Australian Government
Department of the Environment and Energy

COVER SHEET FOR SUBMISSIONS

/ndependent Review into the Future Security of the National Electricity Market

Overview

Please include this cover sheet with your submission on the Preliminary Report of the Independent Review into the Future Security of the National Electricity Market.

Background

The Preliminary Report outlines the Panel's observations about the current state of the NEM and offers questions on the major issues the Panel has identified. The questions are designed to elicit suggestions or answers that may help form the Panel's final recommendations.

The Preliminary Report serves as an issues paper for broad public consultation. As such, the questions and views will be subject to further consideration and discussion, in anticipation of the final blueprint being produced in 2017.

Stakeholders are encouraged to keep their submissions as succinct as possible, and include a one-page executive summary.

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Do you want this submission to be treated as confidential? ☐ **Yes** ☒ **No**

Submission Instructions

The submission period will be open until close of business on Tuesday **21 February 2017**.

All submissions should be emailed to the NEM Security Review at the mailbox: NEMSecurityReview@environment.gov.au

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27 February 2017

Dr Alan Finkel AO
Chair
Independent Review into the Future Security of the National Electricity Market

By Email: *NEMSecurityReview@environment.gov.au*

Dear Dr Finkel

Independent Review into the Future Security of the National Electricity Market Preliminary Report – AEMO Submission

Thank you for the opportunity to submit to this preliminary report. As the independent National Electricity Market (NEM) and Western Australian Wholesale Electricity Market (WEM) market and systems operator, and the NEM National Electricity Transmission Planner, AEMO recognises the significance of this Review at this time and wishes to support its deliberations through provision of policy context and technical information.

AEMO would welcome the opportunity to discuss the issues raised in this submission.

Should you have any questions in relation to this submission, please contact me on (08) 8201 7371.

Yours sincerely

David Swift
Executive General Manager, Corporate Development

Executive Summary

AEMO welcomes the Independent Review, and strongly agrees with the sentiment that the NEM is going through rapid, dramatic change that requires a forward-looking regulatory regime that can drive efficient and transparent adaptation to new energy paradigms. AEMO is keen to assist the review panel, other institutions and COAG to adapt the NEM regulatory framework to meet its future needs.

The changes are driven by a combination of technology, customer choice and government policy, but require regulatory and market processes to keep pace with, or preferably get ahead of, the transition. This is the only way to facilitate the transition while efficiently meeting the broad range of policy and stakeholder expectations.

Key Priorities for the Independent Review

As the independent power system and market operator, with transmission planning responsibilities at the national level and within the state of Victoria, one of AEMO's key responsibilities is to manage the security of the power system through these changes. Accordingly, power system security is a central focus of AEMO's submission to the independent review.

AEMO's submission provides specific answers to most of the questions posed in the consultation paper, but the following summarises those matters AEMO considers to be of greatest urgency for the independent review to address:

- ***Speed of regulatory decision-making to effect change*** – the NEM governance framework has a hierarchy of regulatory levels including legislation, Rules, Reliability Panel, industry procedures and operational systems. Some changes can take well over 6 months for each of a number of layers to serially make assessments. Once decisions are made, upwards of a year might then be required to implement changes, and transition periods are also required in some cases. Changes can therefore take many years from proposal to delivery.

  The current arrangement is therefore not sufficiently responsive or forward-looking to meet the needs of the paradigm shifts the NEM and its participants need to embrace.

  AEMO suggests that changes are required to the regulatory regime so that upper layers, including the Rules, are used to define roles and policy principles with broad expression rather than detailed definition. Detailed adaptation of processes or settings within that broad policy space could then be managed and driven at a single regulatory level by agencies such as AEMO and the AER, through a continuous, transparent, well-defined industry mechanism.

  Furthermore, policy and Rules settings should more clearly assign forward-looking risk assessment and management roles to agencies such as AEMO and NSPs with a view to identifying emerging technical issues early enough for them to be addressed proactively rather than reactively. It is often argued that there is nothing in the Rules to stop agencies from taking on these roles autonomously, however the work requries allocation of expert resources, funding and often also access to information from other businesses, and then only to promote change rather than effect it. Therefore, in practice, unless there is a clear obligation assigned to an appropriate body on a continuous basis, there is no certainty that forward risk assessments can be progressed with the necessary focus.

These regulatory design principles could be applied in a number of areas of the NEM that require continuous assessment and adaptation. One example is the critical need to continually adapt the technical standards applied to generators seeking connection to the grid. These standards are currently embedded in the Rules and have not been updated in some time. Adaptation in this area is currently beginning to take place at the jurisdictional level (eg through generator licence conditions managed by ESCOSA in South Australia), based primarily on advice from AEMO. AEMO would prefer the national arrangements to update standards to be more responsive and deliver national consistency. Clear, up to date standards could better position the power system to meet future needs and supply prospective investors with the desired level of certainty. This matter is covered in section 7.6 of the submission.

- ***Availability of detailed power system information*** – AEMO has found that the information available to support technical modelling of power system performance is progressively becoming inadequate as small, distributed energy resources (DER) increase in dominance to the point where they have a material impact on performance of the transmission grid. AEMO considers that this issue, if left unaddressed, will rapidly grow and require conservative constraints to be imposed on the operation of the transmission system to maintain power system security in light of uncertainties as to DER characteristics. By way of example, AEMO published a study of the Response of Existing Photo-Voltaic (PV) inverters to Frequency Disturbances, which demonstrates that it was only through good fortune that AEMO was able to access information barely sufficient to verify that PV inverter settings would be unlikely to result in a major NEM-wide generation loss during frequency disturbances. Addressing this information collection and management issue will require regulatory changes beyond the normal bounds of the national electricity rules. The matter is discussed in sections 4.6 and 7.4.
- ***Support for "proof of concept" mechanisms*** – the emergence of new technologies, and increased consumer participation in energy choices can both serve to drive innovation in the NEM. For example, distributed energy resources such as customer load control, embedded generation and storage could become new providers of power system services such as frequency control services and load balancing services.

