AEMC

REVIEW

Australian Energy Market Commission

FINAL REPORT

Advice to SCER on linking the reliability standard and reliability settings with VCR

20 December 2013

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About the AEMC

The Council of Australian Governments (COAG), through its then Ministerial Council on Energy (MCE), established the Australian Energy Market Commission (AEMC) in July 2005. In June 2011, COAG established the Standing Council on Energy and Resources (SCER) to replace the MCE. The AEMC has two main functions. We make and amend the national electricity, gas and energy retail rules, and we conduct independent reviews of the energy markets for the SCER.

Summary

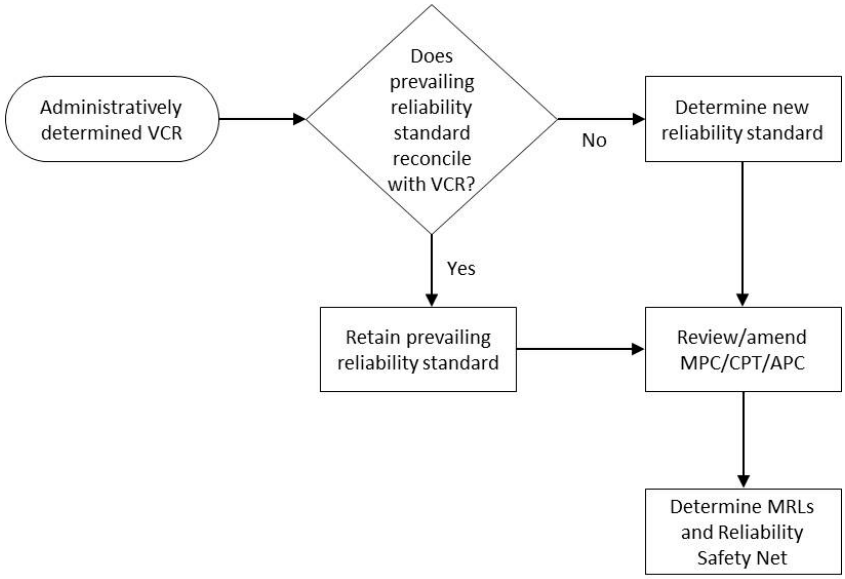
The Australian Energy Market Commission has been asked to provide advice to the Standing Council on Energy and Resources (SCER) on linking the national electricity market (NEM) reliability standard and reliability settings in the wholesale energy market with a value of customer reliability (VCR).

The overall reliability of supply to customers depends on the reliability of each part of the supply chain. That is, the stock of generating units, the transmission network and the distribution network. Currently, reliability standards associated with each part of the supply chain are independently determined. This advice is focussed on reliability of the generation and bulk-transmission sectors.

After considering stakeholder submissions and conducting its own analysis, the Commission recommends that a single, VCR estimate be used in the process of setting the reliability standard and reliability settings. Specifically, the VCR estimated for the customers most affected by a supply shortfall should be used as a cross-check on the reliability standard to assess how well the prevailing standard reflects the value customers place on reliability.[1] This check would occur as the first step in the regular review of the reliability standard, as required under the National Electricity Rules (NER). If it was found that the prevailing standard no longer reflected customers' reliability expectations, the reliability standard could be amended as appropriate. The aim would be to determine a reliability standard consistent with minimising total costs to consumers.

Figure 1 illustrates the Commission's preferred approach.

Figure 1 Summary of preferred option



1 This would be achieved by determining the minimum combined costs of generation and unserved energy to meet that reliability standard.

The market price cap would then be set at a level sufficient to deliver the investment in generation needed to meet the reliability standard. This approach provides for the level of generation reliability in the NEM to broadly reflect the value that customers place on reliable electricity supply. This will promote efficient market outcomes that are at least consistent with those delivered by the NEM's current reliability standard and settings.

This approach is also consistent with the framework recommended by the AEMC for setting transmission reliability levels in the NEM. That process involves assessing the way that the cost of operation and investments in transmission networks change reliability levels, and selecting a reliability standard where the cost of investment and operation equates to the value placed on reliability by customers.[2]

Reliability in the NEM

The overall reliability of supply to customers depends on the reliability of each part of the supply chain. That is, the stock of generating units, the transmission network and the distribution network. While different entities plan and operate each part of the supply chain, the associated reliability standards are currently independently determined. This advice is focussed on reliability of the generation and bulk-transmission sectors. For the purposes of reliability, bulk-transmission capacity refers to inter-regional capability. In the NEM, the reliability standard is used to evaluate whether sufficient investment in generation capacity is occurring to meet consumer demand for electricity. As such, the reliability standard applies primarily to generation, but also includes inter-regional transmission to capture the benefits of generation from across regional boundaries.

The reliability standard is set by the Reliability Panel (the Panel) in accordance with the NER. Its objective is to deliver an expectation of reliability that reflects the value that consumers place on reliability. The current approach specifies the maximum expected unserved energy (USE). Currently, the level of USE is set at 0.002 per cent of the annual energy consumption for the associated NEM region or regions per financial year.

To encourage sufficient investment in generation capacity and demand-side response to meet the reliability standard, the NEM design includes three key 'reliability settings'. The market price cap (MPC), market floor price and the cumulative price threshold (CPT) arrangements form the key price envelope within which the wholesale spot market balances supply and demand and encourages the delivery of capacity to meet the reliability standard.

The challenge of maintaining reliability in the NEM is setting the market price cap high enough to incentivise sufficient levels of generation capacity and demand-side response to deliver the expected reliability outcome, but no higher than consumers are willing to pay for that outcome. Currently, the MPC is determined by the AEMC on the recommendation of the Reliability Panel. Supply-side modelling is typically used to estimate the costs required to incentivise generation investment up to the point where

2 The AEMC published its final report on the review of the national framework for transmission reliability on 1 November 2013. See www.aemc.gov.au.

load shedding is reduced to the administratively determined level of reliability. That is, to the reliability standard.

An alternative approach could be to link the level of the market price cap with an estimate of the value that customers place on reliability. A direct link between the MPC and the VCR could remove the need for an explicit reliability standard, since the reliability that consumers' desire would be expressed through the VCR. However, to date, a VCR for all NEM customers has never been estimated. Undertaking this task necessarily involves complex issues such as variations in VCR across customers in different sectors and locations. In addition, recent work by the Reliability Panel has indicated that the link between the MPC and the VCR may not be straightforward in practice.[3] While the measures are related, they do not necessarily equate.

Approach to the advice

This advice has examined whether efficient reliability outcomes can be achieved by linking the reliability standard and reliability settings with a measure of the value that customers place on reliable electricity supply.[4] In doing so, it has explored a number of approaches to setting the reliability standard and reliability settings which use demand-side measures, such as VCR.

Specifically, the AEMC has developed this advice to SCER using the following approach:

- Having regard to the national electricity objective (NEO), identify an assessment framework to guide the evaluation of possible approaches to linking the reliability standard and reliability settings with VCR.
- Explore the relationship between the reliability standard and reliability settings and VCR.
- Identify possible approaches to linking the reliability standard and reliability settings with VCR.
- Using the assessment framework, evaluate each of the approaches identified to determine whether they are likely to satisfy the NEO.
- Identify a preferred approach.

3 The Reliability Panel is currently undertaking its Reliability Standard and Settings Review 2014. The review will assess the appropriate standard and settings that should apply from 1 July 2016. A draft report prepared by ROAM Consulting has been published and the Reliability Panel's draft report will be published in February 2014. See www.aemc.gov.au.

4 Requiring the consideration of the value of customer reliability when determining the reliability standard and reliability settings would formally recognise that a relationship exists between generation reliability and the value placed on reliability by customers.

Background to the advice

SCER requested this advice in response to the AEMC's review of the effectiveness of NEM security and reliability arrangements in light of extreme weather events. The final report for that review was published in May 2010. In it, the AEMC made a number of recommendations, including that a new requirement be included in the NER for a VCR, based on the residential consumer class, to be considered when determining the levels for the reliability standard and reliability settings.

In June 2012, SCER provided a response to the AEMC's final recommendations. While the majority of the recommendations were endorsed, SCER requested additional advice on the matter of setting the reliability standard and reliability settings with reference to an agreed VCR. The AEMC received terms of reference from SCER in January 2013.

Contents

1 Introduction

The Australian Energy Market Commission (AEMC or Commission) has been requested by the Standing Council on Energy and Resources (SCER) to provide advice on linking the wholesale electricity market's reliability standard and reliability settings with the value of customer reliability (VCR).[5] This report sets out this advice.

1.1 Context of this advice

On 28 April 2009, the Ministerial Council on Energy (MCE) (now SCER) directed the AEMC to conduct a review of the effectiveness of national electricity market (NEM) security and reliability arrangements in light of extreme weather events (the review or extreme weather review).[6]

The terms of reference for the extreme weather review required the AEMC to respond to the following questions:

- Under the scenario that extreme weather events become more frequent, are the current arrangements for managing security and reliability in the NEM appropriate to deliver reliable and secure electricity supply?
- If not, what cost effective amendments could be made to the market arrangements in the short and longer terms to address any identified risks to security and reliability under that scenario?

On 31 May 2010, the AEMC published its final report for the review.[7] The final report concluded that in a scenario with more extreme weather events, there were a number of areas within existing frameworks where improvements could be made to enable consumer expectations for quality of supply to be maintained. The key areas included:

- technical performance and power system security;
- the reliability standard;
- governance arrangements for determining the reliability standard and reliability settings; and
- processes for determining the reliability standard and reliability settings.

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5 SCER, *Terms of Reference, Australian Energy Market Commission (AEMC), linking the Reliability Standard and Reliability Settings with the Value of Customer Reliability*, 8 January 2013. Hereafter, this is referred to as "terms of reference".

6 At its meeting on 6 February 2009, the MCE noted the significance of the interruptions in Victoria and South Australia on 29 and 30 January 2009 as the result of severe heat wave conditions, and agreed that there was a need to review energy market frameworks in light of the impact of the heat wave on electricity supply.

7 AEMC 2010, *Review of the Effectiveness of NEM Security and Reliability Arrangements in light of Extreme Weather Events, Final Report*, 31 May 2010, Sydney.

The AEMC made a number of recommendations including that a new requirement be included in the National Electricity Rules (NER) for a VCR, based on residential customer class, to be considered when determining the levels for the reliability standard and reliability settings.[8] In making this recommendation, the AEMC recognised that there were a number of different approaches to estimating a VCR and which approach was adopted could result in different outcomes, with different implications for consumers and the market.

In June 2012, SCER provided a response to the AEMC's final report for the extreme weather review.[9] While SCER endorsed the majority of the AEMC's recommendations, it noted that, given the complexity of the proposal that the reliability standard and reliability settings be set with reference to a defined VCR, it required additional advice on this matter before considering its policy position.

In January 2013, the AEMC received terms of reference from SCER to provide advice on linking the reliability standard and reliability settings with VCR.

1.2 Purpose of this advice

The purpose of this advice is to examine whether more efficient reliability outcomes can be achieved by linking the reliability standard and reliability settings with a measure of the value that customers place on reliable electricity supply.

Reliable, continuous electricity supply to customers is dependant (in part) on adequate generation capacity and network capability being available to deliver electricity to customers. In the NEM, investment in network capacity is driven by the regulatory framework in the NER and its application by the Australian Energy Regulator (AER) in periodic decisions on regulated revenues. On the other hand, generation investment (the focus of this advice) is incentivised through the opportunity to earn revenue through the wholesale market. The spot price (or derivatives of the spot price through contracting) is the primary income for generators and provides a signal for the timing, form and location (on a regional basis) of investment in new generation. Similarly, the spot price provides signals for investment in demand-side initiatives.

The spot price in the NEM is capped at the level of the market price cap (MPC), the key reliability setting. While the MPC limits overall risk for market participants and consumers, it must be set at a level high enough to incentivise the delivery of sufficient generation capacity and demand-side response to meet the reliability standard. The reliability standard is an administratively determined measure which represents an expectation that a level of supply reliability will be achieved.

Currently, the MPC is determined using supply-side modelling which estimates the costs required to incentivise generation investment up to the point where load

8 AEMC 2010, *Review of the Effectiveness of NEM Security and Reliability Arrangements in light of Extreme Weather Events, Final Report*, 31 May 2010, Sydney, Chapter 8.

9 MCE 2012, *Review of the Effectiveness of NEM Security and Reliability Arrangements in light of Extreme Weather Events, MCE response to AEMC Final Report*, June 2012.

shedding would be reduced to an administratively determined level of reliability. That is, to the reliability standard.

However, there are other possible approaches to determining the market price cap (and other reliability settings) which employ demand-side measures such as estimates of the value that customers place on reliable electricity supply. This advice explores possible alternative approaches to setting the reliability standard and reliability settings. Specifically, it will focus on approaches which use VCR as an input into the reliability standard and reliability settings review process.

1.3 Terms of reference for this advice

In providing its advice to SCER, the terms of reference require the AEMC to complete the following:

- Describe how the reliability standard and reliability settings (especially the role of the MPC in the operation of the wholesale market) support, at a high level, the national electricity objective (NEO).
- Describe the different methodologies by which the AEMC might amend the reliability standard and reliability settings (principally the MPC) to reflect a VCR and include an assessment of each methodology's benefits, limits and suitability in meeting the NEO.
- Show how linking the reliability standard and reliability settings (especially the MPC) with a VCR may better support the NEO, giving specific focus to how this occurs with the MPC impacts on reliability outcomes for consumer classes with varying VCRs.
- Analyse the expected costs and benefits with linking the reliability standard and reliability settings (specifically the MPC) with a VCR in terms of:
  - the potential impact on consumers, including for price and reliability;
  - the potential impacts on generators, retailers and other relevant market participants, including impacts on investment signals; and
  - the extent to which linking the MPC to a VCR could duplicate the signals provided by the reliability standard and other existing market settings.
- Based on this analysis, outline a preferred approach including any implementation considerations.

The terms of reference also require that the AEMC have regard to:

- the work by the Australian Energy Market Operator (AEMO) in establishing regional and national VCR levels; and
- the processes and outcomes associated with other related work.

The original terms of reference required the AEMC to provide a report setting out its advice and recommendations by 30 June 2013. However, following a request from the AEMC for an adjustment to the delivery date for the final report, SCER subsequently amended the date for completion of this advice to 31 December 2013.

1.4 Other relevant matters

There is a range of work that is currently or has recently been undertaken that may have implications for the current advice request. The most relevant of these are summarised below.

