEMO uses the 50th percentile of responses above $7,500/MWh as an approximation of the likely DSP response. This trigger is only met when at least three 5-minute intervals have reached the MPC over the 30-minute trading period.

At most, only a few regions experience reliability events in any year. Where they do occur, AEMO assesses the forecast accuracy against observed response. Should it be apparent that a different percentile or price level better matches the DSP response during reliability events, AEMO will announce and justify the change in its annual forecast improvement plan. For example, should a small number of large customers exhibit a pattern of DSP behaviour during reliability events, assuming the observed pattern will continue may result in a better forecast of DSP. In this instance, the inclusion of this consistent behaviour may result in the forecast being different to the 50th percentile overall.

Network event programs

The 50th percentile (or other level) response therefore acts as the starting point for the reliability-driven estimate of DSP. To this, AEMO adds the estimated response from network event programs.

The network event programs can usually only be called on a limited number of times per year, and they generally reflect loads that would not respond to price when forecast demand is very high.

Such programs generally have a large customer base, making it computationally challenging to use a NMI-level methodology as used for market-driven responses. Accordingly, AEMO may use estimated responses from the organisations running these programs, rather than calculating response itself. Where practicable, and efficient to do so, AEMO will model such programs itself at the NMI level. This will best capture the level and variability of DSP response performance.

As some network event programs are summer only, AEMO generally presents different forecasts for summer and winter seasons.

Additional adjustments

Occasionally, AEMO learns of new loads or changes to consumption patterns that may reasonably result in changed DSP response during reliability events. AEMO may in these cases adjust the combined reliability response with the estimated impact of the change, which will be based on the size of these loads and assumed (for new loads) or observed (for existing loads) response pattern. This may include a limitation of the duration of any response, where relevant.

An example of such an adjustment is where a site has a potential response contracted for RERT, but the remainder of the site remains able to respond to normal price or reliability signals. AEMO can, when it has seen evidence of such behaviour, include an estimate of this response.

Combined reliability response

In total, the combined reliability response assumed is:

Reliability response = market response (>$7,500/MWh) + network event response + adjustment

3.5 'Load-on' DSP

Similar to load curtailment (or increase of embedded generation) during high prices, DSP in a wider sense can also include load increase (and/or reduction of embedded generation) during low or negative price events. This type of DSP can be an important means to address power system security issues during minimum load conditions. 'Load on' DSP is assessed in the same way as other price triggers, using a calculated baseline as reference point, and AEMO will include this form of DSP should evidence of such behaviour warrant its inclusion.

'Load-on' DSP will be analysed for prices less than $0/MWh for NMIs participating in DSP programs where they are incentivised to consume electricity at times of low or negative wholesale prices.

Should AEMO's analysis of 'load-on' events suggest that more price trigger bands would result in more accurate DSP forecasts, these will be consulted on via the Forecasting Reference Group and/or AEMO's Forecast Improvement Plan.

3.6 Validation of existing DSP response

Ahead of publishing the final DSP forecasts, both the market response and reliability response projections are verified using the information submitted to the DSP IP and the most recent observed DSP responses to both high price and reliability events.

Draft DSP forecasts will be presented to AEMO's Forecasting Reference Group for feedback. AEMO will, where required based on feedback, update the forecast before publishing as final.

4 Forecasting future DSP

Section 4 outlines AEMO's approach to estimating future DSP levels. AEMO's treatment of future DSP developments differs depending on whether the new DSP is committed or prospective.

4.1 Committed DSP

AEMO treats future DSP projects as committed if they are:

- reported through the DSP IP as qualifying contracts under the Retailer Reliability Obligation (RRO), or
- an approved Demand Management Incentive Scheme (DMIS) initiative under the Australian Energy Regulator's (AER's) revenue reset process, or
- other initiatives providing a similar level of certainty of the DSP progressing.

AEMO's reliability forecasting processes, referred to in Section 2.3.2, include an estimate of existing DSP (Section 3.3) and committed changes outlined above.

AEMO also accounts for committed closures of major sites currently providing DSP, reducing the level of DSP accordingly.

Beyond the committed changes, AEMO assumes that the DSP capacity remains static over the forecast horizons for use in reliability forecasts.

4.2 Additional growth in DSP

While AEMO's reliability assessments only assume current and committed DSP, the ISP (and other longer-term studies) use a scenario-based approach to explore DSP evolution across a wide range of plausible scenarios.

In keeping with Section 3.1, the forecast still excludes growth from technologies captured elsewhere in AEMO's forecasts. Examples of such technologies includes standalone battery storage, and storage operated in aggregate as virtual power plants (VPPs). These technologies are accounted for in the demand forecast (individually operated systems) and the supply forecast (all systems aggregated as VPPs) respectively.