  The Review's discussion of "proof of concept" mechanisms used to support innovation is highly relevant to this context for the purpose of demonstrating and testing novel technologies and mechanisms while sharing cost and risk between appropriate parties for a period of time. At present, new concepts that are inconsistent with the Rules must be proven to the point where a Rule change can be made prior to being used in the NEM, creating a "catch-22" situation. AEMO therefore encourages the Review Panel to progress a formal proof of concept provision that can be readily used by AEMO and other agencies as a matter of priority. This matter is discussed in section 1.2.
- ***Reliability*** – AEMO considers it valuable to clearly distinguish between the concepts of power system security and supply reliability as they require different solutions and confusing the concepts can result in misdirected effort. Generation adequacy has been a relatively minor concern in recent years, although we are observing a tightening at present. This will need to be monitored and action taken from time to time to manage the transition to a different energy mix and hence market. In the medium term, it is expected that the reliability framework in the Rules will provide an

adequate foundation from which reliability settings can evolve over time, and, in the longer-term, distributed technologies should permit consumers to choose their individually preferred price / reliability trade-off, lessening the role of central settings. The changed and additional ancillary services that may be required to meet security concerns will also change the NEM and potentially supply additional revenue streams for some generators. The provision of customer choice in this respect is however dependent on the need to maintain the fundamental security of the power system.

Matters currently being progressed by AEMO

AEMO is currently progressing a range of work to adapt power system management through its Future Power System Security (FPSS) program and through collaboration with the AEMC. The FPSS has four key areas of focus at present:

- Frequency management
- System strength
- Information, models and tools
- Managing extreme power system conditions

AEMO encourages the Review Panel to note the work under way in these areas, and the areas of work that will be progressed next – the information is available on AEMO's website.

A range of urgent initiatives are being progressed to improve the resilience of the South Australian network in the short-term and are discussed in section 4.1. This includes a new category of "protected events" and provisions to support modernising the infrastructure which manages frequency in extreme circumstances. These initiatives are critically important and AEMO supports their finalisation and implementation without delay.

The NEM has successfully dispatched and co-optimised market ancillary services for many years. However, current mechanisms may not deliver the services required for the future as they become more scarce through retirement of synchronous plant. Services required in the NEM in the future go beyond those procured through the existing ancillary service markets and include services such as inertia and fast frequency response.

In the future, the power system will need to obtain services from non-traditional sources like utility scale solar PV, wind farms and batteries, and most importantly from distributed energy sources such as behind the meter facilities installed in customer premises. AEMO expects that a comprehensive regime with elements of mandation (through updated technical standards), contracted services and market arrangements will need to be considered.

Although AEMO is progressing this work through its FPSS program and in collaboration with the AEMC, it would be helpful if the outcome could be implemented in a way that supports continuous forward-looking adaptation as discussed in the priority areas above. The Independent Review could provide therefore particular value in addressing the broader structural issue of speed of regulatory change.

The attached builds on these key messages, and provides responses to some of the questions asked in the Preliminary Report.

Response to Preliminary Report Questions

AEMO's responses have been aligned with the order of the consultation questions in the Preliminary Report. We have not responded to all questions so the section numbering is not entirely sequential.

1. Technology is transforming the Electricity Sector

AEMO agrees with the significance and sentiment expressed in this chapter that power systems are facing fundamental change due to technology change and environmental constraints. The NEM is no exception. In particular we anticipate the rapid development of:

- Distributed energy resources.
- Low emissions generation sources of different character and location to traditional generators.
- Battery storage.

This change is at the forefront of all AEMO's activities at present, and our engagement with it is expressed in AEMO's Future Power System Security (FPSS) Program[1]. It is also driving the Australian Energy Market Commission's (AEMC) System Security Market Frameworks Review (SSMFR)[2].

Some of the matters under consideration of these programs are acute and require urgent response, particularly those in South Australia. Recent progress has been made in that regards and is discussed in detail in section 4.1. AEMO considers that the Review should allow such activities to progress. The Review's focus is more valuably directed toward longer-term NEM-wide matters.

1.1. *How do we anticipate the impacts, influences and limitations of new technologies on system operations, and address these ahead of time?*

AEMO's FPSS seeks to identify possible future trends and technical challenges in the NEM, and how these can be addressed. In it AEMO is consulting with stakeholders, technology companies, international market operators and academic researchers, ensuring that the latest global research is reflected in AEMO's analysis including its forecasting and planning publications. AEMO is a member of GO15[3], an association of the 18 largest grid operators in the world and participates in joint activities with other members. A recent review of international experience undertaken as part of our FPSS program identified Ireland as one market addressing many of the same issues. As a result, AEMO has established linkages with Eirgrid and SONI. Early experiences in other markets can inform AEMO (and other market participants) of emerging challenges.

AEMO is also seeking to engage with Australian Renewable Energy Agency (ARENA). and to accommodate emerging technology providers who are seeking to undertake trials in the NEM. While there is value in tapping into International experience, it is important to also trial emerging technologies in the Australian market and power system. This can provide insights into both the potential impacts of these technologies and any need to modify the market and regulatory frameworks as a result.