1.4.1 AEMO review of the value of customer reliability

In March 2013, AEMO commenced work on its Review of the Value of Customer Reliability. AEMO was requested to undertake the review by SCER following SCER's response to the AEMC's 2010 extreme weather review.[10]

As part of this review, AEMO has considered the existing methodologies to measure VCR and has commissioned surveying to develop VCRs for use across the NEM. In November 2013, it published a Statement of Approach document which confirmed its intention to use a choice modelling survey-based approach to obtain VCR data from customers.[11] This methodology will be used to develop VCR figures for four different customer types. The VCRs for each customer type will then be used to develop VCRs for each transmission connection point in the NEM. AEMO will publish its final VCR figures in March 2014.

The review by AEMO interacts with this advice as the successful implementation of an approach which links the reliability standard and reliability settings with a VCR will depend, in part, on the availability of appropriate and regularly updated VCR estimates.

1.4.2 AEMC review of the national frameworks for transmission and distribution reliability

On 27 September 2013 and 1 November 2013, the AEMC published final reports for its reviews of the national frameworks for distribution and transmission reliability, respectively.[12] The AEMC was requested to undertake these reviews by SCER.

The final reports set out the AEMC's recommended frameworks for transmission and distribution reliability. Each are designed to promote greater efficiency, transparency

10 MCE 2012, *Review of the Effectiveness of NEM Security and Reliability Arrangements in light of Extreme Weather Events, MCE response to AEMC Final Report,* June 2012.

11 AEMO 2013, Value of Customer Reliability Statement of Approach, 11 November 2013.

12 AEMC 2013, *Review of the national framework for transmission reliability, Final report*, 1 November 2013, Sydney; AEMC 2013, *Review of the national framework for distribution reliability, Final report*, 27 September 2013, Sydney.

and community consultation in how network reliability levels are set and provided across the NEM. A key feature of both frameworks is an economic assessment process to inform the setting of reliability targets. The process involves evaluating the way network costs vary with different levels of reliability, and explicitly assessing the expected costs of investments against the value that customers place on reliability and the probability of interruptions.

Given that VCR forms a key component of both frameworks, the final reports make a number of recommendations about the body responsible, and process for, updating the VCR data used under the frameworks. These recommendations are set out in Chapter 3 of this final report and are relevant in the context of this advice to the extent that accurate and up-to-date information on customer values of reliability are needed in the generation reliability standard setting process.

1.4.3 Reliability Panel reliability standard and settings review 2014

Under the NER, the Reliability Panel (the Panel) is required to carry out a review of the reliability standard and reliability settings once every four years. This regular review allows the Panel to take into account any changes in market arrangements over the previous four years, and consider whether the reliability standard and reliability settings (specifically the MPC, market floor price and cumulative price threshold) will continue to meet the requirements of the market, market participants and consumers.

On 9 May 2013, the Panel published an issues paper for its 2014 review of the reliability standard and reliability settings.[13] The Panel will review the current reliability standard and settings to determine whether these should continue to apply from 1 July 2016. In undertaking the review, the Panel must have regard to the NEO, the potential impact of any proposed change on market participants and consumers, as well as the potential impacts on the market including the spot market, contract market and investment signals. Where appropriate, the Panel will also take into account any value of customer reliability determined by AEMO.

The Panel is required to complete the review by 30 April 2014.[14]

1.5 Stakeholder consultation

SCER requested the AEMC consult with AEMO, the AER, the Reliability Panel and jurisdictions during the preparation of this advice. Where appropriate, the AEMC may also consider consultation with other key stakeholders while preparing its advice.

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13 AEMC Reliability Panel 2013, *Reliability Standard and Settings Review 2014, Issues Paper*, 9 May 2013, Sydney.

14 Currently, the Reliability Panel is responsible for reviewing and, where appropriate, amending the reliability standard. The Reliability Panel is also required to review the reliability settings. However, any change to the reliability settings must be considered and approved by the AEMC through the rule change process.

On 29 October 2013, the AEMC published a consultation paper inviting stakeholder views on a number of issues associated with linking the reliability standard and reliability settings in the wholesale market with VCR. Submissions closed on 26 November 2013.

The AEMC received eight submissions to the consultation paper.[15] Responses to the consultation paper have been used to further inform and enhance the Commission's understanding of the key issues relevant to this advice. Relevant comments from submissions are used throughout this final report.

1.6 Structure of this report

The remainder of this report is structured as follows:

- Chapter 2 provides an overview of the reliability framework in the NEM. It also considers the relationship between the reliability standard and reliability settings and the value that customers place on reliable electricity supply.
- Chapter 3 outlines some of the issues associated with developing a reliable and accurate VCR estimate for use in setting the reliability standard and reliability settings.
- Chapter 4 describes possible approaches to linking the reliability standard and reliability settings with VCR and evaluates each option against the NEO.
- Chapter 5 sets out the Commission's preferred approach, including the implementation issues.
- Appendix A sets out the approach, scope and overarching objective (the NEO) used to guide this advice.
- Appendix B sets out a brief history of the current reliability arrangements in the NEM.
- Appendix C provides an overview of the electricity wholesale markets considered by NERA Economic Consulting (NERA) in its review of alternative approaches to setting wholesale electricity market price caps.

15 Submissions were received from AEMO, AGL Energy (AGL), Alinta Energy (Alinta), Origin Energy (Origin), GDF Suez Australian Energy (GDF Suez), National Generators Forum (NGF), Major Energy Users (MEU) and the South Australian Council of Social Services (SACOSS).

2 Reliability in the NEM

2.1 Framework for reliability in the NEM

The NEM is an energy-only market that is operated within reliability settings that aim to achieve the reliability standard. The current reliability standard and reliability settings are summarised below.

2.1.1 Reliability standard

The reliability standard describes the maximum amount of energy expected to be at risk of not being supplied to consumers. Currently, the level of unserved energy (USE) should not exceed 0.002 per cent of the annual energy consumption for the associated region or regions per financial year.[16] The reliability standard was set at 0.002 per cent USE per annum by the Reliability Panel at market start in 1998. Appendix B provides an overview of the history behind the reliability standard and reliability settings.

In order to operationalise the reliability standard, AEMO calculates minimum reserve levels (MRLs) for each NEM region. It then compares forecast and actual generation reserve levels against the minimum levels required to manage against the risk that the reliability standard will not be met at the time of dispatch. In the event that forecast reserve is less than the minimum levels, AEMO has the option of responding to a shortfall through a number of intervention mechanisms (these are summarised in section 2.1.4).

2.1.2 Reliability settings

In order to balance supply and demand and encourage the generation capacity necessary to meet the reliability standard to be delivered, the wholesale spot market operates within the price confines established by the reliability settings.

The reliability settings in the NEM are:

- the market price cap, previously known as value of lost load (VoLL), which sets the maximum spot price in a region for a dispatch interval;
- the market floor price which sets the minimum spot price in a region for a dispatch interval; and
- the cumulative price threshold (CPT) which is an explicit risk management mechanism that caps the spot price at the administered price cap (APC).

16 The reliability standard is published on the AEMC Reliability Panel website: www.aemc.gov.au.

Market price cap and market floor price

The MPC is the key reliability setting. It provides the primary price signal to the market to incentivise the delivery of sufficient generation capacity and demand-side response to meet the reliability standard.[17] It also has a number of other objectives which include:

- in conjunction with the CPT, limiting the financial burden that can fall on market participants during periods of high wholesale spot prices;
- limiting the financial risk to retailers resulting from the inability to adjust prices to customers in real time and in line with movements in the wholesale spot price; and
- in conjunction with the market price floor, limiting price volatility in the wholesale spot market and, by implication, the financial contract market.

The MPC limits wholesale spot prices in each half-hourly trading interval. It is currently set at $13,100/MWh for the 2013-2014 financial year and is indexed by the consumer price index (CPI) each financial year.

The market price floor is the lowest allowable value for the wholesale spot price. It is currently set at -$1,000/MWh. Unlike the MPC and CPT, the market floor price is not indexed.

Cumulative price threshold and administered price cap

The CPT is an explicit risk management mechanism designed to limit market participants' exposure to prolonged periods of high prices in the wholesale spot market. It does this by triggering the application of the administered price cap when the sum of spot prices in a region over a rolling seven day period (that is, over 336 consecutive trading intervals) total or exceed this threshold.

The CPT is currently set at $197,100 for the 2013-2014 financial year and is indexed by the CPI each financial year.

In conjunction with the CPT, the APC is designed to reduce the financial exposure of market participants during an extreme market event. Once the level of the CPT is exceeded, wholesale spot market prices are capped at the level of the APC which is currently set at $300/MWh. The level of APC must be set low enough to mitigate the risk of a systemic financial collapse of the market, but sufficiently high not to distort

17 The first review of the market price cap in the national electricity market was carried out by the Reliability Panel in 1999. As part of that review, the Panel considered that clarification of the role of the price cap (termed value of lost load (VoLL)) in the NEM was a vital first step as it would ultimately determine how the level of VoLL was set. The Panel concluded that the primary role of VoLL was that of "price cap" which strikes a balance between allowing the market to clear with minimal intervention and containing market risk to tolerable levels. A secondary role, that of surrogate bid, would only be appropriate if it was concluded that significant ongoing intervention by the market operator to clear the market was inevitable. Appendix B provides a more detailed summary of the history behind the market price cap in the NEM.

the incentives for generators to continue to supply electricity during an extreme market event when the APC is triggered.[18]

A summary of the current reliability framework is provided in the Table 2.1.[19]

Table 2.1 Reliability framework

Parameter	Objective	Level
Reliability standard	Primary mechanism to signal the market to deliver enough capacity to meet customer demand for electricity.	USE < 0.002 per cent annual energy consumption of region
Market price cap	**Key reliability setting**. Provides incentives for supply and demand-side investment to deliver the reliability standard.	$13,100/MWh (2013-2014) Indexed by CPI each financial year
Market floor price	The lowest allowable limit for the spot price and is generally considered unrelated to investment signals.	-$1,000/MWh
Cumulative price threshold	An explicit risk management mechanism designed to limit participants' exposure to protracted levels of high prices in the spot market.	$197,100 (2013-2014) Indexed by CPI each financial year
Administered price cap	Designed to reduce the financial exposure of market participants during an extreme market event while maintaining incentives for MPs to supply electricity.	$300/MWh

2.1.3 The market price cap and system reliability

The price cap is the only market mechanism by which the AEMC can influence overall reliability of the market to achieve the target of not more than 0.002 per cent unserved energy. Achieving the reliability standard relies on there being sufficient generation reserve capacity to ensure that credible contingency events can, on the vast majority of occasions, be handled without involuntary load shedding. The level of the price cap provides the incentive for both generators and loads to participate in those relatively rare events. It follows that if the level of the price cap is not set at the appropriate

18 NER clause 3.14.1(a) requires the AEMC to develop, authorise and publish a schedule to specify an administered price cap for each region to apply to spot prices and market ancillary service prices.

19 Further information on the reliability standard and reliability settings can be found on the Reliability Standard and Settings Review 2014 Fact Sheets: www.aemc.gov.au.

value, it will not be effective in providing that incentive. In such circumstances, it is possible that there could be a reliability shortfall.

2.1.4 Intervention mechanisms

Under the NEM's reliability framework, AEMO can respond to short-term reliability shortfalls through two intervention mechanisms:

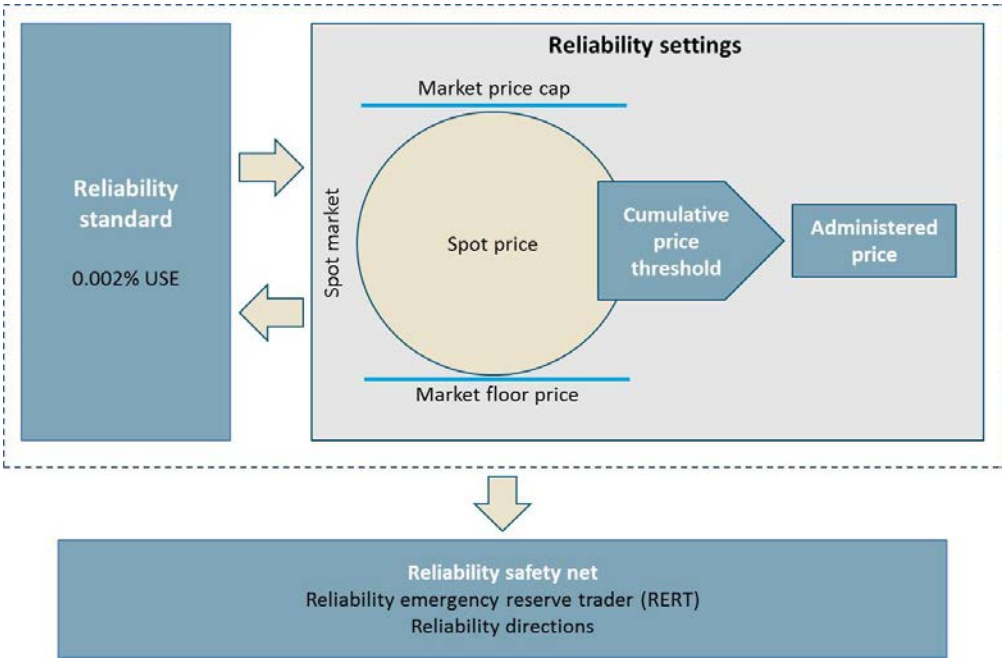
- Reliability emergency reserve trader (RERT): This mechanism provides AEMO with the ability to contract for reserves where generation capacity shortfalls are forecast. This requires AEMO to negotiate and enter into contracts with reserve providers.[20]

- Reliability directions: AEMO may also direct registered participants to take certain action to maintain or re-establish the power system to the required operating state. The reliability directions are governed by the provisions in the NER.[21]

Where there is insufficient generation capacity to meet demand, the intervention mechanisms provide AEMO with a way to better protect customers from the possibility of load shedding. However, these mechanisms do not guarantee that customers will always be supplied.

The interaction between the reliability standard, settings and intervention mechanisms is set out in the figure below.

Figure 2.1 Reliability interactions



20 The RERT provisions expire on 30 June 2016.

21 See NER Chapter 4.

2.2 Why reliability mechanisms are needed

Although there are some exceptions, in most commodity markets the price for the commodity in question is decided at any moment in time through the buyers (the demand-side) and the sellers (the supply-side) agreeing on a price at which to transact. In effect, customers signal the value they place on the supply of a particular commodity and when a shortfall in supply is forecast, a price signal is provided to the market to drive investment in new supply. In such markets, there is no need for a minimum level of supply to be determined by a central body. This is because it is possible for customers, through their consumption decisions, to clearly signal the price at which they are willing to cease supply.

