RELIABILITY PANEL AEMC

REVIEW

Reliability Panel AEMC

CONSULTATION PAPER

DEFINITION OF UNSERVED ENERGY

04 APRIL 2019

INQUIRIES

Reliability Panel
c/- Australian Energy Market Commission
PO Box A2449
Sydney South NSW 1235

E aemc@aemc.gov.au
T (02) 8296 7800
F (02) 8296 7899

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ABOUT THE RELIABILITY PANEL

The Panel is a specialist body established by the Australian Energy Market Commission (AEMC) in accordance with section 38 of the National Electricity Law and the National Electricity Rules. The Panel comprises industry and consumer representatives. It is responsible for monitoring, reviewing and reporting on reliability, security and safety on the national electricity system, and advising the AEMC in respect of such matters.

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RELIABILITY PANEL MEMBERS

Dr Brian Spalding, Chairman and AEMC Commissioner
Trevor Armstrong, Chief Operating Officer, Ausgrid
Stephen Clark, Technical and Economic Lead – Project Marinus, TasNetworks
Mark Collette, Executive Energy, EnergyAustralia
Kathy Danaher, Chief Financial Officer and Executive Director, Sun Metals
Gavin Dufty, Manager Policy and Research, St Vincent de Paul Society, Victoria
Chris Murphy, Strategic Advisor, Meridian Energy; General Manager - Energy Market Interfaces, Telstra
Damien Sanford, Executive General Manager Operations, AEMO
John Titchen, Managing Director, Goldwind Australia
Richard Wrightson, Executive General Manager, Wholesale Markets, AGL Energy

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1 INTRODUCTION

1.1 Scope of this consultation paper

On 26 July 2018, the Australian Energy Market Commission (AEMC) published the final report of its *Reliability Frameworks Review*.[1] This report made a series of recommendations to implement and develop mechanisms in the national electricity market (NEM) aimed at supporting reliable outcomes for consumers at lowest cost.

The *Reliability frameworks review* final report concluded that it was worth examining the definition of unserved energy, given the broader changes occurring in the NEM.

Among other things, the Reliability Panel (Panel) is required to monitor, review and report on the performance of the market in terms of reliability of the national electricity system.[2] Further, the Panel has a number of responsibilities that are directly related to unserved energy, specifically:

- under the National Electricity Rules (NER), the Panel has an ongoing and periodic obligation to review and provide advice to the AEMC on the reliability standard, which is a maximum expected unserved energy in a region of 0.002 per cent of the total energy demanded in that region for a given financial year, and market settings[3] every four years, with its most recent review of the reliability standard and settings published in April 2018[4]
- in reviewing the reliability standard and settings, the Panel must comply with the *Reliability Standard and Settings Guidelines* that it prepares, the most recent of which was published in December 2016 with this version guiding the most recent review of the standards and settings.[5]

Given these functions, the Panel will progress the AEMC's recommendation and consult with stakeholders on whether the current definition of unserved energy for the purposes of the reliability standard in the NER is still fit for purpose and, specifically, what events should be included in or excluded from the calculation of unserved energy for the purposes of determining whether the reliability standard is met. In this consultation paper, the Panel also explores the opportunities to promote transparency through possible clarification and simplification of the definition of unserved energy for the purposes of the reliability standard. Potential changes to the definition of unserved energy for the purposes of the reliability standard would:

- impact the ex-post analysis of the market performance against the reliability standard. However, the Panel notes that any change to the definition of unserved energy will not impact the 'operationalisation'[6] of the reliability standard by AEMO

1 For more information, see: https://www.aemc.gov.au/markets-reviews-advice/reliability-frameworks-review

2 Section 38 (2) (a) of the National Electricity Law (NEL).

3 Market settings are set by the Panel to allow investment sufficient to achieve the reliability standard. The settings comprise: market price cap, cumulative price threshold, administered price cap and market floor price.

4 Clause 3.9.3A(d) of the NER.

5 Clause 3.9.3A(e) of the NER.

6 AEMO provides information to the market based on, and operates the system with reference to the reliability standard. 'Operationalisation' of the reliability standard by AEMO means that AEMO incorporates the reliability standard within its day-to-day operation of the market, and the declaration of lack of reserve or lack of reserve conditions.

- change the way AEMO calculates wholesale unserved energy in a given year.

The Panel notes that the appropriateness of the reliability standard (i.e. whether or not the level and form of the reliability standard is appropriate) and how it is operationalised is out of scope for this consultation paper. This matter is being considered by the AEMC in the *Enhancement to the Reliability and Emergency Reserve Trader* (RERT) rule change request.[7] Instead, this consultation paper focusses on what events should be included in or excluded from the definition of wholesale unserved energy in the NER for the purposes of determining whether the reliability standard is met. This definition sets out which types of events should be included or excluded, in a non-exhaustive manner, when allocating supply interruptions to unserved energy for the purposes of the reliability standard, in an ex-post analysis.

In addition, the Panel has a statutory requirement to review the reliability standard and settings every four years.[8] The Panel will consider whether the current reliability standard and settings remain suitable for expected market conditions in 2022 or earlier if terms of reference is received from the AEMC (in respect of settings for the period 2024-2028).[9]

1.1.1 Structure of this consultation paper

This paper:

- sets out background information relevant to this consultation paper, including an explanation of the definition of unserved energy
- outlines some key potential issues in relation to the definition of unserved energy
- outlines additional potential issues raised by stakeholders.

1.2 Consultation process and next steps

This consultation paper has been prepared to facilitate public consultation on the definition of unserved energy. This includes inviting stakeholders to make written submissions to the Panel in response to this consultation paper.

The Panel welcomes submissions on this consultation paper by **Thursday 02 May 2019** via the AEMC's website, www.aemc.gov.au, using the 'lodge a submission' function and selecting the project reference code REL0072.

The Panel also welcomes interested stakeholders to contact us if they would like to meet with us to discuss this consultation paper or related issues. All enquiries on this project should be addressed to Olga Iaroshevska on (02) 8296 1613 or olga.iaroshevska@aemc.gov.au.

1.2.1 Next steps

Following this consultation with stakeholders and based on the feedback received, and the Panel's own considerations the Panel will assess whether there is benefit in changing the

7 For more information, see: https://www.aemc.gov.au/rule-changes/enhancement-reliability-and-emergency-reserve-trader

8 Clause 8.8.1(a)(1b) of the NER.

9 For example, this could be the case if the AER publishes new value of customer reliability (VCR) numbers that would warrant undertaken the review earlier.

definition of unserved energy in the NER or if the existing definition continues to be appropriate.

If a need is identified, the Panel would then submit a rule change request to the AEMC to change the definition of unserved energy, and publish a final report outlining its rationale.

2 BACKGROUND

This chapter summarises:

- how the reliability framework operates in the NEM, to provide context for understanding the significance of the definition of unserved energy
- what unserved energy is, and what are the possible causes of supply interruptions which lead to unserved energy
- the link between the reliability standard and wholesale unserved energy.

2.1 Reliability in the NEM

2.1.1 Reliability versus security

A 'reliable power system' has enough generation, demand response and network capacity to supply customers with the energy that they demand with a very high degree of confidence. A reliable power system therefore requires adequate investment and disinvestment as well as appropriate operational decisions, so that supply and demand are in balance at any particular point in time.

Reliability is distinct from system security. A secure system is one that is able to operate within defined technical limits, even if there is an incident such as the loss of a major transmission line or large generator. Security events are mostly caused by sudden equipment failure (often associated with extreme weather or bush fires) that results in the system operating outside of defined technical limits, such as voltage and frequency.