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1 http://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Security-and-reliability/FPSSP-Reports-and-Analysis
2 http://www.aemc.gov.au/Markets-Reviews-Advice/System-Security-Market-Frameworks-Review
3 http://www.go15.org/

In analysing the technical challenges and solutions of the power system of the future, the FPSS program will identify and assess the challenges in terms of their technical attributes, and frame solutions around the technical needs of the power system. Implementation frameworks for the technical solutions (for example, redesigning existing market or regulatory structures, or introducing new standards or market mechanisms) will be the remit of the appropriate decision-making authorities. In this respect, AEMO is working closely with the AEMC on their SSMFR.

This work is also supported by AEMO's market forecasting and planning activities, including the Electricity Statement of Opportunities (ESOO)[4], National Electricity Forecasting Report (NEFR)[5] and the National Transmission Network Development Plan (NTNDP)[6], which seek to consider how the NEM may evolve under different external conditions, and any potential limitations. These seek to provide the appropriate signals to the market on the required capability.

An important focus for AEMO is ensuring that the market is robust and fit for purpose across a broad range of potential futures, appropriately allocating costs and benefits in the market. The right mix of solutions to ensure security is maintained and meet customers need for energy services will emerge if we have appropriate market and regulatory arrangements in place and we have an informed market. The market needs to evolve while ensuring that participants have confidence in how new investments will be treated in the market, and help the market to communicate the technical needs of the system to potential participants.

The FPSS publishes ongoing reports into these investigations and interfaces closely with the AEMC's SSMFR.

1.1.1. Performance of existing equipment

As the power system dynamics change, it is equally as important to anticipate the impacts, influences and limitations of existing technologies on power system security. Many network elements including generators, protection systems and network infrastructure were designed and installed under different power system conditions. For example, the current connection standards for generators apply only to those connected after 2007. As a result, older generators in the NEM do not have standards to which they have to adhere in respect to some aspects of their performance. Further, AEMO has only limited knowledge of settings for these generators and data can often only be obtained through testing or by observing extreme disturbances on the power system.

This means that as the power system evolves, AEMO will face challenges in determining how existing technologies will behave under the changing system dynamics. This will affect the operational limitations of the power system. For example, the FPSS program is currently assessing the withstand capabilities of existing South Australian generators to high rates of change of frequency. This assessment will assist in understanding the response of the region to large disturbances.

This observation also opens a key philosophical question on which the Review may wish to contemplate and provide industry guidance. In regards to the technical performance of

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[4] https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/NEM-Electricity-Statement-of-Opportunities
[5] http://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/National-Electricity-Forecasting-Report
[6] http://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/National-Transmission-Network-Development-Plan

legacy plant, the NEM has generally maintained a principle of grandfathering, i.e. if the equipment was approved for connection at some historical time, then it should not be obliged to meet standards that might apply now. This approach has obvious benefits in lowering investor risk, however its retention presents challenges during the dramatic technical changes occurring in the power system currently, meaning that either:

- The network must be operated more conservatively in order to protect sensitive legacy equipment.
- Investments in expensive new regulated network equipment must occur, which may be more costly than retrofitting or retiring the legacy equipment.
- More burdensome obligations must be placed upon new entrants in order to protect the legacy equipment.

An example of such an issue is the ability of some synchronous plant to withstand the more rapid rates of change of frequency (RoCoF) that are expected in a system with lower inertia.

The problem of investor risk may be addressable through compensation, which is justifiable if the removal of a grandfathered standard results in lower total costs. No such mechanism however currently exists.

1.2. How can innovation in electricity generation, distribution and consumption improve services and reduce costs?

A competitive market that allows disaggregated profit-motivated decision making provides the best environment for innovation, and this is very much the original rationale behind the NEM's creation. For example, we have observed legacy generators operating their plants in new, more flexible ways, in order to meet the incentives created by a market that swings more frequently in value as a result of intermittent supply.

A diversity of market participants will support competition and in turn promote innovation. The underlying open access network model combined with reforms such as the Power of Choice[7] program and the AEMC's Distribution Market Model[8] are intended to support that diversity.

In the future, greater participation of loads and embedded generation in the real-time markets provide new ways of managing the power system, and will help all participants better express their preferences for electricity consumption and pricing. For example, households who offer to vary their consumption or output in response to real-time market signals (potentially through an aggregator) will be able to reduce their individual energy costs while also reducing the overall cost of energy production. For this, retailers and networks must have the ability to expose customers to these signals. Further discussion on this point is raised in response to question 4.4.

Over time these innovations are expected to reduce long-term costs as well as providing more options for managing power system security.

In that regard, the Review's discussion of "proof of concept" mechanisms used to support innovation in these matters is potentially useful for the purpose of demonstrating novel technologies and trailblazing their integration into a competitive market. To some extent this is already being achieved through grants provided by ARENA whom we are working with to establish collaborative programs. There will also be the need to deal with Rules, regulations, processes and the like which have been drafted without an expectation of the emerging

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7 http://www.aemc.gov.au/Major-Pages/Power-of-choice

8 http://www.aemc.gov.au/Major-Pages/Distribution-market-model

technology and obtain clearances to deploy the technology in the trial. With respect to supported innovation, it is always important that the funds are limited to early demonstration projects only, because at large scale these funds can undermine private investments in the competitive market, which is counter-productive to the policy intent.