Long-term DSP forecast approach

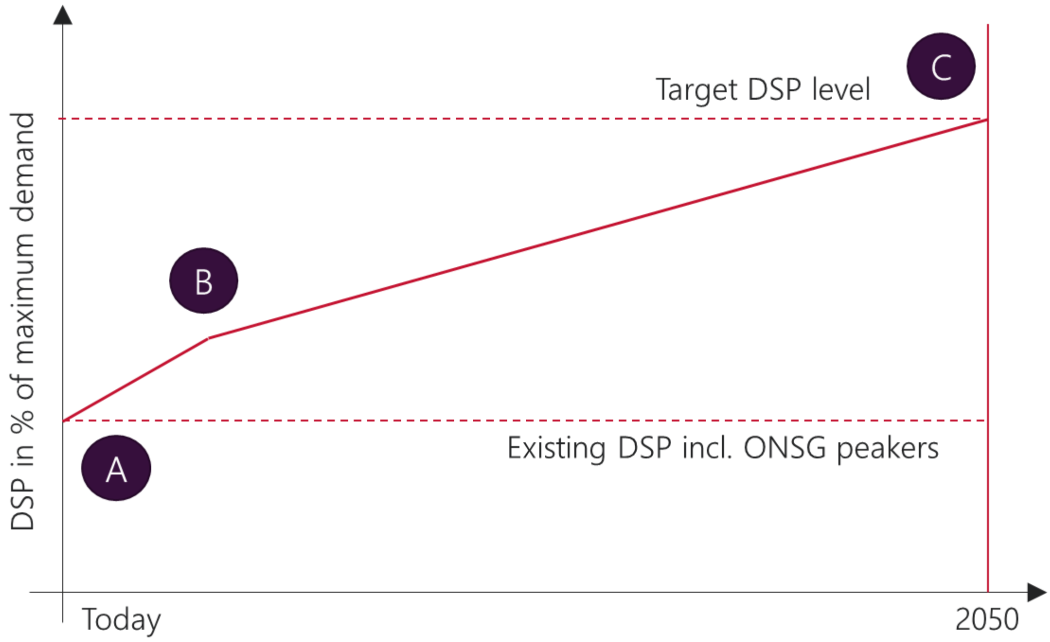
For long-term planning studies such as the ISP, DSP levels are interpolated between the current DSP outlook and scenario assumptions of end of period DSP levels. The scenarios are informed by review and analysis of NEM and international DSP potential.

The process involves:

- Establishing the current level of DSP (see Section 3.1) – point A in Figure 7.
- Making assumptions around committed and anticipated future DSP projects in the next five years (point B in Figure 7). Anticipated future DSP projects represent likely DSP that is not yet committed according to Section 4.1. Ideally, this would be reflected in data submitted to the DSP IP about future DSP programs, however AEMO may also employ its judgement to include potential DSP programs that are not captured in the portal.
- Defining the magnitude of DSP relative to maximum demand at point B in Figure 7 and linearly interpolating the trend from this point to meet the scenario-specific target (point C) at the end of the outlook period.

Price response is obtained by scaling the projected reliability response to trigger levels that maintain the same response proportions as the initial forecast year. For example, if 20% of current DSP is available at the lowest price trigger point, then future lowest price trigger points are estimated so as to preserve a response level of 20% of the total available.

Figure 7 Illustrating how future DSP is forecast



The key driver of future DSP scenarios is the assessed potential of DSP as a percentage of regional maximum demand. To inform the assessment, AEMO may use a variety of sources, including:

- analysis of DSP trends over time
- publications or other commentary on future opportunities for Australian DSP
- literature reviews of the potential for demand response in international energy markets, including the United States and Europe, where DSP response categories, market structures (wholesale price or capacity markets), and DSP policy design are considered comparable by AEMO to the NEM.

Where possible, AEMO will prioritise Australian sources of DSP data or future opportunities, with international examples used for validation and comparison purposes. When consulting on its long-term DSP forecasts, AEMO will clearly set out the source of its assumptions for the forecast ratio of DSP to maximum demand.

4.3 Duration of DSP response

The DSP forecasts produced by this methodology indicate the capacity of DSP available at certain price triggers or during reliability events. The available DSP is then used in AEMO's forecasting publications such as the ESOO and ISP, in accordance with the methodologies approved for those publications. These publications may adopt assumptions about the duration that the DSP capacity can be deployed for.

The DSP Information Guidelines have an optional question regarding the duration of current DSP duration. AEMO will base its assumptions and/or forecasts of DSP duration on this information, plus its own analysis of DSP data, or reviews of information in the public domain. This may be useful if the duration of DSP in the future is expected to be different from historic trends.