Reliability issues occur where the demand-supply balance in the system is tight, typically at times of peak demand for electricity, generally on very hot days. For example, when emergency reserves were exercised in both January 2018 and 2019, it was in the middle of the afternoon with the temperature exceeding 40 degrees Celsius in Victoria.[10] In contrast, security issues can arise at any time - and at present, more often than not tend to occur at off-peak times, when there are low demand conditions.[11] For example, the South Australian state-wide blackout that occurred in September 2016 was a security event, in relatively mild demand conditions.

2.1.2 The reliability framework

Consistent with the National Electricity Objective (NEO), the reliability framework has been designed to balance two costs:

- Costs of reliability - Maintaining reliability involves costs. The higher the level of reliability, the more that investment in capacity (e.g. more generation, demand-side resources or network assets) is required, all of which impose costs on consumers. For example, having

10 AEMO activated reserve contracts to maintain the power system in a reliable operating state. The contracts were activated at 14:00 AEST on 19/01/2018. See: market notice 60843, 19 January 2018, 13:43, market intervention.

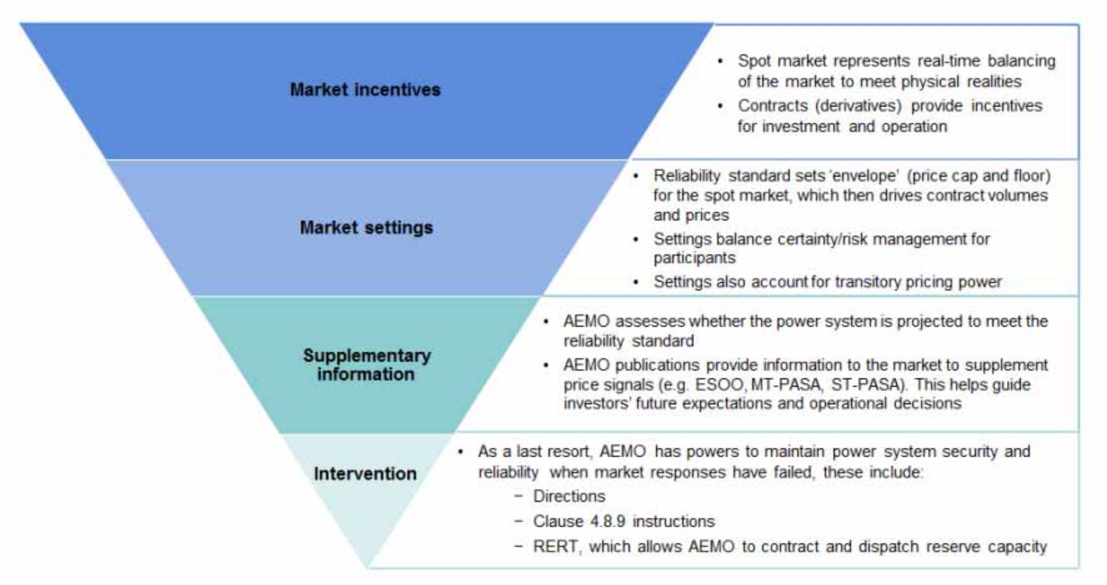
11 For example, on 2 December 2017, AEMO directed on a participant in South Australia to maintain the power system in a secure operating state, with the direction issued at 00:00. The direction was issued at 00:00 02/12/2017, with effect from 01:00 02/12/2017. See: market notice 60176, 2 December 2017, 0:02, market intervention.

more generation being operated to meet a higher standard of reliability creates higher per unit costs of electricity. These costs will be reflected in consumer prices.

- Costs of unserved energy - The alternative to providing energy, no matter the cost, is not to supply the energy under certain conditions. That is to allow for an expected level of supply interruptions to consumers, or simply, for demand for electricity to not be met 100 per cent of the time. This also has a cost - reflecting the customer's willingness to pay for the reliable supply of electricity (this is known as the value of customer reliability). If a customer has their electricity supply interrupted, when they were willing to pay to consume electricity, they will face costs e.g. lost production if it is a business; or a colder/hotter home for residential customers with air conditioning.

Figure 2.1 provides a summary of the existing reliability framework, including the reliability standard, the reliability settings and AEMO's intervention mechanisms. Reliability in the NEM is largely driven through market participants responding to financial incentives and information provided about the need for resources.

Figure 2.1: Current framework with escalating series of interventions



Source: AEMC.

Market incentives

The core objective of the existing reliability framework in the NEM is to deliver efficient reliability outcomes through market mechanisms to the largest extent possible. In a reliable power system, the expected level of supply in the market will include a 'buffer', known as in-market reserves. Expected supply will be greater than expected demand.

As the expected supply/demand balance tightens, spot and contract prices will rise which will inform operational decisions and provide an incentive for entry and increased production, addressing any potential reliability problems as or before they arise. This allows the actual demand and supply to be kept in balance, even in the face of shocks to the system. This framework also provides incentives for an efficient mix of technologies to be deployed.

Put simply, market participants respond to financial, operational and other incentives (such as information provided by AEMO, including on the reliability standard) to provide the level of reliability that is expected by the reliability standard.

Reliability standard and reliability settings

The reliability standard (for generation and inter-regional transmission elements) is the maximum expected unserved energy in a region of 0.002 per cent for a given financial year as a share of total energy demanded in that region. In general terms, 'unserved energy' means the amount of customer demand that cannot be supplied within a region of the NEM due to a shortage of generation or interconnector capacity. Section 2.3 discusses unserved energy and how it links to the reliability standard in more detail, including how AEMO implements the reliability standard in its operations.

The NER contains the reliability standard for the NEM, currently at 0.002 per cent expected unserved energy. The reliability standard is reviewed every four years following a review by the Panel. Crucially, the reliability standard is not zero per cent since this would be too costly. Instead, the reliability standard represents a trade-off between the prices paid for electricity and the cost of not having energy when it is needed: increasing levels of reliability involves increased costs. The reliability standard is set at a level that provides a balance between delivering reliable electricity supplies and maintaining reasonable costs for customers (i.e. an economic trade off between affordability and reliability, based on what consumers value).

In addition to the reliability standard, there are also the reliability market settings that are closely linked to, and derived directly from, the reliability standard. These form a price envelope for spot prices and are: the market price cap[12], the market floor price[13], the cumulative price threshold[14] and the administered price cap[15].

The reliability standard feeds into various wholesale pricing parameters - the reliability settings - that form part of the framework in which investment decisions are made. The objective of the reliability standard is to allow for efficient investment sufficient to provide electricity to the agreed standard.

Under the NER, the Panel has an ongoing and periodic obligation to review and provide advice on the reliability standard and settings to the AEMC every four years, with its most recent review of the reliability standards and settings published in April 2018.[16] When reviewing the reliability standard, the Panel assesses wholesale market modelling findings provided by energy market experts. The Panel engages consultants to provide advice and

12 Currently $14,500/MWh, indexed annually.

13 Currently -$1,000/MWh.

14 Currently $216,900, indexed annually.

15 The administered price cap of $300/MWh applies when an administered pricing period is declared by AEMO whenever the sum of the spot price in the previous 336 consecutive trading intervals (that is, seven days) exceeds the cumulative price threshold.

16 Clause 3.9.3A(d) of the NER.

modelling assistance to inform the Panel's recommendations on the reliability standard and settings. Specifically, the Panel requests consultants to forecast the expected amount of unserved energy over the review period under a set of reliability settings.