However, managing a potentially very large number of active participants with price sensitive demand and generation will be more complex than today's market. Achieving efficient outcomes will require greater data and visibility in the distribution network, and new systems to co-ordinate the distribution and transmission grids. AEMO is currently investigating the technical and market structures that may be required in the future. This is discussed in more detail in sections 4.4.1 and 7.4.

2. **Consumers are driving change**

2.1. *How do we ensure that consumers retain choice and control through the transition?*

AEMO considers that the new NEM rule, Competition in Metering and Related Services[9], a product of the Power of Choice program and due to become effective in December 2017, provides a framework to deliver new technologies and services to all small customers in the NEM. AEMO notes that well in advance and in anticipation of the effective date, market participants have already begun deploying large volumes of new metering technologies across their customer base under the current market framework.

AEMO also considers it likely that the wide spread adoption of advanced metering amongst small customers in the NEM will also lead to indirect benefits to commercial and industrial customers. They should experience lower costs for their meters, as a result of the increased scale and the innovation in design, configurations and customer engagement, driven by competing retailers operating in the small customer space.

Management and access to data, including methods for customers and customers' authorised representatives to access data have also been reviewed by the AEMC in recent times, under the Power of Choice program. Automation in accessing data has also been made possible in recent changes to the B2B framework, contained within Chapter 7 of the NER.

2.3. *How do we ensure the needs of large-scale industrial consumers are met?*

Given the shifts in technology and customer engagement, large customers are also likely to seek to actively manage their energy requirements and pricing. The competitive workings of the NEM are assisted when large customers are prepared to engage by modifying their consumption in response to market signals. This behaviour could support both security and reliability, often at much lower cost than supply-side provision.

Large customer engagement with the NEM is usually managed via a retailer as a specialist intermediary. A recent rule change[10] unbundles the provision of Frequency Control Ancillary Services (FCAS) from energy, allowing industrial customers to sell FCAS directly to AEMO. This service will be available on 1 July 2017 and AEMO has already received interest from potential new providers.

Wholesale Pricing

Electricity affordability discussion is usually focussed on small customers and network tariffs. For large-scale customers, the non-network price components, in particular the wholesale

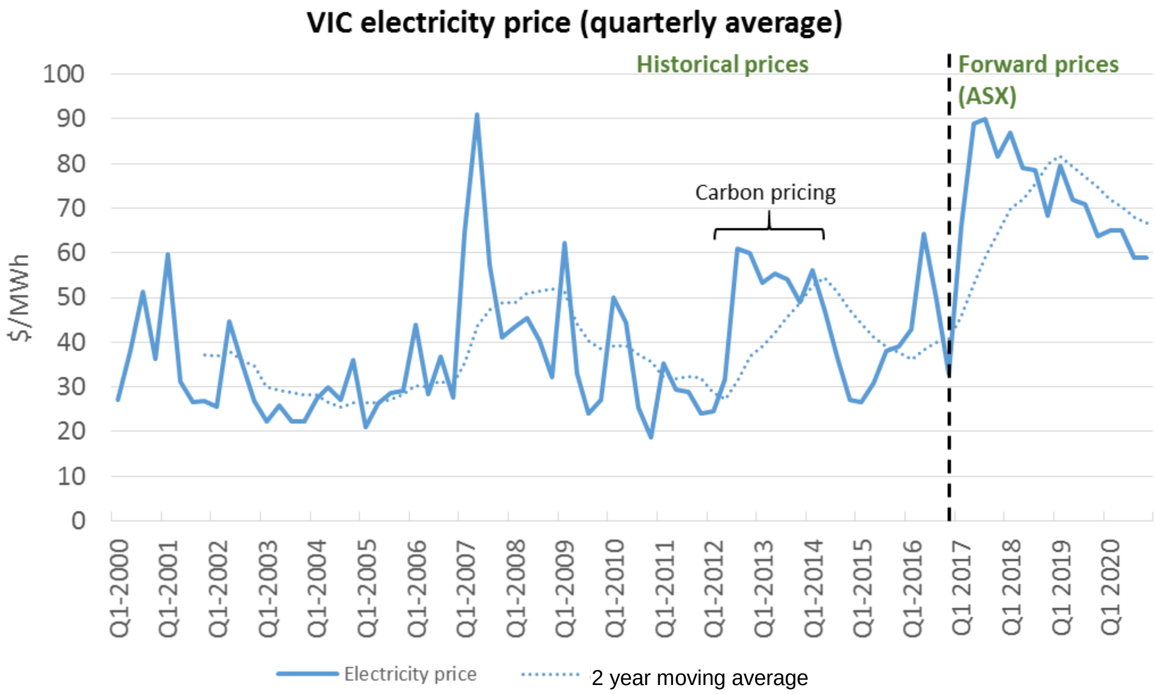
[9] http://www.aemc.gov.au/Rule-Changes/Expanding-competition-in-metering-and-related-serv
[10] http://www.aemc.gov.au/Rule-Changes/Demand-Response-Mechanism

price, form a larger component of the total price. This component tends to be volatile, and many industrial customers who have been arranging retail contracts in recent months have reported sharp increases.

This is also reflected in measures of spot and forward prices as shown in Figure 1. Recent high prices follow an extended period of relatively low wholesale prices (after adjusting for the effect of carbon pricing 2012-2014).

Swings in wholesale prices have occurred previously, most notably in the 2006-2008 period, when severe drought affected available supply.