For a number of reasons, the electricity market differs from other commodity markets. First, it is not cost effective to store electricity in bulk. This means that electricity must be produced by generators and delivered to customers in real time. In addition, electricity customers generally have little direct involvement in the market. In the absence of a wide-spread adoption of smart meters and time-of-use tariffs, most electricity customers currently have neither the means nor the ability to express their preferences quickly.[22] Together, these factors limit the ability of the demand-side to send accurate and effective price signals regarding the 'optimal' level of electricity supply. Further, if customers cannot reveal their willingness to avoid very high prices through their consumption decisions, the price of electricity would predominately be set by the supply-side.[23]

It is for this reason, and because the supply of electricity is considered an essential service, that energy markets tend to rely on regulatory solutions for ensuring reliability. As explained in more detail in Appendix B, such solutions have been a feature of the NEM since it commenced.

From an efficiency perspective, the level of reliability pursued through regulation must have regard to both the rising incremental costs and the diminishing value of greater reliability (Box 2.1). These costs and benefits vary, depending on the type of customer, time of interruption, geographical location, and climate. Hence, to set appropriate standards, regulators need detailed and accurate information about the cost functions of businesses and the value of reliability for customers.

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22 In November 2012, the AEMC submitted its final report for the Power of Choice review to SCER. This review, requested by SCER, explored options for better management of electricity demand by a wide range of consumers. It looked at possible changes to legislation, regulations and commercial arrangements affecting the NEM. It also investigated ways to encourage electricity businesses to better facilitate consumer choice and to invest more efficiently so electricity can be delivered in the most cost effective way. The final recommendations were a package of reforms designed to increase the responsiveness of the demand-side to evolving market, technological developments and changing consumer interests over the next 15 to 20 years. See www.aemc.gov.au.

23 Albeit, with some limited demand-side participation from larger customers who have the ability to signal their price sensitivity and curtail load without impacting other customers.

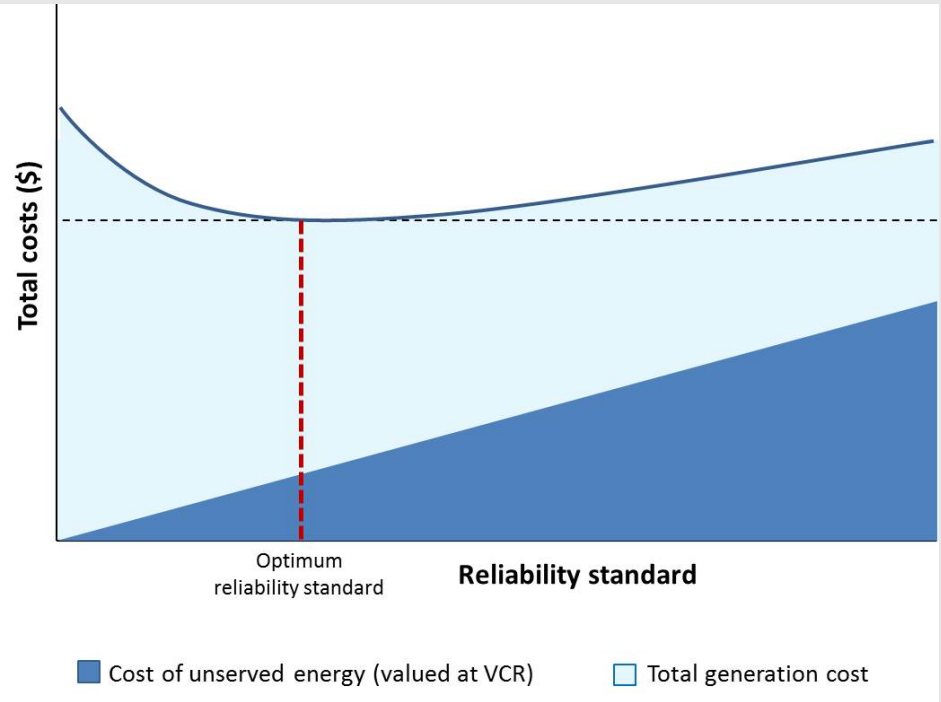
Box 2.1: Delivering reliability at minimum cost to consumers

The total cost to the market of achieving a given reliability standard is the sum of:

- the cost of generation required to meet the reliability standard, and
- the cost of unreliability, as measured by the value of customer reliability multiplied by the level of USE.

The market is optimised from a theoretical perspective when the reliability standard corresponds to the minimum combined cost of generation and USE. A conceptual representation of this relationship is provided in Figure 2.2.[24]

Figure 2.2 Assessment of the Reliability Standard



To date, the value of reliability for all NEM customers has never been evaluated. Such an evaluation necessarily involves complex issues such as variations in valuations across customers in different sectors and locations.

For this reason, the approach used in the NEM has been to measure reliability by the reliability standard. As noted above, the objective of the reliability standard is to deliver an expectation of reliability that reflects the value that consumers place on reliability. The current approach specifies that value in terms of the targeted quantum of USE and applies a derived market price cap set to deliver a level of generation capacity consistent with meeting the reliability standard. The challenge of maintaining reliability in the NEM has therefore been a question as to what level of market price

24 Source: ROAM Consulting, *Reliability Standard and Settings Review*, Draft Report to AEMC, 11 December 2013.

cap is sufficient to incentivise investment and operational behaviours necessary to deliver the expected reliability outcome.

The concept of VCR and its potential application across the supply chain has become particularly topical of late. This interest has been driven by the view that efficient outcomes can be achieved by ensuring planning and investment decisions reflect customers' preferences through estimated values of customer reliability. In light of this, and in line with SCER's terms of reference, the following chapters explore possible alternative approaches for ensuring reliability in the NEM, taking into account the value that customers place on receiving a reliable supply of electricity.

2.3 International approaches to setting wholesale electricity market price caps

To assist in the consideration of possible approaches to linking the reliability standard and reliability settings with VCR, the AEMC has had regard to approaches used in other jurisdictions to set market price caps to reflect consumer expectations of reliable electricity supply. To assist, NERA was engaged to undertake a study and produce a report.[25]

Using the NEM as a comparator, NERA was asked to consider at least seven, primarily energy-only, markets including at least two from Europe and/or Asia and at least two from North America. NERA was also asked to bear in mind the different approaches available for setting market price caps, including both supply and demand-side approaches. The markets chosen were:

- the New Zealand electricity market;
- the Texan electricity market, United States (operated by the Electric Reliability Council of Texas (ERCOT);
- the Singaporean electricity market;
- the Albertan electricity market, Canada;
- the Midcontinent electricity market, United States (operated by the Midcontinent Independent System Operator (MISO));
- the PJM interconnection, United States;
- the Great Britain electricity market; and
- the electricity market in the Netherlands.

25 NERA 2013, *Review of Alternative Approaches to setting Wholesale Electricity Market Price Caps, A Report for the AEMC*, October 2013.

NERA's final report highlighted that there are a number of different methodologies used to determine wholesale market price caps around the world. In general, the methodologies (or approaches) can be split into four broad categories:

- Markets where there is no formal market price cap (Great Britain, New Zealand (under ordinary operating conditions)).
- Markets where the market price cap is set with reference to the cost of a marginal generating unit (ERCOT, Alberta, PJM capacity market, New Zealand (lower price bound when scarcity pricing in place)).
- Markets where the market price cap is set with reference to an amount obtained through direct negotiation between market participants (PJM energy markets).
- Markets where the market price cap is set with reference to the VCR (Singapore, New Zealand (upper price bound when scarcity pricing in place)).

Although most of the price caps in the wholesale electricity markets that NERA investigated were not set with reference to a VCR, estimates of VCR were often used for other purposes. The use of VCR in international jurisdictions and the methodologies used to calculate it are discussed further in the next chapter.

Appendix C includes a table which provides an overview of the seven wholesale electricity markets included in the study. The table includes data on the level of the market price cap(s), the level of VCR, the methodology used to estimate VCR and the relevant market's similarities and differences to the NEM. NERA's full report is available on the AEMC website.[26]

26 See www.aemc.gov.au.

3 Value of customer reliability

The various options for linking the reliability standard and reliability settings with a VCR, discussed in the next chapter, rely to varying degrees on an accurate estimate of the value of customer reliability. SCER's terms of reference do not require the AEMC to comment on which VCR methodology or VCR measure should be used in the context of generation and bulk transmission reliability decisions. Nonetheless, it is important to identify some of the issues associated with developing reliable and accurate estimates of VCR, as the accuracy of any VCR measure can affect the relative attractiveness of the options considered.

3.1 Estimating the value of customer reliability

Estimating the value that customers place on reliability can be a complicated and subjective process. In part, this is because different customers place different values on the reliability of their electricity supply. These values will be influenced by the characteristics of the customer, including type of customer, nature of their activities, whether they have access to alternative energy sources, their demographics and the extent to which they have experienced interruptions in the past. The values are also influenced by the nature of the supply interruption, for example, the duration, frequency, timing and location of an interruption.

In addition, there has been no clear consensus on the best method to value customer reliability. Given that the actual costs to customers of supply interruptions cannot be directly observed, these costs must be estimated on an indirect basis. There are two main approaches to estimating customer reliability values:

- Survey-based approaches, which gather information about the expected costs to customers for hypothetical events. The different approaches include estimating direct costs, estimating costs based on the economic cost of substitution, contingent valuation surveys and choice modelling (or 'conjoint analysis').

- Modelling-based approaches, which include considerations of gross national product per kWh of electricity consumed, wage income per kWh consumed or the costs of a standby generator.

Each approach has its advantages and drawbacks, all of which have been well documented, most recently by AEMO in its Value of Customer Reliability Issues Paper and by the Productivity Commission in its Electricity Network Regulatory Frameworks Inquiry Report.[27]

An indication of the level of uncertainty around customer reliability estimation can be shown by comparing the results of two recent studies undertaken by AEMO and the

27 Productivity Commission 2013, *Electricity Network Regulatory Frameworks, Report No. 62*, Canberra, Volume 2; AEMO 2013, *Value of Customer Reliability Issues Paper*, 11 March 2013.

AEMC to estimate a single value of customer reliability for Victoria and New South Wales (NSW), respectively.

Table 3.1 Sectoral VCRs for Victoria and NSW, 2012

Victoria ($/kWh)		New South Wales ($/kWh)	
Residential	23.80	Residential	20.71
Industrial	41.24	Small business	413.12
Commercial	103.77	Medium-large business	53.30
Agricultural	130.26	-	-
Weighted average	57.88	Weighted average	94.99

Note: The Victorian VCR data is indexed from the Victorian VCR 2007 survey results. See: AEMO 2011, *2011 Victorian annual planning report: Electricity and gas transmission network planning for Victoria*, p. 15. The NSW VCR data was collected for the AEMC's review of distribution reliability outcomes and standard NSW workstream. See: AEMC 2012, *Review of Distribution Reliability Outcomes and Standards, Draft Report - NSW workstream*, AEMC, 8 June 2012, Sydney.

The VCRs for residential and large business customers are similar between the NSW and Victorian surveys. However, there is quite a large difference between the overall weighted average costs for the two jurisdictions. This is due to the significantly higher small business VCR in NSW.[28]

It is difficult to determine from the customer survey data the precise reasons for the significant difference between the small business VCR in NSW and the agricultural and commercial VCRs in Victoria. However, it is possible that the differences could be the result of methodological variations between the two survey approaches used. This highlights the importance of providing transparent details on the methodology chosen, including potential shortcomings. This is critical where VCR is used to inform investment decisions which affect reliability outcomes for consumers.

Overall, given the differences in values across individual customers, and the limitations and uncertainties associated with the various methods of obtaining cost information from customers, attempts to place a single value on reliability for use in the wholesale electricity market will require some discretion and qualitative judgement.

International approaches to estimating the value of customer reliability

As noted in section 2.3, the AEMC engaged NERA to provide advice on international approaches to setting market price caps to reflect consumer expectations of reliable electricity supply. Most of the electricity markets investigated do not set their price

28 The small business category in NSW is most similar to the agricultural and commercial customer types used in the Victorian survey

caps with reference to a value of customer reliability. However, estimates of VCR are often used for other purposes. For example, in New Zealand, a scarcity pricing mechanism imposes a market price band with the lower bound reflecting the cost of marginal generating unit and the upper band an estimate of VCR. Ofgem in Great Britain also recently estimated VCR to inform decisions about the procurement of capacity in light of the proposed energy market reforms. More generally, VCR estimates tend to be used in the context of transmission investment planning and decision making.

NERA observed that the methods used to estimate VCR internationally typically involved:

- stated preference or contingent value surveying (used mostly for residential or small domestic consumers); and/or
- using estimates of industry gross value add and electricity consumption to input the value of electricity to large industry and/or commercial consumers.

NERA also observed that the common theme running through the international VCR studies was the challenges associated with obtaining reliable VCR estimates. The key issue related to the variability of values by (for example) individual consumers and time of day. A number of the more recent studies attempted to address this issue by using a number of different methodologies as a cross-check on the results. For example, using both stated preference and contingent value surveys, and estimating both the willingness to pay and willingness to accept to avoid an outage or not consume.

NERA concluded that, ultimately, whether it is appropriate to use VCR to set the market price cap or not is likely to be a matter of judgement, having regard to the particular circumstances at hand.

3.2 Using VCR to set the reliability standard and reliability settings

Once a method for collecting VCR information from customers is determined, there are number of considerations on how to use the information to derive a single VCR estimate for use in setting the reliability standard and reliability settings.

Overall, the objective is to establish an administratively determined VCR which best reflects the diverse preferences of the customers impacted by certain investment decisions. In the context of generation reliability, the customers most affected by investment in supply and/or demand-side capabilities will be those likely to have their load shed first in the event of a supply shortage.[29]

29 In the event that demand in a region exceeds supply and all other means to satisfy demand (including interrupting large users on interruptible contracts) have been implemented, AEMO can instruct NSPs to shed some customer load. This action is only taken when there is an urgent need to protect the power system by reducing demand and returning the system to balance. Load

In the NEM, load shedding is shared between NEM regions in proportion to the demand in each region (up to the limit of the interconnector flows). At the jurisdictional level, each Jurisdictional System Security Coordinator is responsible for prioritising customers who will be shed in the event of a direction from AEMO to network service providers (NSPs) for the disconnection of customer load. Currently, it is assumed that residential consumers, as a sector, place the lowest value on supply reliability. It is for this reason that residential consumers tend to have their supply interrupted first.