Information to the market

AEMO is required by the NER to publish various materials which provide information to market participants – and any other interested parties – on matters pertaining to the reliability standard; that is, over and above the information contained in contract and spot market prices.

For example, it publishes a range of long-term forecasts in its Electricity Statement of Opportunities as to whether or not the reliability standard is projected to be met in the long-term. These long-term projections of unserved energy signal to the market whether additional investment in generation capacity is required to provide electricity to the agreed standard. In the medium-term, AEMO models the power system through its medium-term projected assessment of system adequacy (PASA) to project whether the expected unserved energy (i.e. a probability weighted average across a number of scenarios) for a given year, in a given region, exceeds 0.002 per cent. The expected values of unserved energy outcomes are proportional to their likelihood of occurring i.e. events with a high probability of occurring are given more weight than events with a low probability of occurring. An expected shortfall, relative to the reliability standard is termed a low reserve condition. AEMO provides all of this information to the market to allow the market to respond what it projects could be a shortfall in reserves.

In the short-term (pre-dispatch and short-term PASA), AEMO operationalises the reliability standard through lack of reserve (LOR) declarations. In this case, AEMO forecasts the level of reserves that are required to be in the market (i.e. MW required). This level is at least the size of the largest credible contingency, or larger to take into account forecasting uncertainty (e.g. that there will be a margin of error in any assumptions that feed into the modelling). If the forecast amount of reserves available falls below the LOR2 level, then AEMO considers this to be a breach of the reliability standard and informs the market of this, expecting a response.

The purpose of these forms of supplementary information is to inform the market of prevailing and forecast conditions, and when reserves may be running low, in order to elicit a market response. In particular, if AEMO identifies a level of unserved energy that breaches the reliability standard through its forecasting and information processes, it is required to inform the market of this, and typically first seeks a market response. These types of information help market participants make operational and investment decisions with respect to reliability and also help AEMO manage the power system.

Intervention mechanisms

As effective as information processes can be in delivering the desired reliability outcomes through market incentives, they do not always elicit the outcomes needed. If the market fails to respond to the information AEMO publishes (for example, by shifting outages in order to increase production), AEMO may use the tools available to it to intervene in the market, namely:

- The Reliability and Emergency Reserve Trader (RERT) is a type of strategic reserve that allows AEMO to pay a premium for additional capacity to be on stand-by in case of emergencies when the demand and supply balance is tight.[17]
- In addition, if there is a risk to the secure or reliable operation of the power system, AEMO can use directions or instructions under NER clause 4.8.9 to:
  - Direct a generator to increase its output, cancel or shift an outage or not to go offline, if this is possible and can be done safely. To be effective, the generator must have enough time to 'ramp up'. If the generating unit is not already generating, it can take time for it to start up and to connect to the network and begin to ramp up. Even generators which are currently generating cannot typically change their output instantly.
  - Direct a large energy user, such as an industrial plant, to temporarily disconnect its load or reduce demand. If there continues to be a shortfall in supply, even after these measures have been implemented, AEMO may instruct a network service provider to commence involuntary load shedding as a last resort to avoid the risk of a wider system blackout, or damage to generation or network assets.

However, although AEMO is expected to do all in its power to avoid load shedding using the above intervention mechanisms, there will be times when involuntary load shedding will be regrettable, but, unavoidable because the level of investment and operational decisions are being driven by a reliability standard that is non-zero.

The interrelation between reliability-related intervention mechanisms and the definition of unserved energy is discussed in more detail in section 3.4.

Ex-post reporting on market performance against the reliability standard

With respect to each financial year, AEMO calculates the amount of wholesale unserved energy, that is, the amount of energy that was not delivered to consumers due to generation and interconnection inadequacy. AEMO perform this calculation in accordance with the clause 3.9.3C(b) of the NER which outlines what events should be included or excluded from the calculation of wholesale unserved energy.

The Panel reports on wholesale unserved energy and whether the reliability standard was met in a given financial year in each NEM region in its *Annual market performance reviews*.[18] The Energy Security Board also reports on this metrics in its annual *Health of the NEM* report.[19]

17 Under clause 3.20.7 of the NER.

18 For more information, see: https://www.aemc.gov.au/market-reviews-advice/annual-market-performance-review-2018

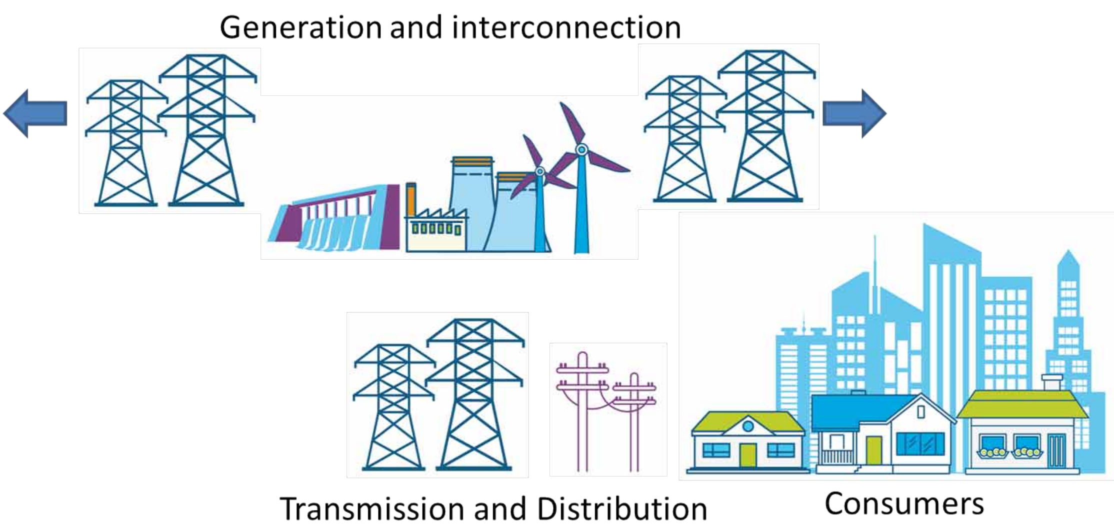
19 For more information, see: http://www.coagenergycouncil.gov.au/publications/health-national-electricity-market

2.2 What is unserved energy?

In general, unserved energy is an estimate of the electricity that would otherwise have been used by customers but for a supply interruption (power cut) and is split according to the parts of the supply chain from which it originates (illustrated in Figure 2.2 below):

- **insufficient generation and interconnection**:
  - reliability-related supply interruptions (not having sufficient generation or interconnector capacity under normal operating conditions to meet demand in a NEM region);
  - power system security-related supply interruptions caused by voltage stability or other power system security limits.
- insufficient network capacity (**transmission and distribution**)
- **consumer** actions such as to comply with agreements made as part of mandatory restrictions provision in the NER.

Figure 2.2: Split of supply chain for measuring unserved energy



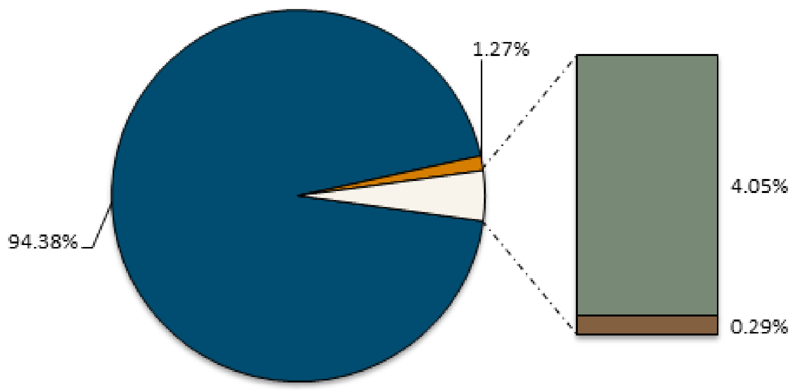
Source: AEMC.