Figure 1



Whilst wholesale prices will fluctuate, they appear unlikely to return to the levels experienced immediately prior to 2016. Relevant matters are:

- The linkage of domestic gas markets to international markets.
- Closure of ageing coal-fired generators.
- The predominant new supplies, being wind and solar, are unable to generate continuously. Non-intermittent generators, such as gas, are therefore still required but operate less frequently. As a result they need higher unit prices at times they are required to operate to recover costs.
- Black coal and gas-fired generators reducing use of long term “take or pay” fuel contracts which have in the past seen generators periodically operating below cost.
- A greater degree of market concentration resulting from the coal closures above and some mergers and acquisitions.

2.5. How do we ensure data sharing benefits and privacy are appropriately balanced

Retention of customer privacy is a key concern of the industry and is considered within the Power of Choice program and its outcomes, such as the Competition in Metering and Related Services rule change[11] and the rule change to Improve Customer Access to nformation About Their Energy Consumption[12].

These developments are intended to ensure that modern metering technologies can be utilised to support customer decision making and innovation, retail competition and to assist grid management, but at the same time they do not reduce customer privacy protections. The Competition in Metering Rule change has provided some additional protections for small customers with an advanced meter by imposing a minimum service specification.

AEMO's Metering Data Provision Procedures[13] ensure the Privacy Act 1988 (Commonwealth) obligations are met by mandating that retailers and distributors identify and publish the information required to verify a retail customer or customer authorised representative who requests metering data.

3. What role should the electricity sector play in meeting Australia's emissions reduction targets?

Whilst Australian electricity sector emissions have declined from their peak in 2009-10, it remains the single largest sectoral emitter and the industry widely accepts that it will need to play a significant part in any efforts to reduce domestic emissions. Depending on the Australian government's approach to the use of international offsets, most observers consider that the NEM will have to absorb at least a pro-rata share of the 26-28% reduction from 2005 levels agreed to in the Paris Agreement. This implies the NEM will have to reduce its emissions from 169 MT in 2016 to 129 MT in 2030.

The moderate NEM emissions declines of recent years can be attributed to:

- Declines in grid electricity demand due to:
  - Structural economic change.
  - Energy efficiency advances.
  - Small-scale solar.
- The federal renewable energy target (RET).
- Closure of some aged unprofitable coal plant.
- The period of carbon pricing 2012-2014.

It is important to note that the closure of aged, high emissions coal plants such as Hazelwood, Wallerawang, Anglesea and Northern were business decisions rather than technical necessities.

NEM energy demand grew again in 2015-16 as Queensland Liquid Natural Gas (LNG) plants came on stream. AEMO's market modelling forecasts that emissions, when subject only to

[11] http://www.aemc.gov.au/getattachment/ed88c96e-da1f-42c7-9f2a-51a411e83574/Final-determination.aspx
[12] http://www.aemc.gov.au/Rule-Changes/Customer-access-to-information-about-their-energy
[13] https://www.aemo.com.au/-/media/Files/PDF/Metering-Data-Provision-Procedures-v10.pdf

existing policy, will exceed the pro-rata target. This is despite the modelling assuming continued declines in renewable energy costs and improvements in energy efficiency.

During 2016 AEMO chose to align its NEM forecasting documents with the Paris Agreement by constraining the NEM's emissions to a pro-rata share. This approach was endorsed by COAG[14] and widely supported by industry who see it as a realistic forecast. It is a significant change in approach, as it assumes new policies will be implemented during the outlook period. The approach is already affecting network investments recommended by AEMO and presumably decisions by market-facing investors.

Whilst the carbon constraint clearly changes the modelling outcomes by bringing forward both generation closures and investments, the impact is not dramatic and we consider the power system can securely adapt to such a constraint if it arises through well designed national policy. This was the focus of AEMO's input to the 2016 Review into the Integration of energy and Emissions Reduction Policy[15] requested by COAG. AEMO's input is incorporated as an appendix to AEMC's final report.

3.1. What is the role for natural gas in reducing greenhouse gas emissions in the electricity sector?

Gas powered generation (GPG) is an extremely useful option have available to a power system undergoing emissions reduction. GPG benefits include:

- In the production of bulk energy, where the best combined cycle (CCGT) plants emit half the emissions of the new ultra-critical coal plants and one third that of some legacy coal plants.
- In the provision of peak electricity, open cycle gas turbines (OCGT) and reciprocating engines have:
    - Low capital costs, making them economically appropriate for such a role.
    - Are very flexible and fast to start, making them valuable options within a power system with a large share of intermittent generation.
    - Can be located close to demand centres lessening transmission costs.
    - Are readily capable of operating on locally stored liquid fuels, allowing them to operate with non-firm natural gas supply.
    - As they are not energy-limited (such as storage), can support extended energy shortfalls occasionally experienced by hydro and wind generation.
- Being synchronous generators, they are readily capable of supplying most of the system security services historically supplied by coal-fired steam turbines.
- Provide highly reliable, firm capacity to meet peak demand conditions.

The role of gas in the transition to lower emissions has been questioned of late due to:

[14] See page 4 and 13 of the 2016 NTNDP https://www.aemo.com.au/-/media/Files/Electricity/NEM/Planning_and_Forecasting/NTNDP/2016/Dec/2016-NATIONAL-TRANSMISSION-NETWORK-DEVELOPMENT-PLAN.pdf

[15] http://www.aemc.gov.au/Markets-Reviews-Advice/Integration-of-energy-and-emissions-reduction-poli

- Increased price of gas in Eastern Australia, which is challenging the economics of CCGTs against existing coal and some new renewables.
- Developments in energy storage that may in time supercede the OCGT role in supplying flexible peak electricity.