It follows that any administratively determined VCR used in the reliability standard and reliability settings process should be set to broadly reflect the preferences of the residential customer sector.

In practice, the administratively determined VCR will represent an average of the VCR estimates collected from the residential customer sector. As a result, there will always be some residential customers who value reliability at a level higher or lower than the administrative VCR. These customers may not, therefore, receive the exact level of reliability that they are willing to pay for.

However, at a broader level, shedding the load of residential customers in the first instance will allow demand and supply to continue to be matched during a supply shortfall. Importantly, this will allow customer sectors who value reliability more than the average residential customer (such as industrial and commercial customers) to continue to receive a reliable supply of electricity, even in the event of a generation shortage.

3.3 National approach to estimating VCRs

As noted in Chapter 1, the final report for the AEMC's review of the national framework for distribution reliability recommended to SCER that the AER develop a common, national methodology for estimating VCRs for use across the NEM.[30] The AEMC also recommended that the AER use that methodology to calculate VCRs for each NEM jurisdiction. The key recommendations from that review are set out in Box 3.1.

At the SCER meeting held on 13 December 2013, Ministers agreed to two interim measures proposed by the AEMC in the final report for the review of the national framework for distribution reliability. Specifically, SCER requested the AEMC develop common definitions for distribution reliability measures and agreed to the AER assuming responsibility for establishing values of customer reliability for use in the setting of reliability requirements for the next round of regulatory determinations commencing in mid-2019.[31]

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shedding involves a temporary suspension of supply to customers in a specific part or region of the NEM.

30 This recommendation was endorsed in the AEMC's subsequent final report for the review of the national framework for transmission reliability.

31 See Standing Council on Energy and Resources, *Meeting Communiqué*, Sydney, 13 December 2013.

These recommendations are relevant in the context of this advice because, as noted in Chapter 1, the successful implementation of an approach which sets the reliability standard and reliability settings with reference to a VCR will depend, in part, on accurate and up-to-date information on customer values of reliability being available.

The implications of using an administratively determined VCR in the reliability standard and settings process are considered further in the AEMC's assessment of options in Chapters 4 and 5.

Box 3.1: National approach to estimating VCRs

On 27 September 2013, the AEMC published its final report for the review of the national framework for distribution reliability. The final report set out a recommended framework for distribution reliability in the NEM and included the next steps for its implementation. As part of the framework, the AEMC recommended the use of an independent and transparent economic assessment process to set reliability targets for distribution networks. This process includes evaluating the expected costs of distribution network investments against the value that customers place on reliability.

Given that full implementation of the proposed framework could take a number of years, the AEMC set out an interim stage designed to improve the existing arrangements for setting, delivering and developing the distribution reliability parameters. This interim stage includes a proposal for the development of values of customer reliability for each NEM jurisdiction.

Specifically, the AEMC has proposed that the AER:

- develop, publicly consult on, and publish a national methodology for estimating the VCR on a consistent basis across the NEM, including the development of a timetable for updating jurisdictional VCRs at least every five years; and
- estimate VCRs for each NEM jurisdiction using the national methodology that has been developed.

The VCR methodology and VCR estimates must take into account an appropriate range of customer types and geographic and demographic differences within each NEM jurisdiction. It must also ensure that VCRs can be used in the economic regulation of NSPs, network investment planning and the setting of reliability standard and settings in the NEM for transmission and distribution networks, and generation.

In performing these tasks, the AEMC considers it is appropriate for the AER to take into account the work undertaken by AEMO to establish a national approach to estimating the VCR, including stakeholder submissions that have been provided during AEMO's review.

It is intended that the length of time between updates to estimate the VCR for each jurisdiction be at the discretion of the AER, but should be no less frequent than every five years. In between updates, the AER must escalate the VCR for each jurisdiction by the consumer price index on an annual basis. The AER must publish escalations of the VCR for each jurisdiction by 31 December each year.

4 Options and analysis

The purpose of this chapter is to identify and analyse possible approaches to linking the reliability standard and reliability settings with VCR. First, it provides a brief recap of the assessment framework set out in Appendix A. It then provides a brief overview of stakeholder submissions before setting out four options for incorporating VCR into the NEM's reliability framework. This includes an analysis of the options drawing on the assessment framework.

4.1 Overview of assessment framework

As set out in Appendix A, the AEMC has developed an assessment framework to evaluate the possible options for explicitly linking the reliability standard and reliability settings with VCR. This is to ensure that any recommended approach is consistent with promoting the NEO.

In evaluating the options, the AEMC has considered the benefits, limits and suitability of each approach in meeting the NEO. The AEMC has also analysed the potential impacts of linking (specifically) the market price cap with VCR, in terms of:

- consumers, including for price and reliability; and
- generators, retailers and other relevant market participants, including in terms of investment signals.

The discussion below also considers the extent to which linking the market price cap to a VCR could duplicate the signals provided by the reliability standard and other existing market settings.

Table 4.1 briefly summarises the benefits and limitations of each option.

Table 4.1 Summary of options analysis

Assessment criteria	Option 1 - direct application of VCR as market price cap	Option 2 - use VCR as cross-check on reliability standard and settings	Option 3 - direct application of VCR as market price cap in "periods of scarcity"	Option 4 - different levels of VCR offered into dispatch
Benefits	Simple and easily understood method. Would deliver a level of reliability as measured by an administratively determined VCR.	Would allow the level of reliability to broadly reflect the value that customers place on reliable electricity supply. The reliability standard would be set to reflect the lowest total cost to consumers. Manages the risks associated with the approximate nature of administratively determined VCRs.	Load shedding would occur at the price at which customers (on average) would be willing to have their supply interrupted. The level of reliability would reflect the administratively determined VCR.	Links the level of reliability received by different customers (or groups of customers) to the value they place on reliable electricity supply. Theoretically delivers the most efficient signals for investment in generation and demand-side response capabilities.
Limitations	Unlikely to be efficient for VCR and MPC to be equal. Dependent on accuracy and robustness of the administratively determined VCR. Changes in customer expectations of reliable electricity supply will have implications for level of the market price cap.	Discretion for Reliability Panel could create some investor uncertainty if it is not limited.	Creates a number of perverse incentives to invoke or avoid a period of scarcity, which may impact the efficiency of investment in generation and demand-side response capabilities.	Constrained by limits of current metering and electricity network management technology. Therefore, dependent on accuracy and robustness of the administratively determined VCRs for different customers and ability to interrupt supplies on a granular basis.

Assessment criteria	Option 1 - direct application of VCR as market price cap	Option 2 - use VCR as cross-check on reliability standard and settings	Option 3 - direct application of VCR as market price cap in "periods of scarcity"	Option 4 - different levels of VCR offered into dispatch
Suitability in meeting the NEO	Has potential to create strong signals for investment. In practice, unlikely to be workable (as success relies heavily on accuracy of administratively determined VCR).	Creates strong signals for efficient investment. In practice, workable (as it provides the best approach to manage risks associated with administratively determined VCR).	In theory, may create strong signals for efficient investment. In practice, a high risk approach which would be a significant change without clear justification.	In theory, best approach for achieving efficient investment. In practice, not currently workable (due to technology constraints).

4.2 Overview of submissions

As noted in section 1.5, eight stakeholders provided submissions to the consultation paper.[32] The majority of stakeholders did not support a change to the NEM's current reliability framework to include explicit consideration of the value of customer reliability.

Origin, GDF Suez, AGL and the MEU did not consider that sufficient evidence had been presented to demonstrate a deficiency with the current framework. Among other things, these stakeholders noted the following:

- GDF Suez requested that the AEMC more clearly spell out the nature of the problem that the proposed changes were seeking to resolve as this would allow the industry to better assess the options against the NEO.[33]
- AGL considered that linking the reliability settings with VCR would be unlikely to have the desired effect given the current oversupply in generation capacity coupled with the decline in peak demand. It also noted the major shortcoming with the options were the difficulties in obtaining an accurate estimate of VCR.[34]
- Origin also considered that reasonable limitations should be applied on the application of VCR to the market settings given that the methods for determining VCR were not sufficiently reliable to ensure accurate estimates.[35]
- The MEU considered the current approach more than meets the needs of consumers and the requirements of the NEO.[36]

The MEU did not support any of the four options put forward by the AEMC in the consultation paper. However, Origin, GDF Suez and AGL expressed in principle support for option 2 on the basis that it retains an indirect link between the reliability settings and VCR.

The NGF also opposed the options to incorporate VCR into the NEM's reliability framework.[37] It considered that the AEMC and the Reliability Panel should investigate why the theoretical application of the current reliability standard and settings in the

32 Submissions were received from AEMO, AGL , Alinta, Origin, GDF Suez, NGF, MEU and SACOSS.

33 GDF Suez, consultation paper submission, p. 1.

34 AGL, consultation paper submission, p. 1.

35 Origin Energy, consultation paper submission, pp. 1-2.

36 Major Energy Users, consultation paper submission, p. 35.

37 National Generators Forum, consultation paper submission, p. 4.

NEM does not match what happens in practice before considering changing the reliability settings to match VCR.[38]

In its submission, which was accompanied by a short report from St Kitts Associates, SACOSS considered that the most appropriate way to link VCR in the wholesale energy market would be to implement an effective demand response mechanism as recommended by the AEMC in its Power of Choice review.[39]

In contrast to these views, Alinta Energy welcomed further investigation of options 1 and 2 as approaches which could positively contribute to the MPC and VCR and promote efficient market responses.[40]

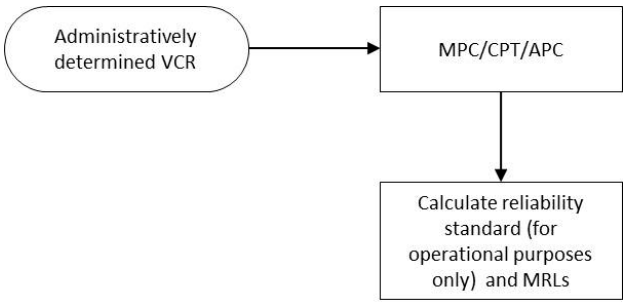
Stakeholder views in relation to each of the four options are summarised further in the relevant sections below.

4.3 Option 1 – direct application of VCR as market price cap

4.3.1 Description of option 1

Option 1 is based on one of two options put forward by the AEMC in the extreme weather review in 2010.

Figure 4.1 Summary of option 1



The MPC would be set equal to the administratively determined VCR as a starting point, but may be adjusted to take account of other factors such as market risk or investor certainty. For example, the MPC could be adjusted if the Reliability Panel considered that the administrative VCR was too low to provide sufficient investment signals to deliver a level of reliability consistent with customer expectations or, alternatively, so high that it could lead to inefficient overinvestment. The burden of proof would be on the Reliability Panel to demonstrate that the MPC should not be set equal to the VCR. The MPC would continue to include annual indexing (for example, to CPI).

38 The NGF questioned why it was that the NEM appeared to be providing adequate levels of generation reliability despite the Reliability Panel's 2010 review of the reliability standard and settings indicating that the market price cap was not high enough to meet the reliability standard.

39 South Australian Council of Social Services, consultation paper submission, p. 1.

40 Alinta Energy, consultation paper submission, p. 6.

Under this approach, the administratively determined VCR would be a key reliability parameter and would replace the need for an explicit reliability standard. However, comparisons of actual reliability performance against a benchmark level of reliability could inform reviews of the MPC and aid in determining of the validity of the VCR estimate.

Parameters	Option 1
Reliability standard	Not required
Market price cap	MPC set to equal VCR
Other reliability settings	Other risk management measures, such as CPT, likely to be required
VCR	Single administratively determined VCR

4.3.2 Discussion of option 1

Potential impact on consumers

Option 1 would deliver a level of reliability that reflects an administratively determined VCR.

However, as discussed in Chapter 3, determining an appropriate VCR estimate for use in setting the level of reliability in the generation sector is likely to require some judgement and, as such, should only be viewed as an aggregate approximation. Reliance on it as a measure of customers' valuation of reliable supply is likely to lead to customers either not receiving the level of reliability they are willing to pay for, or paying more than they were willing to for reliability.

In addition, the characteristics of the electricity market described in section 2.2, such as the inability for consumers to respond quickly to prices, mean it is unlikely to be efficient for MPC to equal VCR. The Reliability Panel's current review of the reliability standard and settings has shown that the VCR-MPC link is not straightforward in practice. While the measures are related, they do not necessarily equate. In order to minimise costs to consumers, the reliability standard should be set at the level which minimises the sum of the cost of generation required to meet the reliability standard and the cost of unreliability (that is, the value of customer reliability multiplied by the level of USE). This relationship was shown in Figure 2.2.

Allowing flexibility for the market price cap to be adjusted to take account of risks and costs may, to some extent, mitigate the issues associated with estimating the VCR. It may allow the Reliability Panel to take account of the cost of USE under a given reliability standard, or to consider a broader range of VCR estimates for different customers or other factors that customers value. However, such adjustments would diminish the simplicity of this approach and are more suited to option 2.

Potential impacts on relevant market participants

Investment in new electricity infrastructure (and in maintaining existing infrastructure) should take place wherever a shortfall is expected in the capacity to meet customers' demand for electricity. This method would provide signals for efficient investment in electricity if the level of the administratively determined VCR is an accurate reflection of customers' valuation of reliability.

The key advantage of this approach is its simplicity. That said, providing flexibility for the Reliability Panel to adjust the MPC in response to broader market risks and costs may diminish that simplicity. This could be mitigated by clearly specifying the types of factors that could be considered, as well as the extent to which each may affect the level of the MPC. Such specification could be included in the NER.

A potential drawback of this approach is that the MPC is likely to change whenever a new VCR survey is conducted. This could result in undesirable volatility that could affect the value of investments and the risk of investing. To mitigate this, the timing for these surveys could be determined several years in advance (for example, by setting out a period for recurring reviews) so that investors can factor the risk of change into their investment decisions.