The Panel notes that interruptions to consumer supply relating to the reliability of generators and interconnectors have historically represented a very small amount of all supply interruptions experienced by customers.

As shown in the figure below, distribution outages are responsible for about 94.38 per cent (in terms of GWh) of all supply interruptions. This is because the distribution network represents the largest set of infrastructure in the electricity supply chain, with many possible points of failure.

From 2007/08 to 2017/18, about 0.23 per cent of total supply interruptions were the result of reliability events.

Figure 2.3: Sources of supply interruptions in the NEM from 2007/08 to 2017/18



Source: AEMC analysis and estimates based on publicly available information from AEMO's incident reports and the AER's RIN economic benchmarking spreadsheets.

Note: With regard to outages on the distribution network in 2017/18, a number of distribution network service providers (DNSPs) have reported unsupplied energy data on a calendar year rather than financial year basis via the RINs. For these DNSPs, the data for the 2017 calendar year was treated as 2017/18 financial year data. The DNSPs reporting unsupplied energy data on a calendar year basis are: ActewAGL, Endeavour Energy, Energex, Ergon, SA Power Networks and TasNetworks.

The cause of a supply interruption does not change the customer's experience of having no power. To a customer, the impact of an interruption to its supply is the same regardless of whether it was caused by a lack of generation availability or a downed power line in its residential area.

However, from a regulatory perspective, these causes of supply interruptions are treated differently. The part of the supply chain that caused the unserved energy is associated with a different set of arrangements for determining the maximum amount of unserved energy that customers should experience. For example, the amount of unserved energy that can be attributed to local network outages is determined by state governments and is measured separately by the transmission and distribution network companies.

In the NER, the concept of unserved energy with respect to wholesale-level reliability is applied to measure any supply interruptions consumers experience from generation and interconnection inadequacy. That is, the amount of customer demand that cannot be supplied within a region of the NEM due to a shortage of generation, demand-side participation, or interconnector capacity. In other words, it is the amount of wholesale unserved energy that is relevant for the purposes of reporting on the reliability standard.

Unserved energy is defined in Chapter 10 of the NER as:

'This amount of energy demanded, but not supplied, in a region determined in accordance with clause 3.9.3C(b)[20], expressed as:

- GWh; or
- a percentage of the total energy demanded in that region over a specific period of time such as a financial year.'

Unserved energy is generally expressed as the latter of the two, i.e. as a percentage of total energy demanded in a region.

2.3 The link between the reliability standard and unserved energy

Clause 3.9.3C(a) of the NER links unserved energy to the reliability standard:

> The reliability standard for generation and inter-regional transmission elements in the national electricity market is a maximum expected unserved energy in a region of 0.002 per cent of the total energy demanded in that region for a given financial year.

The reliability standard is breached if expected unserved energy exceeds 0.002 per cent of annual demand in a region in a given financial year. In simple terms, the reliability standard requires there be sufficient generation and transmission interconnection in a region such that at least 99.998 per cent of forecast total energy demand in a financial year is expected to be supplied.

In other words, the reliability standard implies that some load shedding (0.002 per cent and below) is acceptable when considering the costs of eliminating unserved energy between 0.002 per cent and zero. The reliability standard is set at a level that provides a balance between delivering reliable electricity supplies and maintaining reasonable costs for customers (i.e. an economic trade off between affordability and reliability, based on what consumers value).

The Panel reports the actual unserved energy (and whether or not it was below 0.002 per cent) annually in its *Annual market performance reviews*.[21]

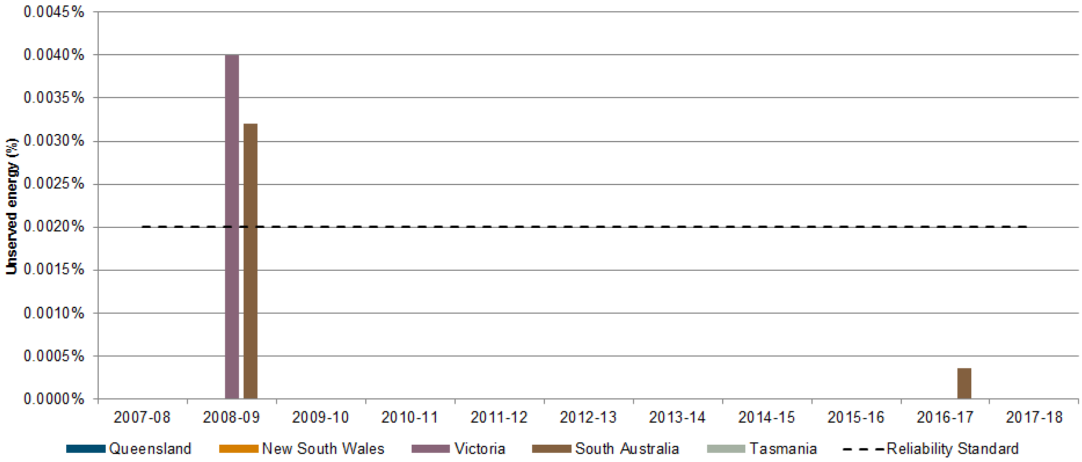
Unserved energy for the purpose of the reliability standard is relatively rare in the NEM, as shown in Figure 2.4 below. The figure below does not include the most recent reliability event, which occurred in January 2019.[22]

20 Clause 3.9.3C(b) defines the unserved energy for the purposes of the reliability standard. This is discussed further in the section 3.2.

21 See: https://www.aemc.gov.au/market-reviews-advice/annual-market-performance-review-2018

22 Detailed information on the event is not yet available.

Figure 2.4: Unserved energy in the NEM from 2007/08 to 2017/18



Source: AEMO.

As an example, on 8 February 2017 in South Australia, there was some unserved energy in South Australia due to a reliability event. High temperatures contributed to high demand on that day. At approximately six o'clock in the evening, demand was higher than forecast, wind generation was lower than forecast, and thermal generation capacity was reduced due to forced outages. At this time, ENGIE, the operator of Pelican Point Power Station, notified AEMO that 165 MW of capacity was unavailable. ENGIE advised AEMO of a start-up time for Pelican Point which would not have enabled AEMO to meet the system security requirements under the NER. AEMO instructed load shedding (100 MW for 27 minutes)[23] to restore the power system to a secure state.[24]

2.3.1 Reliability standard

The reliability standard is an ex-ante standard which is operationalised by AEMO to provide information to the market about the state of reliability in the NEM. It is not a regulatory or performance standard that is 'enforced'. Rather, the reliability standard is an expression of the reliability sought from the electricity market's generation and inter-connection assets, which form the basis of the wholesale supply of electricity. The role of the reliability standard in the NEM is discussed in more detail in section 2.1.2.

The NER contains the reliability standard for the NEM, which is currently 0.002 per cent expected unserved energy. The reliability standard is reviewed every four years by the Panel. If the Panel recommends a change, it then has to submit a rule change request to the AEMC in order to change the reliability standard in the NER.

