REVIEW

Australian Energy Market Commission

FINAL REPORT

Review of the Effectiveness of NEM Security and Reliability Arrangements in light of Extreme Weather Events

Commissioners

Tamblyn
Henderson
Spalding

31 May 2010

Reference: EMO0010
Final Report

Inquiries

Australian Energy Market Commission
PO Box A2449
Sydney South NSW 1235

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

Reference: EMO0010

Citation

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

About the AEMC

The Council of Australian Governments, through its Ministerial Council on Energy (MCE), established the Australian Energy Market Commission (AEMC) in July 2005 to be the rule maker for national energy markets. The AEMC is currently responsible for rules and providing advice to the MCE on matters relevant to the national energy markets. We are an independent, national body. Our key responsibilities are to consider rule change proposals, conduct energy market reviews and provide policy advice to the Ministerial Council as requested, or on AEMC initiative.

Executive Summary

This Final Report presents findings and recommendations from the Australian Energy Market Commission (AEMC) with respect to the Review of the Effectiveness of National Electricity Market (NEM) Security and Reliability Arrangements in Light of Extreme Weather Events (the Review).

The purpose of the Final Report is to provide our final advice to the Ministerial Council on Energy (MCE) on the areas where the existing energy market frameworks require change, and our recommendations to address identified risks. This Final Report also highlights a number of issues which require change but can be addressed under existing regulatory frameworks.

We provide our final advice based on the analysis undertaken during the course of the Review and evidence provided by stakeholder submissions.

Conclusions and Recommendations

We consider that there are a number of key areas regarding the existing framework and mechanisms that could be improved to enable consumer expectations for quality of electricity supply to be maintained in a future in which the frequency and/or severity of extreme weather events could be greater. These are discussed below.

Consumers who experience supply interruptions are not generally concerned with the type of supply interruptions, however the current NEM framework categorises supply interruptions to enable more targeted mechanisms to be developed to ensure optimal power system performance and that supply is delivered to consumers as efficiently as possible. Supply interruptions are generally categorised under the NEM framework in accordance with the relevant stage of the supply chain, namely, as either generation, transmission or distribution. Supply interruptions are also categorised according to the cause of the problem, that is, either as a reliability related event or security related event. Reliability events are those caused by a lack of capacity due to power system equipment reaching operational limits. Reliability events generally occur when reserve capacity in the system has been exhausted. Security events are, however, generally those caused by a rapid disconnection of power system equipment from service due to either equipment failure or the activation of protection systems. Security events generally occur when reserve capacity is still available in the system, but that reserve capacity cannot be accessed.

Supply interruptions originating in the generation or transmission sectors account for less than 10 per cent of the duration of all interruptions to end-user supply, with supply interruptions originating in the distribution sector accounting for the remainder. Of the supply interruptions originating in the generation or transmission sectors from 2005 onwards, around 12 per cent were due to reliability events, whereas 88 per cent were due to security related events. It is likely that if the frequency and/or severity of extreme weather events were to increase, then it is also likely that the incidence of security events would also increase.

Technical Performance and Power System Security

If the frequency and/or severity of extreme weather were to increase, this would likely impact mostly on the incidence of security events. Power system security is affected by the technical performance of power system equipment, the processes and procedures for managing the power system, and the systems used for managing consumer load shedding. This is a complex area of the NEM's design, and not necessarily well understood by all stakeholders. In this Report, we provide examples of areas where changes can be made that may enable the power system to be operated in a way that would reduce the incidence and impact of security events. We note that these changes would not be without cost.

We recommend that the Australian Energy Market Operator (AEMO) commence, as soon as practicable, a comprehensive review of the current arrangements for managing technical performance of the NEM, with the objective of identifying priority areas for improving power system security. Following AEMO's review, we recommend that the AEMC should consider the outcomes and, to the extent that refinements are needed to market frameworks or mechanisms, develop a work program to consider options for change. In addition to AEMO's review above, the AEMC intends to commence the Comprehensive Review of Technical Standards that was foreshadowed by the Reliability Panel.

We also recommend that AEMO should report annually in the Electricity Statement of Opportunities (ESOO) on the extent that the impact of long term weather trends have been incorporated into the ESOO load forecasts.

Whole of Power System Reliability

Overall reliability of supply depends on the reliability of each segment of the supply chain, that is, the stock of generating units, the transmission network and the distribution network. However, different entities plan and operate each segment of the supply chain, and the associated reliability standards are currently independently determined.

We conclude that efficient investment in reliability across the supply chain can be achieved by investing to the level of Value of Customer Reliability (VCR) for those consumers most affected by the investment. We recommend that for generation investment the VCR level for residential consumers should be used because this class of consumer places the lowest value on reliability and are usually shed first during a reliability event. At present the VCR level for residential consumers (which has currently only been explicitly estimated for Victorian consumers) is estimated to be $13 250/MWh, which aligns reasonably close to the MPC of $12 500 that will apply from 1 July 2010. For transmission network investments, we recommend that the level of VCR should reflect the class or classes of consumers that would be affected by the investment.

The Reliability Standard

The Reliability Standard is used to evaluate whether sufficient investment in generator capacity is occurring to meet changes in consumer demand. 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. We note that an issue with having separate measures of performance for each element of the power system is that the measures and mechanisms for delivering performance against those measures may not be consistent, and may not meet overall consumer expectations for quality of supply. This is particularly relevant in the context of extreme weather where the nature of supply interruptions may change in the future.

We recommend that the Annual Market Performance Review currently undertaken by the Reliability Panel be expanded to better examine the performance of the power system as a whole (as experienced by consumers at the point of consumption) and the individual segments of the power system (including distinguishing between main system reliability and security events). We also recommend that the AEMC review the findings of the Annual Market Performance Review from the perspective of market design and if it is found that the current market design is no longer efficiently meeting the expectations of consumers for quality of supply, changes would be recommended to the MCE as appropriate.

The Market Price Cap and other Reliability Settings

The Market Price Cap (MPC) is one of the key mechanisms available in the NEM for incentivising investment in generation to meet the reliability expectations of consumers. Modelling undertaken for this Review indicated that if demand were to increase due to an increase in the incidence of extreme weather (such as more extreme heatwaves), additional investment in generator capacity (or demand-side participation) would be required to satisfy that demand.

However the MPC would not necessarily need to rise to deliver that additional generator capacity. The level of the MPC is dependent on the shape of the demand profile. If demand spikes were to become higher but not necessarily longer (such as due to hotter but not necessarily longer heatwaves), then a higher MPC may be required because more generation would be required to run for very short periods to satisfy the higher demand peak. However if the frequency or duration of demand spikes were to increase (such as due to longer and more frequent heatwaves), then the MPC would not necessarily need to increase to deliver additional investment in generator capacity. This is because under this scenario there would be increased opportunity for peaking generators to run and earn pool revenue and thus the pool price would not need to be as high for peaking generators to be profitable.

For this Review we examined an arrangement that would allow a different MPC in each region to recognise differences in jurisdictional reliability expectations. We recommend that an arrangement allowing the level of the MPC to vary between regions should not be pursued further. Introducing new regional specific arrangements into the inter-connected NEM would most likely be detrimental to overall NEM efficiency and would be unlikely to contribute to the achievement of the National Electricity Objective. Such an arrangement would also present problematic implementation issues. In addition, in our view, varying MPCs is not needed because we believe that the current assumption that the reliability expectations of residential consumers are consistent in all NEM regions is still relevant.

Governance arrangements for determining the Reliability Standard and Reliability Settings

The current governance arrangements for reliability may restrict the ability of the NEM to efficiently respond to a possible increase in the frequency and/or severity of extreme weather. Specific weaknesses we identified include that: the institution that sets the Reliability Standard (the Reliability Panel) is not the same institution that determines the Reliability Settings to achieve that standard (the AEMC); and there is no high level guidance provided in the Rules for setting the Reliability Standard or the Reliability Settings. We recommend the following governance arrangements for reliability decisions, which we consider to be consistent with the roles envisaged under the National Electricity Law (NEL):

- the AEMC make all reliability parameter decisions (that is to review and, if need be, amend the Reliability Standard and Reliability Settings);
- AEMO make all reliability operational decisions (including to initiate the Reliability and Emergency Reserve Trader (RERT) and to review and, if need be, amend the Minimum Reserve Levels (MRLs); and
- high-level policy guidance be included in the Rules, which the AEMC would need to have regard to when reviewing and, if need be, amending the Reliability Standard and Reliability Settings.

Processes for determining the Reliability Standard and Reliability Settings

We consider that the current processes for determining the Reliability Standard and Reliability Settings do not promote consistency across the electricity supply chain and do not include an explicit requirement for the Reliability Standard and Reliability Settings to reflect the value that consumers place on reliability. We also consider that the current processes provide limited longer-term pricing certainty and provide minimal Rules based guidance to the decision makers for the Reliability Standard and Reliability Settings.

We recommend that the existing processes for determining the Reliability Standard and Reliability Settings are changed such that:

- an explicit requirement for the Reliability Standard and Reliability Settings to reflect the level of reliability valued by consumers be included in the Rules;
- the MPC and VCR would be checked against each other to assess whether the reliability parameters are consistent with the value that consumers place on reliability;

- the Reliability Standard and Reliability Settings would be reviewed, and amended where necessary, by the AEMC every 5 years;
- the Reliability Standard and Reliability Settings would be specified and given effect in a schedule referred to in the Rules;
- AEMO would use the same VCR for its transmission planning activities as is used for determining the reliability parameters; and
- the methodology and assumptions that would be applied to determine the Reliability Standard and the Reliability Settings, MRLs and the VCR would be subject to public consultation and would be established before the process for determining these parameters commences.

To effect the changes regarding the governance arrangements and processes for determining the Reliability Standard and the Reliability Settings, we have provided a proposed Rule change for the MCE's consideration.

Alternative mechanisms to deliver reliability in the NEM

It is possible that the NEM's demand profile may change in the future if the frequency and/or severity of extreme weather increases. If extreme weather resulted in a peakier demand profile, then this would require a greater incentive for investment in low-utilisation generator plant (or demand side participation). Raising the MPC (to incentivise generation) increases NEM costs and risks, and if there are barriers to managing these risks then at some point the NEM's energy-only market design may no longer be an efficient and effective model for delivering power system reliability.

In this Report we discuss some of the possible alternative market mechanisms which could be implemented to deliver satisfactory reliability in the NEM including a capacity market, forms of standing reserve and a reserve ancillary service.

We consider that implementation of alternative mechanisms is not needed at this stage as there is no evidence to suggest that reliability in the NEM has not been achieved with the application of the current Reliability Standard and Reliability Settings. We do consider however that the performance of the NEM's energy only design should be monitored to determine if the market design remains resilient and sustainable over time, particularly if extreme weather events do become more frequent in the future. As discussed above, we consider that the proposal to expand the Annual Market Performance Review undertaken by the Reliability Panel, and for the outcomes of that review to be considered by the AEMC, would assist to test the resilience of the energy-only market on an ongoing basis.

Reliability Forecasting and Information

We do not consider that any fundamental changes are needed to the tools and mechanisms for reliability forecasting. We support AEMO working with industry to make incremental improvements to forecasting methods as appropriate.

The Review and its context

At its meeting on 6 February 2009, the Ministerial Council on Energy (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.

On 28 April 2009, the MCE directed the AEMC to conduct a Review of the Effectiveness of the NEM Security and Reliability Arrangements in Light of Extreme Weather Events. The weather events the AEMC was to have regard to included droughts, heat waves, storms, floods and bushfires.

In essence, the Review required us to consider 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; and

- 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.

The AEMC was initially required to present its advice to the MCE in two stages. A First Interim Report for the Review was submitted to the MCE on 29 May 2009. This report described the measures currently under consideration to improve system reliability and security and also identified any further cost-effective measures that could be taken in the short-term that would impact on system reliability for the summer of 2009-10.

On 14 August 2009, the MCE revised its original Terms of Reference for the Review, requiring additional analysis and advice. A Second Interim Report was provided to the MCE which focussed specifically on advice in relation to the NEM Reliability Standard and Reliability Settings. We submitted the Second Interim Report to the MCE on 18 December 2009.

Recommendations and Implementation Timetable

Review Recommendations	**Responsibility**	**Suggested Target Dates**
Technical Performance and Power System Security		
That a comprehensive review be undertaken as soon as practicable of the current arrangements for managing technical performance of the NEM. The objective of this Review would be to identify priority areas for improving power system security.	AEMO	Completed by June 2011
The outcomes of the above review to be considered by the AEMC, and to the extent that refinements are needed to market frameworks or mechanisms, the AEMC to develop a work program to consider options for change.	AEMC	Commence following completion of AEMO's review
The ESOO should include a report regarding the extent to which the impact of long term weather trends have been incorporated into the ESOO load forecasts.	AEMO	Annual basis - to be included from 2010
The Comprehensive Review of Technical Standards that was foreshadowed by the Reliability Panel will be undertaken by the AEMC.	AEMC	To commence in second half of 2010.
The Reliability Standard		
The Annual Market Performance Review currently undertaken by the Reliability Panel be expanded to better examine the performance of the power system as a whole (as experienced by consumers at the point of consumption) and the individual segments of the power system (including distinguishing between main system reliability and security events).	AEMC Reliability Panel	Annual basis - apply from next Review (2009/10)
The findings of the expanded Annual Market Performance Review should be reviewed from the perspective of market design and if it is found that the current market design is no longer efficiently meeting the expectations of consumers for quality of supply, changes are recommended to the MCE as appropriate.	AEMC	Following completion of Reliability Panel's Report.

Review Recommendations	Responsibility	Suggested Target Dates
Governance arrangements for determining the Reliability Standard and Reliability Settings & Processes for determining the Reliability Standard and Reliability Settings		
That the existing governance arrangements and processes for determining the Reliability Standard and Reliability Settings be amended as reflected in the proposed draft Rule. The proposed changes include that the AEMC to make all reliability parameter decisions; and AEMO make all reliability operational decisions. These amendments would also add high level policy guidance into the Rules covering all reliability decisions, including a requirement for the Reliability Standard and Reliability Settings to reflect the level of reliability valued by consumers.	MCE to submit Rule change proposal to AEMC	Rule change proposal submitted to AEMC by August 2010.

Contents

1 Introduction

1.1 Background to the Review

In late January 2009, South Australia and Victoria experienced extreme temperatures. In Adelaide, maximum temperatures exceeded 35ºC for nine consecutive days, with six consecutive days over than 40ºC.[1] For the first time in recorded history, Melbourne recorded three consecutive days over 43ºC.[2]

The heat wave conditions created high demand for electricity in South Australia and Victoria. The maximum electricity demands recorded on 29 January 2009 were the highest ever recorded in the South Australian and Victorian regions. Maximum demands on 30 January 2009 were only slightly lower.[3]

Equipment used in the production and delivery of electricity to consumers is designed to operate safely within specific temperature ranges. At temperature extremes the performance of equipment degrades prior to being required to be withdrawn from service. The high temperatures in South Australia and Victoria resulted in reductions in the availability of transmission elements at short notice, including the Basslink interconnector[4], and progressively reduced the availability of the Victorian generators on both 29 and 30 January 2009. In order to restore the balance between supply and demand, the Australian Energy Market Operator (AEMO, formally NEMMCO) instructed that demand be reduced in both South Australia and Victoria. Consequently, there were supply interruptions to business and residential consumers.

On 6 February 2009, the Ministerial Council on Energy (MCE) noted the significance of the interruptions during this period.[5] The MCE decided to request the Australian Energy Market Commission (Commission) to review energy market frameworks in light of the impact of extreme weather events on electricity supply.

---

1 Electricity Supply Council of South Australia (ESCOSA), Performance of ETSA Utilities during January–February 2009 Heatwave, fact sheet, www.escosa.sa.gov.au/webdata/resources/files/090401-D-PerformancOfETSAJanFeb09Heatwave_df.pdf

2 National Electricity Market Management Company (NEMMCO), Power System Incident Report – Actual Lack of Reserve in Victoria and South Australia on 29-30 January 2009, 26 May 2009, p.5.

3 Ibid, p.3.

4 Basslink is protected by a thermal protection mechanism that reduces its ability to transfer electricity between Tasmania and the mainland. For example, its availability reduces when temperatures at the George Town Convertor Station in northern Tasmania exceed 33ºC and is reduced to 0 MW when temperatures exceed 35ºC. These protection mechanisms were activated on 29 and 30 January 2009, when temperatures at the George Town Converter Station reached 37.2ºC and 37.5ºC respectively. Accordingly, the reduction in Basslink's availability on 29 and 30 January was consistent with its operational design.

5 MCE, Communiqué, Canberra, 6 February 2009, p.1.

1.2 Review requirements

1.2.1 MCE Direction

On 28 April 2009, the MCE 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 (MCE Direction).[6] The Terms of Reference for the Review is provided at Appendix B.

The MCE Terms of Reference required the AEMC, in the context of extreme weather events such as droughts, heatwaves, storms, floods and bushfires, to:

- examine the current arrangements for maintaining the security and reliability of supply to consumers of electricity and assess the capability of those arrangements to maintain adequate, secure and reliable supply;
- provide advice on the effectiveness of, and options for, cost-effective improvements to current security and reliability arrangements; and
- if appropriate, identify any cost-effective changes to the market frameworks that may be available to mitigate the frequency and severity of threats to the security and reliability of the power system.

The MCE Direction particularly required the AEMC to focus primarily on the security and reliability performance of those elements of the NEM that are currently within the national energy framework, that is, the generation and transmission elements of NEM. While the MCE Direction invited observations in the Review about distribution networks, noted that matters concerning the reliability and security performance of distribution networks in the NEM (including network planning standards) are determined and monitored by jurisdictional bodies.

The MCE Terms of the Reference also required the AEMC, when undertaking this Review, to have regard to:

- options for change that are proportionate;
- the value of stability and predictability in the energy market regime;
- possible benefits or lessons for the broader energy market framework from the recommendations arising from the Review; and
- other Reviews and Rule change proposals being progressed by the AEMC and/or the Reliability Panel.

---

6 Under section 41(1)(a) of the National Electricity Law, the MCE may give a written direction to the Commission requiring the Commission to conduct a review into any matter relating to the national electricity market.

The MCE noted that it did not consider that the Review would result in a fundamental revision of the electricity market design.

1.2.2 First Interim Report

We submitted the First Interim Report for the Review to the MCE on 29 May 2009. This Report discussed the current arrangements in place for managing security and reliability in the NEM and outlined the recent improvements and measures that are being developed to further improve the ability of the NEM to withstand extreme weather events in the future. The Report also identified five key areas which we considered required further investigation for the Review, including:

- demand and capacity forecasting;
- provision of information to the market;
- market mechanisms;
- generator and network technical standards; and
- financial network incentives on regulated networks to encourage stronger network reliability performance.

1.2.3 Revised MCE Direction

Following consideration of the First Interim Report, the MCE revised the existing Terms of Reference for the Review and sought a Second Interim Report on specific matters relating to the NEM reliability standard and settings. MCE also revised the timing for the delivery of the Final Report from 30 October 2009 to 28 May 2010.[7]

In the Second Interim Report, the AEMC was required to address specific questions relating to the NEM Reliability Standard and NEM Reliability Settings, including to provide the following information:

1. a comparison of historical NEM reliability forecasts with outcomes that occurred in the first ten years of the NEM (averages and extremes);

2. the expected distribution of reliability outcomes, particularly the frequency of extreme load shedding, that are implicit in forecasts of average levels of reliability in the NEM;

3. an analysis of the reliance that may be placed on NEM reliability forecasting methods, taking into account the outcome of (1) and (2), sensitivity analysis and other relevant considerations; and

4. modelling projections of the price-reliability trade-offs of a phased increase in the NEM market price cap (MPC) to:

7 The revised MCE Direction is provided at Appendix C.

(a) an interim level of $20 000 per MWh;

(b) the current value of customer reliability in the study by CRA International dated 12 August 2008 for VENCorp; and

(c) any other level that the AEMC decides is relevant to the MCE's consideration.

Further, the MCE sought advice on the following:

1. whether the NEM Reliability Standard has been interpreted to date either as a maximum which cannot be exceeded, or as a mean which is not to be exceeded over a number of years;

2. the appropriate specification and interpretation of the NEM Reliability Standard in the future;

3. the appropriate roles for the MCE, the AEMC, AEMO, and the Reliability Panel in policy decision-making on reliability standards; and

4. the feasibility of mechanisms for recognising differences in jurisdictional expectations regarding the price-reliability trade-off and delivery of outcomes consistent with those expectations.

1.2.4 Second Interim Report

On 18 December 2009, we provided the Review's Second Interim Report to the MCE. In this Second Interim Report, we made the following observations and recommendations:

- Specification of the Reliability Standard in terms of the targeted level of Unserved Energy (USE) remains appropriate for a future where extreme weather is more likely. It was noted, however, that it would be beneficial if additional information were provided in relation to the frequency and duration of supply interruptions to enable policy makers and the market operator to better understand the nature of supply interruptions and the efficacy of current mechanisms for delivering reliability.

- The Reliability Standard has been interpreted as a target to be achieved every year, but compliance is measured over the long term. That is, the Reliability Standard is measured as a 10 year moving average of reliability outcomes measured against the Reliability Standard. However this interpretation may result in delays to respond to causes of reliability degradation. As a result, we recommended that it would be more appropriate to review the reliability of the NEM each year, in particular following incidents that have resulted in USE.

- If differences in jurisdictional expectations were recognised as expressed through different MPCs across regions, then this would be a fundamental change to the current market design and would require changes to the policies and operational arrangements used to achieve reliable supply. Our preliminary view was that adopting different MPCs across regions would reflect differences in jurisdictional expectations and may be economically efficient in the sense that supply continuity is provided up to the level at which it is valued in a particular region. However there would be implications for economic efficiency when considered on a NEM-wide basis and implementation would present some challenging policy questions. It would be difficult to assess these impacts without detailed modelling.

- In relation to governance arrangements, we proposed that the primary decision maker relating to the determination of the reliability standard and reliability settings should be the AEMC, with policy input provided by the MCE and the decision conducted under normal statutory consultation processes.

1.2.5 Stakeholder consultation

As directed by the MCE, we undertook stakeholder consultation on the findings and draft recommendations provided in the Second Interim Report for the Review. All stakeholder comments have been taken into account in forming our final policy advice to the MCE for the Final Report. An overview of stakeholder comments arising from submissions is provided in Appendix I.

1.2.6 Linkages to other reviews and processes

Many of the issues being considered under the Review impact, or at least intersect, with current work being undertaken by the AEMC and other reforms being progressed by the MCE. The MCE has requested that the AEMC take these into account for the Review. The reviews and processes of particular relevance to this Review, include the:

- Reliability Panel's Reliability Standard and Reliability Setting Review Final Report - 30 April 2009;[8]

- Transmission Reliability Standards Review - on 3 July 2007, the MCE directed the AEMC to conduct a Review into electricity transmission network reliability standards, with a view to developing a consistent national framework. The AEMC provided a final report to the MCE on 30 September 2008, in which it made recommendations for a framework to promote consistency in transmission reliability standards, and for the implementation of this framework. The MCE response to this report is currently outstanding;[9]

- Transmission Frameworks Review - on 20 April 2010, the MCE directed the AEMC to conduct a Review of the arrangements for the provision and utilisation of electricity transmission services in the NEM, with a view to ensuring that the incentives for generation and network investment and operating decisions are

8 http://www.aemc.gov.au.

9 http://www.aemc.gov.au/Market-Reviews/Completed/Transmission-Reliability-Standards-Review.html.

effectively aligned to deliver efficient overall outcomes. This review stems from the AEMC's previous Review of Energy Market Frameworks in light of Climate Change Policies, in which it recommended that further work be undertaken in this area. The MCE requires that the AEMC provide a final report setting out its policy conclusions and recommendations by 30 November 2011.[10]

1.2.7 Structure of this Report

This Final Report sets out our findings and recommendations in relation to improvements that could be made to existing energy market frameworks and mechanisms in the NEM to respond to a scenario with more extreme weather events.

This introductory Chapter chronicles the background to the Review, including the relevant stakeholder consultation undertaken. This Chapter also outlines other relevant reviews and processes that intersect or are related to this Review.

Chapter 2 provides the context for the Review, including a description of the various types of extreme weather events and their respective impacts upon the NEM. Chapter 2 also discusses categories of electricity supply interruptions, that is, as reliability events and security events and also presents evidence on the incidence of reliability events and security events based on the historical performance of the NEM.

Chapters 3-9 consider the issues related to the key areas identified as priorities for this Review. Chapter 3 specifically focuses on the technical performance of the power system. In the context of extreme weather events, Chapter 3 provides our findings and recommendations to improve technical performance in order to address potential supply interruptions.

Chapter 4 considers whole of system power reliability, including the interactions between investment regimes for transmission and generation. We present our findings for how the reliability standards and processes for generation and transmission could be better aligned, including to ensure that the value of customer reliability used in the planning regimes for transmission and generation investment is applied consistently.

Chapter 5 examines the form, level and scope of the existing Reliability Standard, and its particular application to the generation and inter-regional transmission sectors of the electricity supply chain. Chapter 5 also provides information on how the historical performance of the NEM has met the current Reliability Standard to date. Furthermore, Chapter 5 presents our findings and recommendations regarding the specific measures that could be introduced to ensure compliance with the Reliability Standard in the context of this Review.

Chapter 6 presents the results of the modelling undertaken to determine the effect of increasing the MPC to achieve a particular Reliability Standard and also discusses the range of impacts that would result in the NEM should there be an increase in the MPC.

---

10 http://www.aemc.gov.au/Market-Reviews/Open/Transmission-Frameworks-Review.html

Chapter 6 also provides an analysis of the implications of having different MPCs in different regions.

Chapter 7 sets out the roles and responsibilities of the various energy market institutions in making decisions concerning reliability. We provide our findings and recommendations regarding the future governance arrangements for making the respective decisions concerning reliability.

Chapter 8 provides our analysis of the existing processes for determining the Reliability Standard and Reliability Settings and recommends our changes to these processes.

Chapter 9 discusses the alternative mechanisms (in addition to the Reliability Standard and Reliability Settings) that may be considered, if required, to deliver satisfactory reliability in the NEM.

Chapter 10 addresses whether the current tools for the provision of information and forecasting of reliability are adequate in the context of extreme weather events.

Finally, supporting the Report are a range of consultant reports that were commissioned to inform our analysis. These are provided at Appendix D to K.

2 Context

Chapter Summary

This Chapter provides context to the Review, including what is extreme weather, how such weather events may impact security and reliability of electricity supply in the NEM and how the current NEM framework categorises supply interruptions to consumers (i.e. as reliability or security events). This Chapter also provides an overview of the historical performance of the NEM, with an analysis of the likely risks to the current arrangements for maintaining security of supply in the context of more frequent extreme weather events.

Consumers who experience supply interruptions are not generally concerned with the type of supply interruptions, however the current NEM framework categorises supply interruptions to enable more targeted mechanisms to be developed to ensure optimal power system performance and that supply is delivered to consumers as efficiently as possible. Supply interruptions are generally categorised under the NEM framework in accordance with the relevant stage of the supply chain, namely, as either generation, transmission or distribution. Supply interruptions are also categorised according to the cause of the problem, that is, either as a reliability related event or security related event. Reliability events are those caused by a lack of capacity in generation due to power system equipment reaching operational limits. Security events are, however, generally those caused by a rapid disconnection of power system equipment from service due to either equipment failure or the activation of protection systems.

We note that the majority of supply interruptions experienced in the NEM to date have been caused by security events in the network sector, particularly distribution. There have been some reliability events in the generation and transmission sectors. However, these have accounted for less than 10 per cent of the duration of all interruptions to main system supply. It is likely that if the frequency and/or severity of extreme weather events were to increase, then it is also likely that the incidence of security events would also increase.

2.1 What is extreme weather?

Extreme weather can be classified as the infrequent events at the high and low end of the range of values for a particular weather variable.[11] Relevant weather variables can include temperature, rainfall, sea levels and the frequency and intensity of weather events such as droughts, tropical cyclones, strong winds and hail.

11 Neville Nicholls, *Australian Climate and Weather Extremes: Past, Present and Future*, A Report for the Department of Climate Change, Canberra, January 2008, p.4.

This Review focuses on the effects that four types of extreme weather can have on the security and reliability of electricity supply; namely, heat waves, droughts, storms and floods. A sound understanding of how extreme weather events affects the electricity supply chain is critical so that we can evaluate the effectiveness of the current arrangements in the NEM for managing security and reliability given the presence of extreme weather events.

2.1.1 Heat waves

A heat wave is a period of abnormally hot weather lasting several days.[12] The most recent heat waves were most recently observed in South Australia and Victoria in January and February in 2009. In Adelaide, maximum temperatures exceeded 35ºC for nine consecutive days. During this period, the temperatures recorded on six consecutive days were greater than 40ºC.[13] For the first time in history, Melbourne recorded three consecutive days over 43ºC.[14] The heat wave conditions in Victoria also exacerbated the bushfires burning throughout the state.

A consequence of heat wave conditions for the NEM can be very high electricity demand for extended periods. In some cases, peak demand can reach record levels. This occurred in the South Australian and Victorian regions on 29 January 2009, when the recorded maximum demands were the highest ever recorded.[15] High peak demand is often observed in regions where a large proportion of the population relies on electric air-conditioning units, as is the case in South Australia.[16]

The principal effect of a heat wave on generating plant is that it restricts the ability of plant to produce rated output and thus to meet high levels of demand. There are a number of other reasons why a generating unit may be prevented from achieving rated production levels. These reasons include: reduced thermal capacity; limited access to cooling water; increased risk of plant failure; technical limitations; and planned and unplanned maintenance.

Heat waves and bushfires can also adversely affect the capability of a transmission network to transport electricity to load centres by forcing transmission lines to reach their thermal limits or also by arcing. Heat waves and bushfires can also disrupt the ability of distribution networks to supply electricity.

---

12 Bureau of Meteorology, www.bom.gov.au/lam/glossary/hpagegl.shtml.

13 ESCOSA, *Performance of ETSA Utilities during January–February 2009 Heatwave,* fact sheet, www.escosa.sa.gov.au/webdata/resources/files/090401-D-PerformancOfETSAJanFeb09Heatwave_df.pdf

14 NEMMCO, *Power System Incident Report – Actual Lack of Reserve in Victoria and SA* on 29-30 January 2009, 26 May 2009, p.5.

15 Ibid, p.3.

16 ESCOSA, *Performance of ETSA Utilities during the Heatwave of January 2009*, Information Paper, Adelaide, April 2009. Available at www.escosa.sa.gov.au/site/page.cfm?u=4&c=3145.

2.1.2 Droughts

A drought, of itself, is unlikely to have a direct effect on demand patterns, especially patterns of peak demand. To the extent that droughts increase the frequency or severity of heat waves, the effects on demand are likely to be similar to heatwaves.

Droughts can, however, have serious consequences for generation availability. As noted above, some thermal generators may require fresh water to cool generating units. Where there is insufficient water available for cooling, the output of the generating unit is necessarily constrained.

Droughts also have important effects on the ability of hydro generators to generate electricity. Clearly, the absence of sufficient reservoir capacity will have a direct and practical impact on whether a hydro generating unit is physically able to generate electricity. However, limited water supply will also increase the opportunity cost of producing electricity. Hydro generators may therefore face changed incentives in deciding what price and level of capacity, if any, they will offer into the market.

Droughts tend not to have unique direct impacts on the transmission or distribution network capacity.

2.1.3 Storms and floods

Storms and floods generally have an immaterial effect on demand levels. Similarly, generation availability is largely unaffected unless the generation unit sustains direct damage; for example, strong winds may damage a building that houses a generation unit, which then sustains water damage.

Supply interruptions caused by storms and flooding occur most commonly because of damage to an element within the transmission network. Lightning strikes during storms can cause arcing between lines in a similar way to bushfires. The built-in protection systems will activate to trip the endangered lines.

Floods and high winds during storm periods and cyclones may also mobilise debris. This debris can damage transmission elements, such as wires and substations, causing supply interruptions.

The effects of lightning, high winds and floods on distribution networks are similar to the effects on transmission networks. However, distribution networks are more prone to supply interruptions. With a minimum ground clearance that is lower than that for transmission networks, distribution networks are more susceptible to damage or interruption due to falling trees and debris during storms and floods.

2.2 How is Australia's climate forecast to change in the future?

Australia's Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the Bureau of Meteorology (BOM) review and produce a range of reports regarding Australia's climate. It is noted that there are many reports regarding the potential changes in the future to Australia's climate. For example, a recent report on prospective Australian weather conditions, prepared jointly by the BOM and CSIRO, the 2010 State of the Climate Report, concluded that:[17]

- Australian average temperatures are forecast to rise between 0.6 degrees Celsius to 1.5 degrees Celsius by 2030;
- that much of Australia will be drier in coming decades; that is, there will be an increase in the number of drier days across the country, but it is likely there will be an increase in intense rainfall events in many areas;
- it is forecast for there to be an increase in the frequency of hot days and warm nights;
- a substantial increase in fire weather risk is likely; and
- drought occurrence is projected to increase over most of Australia.

For this Review, we have not sought to assess nor comment on the accuracy of those reports, but rather utilise the information to inform our understanding of the likelihood of more frequent extreme weather events.

2.3 NEM framework for categorising supply interruptions

This section provides an overview of how supply interruptions are categorised. An understanding of how supply interruptions are categorised under the current NEM framework assists in examining the potential impacts of, and responses to, extreme weather events in the NEM.