Potential duplication of signals

Creating a direct link between the MPC and VCR may remove the need for an explicit reliability standard. This is because the level of reliability that customers desire would be expressed through the VCR. Nevertheless, the level of USE could be estimated by modelling the wholesale market with the MPC set to the administratively determined VCR. In view of the difficulties associated with determining an appropriate VCR estimate, a comparison of actual reliability performance against a generally accepted level of reliability could aid in determining the validity of the VCR estimate. Such a comparison could also inform AEMC reviews of the MPC.

This approach would be likely to require other risk management mechanisms to be in place, such as the CPT. That is, it would be futile to set an economically efficient price during intervention if the consequent levels of risk were too great to attract investment in the market.

4.3.3 Stakeholder views on option 1

The majority of stakeholders did not support option 1.

Origin, AGL and the MEU considered that option 1 placed too much reliance on VCR. Origin referenced a report by Oakley Greenwood outlining the findings of a number of past VCR surveys, all of which indicated a VCR at multiples above the current MPC.[41] As a result, it considered that setting the MPC to a determined VCR could significantly

41 Origin Energy, consultation paper submission, p. 2.

increase the risk profile for operating in the NEM and also increase the cost of hedging. This could lead to higher prices for consumers.

A similar view was held by the MEU who considered that using a VCR estimate that was unreliable, inconsistent over time and significantly higher than the current MPC could substantially increase market risk with no clear benefit in terms of improved reliability of supply.[42] AGL also considered that option 1 would create uncertainty and volatility in the physical and contract markets in the instance the MPC was allowed to be adjusted to correct for errors in the VCR estimate.[43]

In contrast, Alinta supported further investigation of option 1.[44] It considered that closer alignment of the VCR and MPC was needed to ensure sufficient incentives existed for marginal generation to be built, while satisfying expectations of reliability standards at least cost. However, it also supported investigation of an implementation strategy to avoid market and stranded asset risk.

While not supportive of any change being made to the current reliability framework, the NGF noted that options 1 and 2 were largely interchangeable.[45] In the instance that either option was considered further, it advocated an indexation down of the market price floor in proportion to any resulting increase in the MPC.

AEMO identified a number of issues with option 1, including the exclusion of a reliability standard which it and other stakeholders relied on for current processes and benchmarks.[46]

4.4 Option 2 – use VCR as a cross-check on the reliability standard and reliability settings

4.4.1 Description of option 2

Option 2, like option 1, is based on an option put forward by the AEMC in the extreme weather review in 2010.

The diagram below sets out the link between VCR and MPC under option 2, which is described in more detail below.

42 Major Energy Users, consultation paper submission, p. 36.

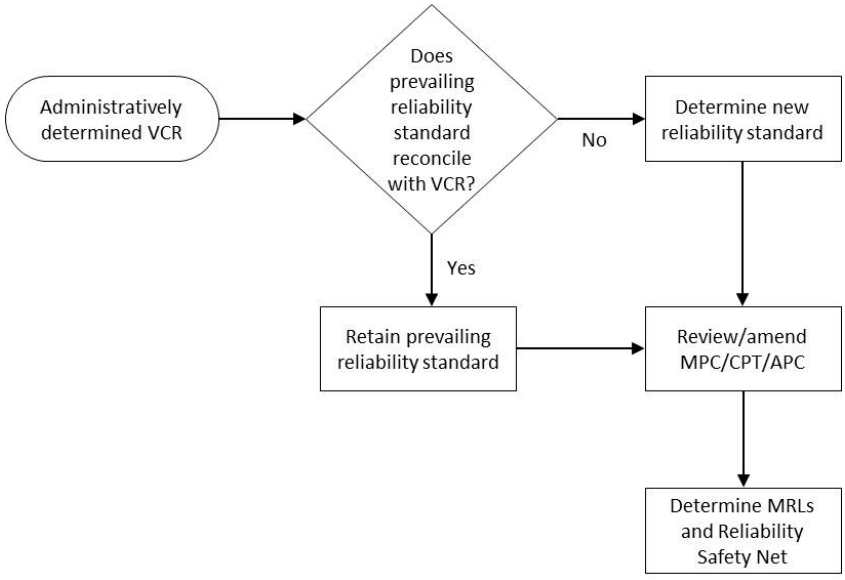
43 AGL Energy, consultation paper submission, p. 1.

44 Alinta Energy, consultation paper submission, p. 4.

45 National Generators Forum, consultation paper submission, p. 4.

46 AEMO explained that without a reliability standard to assess forecast reliability against, it would have no basis for triggering reliability emergency reserve trader (RERT) and reliability directions. It also noted that performance against the reliability standard was an important benchmark by which stakeholders judged the effectiveness of the market in efficiently delivering investment to meet the demand. AEMO, consultation paper submission, p. 4.

Figure 4.2 Summary of option 2



The first step in the process would involve the Reliability Panel reviewing the reliability standard by calculating the VCR implied by the prevailing standard. It would do this by determining the minimum combined costs of generation and USE to meet the reliability standard.[47] In the event the administratively determined VCR was found to diverge materially from the VCR determined by the reliability standard, the cause of the mismatch would be investigated. The divergence may be due to the reliability standard no longer reflecting the value that customers place on reliability. Alternatively, it may be the result of inaccuracies related to the administratively determined VCR. Where the divergence is due to the reliability standard no longer reflecting customer expectations of reliability, a new reliability standard would be determined by detailed analysis.

Following the review of the reliability standard, the relevant body would then review the reliability settings, starting with the MPC. Under option 2, the level of the market price cap would be determined by supply-side modelling (similar to the current methodology for setting the MPC). The aim would be to set the market price cap at a level sufficient to deliver the investment in new generation needed to meet the reliability standard at minimum cost to consumers.

AEMO would give effect to the reliability standard for operational purposes through the development of MRLs.

47 An example of how this could be done is described in ROAM Consulting, *Reliability Standard and Settings Review*, Draft report to the AEMC, December 2013, p.11. In this example, ROAM considered a number of alternative levels of reliability in the NEM and then assessed the total cost of generation, including the annualised capital costs of new entrant generation, in each of the simulations. The cost of USE was valued at an assumed VCR. The total cost to the market was then calculated as the sum of the cost of generation and reliability and analysed as a function of the level of USE in the market. The market is optimised from a theoretical perspective when the reliability standard corresponds to the minimum cost.

This approach is consistent with the Commission's recommended frameworks for transmission and distribution reliability.[48]

Parameters	Option 2
Reliability standard	Required
Market price cap	Set according to the costs of generation to meet reliability standard
Other reliability settings	Other risk management measures, such as CPT, required
VCR	Single administratively determined VCR used to inform reliability standard

4.4.2 Discussion of option 2

Potential impact on consumers

Under this approach the market price cap may not precisely reflect the administratively determined VCR. However, the cross-check of the reliability standard against the administratively determined VCR would allow the level of reliability to broadly reflect the value that customers place on reliable electricity supply.

While the MPC and VCR are related, it is not necessarily efficient for them to equate. In order to minimise costs to consumers, the reliability standard should be set at the level which minimises the sum of generation costs and the costs of USE. Using the VCR as a cross-check only, rather than directly linking it to the MPC, allows the Reliability Panel to analytically link the two values in a way that minimises costs. Furthermore, given the approximate nature of the administratively determined VCR, other issues such as the likelihood of measurement error and the range of VCRs associated with different customers could also be taken into account.

Potential impacts on relevant market participants

This approach promotes efficient investment signals by considering both supply-side costs and demand-side willingness to pay in determining the MPC. If the reliability standard was found to be inconsistent with the administratively determined VCR, the Reliability Panel could review the reasons and amend the reliability standard. Alternatively, it could amend the MPC if it considered that it would lead to a more appropriate and efficient level of investment.

The methodology for initially determining the MPC – that is, based on the costs of the generation required to meet the reliability standard – is known and understood as it set out in the NER and has been used for a number of years. However, the ability for the

48 AEMC, *Review of the national framework for transmission reliability*, Final report, 1 November 2013, and AEMC, *Review of the national framework for distribution reliability*, Final report, 27 September 2013.

Reliability Panel to cross-check the reliability standard against the VCR could create an area of uncertainty for generators and retailers, in comparison with option 1 for example. Under option 1, it is clear that the MPC will always equal the prevailing level of VCR. However, under this option the Reliability Panel has a degree of discretion to amend the MPC, taking into account a range of factors.

The uncertainty created by this discretion could be minimised by clearly setting out (for example, in the NER) the factors that the Reliability Panel can take into account when reviewing the MPC, and the criteria required to be satisfied before making any changes. In effect, the Reliability Panel's discretion could be limited. Under these circumstances, limited discretion may reduce the uncertainty of market participants.

Any changes which are deemed appropriate could be phased in over time to reduce disruption to the market.

Potential duplication of signals

Option 2 provides a link between the MPC, the VCR and the reliability standard. The market price cap (and other reliability settings) would continue to be set using supply-side modelling (based on the cost of meeting the reliability standard). The reliability standard and reliability settings would therefore remain complementary.

While a high market price cap would be unlikely to lead to systematic overinvestment, it would introduce the possibility that a one-off episode of extremely high prices could threaten the integrity of the market. Other mechanisms (such as the current CPT) would need to be in place to limit the risk of a sustained period of prices threatening the financial viability of market participants.

4.4.3 Stakeholder views on option 2

Overall, stakeholders were broadly supportive of option 2.

Alinta considered that by allowing reliability to reflect the value placed on it through the VCR, the cross-check approach under option 2 would achieve an appropriate balance between reliability, least cost solutions and encouraging price incentives for investment.[49]

Origin offered in-principle support for option 2 on the basis that it would allow MPC to be set based around the cost of generation to achieve the reliability standard.[50] It considered that application of VCR should not be a determining factor in calculating the market settings but could be used to assess whether the reliability standard and settings are broadly appropriate and reflect a value consumers place on the reliability of supply. Origin also observed that option 2 was consistent with the approach taken

49 Alinta Energy, consultation paper submission, p. 4.

50 Origin Energy, consultation paper submission, p. 3.

by the AEMC to develop a nationally consistent framework for network reliability, supported by the AEMO VCR review.[51]

AEMO observed that option 2 directly retains a reliability standard which would allow it to retain current processes aimed at maintaining reliability, both in terms of issuing warnings and through intervention (RERT).[52]

AGL was supportive of the MPC being based on the reliability standard.[53] However, it noted this option would also create uncertainty in the market if the instance the MPC subsequently needed to be adjusted to reflect the VCR.

The MEU questioned the value of using VCR as a cross-check on MPC, given the unreliable and inconsistent nature of the VCR estimate.[54] It also expressed concern around the subjective assessment required to adjust the MPC in the instance there was a significant divergence between VCR and the MPC.

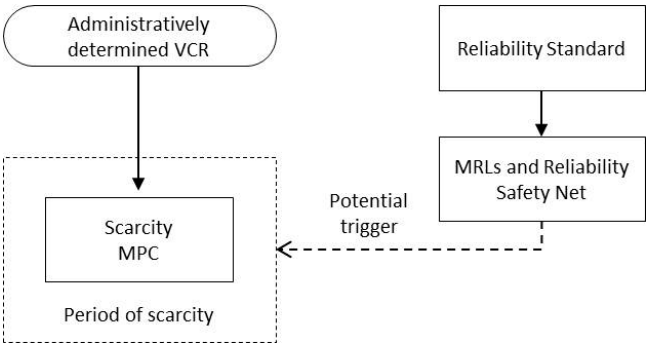
4.5 Option 3 – direct application of VCR as market price cap in "periods of scarcity"

4.5.1 Description of option 3

Option 3 is one of two options developed by the AEMC for this advice after considering arrangements in a number of overseas markets.

The diagram below sets out the link between VCR and MPC under option 3.

Figure 4.3 Summary of option 3



A pre-defined volume or type of load shedding in the electricity market would trigger a "period of scarcity". In this scarcity pricing period, a market price cap based on an

51 The national framework for transmission reliability could optimise transmission planning and investment to reflect the value that consumers place on the reliability of supply or for jurisdictions to apply a planning "safety net" to achieve the reliability standard when it may not be necessarily economic to do so.

52 AEMO, consultation paper submission, p. 4.

53 AGL, consultation paper submission, p. 1.

54 Major Energy Users, consultation paper submission, pp. 36-37.

administratively determined VCR would apply. The VCR would apply directly, as under option 1, but only in this period of scarcity. At all other times, there would be no market price cap.

Under this option, the trigger point for a period of scarcity needs to be determined. For example, a pre-defined level of load shedding could trigger application of the scarcity pricing period. Alternatively, the trigger could be a loss of supply to a particular category of customer (for example, residential customers).

This approach has similarities with the arrangements in New Zealand, where a market price "band" applies when "scarcity pricing" is triggered.[55]

The development of a reliability standard would still be required under option 3. This would be made operational by AEMO through the development and implementation of MRLs.

Parameters	Option 3
Reliability standard	Required (potential 'scarcity period' trigger).
Market price cap	There would be no MPC under normal conditions. An MPC would be in place only during a scarcity pricing period.
Other reliability settings	Other risk management measures, such as CPT, likely to be required
VCR	Single administratively determined VCR

4.5.2 Discussion of option 3

Potential impact on consumers

Option 3 would deliver a level of reliability that reflects an administratively determined VCR because when the demand-side is required to balance supply and demand, load shedding would occur at that price.. However, as is the case with option 1, the ability of this approach to achieve efficient outcomes will depend in part on the accuracy of the administratively determined VCR.

As discussed under option 1, while the VCR and MPC are related, it is not necessarily efficient for them to equate. In order to minimise costs to consumers, the reliability standard should be set at the level which minimises the sum of generation costs and the costs of USE.

55 For a summary of New Zealand's scarcity pricing mechanism, see NERA 2013, *Review of Alternative Approaches to setting Wholesale Electricity Market Price Caps, A Report for the AEMC*, October 2013, Chapter 3.

As there would be no market price cap in place outside the predefined period of scarcity, it is possible that customers could still pay a higher price for their electricity supply than the value they place on it.

Potential impacts on relevant market participants

Option 3 provides a strong signal for efficient investment in electricity generation. In addition to the current incentive to invest to meet demand (provided by an expectation of receiving the market price), there would also be an incentive on generators to avoid entering a scarcity pricing period in order to avoid the price they are paid for their output being capped.

As the market price cap under this approach would only apply on certain (and probably rare) occasions, any changes to the level of the MPC in response to changes in customers' valuations of reliability may create less disruption to the market relative to methods where the MPC applies at all times.

However, the additional incentive on generators to invest in order to avoid entering a scarcity pricing period may lead to over-investment in generation, relative to customers' willingness to pay for a reliable electricity supply.