23 The actual amount of load shed by South Australian Power Networks was approximately 300 MW due to a software error. SA Power Networks, *Statement re load shedding event (8 February 2017)*, 15 February 2017, p. 1.

24 AEMO, *System event report, South Australia, 8 February 2017*, February 2017.

Notably, before March 2015, the Panel was responsible for setting the reliability standard as part of its requirement to undertake and publish a four-yearly review of the reliability standard and reliability settings. The level of the reliability standard and the definition of unserved energy was outlined in the Panel's *NEM Reliability Standard - Generation and Bulk Supply* documents. In March 2015, the AEMC made the rule that placed the reliability standard in the NER. As a result, the reliability standard may only be changed by a rule change made by the AEMC in response to a rule change request.[25]

While the final rule did not make any material changes to the form, level and scope of the reliability standard, it made some amendments to the articulation of the reliability standard. Specifically, the former clauses on the form and level of the reliability standard, as it was determined by the Panel, provided that the reliability standard 'is expressed in terms of the maximum expected unserved energy, *or the maximum amount of electricity expected to be at risk of not being supplied to consumers, per financial year'*.[26] These references were not retained in the final rule as they were considered redundant. The reasoning was that the expected unserved energy is a forecast and so expressing it as a potential risk is unnecessary.[27]

25 AEMC, *Governance arrangements and implementation of the reliability standard and settings*, final determination, March 2015.

26 Reliability Panel, *NEM Reliability Standard - Generation and Bulk Supply*, July 2012, p. 1.

27 AEMC, *Governance arrangements and implementation of the reliability standard and settings*, final determination, March 2015.

3 POTENTIAL ISSUES

This chapter outlines four core areas that the Panel considers may be potential issues associated with the definition of unserved energy.

3.1 Definition of unserved energy in Chapter 10 of the NER

As discussed in chapter 2.1, there are a number of causes of supply interruptions to customers: reliability (e.g. having insufficient generation, or interconnector capacity to meet demand); security (e.g. load being shed to manage frequency across the system); or network (e.g. a particular distribution line being out driving a network outage).

In the NER, the concept of unserved energy with respect to wholesale-level reliability is applied to measure any supply interruptions consumers experience from generation and interconnection inadequacy. That is, the amount of customer demand that cannot be supplied within a region of the NEM due to a shortage of generation, demand-side participation or interconnector capacity.

Unserved energy is defined in Chapter 10 of the NER as:

'The amount of energy demanded, but not supplied, in a region determined in accordance with clause 3.9.3C(b), expressed as:

- GWh; or
- a percentage of the total energy demanded in that region over a specific period of time such as a financial year.'

The Chapter 10 definition links unserved energy to clause 3.9.3C(b), i.e. to the reliability standard. However, some stakeholders may interpret the definition as being broader than just for interruptions associated with wholesale-level reliability, to include other types of interruptions.

It may be helpful to clarify the definition of unserved energy in Chapter 10 of the NER, to make it clearer that the definition of unserved energy for the purposes of the reliability standard is isolated to wholesale supply interruptions caused by generation and interconnection inadequacy, and does not include unserved energy due to other causes of supply interruptions.

As noted in section 1.1, the scope of this work does not include the appropriateness of the unserved energy metric itself. The Panel is only interested in stakeholders' views on clarity. The metric (GWh) or how unserved energy is expressed in Chapter 10 of the NER (i.e. amount of energy demanded but not supplied as a proportion of total demand over a given financial year) are outside of the scope of this consultation paper.

QUESTION 1: DEFINITION OF UNSERVED ENERGY IN CHAPTER 10 OF THE NER

Do stakeholders agree that the definition of unserved energy in Chapter 10 of the NER lacks clarity? If so, how should it be clarified?

3.2 Contingency-based framework

Clause 3.9.3C(b) states that unserved energy, for the purposes of the reliability standard, includes unserved energy associated with power system reliability incidents that result from:[28]

- a single credible contingency event[29] on a generating unit or an inter-regional transmission element, that may occur concurrently with generating unit or inter-regional transmission element outages; or
- delays to the construction or commissioning of new generating units or inter-regional transmission elements, including delays due to industrial action or acts of God.

Clause 3.9.3C(b)(2) states that unserved energy for the purposes of the reliability standard excludes unserved energy associated with power system security[30] incidents that result from:

- multiple contingency events, protected events or non-credible contingency events on a generating unit or an inter-regional transmission element,[31] that may occur concurrently with generating unit or inter-regional transmission element outages;
- outages of transmission network or distribution network elements that do not significantly impact the ability to transfer power into the region where the unserved energy occurred; or
- industrial action or acts of God at existing generating facilities or inter-regional transmission facilities.

The current contingency-based definition of unserved energy for the purposes of the reliability standard could be potentially complex to interpret in the constantly evolving power system. It is also possible for forecast and availability deviations, both on the demand and on the supply side, to be larger than the largest credible contingency, particularly on extreme weather days. Further, during some complex events, there may be both a power system security and a power system reliability event occurring in parallel, potentially unrelated to one another.

For instance, on 10 February 2017 in New South Wales, the supply-demand balance was tight and AEMO had issued a number of LOR notices to signal low reserve conditions. Typically, this would suggest a potential reliability event given that it relates to supply adequacy. However, all four Colongra units (667 MW in total) failed to start as expected, which ultimately resulted in the unserved energy experienced on the day.[32] The failure of the units to start was a non-credible contingency event, which is excluded under the definition of

28 Clause 3.9.3C(b)(1) of the NER.

29 For example, this would be a sudden outage of a unit. Specifically, it is an event described in Clause 4.2.3(b) of the NER.

30 Defined in Chapter 10 of the NER as the safe scheduling, operation and control of the power system on a continuous basis in accordance with the principles set out in Clause 4.2.6 of the NER.

31 For example, an interconnector.

32 AEMO, *System event report, New South Wales, 10 February 2017*, February 2017.

unserved energy.[33] This was therefore classified as a power system security incident and excluded from the calculation of unserved energy.

The Panel also notes that on consumer sides of the meter there is a continued uptake of distributed energy resources (DER), with continued strong growth of rooftop PV. Currently, the definition of unserved energy does not account for the loss of electricity supplied by DER as it would not be included in demand calculations. That is, potentially, there could be instances when reliability-related loss of electricity supply used to operate DER (included in the calculation of unserved energy) leads to higher levels of actual experienced unserved energy due to the interruption in electricity supply provided by DER (excluded from the calculation of unserved energy). The Panel notes that calculation of unserved energy due to DER trip may present significant methodological and practical challenges.

3.2.1 Relevant market developments

In the *Reliability frameworks review*[34] final report, the AEMC noted that there had been a shift in the way the reliability standard is operationalised over the short term to be less reliant on the concept of contingencies.[35]

In particular, the AEMC made a final rule in December 2017 to change the way that the lack of reserve (LOR) declaration framework works, specifically to move away from AEMO being required to declare a LOR based on the concept of credible contingency events[36] alone (see Box 1).

BOX 1: CHANGES TO THE LOR DECLARATION FRAMEWORK

On 19 December 2017, the AEMC made a final rule to modify the framework for the declaration of LOR conditions to make it more flexible and transparent.

Before the change was made, AEMO calculated LOR levels[1] (LOR1 and LOR2) based on the credible contingency-based framework that was outlined in the NER. For a LOR1, this was the amount of capacity needed to withstand two credible contingency events without resorting to load shedding. Similarly, in the case of a LOR2, this was the amount of capacity needed to withstand one credible contingency event without the need for load shedding. Using this method, AEMO calculated LOR levels for each region for each time period. AEMO then compared the calculated LOR levels against the forecast total reserve level in order to determine whether to declare an LOR condition.