AEMO's 2016 National Gas Forecasting Report (NGFR)[16] and National Transmission Network Development Plan (NTNDP)[17] were prepared cogniscent of the latest information available on these two factors. Nevertheless they forecast a growing role for GPG in the provision of both low emissions energy and peaking capacity through the next decade.

Whilst its actual share will be ultimately determined in the competitive market place, it is very important that policy settings allow GPG to play a significant part of the NEM. This should be considered with respect to policies affecting natural gas' extraction, transportation and trading. Despite being fossil fuelled, a supportive policy environment for GPG is more likely to assist the secure transition to a low carbon industry, including one with a large share of renewable energy, rather than delay it. There may need to be changes to the market's reliability settings, income from the introduction of different ancillary services or other market changes to support investment in the plant required to meet the reliability standard. AEMO's views on progressing this are set out in response to question 6.1.

3.2. What are the barriers to investment in the electricity sector?

The challenges in gaining certainty and national consistency in environmental policy are well recognised as the greatest challenge for investment in the NEM. AEMO has discussed this above and in sections 3.3 and 7.5.2.

3.2.1. Network Access

Potential investors in new wholesale generation capacity face challenges in obtaining a timely and competitively priced connection to the transmission network. The AEMC is considering potential reforms to the connections framework as part of its decision on the Transmission Connections and Planning Rule Change Proposal.[18]

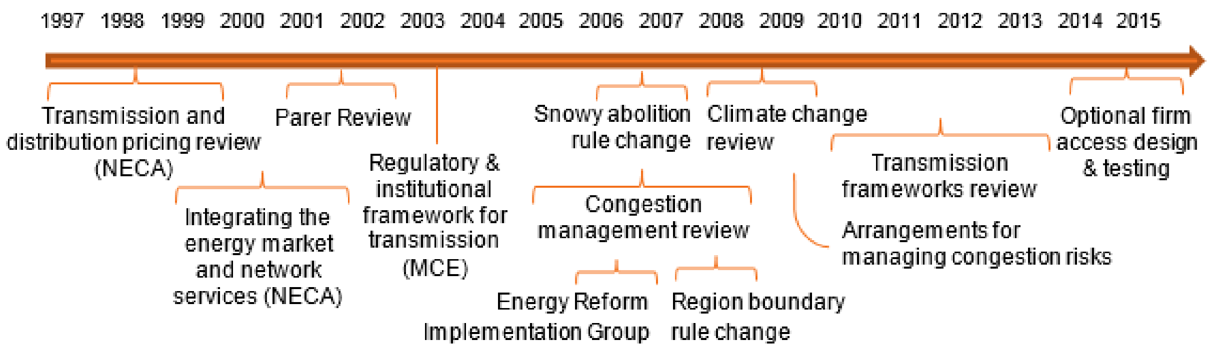
During that Rule Change consultation, broad-based industry support for a strong contestable model emerged. The Draft Rule however adopts a relatively limited approach.

Another potential barrier to investment is the absence of deep access rights for generators. Generators therefore face subsequent connection risk – i.e. the risk that a new connecting generator will cause congestion on the transmission network that diminishes existing generators' ability to access the regional reference price. For example, AEMO has highlighted this issue in relation to its Transmission planner role in Victoria and the connection of new renewable energy generators in North Western Victoria[19].

Access reform is contentious because it brings the interests of different generators into conflict. As shown in Figure 2, there have been twelve major reports and reviews dealing with various aspects of congestion management and generator access.

[16] http://www.aemo.com.au/Media-Centre/AEMO-has-released-the-2016-National-Gas-Forecasting-Report
[17] http://www.aemo.com.au/Media-Centre/New-Era-For-Transmission-Planning-In-National-Electricity-Market
[18] http://www.aemc.gov.au/Rule-Changes/Transmission-Connection-and-Planning-Arrangementsn
[19] http://www.aemo.com.au/-/media/Files/PDF/Q%20and%20A%20WESTERN%20VICTORIA%20AEMO%20template.ashx

Figure 2



In the latest review, the Optional Firm Access Design & Testing (OFA) review[20], the AEMC developed a model that would allow generators to hedge against the risk of congestion by giving them the option of buying firm access rights to the regional reference node. However, in its final report, the AEMC concluded that the model would not be beneficial under market conditions characterised by declining demand growth and surplus generation capacity.

3.3. What are the key elements of an emissions reduction policy to support investor confidence and a transition to a low emissions system?

AEMO participated in a joint study with the AEMC in 2016 commissioned by COAG[21]. In that study, it was proposed that an emissions reduction policy should:

- Be national, allowing the response to occur over the broadest possible area.
- Be technology-neutral, i.e. it should focus on the desired outcome of low emissions rather than pushing any particular technology into the market place.
- Be economically efficient.
- Provide investor confidence in its continuity and ambition.

4. Integration of Variable Renewable Electricity

4.1. What immediate actions could be taken to reduce the emerging risks around grid security and reliability with respect to frequency control, reduced system strength, or distributed energy resources?

In the very short-term, AEMO is managing South Australian security through a number of actions22 which include:

- Actions taken within AEMO's existing powers.
- Interventions supported by a state government instruction and the power of the Essential Services Commission of South Australia (ESCOSA).