Another possible drawback of this approach is that, in some circumstances, there could be perverse incentives on portfolio generators to withdraw generation capacity in order to trigger a scarcity pricing period and invoke the market price cap. For example, if one power station in the generator's portfolio experienced a fault so that it was unable to deliver against a contract, the generator may benefit from withdrawing supply from other power stations in its portfolio in order to invoke the MPC and minimise its losses on that contract. Alternatively, customers and retailers could have a perverse incentive to increase demand in order to invoke the MPC whenever the market price rises above the cap, in order to limit the price they have to pay for each unit of electricity.

Potential duplication of signals

Intervention by the market operator may be needed at times to maintain the reliability standard. The reliability standard could take on greater importance under this approach, particularly in the instance that intervention (that is, load shedding) to maintain the reliability standard acts as the trigger for a period of scarcity.

While the scarcity pricing mechanism would effectively cap the market price in the most extreme circumstances, there would remain a risk of high prices occurring outside periods of scarcity. This could occur, for example, when a large volume of high-priced generating plant supplies the market to avoid load interruptions. Other risk management mechanisms (such as the current CPT) may therefore be needed to cap the risk to market participants of prolonged periods of high prices.

4.5.3 Stakeholder views on option 3

In general, stakeholders did not support further consideration of option 3.

While Alinta Energy considered this option would assist in valuing reliability against the theoretical expectation of the price at which customers would agree to have their supply interrupted, it considered there were several deficiencies with this approach that would unlikely be resolved in the short term.[56] Alinta also noted that applying the VCR as the MPC during periods of scarcity, and at other times applying no MPC, would be "unlikely to realistically gain traction with market participants". Overall, it did not support further investigation of this option.

Origin noted that price volatility in the NEM was not limited to periods of extreme demand created by a lack of generation capacity or periods of scarcity.[57] The removal of a MPC during periods that would not classify as a period of scarcity could create significant risk and uncertainty for market participants, inconsistent with the NEO.

AEMO noted that by allowing higher prices in non-scarcity periods, this option would appear to increase financial risk on market participants without delivering a more optimal level of reliability.[58] This is because, in non-scarcity periods, it is possible that the market could clear at prices above those that customers were willing to pay. AEMO also agreed with the AEMC's recognition of potential perverse incentives, including the risk of market participants artificially inducing scarcity. Without clear articulation of its benefits, AEMO did not support this approach.

The MEU considered the MPC under this approach would be unlikely to be applied frequently given the high levels of supply relative to demand in the NEM.[59] However, it recognised that this approach had a number of shortfalls, including providing opportunities for gaming and potentially leaving retailers and their consumers exposed to the risk of uncapped price events occurring in the absence of genuine supply shortfalls (for example, through generator strategic bidding behaviour).

AGL did not support option 3 on the basis that it could create volatility in the market.[60] If an MPC only applies in defined periods of scarcity, there is a risk of extreme prices occurring outside the defined periods which will not be capped, which could expose participants to an unacceptable level of risk.

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56 These included how a period of scarcity would be defined, the implications of removing a price cap completely and the existence of perverse incentives. Alinta Energy, consultation paper submission, p. 5.

57 Origin Energy, consultation paper submission, p. 3.

58 AEMO, consultation paper submission, p. 5.

59 Major Energy Users, consultation paper submission, p. 37.

60 AGL, consultation paper submission, p. 1.

The NGF held concerns over option 3, noting that it would allow for the NEM to clear at a price above the VCR, leading to situations where consumers may be paying more for electricity than the average utility they receive from consuming it.[61]

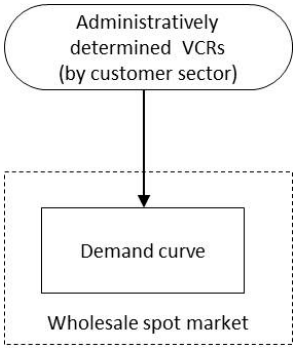
4.6 Option 4 – different levels of VCR offered into dispatch

4.6.1 Description of option 4

Option 4, like option 3, was developed by the AEMC for this advice after considering the arrangements operating in a number of overseas markets.

The diagram below sets out the link between VCR and MPC under option 4.

Figure 4.4 Summary of option 4



Rather than setting an absolute market price cap for the electricity market, this approach would involve a range of values for MPC, each representing the VCR of a given set of customers, being offered into the wholesale market in competition with generator offers.

Where customers (or groups of customers) have sufficiently sophisticated electricity management functions, they could offer their "demand response" directly into the wholesale market pool. For example, a large customer may offer to reduce consumption in a given period, in return for a price it chooses (likely to be its individual VCR). All other customers would have an administratively determined VCR assigned to them. A volume representing this group of customers' load in each period would be offered into the market at this level of VCR.

Demand response offers would be treated in the same way as generator offers in the wholesale market dispatch process. For example, where the VCRs of a group of customers were lower than the prices offered into the pool by higher priced generators, interruption of those customers' load could occur prior to those generators being dispatched. If the market price is equal to or above a customer's offered price (whether that is the administratively determined VCR or self-determined offer price), the

61 National Generators Forum, consultation paper submission, p. 4.

customer would have its load interrupted (or would self-interrupt), and would receive the market price for each unit of electricity curtailed.[62]

Potentially, different VCRs for different times of the day, week or year could be used, if VCR data allowed.

Parameters	Option 4
Reliability standard	Not required
Market price cap	No MPC
Other reliability settings	Other risk management measures unlikely to be required if all customers' VCR represented
VCR	Multiple administratively determined VCRs

4.6.2 Discussion of option 4

Potential impact on consumers

To the extent that the administratively determined VCRs are accurate, and where technology allows, this approach directly links the level of reliability received by different customers (or groups of customers) to the value they place on reliability.

In practice, however, current metering and electricity network management technology would limit the way in which customer groups could be identified and managed for the purposes of load interruption. For example, it is likely that residential customers would need to be grouped by the part of the distribution network to which they are connected (for example, by zone substation). This is because interruption at a more granular level is currently not feasible, given existing technology and network configuration. To the extent that this type of grouping occurs, the likelihood that any one customer receives the level of reliability they are willing to pay for is reduced.

It may be possible for larger customers to participate in the wholesale market in the way this option describes. The AEMC proposed a demand response mechanism (DRM) as part of its 2012 Power of Choice review which would enable such participation. This mechanism could operate alongside a market-wide MPC, under any of options 1 to 3 above.

That said, at its meeting on 13 December 2013, SCER considered the DRM and the recent work undertaken by AEMO to develop a rule change proposal to implement such a mechanism. Ministers also noted the change in market circumstances since the completion of the Power of Choice review. While continuing to recognise the value of demand side reform, ministers agreed to request AEMO to defer lodgement of the rule

62 The AEMC proposed a demand response mechanism as part of its 2012 Power of Choice review. We are currently awaiting a rule change request from AEMO to implement such a mechanism.

change proposal and requested officials to undertake further work on DRM, including a cost benefit study, and report back to ministers at their first meeting in 2014.[63]

Potential impacts relevant market participants

This approach theoretically represents the most economically efficient method of determining prices in the wholesale market, and therefore delivers the strongest signals for efficient investment in generation and demand-side capabilities. However, as noted above, technical and administrative difficulties mean that efficient outcomes may not be achievable in practice.

In addition, option 4 presents difficulties in choosing the volume of load interruption which would be offered into the wholesale electricity pool for each group of customer. As consumption in a given period cannot be accurately forecast in advance, the volume offered would need to be based on observations of the relevant customer group's consumption in similar periods. The volume offered would need to be a conservative estimate, to be sure that the full volume offered is available to be interrupted. As a result it is likely that only a proportion of the group's consumption would be interrupted. Some electricity would therefore be supplied at a price above those customers' VCR.

Any change in VCR for a group or groups of customers would be reflected in the offers submitted to the wholesale market. A material change in the VCR of a large group of customers could potentially have an impact on wholesale prices in some periods.

Potential duplication of signals

If this approach could be fully implemented, it would remove the need to specify a reliability standard, as the wholesale market would work to automatically deliver customers' desired level of reliability.

If it was partially implemented (for example, if a demand response mechanism for large customers was implemented), the need for a reliability standard would depend on the approach taken to the market-wide price cap (that is, whether option 1,2 or 3 above is adopted).

4.6.3 Stakeholder views on option 4

While a number of stakeholders recognised that, in theory, option 4 may provide the most efficient means of linking the reliability settings with the value that customers place on reliability, most agreed that the technical and administrative difficulties associated with implementing this approach meant it would be unlikely to work in practice.

Alinta considered that while theoretically this option may be the most efficient method in prioritising load shedding, on a practical level the technical and administrative

63 See Standing Council on Energy and Resources, *Meeting Communiqué*, Sydney, 13 December 2013.

issues involved make it impossible to progress.[64] In addition, Alinta noted that demand side management was already a practice in which several participants engaged as best suits their needs and contract position.

Origin was of the view that the uncertainty associated with VCR estimates made them unsuitable for representing bid offers for demand response.[65] Origin also considered that this option would be unlikely to be effective given that most published VCRs were significantly higher than the MPC, meaning generation offers would be more economic in achieving the reliability standard than demand response. Origin also noted that there were currently a range of mechanisms for demand response available in the NEM.

While the MEU considered this option had some appeal, it agreed that the technical and administrative difficulties associated with implementing this approach would restrict the delivery of efficient outcomes.[66] AGL also considered that the metering difficulties with grouping customers according to their VCR made this option impractical and costly.[67]

AEMO was of the view that option 4 was essentially already permitted and beginning to operate.[68] While it recognised that there were still some limitations to all customers in the NEM being able to participate directly in demand response , it considered that it would be better to support processes to remove the barriers to full participation rather than rely on a central agency to price and dispatch centralised load shedding through some kind of VCR merit order.

The NGF did not support this option, noting that generators could produce reliable electricity at well below the cost associated with shedding load for the vast majority of consumers.[69] Further, the NGF noted that any customers that presently shed load in response to high wholesale prices did so through agreements with their electricity retailer or through their own trading activities. This highlighted that there was presently no regulatory impediment or need for regulatory oversight for these consumers to compete with producers in the NEM.

64 Alinta Energy, consultation paper submission, p. 6.

65 Origin Energy, consultation paper submission , p. 3.

66 Major Energy Users, consultation paper submission, pp. 37-38.

67 AGL, consultation paper submission, p. 2.

68 AEMO, consultation paper submission, p. 5.

69 National Generators Forum, consultation paper submission, p. 4.

5 Commission's recommended approach

In line with the terms of reference for this advice, this chapter outlines the Commission's preferred approach to linking the reliability standard and reliability settings with a value of customer reliability, including the key implementation considerations.

5.1 Recommended approach

The four options described in the previous chapter set out possible approaches to linking the reliability standard and reliability settings with an administratively determined VCR. Having regard to the benefits, limitations and suitability in meeting the NEO of each approach, the Commission has concluded that option 2 would best deliver efficient market outcomes that are at least consistent with those delivered by the NEM's current reliability standard and settings.

As noted previously, option 2 is similar to the current process for determining the reliability standard and reliability settings. The key difference, however, is the inclusion of a requirement for the reliability standard to be compared with the VCR estimated for the customers most affected by a supply shortfall to determine whether the reliability standard is consistent with the value that customers place on reliability. The link between the reliability standard, MPC and VCR under option 2 was shown in figure 4.2.

This approach consists of the following key processes:

- *Value of customer reliability*: A single, administratively determined VCR representative of the customers most effected by a supply shortfall would be calculated by the appropriate body using a VCR methodology developed in consultation with industry participants.[70] The methodology would be expected to take into account an appropriate range of customer types, demographics and geographic locations across the NEM. This would assist the appropriate body in calculating a single, administrative VCR which is fit for purpose in setting the level of reliability in the generation sector.

- *Reliability standard*: As the first step in reviewing the reliability standard, the Reliability Panel (or other appropriate body)[71] would calculate the VCR implied by the prevailing standard. It would do this by determining the minimum

70 AEMO is currently developing VCRs for use across the NEM as part of its Review of the Value of Customer Reliability. However, as noted in section 4.2, the AEMC has recently recommended to SCER that the AER assume responsibility for calculating VCRs for each NEM jurisdiction using the national methodology which has been developed.

71 Currently, the NER requires the Reliability Panel to review the reliability standard and reliability settings once every four years. However, the AEMC recently received a rule change request from SCER proposing a number of changes to the governance arrangements associated with the reliability standard and reliability settings process. The Commission will commence its consideration of this rule change request in early 2014.

combined costs of generation and USE to meet the reliability standard. In the event the administratively determined VCR was found to diverge materially from the VCR determined by the reliability standard, the Reliability Panel would investigate the reasons for any divergence.[72] If it is concluded that the reliability standard no longer reflects the value that customers place on reliability, a new reliability standard could be determined after detailed analysis.

- *Reliability settings*: Following the review of the reliability standard, the Reliability Panel would then review the reliability settings. The market price cap (and other reliability settings) would be determined by supply-side modelling (as it is under the current methodology for determining the reliability settings). The aim would be to set the level of the market price cap at a level that would be sufficient to deliver investment in new generation to meet the reliability standard.

- *MRLs and reliability safety net provisions*: AEMO would give effect to the reliability standard for operational purposes through the development of MRLs. AEMO would also develop reliability safety net provisions for operational purposes, as it currently does.

As noted in chapter 1, there are a number of other pieces of work being carried out by the AEMC and others which have implications for the different processes outlined above. Given this work, the AEMC has not provided additional detail on how this approach could operate in practice. Nor has the AEMC recommended any particular assignment of responsibilities or specification of timeframes for each of the various processes. Rather, the focus of this advice has been on clearly defining the relationship between the reliability standard, reliability settings (specifically MPC) and VCR.

The Commission's recommended approach is consistent with the framework recommended by the AEMC for setting transmission reliability levels in the NEM. That process involves assessing the way that the cost of operation and investments in transmission networks change reliability levels, and selecting a reliability standard where the cost of investment and operation equates to the value placed on reliability by customers.

5.2 Reasons for recommended approach

The consultation paper set out four options for linking the VCR with MPC. The Commission's assessment of the options revealed some significant risks and limitations of both options 3 and 4.

Option 3, the direct application of VCR as market price cap in periods of scarcity, may create incentives for generators to avoid entering a scarcity period in order to avoid the price they receive for their output being capped. This in turn may provide an incentive to over-invest, relative to customers' willingness to pay for a reliable electricity supply.