In the final determination, the AEMC agreed with AEMO that the credible contingency-based

33 Clause 3.9.3C(b)(2)(i) of the NER.

34 For more information, see: https://www.aemc.gov.au/markets-reviews-advice/reliability-frameworks-review

35 A contingency event means an event affecting the power system which Australian Energy Market Operator (AEMO) expects would be likely to involve the failure or removal from operational service of one or more generating units and/or transmission elements. Clause 4.2.3(a) of the NER.

36 A credible contingency event means a contingency event the occurrence of which AEMO considers to be reasonably possible in the surrounding circumstances including the technical envelope. Clause 4.2.3(a) of the NER.

LOR framework was no longer fit for purpose. AEMO's analysis has shown that significant, rapid deteriorations in short-term power system conditions now occur due to non-contingency based variations, particular in extreme temperatures which can affect both variable renewable energy as well as thermal generation. Similarly, the retirement of large thermal generation units has meant that these variations are sometimes larger than the loss of the largest unit in a particular region would be. The energy demand profiles are also expected to change further as a result of technology advance and the growth in distributed energy resources, further impacting potential variations.

The AEMC concluded that these changes mean that the concept of a credible contingency event alone is becoming less relevant in managing short-term reserves. While credible contingency events are still affecting reserve levels, demand and supply forecast (or availability) errors sometimes can now be larger than the largest credible contingency. Rapid unexpected declines in supply or unexpected increases in demand, sometimes occurring simultaneously, translate to rapid, unexpected decreases in reserves that, in some instances, are larger than the size of the largest credible contingency event.

Given these considerations the AEMC made the rule to, among other things:

- remove contingency-based LOR descriptions from the NER and replace them with a single high-level description of LOR condition, namely that AEMO declares a LOR condition when it determines that the probability of involuntary load shedding is, or is forecast to be, more than remote, according to the reserve level declaration guidelines
- require AEMO to make and publish the reserve level declaration guidelines, which set out how AEMO determines LORs.

In January 2018, AEMO published final reserve level declaration guidelines. The new process introduces a probabilistic element into the determination, which allows for the impact of estimated reserve forecasting uncertainty in the prevailing conditions. These estimates are made on the basis of past reserve forecasting performance for demand, output of intermittent generation and availability of scheduled generation. The new LOR framework has been used by AEMO since February 2018.

Source: AEMC, *Declaration of lack of reserve conditions*, final determination, December 2017; AEMO, *Overview of new method for determining Lack of Reserve (LOR) levels*, February 2018.

Note: 1 - There are three different levels of assessment of the availability of lack of reserve, each corresponding to a different availability of reserves. LOR3, however, is the threshold when the forecast reserve in a region is at or below zero. An LOR3 condition would represent load shedding.

In the *Reliability frameworks review* final report, the AEMC stated that it is possible for forecast and availability deviations, both on the demand and on the supply side, to be larger than the largest credible contingency, particularly on extreme weather days. These deviations are not related to credible contingency events, and as such, the contingency-based LOR framework did not consider such deviations. Therefore, according to the AEMC, it may be worth assessing if the existing definition of unserved energy, which is linked to the concept of contingencies, is still appropriate.[37]

The Panel is interested in stakeholders' views on the appropriateness of the contingency-based definition of unserved energy, given that unserved energy relates to wholesale-level reliability, i.e. an inadequacy of generation or demand response capacity as well as interconnection capacity.

In addition, the Panel considers that there may be value in generally clarifying clause 3.9.3C(b). As currently drafted, the clause is complex and lacks clarity.

> QUESTION 2: CONTINGENCY-BASED DEFINITION OF UNSERVED ENERGY
>
> 1) Do stakeholders see particular benefits in maintaining contingency events as a base for the definition of unserved energy?
>
> 2) Do stakeholders have any views on whether or not the distinction between events that are included and events that are excluded from the definition of unserved energy need to be simpler and clearer? If so, do stakeholders have any suggestions as to how this could occur?

3.3 Power system security events

AEMO manages power system security to maintain the power system within technical limits via a range of tools, including applying network constraints to the NEM dispatch engine, dispatch of voltage control/reactive power, and requirements for frequency control ancillary services (FCAS).

The reliability standard is not designed to limit supply interruptions caused by problems maintaining power system security. Increasing generation or demand response capacity may not necessarily alleviate a power system security issue. For example, additional generating units may not necessarily participate in FCAS markets or provide the specific system security service that is required, such as system strength or inertia. Further, unlike security events, the management of any reliability events that may emerge would be managed through the existing reliability framework, for example, through the review of the reliability standard and settings or, operationally, if the market fails, by using the RERT. Neither of these instruments is an appropriate way to reduce the risk of repeating security events. As mentioned above, AEMO applies a different set of tools to manage security events.

AEMO reviews power system security events, including those that result in unserved energy (i.e. load shedding), to check its actions and operating procedures are appropriate to minimise the amount of unserved energy that such events may cause in the future. This might result in AEMO changing their operating procedures, constraint equations, or other pre-contingent actions that mitigate the likelihood of the event and any further unserved energy.

37 AEMC, *Reliability frameworks review*, July 2018.

Separating reliability-related unserved energy from supply interruptions caused by power system security events is managed via the exclusions outlined in clause 3.9.3C(2):

- exclude unserved energy associated with power system security incidents that result from:
    - multiple contingency events, protected events or non-credible contingency events on a generating unit or an inter-regional transmission element, that may occur concurrently with generating unit or inter-regional transmission element outages;
    - outages of transmission network or distribution network elements that do not significantly impact the ability to transfer power into the region where unserved energy occurred; or
    - industrial action or acts of God at existing generating facilities or inter-regional transmission facilities.

The power system security incidents, resulting from the causes listed above, are excluded from the calculation of unserved energy for the purpose of the reliability standard. For example:

- The black system event that occurred in South Australia on 28 September 2016 was a power system security incident and therefore supply interruptions from that event are not included as unserved energy for the purposes of the reliability standard.[38]
- Similarly, on 1 December 2016, a fault on the Moorabool to Tarrone 500 kV transmission line in Victoria resulted in the loss of the Heywood interconnector between South Australia and Victoria and led to the disconnection of load. The power system was not in a secure operating state after this incident.[39] This was excluded from the calculation of unserved energy because the 500 kV transmission line was not an inter-regional transmission element.

Importantly, the NER, as currently drafted, do not exclude all power system security events from the definition of unserved energy for the purpose of the reliability standard - it only includes a non-exhaustive list. There could be instances where an event, not captured in the specific exclusions for the calculation of unserved energy set out in the NER, could be captured in the definition and calculation of unserved energy.

In relation to this issue, the AEMC stated in its *Reliability frameworks review* final report: '...the current definition does not explicitly exclude all power system security events, even though in practice, it appears that this has been the case. It may be worth exploring whether the NER definition could be simplified or clarified in order to accurately reflect what is meant to be captured within unserved energy for the purposes of the reliability standard'.[40]

Notwithstanding the appropriateness of a contingency-based definition of unserved energy, the Panel is interested in receiving stakeholders' views on whether all security events should be explicitly excluded from the definition of the unserved energy, and how to make the distinction between security and reliability incidents simpler and clearer.