[20] See http://www.aemc.gov.au/Markets-Reviews-Advice/Optional-Firm-Access,-Design-and-Testing#
[21] http://www.aemc.gov.au/Markets-Reviews-Advice/Integration-of-energy-and-emissions-reduction-poli
[22] See http://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Security-and-reliability/FPSSP-Reports-and-Analysis and http://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Security-and-reliability/Power-system-operation

The actions taken in recent months include:

- The inability of some windfarms to ride-through multiple network disturbances, a key matter in the 28 September 2016 event, has been addressed.
- The South Australian Under Frequency Load Shedding (UFLS) has had improved response times implemented.
- A South Australian over-frequency generation shedding scheme (OFGS) is being designed for implementation in the next few months.
- A temporary operating advice to limit post-separation Rate of Change of Frequency (RoCoF) to less than 3 Hz per second.

Other activities underway which will lead to further actions in the short-term to support South Australian security include:

- Introduction of more stringent requrements for connecting asynchronous generation[23].
- Rule changes[24] to:
    - Create a framework for the oversight and implementation of emergency over and under frequency control schemes.
    - Create a framework to investigate and declare "protected events" to limit the impact of certain non-credible contingencies.

In the medium-term, security enhancements are being developed through the FPSS and SSFMR. These reviews will then look toward efficient and competitive solutions, and will consider such options as:

- Installation of new network equipment by Network Service Providers (NSP) with costs recovered from consumers.
- Bilateral contracting of system security services from generators or customers to AEMO.
- Additional ancillary services markets, such as fast-frequency control.
- Provision of system security services from generators as an obligation of connection, either directly at the connection point or under agreement from another point.

There is a great range of technologies available to provide these services, ranging from old technologies to new designs. These include:

- Existing synchronous generators.
- Synchronous condensers integrated into the network or co-located with an asynchronous generator.
- Dynamic solid-state reactive power equipment integrated into the network or co-located with an asynchronous generator.
- Batteries with power conversion systems.

[23] See http://www.escosa.sa.gov.au/projects-and-publications/projects/inquiries/inquiry-into-licensing-arrangements-for-inverter-connected-generators

[24] http://www.aemc.gov.au/Rule-Changes/Emergency-frequency-control-schemes-for-excess-gen

- Asynchronous generators with sophisticated control systems.
- Fast load reductions.

Note that the above technologies are only partially substitutable. For example, AEMO considers it necessary, in the short-medium term outlook, that at least some mechanical (non-synthetic) inertia is required for power system stability.

AEMO also notes that immediate action at government level is required in relation to the collection of distributed energy resources data. This is discussed further in our responses to questions 4.6 and 7.4.

4.2. Should the level of variable renewable electricity generation be curtailed in each region until new measures to ensure grid security are implemented?

Whilst this approach has been used in a few overseas power systems, it is not AEMO's preferred model as it is neither outcome focussed nor technology neutral. In AEMO's view, the specific services required to operate the power system securely should be quantified and procured. In some situations this may have an indirect effect of curtailing asynchronous generation, but this should not be its direct intention.

A relevant matter that has affected some European power systems that have imposed maximum generation limitations are directives that wind and solar generation be treated as "must-run" in dispatch. This means power system planners must consider "worst-case" scenarios of maximum generation combined with minimum local demands and network outages. Such directives can be counter-productive to the growth of renewable energy, as it necessitates conservative planning and operating approaches.

The NEM however uses a technology neutral approach to dispatch which allows all scheduled and semi-scheduled generating sources to be constrained off when the network capacity is insufficient. Furthermore, the use of negative pricing means that when there is a region-wide generation surplus, price exposed generators voluntarily participate in supply/demand balancing, including solar and wind.

AEMO has expressed concern that the "Contract for Differences" approach to encouraging renewable energies can inadvertently undermine these beneficial behaviours if poorly designed and have similar counter-productive effects[25].

4.2.1. Scheduling Threshold

The NEM rules apply minimum thresholds to scheduled and semi-scheduled generators, generally permitting those below 30 MW capacity, and legacy intermittent generators, to register as non-scheduled. This has a similar effect as the "must run" directive discussed above resulting in:

- Some parts of the network being operated conservatively.
- Error in AEMO's forecasting and pricing mechanisms as the unscheduled generator is only observed as a passive change in demand.

[25] See AEMO's submission to the VRET consultation http://www.delwp.vic.gov.au/__data/assets/pdf_file/0009/361467/Australian-Energy-Market-Operator.pdf

The status is however privately beneficial for the generators who effectively receive priority access to the network ahead of scheduled generators. There is some evidence of generators intentionally sizing their registration to remain beneath the threshold.

The matter is being contemplated by the AEMC in a rule change[26]. AEMO considers that incorporating more generators in the scheduling process would assist NEM security and improve market forecasting and accurate price setting.

4.3. *Is there a need to introduce new planning and technical frameworks to complement current market operations?*

It is important to ensure that the technical challenges arising as a result of changing market structures are dealt with. For instance, as traditional sources of ancillary services become less widely available, arrangements must be put in place to procure these services from non-traditional sources.

The design of the electricity market needs to accommodate the laws of physics. In practice, policy makers and market designers face difficult choices given the complexity of the issues and multiple competing interests. Decisions must explicitly take into account:

- the technical consequences of different market design options; and
- the costs and benefits of potential solutions to any technical problems.

Policy choices should be made with a full understanding of the technical consequences of the chosen option. In many cases, an iterative process may be required.

The energy market transformation involves many players and is likely to involve a series of step changes. Often these step changes are driven by commercial factors rather than power system security, for instance when a large generator makes a decision to exit the market. Customers and policy makers expect power system security and reliability to be maintained throughout the transition.

For these reasons AEMO has proposed a more responsive, and forward looking, governance over technical frameworks in response to question 7.6.

It is also important that planning frameworks take a national perspective, and that important issues are not overlooked between state planners and between them and AEMO. AEMO also discussed different approaches to whole-of-system planning frameworks in reponse to question 7.1.