72 The divergence could be due to, for example, inaccuracies in determining VCR, or the reliability standard no longer reflecting the value that customers place on reliability, or the market price cap may no longer reflect the value that customers place on reliable electricity supply.

However, in some circumstances there could be perverse incentives on portfolio generators to withdraw supply in order to invoke the MPC. Customers and retailers could have a perverse incentive to increase demand in order to invoke the market price cap, to reduce the price they pay for each unit of electricity.

Option 4, using different levels of VCR to offer into dispatch, is theoretically attractive but unlikely to be achievable in practice with current technology. For example, most residential customers may have to be grouped on the basis of the part of the distribution network they are connected to, as managing supply is not currently feasible at a more granular level. Consequently, technical and administrative difficulties mean that the efficient outcomes suggested by option 4 are unlikely to arise in practice in the current market.

The Commission considers that drawbacks of options 3 and 4 are sufficiently large that neither option should be considered for implementation in the near term. Submissions supported this view, with no support for either option expressed. Therefore, the detailed assessment of the options in the remainder of this chapter is limited to a comparison of options 1 and 2.

5.2.1 Potential impact on consumers, including for price and reliability

Option 1 would set the market price cap to an administratively determined value to customers of maintaining reliable electricity supply. However, this is unlikely to meet the reliability standard at the lowest cost to consumers. Under option 2, the MPC would be set using supply-side modelling to reflect a pre-determined reliability standard. The VCR would be used as a cross-check on the reliability standard. Given the characteristics of the electricity market, including the inability for consumers through their consumption decisions to respond quickly to prices, it is unlikely to be efficient for MPC to equal VCR. In order to minimise costs to consumers, the reliability standard should be set at the level which minimises the sum of generation costs and the costs of USE.

Option 1 also has two key challenges from a practical perspective.

First, it relies on being able to accurately estimate the value of customer reliability. As discussed in chapter 3, the actual costs arising from curtailment (that is, load shedding) events will vary depending on factors such as type of customers affected, event duration and the time of day and year when they occur. As a result, it is very difficult to represent the value customers place on reliability with a single number.

In addition, even if every curtailment event were exactly the same in character, it would still be difficult to estimate the cost. This is because the actual costs to consumers cannot be directly observed and must be estimated. For example, cost information may be gathered through interviews or surveys of users about the expected costs for hypothetical events. Cost information could also be inferred from questions on users' willingness to take action to mitigate the effect of a curtailment. An indication of the level of uncertainty in VCR estimation is highlighted by the

differences in AEMO's VCR estimates for Victoria and the AEMC's VCR estimates for NSW (see section 3.1 of this document).

If the administratively determined VCR overestimates customers' real willingness to pay for reliability, the market would overinvest in generation reliability in response. Customers would then pay more for reliability than the value they place on it. Conversely, if the VCR underestimates customers' willingness to pay, customers may suffer supply interruptions despite being willing to pay more to avoid those interruptions.

As option 2 does not directly apply the administratively determined VCR, it would be less sensitive to these risks of the VCR estimate being unrepresentative of customers' real willingness to pay for reliability. Option 2 would continue to achieve the level of reliability (from the generation sector) that has generally been considered acceptable since the start of the market. At the same time, reconciling the MPC, estimated VCR and reliability standard would allow reliability under this model to adapt to changes in costs of providing reliability, or the value customers place on reliability, if the Reliability Panel determined it to be appropriate.

5.2.2 Potential impacts on generators, retailers and other relevant market participants, including impacts on investment signals

Given the variable nature of VCR estimates, it is possible that a direct application of the administratively determined VCR (under option 1) could lead to dramatic changes in MPC values (up or down) over time. This would tend to make risk management (for example, the pricing of contracts) difficult, thereby increase uncertainty for market participants. For example, it could increase both revenue uncertainty for generators or demand-response providers, and cost uncertainty for retailers and consumers. This, in turn, would increase uncertainty of market outcomes. While option 2 allows for consideration of the level of the administratively determined VCR, it could avoid sudden changes in the level of the MPC should there be volatility in the level of VCR each time it is updated. That is, a more stable framework which minimises risk of sudden change supports regulatory certainty and should create a more attractive investment environment.

One benefit of basing MPC on supply-side modelling is that, while the cost of building generation to meet a given reliability standard may change over time, such changes do not tend to happen quickly. For example, the efficient mix of generation may change, new generating technologies may be developed or the costs of existing generating technologies may change. Where the MPC is based on assumptions about the cost of building generation capacity to meet a particular reliability standard, the assumptions - and therefore the MPC - could become out-dated. However, so long as the MPC is reviewed every few years, this risk should remain low. .

The ability for the Reliability Panel to cross-check the reliability standard against the VCR under option 2 could create some uncertainty for generators and retailers, in comparison with option 1. Under option 1, it is clear that the MPC will always equal the prevailing level of VCR. Under option 2, the Reliability Panel has a degree of

discretion to amend the MPC or the reliability standard, taking into account a range of factors (such as the accuracy of the VCR or the prospects for efficient investment).

The level of risk and uncertainty created by this discretion could be minimised by clearly setting out (for example, in the NER) the factors that the Reliability Panel can take into account when reviewing the reliability standard and settings, and the criteria for making any changes. Under these circumstances, limited discretion may reduce uncertainty for market participants, for example by mitigating against the impact of anomalous results from the VCR surveys.

5.2.3 The extent to which linking the MPC to a VCR could duplicate the signals provided by the reliability standard and other existing market settings

By introducing a direct link between the MPC and VCR, option 1 would remove the need for a reliability standard since the reliability that customers desire would be expressed through the administratively determined VCR. Given the risks identified in determining a robust VCR administratively, other mechanisms such as the CPT are likely to play an important role under option 1.

Option 2 provides a link between the MPC, the VCR and the reliability standard. The MPC is set based on the cost of meeting the reliability standard. The standard and the settings would therefore remain complementary.

5.2.4 Conclusion

Given the characteristics of the electricity market such as the inability for consumers to respond quickly to prices, it is unlikely to be efficient for MPC to equal VCR. In order to minimise costs to consumers, the reliability standard should be set at the level which minimises the sum of generation costs and the costs of USE.

In view of this, and the issues associated with determining a VCR administratively, the Commission recommends option 2, using VCR as a cross-check on the reliability standard and reliability settings, as the preferred approach to linking VCR and MPC.

As technology and pricing changes over time, it may be possible to more accurately estimate different consumers' VCR through observed actions (for example, consumption changes in response to time-of-use tariffs). Such developments may enable the market to place an increasing reliance on VCR as a cross-check on the reliability standard and the MPC.

5.3 Implementation considerations

Option 2 represents a very similar approach to the current process for setting the market price cap. Consequently, little change is required to current practice. However, two changes could be considered to clarify the approach and provide certainty to market participants:

- The role of the VCR as a cross-check on the reliability standard and settings could be formalised in the NER.

- A set of principles could be developed for the Reliability Panel to follow in considering changes to the MPC. This might include, for example, consideration of the robustness of the administratively determined VCR, the impact on investment signals, and whether the subsequent reliability standard would be consistent with customer expectations.

In addition, the Panel's review of the reliability standard and reliability settings is undertaken in accordance with the requirements under the NER and terms of reference which are issued by the AEMC.[73] The changes to the reliability framework recommended in this report could also be included within the terms of reference for future reviews.

73 The requirements for the review are set out under clause 3.9.3A(a) of the NER. The terms of reference are published on the AEMC website: www.aemc.gov.au.

Abbreviations

ACCC	Australian Competition and Consumer Commission
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
APC	administered price cap
Code	National Electricity Code
Commission	See AEMC
CPI	consumer price index
CPT	cumulative price threshold
ERCOT	Electric Reliability Council of Texas
MCE	Ministerial Council on Energy
MISO	Midcontinent Independent System Operator
MPC	market price cap
MRL	minimum reserve level
NECA	National Electricity Code Administrator
NEL	National Electricity Law
NEM	national electricity market
NEMMCO	National Electricity Market Management Company
NEO	national electricity objective
NER	National Electricity Rules
NERA	NERA Economic Consulting
NSPs	network service providers
NSW	New South Wales

RERT	Reliability emergency reserve trader
SCER	Standing Council on Energy and Resources
USE	unserved energy
VCR	value of customer reliability
VoLL	value of lost load

A Approach, scope and objective

This appendix sets out the AEMC's approach to, and scope of, this advice. It also identifies the overarching objective and assessment framework used to guide its development.

A.1 Approach

The AEMC has based the development of this advice to SCER on the following approach:

- Having regard to the NEO, identify an assessment framework to guide the evaluation of possible approaches to linking the reliability standard and reliability settings with VCR.
- Explore the link between the reliability standard and reliability settings, and VCR. This will include discussion around why reliability mechanisms are needed in energy-only markets.
- Identify possible approaches to linking the reliability standard and reliability settings with VCR. In doing so, the AEMC will:
  - review the approaches considered by the AEMC in the extreme weather review;
  - consider whether there are any other approaches to linking the reliability standard and reliability settings with VCR; and
  - where relevant, review international approaches to setting market price caps to reflect consumer expectations of reliable electricity supply.
- Using the assessment framework, evaluate each of the approaches identified to determine whether they are likely to satisfy the NEO.
- As required by the terms of reference, identify a preferred approach.

A.2 Scope

The scope of the analysis to develop this advice is framed by the terms of reference (see section 1.3). Consistent with the terms of reference, the AEMC has not carried out a detailed review of the existing reliability standard and settings to determine whether they have been, or will continue to be, effective in encouraging sufficient investment in generation capacity in the NEM. The form, level and scope of the existing parameters are currently being reviewed by the Reliability Panel as part of the four-yearly review required by the NER. These are therefore beyond the scope of this advice.

In addition, this review has not included consideration of whether there is a case for action – that is, whether there is a need to amend the existing approach used to set the

reliability standard and setting in the NEM. Rather, this advice has focussed on exploring the relative merits, and costs and risks, of the possible approaches that can be used to set the reliability standard and settings, having regard to the value that customers place on reliable electricity supply. This has included consideration of whether the possible approaches are consistent with the NEO.

The ultimate objective of this advice is to identify whether there is an alternative approach to setting which may better promote the NEO than the current approach. However, further work would likely be required ahead of changing the current arrangements. This may include carrying out a cost-benefit assessment to determine whether the benefits of implementing an alternative approach would outweigh the costs of doing so. This is particularly important given the practical issues associated with measuring VCR and the implications for market participants and customers from making changes to the existing reliability framework.

A.3 National electricity objective

The AEMC is required to have regard to the NEO in every review that it undertakes and every change to the NER that it assesses. The NEO is therefore the overarching objective guiding this advice to SCER. The NEO is set out in s. 7 of the National Electricity Law (NEL), which states:

> "The objective of this Law is to promote efficient investment in, and efficient operation and use of, electricity services for the long term interests of consumers of electricity with respect to -
>
> (a) price, quality, safety, reliability and security of supply of electricity; and
>
> (b) the reliability, safety and security of the national electricity system."

In considering the different approaches to linking the reliability standard and reliability settings with VCR, the terms of reference require the AEMC to consider the benefits, limits and suitability of each approach in meeting the NEO. The terms of reference also request an analysis of the potential impacts of linking, specifically, the market price cap with VCR, in terms of:

- consumers, including for price and reliability; and
- generators, retailers and other relevant market participants, including in terms of investment signals.

Consideration of the extent to which linking the market price cap to a VCR could duplicate the signals provided by the reliability standard and other existing market settings has also been provided.

B Historical justification for the reliability standard and reliability settings

B.1 Reliability standard

Prior to the commencement of the national electricity market in 1998, each jurisdiction established its own standards for reliability and applied these in decisions relating to the installation of new generation capacity.[74] Long standing practice had generally been to manage the number of times interruptions to supply were likely. This was achieved by ensuring that sufficient generation reserve was available to replace the failure of the largest one, two or three generating units relatively quickly (the number varied between jurisdiction and over time).

In 1998, the Reliability Panel conducted a review to determine the power system reliability standards to apply in the new national electricity market. It also needed to form the guidelines for market intervention by National Electricity Market Management Company (NEMMCO) as a last resort to maintain the reliability standards.[75] The Panel's review was informed by advice from NEMMCO which was based on:

1. setting a level of reliability which "relates as directly as possible to the continuity of supply to customers"; and

2. developing a threshold level of generation reserve as a trigger for NEMMCO intervention.

In respect of the reliability standard, the Panel considered both the units of measurement of reliability and the level of the reliability to apply in the national market. On the former, it determined to adopt the percentage of unserved energy (USE) in a region as the relevant measure of reliability.[76] This decision was guided by the Panel's view that reliability standards in a market environment should be focussed towards individual customer reliability, rather than on managing the number of occurrences of interruption (the focus of the previous jurisdictional based reliability standards).

On the latter, the Panel determined that the reliability standard in the national market would be set a maximum of 0.002 per cent of USE in any region over the long term. The level of reliability was the critical element of the Panel's determination. The major issue

74 NECA Reliability Panel 1998, *Power system reliability standards and guidelines for market intervention, Discussion Paper*, February 1998, p. 17.

75 See: NECA Reliability Panel 1998, *Power system reliability standards and guidelines for market intervention, Discussion Paper*, February 1998; NECA Reliability Panel 1998, *Determination on reserve trader and direction guidelines*, June 1998.

76 The measures developed for use by utilities under the centralised industry structure varied widely, from simple capacity margins through to sophisticated statistical indicators focussing on particular aspects of reliability (for example, the amount of energy likely not to be able to be supplied (USE) and the number of hours in a period in which some load will not be able to be supplied).

for the Panel at the time was "a desire to introduce a common approach across the National Market at a level which balances natural energy market outcomes and avoids undesirable reliability shocks." The Panel noted that it was "acutely aware of the risk of destroying confidence in the reform process by setting inappropriately high or low standards for the opening of the market."[77]

The Panel therefore established a uniform approach to the NEM's reliability standards at approximately the same level as the existing standard in each jurisdiction. This was "an on balance decision, taking into account the stage of development of the market and an assessment of wider community expectations."[78]

B.2 Reliability settings

Inclusion of a price cap in the NEM design

In general, competitive markets do not have a price cap. Inclusion of a price cap in the NEM design required authorisation under the *Trades Practices Act 1974* by the Australian Competition and Consumer Commission (ACCC) at the time the National Electricity Code (Code) was authorised.[79]

The ACCC accepted that a price cap was warranted in the early stages of the market to guard against the consequences of unmanageable market risk at what was anticipated would be a potentially volatile and uncertain period. Inclusion of a price cap was also justified on the basis of there being minimal opportunities available for demand-side response to actively participate in the market. The ACCC recognised that such opportunities were an important mechanism for buyers to counteract the potential price setting power of the supply-side.[80]

In seeking approval from the ACCC for the price cap, NEMMCO and the National Electricity Code Administrator (NECA) recommended that VoLL (the term given to the market price cap) initially be set at $5,000/MWh. This value was considered appropriate to ensure that market risks were capped at an acceptable level. It was also noted that this value was consistent with that used in the England-Wales market at that time.[81]

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77 NECA Reliability Panel 1998, *Determination on reserve trader and direction guidelines*, June 1998, p. 8.