2.3.1 Categorising supply interruptions

In the first instance, it is important to note that consumers who experience supply interruptions are unlikely to be concerned with the “type” of supply interruption. From a consumer's perspective, the lights are either on or they are not.

Source of Supply Interruption

Supply interruptions are categorised according to the source of the interruption; that is, either generation, transmission or distribution. For example, if consumer supply is interrupted because there is insufficient generation to supply all load in the system,

---

17 Bureau of Meteorology and CSIRO (2010), State of the Climate Technical Report (http://www.bom.gov.au/inside/eiab/State-of-climate-2010-updated.pdf).

this interruption is categorised as originating in the generation sector. If consumer load is interrupted because the distribution line feeding that load is damaged, then this interruption would be categorised as originating in the distribution sector.

Cause of Supply Interruption

Supply interruptions in the generation and transmission system are also categorised according to the cause of the problem; that is, either reliability or security.

Reliability events are characterised as those supply interruptions caused by a lack of capacity due to power system equipment reaching operating limits. A reliability event occurs when all reserve capacity is exhausted. The likelihood of reliability events can generally be predicted ahead of real-time as demand and generation availability forecasts reveal supply deficits. As such, reliability events can be planned for and consumer load shedding can be managed (and is often shared) across the NEM. Examples of a reliability event would include a supply interruption caused by insufficient generation or network capacity to meet consumer load. An efficient approach to reducing the incidence of reliability events would generally involve investment in additional capacity.

Security events are characterised as those supply interruptions caused by the rapid disconnection of power system equipment from service due to either equipment failure or the activation of protection systems. Security events occur when reserve capacity may still be available in the system, but that reserve capacity cannot be accessed. Security events can generally not be predicted ahead of real-time as equipment failure is sudden and unexpected. As such, load shedding is generally indiscriminate, and is most often location specific or triggered automatically under the NEM's under frequency load shedding arrangements. Examples of a security event include the simultaneous tripping of more than one generating unit due to a system disturbance, or the tripping of several transmission lines due to a bushfire. An efficient approach to reducing the incidence of security events would generally involve improving the performance or management of power system equipment or, in some circumstances, capital expenditure to provide redundancy.

2.3.2 Why categorise supply interruptions?

Supply interruptions are categorised in the NEM to support the setting of various NEM incentive mechanisms at levels that deliver supply to consumers as efficiently as possible. The value of delivering reliability and security should be consistent at each stage of the supply chain. Categorising supply interruptions identifies any weak links in the supply chain and supports the strengthening of incentives aimed at addressing that identified weakness.

For example, it would not be efficient to build new generator capacity to improve the quality of consumer supply if the generation sector is already highly reliable but the network sector is unreliable. Historically, on occasions, a new generator has acted as a substitute for the networks and hence addressed a reliability issue caused by the networks. However, generally, it would be more efficient to invest in the network to address a network reliability issue. Equally it would not be efficient to invest in a parallel transmission set of lines (a reliability investment) located adjacent to an existing set of transmission lines to manage capacity constraints caused by bushfires (a security event) because a bushfire would most likely remove both lines from service.

Stakeholders stated that most supply interruptions originated in the network sector of the supply chain.[18] Consequently, measures to target supply interruptions should be directed to the network sector. It was thus argued that the focus of this review should be on network security and reliability.[19] Stakeholders also recognised the need to distinguish between the causes of supply interruptions; that is, between security and reliability events. Thus, for example, changing the reliability settings may not be the best mechanism to address system security issues arising from more frequent extreme weather events.[20]

Chapter 4 explores the interactions between each stage of the supply chain in providing reliable supply, and promotes an approach where reliability is valued consistently at all stages of the supply chain to efficiently deliver acceptable reliability at the consumer point of consumption.

2.3.3 NEM mechanisms for delivering reliable and secure supply

Different mechanisms are available in the NEM to change the quality of electricity delivered from each stage of the supply chain.

Generation

Reliability in the generation sector can be improved through investment in new generating capacity. The primary mechanism in the NEM for incentivising investment in generation is the opportunity to earn revenue and respond to the market price cap (MPC). When the level of the MPC is increased, revenue potential for generators from the spot market and the contract market increases thus incentivising investment in generation. Further discussion of the MPC is provided in Chapter 6.

Security events originating in the generation sector can be reduced by tightening performance standards applying to generators and by strengthening the regime that enforces compliance with those standards.

The performance of the generation sector, with respect to both security and reliability, is also affected by AEMO's operational practices. Some operational requirements are specified in the Rules (for example, classifying contingency events) whereas other operational practices are developed within AEMO (for example, Minimum Reserve Levels).

18 Alinta Submission, p.1; Tasmanian Office of Energy Planning and Conservation Submission, p.2, Major Energy Users (MEU) Submission, p.3.

19 Consumer Utilities Advocacy Centre (CUAC) Submission, p.3.

20 Energy Retailers Association of Australia (ERAA) Submission, p.1; Origin Energy Submission, p.2.

Transmission and distribution

Reliability events originating in the transmission or distribution sectors can be reduced through investment in new network capacity. Network investment is driven by the regulatory framework in the Rules and its application by the Australian Energy Regulator (AER) in its periodic decisions on regulated revenues and prices. Transmission Network Service Providers (TNSPs) and Distribution Network Service Providers (DNSPs) must invest so that their networks achieve transmission reliability standards which are currently set by jurisdictions. Currently there is no direct obligation on TNSPs to invest in interconnector capability.[21] TNSPs can receive a regulated return on investment in inter-regional transmission capability if it can be demonstrated that the investment meets the Regulatory Investment Test for Transmission (RIT-T).[22] In addition to a TNSP's analysis of transmission capability, AEMO will identify any need to strengthen inter-regional transmission capability in its National Transmission Network Development Plan.[23] However, as noted above, there is nothing to compel a TNSP to strengthen the capability of its inter-regional network. The AEMC may direct a TNSP to perform the RIT-T on an inter-regional network augmentation under its last resort planning power, however, the AEMC cannot direct a TNSP to undertake the investment.[24]

Security events originating in the transmission or distribution sectors can be reduced by tightening performance standards and by strengthening the incentive and enforcement regimes applying to network businesses.

As with generators, the performance of networks is also affected by AEMO's operational practices.

2.3.4 Categorising extreme weather events

As discussed, extreme weather events impacting power system security and reliability include heat waves, bushfires, electrical storms, high wind storms, and droughts. In section 2.1, we outlined each of these extreme weather events and their impacts on elements of the supply chain. Below we further discuss whether these events are typically categorised as security or reliability events under the current framework.

Heatwaves increase demand due to air conditioner usage, reduce operating capacities of power system equipment (including both generation and network elements), and can heighten the risk of equipment failure as power system equipment is operated close to operating limits. Supply interruptions due to high demand or reductions in equipment operating limits are considered reliability events because they are due to

21 The Commission is addressing this issue as part of the MCE's Inter-regional Transmission Charging Rule Change Request: http://www.aemc.gov.au/Electricity/Rule-changes/Open/Inter-regional-Transmission-Charging.html.

22 Clause 5.6.5B of the Rules.

23 section 49(2)(a) of the NEL; Rule 5.6A of the Rules.

24 Clause 5.6.4 of the Rules.

inadequate capacity to meet the demand at a particular point in time. Supply interruptions due to equipment failure are considered security events by definition.

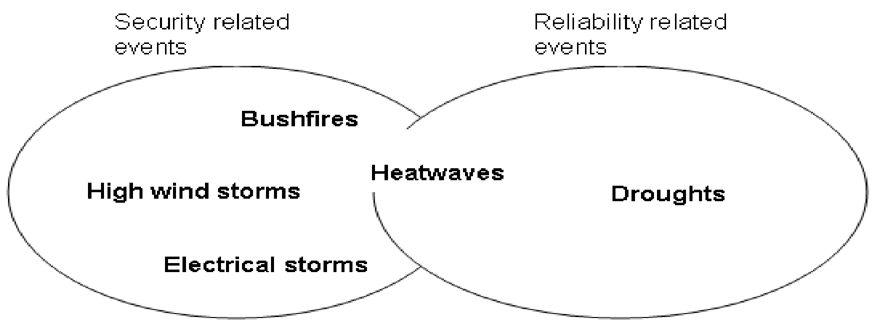
Bushfires can cause equipment to trip from service due to short-circuiting, heat damage or due to the activation of protection systems. By definition, supply interruptions due to bushfires are considered security events.

Electrical storms can cause equipment to trip from service due to short-circuiting or due to the activation of protection systems. By definition, supply interruptions due to electrical storms are considered security events.

High wind storms can cause physical damage to transmission and distribution networks. By definition, supply interruptions due to high wind storms are considered security events.

Droughts can constrain the amount of energy that a generator is able to deliver due to limitations on water use for powering hydro generators and for cooling some thermal generators. Supply interruptions due to droughts are considered reliability events because they reduce effective installed capacity.

Figure 2.1 Weather event supply interruptions in the NEM

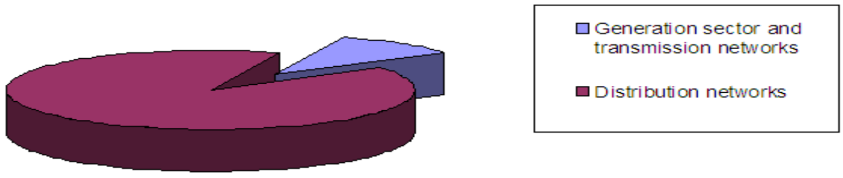


2.3.5 Historical performance of the NEM

To date, the majority of supply interruptions experienced by consumers in the NEM have been caused by security events in the distribution sectors. Supply interruptions originating in the generation and transmission sectors account for less than 10% of the duration of all interruptions to supply, while disruptions to supply within distribution networks account for over 90% of the duration of all interruptions to supply.[25]

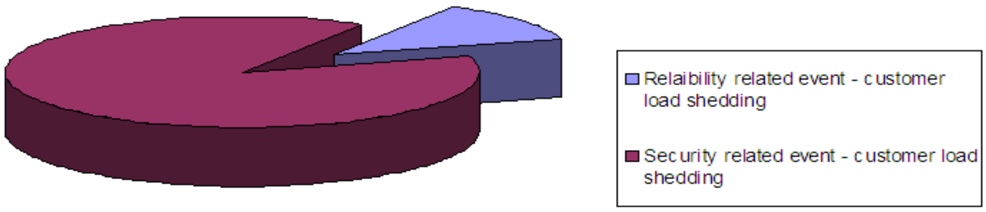
25 Australian Energy Regulator, State of the Energy Market 2008, Melbourne, 2008, p.156.

Figure 2.2 Historical performance of the NEM - Supply interruptions experienced by consumers



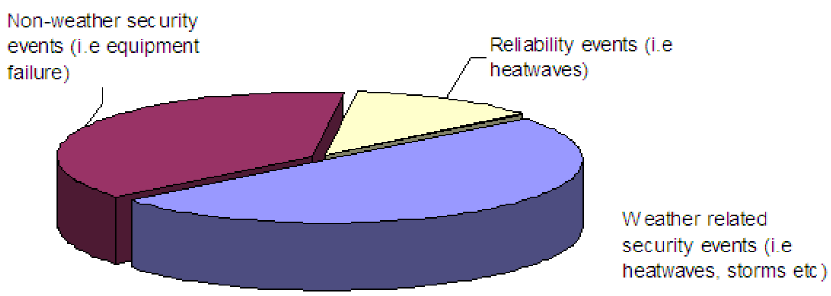
Appendix F contains a list of all significant power system events in the generation and transmission sectors resulting in consumer load shedding since 2005. Of all supply interruptions arising from the generation and transmission sectors only (that is, it excludes supply interruptions from the distribution sector), it was found that 12 per cent of consumer load shedding was due to reliability-related events, whereas 88 per cent of consumer load shedding was due to security-related events. This suggests that improvements to the quality of consumers' electricity supply due to generation and transmission would most effectively be achieved through measures to reduce the incidence of security events. Such measures are discussed in Chapter 3.

Figure 2.3 Significant power system events in the NEM since 2008



Of all the load shedding due to supply interruptions in the generation and transmission sectors of the supply chain, we estimate that approximately 50 per cent was due to weather related security events (such as heatwaves, lightning, storm damage), approximately 38 per cent was due to non-weather related security events (such as equipment failure), and the remaining 12 per cent was due to reliability events (generally due to heat waves). These estimates demonstrate the impact that extreme weather has on power system security. Any increase in the incidence of extreme weather events is therefore likely to have greatest impact on the security of the power system. We discuss the impact of extreme weather on power system security in Chapter 3.

Figure 2.4 Supply interruptions related to weather events



2.3.6 Extreme weather risk analysis

The MCE Direction included a requirement for the Review to examine the current market arrangements for maintaining the security and reliability of supply to consumers and to provide a risk assessment of the capability of those arrangements to maintain secure and reliable supply. To address this requirement we have undertaken a comprehensive assessment of the relevant risks of increased frequency and severity of extreme weather events. This risk analysis is provided in detail in Appendix G. The risk analysis provides a summary of the risks identified during this Review, with an assessment of the likelihood and severity of each risk identified. We considered the issues in terms of the current level of risk and under the assumption that extreme weather events become more frequent. The primary focus of the risk analysis is on generation and transmission incidents, and their impact on the reliability and security of supply as seen by consumers, as well as risks to the investment necessary to maintain ongoing reliable supply to consumers.

The analysis identified two risks as being high priorities should the incidence of extreme weather increase:

- Supply interruptions as a result of extreme temperatures creating high demand and degradation of equipment capacity. The impact of this risk was considered high as it could result in significant consumer load shedding, however the likelihood of this risk was considered moderate because extreme temperatures in excess of what the NEM is designed to withstand are only expected once in every 10 to 20 years.

- Supply interruptions due to severe security events such as bushfires or lightning that causes multiple transmission lines to trip from service in the same vicinity. This risk is considered to have a high impact because large amounts of consumer load can be affected and operators have minimal control over which loads to shed. The likelihood of this risk is also considered high because high temperatures, bushfires, and storms occurs somewhere in the NEM most years.

3 Technical performance and power system security

Chapter Summary

In this Chapter we provide an overview of technical performance of the power system including examples where technical performance can impact on security and reliability events. These include whether:

- new generating units and transmission plant should be designed to higher technical standards;
- special protection schemes should be developed for low probability but high impact events;
- AEMO's previous operating incidents should be reviewed to determine whether all the lessons from previous reliability and security incidents have been learned; and
- load shedding could be better managed when it does occur.

Most of the unserved energy in the generation and transmission systems has been caused by power system security events, with only a small portion due to reliability events due to insufficient capacity within a region. However, most of the focus of stakeholders has been on the regulatory arrangements for reliability and much less attention has been given to the technical performance of the power system.

Given the range of potential issues identified, we recommend that AEMO commences, as soon as practical, a review of the current arrangements for managing technical performance in the NEM, with the objective of identifying priority areas for improving power system security (where economically justified). Such a Review could include, but not be limited to:

- a review of AEMO's previous power system incident reports to determine whether any patterns emerge from the incident reports that could indicate a systemic risk, and whether all the recommended remedial actions from its reports have been implemented (acknowledging that this has been undertaken to some degree by AEMO and the AER);
- whether the existing criteria for classifying contingencies as credible or non-credible should be amended;
- whether any additional special protection schemes should be developed to manage the impacts of low probability - high impact contingencies; and
- whether load shedding is effectively managed to reduce its economic impact, if it does occur.

We anticipate that this review by AEMO would be completed by the end of June 2011.

Following AEMO's review, we recommend that the AEMC should consider the outcomes and, to the extent that refinements are needed to market frameworks or mechanisms, develop a work program to consider options for change. This work would be undertaken in consultation with stakeholders and should be informed by the Reliability Panel's expanded Annual Market Performance Review, as discussed in Chapter 5.

We also recommend that AEMO should report annually in the ESOO on the weather assumptions that have been incorporated into the ESOO load forecasts.

In addition to AEMO's review above, the AEMC intends to commence the Comprehensive Review of Technical Standards that was foreshadowed by the Reliability Panel in its Final Report on "Technical Standards Review".[26]

3.1 Introduction

As discussed in Chapter 2 of this Report, approximately 88% of the unserved energy from major supply interruptions in the NEM are caused by power system security events rather than reliability events. In addition, the supply interruptions associated with extreme weather conditions are generally extensive and affect large numbers of consumers. Therefore, if the number of high temperature events does increase in the future, it can be expected that the number of severe supply interruptions will also increase, unless mitigation steps are put in place.

This Chapter discusses the technical performance of the power system in relation to power system security and some specific areas that may require further investigation in a subsequent review.

3.1.1 Framework for power system reliability

The reliability standards, and the associated arrangements to implement these standards, covering generation and the transmission and distribution networks are specified by the relevant regulatory bodies and mechanisms are in place to monitor their implementation.

We also note that the regulatory regimes covering power system reliability events have been further developed in recent years through the following reviews:

26 The Final Report of the Reliability Panel's "Technical Standards Review" was published on 30 April 2009 and is available on the AEMC website.

- The Comprehensive Reliability Review (CRR)[27]
- The Reliability Standard and Reliability Settings Review[28]
- The Energy Adequacy Assessment Projection (EAAP)[29]
- The RERT[30]

In addition, the following reviews were recently completed by the AEMC, but the associated recommendations are yet to be implemented:

- The Transmission Reliability Standards Review[31]
- Review of National Framework for Electricity Distribution Network Planning and Expansion[32]

Further improvements to the frameworks for power system reliability are discussed in Chapters 4 to 9.

3.1.2 Framework for power system security

The framework for power system security is set by a combination of the National Electricity Rules (Rules or NER) and determinations of the Reliability Panel.[33] However, the framework does not include a specific standard in terms of unserved energy, as is the case for power system reliability.

Under this framework, AEMO has the responsibility to maintain power system security. The power system is deemed secure when all equipment is operating within

---

27 "Comprehensive Reliability Review", AEMC Reliability Panel, Final Report published on 21 December 2007.

28 The Final Report of the "Reliability Standard and Reliability Settings Review" was published on the AEMC website on 30 April 2010.

29 The EAAP is a quarterly information mechanism which will provide the market with projections of the impact of generation input constraints on energy availability. The EAAP was proposed by the AEMC Reliability Panel in the CRR which was submitted to the AEMC as a Rule change proposal in 2008. The AEMC made the associated Rule "NEM Reliability Settings: Information, Safety Net and Directions" on 26 June 2008.

30 The RERT is the modified reserve trader that was proposed by the AEMC Reliability Panel in the CRR and submitted to the AEMC as a Rule change proposal in 2008. The AEMC made the associated Rule "NEM Reliability Settings: Information, Safety Net and Directions" on 26 June 2008.

31 "Transmission Reliability Standards Review", AEMC Reliability Panel, Final Report published on 31 August 2008, and "Transmission Reliability Standards Review", AEMC, submitted to the MCE on 30 September 2008. The MCE is still considering the Recommendations from this Review.

32 "Review of National Framework for Electricity Distribution Network Planning and Expansion", AEMC, published on 28 September 2009.

33 The Reliability Panel determines the Power System Reliability and Security Standards (PSRSS) in accordance with Clauses 8.8.3 of the Rules. Under chapter 10 of the Rules, the PSRSS may include but are not limited to standards for the frequency of the power system in operation, contingency capacity reserves (including guidelines for assessing requirements), short term capacity reserves and medium term capacity reserves.

safe loading levels and will not become unstable in the event of a single credible contingency. Under some circumstances consumer load may need to be manually interrupted in order to return to a secure power system, even though there may be sufficient generation in the NEM to meet the demand. Secure operation depends on the combined effect of controllable plant, ancillary services, and the underlying technical characteristics of the power system plant and equipment. To achieve this AEMO must schedule, operate and control the power system in such a way that:[34]

- it is within its defined technical limits;
- if any credible contingency event occurs, the power system will return to operating within its defined technical limits;[35] and
- if any contingency event occurs, AEMO can return the power system to operate within its defined technical limits within thirty minutes.[36]

In addition, under the Rules AEMO has a number of functions in relation to system security including:

- giving a direction to a registered participant if it is satisfied that it is necessary to do so to maintain or re-establish the power system to a secure operating state, a satisfactory operating state, or a reliable operating state;[37]
- giving an instruction to any person to do anything[38] if it is satisfied that it is necessary to do so for reasons of public safety or the security of the electricity system;[39]
- providing advice to TNSPs and network users in relation to the negotiation of technical standards where there is a potential impact on power system security;[40] and
- publishing system incident reports for each significant security event.[41]

The Rules also place responsibilities on other market participants and NEM institutions including requiring:

- market participants to meet their agreed technical performance standards;[42]

---

34 Power system security is defined in Chapter 10 of the Electricity Rules as the safe scheduling, operation and control of the power system on a continuous basis in accordance with the principles set out in clause 4.2.6.

35 In accordance with clause 4.2.4(a).

36 In accordance with clause 4.2.6(b).

37 Clause 4.8.9(a)(1) of the Rules.

38 Section 116 of the NEL prescribes the actions that AEMO may instruct a person to undertake ensure safety and security of national electricity system.

39 Clause 4.8.9(a)(2) of the Rules.

40 Clause 5.3.4A(a) of the Rules defines where AEMO is to provide this advice.

41 In accordance with clause 4.8.15 of the Rules.

- the AER to monitor compliance with the NEL and Rules, including AEMO's system security responsibilities and participant's obligations with respect to power system security;[43] and
- the Reliability Panel to monitor, review and report on the safety, security and reliability of the national electricity system.[44]

The process for complying with, and enforcement of, technical standards is crucial to maintaining power system security, and ensuring that the power system is operated within its technical envelope. In 2006 we undertook a review[45] into these arrangements and recommended an integrated package of measures intended to ensure that:

- performance standards for existing power generators are properly documented[46] and that procedures for ensuring compliance with those performance standards are improved;[47] and
- the technical standards on which the performance standards are based are comprehensively reviewed;[48] and
- appropriate penalties for failure to comply are in place.

The effectiveness of these arrangements for managing power system security is investigated further in the remainder of this Chapter.

3.2 Stakeholder submissions

Generally, stakeholders considered that a technical standards review is required.[49] The following specific suggestions for a potential review were noted:

42 The process for registering agreed technical performance standards is summarised in the Reliability Panel's "Annual Market Performance Review 2008-09", which is available on the AEMC website.

43 In accordance with section 15 of the NEL.

44 In accordance with section 38 of the NEL and with the requirements of the Rules.

45 The Final Report of the AEMC's "Review of Enforcement of and compliance with Technical standards" was published on 1 September 2006 and is available on the AEMC website.

46 The AEMC made the National Electricity Amendment (Resolution of existing generator performance standards) Rule 2006 No. 21 in December 2006 in response to a Rule change proposal from NEMMCO. NEMMCO then undertook a process to registered all generator performance standards.

47 The AEMC made the National Electricity Amendment (Performance Standards Compliance of Generators) Rule 2008 No. 10 in October 2008 in response to a Rule change proposal from the National Generators Forum (NGF). Also, the Reliability Panel published templates to assist generators to develop their compliance programs.

48 The Reliability Panel published a report on the first stage of this review on 30 April 2009, and its report is available at http://www.aemc.gov.au/Market-Reviews/Completed/Reliability-Panel-Technical-Standards-Review.html.

49 NGF Submission, p.7, Loy Yang Market Management Company (LYMMCO) Submission, p.6, TRUenergy Submission, p.3.

- any industry supported recommendations should be adopted and implemented in a timely fashion;[50]

- technical standards should be grand fathered to ensure that changes do not reduce available capacity;[51]

- operating temperature limits on inter-regional transmission assets should be addressed, which may trigger reliability events and result in adverse impacts on retailers;[52]

- incentives for TNSPs and DNSPs to mitigate the impact of major storms by taking preparative action should be examined;[53] and

- the hypothesis that probabilistic planning standards are better than deterministic planning standards should be examined, which would lead to harmonised network planning standards.[54]

3.3 Areas for improvement

The framework for power system security has generally proven to balance the risks of major system disturbance with the cost of achieving the current level of power system security.

However, we consider that some aspects of the framework for power system security should be examined to determine if improvements could be made. Examples of these potential aspects of improvement are discussed in sections 3.4 to 3.9 below. We intend to undertake that review of those aspects of the framework that have the potential to improve the security of the power system.

3.4 Potential benefits of higher technical standards for new generating and transmission plant

Extreme weather events such as high temperatures and bushfires place various items of power system equipment under stress which can lead to a deterioration of the performance of the NEM power system. Examples of how extreme weather can deteriorate the performance of the power system can include:

- degradation of the capability of generating equipment at high ambient temperatures;

- degradation of the transfer capability of transmission lines and transformers at high ambient temperatures;

---

50 Origin Energy Submission, p.5.

51 NGF Submission, p.7.

52 ERAA Submission, p.4.

53 Tasmanian Office of Energy Planning and Conservation Submission, p.2.

54 Alinta Submissionp.2.

- catastrophic failure of transmission and/or distribution network equipment caused by overloading at high ambient temperatures;
- cascading failures of equipment physically or electrically close to items of equipment that experience a catastrophic failure;
- intermittent faults on transmission lines caused by lightning storms and bushfire smoke and flames; and
- catastrophic failure of transmission and/or distribution lines caused by excessive heat from bushfires.

The overall continuity of supply to consumers depends on the technical performance of the generating and network plant. Therefore, it could be argued that it is possible to improve the overall performance of the power system by requiring new generating units and network plant to be designed to higher technical requirements. For example, whether new generating and network plant should be required to:

- be more tolerant to the higher ambient temperatures associated with some extreme weather events;
- be capable of continuous operation during more severe faults than those required under the current technical standards;
- incorporate physical and electrical protection systems to reduce the vulnerability of the power system in bushfire and storm prone areas; and
- be fitted with blast protection shields to make the plant resilient to cascading equipment failures.

However, requiring new generation and transmission plant to meet higher technical standards may not always be either economic or appropriate.

Technical standards for generating equipment

In principle, requiring generating units to meet higher technical standards would be expected to increase the performance of the power system. For example, such potential improvements could relate to the ability of the generating unit to continue to operate during, and following, a disturbance in the operation of the power system caused by lightning.

Therefore, potential improvements to the performance of the power system could be made by requiring existing generators to upgrade their generating units and new generating units to meet higher technical standards.

However, requiring existing generating units to be upgraded and new generating units to meet higher technical standards may not be cost effective. In addition, requiring new generating units to meet higher technical standards is unlikely to improve the overall performance of the NEM power system until a large portion of the existing stock retires. This may take many years to occur due to the long life of generator assets.

The Rules require the proponents of new generating units to meet specific technical performance requirements with respect to the operation of their units and their potential impacts on the security of the power system.[55] This is necessary because, while the proponents and operators of a generating unit face financial risks if the generating unit is not reliable, the risks associated with NEM power system security are shared by all NEM stakeholders.

We note that retrospectively requiring existing generating units to be upgraded creates regulatory uncertainty for generator proponents. Under the Rules existing generators are protected from future changes to the technical standards.[56]

Technical standards for transmission equipment

In a similar fashion to generating units, potential improvements to the performance of the power system can also be made by requiring TNSPs to upgrade their networks to meet higher technical standards.

We note that the regulatory regime and investment incentives for transmission networks are significantly different to those for generating units. In particular:

- the decisions to augment the network or otherwise improve the technical performance need to be justified against the RIT-T;
- the costs of the investment (and much of the associated risks) are passed onto consumers through the transmission use of system (TUoS) charges;
- the TNSPs have specific reliability obligations which must be met (as discussed in Chapter 4); and
- the TNSPs are required to meet the technical standards specified in the Rules.

Thus TNSPs have the scope to upgrade their networks, passing on the costs to consumers, when:

- the reliability of the network is projected to be at risk, including due to load growth or other changes in network usage;
- the reliability standard is changed; or
- the technical standards are amended.

55 Chapter 5 of the Rules requires generating unit proponents to negotiate their connection arrangements with the associated TNSP. Where the technical performance has an impact on system security, AEMO must be consulted.

56 We considered the issues associated with changing the technical standards in the Rules under National Electricity Amendment (Technical Standards for Wind Generation and other Generator Connections) Rule 2007 No.2. Rule No.2 "Technical Standards for Wind Generation and Other Generator Connections".

Review of the standards for generating and transmission equipment

The level of technical standards for generating units and transmission networks have a large impact on the performance of the security of the power system. Therefore, we consider that there should be a review of these standards to determine whether they are currently set at the most economic levels. A comprehensive review of technical standards was foreshadowed by the Reliability Panel in its Final Report, the Technical Standards Review. The AEMC intends to commence this Comprehensive Review of Technical Standards in the second half of 2010.

3.5 Load forecasts to include climate change trends

As discussed in Chapter 2, the BOM and CSIRO have undertaken long term climate projections for Australia. Under these projections, BOM and CSIRO state that the weather in the future is likely to differ from the past years in that, amongst other things:

- the average expected temperatures are likely to increase;
- an increased frequency of hot days and warm nights; and
- extreme temperatures are more likely to occur.

The annual maximum demand in a region is strongly dependant on the maximum temperature for that region (as measured at the largest load centre). Therefore, the load forecasts used by AEMO in its ESOO and by the TNSPs in their planning processes should consider the impact of these long term trends in the climate. This is important to ensure that sufficient transmission and generation investments are made to reliably support the consumers in that region, and hence to minimise market intervention by AEMO. We understand that some of the TNSPs have considered the impact of long term climate trends in their load forecasts.

Therefore, we consider that AEMO should coordinate with the TNSPs to determine the extent to which the impact of any long term weather trends are factored into the load forecasts in the ESOO. We also recommend that AEMO reports on this in its ESOO.

3.6 Criteria for defining credible contingencies

Under the Rules AEMO is required to maintain the power system in a secure operating state.[57] This means that the power system should be able to continue to operate following any single credible contingency. The Rules provides guidance to AEMO as to which contingencies should be regarded as credible but leaves AEMO with some discretion.[58] In addition, the Rules allows AEMO to reclassify a non-credible (or rare) contingency as a credible contingency under abnormal conditions such as severe

57 Clause 4.3.1 of the Rules.

58 Clause 4.2.3 of the Rules.

weather conditions, lightning, storms and bushfires.[59] To achieve a secure operating state AEMO will limit the flows in the network and procure ancillary services.

The criteria for determining which events should be regarded as credible requires a trade off between the probability of a potentially disruptive event occurring, and the costs of the additional congestion associated with restricting network transfers and the costs procuring ancillary services.

Therefore, given its high impact on the transfer capability of the power system and the associated costs, we consider that it could be worthwhile examining the criteria for determining which contingencies should be credible. This is particularly important if more extreme weather may be likely in the future as this would increase the risk of power system security events, in the absence of further improvements to the arrangements for managing major system security events.

3.7 Special protection schemes for low probability - high impact contingencies

We noted that several of the major supply interruptions in the NEM are associated with low probability - high impact contingencies. A specific example of this was the loss of supply in Victoria on 16 January 2007 where bushfires tripped the double circuit transmission lines between the Snowy generating units and Melbourne, resulting in the interruption of 2490 MW of Victorian load. Other examples could include where:

- double circuit lines on a single tower are in an area that is prone to either bushfires or lightning;
- several high voltage lines are located in a single corridor that is prone to bushfires; or
- bus bar faults that are not considered as credible contingencies.

Under some circumstances such low probability - high impact contingencies can already be mitigated to some degree. For example, where there are bushfires in the vicinity of a double circuit line, AEMO can reclassify the loss of both circuits as a credible contingency (as discussed above). Generally this reduces the network transfer capability to limit the impact if the contingency does in fact occur. However, reducing the network transfer capability can potentially:

- increase generating costs if energy imports from another regions are constrained;
- increase the spot price in an importing region;
- require load shedding in an importing region to maintain the network flows below the reduced secure operating limits.

---

59 Clause 4.2.3A of the Rules.

Given the potentially high costs to the market of reclassifying a contingency as credible, AEMO only reclassifies contingencies where there is an increased probability of the contingency occurring. A special control scheme to manage the risks of not reclassifying the contingency may be justifiable to cover the low risk periods when the specific contingency would not be reclassified by AEMO.

The Rules already require TNSPs to consider where low probability-high impact contingencies could potentially endanger the stability of the power system.[60] Where a contingency is likely to cause a severe disruption, an emergency control scheme should be installed to minimise disruption to the power system, including to significantly reduce the probability of a cascading failure.[61] In addition, such schemes should be coordinated to ensure that they do not interact in an adverse manner.

Given the potentially high impact of some contingencies, we consider that there may be further opportunities in the NEM where it is economic to implement a special control scheme to better manage some of these low probability - high impact contingencies.

3.8 Review of power system operating incidents

AEMO prepares an operating incident report whenever a material incident occurs.[62] These reports review the circumstances of the incident and often include recommendations for remedial actions, which may include:

- improvements to AEMO and the TNSPs' operating procedures to better manage a similar incident if it occurs in the future; and
- repairs or modifications to the protection or control systems of the associated TNSP(s), generator(s) and transmission network loads.

The ongoing technical performance of the power system depends on these remedial actions being satisfactorily completed. It may also be important to determine whether any patterns emerge from the incident reports that could indicate a systemic risk.

AEMO undertakes a process to monitor the extent to which the remedial actions it has recommended are progressed, particularly in relation to major system incidents. In addition, the AER also considers progress on AEMO's recommendations, particularly where they relate to participants' compliance with the requirements in the NEL and Rules.