38 AEMO, *Black system South Australia 28 September 2016*, final report, March 2017.

39 AEMO, *South Australia Separation Event, 1 December 2016*, final report, 28 February 2017.

40 AEMC, *Reliability frameworks review*, July 2018, p. 243.

> QUESTION 3: POWER SYSTEM SECURITY EVENTS
>
> Do stakeholders agree that all power system security events should be explicitly excluded from the definition of unserved energy?

3.4 Reliability-related interventions

The Panel is also considering how to account for AEMO's reliability-related interventions, such as involuntary load shedding or the RERT.

The purpose of interventions is to help maintain and/or re-establish the reliability and security of the NEM when regulatory processes or market responses have not delivered desired outcomes. AEMO may only deploy intervention tools in the event that wholesale and contract market price signals, AEMO's information disclosure processes and its informal negotiations with market participants fail to elicit the outcomes needed to alleviate the projected or actual, reserve shortfalls or system security issue.

The RERT, directions and instructions are the three key intervention mechanisms available to maintain or re-establish power system reliability.[41] In brief, the three mechanisms are:

- The RERT is a type of strategic reserve that allows AEMO to pay a premium for additional capacity to be on stand-by in case of emergencies when the demand and supply balance is tight.[42]
- Directions allow AEMO to require a generator to increase (or decrease) its output or a scheduled load to decrease (or increase) consumption.[43]
- Instructions allow AEMO to require a large energy user to temporarily disconnect its load or reduce demand. AEMO may also instruct a network service provider to shed and restore load consistent with schedules provided by the relevant state government.[44] Instructions refer to all remaining registered participants that cannot be subject to a direction (i.e. not scheduled plant or a market generating unit).

The Panel's initial thinking is that the definition of unserved energy for reliability purposes could:

- include the RERT resources dispatched or activated[45] by AEMO to the extent that these actions would have avoided other consumers experiencing unserved energy
- include generation that became available to the market through a reliability direction issued by AEMO to a generator

41 These tools are also used to maintain or re-establish power system security. This is important because if the lack of supply to meet demand is allowed to continue an insecure power system will almost always be the result.

42 Under clause 3.20.7 of the NER.

43 Under clause 4.8.9 of the NER.

44 Under clause 4.8.9 of the NER.

45 Scheduled reserves are dispatched, unscheduled reserves are activated.

- continue including load shedding instructions issued by AEMO under clause 4.8.9 of the NER if the event is classified as a reliability event (including a clause 4.8.9 instruction to a registered participant to reduce load).

However, unserved energy would not include:

- the proportion of the RERT resources dispatched or activated that was unneeded
- load shed under clause 4.8.9 instructions that was in excess of what was needed
- the proportion of generation that became available to the market through a reliability direction and was unneeded.

An example is a situation where the RERT was dispatched/activated prior to a change in conditions (e.g. weather reducing demand and more generation made available) that means there is spare generation in excess of the RERT quantities dispatched, which indicates no load shedding would have been needed.

Practically, this would mean that AEMO would need to assess each event on an ex-post basis to determine if, for example, the direction or RERT dispatch was actually needed to avoid involuntary load shedding. If it determines that they were not needed, then these events would be excluded from the calculation of unserved energy. In practice, this assessment may be present some challenges.

For example, the Panel notes that due to the nature of the RERT and how it is operationalised by AEMO, there will be instances where the ex-post analysis would show that the RERT was not needed. This is because AEMO tends to dispatch emergency reserves on an ex-ante basis, based on a forecast LOR2, rather than waiting for an actual LOR2 or an LOR3[46] to occur.[47] The main reasons for this are:

- There are a number of steps that AEMO must take before it dispatches emergency reserves, which means that in practice, AEMO cannot wait until the very last minute to dispatch emergency reserves. Further, the RERT is an out-of-market, last resort mechanism. As a result, emergency reserves typically have a pre-activation (getting ready to be called upon, which usually occurs about 20+ hours ahead of a shortfall) and activation lead time (getting ready to be dispatched), as well as deactivation lead times (ramping down to zero or ramping up in the case of demand response).
- Importantly, forecast or actual LOR2 assumes that there will be a lack of generation capacity (load shedding), if the largest credible contingency event occurs or the prevailing conditions change significantly (for instance, sudden drop in the wind generation). Hence, to account for these possible scenarios, AEMO dispatches emergency reserves in response to a forecast or actual LOR2. Consequently, if a large credible contingency event eventuates or the prevailing conditions change significantly, the ex post analysis may show that the RERT was needed. Alternatively, if there is no change in the system conditions, the ex-post analysis may show that the RERT was not required to meet the demand.

46 When load shedding is imminent.

47 On 30 November and 19 January 2017, the RERT was activated based on forecast LOR2s.

Further, each RERT contract may have different minimum run times and hours of reserve availability. It is possible for the actual LOR2 or LOR3 condition being significantly shorter than the minimum run time according to a specific RERT contract. In this case, AEMO has to continue dispatching the RERT according to the contract's terms and conditions, even if the RERT is no longer needed. The ex-post analysis may then show that the RERT was needed for the duration of the LOR2 or LOR3 condition but was not needed for the rest of the activation time.

The following example illustrates how market participants and AEMO apply the reliability framework in practice. It also demonstrates why AEMO tends to dispatch emergency reserves on an ex-ante basis, based on a forecast LOR2, rather than waiting for an actual LOR2 or an LOR3[48] to occur.

Consider that on a hot summer day when there is high demand forecast, AEMO's processes forecast that there are not enough reserves in the market. AEMO publishes an LOR2 seeking a market response. No market response occurs[49] and the forecast LOR2 persists. AEMO determines that it will intervene through emergency reserves. It dispatches unscheduled emergency reserve contracts at a time that it has determined is the latest by which it needs to intervene, taking into account the amount of time it takes for the emergency reserves to be ready for activation. This has the effect of reducing demand and there are once again enough reserves in the market for the duration of the RERT event. Reliability is maintained. Because the emergency reserves have a minimum run time, their activation continues beyond the forecast LOR2 period.

Under the alternative scenario, the RERT was not dispatched[50] and the forecast LOR2 persists into an actual LOR2. At that point, one unit unexpectedly trips, leading to a drop in reserves and an actual LOR3 occurring - this means that load shedding is imminent due to the market having run out of reserves. AEMO then instructs networks to shed load in the affected region. This is typically done in a controlled manner, through what is known as rotational load shedding. Involuntary load shedding is the last resort, after all other avenues have been exhausted, and is typically done so as to avoid potentially larger issues occurring, such as interconnector flows exceeding secure limits (i.e. the system being in an insecure state), with the risk of more widespread blackouts should a further contingency occur.

Given all the above, the Panel is interested in stakeholders views on the extent to what interventions should be included into the definition of unserved energy. The possible options are:

- Excluding reliability-related interventions from the definition of unserved energy (as currently is the case). This calculation indicates customers' experiences in relation to wholesale reliability only. That is, in some instances even though supply shortfalls are forecast, customers do not experience a supply interruption because of emergency

48 When load shedding is imminent.

49 For example, either due to participants having different views to AEMO as to what the forecast entails; or there is insufficient available capacity in the market; or no planned outages could be cancelled.

50 Due to not being available to AEMO in sufficient quantities or in sufficient time and the market does not respond as there is no spare generation or demand response.

reserves being dispatched by AEMO, which then avoids load shedding. However, by excluding reliability-related interventions from this calculation, it may potentially misrepresent the market's ability to meet customer demand.