78 ibid.

79 In November 1996, NEMMCO and NECA formally applied to the ACCC for authorisation of the National Electricity Code (Code) under the Trade Practices Act. The submission that accompanied that application set out the rationale for including a price cap (termed VoLL) in the NEM design.

80 Without price transparency to end-use customers, there is little incentive for them to reduce load at times of high market prices. Under these circumstances, retailers have no option but to continue to supply at a potentially substantial loss. A cap on these potential losses was considered desirable in view of this lack of short term elasticity of demand.

81 The Electricity Pool of England and Wales (the Pool) was a mandatory auction spot market established in 1990. The Pool included capacity payments to encourage generators to invest and provide reserve capacity. Capacity payments were aimed at reflecting the expected cost to the user

In its determination, the ACCC acknowledged that the proposed value of VoLL was arbitrary. However, it recognised that it was not in a position to recommend a more appropriate level. The ACCC accepted the proposed level of $5,000/MWh and anticipated that a revision would occur within 12 months of market start, and annually thereafter.[82]

Review of VoLL by the Reliability Panel

In July 1999, in line with its obligations under the Code, the Reliability Panel commenced its first annual review of VoLL.[83] In the issues paper for the review, the Panel considered the role that VoLL was intended to play in the market. It noted the following:[84]

> "The Code's term, "VoLL" is an acronym for "value of lost load", suggesting its role in the market is that of surrogate bid, representing the price at which customers will be indifferent to having their loads curtailed.
>
> The Code also refers to VoLL as a "price cap", as did the application to the ACCC authorising the Code… This suggests VoLLs role is to balance the objectives of allowing unfettered market operation on the one hand and maintaining an acceptable risk environment on the other."

The Panel considered that clarification of the role of VoLL in the national electricity market was a vital first step as it would ultimately determine how the level of VoLL was set. The Panel concluded the following:[85]

> "The primary role of VoLL should be that of a price cap which strikes a balance between allowing the market to clear with minimal intervention and containing market risk to tolerable levels. A secondary role, that of surrogate bid, would only be appropriate if it was concluded that significant ongoing intervention by the market operator to clear the market was inevitable. It would then be reasonable for the focus of the price cap to shift to promoting economically-appropriate prices during intervention."

The core principle guiding the Panel's review of VoLL was therefore the need to balance the ability of the market to consistently clear on a voluntary basis, within the

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of a supply interruption, measured by VoLL. VoLL was set administratively at £2,000/MWh in 1990 and was then increased annually by the retail price index. In 2000, it stood at £2,816/MWh.

82 Following approval of the National Electricity Code at market start, the ACCC was responsible for authorising any changes to the Code, including changes to the level of the reliability settings. Following a number of subsequent changes to the Code (which included requiring the NECA Reliability Panel to conduct, in consultation with market participants, annual reviews of the level of VoLL in the NEM), the ACCC is no longer involved in decisions relevant to the market price cap.

83 NECA Reliability Panel 1999, *Review of VoLL in the national electricity market, Issues Paper*, 12 May 1999; NECA Reliability Panel 1999, *Review of VoLL in the national electricity market, Final Report,* July 1999.

84 NECA Reliability Panel 1999, *Review of VoLL in the national electricity market, Issues Paper*, 12 May 1999, p. 11.

85 ibid, p.12.

reliability standard set by the Panel, in all but the most extreme circumstances, against risk. The strength of the incentive provided by the market price at peak times was therefore considered critical in satisfying the core principle.[86]

In reviewing the appropriateness of the initial level of VoLL, the Panel found that a price cap of $5,000/MWh would be unlikely to maintain supply reliability consistent with the reliability standard, without some form of central intervention. In other words, the level of VoLL was too low to ensure the market would continue to consistently clear on a voluntary basis.[87]

In considering a more appropriate level of VoLL, the Panel analysed possible supply and demand-side responses. On the supply-side, the Panel found that VoLL would need to be set at a level of at least $10,000/MWh, and possibly as high as $20,000/MWh, in order for there to be a reasonable prospect of supply-side resources emerging to voluntarily clear the market for all but the five hours per year over the long run (the reliability standard).

While very aware of the limitations of available data on end-use customer value of lost load, the Panel nonetheless concluded that a significant demand-side contribution would be unlikely below a level of at least $15,000-$20,000, that is, at the level at which a marginal supply-side response was probable (demand-side considerations are considered further below).

The Panel subsequently recommended that the following changes be made to the Code:

- VoLL be increased in two steps: to $10,000/MWh in September 2001 and to $20,000/MWh in April 2002.
- A rolling three-year schedule of VoLL be introduced, extended by one year in each annual review.
- A cap on the market price be imposed if the cumulative effect of high spot prices exceeded a threshold level. Specifically, if the spot price in the preceding week (336 trading intervals) exceeds a cumulative price threshold (CPT) of $300,000, the market price cap would be reduced to the administered price cap. The APC would be set at $300/MWh in peak times of the day and $50/MWh in off-peak times of the day.[88]

86 NECA Reliability Panel 1999, *Review of VoLL in the national electricity market, Final Report*, July 1999, p. 6.

87 While the Panel recognised that there were a number of new investments occurring and planned, it did not consider that these were not demonstrative of the core principle (that is, the ability of the market to clear voluntarily) being met purely from market signals at peak times.

88 A cumulative spot price of $300,000 would require 7.5 hours at a VoLL of $20,000/MWh or 30 hours at a VoLL of $5,000/MWh before the APC is applied.

On 29 September 1999, NECA lodged an application with the ACCC for authorisation of the recommendations made by the Reliability Panel in the VoLL review.[89]

Authorisation of changes to VoLL by the ACCC

In its determination on the proposed changes, the ACCC stated that an increase to $20,000/MWh would introduce significant additional risk to market participants, which might not easily be accommodated. It also expressed concerns over potential generator market power and possible consequences for higher power prices across the NEM resulting from the higher price cap.

The ACCC acknowledged that the proposed increase in VoLL would provide a public benefit on the basis that it would encourage investment in peaking capacity in circumstances where demand peaks occur for only a few hours a year. However, it did not consider that the other major public benefit presented by NECA (that VoLL provided the incentive for reliability of supply through improved demand-side response) had been demonstrated. As such, the ACCC did not consider that an increase in VoLL to $20,000/MWh would deliver sufficient public benefit to outweigh the potential anti-competitive detriments noted above.

The ACCC therefore proposed to limit the increase in VoLL to $10,000/MWh, and to delay the increase until April 2002 to allow market participants sufficient lead-time to put in place necessary arrangements to accommodate the increase in risk. The ACCC also determined to reduce the CPT to $150,000, reducing the risk of market participants being exposed to prolonged periods of high prices.

B.3 Demand-side considerations

In addition to marginal supply-side investment, demand-side response also has a critical role to play in ensuring reliability in the NEM. For example, customers may be able to respond to market conditions by voluntarily reducing demand in response to price.

While demand-side response was much less developed than the supply-side at the time of market start, it was recognised that greater participation would strengthen the market position of customers in the NEM and provide the opportunity for significantly reduced peak prices by requiring less peak generation.[90]

At the time of Panel's first review of VoLL, Monash University had undertaken work which indicated that different customers would (if it was practical to do so) reduce

89 This application was accompanied by a number of other applications for changes to the Code in relation to capacity mechanisms and price floor arrangements.

90 If a customer is to voluntarily reduce demand, the incentive to do so will be a combination of the attraction of avoiding paying the market price, and any incentive offered by a retailer balanced against the value foregone by not taking supply. The net incentive must be greater than the net opportunity cost incurred in reducing demand.

their demand at prices ranging from $1,000/MWh to $90,000/MWh.[91] Monash University also developed a single aggregate representative value of customer lost load of approximately $25,000/MWh.

While the Reliability Panel recognised the possibility that, if attracted to the market, sufficient demand-side response may be able to clear the market at a price lower than that required by the supply-side, it was reluctant to rely on a single representative customer VoLL as a benchmark for setting the value of the price cap.[92] This was due in part to the wide range of customer valuations and the uncertainties associated with the survey techniques and averaging methodology.

A possible alternative to relying on customer surveys for estimating customers' value of lost load would be for individual customers to express their own values of lost load either directly through the wholesale market or, more practically, through negotiated retail tariff arrangements with retailers.[93] While this would avoid some of the limitations of survey methodologies, the Panel recognised that there were significant cost and technology barriers constraining the ability of customers to participate in this way.

The Panel considered that while customer VoLL may be a useful concept when better alternatives were not available, it was not appropriate to use as the basis of decisions on the level of the price cap, particularly at that stage of the NEM's development.

91 In this section, 'customer VoLL' is defined as the value that a consumer is ready to pay for the last kWh of electricity rather than being disconnected. References to 'VoLL' are to the market price cap.

92 NECA Reliability Panel 1999, *Review of VoLL in the national electricity market, Final Report,* July 1999, pp. 10-11.

93 An example of direct participation by the demand-side in the wholesale market would be to require customers to nominate bid prices at which they would be willing to forego part or all of their supply. The nominated bids would be used to prioritise loads for shedding and to set the price when a particular price-class was shed. However, the administrative effort of acquiring up to date bids and processing them could be significant. Further, the absence of effective mechanisms for discriminating among loads on the basis of the bid price during load shedding would also be an issue.

C International approaches to setting market price caps

An overview of the electricity wholesale markets considered by NERA is provided in Table D.1 below. It is important to note that the level of the market price cap in each market is impacted by the choice of regulatory mechanisms in place in each jurisdiction for ensuring reliability.[94] For this reason, a direct comparison of the market price cap levels is unlikely to be helpful without first understanding the characteristics of the electricity markets being considered.

Table C.1 Overview of wholesale electricity markets considered by NERA[95]

Jurisdiction	Level of VCR	Methodology for estimating VCR	Market price cap	Market similarities to the NEM	Market differences to the NEM
New Zealand	NZ$20,000 (AU$17,690)	Survey in 2010 of approximately 14,000 electricity customers as well as smaller follow-up surveys in 2012.	No official market price cap (in most operating circumstances) Price range of between NZ$10,000 (AU$8,850) to NZ$20,000 (AU$17,690) when scarcity pricing arrangements are triggered	Energy-only market, rural/urban population split.	Higher population density, less variable temperatures, lower GDP per capita, lower peak demand, winter peaking.
ERCOT (Texas, United States)	NA	Neither the current market cap nor the proposed market cap increases are based on an analysis of	Currently US$5,000 (AU$5,320) but increasing to US$9,000 (AU$9,570)	Energy-only market, large land size, GDP per capita, summer peaking.	Higher population density, peak demand, rural population percentage and less variation in

94 For example, in the PJM and MISO markets, the market price cap in the energy market (as distinct from the capacity market) does not need to be set at a level sufficient to encourage new generation investment because the costs of generation can be expected to be recovered directly through capacity market payments.

95 Approximate Australian dollar conversions use exchange rates at 26 September 2013.

Jurisdiction	Level of VCR	Methodology for estimating VCR	Market price cap	Market similarities to the NEM	Market differences to the NEM
		customers' VCR or an analysis of the price cap needed to sustain investments.	over the next two years		temperature.
Singapore	S$5,000 (AU$4,240)	Singaporean GDP divided by total energy consumed.	Market price caps are defined as portions of the VCR Current energy price cap is S$4,500 (AU$3,810), ie, 0.9 of VCR	Energy-only market.	Much higher portion of commercial and industrial customers, less variable temperatures, higher population density, higher proportion of urban customers, higher GDP per capita.
Alberta (Canada)	NA	There has been no explicit consideration of the value that customers place on reliable electricity supply in setting the current price cap.	US$1,000 (AU$1,060)	Energy-only market, increasing wind penetration.	Much higher portion of commercial and industrial customers, large degree of interconnectedness with neighbouring jurisdictions, low natural gas prices, large degree of Power Purchase Agreements set to expire by 2020 (5,000MW).
Great Britain	GB£16,940 (AU$28,880) for domestic and SME users GB£1,400 (AU$2,386) for industrial and commercial consumers	Used stated preference choice experiments (small and medium sized businesses) and value-at-risk approach and econometric techniques (commercial	No price cap	Energy-only market – however, introducing a capacity market with the first capacity auction to be held in 2014, peak demand is falling.	Winter peaking, higher peak demand, higher total annual consumption.

Jurisdiction	Level of VCR	Methodology for estimating VCR	Market price cap	Market similarities to the NEM	Market differences to the NEM
		and industrial).			
MISO (United States)	US$3,500 (AU$3,720)	Used previously conducted studies conducted between 1989 and 2002, using MISO-specific values for the independent variables.	US$3,500 (AU$3,720)	GDP per capita, summer peaking, market price cap is set to VOLL.	Voluntary capacity market, higher population density, less variable temperatures, connected to another network (ie, PJM), higher peak demand, greater proportion of rural customers.
PJM (United States)	NA	Price caps in the energy markets are based on negotiations between entities from both the demand and supply side of the PJM, not VCR.	Historically been US$1,000 (AU$1060) but a price cap of US$2,700 (AU$2,870) is being phased in over four years Currently US$1,800 (AU$1,910)	Large area covered (largest centrally dispatched grid in North America), summer peaking.	Forward capacity market, generators face significant scrutiny with regard to their market offers, higher peak demand, high degree of demand response.
The Netherlands	NA	NA	€3,000 (day-ahead auction and strips market) €99,999.90 (intraday market)	-	Large amount of interconnectedness with neighbouring countries, binding forward market, large degree of vertical integration, winter peaking.

Source: NERA 2013, *Review of Alternative Approaches to setting Wholesale Electricity Market Price Caps, A Report for the AEMC*, October 2013.