Given the importance of these reviews, and the implementation of remedial actions, we consider that a Review of AEMO's power system incident reports should be undertaken. This review should be undertaken by AEMO and could include an audit

60 Schedule 5.1.8 of the Rules.

61 AEMO has been providing assistance to the TNSPs on this issue through its Operations Planning Working Group.

62 This is a requirement under clause 4.8.15 of the Rules.

of the remedial actions and an assessment of whether any systemic risks can be identified. This review should seek the perspectives of both AEMO and the affected plant owners to ensure that all learnings are uncovered.

3.9 Managing emergency load shedding

Load shedding can occur in the NEM due to reliability and security events. The probability of load shedding for reliability and security events would be reduced to some degree if:

- AEMO and the TNSPs adopted a more conservative approach to the reclassification of non-credible contingencies and credible contingencies;
- the Reliability Standard was tightened (from 0.002% to say 0.001%); and
- the Transmission Reliability Standards applied by the TNSPs and AEMO were tightened.

However, if AEMO and the TNSPs were to be more conservative when reclassifying contingencies then this would tend to reduce the transfer capability of the transmission network and that would also lead to higher costs to consumers.[63] Similarly, to significantly tighten the reliability standards for generation and the transmission networks would require increased investment in additional generation and transmission plant. This would mean more:

- generators to meet the tighter Reliability Standard; and
- transmission elements such as substations, transmission lines and transformers to provide additional redundancy in the network that would be necessary to meet a tighter Transmission Reliability Standard.

This additional plant would substantially increase costs to generators and TNSPs, and these costs would be expected to be passed onto consumers. The additional plant could also have a large environmental impact, particular any additional transmission lines requiring new corridors.

The cost of improving the reliability to consumers increases rapidly as the targeted probability of load shedding is reduced towards zero. That is, it would require very high levels of additional investment to significantly improve the reliability to consumers. It would be infinitely expensive, and technically impossible, to deliver perfect reliability.

63 In some cases a more conservative approach to reclassification could actually increase risks in cases such as bushfires where threats are widespread. This is because a reclassification of lines in one corridor will most likely increase flows in other corridors and this would increase risks if a non-credible event would occur unexpectedly in that other corridor.

Reducing the impact of managed load shedding

While it is not possible to completely avoid the need for AEMO to direct TNSPs to shed load, it may potentially be possible to implement control schemes and procedures that significantly reduce the impact when load shedding is needed. These proposed measures would have the potential to better manage load shedding, and hence reduce the economic and social impact.

When the power system is not secure AEMO is required to return it to a secure operating state as quickly as possible but within 30 minutes.[64] This may require AEMO to direct one or more transmission network operators to shed the necessary quantity of load to reduce flows within the affected network. The transmission network operators coordinate with the distribution network operators in that region to implement the required load shedding. Under these circumstances the available time can be used to manage the impact of the load shedding to some degree.

During some more rare emergency conditions, including the operation of the under-frequency control scheme, the necessary load shedding occurs automatically. Under these circumstances there is less control of the impact as the load to be shed is determined when the scheme is designed.

Load shedding at a lower voltage

The management of load shedding can potentially be improved if it is performed at a lower voltage (for example 11 kV). This allows:

- greater discrimination between consumers thus, where possible, shedding mostly residential consumers[65] who place a lower value on reliability whilst maintaining supply to those who place a higher value on reliability;
- rotating load shedding between consumers could be more easily achieved;
- the size of the load that is shed can be more accurately determined, thus reducing the excess load shedding that occurs when large loads are shed at higher voltages; and
- the restoration of the loads can be more precisely controlled, thus more quickly returning supply to interrupted consumers.

Rotating load shedding

We note that, when a reliability event lasts several hours, there is a trade off between:

1. interrupting a smaller number of consumers for the whole duration of the outage; and

---

64 Clause 4.2.6 of the Rules.

65 It has been assumed that residential consumers, as a class, have the lowest VCR. This may not be the case generally and some large industrial consumers may have a lower VCR for short outages.

2. rotating the load shedding thus interrupting a greater number of consumers, but for a shorter period.

Interrupting a larger number of consumers for a shorter period is more equitable as it tends to share the pain of the interruption. However, the costs and inconvenience of an outage for residential consumers depends on its duration, usually with:

- a high initial impact due to the interruption in the operation of appliances etc;
- a lower impact for shorter outages, say less than a few hours;[66] then
- an increasing impact as refrigerated and frozen food spoils.

Therefore, the use of rotating load shedding should aim to minimise the overall impact across all residential consumers.

Review of arrangements

The load shedding arrangements vary between the jurisdictions. There could be merit in reviewing these arrangements in each region to ensure that the most effective control schemes and procedures are in place and to identify potential improvements. We note that the final outcomes will depend on:

- how well the current arrangements have been developed in each region;
- the size of the load blocks that are typically connected at different voltages; and
- how easily it would be to differentiate between various classes of consumers.

Future trends

We note that advances in Smart Meters and Smart Grid, also known as Advanced Metering Infrastructure (AMI), will have the potential to enable:

1. more granular emergency load shedding by allowing a "bottom-up" choice of which consumers to shed; and
2. implementation of agreed load limits, including emergency supply constraints.

Both these functions will have the potential to significantly improve the management of load shedding events, other than for emergencies such as under frequency load shedding. The first AMI function will allow very precise selection of the loads which have, or are assumed to have, the lowest economic value of reliability. The second

66 Residential consumers sensitivity an outage of more than about 30 minutes is likely to increase if the temperature is high due to the interrupted operation of air conditioning.

function allows the rationing available supply to allow individual consumers to continue to operate those loads that they consider to be most important to them.[67]

Recommendations

Given the range of potential issues identified, we recommend that AEMO commences, as soon as practical, a review of the current arrangements for managing technical performance in the NEM, with the objective of identifying priority areas for improving power system security (where economically justified). Such a Review could include, but not be limited to

- a review of AEMO's previous power system incident reports to determine whether any patterns emerge from the incident reports that could indicate a systemic risk, and whether all the recommended remedial actions from its reports have been implemented (acknowledging that this has been undertaken to some degree by AEMO and the AER);
- whether the existing criteria for classifying contingencies as credible or non-credible should be amended;
- whether any additional special protection scheme should be developed to manage the impacts of low probability - high impact contingencies; and
- whether load shedding is effectively managed to reduce its economic impact, if it does occur.

We anticipate that this review by AEMO would be completed by the end of June 2011.

Following AEMO's review, we recommend that the AEMC should consider the outcomes and, to the extent that refinements are needed to market frameworks or mechanisms, develop a work program to consider options for change. This work would be undertaken in consultation with stakeholders and should be informed by the Reliability Panel's expanded Annual Market Performance Review, as discussed in Chapter 5.

We also recommend that AEMO should report annually in the ESOO on the weather assumptions that have been incorporated into the ESOO load forecasts.

In addition to AEMO's review above, the AEMC intends to commence the Comprehensive Review of Technical Standards that was foreshadowed by the Reliability Panel in its Final Report on "Technical Standards Review".[68]

67 Further information on the potential impact of AMI can be found in the report "AMI leveraged projects: An assessment of the justifiable need for investment in additional capabilities", prepared for CitiPower and Powercor by PriceWaterhouseCoopers, October 2009.

4 Whole of power system reliability

Chapter Summary

This Chapter provides our analysis of overall reliability of supply to consumers in the context of extreme weather events, specifically:

- the interactions between investment regimes for transmission and generation;
- the relationship between the value of customer (consumer) reliability (VCR) used in transmission planning and the market price cap (MPC) used to signal generation investment;
- whether increasing the MPC would result in higher reliability to final consumers; and
- how the reliability standards and processes for generation and transmission could be better aligned.

Overall reliability of supply depends on the reliability of each section of the supply chain, that is, the stock of generating units, the transmission network and the distribution network. However, different entities plan and operate each section of the supply chain, and the associated reliability standards are independently determined .

We conclude that:

- efficient investment in reliability across the supply chain can be achieved by investing to the level of VCR for those consumers most affected by the investment. For generation investment the VCR level for residential consumers should be used because this class of consumer places the lowest value on reliability and are usually shed first during a reliability event. At present the VCR level for residential consumers (in Victoria) is estimated to be $13 250/MWh, which aligns reasonably closely with the current MPC; and
- for transmission network investments, the level of VCR should reflect the class of consumers that would be affected by the investment.

68 The Final Report of the Reliability Panel's "Technical Standards Review" was published on 30 April 2009 and is available on the AEMC website.

4.1 Interactions between investment regimes for generation and transmission

4.1.1 Introduction

This section explains the current interactions between the investment regimes for generation and transmission. The investment regimes for generation and transmission interact in a number of ways, including that:

- transmission planners consider generator capability when assessing augmentations;
- generator proponents consider the existing transmission network and possible future augmentations when assessing future investments, including whether:
  - intra-regional constraints are likely to constrain-off their proposed generating unit, including the impact of potential future augmentations; and
  - future interconnector augmentations are likely to impact the region.

4.1.2 Reliability of supply to the final customer

The reliability of supply to end use consumers depends upon the combined reliability of all elements of the supply chain, namely the generation sector, the transmission network and the distribution network (the latter of which is not considered further in this Chapter), as well as the extent to which the different elements act as substitutes. That is, additional capacity in the transmission network may permit distant generators to supply a particular point if a local generator is out of service. Similarly, additional generation capacity in the right location may permit supply to be continued in the event of an outage on the transmission network.

As demand increases, the physical capability of the combined elements of the supply chain to serve the maximum demand will diminish, and new investment will be required to ensure continuity of supply. In addition, both the maximum demand and the physical capability of supply are themselves uncertain. That is:

- The maximum demand will vary in both the short term (for example, with the weather) and medium term (for example, with economic growth).
- Elements of the supply chain will be out of service at unpredictable times. In particular, elements also will fail randomly, including because of external events (such as storms or fires) and because of equipment failure (in turn a function of the condition of the asset). Elements of the supply chain also need to be taken out of service intentionally for planned maintenance, although asset operators typically have substantial discretion about the timing of planned outages and the ability to avoid taking assets out of service when the relevant asset is most needed to ensure supply to final customers. AEMO can disallow the planned

outages of major transmission equipment where the outage would cause system security issues.

- The capability of elements of the supply chain may vary with weather conditions. In particular, the maximum available output from generating units and the transfer capability of transformers and transmission (and distribution) lines reduces at high temperatures. This can reduce the available supply to consumers and hence the reliability they experience.

Thus, reliability of supply, at any point in time, is a function of the quantity of assets that are in existence, the quantity of assets in service at any point in time, the possible events that may affect the availability of assets and demand.

4.1.3 Interactions between the frameworks for generation investment and transmission investment

The frameworks under which decisions about investment are made by generators and TNSPs differ substantially.

- Generators sell their product into a contestable market. Thus, in broad terms, a generator would be expected to forecast the future cash flow that could be earned from the sale of electricity net of future operating costs, and compare that value to the estimate of the cost of the plant. The forecast of future cash flow would depend, in turn, on forecasts of future spot and contract prices for electricity at the relevant regional reference node and intra-regional transmission losses, whether other sources of revenue are available (such as from the sale of renewable energy certificates), the amount of power that they would expect to produce at each point in time, including whether capacity constraints in the transmission network may limit the power that could be produced (discussed further below).

- The investment decisions of transmission businesses in jurisdictions except for Victoria are driven by a combination of the financial incentives created under the regulatory regime, mandatory reliability requirements (where they exist) and the effect of administrative (transparency) requirements. For Victoria, AEMO decides what transmission investment is justified, applying the RIT-T. The intention of the combination of these financial incentives, administrative requirements and (for Victoria) ownership/governance structures is to encourage transmission investment where the social benefits exceed the cost.[69]

These decisions are made separately; however, they interact. This is because the value of a generator will depend upon the stock of transmission assets that are in place. Equally, the benefits from a particular transmission investment, and the potential for a

69 To be more precise, the intention of these arrangements is to encourage investment where the benefits to parties in their roles as electricity generators, transporters, retailers and final consumers exceeds the costs. The regime is not intended to factor in wider externalities – this is left for more general measures (such as an emissions trading scheme for carbon pollution).

transmission investment to proceed as a regulated transmission asset, will depend upon the type and location of existing and potential future generation assets:

- A generator's decision about whether to enter, and where to locate, will be affected by the ability for the transmission network to absorb power in each location, as well as the spot and contract market prices that are expected at the applicable regional reference node. Thus, the value of a generation project is increased where there is sufficient transmission capacity to absorb its power (that is, to connect it to a demand centre), but decreased where there is more transmission to link other sources of generation to compete to supply the same demand centre.

- The effect of generation on the different (economic) benefits that a transmission augmentation may deliver – and hence, the potential for that project to be efficient – include the following:

  — *Reliability* – the effect of a particular transmission investment on the reliability of supply to final consumers will depend upon the quantity, location and type of existing and future generators. For a transmission augmentation to provide reliability benefits, it must either increase the capacity for the network to transport energy from a generation location to a demand centre (requiring an existing or expected surplus of generation capacity at that location) or to increase the resilience of the network to outages (and so the benefit from that additional network resilience would depend upon the quantity of generation that would be served by the project). The magnitude of the reliability benefit will also depend upon the reliability of the generation that is served by the network project, with intermittent generation (like wind) providing a lower contribution to reliability than a gas peaking plant of equivalent capacity. Securing reliability benefits is the dominant reason or driver for transmission augmentation.

  — *Energy (dispatch) benefit* – this is the saving that is possible by removing a transmission constraint to permit a lower (operating) cost generator to be used more often in preference to a higher cost generator. This benefit requires existence of a surplus of (lower cost) generation that can be used more frequently if the relevant transmission constraint is removed.

  — *Generation capital benefit* – this is the saving in future generation costs that may be expected if the construction of a transmission link encourages better use of current generation capacity (i.e., a deferral of new entry) and/or the entry of generation capacity in a lower cost location than otherwise (for example, by relieving a constraint from a lower cost generation location, thereby attracting further entry there). This requires excess current generation capacity and/or for transmission assets to change the economics of generation investment in a desirable location.

In economic terms, transmission and generation are both substitutes and complements.

- In the short term, if there is surplus capacity in generation (albeit constrained in its output at times) and a surplus of transmission in other locations, then additional supply to consumers may be met through either transmission augmentation or additional generation investment. Thus, in the short term, transmission and generation may be substitute means of serving demand growth (or equally to improve reliability for a given level of demand).
- In contrast, in the longer term, once the surplus capacity in generation becomes fully used, additional generation will be required to meet demand. In addition, once the surplus capacity in transmission becomes fully used, further investment in transmission will also be required. Thus, in the long term, generation and transmission are complements as investment in both may be the efficient means of serving demand growth.

Under current market frameworks, the benefits from augmentations to the shared transmission network will usually be dependent upon decisions that have already been made by generators. That is, once a generator has located at a particular point, it will generally be economically efficient, given that generator's decision, to augment transmission capacity to make use of that generator once demand has risen to a level where additional supply is required.

However, it may have been more economically efficient overall for the generator to have located elsewhere, for example, if this would have led to a higher cost of generation, but a more than offsetting reduction in the cost of transmission augmentations. It follows that there is a rationale for encouraging generators to take account of the future cost of transmission augmentations when those generators make their entry decisions. For this reason, the Commission has recently recommended the introduction of a transmission charge to signal to generators the extent to which network costs vary by location.[70]

In the absence of such signals, recent reforms to transmission frameworks have focussed on improving the identification and maximisation of the economic benefits of transmission augmentations, and ensuring that such augmentations are planned in a more strategic and efficient manner. These developments include the establishment of the National Transmission Planner function within AEMO and the forthcoming introduction of the new Regulatory Investment Test for Transmission (RIT-T).

4.1.4 AEMC Transmission Frameworks Review

On 20 April 2010, the MCE directed the AEMC to conduct a review of the arrangements for the provision and utilisation of electricity transmission services in the NEM, with a view to ensuring that the incentives for generation and network

70 AEMC 2009, Review of Energy Market Frameworks in light of Climate Change Policies: Final Report, September 2009, Sydney, Chapter 3.

investment and operating decisions are effectively aligned to deliver efficient overall outcomes.

The AEMC will review the role of transmission in providing services to the competitive sectors of the NEM, through considering the following key areas together in a holistic manner:

- transmission investment;
- network operation;
- network charging, access and connection; and
- management of network congestion.

This Review stems from the Commission's previous Review of Energy Market Frameworks in light of Climate Change Policies. In the Final Report for that Review, the Commission recommended that further work be undertaken in relation to the efficient provision and utilisation of the transmission network, including the development of a transmission charge to signal locationally varying network costs to generators.[71] This reflected the finding that climate change policies will fundamentally change the utilisation of transmission networks over time, both between and within regions of the NEM, and that this would place stress on existing market frameworks.

It is anticipated that the public consultation process for the Transmission Frameworks Review will commence in the second half of 2010.

4.2 Relationship between the VCR used in transmission planning and MPC used to signal generation entry

4.2.1 Role of VCR in transmission planning

In Victoria, assumptions about the VCR are an explicit aspect of transmission investment decision making. In South Australia the deterministic planning standards are based upon the VCR. In New South Wales, Queensland and Tasmania, the deterministic planning standards are not explicitly based upon the VCR.

In this section the Victorian planning arrangements are considered. This is followed by an examination of the South Australian planning arrangements scheme in which deterministic planning standards are set with reference to the VCR. We have not examined the planning arrangements for New South Wales and Queensland because the VCR is not explicitly taken into account in setting planning standards in these jurisdictions.

On 3 July 2007, the MCE directed the AEMC to conduct a Review into electricity transmission network reliability standards, with a view to developing a consistent

71 Ibid.

national framework. The AEMC provided a final report to the MCE on 30 September 2008, in which it made recommendations for a framework to promote consistency in transmission reliability standards and that the reliability standards should be derived from economic considerations that strike a reasonable balance between transmission system cost and customer reliability.

We note that implementation of the AEMC's recommendations would be required to achieve national consistency in the use of economically based transmission reliability standards, including in New South Wales and Queensland. The MCE response to this report is currently outstanding.[72]

Victorian planning arrangements

In broad terms, the planning criterion applied in Victoria is to undertake investments where the benefits exceed the costs and, where there are alternative projects, the net benefit is maximised. The main benefit from transmission augmentation is improved reliability of supply to final consumers, which can be measured using the VCR. The process for calculating this benefit is as follows.[73]

- Firstly, a screening process is applied to determine where network constraints may emerge and be sufficiently material to warrant further detailed investigation. The process applied in Victoria includes forecasting when generator re-dispatch or load shedding may be required in the future under specific critical conditions, including when demand is very high. There is substantial interchange between Victoria and other states, including when there are transmission assets out of service.

- Secondly, where further investigation is considered to be warranted, the expected amount of energy that will not be served in the future in the absence of an investment project is estimated.[74] The process that is employed is to simulate the outcomes for the power system on an hour-by-hour basis across a large number of future scenarios. For each scenario, the system operator is assumed to maintain the power system within the system performance requirements,[75] which in some cases will require specific interventions by the operator – the action that is relevant for an analysis of reliability benefits is where a quantity of

72 http://www.aemc.gov.au/Market-Reviews/Completed/Transmission-Reliability-Standards-Review.html.

73 This is taken from: AEMO, 2009, Victorian Electricity Transmission – Network Planning Criteria, November (the current version notes that AEMO is currently updating these criteria).

74 Expected here refers to a mathematical expectation, which is the probability weighted average of the possible future outcomes.

75 The system performance requirements comprise the technical criteria within which the power system is required to be operated, as prescribed in Chapter 4 of the National Electricity Rules. In non technical terms, these criteria require the system to be operated such that the power is suitable for consumption and that the risk of a major outage is minimised.

forced load shedding is required.[76] Some of the variables that are included within the simulations (that is, are assumed to be stochastic with a defined probability distribution) include:

— demand over the planning horizon, which will depend upon factors such as weather and economic growth;

— the probabilities that generators will be available at any point in time and the likely bidding behaviour of generators;[77] and

— the probability that major transmission plant may be unavailable, which includes the probability that individual items of plant may be out of service (that is, assuming that each transmission outage event is independent of others) and an assessment of multiple, dependent outages and low probability events.

- Thirdly, the second step is repeated on the assumption that the new transmission project(s) proceed, and the change in the expected unserved energy is calculated.
- Fourthly, the value to consumers from the reduction in the expected unserved energy is estimated as VCR multiplied by the reduction in the expected unserved energy. The VCR that is applied may be the region-wide average $55 000/MWh or a more appropriate value for the specific beneficiaries of the reliability project may be used.[78]

The benefit that is calculated using this method is then compared to the cost, and a project is adjudged economically beneficial if it delivers a net benefit (and a greater absolute net benefit than possible alternative investments). As demand is (typically) forecast to increase over time, the reliability benefit from an augmentation typically would increase over time in parallel. Therefore, one of the important choices when determining whether to undertake an investment is when that project should be undertaken.

The stock and condition of generators is factored explicitly into the analysis of the benefits of transmission projects. That is, reliability benefits will only exist to the extent

76 The operator's actions generally would involve network switching and generation re dispatch (that is, out of merit order dispatch) prior to load shedding. Reducing the incidence (and hence cost) of generator re dispatch is a further potential benefit from transmission augmentation, which was referred to above as 'energy (dispatch) benefit'.

77 The assumed bidding behaviour would only affect the estimated reliability benefits if it was assumed that generators did not offer their full capacity if available (different price offers would affect only the market price).

78 The VCR of $55 000/MWh is an escalated value of the 2007 state wide average estimate of $47 850/MWh (see CRA, 2008, Assessment of the Value of Customer Reliability: Report to VENCorp, August). This latter estimate is a weighted average of the residential ($13 250/MWh), agricultural ($111 060/MWh), commercial ($90 760/MWh) and industrial ($36 070/MWh) sectors, with the weights reflecting the state wide average energy consumption of the different sectors (the shares being 0.34, 0.01, 0.34 and 0.31, respectively). Where the consumers that would benefit from a

that relieving a transmission constraint allows additional output of existing generators to supply a demand centre. Moreover, the quantum of that benefit will reflect the characteristics of the generator(s) in question, so that whether a generator is (for example) intermittent would be factored automatically into the analysis.

South Australian planning arrangements

For jurisdictions other than Victoria the Commission has proposed that deterministic planning standards should be specified, but that these should be set with reference to an analysis of the costs and benefits of meeting those standards. This is the regime that exists at present in South Australia, under which AEMO (in its former role as Electricity Supply Industry Planning Council (ESIPC) applied for ESCOSA as follows:[79]

- Firstly, for each connection point the expected unserved energy was calculated using assumptions about rates of outage of lines and transformers and the average demand for that connection point. The expected unserved energy was then multiplied by the assumed value of customer reliability to derive the total loss to consumers from that outage.[80]
- Secondly, where the total loss to consumers was sufficiently high, the capital cost of upgrading the connection point from its current reliability standard to the next highest standard was estimated and compared to the benefits. If the benefit exceeded the cost then the Reliability Standard was raised.

Comparing Victoria and South Australia

Accordingly, the methods applied in Victoria and South Australia include an assessment of the consumer value of increasing reliability against the cost. The difference between the method that is applied in Victoria and South Australia is that the latter tests only discreet levels of redundancy (that is, whether supply would be maintained if one asset is out of service when demand is at a level that it would only exceed on 10 per cent of occasions). In contrast, the Victorian method would permit a wider range of outcomes for reliability. For example an investment may be found to be justified even though it provided no additional redundancy when demand was at a level that was only exceeded on 10 per cent of occasions, but where it would provide additional redundancy for a higher level of demand (such as a value that would only be exceeded on 5 per cent of occasions). The Victorian method also requires an explicit

---

reliability improving project differ materially to the region wide average (for example, if the beneficiaries are predominantly residential) a different VCR is appropriate.

79 This is taken from: ESCOSA, 2006, Review of the Reliability Standards Specified in Clause 2.2.2 of the Electricity Transmission Code: Final Decision, September, section 1.3. Further detail is provided in ESIPC, 2005, Transmission Code Review, October.

80 In ESIPC's last review of the South Australian planning standards (reported in October 2005) it used a value of customer reliability (which it referred to as the value of customer load (VCL) of $20 000/MWh. This was based upon the then estimate of VCR for Victoria, but re-weighted to reflect the proportion of the different consumer types in South Australia.

assumption about the reliability of the generation that would be served by the network augmentation.

4.2.2 Role of the MPC in encouraging generation entry

As discussed above, generators make their entry decisions (size, type and timing of plant) based upon the value at which they expect to sell their output compared to the cost of the plant. In the absence of market power or real options, a new generator would be predicted to enter when the present value of sales revenue (net of future costs) exceeds the cost of the plant, with future cash flows discounted at the cost of capital. Sales revenue would comprise the revenue expected under contracts that are entered into, plus the net effect of spot market exposures.[81] The presence of market power may imply that the timing of new generation is later than determined from the present value calculation – this matter is returned to below.

An important issue is the extent to which a generator would expect to recover the economic benefit that it may produce by entering the market and being available to generate. The benefit that a generator would derive from constructing its plant and being available to supply would be a function of its sales (or purchases) at the prevailing spot price and revenue under contracts. The standard contracts that are entered into are futures or forward contracts (swaps)[82] and caps[83] and options over the future purchase/sale of these contracts (swaptions and captions), although these simple instruments can be combined in any way to form a portfolio of instruments, and indeed any risk sharing agreement can be created if there is a counter party. The prices at which these contracts are struck should bear a close relationship with the spot price. Economic principles would suggest that the price at which swaps are negotiated should reflect the expected spot price over the period, adjusted by a possible risk premium.[84] Similarly, the price for caps would bear a relationship to the likelihood of spot prices exceeding the strike price (typically $300/MWh) and the magnitude and duration for which they may be above this level.

Where there is a shortage of electricity generation and the market operator is required to shed load in order to maintain system security, the price is set at the MPC. At present the MPC is $10 000/MWh, although it is scheduled shortly to rise to $12 500/MWh on 1 July 2010.[85] Where either a generator or the market perceived there

---

81 That is, uncontracted output would be sold at the prevailing spot price, whereas output that is lower than contracted amounts is implicitly purchased at the prevailing spot price.

82 Under these contracts, the generator and counter party make payments so that the effect is that the generator receives, and the counter party pays, an agreed price for an agreed quantity of energy. Strictly speaking, the contracts are 'contracts for differences' around the spot price.

83 Under these contracts the generator receives a premium upfront in return for paying the counter-party the difference between the spot price and $300/MWh for an agreed quantity of energy if the spot price exceeds $300/MWh.

84 The industry rule of thumb is that swaps trade at about a 5 per cent margin over the time weighted spot price for the relevant period, at least when there is reasonable liquidity in the futures market.

85 On 30 April 2010 the Reliability Panel published its recommendations for the values of the MPC, Cumulative Price Threshold (CPT) and Market Floor Price (collectively the Reliability Settings) that

to be a risk of supply shortages, the reward that a generator would expect to receive, or that would be factored into derivative instruments (like caps), from being able to supply at that time would be limited to MPC.

Thus, in the presence of an expected shortage of supply, new generation entry would only be expected where the cost of meeting that shortfall in demand (in $/MWh terms) is lower than the MPC (that is, $10 000/MWh or $12 500/MWh). To the extent that final consumers placed a higher value on supply than MPC the private benefit to a generator from being able to supply during a period where there otherwise would be a shortage would be lower than the social benefit of that additional supply.

4.2.3 Comparing transmission and generation investment

The two previous sections suggest that on a first principles analysis:

- transmission investment for reliability purposes should be expected whenever the cost of that investment is less than the estimate of the VCR that is used in planning, which currently is on average $55 000/MWh in Victoria; whereas

- generation investment directed to improving reliability (i.e. to supply load that otherwise would have been shed) should be expected in a well functioning market up to the point that the cost of the generation option is less than the market price cap, which currently is $10 000/MWh but will shortly rise to $12 500/MWh on 1 July 2010.

It follows that where the costs of reliability-improving opportunities are lower than the MPC, investment in both generation and transmission would be attracted. Whether the efficient mix of transmission and generation investment occurs will depend upon such matters as the locational signals that are provided to generators and how the assessment of transmission augmentations was undertaken by the relevant planning entity, but the MPC would not be a constraining factor.[86]

Where the cost of a reliability-improving project exceeds the MPC, a generator would not be expected to find that project privately profitable and hence generation projects

---

should apply from 1 July 2012. The Reliability Panel recommended that both the MPC and CPT should be indexed by the Producer Price Index from this date. The Reliability Panel's report is available at http://www.aemc.gov.au/Market-Reviews/Completed/Review-of-the-Reliability-Standard-and-Settings.html.

86 This issue is mentioned here only for completeness as the focus of the analysis is on whether the efficient mix of reliability-improving transmission and generation is selected for projects that have an implied cost (in $/MWh of additional energy delivered) in excess of the MPC. However, it is noted that it is not clear that an efficient mix of generation and transmission projects naturally would emerge from the current market settings given that generators are not exposed transparently and directly to the cost associated with transmission network augmentations within regions. That is, the risk exists that a generator may locate at a certain point in the expectation that the transmission network would be augmented subsequently to permit it to export all of its energy even though it may have been beneficial from society's point of view for a generator to be constructed in a location that may have higher generation costs but where it is less costly to augment the transmission network.

would not proceed. In contrast, higher cost transmission projects may continue to be constructed until the cost of those projects (in $/MWh for the additional energy sold) rose to the value of customer reliability that was used in planning (currently on average $55 000/MWh in Victoria). Thus, the MPC would affect the mix of projects that would be expected to be employed to improve reliability, with only transmission options expected after the cost of the reliability improving project exceeds the MPC. The effect of the MPC on the cost of reliability-improving projects and the resulting level of reliability is discussed in Chapter 6.

4.2.4 Other matters affecting the mix of generation and transmission investment

There are three other matters that may affect the relative mix of generation and transmission options.[87]

Market power

Firstly, the discussion above about the conditions under which a new generator would be expected to enter assumed there was no market power present in the generation market. If there was some transitory market power expected, the timing of generation entry may be affected by other, strategic considerations of the generators. In particular, an independent generator may be dissuaded from entering out of a concern that incumbents may retaliate if it enters. Alternatively, an incumbent may construct new plant earlier than would otherwise be efficient in order to 'fill the available gap' in supply and so deter other entrants.

The predicted outcome for the timing of generation entry in the presence of market power is complex and has not been analysed here.

Lumpy investment

Secondly, if a generation plant is large compared to the relevant market then its entry may affect both spot and contract prices. This in turn implies that the generator would not be able to internalise all of the reliability benefit that is generated as it would get paid for all units of supply at the final spot and contract price rather than at the higher prices that would have been observed if it had not entered.

Again, this matter is complex and is not addressed in detail here, apart from observing that this factor may lead generators to defer entry (all else being constant) compared to the efficient timing.

---

87 A further real life feature that was assumed away was the presence of 'real options'. Real options may imply that it is efficient for sunk investment to take place earlier or later than a simple net present value analysis would indicate, depending on the character of the real option that is assumed. While applying real options analysis in practice to investment appraisal is notoriously difficult, if entry is advanced or deferred due to the presence of real options then that is an efficient outcome.

Relative risk of generation and transmission investment

Thirdly, it is likely to be the case that generators are subject to more risk than transmission businesses, and hence generally seek higher rates of return on their investments. For example:[88]

- If there is a downturn in demand (for example, arising from a recession), then the returns to generator would be expected to fall. In contrast, the revenues to transmission businesses are largely preserved in the face of demand shocks, both between price reviews (as they are under a revenue cap) and as a result of prices being reset to cost at a review.

- Similarly, generators also have a greater exposure to interest rate movements as changes in interest rates would only be expected to flow through into spot and contract energy prices only over time, whereas transmission business revenues are reset in line with prevailing interest rates every five years.

- In addition, generators face the risk that new technology may make their assets uncompetitive earlier than expected ('stranded') and also face the risk of not being able to sell all of their output if transmission constraints occur (and, if the generator's output was contracted and spot prices were high, it could incur a large liability under those contracts), whereas transmission businesses are shielded from this or equivalent risks.

Are the generation and transmission VCRs the same?

It was assumed in the discussion above that the VCR associated with generation and transmission is the same. However, whether this is the case depends upon which types of consumers are affected by an outage.

As noted above, the most recent estimates of the VCR (which was undertaken for Victoria, although they should be broadly relevant to other jurisdictions) was based upon an estimate of VCR for four different sectors and a weighted average calculated, with the weights reflecting the shares of energy consumption of the different sectors. The estimates of VCR for the different sectors (and their weights, based on annual energy consumption) were:

- residential – \$13 250/MWh (0.34)

- agricultural – \$111 060/MWh (0.01)

- commercial – \$90 760/MWh (0.34)

- industrial – \$36 070/MWh (0.31).

---

88 The first two of the factors below are likely to affect the relative systematic (beta) risk of the assets, and hence the cost of capital. The third factor is relevant to the question of how quickly costs would be expected to be recovered.

It follows that the actual VCR associated with a project is sensitive to the identity of the consumer that would benefit from the project or, equally, the identity of the consumer that may have lost supply if the relevant project had not taken place.

The potential exists for generation and transmission outages to have a different impact across the various sectors and so have a different VCR. Indeed, the fact that the VCR for commercial and industrial consumers are almost seven and three times the VCR for residential consumers (respectively) means that, where load shedding is required, material efficiency gains may exist from targeting the load shedding towards residential consumers to the extent that the response time and technology exists.