- Including reliability-related interventions in the definition of unserved energy to the extent that they were required to meet demand. Potentially, this may provide a clearer indication of the amount of customer demand that cannot be supplied within a region. Further, this change may deliver more accurate information to the market (through ex-post analysis) in relation to the required level of investment, as it will reflect both the amount of customer demand not supplied at all and the amount of demand supplied through intervention mechanisms, not market ones. The amount of demand supplied through intervention mechanisms can be seen as demand which was not supplied by the market. The market is expected to be able to meet customer demand without the activation of emergency reserves. Therefore, if reliability interventions occur and prevent load shedding, there may be a benefit in signalling to the market the need for additional investment through the ex-post analysis of market performance against the reliability standard.
- Calculating two unserved energy figures for the purposes of the reliability standard. One calculation would exclude reliability-related interventions (as currently is the case) and reflect customers' actual experiences. Another calculation would include reliability-related interventions to the extent that they were required to meet demand and more accurately reflect the market's ability to supply customer demand. This may provide market participants with another set of information on matters pertaining to the reliability standard and market performance.

The Panel acknowledges another reliability intervention mechanism, namely, mandatory restrictions. Mandatory restrictions on the use of electricity may be imposed by a jurisdiction as a means of controlling demand and averting a situation where there is insufficient generation capacity to meet demand, particularly in situations where mandatory load shedding is or would otherwise be necessary. When restrictions are imposed on a region, electricity users are requested to reduce demand (and large users may be required to reduce demand). This reduces the quantity of electricity traded, the spot price, and thus the revenue earned by generators. The level of demand response that will be achieved by restrictions is difficult to estimate and the actual response by consumers may be greater than is necessary. The Panel notes that mandatory restrictions have never been used.

The Panel welcomes stakeholders' views on whether or not mandatory restrictions should be included as well. As with other interventions, if they are to be included, it would only be to the extent that they would have avoided load shedding.

QUESTION 4: DEFINITION OF UNSERVED ENERGY

Do stakeholders agree that AEMO's reliability-related interventions should be included into the definition of unserved energy? If so, to what extent should they be included and which of the three options described above is preferred?

4 OTHER ISSUES RAISED BY STAKEHOLDERS

A number of stakeholders have commented on the definition of unserved energy throughout the *Reliability Frameworks Review*:

- Energy Networks Australia noted that there is consumer dissatisfaction with the amount of unserved energy reported vis-à-vis the amount of load shedding in New South Wales and that consumer expectations should be regarded as an important consideration in defining, and attaining a more holistic understanding of, unserved energy.[51]
- TransGrid stated that there should be a rethink of the unserved energy definition to include voluntary curtailment or curtailment of large loads.[52]

4.1 Matching consumer experience of supply interruptions

Energy Networks Australia's suggested change is that the definition of unserved energy should be aligned with consumer experiences of supply interruptions, whatever their cause. It was suggested that consumer expectations should be regarded as an important consideration in defining and attaining a more holistic understanding of unserved energy.[53]

The Panel acknowledges the definition of unserved energy is not the same as that which is experienced by the customer. Reliability interruptions are the only source of interruptions that count towards unserved energy and, as it was shown in Figure 2.3, they constitute only 0.29 per cent of all supply interruptions.

However, the reliability standard targets the amount of unserved energy consumers can expect from a particular cause, i.e. insufficient generation/demand response and interconnection within a NEM region. Including every single supply interruption event in the measurement of unserved energy would likely create the mistaken impression that it is possible to reduce all forms of supply interruptions by increasing generating capacity or increasing demand response.

It may also have significant implications for reliability in the NEM. Irrespective of whether the reliability standard was met, the yearly assessment would show that it was not. Including all types of interruptions for a metric that is only meant to be used for the reliability framework is not appropriate. Furthermore, broadening the definition of unserved energy to reflect actual consumer experience of supply interruptions may have significant implications for investment. Including every single supply interruption event, as an example, would substantially inflate the amount of unserved energy and lead to over-investment in capacity (i.e. generation supply or demand response) at the wholesale level, with costs ultimately paid by consumers.

Network reliability is managed by the governments in each jurisdiction. There are existing state-based reliability standards that signal the level of reliability expected of a region's network assets (transmission and distribution). Supply interruptions as a result of a network

51 Energy Networks Australia, submission to interim report of *Reliability Frameworks Review*, February 2018, pp. 4-5.

52 TransGrid, submission to the interim report of *Reliability Frameworks Review*, February 2018, pp. 2-3.

53 Energy Networks Australia, submission to interim report of *Reliability Frameworks Review*, February 2018, pp. 4-5.

outage therefore count towards a breach of jurisdictional network reliability requirements (typically imposed through licence conditions), rather than a breach of the NEM's reliability standard.

The Panel's view is that this approach remains appropriate because increasing generation capacity would not necessarily improve network reliability. Additional supply would be of no use if network constraints prevent it from being transmitted to where it is demanded.

> QUESTION 5: MATCHING CONSUMER EXPERIENCE OF SUPPLY INTERRUPTIONS
>
> Do stakeholders agree with the Panels's view that supply interruptions other than wholesale-level reliability interruptions should remain excluded from the unserved energy definition?

4.2 Voluntary curtailment or demand response

During the AEMC's *Reliability frameworks* review,[54] TransGrid noted that actions such as voluntary curtailment and large market responses are not included in the definition, even when the effect on consumers is similar to unserved energy. This was echoed by ENA. TransGrid suggested that a broadening of the definition would better align it with the level of reliability experienced by consumers.[55]

Unserved energy does not include voluntary curtailment, including:

- to reduce a customer's own exposure to the wholesale price (e.g. demand response due to being spot-exposed)
- in response to incentives from retailers or third-parties (e.g. demand response through a retailer)
- in response to jurisdictions' calls to reduce consumption (e.g. system event in New South Wales on 10 February 2017, often referred to as voluntary curtailment).[56]

The Panel sees voluntary demand response as being similar to additional generation, i.e. it is capacity at the wholesale level rather than avoided load shedding. In other words, voluntary demand curtailment is considered to be the 'in market'. Demand is not unmet in these instances as it is a voluntary action taken by the consumer to curtail consumption. It is currently treated as such in the unserved energy calculation since any wholesale demand response would reduce total energy demanded, which has the effect of improving reliability outcomes. This is different from demand response provided through RERT, which is an out-of-market mechanism used only after the market has addressed any potential reliability issue, including through voluntary in-market demand response.

54 For more information, see: https://www.aemc.gov.au/markets-reviews-advice/reliability-frameworks-review

55 TransGrid, submission to the direction paper of *Reliability Frameworks Review*, May 2018, p. 5.

56 AEMO, *System event report New South Wales 10 February 2017*, February 2017.

Voluntary curtailment and demand response provide consumers with the opportunity to choose their own level of reliability up to the market price cap imposed by the Panel. Hence, only AEMO's interventions under clause 4.8.9 of the NER and RERT would have the potential to be included as unserved energy (see section 3.4).

QUESTION 6: VOLUNTARY CURTAILMENT OR DEMAND RESPONSE

Do stakeholders agree with the Panel's view that voluntary curtailment and in-market demand response should remain excluded from the definition of unserved energy?

ABBREVIATIONS

AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
FCAS	Frequency Control Ancillary Services
LOR	Lack of reserve
Panel	Reliability Panel
NEL	National Electricity Law
NEM	National electricity market
NER	National Electricity Rules
RERT	Reliability and Emergency Reserve Trader