To the extent that the operator has more time to respond to shortages in generation than it does for a shortage of transmission, then a longer response time would be expected to permit a greater targeting of the load shedding to the extent that this is practicable[89], and (if so) a commensurately lower VCR.

Furthermore, the introduction of smart meters and associated back office systems would enhance the capacity for load shedding to be targeted in a manner that would be expected to reduce the cost of outages. In particular, smart meters will bring the capacity to effect load shedding remotely at the consumer meter, and hence permit consumer types that have a low VCR to be turned off in preference to those with a high VCR and also to ensure that high value loads (such as traffic lights, public transport and public events) are maintained with certainty. In addition, smart meters can also permit a load shedding requirement to be effected by turning down a larger number of consumers rather than turning them off altogether,[90] which would also be expected to reduce the costs caused by an outage.[91]

4.3 Impact of increasing the MPC on reliability to final consumers

4.3.1 Introduction

The reliability of supply to the connection point between the transmission and distribution networks depends on the reliability of the generation sector in addition to the reliability of the transmission sector.

89 The extent to which it is practical to discriminate between customers during periods of load shedding is discussed further in Chapter 3.

90 This can be given effect by imposing a capacity limit on a consumer's consumption so that the connection would remain energised if the rate of consumption was below that limit, but would be disconnected if the rate would otherwise exceed the limit. Consumer education and communication during an incident would be necessary to make the scheme fully effective.

91 This follows because the first unit of consumer's consumption (for example, a refrigerator or lights) is likely to be more valuable than the last unit of a consumer's consumption (for example, a pool pump or plasma television), which means that the saving in consumer benefit from not turning certain consumers off completely would outweigh the consumer cost from partially turning off consumers that otherwise would have been unaffected.

In this section we consider whether the reliability at the connection point between the transmission and distribution networks is determined by the greater of the MPC and the VCR in transmission planning standards (implicit or explicit). That is, would increasing the MPC result in higher end-user reliability, or in the longer term would transmission investment reduce because less transmission is required to meet transmission reliability standards when the generation sector is more reliable – thus resulting in no change to reliability for consumers but less efficient investment mix.

4.3.2 Impact of increasing MPC

We consider that the level of the MPC does impact on the overall reliability.

At the outset, it is important to note that the VCR is not a level of reliability, but is an estimate of the value customers will be willing to pay in the short term to maintain continuity of supply. The other factor that would affect whether a reliability improvement would be efficient is the cost of improving reliability. Thus, if it is very cheap to improve reliability then it is more likely that reliability-improving projects would be undertaken than if it was expensive to improve reliability. In turn, the level of reliability in the former case would be expected to be higher reflecting the additional projects that were undertaken.

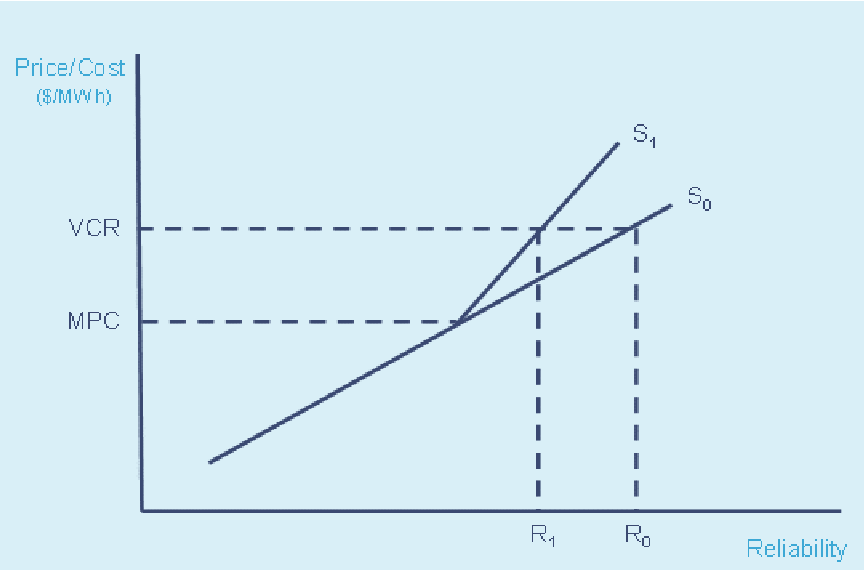
Further, generation investment for reliability purposes would not be expected beyond the point where the cost of the option exceeded the MPC. Beyond this point, the supply of reliability improving projects would be restricted to transmission investments only. If it is the case that there were generation projects that had a cost that was greater than the MPC but were cheaper or more effective than transmission options, then if only the transmission projects were implemented (up until the cost of the project equates to the VCR), then fewer reliability improving projects would implemented and a lower level of reliability would result.[92]

This process can be shown diagrammatically Figure 4.1. In the figure, there is assumed to be a range of independent reliability improving projects that comprise both generation and transmission options, that span low cost projects to progressively higher cost projects. These series of reliability-improving projects can be thought of as the supply of reliability, and is depicted by S0. If all of these reliability improving projects were available, those projects would be undertaken successively until the cost at which additional reliability can be supplied equates to the VCR, which yields a level of reliability of R0.

However, if the generation options are ignored when the cost of projects exceeds the MPC then a lower quantity of reliability improvement would be available than before (which is the same as saying that the cost of achieving any quantity of reliability improvement is higher). This is depicted as S1, the horizontal difference between S0 and S1 being the quantity of generation reliability improvements that are available at each cost band. With the reduced quantity of reliability improving projects available reliability improving projects would only be undertaken until reliability reached R1.

92 The is assumed in this section that the VCR for transmission and generation projects are the same.

Figure 4.1 **Supply and expected level of reliability with and without generation**



Thus, the predicted effect of the MPC being lower than VCR is that reliability would fall from R0 to R1.

The assumptions in Figure 4.1 are strict, in particular the assumption that the projects all have an independent effect on reliability is unlikely to be the case (unless the reliability improvements relate to separate parts of the network: for example, to connection assets). It should also be noted that the VCR used for transmission planning may also drive non-network solutions, such as generation or demand side options, where these options are more cost-effective than the available network augmentations.

An alternative, and possibly more realistic outcome is that if transmission projects are undertaken in the cost range that is above MPC but generation options are not, then the reliability yield of transmission projects will be lower than otherwise. The reason as to why the reliability yield of further transmission projects would fall is because transmission and generation projects are (at least in part) complements – as discussed above, the reliability benefits provided by transmission depend upon the stock of generation. Thus, there are likely to be cases where a generation project combined with a transmission project will increase the reliability yield and reduce the unit cost of reliability improvements. This outcome is also described in Figure 4.1. In this case, So refers to the cost of delivering reliability improvements by augmenting the transmission network when efficient generation projects proceed in parallel. S1 shows how the per unit cost of improving reliability through transmission augmentations falls if generation projects cease. Again, the effect of raising the per unit cost of reliability improvement is that fewer reliability improving projects occurs before VCR is reached, and so the level of reliability is lower.

4.4 How reliability standards and processes for generation and transmission investment could be better aligned

The main implication of the analysis above is that setting the MPC for the energy market at a level that is lower than the value that consumers place upon reliability would be expected to reduce the level of reliability. While transmission investment will continue until the cost of the last project (in terms of $/MWh of additional energy supplied) equated to the estimate of the VCR (also in $/MWh terms), if the cap precludes more effective generation options being undertaken, the level of reliability will be lower.

However, there are several issues with implementing this approach.

Firstly, while it is often assumed that there is one VCR for generation and transmission projects, this need not be the case. The VCR for either project depends upon how the operator is expected to respond when there is a shortage of generation or transmission and, in particular, whose load is likely to be shed. The empirical information on the VCR for different consumer types suggests that large efficiency gains are available from targeting load shedding to residential consumers in preference to commercial or industrial consumers. To the extent that a greater response time is available for a generation shortage compared to a transmission shortage, then the scope for more efficient load shedding, and hence a lower VCR, exists.

It was also noted that technology, in the form of smart meters, is likely to improve the capacity to load shed in an efficient manner. Smart meters will permit load shedding on a per consumer basis and also permit a wider group of consumers to be turned down rather than turned off altogether.

Secondly, an important consideration with the MPC is the trading risk borne by retailers from changes to the MPC. To the extent that the conclusions above are considered to warrant a material increase in the MPC, this would need to be balanced off with a consideration of the implications for trading risk.

4.5 Conclusions

We conclude that efficient investment in reliability across the supply chain can be achieved by investing to the level of VCR for those consumers most affected by the investment. With respect to generation investment, the level of VCR for residential consumers should be used because this class of consumer places the lowest value on reliability and are usually shed first during a reliability event. At present the VCR level for residential consumers (in Victoria) is estimated to be $13 250/MWh, which aligns reasonably closely with the current MPC. For transmission investments, the level of VCR should reflect the class of consumers that would be affected by the investment.

As noted above, economic criteria incorporating the VCR are used in developing transmission standards in Victoria and South Australia, however the deterministic transmission planning standards applied in New South Wales, Queensland and Tasmania are not explicitly based on the VCR or related economic criteria.

In order to implement our conclusion that transmission planning and investment should occur up to the level of the VCR for the relevant consumer class, it would be necessary to approve, and implement the recommendations of the AEMC's Transmission Reliability Standards Review, which is currently with the MCE for consideration.

5 The Reliability Standard

Chapter Summary

This Chapter provides our analysis of whether the specification and interpretation of the Reliability Standard is appropriate for the future, and we have made some recommendations for improvement.

The purpose of the Reliability Standard is to assess whether sufficient investment in generator capacity is occurring to meet changes in consumer demand. 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.

Under the NEM reliability framework the key mechanism for delivering investment in generation is the expectation of future prices which can be influenced by modifying the level of the MPC. There is a direct linkage between the mechanism for delivering investment in generation, that is the MPC, and the measure for assessing whether sufficient investment in generation is taking place, that is the Reliability Standard. This linkage is important to ensure that efficient and appropriate investment takes place. For this reason, we consider that the current scope of the Reliability Standard (that is, applying to generation and inter-regional transmission only) is appropriate.

The issue with having separate measures of performance for each element of the power system is that the measures and mechanisms for delivering performance against those measures may not be consistent, and may not overall meet consumer expectations for quality of supply.

We therefore recommend that the Annual Market Performance Review currently undertaken by the Reliability Panel be expanded to better examine the performance of the power system as a whole (as experienced by consumers at the point of consumption) and the individual segments of the power system (including distinguishing between main system reliability and security events). We also recommended that the AEMC review the findings of the Annual Market Performance Review from the perspective of market design and if it is found that the current market design is no longer efficiently meeting the expectations of consumers for quality of supply, changes would be recommended to the MCE as appropriate. We consider that the Annual Market Performance Review for the 2009-10 financial year can incorporate these additions.

We consider that based on available information the level of the Reliability Standard (0.002% of unserved energy) currently broadly reflects the level of reliability valued by consumers. In Chapter 7, we recommend changes to the arrangements for determining the Reliability Standard to ensure that the standard continues to reflect consumer expectations into the future including under a possible future scenario of increased extreme weather.

Finally we support the recent decision by the Reliability Panel to amend the Reliability Standard so that the circumstances contributing to each reliability event would be investigated on an annual basis to determine whether each reliability event is consistent with the anticipated performance of the NEM. We are of the view that an annual review of reliability events would enable market institutions to identify a degradation in reliability due to extreme weather, and take the necessary remedial action sooner than would be likely under the current practice of compliance.

5.1 Introduction

This chapter provides our final advice on the appropriate specification and interpretation of the Reliability Standard for the future (as requested by the MCE in the revised terms of reference for this Review). Specifically this chapter examines:

- the definition of the Reliability Standard;
- the performance of the NEM against the Reliability Standard over the past ten years;
- the specification and interpretation of the Reliability Standard for the future in terms of the form, scope and level; and
- further measures to assess compliance with the Reliability Standard.

The Reliability Standard applies to supply interruptions that are classified as 'reliability events' and originate in the generation sector (and the inter-regional elements of the transmission sector). As such, the recommendations in this Chapter will not specifically address:

- supply interruptions originating in the intra-regional transmission or distribution networks. These supply interruptions would be more efficiently addressed through the network planning regimes. It is recognised that in some circumstances, measures applied in the generation sector can be used to address a network capacity constraint, although in those circumstances, the generation investment would be incentivised through the network planning regime rather than through the generation planning regime (i.e. not the MPC). These matters are further addressed in the AEMC's Report to the MCE on Transmission Reliability Standards Review.[93] The network planning regimes are discussed further in Chapter 4;
- supply interruptions caused by security events (the distinction between reliability and security events is outlined in Chapter 2). Security related events are discussed in Chapter 3.

93 www.aemc.gov.au.

Consumer supply continuity is dependent on the ability of the power system to deliver power across the entire supply chain. Chapter 4 discusses the important interactions between the planning and investment regimes for each stage of the supply chain and the importance of considering all stages of the supply chain when assessing consumer supply continuity.

5.2 Definition of the Reliability Standard

Reliability in the NEM is a measure of the adequacy of the electricity generating systems and networks to meet the demand of consumers. Reliability depends on:

- whether there is sufficient generation available for a given region of the NEM to meet the consumer demand in that region; and
- the availability and adequacy of the transmission and distribution networks to deliver electricity from the generators to consumers.

The relevant Reliability Standard discussed in this Chapter refers specifically to reliability affecting the generation sector and inter-regional transmission. The Reliability Standard excludes distribution and those transmission components that do not impact on inter-regional transfer capability. In terms of events, the Reliability Standard currently excludes power system security incidents and exogenous incidents such as industrial action and terrorism.

The Reliability Standard is an expectation that a level of reliability will be achieved over the long term. Importantly, the Reliability Standard is not a guarantee that the power system will not exceed the unserved energy (USE) for a particular region. Rather, the Reliability Standard is a statistical measure that accounts for variability in the actual reliability achieved for a given year.

In operational terms, the level of the Reliability Standard specifies how much USE is acceptable as a percentage of annual demand. The level is currently set at 0.002% USE per annum measured over the long term. This equates to the interruption of supply to every consumer in a region for approximately 10 minutes each year. The Reliability Standard is measured over the long term because it is not possible to guarantee that USE will not exceed 0.002% in any one year. A particularly onerous combination of random equipment failures, or a very high demand peak, could result in USE greater than 0.002% in a year. The Reliability Standard is designed to deliver an expectation of 0.002% USE in a year. However, it is possible that the USE will be greater than 0.002% in some years and will be less than 0.002% in other years. The Reliability Settings for the NEM are designed such that on average, over the long term, the power system will achieve 0.002% USE.

The Reliability Standard is targeted to be achieved every year, but compliance with the Reliability Standard is measured over the long term. The Reliability Standard is currently measured using a moving average of the actual observed levels of annual

USE for the most recent ten financial years.[94] AEMO aims to not exceed the Reliability Standard for each year. If AEMO's analysis determines that it is likely that the Reliability Standard will not be achieved in a year, AEMO contracts for reserves under the RERT provisions. Due to demand and generator availability uncertainty, AEMO cannot guarantee that the USE would not be greater than 0.002% in any year. However, AEMO can contract for reserves under the RERT provisions to increase the probability of achieving the Reliability Standard. In real-time, AEMO targets zero USE by taking all possible action to avoid involuntary load shedding. AEMO is able to target zero USE in real-time because close to dispatch it has a higher degree of certainty regarding demand and equipment availability and thus the likelihood of a capacity shortfall.

5.3 Performance of the NEM against the Reliability Standard to date

This section examines the performance of the NEM against the Reliability Standard. Since its inception in 1998, the NEM has performed well against the Reliability Standard. Table 5.1 below shows the performance of the NEM against the Reliability Standard for the past 10 years.

Table 5.1 Regional USE for the past 10 years

	Qld	NSW	Vic	SA	Tas[95]
2008-2009	0.0000%	0.0000%	**0.0040%**	**0.0032%**	0.0000%
2007-2008	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%
2006-2007	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%
2005-2006	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%
2004-2005	0.0000%	**0.00005%**	0.0000%	0.0000%	0.0000%
2003-2004	0.0000%	0.0000%	0.0000%	0.0000%	
2002-2003	0.0000%	0.0000%	0.0000%	0.0000%	
2001-2002	0.0000%	0.0000%	0.0000%	0.0000%	
2000-2001	0.0000%	0.0000%	0.0000%	0.0000%	
1999-2000	0.0000%	0.0000%	**0.0004%**	**0.0019%**	
Average	**0.0000%**	**0.0000%**	**0.00044%**	**0.00051%**	**0.0000%**

As illustrated above, the average annual USE over the past 10 years is well within the Reliability Standard of 0.002% for all regions and for the NEM as a whole.

94 Note that as discussed in section 5.6, the Reliability Panel has amended the Reliability Standard, to take effect from 1 July 2012, such that performance of the NEM will be examined against the Reliability Standard each year rather than measured against a 10-year moving average.

95 There is no data reported for first five years as TAS joined the NEM in May 2005.

In Victoria and South Australia USE for 2008-09 was above 0.002%. The conditions that lead to the 2008-09 load shedding event have been estimated by AEMO as a 1 in 20 year event. As the NEM is planned to meet 1 in 10 year extreme demand events, some load shedding during 1 in 20 year extreme demand events is not unexpected.

Table 5.1 demonstrates that the NEM Reliability Settings (primarily the MPC) and AEMO, in its operational capacity, have delivered a high level of reliability in the NEM (measured against the Reliability Standard). However, past performance is not necessarily a guide to future performance when the power system will need to be sufficiently resilient to cope with changing demand and possible changing weather patterns. The forecasts used to derive the NEM Reliability Settings include an allowance for small increases in temperature to account for climate change, but do not model increased severity or frequency of extreme weather.

The 2009 Electricity Statement of Opportunities (ESOO) indicated that Victoria and South Australia are the regions most likely to first experience a reserve shortfall. Between the 2008 and 2009 publications of the ESOO, new investment in generation and a reduction in demand forecasts in Victoria and South Australia have lengthened the projected years until reserve shortfall in Victoria and South Australia from 0 years (2008 ESOO) to 3 years (2009 ESOO). The ESOO uses very high demand forecasts (maximum annual demands that are expected to occur just once in every 10 years, known as 10% Probability of Exceedance (POE) demand). However, in extreme years actual demand can exceed the demand forecasts used in the ESOO (for example if a 1 in 20 year maximum demand event were to occur such as that which occurred in Victoria/South Australia in January 2009). Thus if a period of extreme weather, as exemplified in Victoria and South Australia during January 2009, were to occur again within three years, then it would be possible that Victoria and South Australia would experience reserve shortfalls and a heightened risk of supply interruption.

High performance against the Reliability Standard does not necessarily equate to a high level of supply continuity experienced by end-use consumers. As discussed in Chapter 2, it is appropriate for the Reliability Standard to only apply to supply interruptions caused by reliability events originating in the generation sector. In order to examine supply continuity experienced by consumers, supply interruptions originating in the transmission and distribution sectors as well as security-related events must also be considered.

5.4 Submissions on the Reliability Standard

Views were sought from stakeholders as to the adequacy of the current Reliability Standard. Some stakeholders considered that the current Reliability Standard is adequate for present purposes.[96] Other stakeholders, however, suggested options for improving the current Reliability Standard. The following key issues were raised:

96 TRUenergy Submission, p.3; NGF Submission, p.6.

1. it would be more appropriate to supplement the 10 year rolling average with an additional five year rolling average;[97]

2. it would be beneficial to introduce measures that translate outages into expected frequency and duration of events;[98]

3. a decaying rolling average (rather than the current 10 year rolling average) would lessen the impact of an outage over time;[99] and

4. there is a need to introduce new measures to improve the market's understanding of unserved energy or to assess whether annual unserved energy outcomes are within an acceptable statistical range (i.e. statistical process control or control interval techniques).[100]

The Victorian Department of Primary Industries (DPI) noted specifically a study that explored the value that consumers place on reliability of supply of electricity.[101] Similar studies have not been conducted in other regions. DPI suggested that the results of this study could either be applied to other regions or be specifically applied to determining the Reliability Standard and Reliability Settings for Victoria.[102]

The MEU argued that the current Reliability Standard in the NEM is too aggressive (that is, USE of 0.002%) and posed arguments that the level of USE could be relaxed with little detriment to consumers while generating some cost savings for the benefit of consumers.[103]

5.5 Specification and interpretation of the Reliability Standard in the future

To meet the community's expectations regarding reliable electricity supply in the future, the Reliability Standard must be specified and applied so as to facilitate the most efficient delivery of reliability at costs that reflect the value placed by consumers on reliable power supply.

There are three main aspects to any Reliability Standard: form, level and scope.

- The form of the standard is the method by which reliability is measured. The current NEM standard is an output-based measure expressed in terms of targeted permissible USE.

---

97 LYMMCO Submission, p.5.

98 Ibid.

99 Tasmanian Office of Energy Planning and Conservation Submission, p.2.

100 NGF Submission, p.6; International Power Australia (IPRA) Submission, p.3; LYMMCO Submission, p.5.

101 Charles River Associates, *Assessment of the Value of Customer Reliability (VCR) - prepared for VENCorp*, 12 August 2008, www.aemo.com.au.

102 Victorian Department of Primary Industries Submission pp.3-4.

103 MEU Submission, p.35.

- The level of the standard specifies the targeted level of permissible interruption to supply that is judged to reflect the community's value of the trade-off between supply reliability and the associated cost. This is also an expression of risk. The current level of the standard is defined as 0.002% USE per annum.

- The scope of the standard defines what does and does not count towards the NEM's reliability performance. In terms of the electricity supply chain, the standard currently includes generation and bulk transmission capacity (that part of the transmission network used to transport electricity between regions). The current standard does not include the reliability performance of intra-regional transmission (that part of the transmission network used to transport electricity within regions) or distribution networks. In terms of events, the standard currently excludes power system security incidents and exogenous incidents such as industrial action and terrorism.

5.5.1 Form of the Reliability Standard

There are various approaches used to define the form of the Reliability Standard. These approaches typically refer to:

- the frequency of supply interruptions – for example, the number of days per year in which an interruption occurs;

- the cumulative duration of interruptions – for example, the total number of hours per year that interruption to any (not necessarily the same) consumer occurs; and

- the amount of energy not supplied in a period.

The NEM's Reliability Standard, which is expressed in terms of USE, is an example of the third approach outlined above.

The use of any particular form of Reliability Standard poses limitations in terms of the information not provided. For example, the NEM's USE standard provides no information about the frequency of supply interruptions nor about the impact of any single interruption. Further, the USE standard does not capture the difference in the actual experiences of consumers in different regions. For example, in a region where the demand profile is very peaky (e.g. air-conditioning use increases dramatically on occasional very hot days), the entire allowance of unserved energy (the whole 0.002%) could be experienced in a single hot day. Alternatively, in a region where the demand profile is quite flat (e.g. air-conditioning use is minimal or fairly constant because temperatures are consistently high), shortfalls in supply are likely to be less severe but may be more frequent.

In the CRR, the Reliability Panel considered the introduction of a hybrid standard which would be a combination of a number of the reliability definitions outlined above. The Reliability Panel concluded that:

> "The current USE standard in the NEM is an energy standard for an energy-only market. This design is well suited to placing value on cumulative, long-term energy shortfall and thus rewarding additional energy generation or consumer responses to reduce that shortfall. Introducing a hybrid standard is likely to create conflicting objectives that cannot readily be incorporated into the market design. For instance, introducing parameters to limit the frequency or depth of individual events may unavoidably affect the cumulative, long-term energy shortfall. Such parameters are also incompatible with the ability of the energy-only market to provide the necessary financial incentives for investment in generation. Hybrid standards, in effect, are as restrictive as their most restrictive element, whether that is long-term USE, annual shortfall, or shortfall from an individual event. Introducing an additional parameter, therefore, may cause the USE standard to be inadvertently tightened, with an associated cost to the consumer.[104]"

In our Second Interim Report for this Review, we concluded that:

- the Reliability Panel's reasoning for maintaining a single form of Reliability Standard is still relevant today;
- USE remains the most appropriate form for the Reliability Standard, because it is relatively easy to measure and interpret from an operational perspective, reflects the economic impact on typical end-users and aligns with the existing mechanisms in the NEM to incentivise and deliver reliability; and
- it is essential that the form of the Reliability Standard be consistent across all regions of the NEM.

We noted in the Review Second Interim Report however, that there is scope to provide more comprehensive information in relation to the frequency and duration of supply interruptions while maintaining the USE form as the single parameter for specification of the Reliability Standard. Greater information regarding supply interruptions would assist policy makers and market institutions to better understand how supply interruptions are impacting end-users. This would facilitate early identification of problems and the need for improvements to the current mechanisms available for delivering reliability. In the context of extreme weather, this information would be particularly pertinent because, while the total level of USE may not change, the impact on end-users could change considerably (such as fewer consumers being impacted, but those consumers being impacted to a much greater extent).

With respect to the information required, we recommend that an Annual Report that details the performance of the NEM for the preceding twelve months is produced. This Annual Report would address concerns expressed by jurisdictions that the quality of electricity supply as experienced by consumers (at the point of consumption) is not currently assessed against consumer expectations. The performance of some of the

104 AEMC Reliability Panel, *Comprehensive Reliability Review*, December 2007, p.24, www.aemc.gov.au.

individual components of the power system contributing to the quality of consumer supply are assessed (such as the reliability of the generation sector being assessed against the Reliability Standard), but the performance of each individual component of the power system are not considered in aggregate (including aggregating reliability and security events) to ensure that overall consumer expectations of quality and value are being met efficiently. We recommended that the Annual Report should contain the following features:

- a statistical analysis of reliability and security events affecting supply continuity for consumers, including events originating in the generation, transmission and distribution sectors. The data would be categorised based on the cause and origin of the event (e.g. security event originating in the transmission sector). This would enable the performance of each sector of the power system to be examined and compared with the other sectors to ensure a consistent level of performance is being delivered across the supply chain. It would also assist in identifying the most efficient action to take to effect a change in the performance of the power system;

- aggregated data to assess the overall performance of the power system. This would enable the performance of the power system as experienced at the consumer connection point to be assessed against consumer expectations for reliability;

- a complete picture of consumer experience, supply interruptions to be reported against different measures including the frequency of supply interruptions, the total duration of supply interruptions, and the total amount of energy not supplied during the year. At least one common metric would be required to compare the performance of each sector of the supply chain;

- a detailed examination of any supply interruptions would be reported against the Reliability Standard applying in the generation sector. This examination would consider the impacts on each class of consumer, and would also consider state-wide and national impacts such as the impact on the economy or investment. The examination would then consider whether the event is within the distribution of events expected from the power system or whether changes are required to the market design or settings to improve the performance of the power system. The purpose of these examinations is discussed further in section 5.6; and

- an assessment of whether the NEM's frameworks and mechanisms are delivering the quality of supply as valued by consumers.

We note to produce such a report, all the data required would be available from various sources including AEMO, the AER, or relevant jurisdictional regulators. We do not envisage this report publishing any new data.

One of the Reliability Panel's functions is to "monitor, review and report on the performance of the market in terms of reliability of the power system".[105] Given this function, we consider that the Reliability Panel would be the appropriate body to produce the Annual Report. This would be a natural progression of the Annual Market Performance Review currently undertaken by the Reliability Panel.[106] We intend to implement this Annual Report by providing a Terms of Reference to the Reliability Panel[107] on an annual basis specifying the requirements for the Annual Report. We consider that the Annual Market Performance Review for the 2010-11 financial year can incorporate these additions.

The AEMC will review the findings from the Annual Report from the perspective of market design and if it is found that the current market design is no longer efficiently meeting the expectations of consumers for quality of supply, we will recommend changes to the MCE.

Recommendation

We recommend that the Annual Market Performance Review currently undertaken by the Reliability Panel be expanded to better examine the performance of the power system as a whole (as experienced by consumers at the point of consumption) and the individual segments of the power system (including distinguishing between main system reliability and security events). This improved report would better enable policy makers to monitor whether the power system in aggregate continues to deliver the quality of supply valued by consumers and to provide evidence to support efficient changes to the market design or settings when consumer expectations are not being met.

This will be implemented by the AEMC providing a Terms of Reference to the Reliability Panel in accordance with (clause 8.8.3(b) of the Rules) on an annual basis outlining the requirements of the report. We consider that the Annual Market Performance Review for the 2009-10 financial year can incorporate these additions.

It is further recommended that the AEMC will review the findings from the Annual Market Performance Report from the perspective of market design and if it is found that the current market design is no longer efficiently meeting the expectations of consumers for quality of supply, we will recommend changes to the MCE.

105 Clause 8.8.1(a)(1) of the Rules.

106 Clause 8.8.2(b) of the Rules.

107 Under clause 8.8.3(b) of the Rules.

5.5.2 Level of the Reliability Standard

The level of the Reliability Standard has been set at 0.002% USE since the commencement of the NEM.

The Reliability Panel reviewed the level of the standard as part of the CRR and concluded that the Reliability Standard should be maintained at 0.002% for the following reasons:

"• There has been no call from stakeholders in their submissions, particularly those of consumer representative groups, for a change to the standard's level.

• Countries that appear to have more stringent standards generally have characteristics (such as larger system size and high levels of interconnectedness) that would make a higher standard less costly to achieve.

• Reliability events are responsible for a very small proportion of actual or forecast interruptions.

• Any tightening of the level of the standard would likely have a substantial cost in terms of required new investment.[108]"

The Reliability Panel also noted that there was no request from stakeholders, including those of consumer representative groups, for a change to the standard's level. This was consistent with the NEM's historical out-performance of the targeted level of reliability and hence the absence of an evident case for change.

The Reliability Panel has recently completed a further review of the level of the Reliability Standard in its Reliability Standard and Settings Review[109]. Only one submission (Major Energy Users[110]) to that review proposed a change to the level of the Reliability Standard (a relaxation of the standard). The Panel also concluded that there was no compelling evidence to change the level of the Reliability Standard.

The objective of the Reliability Standard is to deliver an expectation of reliability that reflects the value that consumers place on reliability. As discussed in Chapter 4 we highlighted that the level of the MPC (which is due to rise to $12 500 on 1 July 2010) is similar in level to the VCR calculated for Victorian residential consumers ($13 250[111]). It has been shown that consumers residential consumers value reliability least out of all consumer classes in the NEM[112], and as such should be shed before other classes of

108 AEMC Reliability Panel, *Comprehensive Reliability Review,* December 2007, p.32.

109 AEMC Reliability Panel, *Reliability Standard and Reliability Settings Review*, 30 April 2010.

110 Major Energy Users Inc, Submission to Draft Report, February 2010.

111 We believe it is most likely that residential consumers in all NEM regions would value reliability at broadly the same level.

112 CRA International, *Assessment of the Value of Customer Reliability - A report prepared for VENCorp,* 12 August 2008.

consumer under efficient load shedding arrangements. Based on this analysis, we advanced a position that the level of the MPC would deliver an expectation for reliability broadly consistent with consumer expectations because the spot price can rise to the level to which the consumer class most effected by supply interruptions (residential) are willing to pay to maintain continuous supply. As the MPC is set consistent with achieving the Reliability Standard, we concluded that the level of the Reliability Standard is set at the appropriate level to deliver an expectation of reliability reflective of the value that consumers place on reliability. This reasoning is expanded in Chapter 4.

Whilst we consider that the level of the Reliability Standard is currently broadly reflective of consumer expectations, we do not consider that this was necessarily due to good market design and governance arrangements. In Chapter 8 we make some recommendations for changes to current arrangements that would ensure that the Reliability Standard continues to reflect the value that consumers place on reliability, including under a possible future scenario where the incidence of extreme weather events is greater.

Rather than setting a target for reliability, an alternative approach would be to set the MPC to the value consumers place on reliability. That is at an estimate of the electricity price above which energy users would prefer not to consume rather than pay the cost involved, often referred to as Value of Customer Reliability (VCR). However the VCR for all NEM consumers has never been evaluated and such an evaluation will necessarily have to address complex issues such as variations in VCR across different classes of consumers and consumers in different locations. Under such an approach, changes to the arrangements for the management of any short term imbalances between supply and demand by AEMO may need to be developed. This option is considered in detail in Chapter 8.

We consider that based on available information, the level of the Reliability Standard currently broadly reflects the level of reliability valued by consumers. This is because the level of the MPC appears to be broadly consistent with the VCR determined for residential consumers, the consumer class most frequently impacted by reliability events.

5.5.3 Scope of the Reliability Standard

The scope of the Reliability Standard defines those elements of the supply chain that are covered by the standard and the causes of supply interruptions that are, or are not, taken into account when targeting reliability and measuring reliability outcomes.

The Reliability Standard covers the generation and bulk transmission elements (that is that part of the transmission network that transports generation between regions). In relation to causes, the Reliability Standard takes into account 'reliability events', but not 'power system security events' and 'external factors' (such as industrial action). It is important that the Reliability Standard only measures supply interruptions that can be addressed through investment in new generation. It is for this reason that power system security issues and external factors are excluded.

Other standards and incentive mechanisms are available to address other areas of consumer reliability (for example, network investment is driven by the regulatory framework in the Rules and network reliability standards that are currently set by jurisdictions).

We consider it is appropriate that the Reliability Standard applies to bulk transmission in addition to generation. As a region can rely on generation from another region to satisfy its consumer load, it is important that the inter-regional transmission system is capable of delivering that generation to the load. We also consider it is appropriate that the Reliability Standard excludes system security events and external factors. System security events are often location specific. As such, new generation delivered by a regional price signal could be located in the wrong location to address the issue. In addition, it may be more efficient to better incentivise existing equipment owners to minimise system security events rather than investing in new generators that would largely remain on standby until an item of equipment fails.

USE due to external factors such as industrial action at a power station is not included in the Reliability Standard. It would not be efficient to lift the MPC to incentivise additional generation to manage the rare event of some industrial action that causes load shedding.

We consider that the scope of the Reliability Standard, that is, that the Reliability Standard covers generation and inter-regional transmission only, is appropriate. The purpose of the Reliability Standard is to measure the adequacy of investment in the generation sector and to form a basis for modifying the incentives that apply to generation investment. Other factors affecting the quality of electricity delivered to consumers are measured and incentivise by other mechanisms that are more appropriate for each individual factor.

5.6 Further measures to assess compliance with the Reliability Standard

Prior to the Reliability Panel's CRR, the Reliability Standard was expressed as a target of 0.002% USE that was defined as being 'over the long term'. However, the Reliability Panel considered that this timeframe was unclear and changed the definition of the Reliability Standard to measure USE as a 10-year moving average.

Interpreting the performance of the NEM against the Reliability Standard using a 10-year moving average posed the following problems:

- more than ten years of data is required to give a statistically meaningful estimate of compliance with the Reliability Standard (e.g. a 1 in 100 year weather event could result in significant USE such that the Reliability Standard remains exceeded for 10 years);
- the underlying distribution of possible USE outcomes can vary over time, so that it is not statistically meaningful to use the moving average as an effective measure; and

- a ten year delay in measurement is not satisfactory if its purpose is to promote continuous improvement of the processes for meeting the Reliability Standard (i.e. an assessment of the January 2009 load shedding would not be fully assessed against the Reliability Standard for 10 years).

The last two points above are particularly relevant in the context of extreme weather. If the delivered level of reliability is degrading because the incidence of extreme weather events is increasing, this would indicate a structural shift in the underlying distribution and it would not be satisfactory to delay responding to the impact of more regular extreme weather events on reliability for up to 10 years. Accordingly, the practice of measuring compliance with the Reliability Standard over 10 years could result in delays in responding to causes of reliability degradation including increased incidence of extreme weather.

It is in fact difficult to meaningfully measure the performance of the power system against the Reliability Standard over any timeframe. The USE outcome for a given year depends on complicated interactions between a number of random factors including the uncertainty of demand, generation and network capability and both planned and unplanned outages of power system equipment. When the actual USE varies from the Reliability Standard, it does not necessarily mean that the NEM’s reliability processes are flawed, but rather it may be an outlier from the distribution of possible USE values.

USE in excess of the Reliability Standard may be due to a rare combination of extremely high demand and the coincidental outage of several items of plant. This arduous combination of events may not be due to inappropriate reliability processes or settings, but rather may represent an extremely rare event, the severity of which is unlikely to be repeated for many years. In response to such circumstance it would be inappropriate to modify reliability processes and settings.

The Reliability Panel has just amended the Reliability Standard to take effect from 1 July 2012.[113] Under the revised Reliability Standard, the performance of the NEM will be measured against the Reliability Standard each year. Rather than the current practice of measuring compliance with the Reliability Standard over a 10-year moving average, the objective of the revised Reliability Standard is to provide continuous improvement to the processes that monitor and maintain reliability in the NEM. The amended Reliability Standard will address the problems with measuring compliance with the Reliability Standard over a ten year moving average as outlined above.

We agree with the Reliability Panel's amendments to the Reliability Standard. Rather than measuring actual reliability against the Reliability Standard, we agree that it would be more appropriate to investigate the circumstances contributing to each reliability event to determine whether each reliability event is consistent with the anticipated performance of the NEM. This would enable the impact of the event to be examined as well as the factors that contributed to the event. This approach would allow market institutions to respond to any impediments in the market design or

113 AEMC Reliability Panel, *Review of the Reliability Standard and Settings*, 30 April 2010, www.aemc.gov.au.

settings without delay. Considering there have been few reliability events since market start, we consider it is feasible that every reliability event in the bulk supply system should be investigated as outlined above.

AEMO currently undertakes a detailed operational investigation into the cause of each event. We consider that the appropriate body to examine each event from the perspective of whether the market design and settings have delivered performance consistent with consumer expectations is the body responsible for setting the Reliability Standard and Reliability Settings. Under our governance proposals in Chapter 7, we recommend the AEMC as the appropriate body setting the Reliability Standard and Reliability Settings. As discussed in Section 5.5.1, this examination together with any recommendations for change, would be incorporated into the expanded Annual Market Performance Review proposed in this section.

Conclusion

We support the recent decision by the Reliability Panel to amend the Reliability Standard so that the circumstances contributing to each reliability event would be investigated on an annual basis to determine whether each reliability event is consistent with the anticipated performance of the NEM. This is an improvement on the current practice of measuring compliance with the Reliability Standard over a 10-year moving average, as it would allow market institutions to respond to any impediments in the market design or settings without the delay. If the incidence of extreme weather increased in the future, it may take several years for the impact to be fully revealed in a 10- year moving average.

We consider that the expanded Annual Market Performance Review recommended in Section 5.5.1 would enable the Reliability Panel and the AEMC to identify a degradation in reliability due to extreme weather, and take the necessary remedial action sooner than would be likely under the current practice of compliance.

6 The Market Price Cap and other Reliability Settings

Chapter Summary

This chapter provides our analysis of the impact of raising the MPC on reliability, the possible MPC requirements for a future scenario of increased extreme weather and the feasibility of introducing a different MPC in each region to recognise differences in jurisdictional expectations for reliability.

Modelling undertaken for this review indicated that the USE expectation under the Reliability Standard could be halved to 0.001% (an improvement to reliability) by increasing the MPC to $55 000. We do not however recommend this course of action as a means of improving consumer supply continuity because:

- raising the MPC increases the costs and risks of NEM participation, and it is difficult to quantify the costs and risks of raising the MPC to $55 000 without empirical evidence;
- tightening the Reliability Standard would only have a minor impact on the quality of supply experienced by consumers because the reliability of the generation sector currently makes only a small contribution to consumer supply continuity; and
- reliability standards that apply to the distribution and transmission sectors would also need to be modified to maintain consistency with any improvement in reliability delivered by the generation sector.

If demand were to increase due an increase in the incidence of extreme weather (such as more extreme heatwaves), additional investment in generator capacity (or demand-side participation) would be required to satisfy that demand. However, the MPC would not necessarily need to rise to deliver that additional generator capacity. The level of the MPC is dependent on the shape of the demand profile. If demand spikes were to become higher but not necessarily longer (such as due to hotter but not necessarily longer heatwaves), then a higher MPC may be required because more generation would be required to run for very short periods to satisfy the higher demand peak. However, if the frequency or duration of demand spikes were to increase (such as due to longer and more frequent heatwaves), then the MPC would not necessarily need to increase to deliver additional investment in generator capacity. This is because under this scenario there would be increased opportunity for peaking generators to run and earn pool revenue and thus the pool price would not need to be as high for peaking generators to be profitable.

We recommend that an arrangement allowing the level of the MPC to vary between regions should not be pursued further. Introducing new regional specific arrangements into the NEM's inter-connected market would most likely be detrimental to overall NEM efficiency and would be unlikely to contribute to the achievement of the National Electricity Objective. Such an arrangement would also present problematic implementation issues. In addition, in our view varying MPCs is not necessary because we believe that the current assumption that the reliability expectations of residential consumers are consistent in all NEM regions is still relevant.

6.1 Introduction

This chapter provides our final advice on the level of the MPC (as requested by the MCE in the revised terms of reference for this Review). Specifically this chapter examines:

1. the expected levels of reliability that could be delivered from the generation sector as a result of raising the level of the MPC;

2. the likely level of MPC required to deliver generation investment consistent with the Reliability Standard under a scenario of increased extreme weather; and

3. the feasibility of recognising differences in jurisdictional expectations for reliability by setting a different MPC in each region.

6.2 Increasing the MPC to deliver improved reliability in the generation sector

6.2.1 Background

For this review we have examined what levels of reliability could be expected to be delivered from the generation sector if the MPC was raised above the current level set to achieve the Reliability Standard.

The current NEM framework for reliability in the generation sector places significant emphasis on prices in the spot market as the primary signal for investment. Under the current arrangements, the spot price (or derivative of the spot price through contracting) is the primary income to a generator and provides price signals for the timing, form and location (on a regional basis) of investment in new generation. Similarly, the spot price also provides price signals for investments in demand side initiatives.

Investor decisions in the NEM are based on the expectation of future prices as opposed to the current level of prices. Therefore for the NEM's reliability framework to incentivise investment, it must be stable and predictable. There are many forces outside of the NEM reliability framework affecting prices, such as those discussed in Section 6.2.4. By providing certainty in relation to the NEM's reliability framework, investors are better able to form their own view on how external factors would likely influence future prices.

The spot price in the NEM is capped at the level of the MPC. The spot price is capped to limit overall risk for market participants, but the level of the MPC must be set high enough to incentivise investment in sufficient generation to deliver performance consistent with the Reliability Standard. In theory, raising the level of the MPC increases the revenue potential of generators thus incentivising greater investment in generating capacity (particularly peaking generation). However, as discussed in Section 6.2.4, there are risks and costs involved in raising the level of the MPC, such that at some level of the MPC the benefits of raising the MPC (in terms of investment incentive) would be outweighed by the additional risks and costs introduced by raising the MPC.

The MPC is currently set at $10 000, but will rise to $12 500 on 1 July 2010. The Reliability Panel has just recommended that starting on 1 July 2012, the value of the MPC is increased annually in real terms from $12 500/MWh according to the change in the Stage 2 (intermediate) Producer Price Index (PPI).[114]

6.2.2 Modelling

To assist us in examining the price-reliability trade-offs of a phased increase in the MPC we engaged the services of ROAM Consulting (ROAM). ROAM is a provider of energy modelling expertise and has experience in the NEM as well as other energy markets around the world.

Our engagement of ROAM was concurrent with the Reliability Panel's engagement of ROAM to undertake the market modelling for their biennial review of the Reliability Standard. This concurrent engagement has allowed us to use the same model (and assumptions) as those used to inform the Reliability Panel's recommendation on the MPC to apply in the NEM from 2012. This provides a sound basis for comparison.

The modelling undertaken by ROAM emulates the operation of the NEM. It bases dispatch decisions on generator bidding patterns (including renewable energy generators), models of planned generator outages and inter-regional transmission capabilities and constraints. However, the sole driver on investment decisions is profitability delivered through the wholesale market. The modelling does not consider other factors that influence investment such as non-wholesale market revenue, or NEM participation costs and risks.

The modelling methodology involves applying an MPC in each region in each year of the modelling period and adjusting the level of installed generation in each region by withdrawing existing or adding new generation until the revenue earned in the spot market by the marginal generator (last in merit order) is sufficient to make it profitable. That is, the marginal generator can recover its capital, fixed and variable operating costs and achieve its investor's required rate of return. This level of installed generation will provide a level of unserved energy which is associated with the MPC that is applied in the modelling.

114 AEMC Reliability Panel, Reliability Standard and Reliability Settings Review - Final Report, 30 April 2010, p.41, www.aemc.gov.au.

For the Extreme Weather Events Review, ROAM modelled two separate demand scenarios: a 'normal demand' scenario, and an 'extreme demand' scenario. The main difference between the demand scenarios is that the extreme demand scenario includes model runs involving an extreme demand that is only expected to occur once in 20-years (the demand that Victoria experienced in January 2009). This section outlines the results for the normal demand scenario. The results for the extreme demand scenario are outlined in Section 6.3.

Demand-side participation is explicitly catered for by the load projections. The vast majority of demand in the wholesale market currently operates as a series of aggregated loads for the purposes of dispatch. Though some individual consumers may be responsive to price, the majority of end consumers are shielded from short-term price fluctuations through retail contracts. Thus, incentives to reduce demand during high-priced periods are dissipated.

The report provided by ROAM is attached at Appendix D. This report provides a detailed explanation of the methodology and assumptions used in the modelling.

We also engaged EGR Consulting to peer review ROAM's modelling to provide us additional confidence in the modelling results. EGR considered that the methodology used by ROAM "seems basically sound and aligns with similar studies performed in Australia and elsewhere".[115] EGR also concluded that " the method employed by ROAM for the expected USE calculation seems quite accurate for the purpose".[116] EGR's report is provided at Appendix E.

6.2.3 Modelling Projections

The modelling projections of the price-reliability trade-off were undertaken for the following levels of MPC:

- $12 500/MWh;
- $16 000/MWh;
- $40 000/MWh; and
- $55 000/MWh (the current value of customer reliability in the study by CRA International dated 12 August 2008 for VENCorp).

Phased increases to each MPC level were not specifically modelled. Reasonable approximations to a phased increase can be deduced by interpolating between the $12 500, $16 000, $40 000 and $55 000 levels.

Figure 6.1 below illustrates the modelling results for the normal demand scenario. The output of the model is expected unserved energy (USE) for the NEM for each year of the outlook period for a specific value of MPC. The chart shows that an MPC of

115 EGR Consulting, *Review of ROAM's RSSR and EWER Modelling*, 26 March 2010, p.7.

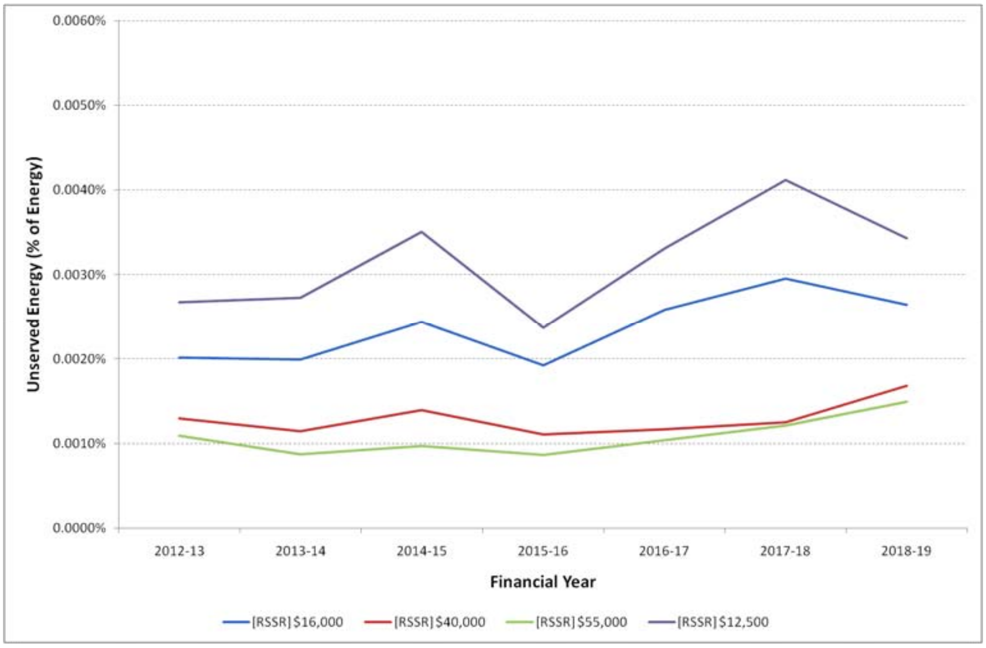
116 Ibid, p.13.

$16 000, effective from 1 July 2012, would deliver roughly an expected 0.002% USE each year over the outlook period. The main reasons why the ROAM modelling shows that a further increase in the level of the MPC from $12 500 to approximately $16 000/MWh are:

- increased capital costs for new entrant open cycle gas turbines;
- peakier demand; and
- more conservative interconnector capacity assumptions.

The chart also shows that by increasing the MPC to $40 000 expected annual USE could be reduced to less than 0.0015%, and by increasing the MPC to $55 000 expected annual USE could be reduced to 0.001% (half the USE of the current Reliability Standard).

Figure 6.1 MPC versus USE - Normal Demand Scenario



However this modelling does not take account of a number of factors such as non-pool income sources, prudential requirements, market power, inter-regional trade, regulatory certainty or the behaviour of market participants – factors which would impact on the decision whether to install the marginal generator rather than just considering revenues from the spot market as is the case in the modelling.

Similarly, raising the MPC to $40 000 or $55 000 in a single step is likely to be counter productive due to the regulatory shock created. The negative impact on investor confidence is likely to outweigh the incentive provided by the potential for greater revenue. To minimise the above risks, a stepped approach to raising the MPC over a number of years may be appropriate.

Table 6.1 below shows the additional capacity that the modelling indicated would be delivered by an MPC of $40 000 and $55 000, relative to the $16 000 base case. Relative to the base case, an additional 619 MW (average over the outlook period) would be expected to be delivered by an MPC of $40 000, and an additional 872 MW would be expected to be delivered by an MPC of $55 000. Thus, to halve the USE expectation under the Reliability Standard, an average of 872 MW of additional generation would be required, delivered by lifting the MPC to $55 000.

Table 6.1 Difference in Generation Capacity between $40 000 and $55 000 and the Base Case ($16 000)

Year	$16 000 MPC (MW)	$40 000 MPC (MW)	$55 000 MPC (MW)	Difference [$40 000 - $16 000] (MW)	Difference [$55 000 - $16 000] (MW)
2012-13	40 536	41 146	41 362	610	826
2013-14	41 470	41 964	42 414	494	944
2014-15	41 889	42 411	42 709	522	820
2015-16	43 519	44 057	44 415	538	896
2016-17	43 977	44 779	44 953	802	976
2017-18	45 201	46 019	46 084	818	883
2018-19	46 492	47 040	47 250	548	758
Average	**-**	**-**	**-**	**619**	**872**

Table 6.2 shows the investment cost of delivering the additional generating capacity outlined above. This is based on a capital cost of $918/kW, which is the real $2009 capital cost for open cycle plant in 2010-11 .

Table 6.2 Capital Cost of Generation Capacity for each MPC level (normal demand scenario)

Year	Additional Installed Capacity [$40 000 - $16 000] (MW)	Additional Installed Capacity [$55 000 - $16 000] (MW)	Capex of Additional Installed Capacity [$40 000 - $16 000] ($M)	Capex of Additional Installed Capacity [$55 000 - $16 000] ($M)
2012-13	610	826	560	758
2013-14	494	944	453	867
2014-15	522	820	479	753
2015-16	538	896	493	823
2016-17	802	976	736	896
2017-18	818	883	751	811
2018-19	548	758	503	696
Average	**619**	**872**	**568**	**800**

The cost of the additional 872 MW required to halve the USE expectation under the Reliability Standard to 0.001% would be $800m. This can be approximately annualised by multiplying by 10% giving an annual cost of $80m. Annual operations and maintenance expenditure would add approximately $10m (calculated at $13/kW according to ACIL Tasman)[117] to this figure providing a total annual cost of $90m.

Thus, for an additional $90m a year, additional generating capacity could be installed that would roughly halve the USE expectation under the Reliability Standard to 0.001%. A However, this result needs to be interpreted with care as it does not consider the other impacts of raising the MPC as described in Section 6.2.4. In addition, it is important to note that halving the USE requirement in the Reliability Standard would have only a minor impact on the reliability experienced by consumers because the reliability of the generation sector currently makes only a small contribution to supply reliability experienced at the consumer connection point. The investment delivered by raising the MPC would not necessarily reduce the impact of security events because security events are generally location specific and investment delivered by a higher MPC could be located anywhere in a region.

117 ACIL Tasman, *Fuel resource, new entry and generator costs in the NEM*, April 2009, www.aemo.com.au.

6.2.4 Costs and other implications of a higher MPC

The MPC modelling for this Review is a simple representation of generator investment in the NEM. The modelling assumes that generation only earns income from the spot market and that raising the MPC would not increase costs or risks for other NEM participants or the NEM more generally. The modelling methodology employed for this Review is consistent with the methodology employed by the Reliability Panel for its biennial review of the MPC.

In order to gain a better appreciation of the costs and risks of raising the MPC, we engaged Frontier Economics (Frontier) to examine the broader impacts of raising the MPC. Frontier's report is attached at Appendix J, and summarised below. As outlined in summary below, it is very difficult to quantify the risks and costs of raising the MPC.

Frontier made the following comments in relation to the potential implications of a higher MPC.

Spot Price

> "We would expect that while generators would continue to offer the bulk of their capacity to the market at or about their SRMC, on the margin, they would increase the price of their offers above $300/MWh. This is approximately at the top of peaking generators' SRMCs in the NEM and about the level of cap strike prices.
>
> Assuming that generators only increased the price of offers above $300/MWh in response to a higher MPC, we hypothesised how historical average spot prices in each region might have been different with higher MPCs. We found that the results varied greatly according to the relevant year for which historical prices were adjusted and that the extent and variance of average price uplift increased non-linearly with the level of MPC. We also found that the mid-point estimate of average price increases for different MPCs varied according to the peakiness of prices – and hence load – in each region."[118]

Demand Side Response

> "At this stage, there is simply insufficient empirical evidence to reasonably predict the quantitative impact of higher MPCs on the level of Demand Side Response (DSR) in the NEM. However, several general comments can be made:
>
> - A higher MPC should, at the margin, increase the quantum of observed DSR by residential and business consumers.

118 Frontier Economics, *Implications for the National Electricity Market from increases to the Market Price Cap and/or Cumulative Price Threshold*, March 2010, p.5.

- As the MPC rises, the quantum of DSR should increase at a decreasing rate.
- However, DSR from smaller consumers requires investment in real-time metering or other demand management systems and a sustained political willingness to allow consumers to face time-varying prices and/or automated supply interruptions. This willingness appears to be limited at the moment."[119]

Prudential Requirements

"The prudential requirements in the Rules are intended to cover AEMO's worst case exposure to potentially defaulting market participants. The derivation of the reasonable worst case scenario takes account of historical spot price volatility in the NEM. To the extent that an increase in the MPC leads to an increase in wholesale spot prices, this is likely to increase this worst case exposure, and thereby increase participants' prudential obligations. Other things being equal, this could raise barriers to entry, particularly for new retailers.

There appears to be no simple means of overcoming the greater barriers to entry for retailers from a higher MPC without compromising the financial integrity of NEM settlements."[120]

Risk Management Implications

"A higher MPC could reasonably be expected to increase the prices of financial risk management instruments. An increase in hedge prices could be the result of increases in spot prices and/or the impact of greater spot price volatility on hedging premiums. Generators benefit from the higher premiums on these options. This is consistent with the rationale to increase MPC, which is to stimulate investment in new capacity.

In the absence of a dedicated modelling exercise, it is difficult to estimate how much hedge prices could rise at different levels of the MPC. However, we note that swap premiums in the NEM have consistently been about $2/MWh over spot prices.

The implications of higher MPCs on hedge market liquidity and duration are less clear. However, we see no reason to expect a large drop-off in liquidity given the increase in Sydney Futures Exchange-traded NEM hedging instruments over the past 4-5 years. We expect the now relatively mature market for hedging instruments will be able to quickly respond to changes in market participants' hedging needs due to an increased MPC. In

119 Ibid, p.6.

120 Ibid, p.6.

our view, this suggests no need for policy interventions in hedging markets due to an increase in MPC and CPT.[121]"

Market Power

"A high MPC can create incentives for generators to exercise transient market power in the NEM. While this may not raise broader Trade Practices Act concerns, if it occurs frequently, transient market power can raise wholesale prices and compromise economic efficiency in both the short and long run. Increasing the MPC is likely to increase existing incentives to exercise transient market power because it increases the 'payoff' to any given generator from engaging in economic withholding strategies.

Various regulatory and market design options are available to mitigate generators' incentives to exercise transient market power. The regulatory options include measures to restrain generators' offers directly and downward adjustments to the MPC and/or CPT. The market design options include implementing some form of capacity mechanism to sit alongside the energy-only market. However, all of these options have drawbacks and create risks of their own for the maintenance of sufficient capacity to help meet the NEM Reliability Standard."[122]

Inter-regional Trade

"Raising the MPC and CPT could indirectly influence inter-regional trade in both the short and the long term.

In the short term, a higher MPC could change the pattern of transmission constraints in the NEM. However, it is very hard to generalise about the tendency, nature or costs of these effects. It is clearer that a higher MPC would be likely to further increase the basis risks of inter-regional contracting in the NEM. This could discourage inter-regional hedging and may ultimately contribute to inefficient longer term locational signals for new investment.

In the longer term, to the extent that a higher MPC results in less firm Inter-Regional Settlement Residue (IRSR) units and deters participants from entering inter-regional electricity derivatives, a higher MPC may distort the locational decisions of new generation investors. New generators may be more encouraged to locate in the same regions as their intended counterparties than is warranted on the basis of the underlying relative costs."[123]

---

121 Ibid, p.7.

122 Ibid, p.7.

123 Ibid, p.7.

Transitional and Systemic Risk Issues

> "An increase in MPC may raise transitional risks for the market. The key issue is to ensure that there is a sufficient lead time between the timing of a formal decision to raise the MPC and its implementation to allow derivative markets to reflect any expected changes to spot market outcomes and to allow participants to arrange any additional prudential support."[124]

6.2.5 Stakeholder submissions

If the MPC was to be raised in order to deliver additional reliability, there would need to be due consideration of the wider non-reliability impacts created by raising the MPC. Stakeholder submissions to the review suggested the following impacts that would result from an increase in the MPC:

- Transmission congestion risks;[125]
- Generators may withdraw capacity from the contract market and thus reduce liquidity in the contract market;[126]
- Vertically integrated businesses are likely to manage these risks by investing in their own plant, thus increasing market concentration;[127]
- Financial risks faced by generators should physical generation not be available at times of high prices;[128]
- There would be retail barriers to entry for small retailers (and hence reduced market competition) due to reduced contract liquidity and increased prudential requirements;[129] and
- Increase in pool price volatility and coupled with increased contract prices would lead to regulators/governments to intervene more frequently and thus increase regulatory risks and impede investment for generators.[130]

6.2.6 Conclusion

Modelling undertaken for this review indicated that the USE expectation under the Reliability Standard could be halved to 0.001% (an improvement to reliability) by

124 Ibid, p.8.

125 NGF Submission, p.4.

126 NGF Submission, p.4; IPRA Submission, p.6; MEU Submission, p.34; LYMMCO Submission, p.4.

127 IPRA Submission, p.7.

128 LYMMCO Submission, p.3; NGF Submission, p.4.

129 NGF Submission, p.4; IPRA Submission, p.7; LYMMCO Submission, p.4; Tasmanian Office of Energy Planning and Conservation Submission, p.4; ERAA Submission, p.2.

130 IPRA Submission, p.7.

increasing the MPC to $55 000 (note that this value is well above the value at which consumers value reliability). However, we do not recommend this course of action as a means of improving consumer supply continuity because:

- raising the MPC increases the costs and risks of NEM participation, and it is difficult to quantify the costs and risks of raising the MPC to $55 000 without empirical evidence;
- tightening the Reliability Standard would only have a minor impact on the quality of supply experienced by consumers because the reliability of the generation sector currently makes only a small contribution to consumer supply continuity; and
- reliability standards applying to the distribution and transmission sectors would also need to be modified to maintain consistency with any improvement in reliability delivered by the generation sector.

6.3 MPC requirements under a scenario of increased extreme weather

6.3.1 Background

This section specifically examines whether there is likely to be a need to increase the level of the MPC to meet the Reliability Standard under a scenario in which the frequency and severity of extreme weather events increases.

The MPC is designed to incentivise sufficient investment in generation to meet the Reliability Standard. As storms, bushfires and floods generally impact networks (rather than the generation sector), the impact of these events has not been specifically considered in this section. Droughts generally impose energy constraints on generators due to reduced availability of water for hydro generators and cooling water for water cooled thermal generators. The MPC delivers investment in capacity and does not specifically consider energy constraints (MPC modelling assumes all energy constrained plant would make capacity available at times of very high demand in response to very high prices). As such, this section does not consider the impact of droughts.[131] This leaves the impact of extreme temperatures which can be managed through increased investment in generation.

6.3.2 Modelling

To assist us in this examination we engaged ROAM consulting to undertake further market modelling. This modelling is an extension of the modelling to determine the reliability that would be delivered by higher levels of MPC as presented in Section 6.2. But, whereas the modelling for Section 6.2 used demand forecasts consistent with

131 The impact of drought is managed in the NEM through information provision though publications such as AEMO's Energy Adequacy Assessment Projection.

historical demand growth (the 'normal demand' scenario), the modelling for this section used higher demand forecasts to represent the demand that would be likely during extreme temperature events (the 'extreme demand' scenario).

6.3.3 Modelling Results

Figure 6.2 illustrates the modelling results for the extreme demand scenario. Modelling simulations were performed for four different MPCs - $12 500, $16 000, $40 000 and $55 000. The output of the model is USE for the NEM for each year of the outlook period.

Figure 6.2 MPC versus USE - Extreme Demand Scenario

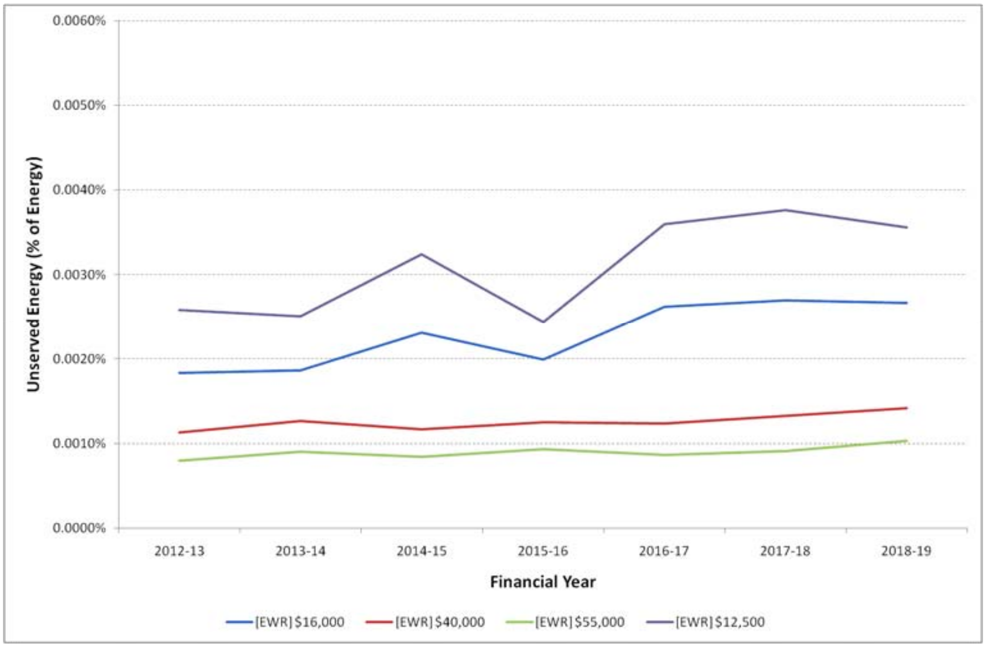


Figure 6.2 shows that to deliver roughly 0.002% USE each year over the outlook period an MPC of $16 000, effective from 1 July 2012, would be required. Figure 6.2 also shows that by increasing the MPC to $40 000 expected annual USE could be reduced to less than 0.0015%, and by increasing the MPC to $55 000 expected annual USE could be reduced to 0.001% (half the USE required by the current Reliability Standard).

The modelling shows that there is little difference in observed USE between the normal demand (Figure 6.1) and the extreme demand scenarios (Figure 6.2), for a given level of MPC. For both scenarios, an MPC of $16 000 is sufficient to incentivise enough investment in generation to satisfy the Reliability Standard (0.002% USE). This is despite there being a much higher level of demand to be satisfied under the extreme demand scenario.

The reason for this is that under the extreme demand scenario there is more opportunity for generation to earn high returns from elevated spot prices. If the incidence of extreme demand and the associated high prices were to double relative to the historical experience, then generators would have twice the opportunity to earn high returns from the spot market to recover their costs. Hence the level of the MPC does not need to be as high for these generators to be profitable.

It is the shape of the demand profile that affects the MPC requirement. If the demand profile is very peaky (that is, a small number of very high demand spikes each of short duration) then the peaking generators would not get much run-time from which to earn pool income to recover their costs. In this scenario the MPC would need to be quite high for generators to be profitable. However, if the demand profile is flatter (that is, a large number of demand spikes of longer duration), then peaking generators would get more run-time in which to earn pool income to recover costs. Relating this analysis to extreme weather, more high temperature events of longer duration (which would be expected to result in more frequent and longer periods of elevated prices) would translate to a lower MPC requirement. Whereas high temperature events larger in magnitude but not necessarily longer in duration or greater in frequency would necessitate a higher MPC.

EGR Consulting[132] presented theoretical analysis to demonstrate that the MPC requirement is determined by the shape of the demand profile rather than the magnitude of maximum demand. Therefore, if the maximum demand for a region was expected to increase significantly, the MPC would not need to rise to deliver reliability if the average demand for the region also rose in proportion to maximum demand. EGR Consulting analysis is at Appendix E.

Table 6.3 below shows the additional generator capacity that was delivered under the extreme demand scenario relative to the normal demand scenario.

Table 6.3 Generator Capacity Delivered under the Normal Demand Scenario and the Extreme Demand Scenario

Year	Normal Demand Scenario (MW)	Extreme Demand Scenario (MW)	Difference (MW)
2012-13	40,536	42,011	1,475
2013-14	41,470	42,907	1,437
2014-15	41,889	43,292	1,403
2015-16	43,519	44,922	1,403
2016-17	43,977	45,452	1,475
2017-18	45,201	46,789	1,588
2018-19	46,492	47,967	1,475
Average	**-**	**-**	**1,465**

132 EGR Consulting was engaged to undertake a peer review of ROAM's modelling.

Despite the MPC being $16 000 in both scenarios, the additional opportunity for earning elevated pool revenue in the extreme demand scenario incentivised additional investment in generation consistent with meeting the Reliability Standard.

6.3.4 Conclusion

If demand were to increase due to an increase in the incidence of extreme weather (such as more extreme heatwaves), additional investment in generator capacity (or demand-side participation) would be required to satisfy that demand. However, the MPC would not necessarily need to rise to deliver that additional generator capacity. The level of the MPC is dependant on the shape of the demand profile. If demand spikes were to become higher but not necessarily longer (such as due to hotter but not necessarily longer heatwaves), then a higher MPC may be required because more generation would be required to run for very short periods to satisfy the higher demand peak. However, if the frequency or duration of demand spikes were to increase (such as due to more frequent or longer heatwaves), then the MPC would not necessarily need to increase to deliver additional investment in generator capacity. This is because under this scenario there would be increased opportunity for peaking generators to run and earn pool revenue and thus the pool price would not need to be as high for peaking generators to be profitable.

6.4 Recognising differences in jurisdictional expectations

6.4.1 Introduction

For our Second Interim Report the MCE requested us to examine the feasibility of mechanisms for recognising differences in jurisdictional expectations regarding the price-reliability trade-off and the delivery of outcomes consistent with these differing jurisdictional expectations.

Point of consumption reliability is achieved through the application of multiple reliability standards for each stage of the electricity supply chain. That is, point of consumption reliability requires meeting generation reliability standards, transmission network reliability standards and distribution network reliability standards. Hence, differences in jurisdictional expectations regarding the price-reliability trade-off can be delivered at any stage of the supply chain (and as discussed in Chapter 4 should be delivered consistently across the supply chain).

For transmission and distribution networks, higher reliability in a region could be delivered by setting higher network reliability standards in that region, which would deliver higher levels of network investment. Jurisdictions are currently able to determine the level of the network reliability standards that meet the price-reliability expectation for consumers in their region. For generation, higher reliability in a region could be delivered by varying the incentives on new generators to locate in a particular region. This could be achieved through changes to various features of the existing energy only market (e.g. varying the MPC between regions, varying the level of the

CPT between regions) or by introducing capacity payments of varying types on a regional basis as discussed in Section 8. Any change may have an element of sovereign risk and could have unanticipated distortionary impacts on investment and market operations.

We understand that the MCE was specifically interested in the feasibility of setting a different MPC in each region to deliver a different price-reliability trade-off from the generation sector. As such, our response to this question focuses on this particular approach.

6.4.2 Analysis for Second Interim Report

In the Second Interim Report we highlighted that raising the MPC in one region relative to another would likely deliver additional investment in that region. This would be expected to deliver higher reliability at an increased cost to consumers in that region. However, an arrangement that allows a different MPC in each region is a fundamental change to the market design. A different MPC in each region assigns a higher value of reliability to the higher priced region(s). Consequently the higher priced region(s) would be given preference in times of supply shortage.

In contrast, the current market design assigns a consistent value of reliability in all regions and the market is operated to, as far as technically possible, target consistent reliability outcomes across the NEM.

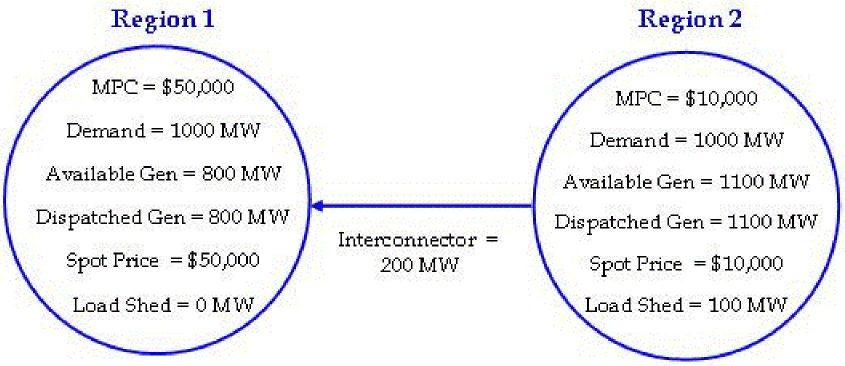
The following two sections set out the practical outworking of such a change in relation to load shedding and interconnector flows as examples of the impact of different MPCs in each region.

Sharing the pain of load shedding

The introduction of different MPCs in each region will have implications for how load shedding is shared between regions. Currently, load shedding as a result of a supply shortfall in any region is shared between all NEM regions in proportion to the demand in each region up to the limit of interconnector flows. This is because consumers in each region are assumed to value reliability equally. However, under a market design where consumers in each region value reliability differently, any requirement for load shedding would be fulfilled in the region that values reliability least. That is, the region with the lowest MPC. This outcome is economically efficient as the consumers that value reliability the most, and are willing to pay the most for their electricity, have their electricity supply interrupted after those who value reliability less.

This is illustrated in Figure 6.3 below. The MPC in Region 1 is $50 000 and the MPC in Region 2 is $10 000. There is a supply shortfall of 200 MW in Region 1, and 100 MW of spare capacity in Region 2, leaving a supply deficit for the system of 100 MW. As Region 2 consumers value reliability less than Region 1 consumers (as indicated by the MPC), the load shedding to address the supply deficit takes place in Region 2. As such, although the supply shortfall originated in Region 1, all load shedding takes place in Region 2.

Figure 6.3 Sharing the pain of load shedding worked example



In practice, this means that consumers in a region with a lower MPC relative to other regions will carry a greater share of total NEM load shedding.

Managing market settlement shortfalls

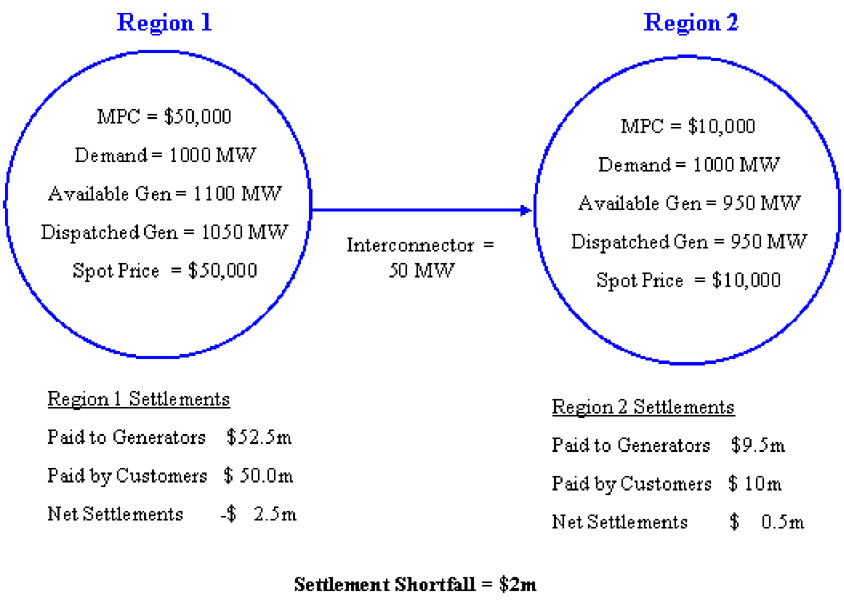
The introduction of different MPCs in each region would create market settlement shortfalls for AEMO.

Market settlement shortfalls can result when the market dispatch outcome results in greater payments to generators than is collected from customers. An example of this would be when power flows on an interconnector from a high priced region to a low priced region. In this situation, generators in the high priced region are being paid more than is being collected from customers in the low priced region.

This situation is quite rare under the current market design where the MPC is the same in all regions. However, by allowing a different MPC in each region, a credible dispatch outcome could be for electricity to flow on an interconnector from a high priced region to a low priced region.

Consider the example illustrated below involving a simple two region model. The MPC is $50 000 in Region 1 and $10 000 in Region 2. Region 2 has insufficient available generation to satisfy demand. As such, 50 MW is imported from Region 1 across the interconnector to avoid load shedding in Region 2. Due to supply scarcity, the spot price is at the level of the MPC in both regions.

Figure 6.4 Managing market settlement shortfalls worked example



Outworking

- A settlement shortfall of $2m per hour.
- This is created because insufficient money is collected to pay generators in Region 1.

Options to Eliminate Settlement Shortfall

Option A – Customer uplift in Region 2 to fund the settlement shortfall

Consequences

- No load shedding.
- Additional $2m charge to customers in Region 2 results in effective spot price of $12 000. This violates the MPC of $10 000.
- This is economically inefficient because supply continuity is provided in Region 2 at a price above the level at which it is valued.

Option B – Cap the price in Region 1 to eliminate the settlement shortfall

Consequences

- The price would only be capped when a settlement shortfall required addressing.
- No load shedding.

- This is economically inefficient because the price in Region 1 is capped below the level at which supply continuity is valued. This would weaken the investment incentive intended by the higher MPC.

Option C – Clamp interconnector flow to 0 MW to eliminate the settlement shortfall

Consequences

- Customer load would be shed in Region 2 whilst generation is available in Region 1.
- The most economically efficient out of the 3 options because supply continuity is provided up to the level at which it is valued.
- However this option is still inefficient from a national perspective. The generators in Region 1 are priced above their costs due to the market design. Load in Region 2 is curtailed despite there being generation available in Region 1 with costs less than the Region 2 price. The market design featuring a different MPC in each region would prevent the Region 1 generators from being dispatched to satisfy region 2 load. Shedding load due to a market design imposed constraint is inefficient.

Thus, the most economically efficient approach to managing a settlement shortfall caused by different MPCs in each region would be to clamp interconnector flow and shed load in Region 2. However, as discussed under Option C, this approach still does not result in an economically efficient outcome overall for the NEM.

6.4.3 Stakeholder submissions

Generally, submissions were opposed to the introduction of different MPCs across regions.[133] If different MPCs across regions were introduced, then this would detract from achieving and maintaining a common national energy market under the National Electricity Objective[134] would represent a significant market distortion[135] and be inefficient and ineffective.[136] In fact, IPRA stated that 'we cannot understand why such a concept is being seriously considered'.[137]

If different MPCs across regions were introduced, then the following issues, according to submissions, would arise:

- Distortion of investment timing and location incentives;[138]

133 NGF Submission, p.5; ERAA Submission, p.2; TRUenergy Submission, p.2; MEU Submission, p.22.

134 ERAA Submission, p.2; TRUenergy Submission, p.1; CUAC Submission, p.2; IPRA Submission, p.2.

135 CUAC Submission, p.2.

136 Origin Energy Submission, p.4.

137 IPRA Submission, p.2.

138 Origin Energy Submission, p.4.

- Dispatch system difficulties;[139]
- Difficulty in AEMO co-optimising ancillary services[140] and effects on Frequency Control Ancillary Services (FCAS) markets;[141]
- System security issues due to generators bidding in a manner that favours a higher priced region to the detriment of system-wide outcomes and resulting in a higher cost;[142] Incentives to arbitrage between regions with different MPCs could impact on system security;[143]
- Impairment of inter-regional trade;[144]
- IPRA notes that 'Questionable arbitrage drivers will be introduced across interconnections, and (unless major changes to regulatory tests are introduced to manage the anomalies, interconnection could be driven to remove the signal)';[145]
- Complexity in managing settlements, including negative inter-regional settlement residues;[146]
- Increased probability of load shedding as a result of managing counter-priced flows between regions with different MPCs;[147]
- Lead to a situation where load-shedding occurred in one region with a lower MPC at the same time it was exporting energy to support consumers from being load-shed in a higher MPC priced region. This could lead to a politically untenable outcomes;[148] and
- Politicises reliability setting in an unacceptable manner. [149]

The Victorian Department of Primary Industries (DPI) took a different view. It stated that there are fundamentally different incentives in the NEM between those regions where generation and transmission differences are privately owned relative to those regions where generation and transmission businesses are government owned.[150] It

139 IPRA Submission, p.2; TRUenergy Submission, p.1.
140 NGF Submission, p.5.
141 TRUenergy Submission, p.1.
142 NGF Submission, p.5; TRUenergy Submission, p.1.
143 ERAA Submission, p.2.
144 TRUenergy Submission, p.1.
145 IPRA Submission, p.3.
146 ERAA Submission, p.2.
147 Origin Energy Submission, p.4.
148 IPRA Submission, p.2.
149 LYMMCO Submission, p.5.
150 Victorian Department of Primary Industries Submission, p.4.

stated that 'regions with private ownership are reliant on appropriate market signals to facilitate investment to meet community expectations.'[151]

The Victorian DPI provided a response to arguments raised against differing MPCs. With respect to the argument that different MPCs in regions increases regulatory complexity, the Victorian DPI stated that the materiality of this issue had not been specified.[152] With respect to the argument that different MPCs would require changes to prudential requirements, this is already expected with the possible introduction of a Carbon Pollution Reduction Scheme.[153]

6.4.4 Analysis for Final Report

Implementation

Adopting different MPCs in each region to reflect differences in jurisdictional expectations regarding the price/reliability trade-offs could arguably be feasible. However there would be implementation challenges to integrate such an arrangement into existing NEM processes and systems including:

- determining how to apportion load shedding between regions that value reliability differently;
- determining rules to manage the accumulation of negative settlement residues across interconnectors;
- changes to AEMO's systems to allow different MPCs in each region; and
- a decision as to whether differential MPCs should also apply to ancillary service markets, and how differential MPC would impact on the co-optimisation of energy and ancillary services between regions with difference MPCs.

Without a detailed analysis of a well defined model for differential MPCs, it is not possible to determine whether it is feasible to implement such an arrangement. We consider it is likely that an implementable model for differential MPCs could be designed. However, such a model would likely involve some regions experiencing greater load shedding than under the current NEM design to the management of negative settlement residue and the redistribution of load shedding between regions. It may not be feasible from a policy perspective to support a change to market design that would result in increased load-shedding for its constituents, and while this might be economically efficient on a regional basis, we do not consider that outcome would be economically efficient overall for the NEM (as discussed below).

151 Ibid.

152 Ibid.

153 Victorian Department of Primary Industries Submission, p.5.

Economic efficiency

Adopting different MPCs in each region to reflect differences in jurisdictional expectations regarding the price/reliability trade-offs could result in economically efficient outcomes when a region is considered in isolation. Provided the MPC for a region is consistent with the value that consumers collectively place on supply continuity, then the resultant levels of investment in supply and demand-side capacity in that region and thus regional specific supply reliability would be economically efficient, i.e. economically efficient because supply continuity is provided up to the level at which it is valued.

However, because the NEM is an interconnected system with power flows between regions, differential MPCs may lead to distortions in investment and operational behaviour which could detract from achieving an economically efficient outcome across the NEM.

The national interconnected power system realised significant economic benefits through increased competition by allowing a load to be supplied by the cheapest generator from any location on the system. Differential MPCs would constrain interstate trade (as discussed below) and thus some of the benefits realised through the creation of the NEM would be lost.

We have undertaken a preliminary consideration of the arrangement for differential MPCs against the relevant elements of the National Electricity Objective including efficient investment in the NEM, efficient operation of the NEM, reliability, price, and regulatory complexity. Each of these are discussed below.

Efficient investment in the NEM

Differential MPCs would change locational investment signals. If generators are able to earn a greater return on investment in one region over another, it is expected that there would be an incentive for new investment to locate in that region relative to other regions. This could result in the region with a lower MPC having less than the desired level of investment in capacity (less than suggested by the MPC/reliability trade-off). Such a distortion in investment may drive further augmentation in interconnector capability above that which is economically efficient. This could result in higher overall costs for supply of electricity in the NEM for a small increase in reliability in one region.

In its submission, the Victorian DPI argued that there are already investment distortions across the NEM due to different incentives on investment. We note that the NEM's reliability regime assumes that all consumers across the NEM value reliability equally. This translates into a common MPC across the NEM. However, the risk, cost and incentives for generation investment can vary between regions. Therefore, a common MPC may deliver different levels of reliability across the NEM. This is quite appropriate as the cost of building additional generation in the region with the lowest level of reliability would exceed the value those consumers place on reliability.

The MPC is determined such that the region with the lowest reliability expectation still achieves the Reliability Standard.

Differential MPCs would also create regulatory and investment uncertainty which would result in higher risk premiums being added to investment projects.

Efficient operation of the NEM

Differing MPCs would increase the risk of entering into hedging contracts with counter-parties in other regions. When a contract is agreed between two participants operating in different regions, the contract reference price for one of the participants will not be the same as the regional price to which they are exposed. This creates basis risk. If MPCs were different in each region, basis risk may increase significantly, potentially discouraging participants from contracting with inter-regional counter-parties. This may reduce competition and liquidity in contract markets, and potentially the efficiency of these markets.

Increasing the MPC in one region relative to another region would also increase the prudential requirements for retailers in that region. This may influence new entrant retailers to locate in a region with a lower MPC.

The efficiency of dispatch would be affected by differential MPCs for several reasons:

- Very high spot prices do not reflect the short-run marginal costs of generators. Allowing a higher MPC in one region may incentivise generators in that region to sacrifice volume to maximise profits though higher spot prices. This could result in the dispatch of higher cost plant from another region.

- AEMO intervention to manage negative settlement residue would likely result in distortions to the efficient dispatch of generation. Higher cost generation could be dispatched in one region in place of lower cost generation from another region which is constrained off due to AEMO's intervention to manage negative settlement residue.

- Varying MPCs may compromise the efficient co-optimisation of energy and ancillary services between regions.

Reliability and price

Increasing the MPC in a region (relative to another region) would be expected to increase the level of installed capacity in that region and thus increase the level of supply reliability in that region. The higher MPC would attract additional investment in generation that would not have been made if the MPC had not risen. This increase in reliability would not be shared equally between all regions consistent with the assumption that their different MPCs reflect their different reliability valuations. Whilst reliability would be expected to increase in a region with a higher MPC, reliability in the low MPC region could fall below that suggested by the

MPC/reliability trade-off because of the greater incentive for capacity to locate in the higher MPC region. In other words, consumers in the low MPC region may not get the supply reliability expected for the price they pay for electricity.

Differential MPCs would create arbitrage opportunities for portfolio generators. This could result in some perverse incentives where generator actions to maximise profits do not align with actions required to maintain power system security and reliability across the NEM. This could result in increased use of directions by AEMO to manage power system security and reliability.

Regulatory Complexity

The introduction of the NEM streamlined the regulatory arrangements for electricity supply across participating NEM states. This reduced regulatory complexity and facilitated the growth of efficient national power flows and trading by nationally focussed energy companies.

If jurisdiction specific pricing arrangements were re-introduced, regulatory complexity and trading risk would likely increase and the administrative cost of NEM participation may also increase. National energy businesses would face greater complexity through exposure to different MPCs across their business portfolio. This could result in a greater need to develop different risk management strategies for each region.

The perception of regulatory complexity can affect an investor's willingness to invest and ability to obtain competitive finance. Regulatory complexity could, to some extent, counter-act the objective of the jurisdictional specific MPCs by delaying investment in new generation. It could lead to regionally, rather than nationally, focussed generation and retail participants with a potential reduction in competition in both the generation and retail sectors in some regions.

Conclusion

We consider that an arrangement allowing the level of the MPC to vary between regions should not be pursued further. Introducing new regional specific arrangements into the NEM's inter-connected market would most likely be detrimental to overall NEM efficiency and would be unlikely to contribute to the achievement of the National Electricity Objective. Also, as outlined above, such an arrangement would present a number of challenging implementation issues, re-apportioning load-shedding between regions.

We believe that the current assumption that consumers (of the same class) value reliability equally in all NEM regions is still relevant. This is especially the case for residential consumers, who, as discussed in Chapter 4, likely to experience the majority of supply interruptions due to a generation shortfall (as they value reliability the least out of all classes of consumer). Our recommendations in Chapter 8 are aimed at ensuring the generator sector delivers the level of reliability valued by consumers. The recommendations in our Transmission Reliability Standards Review are also aimed at delivering reliability from this sector that better reflects the value consumers place on reliability.

We have not been able to conduct a comprehensive assessment of the efficiency implications of allowing a different MPC in some or all regions. Such an analysis would require a detailed specification of implementation assumptions and modelling to identify the more complex interactions and outcomes that would be involved and to understand the implications on achieving the National Electricity Objective.

However, based on our preliminary analysis which has identified some problematic implementation issues and negative impacts on NEM efficiency, and the overwhelming negative response to this concept in submissions, we do not recommend that an arrangement enabling different MPCs in each region be pursued further.

Recommendation

We recommend that an arrangement allowing the level of the MPC to vary between regions should not be pursued further. Introducing new regional specific arrangements into the NEM's inter-connected market would most likely be detrimental to overall NEM efficiency and would be unlikely to contribute to the achievement of the National Electricity Objective. Such an arrangement would also present problematic implementation issues. In addition, in our view varying MPCs is not necessary because we believe that the current assumption that the reliability expectations of residential consumers are consistent in all NEM regions is still relevant.

7 Governance arrangements for determining the Reliability Standard and Reliability Settings

Chapter Summary

This Chapter discusses our findings and recommendations to improve the existing governance arrangements regarding future reliability decisions in the NEM.

Our recommendation proposes that the existing governance arrangements are amended to reflect that:

- the AEMC make all reliability parameter decisions (that is, to review and, if need be, amend the Reliability Standard and Reliability Settings);
- AEMO make all reliability operational decisions (including to initiate the RERT and to review and, if need be, amend the MRLs); and
- high-level policy guidance is included in the Rules, which the AEMC would need to have regard to when reviewing and, if need be, amending the Reliability Standard and Reliability Settings.

Further discussion regarding processes for determining the Reliability Standard and Reliability Settings (collectively, the reliability parameters) is provided in Chapter 8. A proposed Rule regarding the proposed changes to existing governance arrangements and processes is provided at Attachment L.

7.1 Introduction

As part of the Review's MCE Terms of Reference, advice was sought regarding the appropriate governance arrangements for how Reliability Standard and Reliability Settings policy decisions in the NEM should be structured and managed in the future. Therefore, this Chapter specifically examines the:

- application of good governance in the energy market framework;
- roles of energy market institutions in the NEM; and
- existing arrangements for decisions relating to reliability in the NEM.

We conclude with our proposed recommendation for improving the current governance arrangements which apply to decisions concerning reliability in the NEM. Our recommendation has been informed by the stakeholder consultation undertaken for the Review.

7.2 Application of good governance in the energy market framework

As a general proposition, the application of good governance arrangements for decision making should ensure that:

- the decision is made at the appropriate level in the governance structure;
- the decision-maker has access to all relevant information and considerations;
- the decision is made in an appropriate manner, with a sufficient degree of independence, transparency, and accountability; and
- the decision is unbiased, evidence-based, and rigorous and that stakeholders have confidence in the basis and objectivity of the decision.

Consideration of these principles have informed us in examining the appropriate governance arrangements relating to the suite of decisions concerning reliability; that is, the Reliability Standard, the Reliability Settings (including the Administered Price Cap (APC)) and reliability operational decisions.

The National Electricity Law (NEL) (set out in the *National Electricity (South Australia) Act 1996)* provides for the regulation of the wholesale electricity market and the economic regulation of electricity network services. The national electricity legislative framework reflects the 2004 Council of Australian Governments Australian Energy Market Agreement (as amended). This energy market governance framework was designed to:

- improve the quality, timeliness of decision-making for, and to strengthen and streamline governance of the NEM;
- provide an enhanced framework of accountability to governments and market participants through the separation of functions to avoid perceptions of conflicting interests;
- provide for clear consultation, reporting obligations, transparency and avenues of appeal; and
- guide future energy policy decision-making by jurisdictions and to provide increased policy certainty for energy users and for the energy sector.

7.3 Role of energy market institutions in the NEM

The existing governance framework ensures that there is a separation of high level policy direction, rule-making and market development, market operation and administration, and economic regulation and rule enforcement. This is reflected in the roles assigned to the MCE and the various energy market institutions: the AEMC (including the Reliability Panel), AEMO and the AER. We briefly discuss the role of each of relevant market institutions, below.

MCE

The MCE is responsible for high level policy oversight and future strategic direction for the NEM. The MCE establishes the policy framework and governance arrangements for the national energy markets, however it does not become involved in the day-to-day operational activities of the institutional bodies. The MCE is best placed to make high level decisions on the market design or framework and to provide general policy guidance to the AEMC, AEMO and other institutional bodies as needed.

AEMC

The AEMC was established as a statutory commission and is the independent rule maker. It also has a market development function. The AEMC has the legal power to make decisions within the existing market design or framework through its consideration of Rule change requests and to provide advice to the MCE on energy policy, market design or framework changes. It must carry out its functions openly and transparently, and in accordance with the requirements of the NEL.

AEMC Reliability Panel

The Reliability Panel is established as a panel by the AEMC under the NEL. Its functions include monitoring, reviewing and reporting on the safety, security and reliability of the national electricity system. It also has a number of other functions under the Rules that it inherited from the previous governance arrangements. Currently they include determining the reliability standard. The composition of the Reliability Panel is set out in the Rules and includes a broad cross-section of industry representation.

AEMO

AEMO was established as a company and is the independent market operator. In its role as market operator, it is responsible for the day to day operation and administration of the power system and wholesale exchange for electricity. Its role is to administer the market, make decisions around technical operations and undertake actions that allow the market to run efficiently in accordance with requirements in the Rules and the NEL. AEMO also has a role to promote the development and improve the effectiveness of the operation and administration of the wholesale exchange. AEMO must comply with and apply the Rules insofar as they are relevant to its functions.

AER

The AER is responsible, under the NEL and Rules, for the compliance, enforcement, market monitoring and economic regulation of the NEM.

7.4 Current arrangements for decisions relating to reliability in the NEM

The following provides a general discussion of the existing governance arrangements regarding decisions concerning reliability.

Reliability Standard

Under clause 8.8.3(a)(1) of the Rules, the Reliability Panel is responsible for determining the Reliability Standard. Specifically, under clause 3.9.3A (a), by 30 April of each second year (commencing 2010), the Reliability Panel must conduct a Review in accordance with the Rules consultation procedures on the Reliability Standard and Reliability Settings and publish a Report on the Reliability Standard and Reliability Settings that it recommends should apply from 1 July in the year commencing two years after the year in which the Review is conducted. The Reliability Panel publishes the standard on the Reliability Panel's page on the AEMC website.

Reliability settings - MPC, market floor price and CPT

The Reliability Settings, being the MPC, market floor price and CPT are set out in the Rules (clauses 3.9.4(b), 3.9.6(b) and 3.14.1 (c)). The Reliability Panel must conduct a review in accordance with the Rules consultation procedures on the Reliability Settings and must include in the Report of the Review the Reliability Settings that it recommends should apply. [154] Following completion of the review of Reliability Settings, and depending on the outcome of the review of the Reliability Settings, the Reliability Panel may submit a Rule change request to the AEMC to amend the Rules to change the Reliability Settings. A decision to amend any of the settings is then made by the AEMC via a Rule change request.

Administered Price Cap (APC)

Under clause 3.14.1(a) of the Rules, in conjunction with each participating jurisdiction, and after consulting market participants in accordance with the Rules consultation procedures, the AEMC must develop, authorise and publish a schedule to specify an APC for each region. The schedule is published on the AEMC website.

Minimum Reserve Levels

MRLs are determined by AEMO on a periodic basis. They are not determined as a requirement under the Rules, but are rather determined to enable AEMO to fulfil its operational obligations.

154 Clause 3.9.4 of the Rules provides further direction to the Reliability Panel in how it should undertake the review of the MPC. Clause 3.9.6 provides further direction to the Reliability Panel in how it should determine the market floor price.

Reliability safety net measures

The reliability safety net measures are applied by the AEMO in accordance with requirements in the Rules. The Rules provide that AEMO can intervene in the market either by:

- issuing directions or instructions under clause 4.8.9 of the Rules. In relation to reliability, they are most likely to be a direction to a generator to increase its output to the extent that this is physically possible and safe to do. It may include instructions to disconnect load during periods of low reserves if necessary to maintain the secure operation of the NEM power system; or
- procuring additional reserves using the RERT mechanism under Rule 3.20. AEMO has the power to contract for additional reserve capacity (known as reserve trading) when it considers that the market has failed to deliver sufficient reserves to meet the MRLs.

7.5 Improvements to the existing governance arrangements for making decisions concerning reliability in the future

In the Second Interim Report, we observed that the existing governance arrangements provided inadequate high level policy input into the decision making process and that there are different decision making bodies to determine the Reliability Standard and Reliability Settings. Historically, higher level policy guidance regarding community expectations concerning reliability has not been part of the governance framework for reliability decisions, in particular decisions on the Reliability Standard. As discussed in Chapter 4, we considered that the community's expectations of the value and cost of reliable electricity supply should be a key element of the policy decision framework for the NEM's Reliability Standard and Reliability Settings (i.e. the reliability parameters).

Currently, the Reliability Standard is determined by the Reliability Panel, whilst the other Reliability Settings are determined by the AEMC, on the advice of the Reliability Panel. These NEM reliability parameters should be determined under a consistent process and by a single decision making body. This is particularly important given that these parameters are of an economic and market nature and there is a need to review and vary these as a package. We note that these reliability parameters should not be subject to constant review as they provide important signals for long-term investment in capacity by market participants. Maintaining consistency and allowing for a single decision-maker would reduce complexity of the existing processes and ensure that there is appropriate alignment between the Reliability Standard and the Reliability Settings.

Consequently, we proposed three options regarding potential changes to the existing governance arrangements for determining the Reliability Standard and Reliability Settings in the future. Regarding the three options proposed, it was noted that in all the options there would be greater policy input from the MCE and that the AEMC would be the independent decision maker for both the Reliability Standard and Reliability

Settings. Each of these options is depicted in the table below, along with the status quo for comparison.

Table 7.1 Proposed governance options to determine Reliability Standard and Settings

	Status quo	Option 1	Option 2	Option 3
MCE policy input	n/a	MCE SPP on customer value of reliability	As for option 1	As for option 1 or other input from the MCE
Location of reliability policy parameters	Schedule/Rules	Rules	Rules	Schedule or other instrument on AEMC website
Decision maker	AEMC/ Reliability Panel	AEMC	As for option 1	As for option 1
Decision trigger	Review, exercise of functions under Rules	Reliability Panel Review	AEMC review directed by MCE	In accordance with process set out in Law or Rules
Decision mechanism	Rule change request, exercise of functions under Rules	Rule change request from Reliability Panel	Rule change request from MCE	In accordance with process set out in Law or Rules
Other input	Including AEMO	Including AEMO, Reliability Panel	Including AEMO, Reliability Panel	Including AEMO, Reliability Panel

Option 1 provides that the reliability parameters would be set out in the Rules and the Reliability Panel would have the primary role to review these reliability parameters. The Reliability Panel would provide their Report to the AEMC, including recommendations to amend any of the reliability parameters. In order to amend any of the reliability parameters, the Reliability Panel would lodge a Rule change request to the AEMC. The AEMC would assess the Rule change request in accordance with its existing statutory Rule change process.

Option 2 also provides that the reliability parameters be set out in the Rules, however the AEMC would have the primary role to undertake periodic Reviews of the reliability parameters, rather than the Reliability Panel. Following a review, the AEMC may make a recommendation to the MCE whether or not to amend any of the reliability parameters. If the MCE agreed with the proposed AEMC recommendations, and made a Rule change request, the AEMC would then follow its existing statutory Rule change process.

Option 3 provides for the reliability parameters to be set out in a Schedule (i.e. currently the approach for the APC), rather than in the Rules. Including the reliability parameters in a Schedule allows the AEMC to amend the reliability parameters as appropriate. We note that such an approach would not prevent market participants (or any other body) from making a Rule change request to amend the reliability parameters or processes (as discussed in chapter 8). The requirement for the AEMC to review the reliability parameters and the processes for determining the Reliability parameters review (as discussed in chapter 8) would be stipulated in the Rules. In accordance with the AEMC's obligations under the NEL, any review or Rule change regarding the reliability parameters or the process for determining the reliability parameters would need to be assessed against the National Electricity Objective (NEO). Further, AEMC's decision making processes would be undertaken in a transparent, open and consultative manner.

7.6 Stakeholder submissions

Submissions to the Consultation Paper supported a single decision maker to determine the reliability parameters. In addition, most submissions generally supported a role for the Reliability Panel in the governance arrangements for determining the reliability parameters because it is broadly representative group from the power industry that provides the necessary expertise. Most submissions therefore supported the status quo and considered that the case for change had not been sufficiently made.

Submissions also supported greater policy guidance from the MCE insofar as this policy guidance was provided at a high level only and did not descend into detailed prescription. This position was motivated by the view that the MCE provides high level strategic policy advice while the detailed economic and regulatory functions were best placed on other energy governance institutions.

7.7 Proposed model regarding the future governance arrangements for making decisions concerning reliability

Consistent with our advice in the Second Interim Report, we conclude that Option 3 is the preferred approach for determining the reliability parameters in the future. Under the NEL, the AEMC is responsible for rule-making and energy market development at a national level. In its energy market development role, the AEMC can thus make decisions of an economic nature that affects the national energy markets. The decisions concerning the reliability parameters are decisions of a economic and market framework nature and thus relate to issues of market design. Therefore, given the nature of the decisions to be made, it is considered the AEMC is the appropriate body within the existing energy market governance framework to make the decisions concerning the reliability parameters.

We note that with respect to Option 1, the Reliability Panel would initiate the Review of the reliability parameters, and propose recommendations for the AEMC to consider regarding amendments to those parameters. We consider that the Reliability Panel may not be best placed to initiate and review the reliability parameters because of perceived conflict of interest due to the composition of its membership. The expertise of the Reliability Panel would better serve the process of determining the reliability parameters in an advisory role. Regarding Option 2, the MCE would decide if the AEMC is to consider amendments to the reliability parameters. We consider that the proposal would be inconsistent with MCE's role in high-level policy making functions.

The proposed approach would ensure that there is a single decision-maker responsible for the decisions relating to the reliability parameters, which would enhance the efficiency and streamline the process relating to the determination of the reliability parameters. The proposed approach would also ensure that decisions to determine the reliability parameters are made in an integrated manner.

MCE – strategic input

We note that the proposed approach ensures that the MCE provides strategic direction to the AEMC, specifically through its consideration of the proposed recommendations for this Review. In the Second Interim Report, we indicated that there could be a separate high level Statement of Policy Principles as a mechanism to achieve high level strategic input from the MCE on community expectations regarding reliability.

However, in our proposed approach, we recommend that it is more appropriate that the high level principles would be better placed in Rules proposed by the MCE which would be in the form of guidance that the AEMC should take into account when undertaking a review of the reliability parameters. We consider that the insertion of high-level guidance in the Rules regarding the factors which the AEMC must take into account would provide the equivalent level of policy guidance from the MCE as the previously proposed Statement of Policy Principles. However, the insertion of high-level guidance in the Rules would make for a more stream-lined and efficient decision-making process and would enhance regulatory certainty. This is because the set of considerations or high-level guidance that would guide the AEMC in its determination of the reliability parameters would be completely integrated and clearly articulated within the Rules. The MCE's strategic input and guidance would be achieved through consideration of the proposed recommendations arising from this Review and the proposed Rule at Appendix L.

Specification of the reliability parameters

The reliability parameters would be specified in a Schedule which would be published on the AEMC's website. This is similar to current arrangements concerning the APC. Consequently, the reliability parameters would no longer be located within the Rules. This would not preclude market participants, or any other relevant persons, from submitting a Rule change request to the AEMC regarding the location of the parameters.

AEMC's process for determining the reliability parameters

With respect to the process that the AEMC must follow to determine the reliability parameters, this would be prescribed in the Rules. For clarity, the AEMC would not determine the reliability parameters in accordance with its ordinary statutory Rule-making powers. Rather, the AEMC would follow a prescribed process in the Rules. The prescribed process is provided in Appendix L. It is important to note that this prescribed process would be still subject to potential amendments through a Rule change request under the NEL. In addition, any review or Rule change would still be undertaken by the AEMC in accordance with its statutory requirements including consultation, assessment against the NEO and having regard to Statements of Policy Principles from the MCE.

In determining the reliability parameters, a key feature of the process to be followed by the AEMC is that there would be a requirement on the AEMC to consult with respect to the assumptions and methodologies to be used in determining the reliability parameters. This obligation to consult would provide an opportunity for stakeholders (industry, consumers and jurisdictions) to contribute to the development of the process for determining the reliability parameters.

Reliability Panel - providing advice

Under the proposed model, the Reliability Panel would not have a direct role in initiating and determining the reliability parameters. The Reliability Panel's role would be to advise the AEMC on technical and operational matters during the course of the AEMC's review of the reliability parameters. In response to submissions, it is proposed that it be stipulated in the Rules that the AEMC be required to consult with the Reliability Panel during the course of its determination of the reliability parameters. This requirement recognises that the Reliability Panel provides the requisite insight, expertise and views on investment issues pertaining to the supply of electricity. However, it should be noted that the individual members of the Reliability Panel are primarily accountable to the respective boards of the organisations that they represent and thus their views would principally reflect the interests of their respective organisations. It is thus appropriate that the Reliability Panel would be one source of advice among a range of stakeholders representing a wide range of views that would broadly inform the AEMC in determining the reliability parameters.

AEMO - Reliability operational decisions

In accordance with the NEL, AEMO is responsible for the day-to-day administration and operation of both the power system and electricity wholesale spot market in the NEM and other support activities. The reliability operational decisions refer to the setting of the MRLs and reliability safety net measures, which includes the giving of directions and the initiation of the RERT mechanism. It is therefore appropriate that these reliability operational decisions remain the responsibility of AEMO.

Recommendation

We recommend that the future governance arrangements for reliability decisions should be amended to reflect that:

- the AEMC make all reliability parameter decisions (that is, to review and, if need be, amend the Reliability Standard and Reliability Settings);
- AEMO make all reliability operational decisions (including to initiate the RERT and to review and, if need be, amend the MRLs); and
- high-level policy guidance is included in the Rules which the AEMC must have regard to when reviewing and, if need be, amending the Reliability Standard and Reliability Settings.

Further discussion regarding processes for determining the Reliability Standard and Reliability Settings is provided in Chapter 8. A proposed Rule regarding the proposed changes to existing governance arrangements and processes is provided at Attachment L.

8 Processes for determining the Reliability Standard and Reliability Settings

Chapter Summary

This chapter provides our analysis of the processes for determining the Reliability Standard and Reliability Settings.

We recommend amending the existing processes for determining the Reliability Standard and Reliability Settings, specifically that:

- an explicit requirement for the Reliability Standard and Reliability Settings to reflect the level of reliability valued by consumers be included in the Rules;
- the MPC and VCR would be checked against each other to assess whether the reliability parameters are consistent with the value that consumers place on reliability;
- the Reliability Standard and Reliability Settings would be reviewed, and amended where necessary, by the AEMC every 5 years;
- the Reliability Standard and Reliability Settings would be specified and given effect in a schedule referred to in the Rules;
- AEMO would use the same VCR for its transmission planning activities as is used for determining the reliability parameters; and
- the methodology and assumptions that would be applied to determine the Reliability Standard and the Reliability Settings, MRLs and the VCR would be subject to public consultation and would be established before the process for determining these parameters commences.

We have provided a proposed Rule (attached at Appendix L) to implement the recommendations in this Chapter for the MCE's consideration.

8.1 Introduction

In Chapter 7, we recommended changes to the governance arrangements for reliability decisions. In that chapter, we recommended that the AEMC be the single decision-maker for both the Reliability Standard and the Reliability Settings. We also recommended that high level policy guidance be included in the Rules which the AEMC would need to have regard to when determining the Reliability Standard and Reliability Settings. In this Chapter we examine the processes for determining the Reliability Standard and Reliability Settings.

That is, how should the relevant market institutions undertake their roles in relation to reliability decisions under the proposed new arrangements.

Specifically, we:

- evaluate the current processes for determining the Reliability Standard and Reliability Settings against a set of principles to identify strengths and weaknesses;
- provide two alternate models for determining the Reliability Standard and Reliability Settings;
- evaluate the two alternate models against the identified principles; and
- recommend a preferred model for determining the Reliability Standard and Reliability Settings.

8.2 Principles for assessing the processes for determining the Reliability Standard and Reliability Settings

To evaluate both the current process along with the proposed new processes for determining the Reliability Standard and Reliability Settings, we have established a set of key guiding principles. These principles are articulated as follows:

1. Planned reliability should reflect the value that consumers place on reliability.
2. The risk of systemic market failure should not be significant.
3. The processes to determine the Reliability Standard and Reliability Settings should promote investor certainty.
4. Industry should be confident in the outcomes of the determinations regarding the Reliability Standard and Reliability Settings.
5. The Reliability Settings should deliver the reliability to meet consumer expectations in an efficient manner.
6. The various reliability standards for generation and transmission should promote consistency across the supply chain.

Below in this section, we have applied the principles outlined above to the current processes for determining the Reliability Standard and Reliability Settings to evaluate the effectiveness of the current arrangements. As discussed in more detail below, we consider that the current processes for determining the Reliability Standard and Reliability Settings:

- include no requirement for the Reliability Standard and Reliability Settings to reflect the value that consumers place on reliability;

- provide little certainty to market participants and investors as to likely future levels of MPC;
- provide minimal guidance to the decision makers for Reliability Standard and Reliability Settings determinations; and
- do not promote consistency across the electricity supply chain.

Planned reliability should reflect the value that consumers place on reliability

Currently, there is no explicit link between the Reliability Standard and Reliability Settings, and the VCR. The MPC is determined such that there is an expectation that the Reliability Standard would be met. However, the Reliability Standard has not been tested to assess whether it reflects the value that consumers place on reliable supply.

We consider that the current arrangements could be improved by introducing an explicit requirement for the VCR to be considered when determining the levels for the Reliability Standard and Reliability Settings. This would ensure that the reliability parameters reflect the value that consumers place on reliable supply.

The risk of systemic market failure should not be significant

Both the Reliability Panel and the AEMC consider the risk of systemic market failure in making a decision to change the Reliability Standard and Reliability Settings. The AEMC and the Reliability Panel were established to make key decisions in relation to NEM design and settings.

We consider that the current process for making changes to the NEM design and settings provide suitable safeguards against the risk of systemic market failure.

The processes should promote investor certainty

Following a decision to amend the Reliability Standard or Reliability Settings, there is currently a two-year notice period before that decision would take effect and that decision would be expected to remain in effect for a further two years at a minimum. This provides a total of four years pricing certainty for market participants. This is a relatively short period of pricing certainty for long term investments and is considered a risk by financial institutions looking to lend to generators. In addition, it is difficult for market participants to forecast the Reliability Standard and settings beyond four years because of a lack of prescription on the methodology and assumptions to be used in determining the Reliability Standard and Reliability Settings.

We consider that the current arrangements could be improved through amendments that would provide market participants greater long-term pricing certainty.

Industry should be confident in the outcomes of the determinations regarding the Reliability Standard and the Reliability Settings

Currently there is no guidance in the Rules and no defined methodology for determining the Reliability Standard and Reliability Settings. This would likely affect industry confidence in the outcomes of these reviews.

We consider that the current arrangements could be improved by providing greater guidance for reliability decisions in the Rules.

The Reliability Settings should deliver reliability to meet consumer expectations in an efficient manner

The current process for amending the Reliability Settings can involve up to four rounds of consultation. This makes the process very lengthy and burdensome for stakeholders who would need to read four reports and make four submissions to the process to be fully involved.

We consider that the process for setting the MPC could be streamlined.

The various reliability standards for generation and transmission should promote consistency across the supply chain

There are currently no linkages between the reliability standards that apply in each stage of the electricity supply chain. Reliability standards are determined independently of the reliability standards applying at other stages of the supply chain. However, there is some interaction between the planning processes; for example, there is joint planning between a TNSP and DNSP.

We consider that there should be greater consistency between the investment and planning regimes at each stage of the supply chain.

8.3 Stakeholder submissions

In the Consultation Paper for this Review, we discussed options for providing greater long-term pricing certainty for market participants and investors including the introduction of a 10-year MPC trajectory and extending the period between reviews of the Reliability Standard and Reliability Settings from 2 years to 5 years. Stakeholder feedback on these options are considered below.

10-year MPC trajectory

Many stakeholders expressed concern that it would be risky establishing a 10-year MPC trajectory due to difficulties in forecasting the factors influencing investment. Submissions also noted concern that a 10-year trajectory may reduce the AEMC's flexibility to set the MPC at the necessary level to incentivise appropriate investment in generation.

For the reasons given by stakeholders in submissions, we have decided not to recommend the introduction of an MPC trajectory. Instead, we consider that improved investment certainty could be provided to market participants and investors by:

- more transparent and better defined methodologies for determining the Reliability Standard and Reliability Settings;
- extending the period between each review of the Reliability Standard and Reliability Settings; and
- establishing a mechanism for indexing the Reliability Settings.

Period between reviews of the Reliability Standard and Reliability Settings

In relation to the adequacy of the current 2-year timeframe between reviews of the Reliability Settings, some submissions supported the current arrangements.[155] However, other submissions argued that a better balance could be struck in terms of investment certainty by adopting a longer timeframe between reviews.[156] It was suggested that the review of the Reliability Settings occur every four to five years to provide greater investment certainty.[157] TRUenergy noted that a risk premium would need to be added to the MPC if timeframes were extended.[158]

We have retained our recommendation for lengthening the timeframe between reviewing the Reliability Standard and Reliability Settings for the reasons outlined below in this Chapter.

8.4 Proposed models for improving the current processes for determining the Reliability Standard and Reliability Settings

In this section, we specify two new alternate models for determining the Reliability Standard and Reliability Settings. Both models address the weaknesses identified with the current processes for determining the Reliability Standard and Reliability Settings and both are consistent with the governance recommendations outlined in Chapter 7.

The following features are common to both models:

- high level guidance for determining of the Reliability Standard and/or Reliability Settings would be provided in the Rules, including an explicit requirement for the Reliability Standard and Reliability Settings to reflect the level of reliability valued by consumers. This would provide industry and governments greater confidence in the outcomes of these determinations;

155 CUAC Submission, p.4; TRUenergy Submission, p.3.

156 LYMMCO Submission, p.8; Origin Energy, p.3.

157 Tasmanian Office of Energy Planning and Conservation Submission, p.2; Origin Energy Submission, p.3; MEU Submission, p.31.

158 TRUenergy Submission, p.3.

- the Reliability Standard and/or Reliability Settings would be reviewed once every five years, unless the AEMC considered that a material change in circumstances necessitated a change earlier than five years. A method of annual indexing for the Reliability Settings would be defined as part of the Reliability Settings review. These measures would provide industry longer term price certainty;

- the Reliability Standard and/or Reliability Settings would be specified and given effect in a schedule referred to in the Rules. The Rules would define the process to be followed by the AEMC when amending the Reliability Standard and Reliability Settings Schedule and would include consultation with the Reliability Panel and industry. This removes the need for a Rule change proposal to trigger an amendment to the Reliability Standard and/or Reliability Settings. This would ensure that the trigger for amending the Reliability Standard and/or Reliability Settings is not inefficiently influenced by industry or political bias, and streamlines the overall process for amending the Reliability Standard and/or Reliability Settings;

- the methodology and assumptions for determining the Reliability Standard and/or Reliability Settings would be established prior to determining the Reliability Standard and Reliability Settings and would be established in consultation with industry. This would provide industry and governments greater confidence in the outcomes of these determinations; and

- AEMO's current practice of developing MRLs would be formalised in the Rules, including an obligation to develop guidelines covering the methodology for determining the MRLs and VCR. This would provide industry and governments greater confidence in the outcomes of these determinations.

Below we outline the two alternate models. The key difference between each is how the VCR is taken into account in determining the Reliability Standard and Reliability Settings. In Model 1, the VCR is compared to the MPC to check that the reliability parameters are consistent with the value that consumers place on reliability. In Model 2, the VCR is used directly to determine the MPC, and then a Reliability Standard is developed for operational purposes only.

Appendix K contains a detailed explanation of each model together with reasoning for the design features of each model.

8.4.1 Model 1

Model 1 is similar to the current process for determining the Reliability Standard and Reliability Settings except that there is a requirement to check the MPC against the VCR to assess whether the Reliability Parameters are consistent with the value consumers place on reliability. Model 1 is illustrated below in Figure 8.1. This proposed model for determining the Reliability Standard and Reliability Settings consists of the following processes:

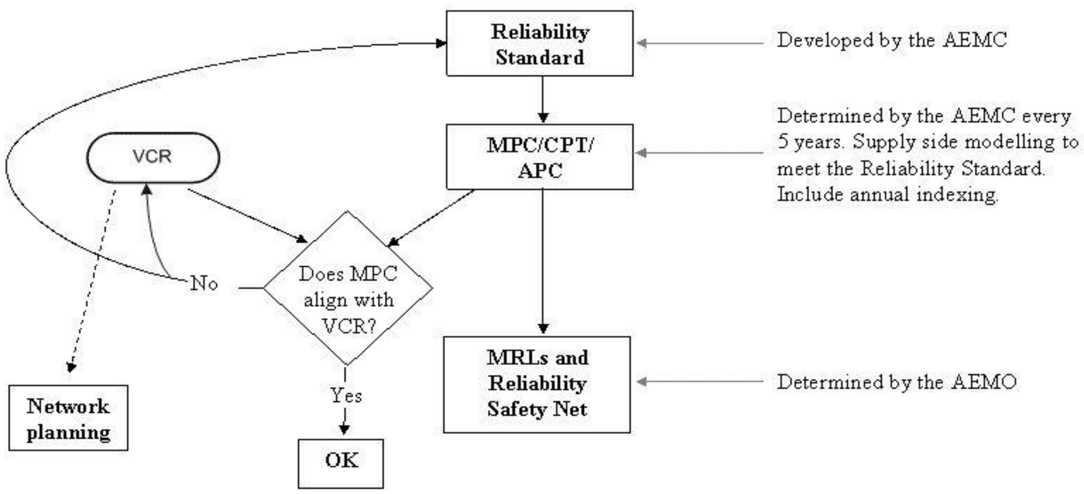
1. AEMO would develop a national VCR for the residential consumer class (AEMO currently determines a VCR for Victorian consumers under its Victorian transmission planning role and is in the process of developing a national VCR to carry out its national transmission planner role).

2. The AEMC, in reviewing the Reliability Standard, would compare the VCR for the residential consumer class with the MPC to assess how well the current reliability parameters reflect the value consumers place on reliability. If the MPC is inconsistent with the VCR, then the AEMC would examine the cause of this inconsistency. This may be due to inaccuracies in the determination of the VCR, the Reliability Standard may no longer reflect the value consumers place on reliability, or the MPC may not be consistent with achieving the Reliability Standard. If it is found that the Reliability Standard no longer reflects the value consumers place on reliability, then the Reliability Standard would be amended.

3. The AEMC would determine the MPC consistent with achieving the Reliability Standard.

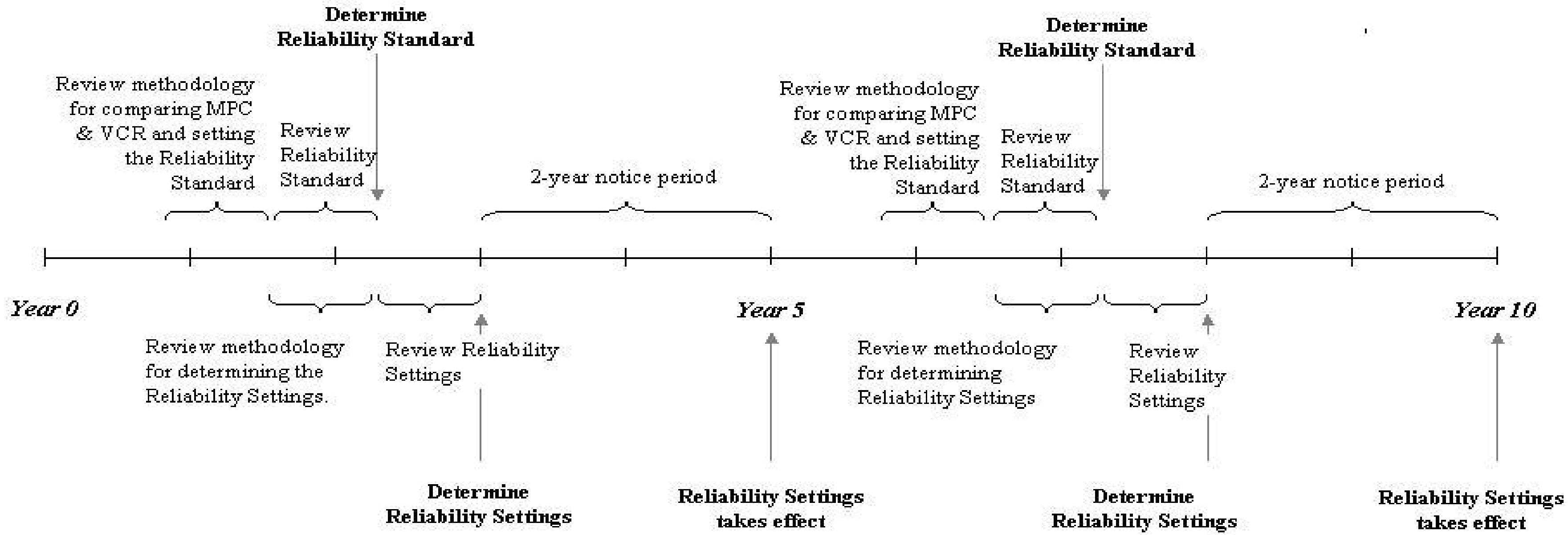
4. AEMO would operationalise the Reliability Standard through the development of MRLs.

Figure 8.1 Model 1



The timeline below in Figure 8.2 illustrates how Model 1 would operate over a 10-year period.

Figure 8.2 Model 1 - Timeline

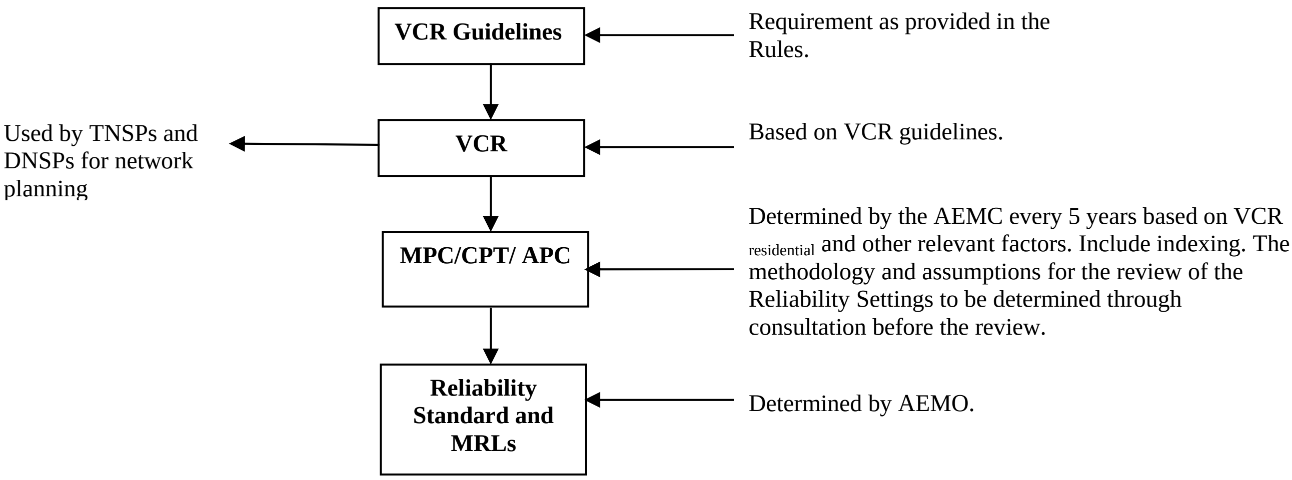


8.4.2 Model 2

Model 2 is illustrated below in Figure 8.3, and consists of the following:

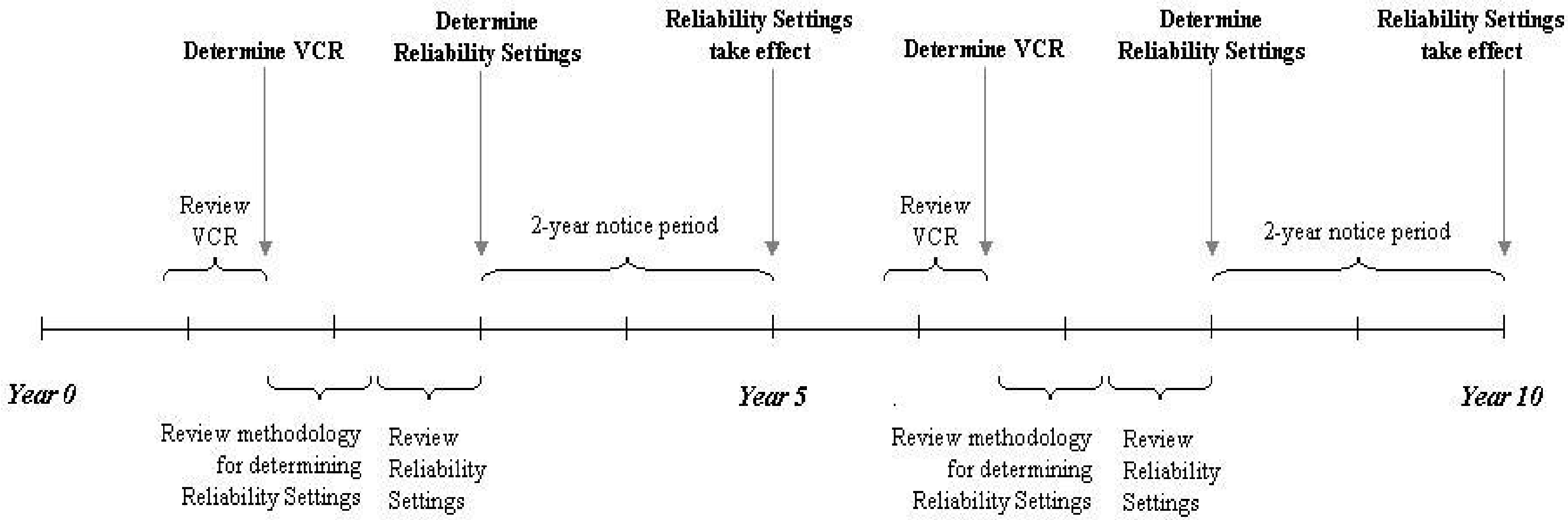
- The AEMC would develop the VCR. Note that under this model the VCR becomes a key reliability parameter and as such should be developed by the AEMC under the governance structure recommended in Chapter 7.
- The AEMC would determine the MPC based on the VCR for residential consumers (the MPC would be set equal to the VCR as a starting point, but may be adjusted to account of risks and costs).
- AEMO would determine the Reliability Standard (derived from the VCR and MPC) and MRLs for operational purposes.

Figure 8.3 Model 2



The timeline below in Figure 8.4 illustrates how Model 2 would operate over a 10-year period.

Figure 8.4 Model 2 - Timeline



8.5 Assessment of proposed models against principles

In this section, we assess each of the two options against the principles outlined in section 8.2.

Planned reliability reflects the value that consumers place on reliability

Reliability under both models would better reflect the value that consumers place on reliability relative to the current arrangements because the VCR is taken into account in both models.

Risk of systemic market failure

Both models adequately consider the risk of systemic market failure in reliability decisions. This is because both models require a formal decision for changes to the reliability parameters to be made by the AEMC. The AEMC is required to determine whether a decision would contribute to the advancement of the NEO, and we do not consider that heightened risk of systemic market failure would contribute to the advancement of the NEO.

For example, a dramatic increase to the survey VCR value would not necessarily be fully reflected in the MPC if the AEMC considered that this heightened the risk of systemic market failure. The risk of systemic market failure has the potential to be higher in Model 2 if supply side risks are not appropriately considered.

Investor certainty

Both models improve investor certainty relative to the current arrangements as a result of consultation on modelling methodology and assumptions and by extending the period between reviews of the Reliability Standard and Reliability Settings to 5 years.

Supply side modelling is less subjective than demand side modelling. Supply side modelling is based on reported facts and has been well developed over many years, whereas demand-side modelling is based on end-user surveys and is not well understood by all stakeholders. As Model 1 is based on supply-side modelling, the outcomes of this model are likely to be more predictable than Model 2. Model 1 also involves less change from the status quo which supports regulatory certainty.

Industry confidence in the outcomes of Reliability Standard and Reliability Settings determinations

Both models would likely improve industry confidence in the outcomes of reliability parameter decisions relative to the current arrangements. Both models:

- appropriately allocate reliability parameter setting to the AEMC, and reliability operational and implementation settings to AEMO;
- include Rules based guidance covering the setting of key reliability parameters; and

- require stakeholder consultation on both the methodology for setting reliability parameters, and the review of reliability parameters.

Model 1 is likely to provide stakeholders greater confidence because the approach of setting the MPC to deliver the Reliability Standard using supply side analysis is well tested and does not require a significant change to existing processes.

Delivering reliability to meet consumer expectations in an efficient manner

Both models would improve the efficiency of reliability parameter decision making by streamlining the roles and process for determining the reliability parameters.

By linking the MPC to the VCR, consistency across the supply chain would be more easily and transparently delivered. This would enable reliability at the point of consumption to be more efficiently achieved.

Consistency across the supply chain

Both models would improve consistency in reliability planning across the supply chain. This is because the same VCR is used in the network planning and investment regime would also be used in the generation investment and planning regime.

8.6 VCR

An essential element of these reforms is the use of a common VCR which will deliver consistency in investment for reliability across the supply chain.

AEMO currently estimates a VCR for Victorian consumers under its transmission planning function for Victoria and is in the process of developing a national VCR to enable it to fulfil its national transmission planning function. A key recommendation of this Review is to apply a common VCR across the electricity supply chain. As such, we have recommended that the VCR determined by AEMO also be used in setting the Reliability Standard and Reliability Settings. We have also recommended placing a formal obligation on AEMO in the Rules to use this same VCR for its transmission planning functions.

To provide industry with certainty and confidence in the outcome of the VCR estimation, we have recommended a new Rule requirement for AEMO to establish guidelines in accordance with the Rules consultation procedures that AEMO would be required to follow in estimating the VCR.

We recognise that the VCR is gaining importance as a key reliability parameter in delivering investment for reliability consistently across the electricity supply chain. We therefore consider that in the future it would be worthwhile examining whether AEMO remains the appropriate organisation under the NEM's governance structure for undertaking the role of estimating the VCR.

8.7 Conclusion

We consider that both models would offer substantial benefits over the current arrangements for determining reliability parameters, particularly in the areas of efficiency of process, efficiency of the outcomes, delivering consistency across the supply chain and planning reliability that reflects the value that consumers place on reliability.

However, we consider that Model 1 is more appropriate for determining the reliability parameters at this stage of the NEM's development. By introducing the VCR into the process for determining the reliability parameters, investment for reliability should be delivered consistent with the value that consumers place on reliability. In addition, as this model is an incremental step from the current arrangements, confidence and certainty in the outcomes of the process should be maintained. Over time, reliance on the Reliability Standard for non-operational purposes may decline at which point further consideration may be given to Model 2.

At Appendix L, we provide a proposed Rule to implement the governance arrangements and processes for determining the Reliability Standard and Reliability Settings as recommended in Chapters 7 and 8.

Recommendation

We recommend amending the existing processes for determining the Reliability Standard and Reliability Settings, specifically that:

- an explicit requirement for the Reliability Standard and Reliability Settings to reflect the level of reliability valued by consumers be included in the Rules;
- the MPC and VCR would be checked against each other to assess whether the reliability parameters are consistent with the value that consumers place on reliability;
- the Reliability Standard and Reliability Settings would be reviewed, and amended where necessary, by the AEMC every 5 years;
- the Reliability Standard and Reliability Settings would be specified and given effect in a schedule referred to in the Rules;
- AEMO would use the same VCR for its transmission planning activities as is used for determining the reliability parameters; and
- the methodology and assumptions that would be applied to determine the Reliability Standard and the Reliability Settings, MRLs and the VCR would be subject to public consultation and would be established before the process for determining these parameters commences.

We have provided a proposed Rule (attached at Appendix L) to implement the recommendations in this chapter for the MCE's consideration.

9 Alternative mechanisms to deliver reliability in the NEM

Chapter Summary

This chapter discusses some of the possible alternative market mechanisms which could be implemented to deliver satisfactory reliability in the NEM and our conclusions as to why these alternative mechanisms are not necessary for the NEM at this stage. The alternative mechanisms considered for this Review include a capacity market, forms of standing reserve and a reserve ancillary service. We discuss each of these drawing on previous advice given to the MCE and also provided in recent AEMC Reviews and related processes.

We consider that implementation of alternative mechanisms is not needed at this stage as there is no evidence to suggest that reliability in the NEM has not been achieved with the application of the current Reliability Standard and Reliability Settings. We do consider however, that the performance of the NEM's energy only design should be monitored to determine if the market design remains resilient and sustainable over time, particularly if extreme weather events do become more frequent in the future.

It is possible that the NEM’s demand profile may change in the future, and thus the NEM’s energy-only market design may no longer be an efficient and effective model for delivering power system reliability. If it is determined, in the future, that the NEM’s energy-only market design no longer delivered acceptable reliability, then we consider that any new arrangement should complement the current energy-only market design rather than replace it. As discussed in Chapter 5, we consider that the proposal to expand the Annual Market Performance Review undertaken by the Reliability Panel, and for the outcomes of that Review to be considered by the AEMC, would assist to test the resilience of the energy-only market on an ongoing basis.

9.1 Introduction

In the Second Interim Report, we noted that at some point raising the MPC to deliver additional investment for ensuring reliability may not be efficient or effective. At that point, the benefits of a higher MPC may not outweigh the costs in terms of market risks (discussed in chapter 6). We also noted that there are a range of possible alternative mechanisms that could be considered to deliver satisfactory reliability in the NEM and thus incentivise additional investment in generation. These alternative mechanisms include: a capacity market, standing reserve and a reserve ancillary service.

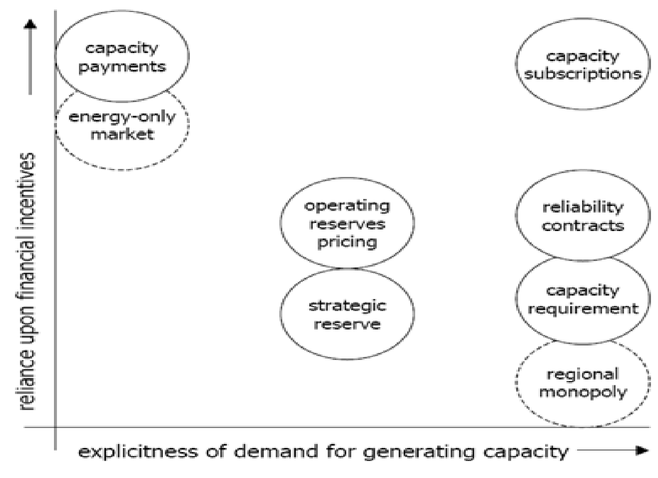
For this Final Report, we have sought to provide some commentary regarding these alternative mechanisms, recognising that they may be relevant at some time in the future if reliability of the power system cannot be achieved with the current market mechanisms. We have given particular consideration to the option for a potential standing reserve, as a result of MCE's response to the recommendations from the AEMC Review of Energy Market Frameworks in light of Climate Change Policies. The MCE in its response specifically asked the AEMC to consider further the issues around standing reserve as a possible measure to ameliorate possible risks of future load shedding in light of extreme weather and climate change policies. We have provided this advice in this Final Report.

We note that a number of AEMC reviews have considered the issue of alternative mechanisms to deliver capacity, including the Review of Energy Market Frameworks in light of Climate Change Policies, Review of Demand-Side Participation (DSP) in the NEM,[159] and also the Reliability Panel's CRR. In addition, we have previously engaged KEMA Consulting (KEMA) to research the models used by other electricity markets to deliver reliability of supply and to report on the key features and issues with those models. KEMA's Report provided to the AEMC is provided at Appendix H. For this Report, we have provided our views based on previous consideration of these alternative mechanisms, and where appropriate, extend that analysis.

9.2 Potential alternative mechanisms

There are a range of possible models to deliver reliability of supply. Figure 8.1 below compares the range of models with respect to reliance on financial incentives and the explicit specification of the level of capacity required. Table 8.1 provides a summary of each of the alternate models from Figure 8.1 for delivering reliability of supply, and also seeks to outline the key features and issues of each model.[160]

Figure 9.1 Overview of market models intended to ensure reliability



De Vries, L.J. Securing the public interest in electricity generation markets, The myths of the invisible hand and the copper plate. Ph.D. dissertation, Delft University of Technology, 2004

159 www.aemc.gov.au.

160 KEMA 2009 *Information Paper on Supplementary Market Mechanisms to Deliver Security and Reliability*, p.4

Table 9.1 Alternate models for delivering reliability of supply

Model	Key Features	Key Issues
Capacity Market	Volume obligations placed on retailers, to be met by purchases of certified volumes from generation	Not clear that security of supply at system peak is enhanced. Some volatility in energy markets may be ameliorated. Volume obligations have to be determined. High transaction and administrative costs.
Reliability Options (Financial)	Call options for forward energy	Strong incentives to make capacity available at time of peak load. Effective hedge against price spikes. High transaction and administrative costs.
Peak Load Reserves	Control and operation of selected peaking plant by the System Operator	Security of supply may be enhanced in the shorter term, but long-term efficiency may be compromised. Concerns about System Operator competing in market. Limited costs.
Operating Reserves Pricing	Market-based procurement and pricing of operating reserves	Focus on security rather than adequacy. May provide additional income to peaking plants. May promote short- and long-term efficiency. Limited costs.
Capacity Payments	Capacity pricing alongside energy pricing, based either on costs or value of such capacity	Not clear that security of supply at system peak is enhanced. No incentives for efficiency. High costs.
Long-term Bilateral Contracts	Use of long-term bilateral contracts	Provides for efficient hedge against uncertainty but unlikely to function on a voluntary basis. Promotion of short-term efficiency. Barriers to entry impair long-term efficiency.
Demand-Side Short-term Pricing	Demand response to (tariff) pricing	Supports reliability / adequacy but unlikely to be sufficient on its own.

Model	Key Features	Key Issues
		Facilitates efficient outcomes for scheduling and dispatch. May reduce costs.
Interruptible Load	Demand response to instruction, or automatically, as a form of Operating Reserve	Supports security but unlikely to be sufficient on its own. Facilitates efficiency of reserve provision. May reduce costs.

In its report, KEMA analysed the above models in the context of the NEM and made some conclusions including that:[161]

- few models provide a reasonable 'guarantee' of actually being able to assure reliability, and where reliability is likely to be guaranteed it comes at the expense of a possible deterioration of long-term efficiency and/or significant costs and complexity of the mechanism;
- there does not seem to be a clear relation between the application of specific capacity mechanisms and improved reliability;
- the potential for demand-side measures strongly depends on the specific consumption structure of a given market, whilst the general application of demand-side measures to all consumers may result in significant costs and complexity; and
- the market-based procurement/deployment and pricing of operating reserves generally shows a positive performance against all of the criteria defined above. The main disadvantage of this model is related to the fact that it provides only an indirect way of promoting reliability.

9.2.1 Capacity market mechanism

A key difference between the NEM and some other market designs is the extent to which there are regulated centralised mechanisms or markets to provide revenue streams other than through the spot market. An obligation on market participants to procure specified amounts of accredited capacity is an example of such a mechanism. In effect, such a mechanism creates a regulated market in capacity.

The capacity markets model requires an explicit requirement for capacity to be maintained. In order to ensure that the same obligation is placed on every market participant, the overall required volume of capacity has to be centrally established by a single entity. This entity is usually the system operator, however, this responsibility may also be transferred to a separate market operator and the final decision may be subject to approval by the regulator. Another option regarding accountability to buy

161 KEMA 2009 *Information Paper on Supplementary Market Mechanisms to Deliver Security and Reliability,* p.4-5.

capacity may be with retailers (or load serving entities as referred to some United States markets) who go to the market for capacity credits or "tickets".

The determination of the required volume of capacity will typically be based on the same principles and criteria as commonly used for system planning purposes and may consider various aspects such as expected demand, reserve requirements and, potentially, any additional capacity which may be firmly available from neighbouring power systems. Depending on the time horizon of the capacity market, the overall capacity requirement may be determined on an annual basis, but may also be varied on a seasonal, monthly, weekly or even daily basis.

We note that the following issues have been identified with respect to the implementation of a capacity market:

- If there is such an alternative source of revenue for new entry generation, then the price cap in the spot market can be much lower. This therefore can reduce price volatility in the spot market, and hence reduce the importance of tools for managing spot market price risk. This does, however, introduce a new form of price risk in the regulated market for capacity;
- If generators offered capacity at long-run marginal costs, the additional income would furthermore be sufficient to cover the fixed costs of peaking plants, which should provide strong incentives to invest;
- Greater emphasis may be placed on regulatory decision-making, for example on what level of capacity market participants should be obligated to buy and how the quality of different forms of capacity should be accredited, and thus there is likely to be a reduced role for decision-making by market participants;
- Reduce the potential impact of market power in the spot market, but can create the possibility for market power in the regulated capacity market including as a result of features of the regulatory design;
- The incentives to be available when needed and the relative reliability of each plant offering capacity needs to be appropriately dealt with; and
- The network transfer capability and management of network congestion should be considered - a well designed scheme would need to ensure risks are apportioned appropriately to effectively deliver reliability and efficiency.

In the CRR, the Reliability Panel noted that a capacity option was likely to significantly increase certainty about reliability because AEMO (or another nominated body) would be charged with entering into contracts for the full capacity needed to cover demand and reserve margins. However, given that the form of contracts would need to be uniform, flexibility and the opportunity for innovation would likely to be reduced. It is also likely that there would be significant changes required to risk profiles and existing contract arrangements. It was also noted that implementation of such a mechanism would likely result in costs to AEMO (or another nominated body) in establishing and conducting the tender or auction to acquire capacity. Transitioning to any such mechanism would therefore likely result in higher indirect and transition costs to participants than any of the other alternative options outlined below. Whilst such a mechanism would be more predictable, it may result in higher average prices for consumers in the medium term.

We also note that the following issues were also raised by KEMA in their report regarding capacity markets:[162]

- The entity that is responsible for setting the overall capacity requirement is not itself exposed to the costs of contracting for this capacity. Although the planning process should ideally involve all stakeholders, this creates a potential risk of erring on the side of excess capacity.

- Capacity markets principally cover the entire amount of installed capacity. As a consequence, it is not only peaking plants that benefit from the resulting payments but also other generators that are already profitable in the energy market. This model may therefore result in considerable windfall profits for the latter group and considerable additional costs for consumers.

- There is an area of interaction between the markets for capacity and energy, especially in an interconnected system:

  - depending on the specific design of the capacity market, this model may create additional incentives for withholding of capacity and thus create additional risks for short-term efficiency; and

  - where generators have the choice of providing their capacity either to the capacity market or to another market, for instance in the form of exports to neighbouring markets, it may be more profitable to infringe on their obligations under the capacity market and use the same capacity for exporting energy at a much higher price.

9.2.2 Reserve ancillary service

The Reserve Ancillary Service (RAS) mechanism was considered by the Reliability Panel in the CRR. It was noted that such a mechanism would operate in a similar way to the existing Market Ancillary Services (MAS)[163] offering real time pricing of reserve and payment to any resource that can provide reserve capability at the time. As a result, prices for reserve would reflect prevailing conditions, that is, RAS prices would be expected to be volatile and rise to a high level as the supply-demand balance tightens. A RAS would provide reserve plant with a more certain revenue stream than the energy market alone and would have a very similar impact on the annual revenue

162 KEMA 2009 *Information Paper on Supplementary Market Mechanisms to Deliver Security and Reliability,* p.32-36.

163 The MAS arrangements, used to manage the effects of sudden disturbances to system frequency, are for fast-acting reserves that can respond in timeframes of five minutes or less.

for reserve plant as does making a capacity contract payment at the marginal value of capacity for the year.

The Reliability Panel considered that the amount of reserve needed to meet the reliability standard would be determined by AEMO. Depending on the detailed design of the scheme, this amount would be up to the current capacity reserve margin used by AEMO. In all cases, however, it would primarily affect peaking plant and thus create a difference between peak and base load. Indirectly, this would provide a market mechanism to redress the effect of uncertainty of revenue available to low-utilisation plant. However, it would not recognise the contribution of high-load factor plant to the capacity available to the market at any time.

The Reliability Panel highlighted that a potential RAS mechanism would use real-time market-pricing principles that are very similar to the current energy-pricing arrangements for spot trading in the NEM. The level of reserve acquired by a RAS mechanism would be set centrally but priced in a spot market. The design would increase the certainty of revenue streams for reserve plant and indirectly increase the probability of merchant investments. It would not create incentives for long-term contracting, but it would address, to some extent, the lack of long-term underwriting of new investment. However, it would address this problem only to the extent that an increased certainty of revenue would reduce the need for investors to have as much of their investment underwritten, thereby implicitly reducing the discount factor that they apply when analysing new investment in peak plant. The price of a RAS mechanism would remain susceptible to external influences that affect spot prices now, such as greenhouse mechanisms.

The Reliability Panel noted the following issues for a RAS,[164] including that such a mechanism:

- is likely to interact with current energy market hedging arrangements, therefore further work would be needed to develop its detailed design;
- would amend the structure of reliability mechanisms because it would increase the frequency of payments to plant that provides reserve, and reduce the volatility of revenue paid to reserve plant;
- depending on the final settings, could result in an increase in overall revenue to marginal plant and a corresponding increase in consumer cost, or it could maintain the same total cost to consumers but increase the certainty of revenue streams to plant.

Overall, while a RAS mechanism may offer some contribution to improving reliability, it would be a complex mechanism delivering limited benefits. Analysis by the Reliability Panel has indicated that revenue earned from a RAS would not provide sufficient incentive to encourage new generation. A RAS mechanism would also be open to 'gaming' in the market, and determining a workable mechanism to marry the temporal effects and co-optimisation would be problematic. As a result, it is likely that a RAS mechanism would have minimal real effect on reliability, and thus the Reliability Panel did not recommend its introduction to the market.

9.2.3 Standing reserve mechanisms

There are several different designs for a possible standing reserve and some of these have been previously canvassed in other reviews by the AEMC or Reliability Panel (in the CRR Report). The design options have included a:

- standing reserve;
- targeted standing reserve; and
- load shedding mechanism.

The following section discusses some of the different designs for standing reserve which have been canvassed to date, and the advantages and disadvantages of each model. We note however, that before any such mechanism is contemplated, regard should be given to the prospect of such a mechanism distorting the existing market. Generally, any mechanism that is invoked to better manage reliability should ensure that contract reserve is quarantined from the energy-only market, and if dispatched, normal price signals would need to be preserved. New centrally managed reserve that could participate in the market would dampen the frequency, duration and magnitude of high price events that signal the need for new capacity. Hence, these reserves would replace reserve that would otherwise appear through the market and capability presented would not otherwise have been offered to the energy market.

A standing reserve

A 'standing reserve' is a generic term to describe an ongoing obligation, for example, on the market operator to buy a set amount of capacity. The capacity is for use by the market operator in limited, prescribed circumstances when the only alternative would be involuntary load shedding. In the Reliability Panel's CRR Report, the AEMC's Review of Energy Market Frameworks in light of Climate Change Policies, and the DSP Review, the option of a standing reserve was considered. In those Reviews, it was noted that such a mechanism may include the following characteristics:

- contracts for a standing level of reserve would span over several years;
- the volume of reserve would be centrally determined;
- the prices for reserve would be determined by a tender or auction process;
- the mechanism would be open to supply or demand-side sources of capacity; and
- reserve would be deployed when the price reached the market price cap and the alternative is load shedding.

164 Reliability Panel Comprehensive Reliability Report, pp.56-57.

We note that the following issues have been raised for a potential standing reserve:

- Such a mechanism may not represent value for money in avoiding interruptions to customers.

- The additional energy capacity procured may not be targeted to address an identified problem and would be procured regardless of whether a market failure is likely to occur. Decisions to invest in standing reserve capacity would occur well ahead of dispatch and prior to information relating to market risks being available. This may lead to inefficient decisions as to the amount, type and location of reserve procured.

- There is a greater likelihood of some distortionary impacts on the energy market. Implementation of a standing reserve may lead to capacity being withdrawn from the energy market, where a revenue stream may be uncertain, in favour of guaranteed returns from participation in the standing reserve. To the extent that capacity withdrawn from the energy market needs to be replaced, energy options with a higher cost than those withdrawn are likely to be required, thus raising the average price of electricity, with no guarantee that the standing reserve would ever need to be deployed.

- The responsibility for the management of market risks is placed in the hands of regulatory bodies rather than the market participants who currently bear this risk.

If a standing reserve were to be implemented, the reserve service providers would likely require some form of availability payment or capacity payment. However, as noted previously, availability (or capacity) payments are distortionary and inconsistent with the principles of an energy-only market. Even if there was a preparedness to compromise the basic principles of an energy-only market and make availability payments for reserve without requiring market failure to be demonstrated, clear efficiency gains to the market from doing so would need to be apparent.[165]

Targeted standing reserve

Another option considered for a standing reserve has been a Prolonged Targeted Reserve (PTR). Such a targeted standing reserve may operate by enabling relevant jurisdictional decision makers (on advice from the AEMO) to trigger the purchase of reserve, subject to appropriate thresholds being reached. In the AEMC's Review of Energy Market Frameworks in light of Climate Change Policies, it was considered that such a mechanism could include threshold tests including whether:

- there is an identified failure to deliver adequate levels of reserve;

165 It is difficult to estimate the likely costs of such an arrangement without undertaking a formal tender. The best cost benchmark available is from the reserve trader exercise conducted by NEMMCO for the 2005-06 summer where the average cost of reserve to be available over a seven week period was in the order of $35 000 per MW. Standing reserve as canvassed would be expected to be provided continuously in each region rather than for defined periods in restricted regions where reserve shortfalls had been identified.

- any anticipated reserve shortfall is highly likely to persist into dispatch timeframes following:
  - a re-examination of relevant up-to-date information (e.g. new demand forecasts that become available in June of each year); and
  - an assessment that the market is unlikely to be able to respond to emerging contract risks by recruiting sufficient alternative sources of energy at or below the market price cap;
- the reserve shortfall is of a magnitude that the RERT mechanism is unlikely to cope with; and
- there is an expectation that, if load shedding were to occur to the extent forecast, the Reliability Standard would be breached.

It was noted however that the threshold tests would present a substantial hurdle, so the PTR would only be invoked when market measures and other interventions are unable to deliver additional reserve. It was also considered that the PTR would be subject to some of the same distortions as the standing reserve, although it is likely to be more efficient than a standing reserve because it would be targeted at an identified market failure.

Load shedding mechanism

The potential for a Load Shedding Mechanism (LSM) was considered and outlined in the AEMC's Review of Energy Market Frameworks in light of Climate Change Policies 2nd Interim Report as an option to more efficiently manage load shedding in the NEM. The LSM model proposed specifically involved contracting with large users of electricity to provide (remunerated) firm load reduction capability, as an alternative to involuntary load shedding through the current regional load shedding schedule.[166] Essentially, contracted loads would be paid upfront for the costs of making their load centrally dispatchable, with further remuneration (based on declared value of customer reliability) dependent on whether or not the load was actually dispatched. Costs for making loads dispatchable and payment for any subsequent dispatch would be recovered by an uplift on market customers. Current intervention arrangements facilitate remuneration for the shedding of scheduled load as a result of a direction from the AEMO, however there are no arrangements for the remuneration of shedding willing, but non-scheduled, load.

Where contracted LSM capability could be more effectively utilised in an alternative mechanism such as the RERT, provided both the system operator and contracted party were willing, such transactions should be allowed. LSM is unlikely to impede the use of directions. Contracted LSM would not be in the set of facilities that would be directed as they would be classified as non-scheduled load.[167] LSM would impact on

166 Further detail on the specification of this mechanism is provided in Appendix H.

167 Remuneration for directions applies only to scheduled plant and market generating units.

the AEMO's instructions to shed load[168] because the facilities involved would effectively be at the top of Network Service Provider (NSP) load shedding schedules.

LSM may be considered to be a more economically and socially desirable outcome than involuntary load shedding. It provides an avenue for consumers to declare their value of reliability and be compensated in accordance with that value, rather than presuming that all customers have the same value for reliability. Operation of the LSM would be more transparent than existing jurisdictional load shedding schedules.

LSM however still presents some risk and uncertainty:

- There is the possibility of interruptible load being withdrawn from market-based DSP in favour of participation in the LSM scheme. However, we consider this to be unlikely as we do not envisage the guaranteed revenue stream from the LSM to be more attractive than market-based opportunities;

- It is acknowledged that LSM would represent an increased cost to Market Customers, in relation to making loads dispatchable and payment for any subsequent dispatch at a price that is likely to be above the maximum market price. Retailers would seek to pass on any uplift to their customer base, but the uncertainty associated with the total costs would make the cost difficult to effectively hedge.

The model for an LSM was one proposal discussed in the AEMC Review of Energy Market Frameworks in light of Climate Change Policies for the more effective management of generation capacity and reserves. It was considered that the LSM presented significant operational overlap with the development of the short notice reserve contracting arrangement in the RERT Flexibility Rule change proposal. Therefore, the LSM model was not developed as a consequence of the consideration and implementation of that Rule change. We noted that as part of that Review, the consideration for an LSM or any other potential reliability mechanisms may be considered, if appropriate, as part of the Reliability Panel's review of the RERT, which must be completed no later 30 June 2011.

9.3 Conclusion

As noted, we do not consider there is evidence to support a need to depart from the NEM's energy-only market design. The NEM has performed well against the reliability standard since market start, and the ESOO shows that the NEM is expected to continue to meet the reliability standard in at least the short to mid term.

However, it is possible that the NEM's demand profile may change in the future, possibly due to changes in Australia's climate, so that the NEM's energy-only market design may no longer be an efficient and effective model for delivering power system

168 This power is under clause 4.8.9 of the Rules. Clause 4.8.9 instructions are very similar to the AEMO's directions powers, but apply to registered participants with non-market, non-scheduled generating units and loads. There is no compensation paid to instructed participants.

reliability. We therefore recommend an annual review of any reliability events in the NEM, to monitor whether the NEM's energy-only market design is continuing to deliver the level of reliability valued by customers. This proposal is further discussed further in Chapter 5.

If it was found in the future that the NEM's energy-only market design no longer delivered acceptable reliability, then we consider that any new arrangement should complement the current energy-only market design rather than replace it. Such an arrangement should not distort investment or the efficient operation of the energy-only market.

Of the arrangements that have been analysed in this Review, we consider that the LSM would have the least distortionary impact on investment or the efficient operation of the energy-only market. This is because energy users are rarely directly involved in the NEM. Therefore by facilitating voluntary participation from users in the operation of the NEM, involuntary load shedding could be reduced without impacting on the investment and operational efficiency of the NEM's current design.

Over the next decade, we anticipate much greater participation from energy users as technology which enables customers to benefit from modifying their usage patterns becomes more readily available. The likely time shifting of load will take considerable pressure off the power system at peak times thus reducing the likelihood of supply interruptions due to reliability related events. Technology will also enable any supply shortfalls to be better shared between customers. In place of a long supply interruption, customers may only experience a short interruption or a supply reduction. Customers place much lower value on avoiding short interruptions or supply reductions compared to a long interruption.

It is also possible that the level of the MPC could peak at some time in the future and then there could be a case for reducing the level of the MPC as lengthy supply interruptions due to generation deficits become very rare. In addition, if DSP can trim the top of demand peaks, extreme peaking plant would not be required in the NEM's generation mix and a very high MPC would no longer be required to incentivise generators that may only run a couple of hours a year.

Recommendation

We recommend that the implementation of alternative mechanisms to deliver reliability is not necessary at this stage as there is no evidence to suggest that reliability in the NEM to date has not been achieved with the application of the Reliability Standard and Reliability Settings.

We note, however, that it is prudent that the performance of the NEM's energy-only design be monitored to determine if the market design remains resilient and sustainable over time, including in the event that extreme weather events become more frequent. We consider that expanding the Annual Market Performance Review undertaken by the Reliability Panel (as discussed in Chapter 5) and for the outcomes of that Report to be considered by the AEMC would assist to test the resilience of the energy-only market on an ongoing basis.

10 Reliability Forecasting and Information

Chapter Summary

This Chapter provides our analysis of the reliability forecasting methods used in the NEM and provides advice on the need for improvements to better inform investment and outage decisions.

We do not consider that any fundamental changes are needed to the tools and mechanisms for reliability forecasting. We support, as proposed by stakeholders, AEMO working with industry to make incremental improvements to forecasting methods as appropriate.

10.1 Background

AEMO operates a number of processes to assess the likelihood that supply availability will be sufficient to meet demand at various points of time in the future. These can be broadly classified as either deterministic or probabilistic reserve projections. We discuss these projections further below.

Deterministic Reserve Projections

Deterministic models are models in which the outcomes are precisely determined though known relationships among states and events, without any room for random variation. In such models, a given input will always produce the same output.

Deterministic reserve projections assess whether expected supply availability is sufficient to satisfy forecast demand plus a predetermined reserve margin. In the NEM, the predetermined reserve margin is the MRL. Deterministic modelling is much quicker and simpler to execute than probabilistic modelling, and is thus well suited to operational reserve projections that require regular updating.

AEMO operates a number of deterministic reserve projections covering a range of timeframes. The reserve projections from each of these processes is compared to the MRL for each region to determine whether projected reserves are sufficient such that there is an expectation that the Reliability Standard would be met. These reserve projections undertaken by AEMO are discussed below.

The Electricity Statement of Opportunities (ESOO) - is prepared annually and provides a ten year reserve projection for both summer and winter maximum demand conditions.

The Medium-Term Projected Assessment of System Adequacy (MTPASA) - provides reserve projections at a daily resolution for a two year outlook period. MTPASA results are updated weekly.

The Short-Term Projected Assessment of System Adequacy (STPASA) - provides reserve projections at a half-hourly resolution for a one week period. The STPASA results are updated every two hours.

The Pre-dispatch Projected Assessment of System Adequacy (PDPASA) - provides reserve projections at a half-hourly resolution for up to thirty-six hours ahead. The PDPASA results are updated every half hour.

The primary purpose of these projections is to:

- inform NEM participants and potential investors of potential periods of low reserves, which would likely correspond to periods of high prices, in order to elicit a market response such as the rescheduling of a planned maintenance outage; and
- inform AEMO of potential periods of low reserves so that AEMO can take action to strengthen reserve levels by:
    - publishing lack of reserve notices to the market;
    - speaking to NEM participants (including TNSPs) about rescheduling planned outages;
    - contracting for reserves through the Reliability and Emergency Reserve Trader (RERT) provisions; or
    - directing participants to make plant available.

A comprehensive comparison of the reserve projections provided by these tools with actual reserve outcomes was provided in the Review's Second Interim Report at Appendix B.

The MCE, in its revised Terms of Reference, specifically requested a comparison of historical NEM reliability forecasts with the outcomes that occurred in the first ten years of the NEM (averages and extremes). In our Second Interim Report, we noted that whilst the comparisons provide a useful insight to the efficacy of the current tools available, the comparison does not necessarily provide a meaningful assessment of the performance of each of the current projections with respect to achieving their intended purpose.

The main reason for this is that these projections are designed to elicit a market response when reserve shortfalls are projected. Ideally, a reserve shortfall signalled in one of the above projections would never eventuate because the market (influenced by the projection and the potential for a high spot price) should respond to that signal. A reserve shortfall projected in the ESOO signals an opportunity for investment. New investment in generation or demand-side management would generally be made before the ESOO reserve shortfall eventuates. A reserve shortfall projected in one of the Projected Assessments of System Adequacy (PASAs) signals an opportunity to potentially benefit from higher prices. Participants would generally reschedule planned outages to make more equipment available for this period, thus reducing the likelihood of reserve shortfalls.

It is thus difficult to meaningfully compare reserve projections over different timeframes to actual reserve outcomes as the reserve projections can change significantly as the market responds to the reserve projections. In the Second Interim Report, we considered that the performance of these projections would be better judged by assessing how useful NEM participants find the reserve projections in informing investment and outage timing decisions, and we committed to consult stakeholders on this question and provide feedback to the MCE in this Final Report.

Probabilistic Reliability Projections

Probabilistic models provide projections on the basis of historical data and the probability of an event occurring again. AEMO performs a number of probabilistic studies to assess likely reliability outcomes. AEMO uses Monte Carlo simulation, which models the probabilities of various power system events (such as generator forced outages), to determine the likely reliability outcome. AEMO performs two main probabilistic reliability studies: the Energy Adequacy Assessment Projection (EAAP), and ad hoc probabilistic reliability studies.

Energy Adequacy Assessment Projection

The EAAP is an information gathering and dissemination mechanism which was introduced to enable the market to forecast and respond to projected times where there may be energy constraints that would affect reliability. An example of such an energy constraint would be a drought that limits the generation from hydro generating units and thermal generating units that rely on cooling water from inland reservoirs. The EAAP provides projected levels of USE for each region for a two year period with a monthly resolution.

The purpose of the EAAP results is to inform stakeholders, including market participants, of periods of low energy availability. It is anticipated that periods of energy scarcity, and hence projected high energy prices, would solicit a market response (which would then be expected to be reflected in MTPASA through changes to unit availability) such as rescheduling maintenance or reallocating scarce resources such as water for cooling or hydro generation.

AEMO published the first EAAP on 31 March 2010. As the first EAAP has only recently been published it is not possible to compare the EAAP projections to reliability outcomes.

Ad hoc Probabilistic Reliability Studies

AEMO performs detailed probabilistic reserve studies when it considers it is necessary to obtain a more comprehensive assessment of the likely reliability outcome for a period. Such an assessment would generally be triggered by a reserve shortfall flagged in MTPASA. Probabilistic reserve studies provide more accurate estimates of likely reserves for a period than do PASAs, and can also derive probabilities for particular reserve outcomes.

In August 2008, MTPASA reserve projections for summer 2008-09 indicated reserve shortfalls of 168 MW in Victoria and no reserve shortfall for South Australia. In response to this projected reserve shortfall, AEMO performed a detailed probabilistic assessment of reserves for summer 2008-09. The probabilistic studies forecast the expected USE for Victoria and South Australia to be less than 0.002%. The actual USE on 29 and 30 January is estimated at 1.88 GWh in Victoria and 0.42 GWh in South Australia. The probabilistic studies conducted by AEMO at the time indicated about a 28 per cent chance in Victoria and a 50 per cent chance in South Australia that the USE would exceed these values.

The actual USE experienced in Victoria and South Australia in January 2009 (0.004% and 0.0032% respectively) was higher than forecast in the probabilistic studies conducted in August 2008 (forecast to be less than 0.002%). This outcome is not unreasonable for several reasons. Firstly, projecting reliability outcomes requires assumptions to be made about the likely impact of random power system events. Through the application of probabilities to each random event, AEMO is able to determine at best an 'expected' outcome. However, if a particularly onerous combination of random events were to occur, the capacity of the power system to deliver would be less than forecast and as such there would be a higher probability for USE than was forecast. Secondly, very high demand forecasts are used in the probabilistic studies.[169] However, in the rare event that actual demand is more extreme than the demands used in the forecasts, then there would be a higher probability for USE than was forecast.

For the January 2009 supply interruptions in Victoria and South Australia, demand was higher than that used in the probabilistic studies[170] and there was significant capacity degradation due to the extreme temperatures. As such, it is not unexpected that actual USE would exceed the likely USE predicted by probabilistic modelling six months earlier. AEMO could use higher demand forecasts and more conservative estimates of available capacity in its probabilistic studies, however this would trigger more intervention through the RERT at a cost to industry.

We do not consider that this would be efficient as the Reliability Standard is being achieved under the current arrangements.[171] Greater intervention would deliver improved reliability, however the cost would exceed the value that customers place on reliability (as defined by the level of the Reliability Standard). However, in the near term, when there is much greater certainty of demand and equipment availability, we consider that there is scope to improve reliability forecasts as discussed in section 10.3.

169 Peak demand that is only expected to occur once in every ten years is used for the probabilistic studies.

170 Peak demand was estimated by AEMO as a 1 in 20 year demand event.

171 See Chapter 5.3.

10.2 Stakeholder submissions

As noted, we sought stakeholders views on whether demand and capacity forecasting and information were adequate or appropriate to inform investment and outage timing decisions.

Generally, stakeholders considered that the current tools available were adequate, however they supported incremental improvement to AEMO's information gathering processes. The NGF specifically suggested that in order to assist AEMO with improved data outcomes and increased transparency, that there should be industry representation in AEMO's relevant working groups. Specifically, the NGF stated that the Load Forecasting Reference Group only contains AEMO and jurisdictional body representation.[172]

With respect to the ESOO, both the NGF and LYMMCO stated that the value of the ESOO was to provide an indicator of potential problems. In both the NGF and LYMMCO's view, the ESOO is, however, not robust enough to act as a justification for market intervention or an actual trigger for possible investment in generation. This is because the ESOO's forecasts, in their view, tend to be too conservative.

Origin Energy made the following specific suggestions on the ESOO energy and maximum demand forecasts:

- a forecast of scheduled generation would be beneficial particularly if it differed from semi-scheduled or non-scheduled generation;
- energy efficiency assumptions for demand and energy projections need to be made more explicit in ESOO and a TNSP's Annual Planning Report (APR); and
- forecasting process could benefit from more transparency and linkage with APRs.

10.3 Conclusion

We consider that the ESOO is an instrument for flagging the possibility of supply scarcity, and to trigger more rigorous analysis by investors to determine whether there is an opportunity for investment. We do not consider that the ESOO could ever be a trigger for actual investment because the conditions and circumstances driving investment decisions vary between businesses. In addition, it would not be prudent for any investor to rely solely on third party analysis.

We consider that the ESOO at a high level fulfils its intended purpose. We note the specific suggestions provided by Origin Energy in relation to forecasts and the NGF in relation to AEMO working groups. However, we consider these matters to be at a level of detail that is too specific for consideration for inclusion in the Rules and would more appropriately be addressed through AEMO's processes.

172 NGF Submission, p.15.

As discussed in section 10.1, we noted that there is scope to improve near term reliability forecasts. We report that AEMO is taking action to improve near-term reliability forecasts, particularly to improve response to extreme weather events, including:

- improvements in the accuracy of the demand forecasts for very high demand days used for STPASA and pre-dispatch;
- explicit modelling of the extreme demand and equipment degradation (similar to that experienced in Victoria and South Australia in January 2009) in the calculation of MRLs for PASA; and
- improved procedures for requiring participants to update equipment availability when extreme temperatures are forecast.[173]

We do not consider that any fundamental changes to reliability forecasting are necessary. However, we support AEMO working with industry to make incremental improvements to forecasting methods on an ongoing basis.

173 These measures were outlined in Appendix E of the Second Interim Report.

Appendices A to L are available on the AEMC website at: http://www.aemc.gov.au/Market-Reviews/Completed/Review-of-the-Effectiveness-of-NEM-Security-and-Reliability-Arrangements-in-light-of-Extreme-Weather-Events.html.