4.3.1. *Should there be new rules for generator connection and disconnections?*

AEMO interprets this question to relate to generator performance standards that must be achieved in order to make a connection agreement, one of which relates to “ride-through”, i.e. the generator’s ability to withstand short electrical disturbances.

The standards need to be flexible and adaptive to the changing dynamics of the power system. There is no “one size fits all” as acceptable performance depends on the local electrical charactistics of the network and surrounding elements (such as generators, loads). For example, a generator seeking to connect to an area of the network which is considered “electrically strong” will have a set of requirements that is not transferrable to those required if connecting to an “electically weak” network, and vice versa. The need for the arrangements to be more responsive to changing technology is further discussed in section 7.6.

[26] http://www.aemc.gov.au/Rule-Changes/Non-scheduled-generation-in-central-dispatch

It is important that the standards include base minimum requirements that is consistent across the NEM while also providing visibility to new developments. These minimum requirements need to be reviewed and changed more frequently as the power system develops. Additional requirements would then need to be negotiated on a case by case basis as is done presently depending on the local conditions.

The consideration of standards also needs to consider the limitations placed on the power system by existing generators. As discussed in 1.1.1, the power system will be exposed to legacy limitations on the performance of generators installed prior to 2007. As the power system evolves, there will be new generator entrants as well as exits. This means that the response of older generators to system disturbances may set the operational limits of the power system at times, which is likely to be much less than the capability of newer plant. One would need to balance the requirement of standards (and associated costs) that are more stringent than what the operational threshold of the power system may be.

4.3.2. Should all generators be required to provide system security services or should such services continue to be procured separately by the power system operator?

Requiring new generators to implement the capability to provide other services represents an additional cost, but may be justified if the current uncertainties in the market (or lack of price signals) prevents developers or investors from making decisions that are efficient in the long-term.

Not mandating individual capability allows participants to specialise and potentially procure these system security services with scale efficiency. Furthermore, each technology is likely to differ in what services it can provide, and for what duration. Imposing a requirement would then remove the technology neutrality of the NEM through either explicit standards for each technology or by creating barriers to entry.

It can at the same time present something of a windfall to incumbents by increasing the cost of new-entrant competitors.

Notwithstanding the above, there are circumstances where an obligation to provide services can be appropriate, such as:

- Where a commercial procurement mechanism for a critical service is under development but not yet in place.
- Where the mechanism is new and meaningful price signals for it have not yet developed to guide investors.
- Where the need for the service is localised, and commercial procurement is unlikely to be competitive.
- Where the cost of installing the individual capability is low and does not justify the transaction costs of a commercial mechanism.

4.4. Is there a role for technologies at consumers' premises in improving energy security and reliability?

As the generation mix changes, the traditional model of supply following demand is being assisted by demands that can follow supply. As smart embedded generation and demand management becomes more prevalent, market structures will need to evolve to allow distributed energy resources (DER) to be deployed efficiently.

Increasing levels of DER brings with it both opportunities and challenges for power system security and reliability. Table 1 provides some examples of how DER can support the grid.

Table 1 ***Examples of DER grid support services***

Network impact	DER based solution
Peak demand management	• DER can be used to reduce network investment requirements by offsetting demand during peak periods. • For instance, customers could receive a payment for temporarily switching off their air-conditioners when the system is under stress, or batteries can store excess rooftop PV output for use during the evening peak.
Thermal loading	• DER can be used to prevent thermal overloads. • For instance, if excess PV generation is leading to upstream power flows, hot water systems can be set to come on during the middle of the day in order to act as a "solar soak". Alternatively, solar PV could simply be curtailed.
Voltage stability	• DER can help with voltage stability if the inverter has reactive power capability and/or low voltage ride through capability. • There is scope to use storage to manage DER output variations.
Frequency stability	• DER, especially storage, can help to maintain frequency stability. • For instance, Reposit Power's GridCredits technology is designed to enable residential batteries to provide frequency control ancillary services (FCAS).
Power factors	• Reactive power enabled inverters can be set to contribute towards power factors.

Embedded technologies such as battery storage and rooftop solar are actively seeking to participate in the existing market ancillary services. AEMO does not anticipate they will be able to fully replace the requirements for some of these services being provided by conventional (synchronous) plant in the short to medium term. Facilitating the participation of distributed energy resources in all aspects of the market will be increasingly important for energy security and reliability as the share of embedded generation increases.

More active distribution system management can also help to decrease the total costs compared to the traditional "fit-and-forget approach" of simply connecting new loads to the network. Research released by the Energy Networks Association (ENA) suggests that if networks buy grid services from DER, this 'orchestration' could replace the need for $16.2 billion in network investment and lower average network bills by around 30% compared to today.[27] However, as discussed in our response to question 4.4.1, it is difficult to create incentives for DNSPs to invest in these technologies under the current regulatory framework.

4.4.1. How can the regulatory framework best enable and incentivise the efficient orchestration of distributed energy resources?

Overarching market framework

Distribution markets bring significant potential benefits in terms of empowering consumers and promoting more efficient outcomes and behaviour. Historically, high transaction costs have precluded the development of distribution level markets. Technological developments are reducing these transaction costs to the extent that such markets are now feasible.

However there are still barriers to achieving these benefits in practice. In particular, if distribution markets are implemented in the presence of inefficient network tariff structures, the markets could act to exacerbate distortions and increase costs from a system-wide perspective. It is important to ensure that any reform package includes the full suite of measures to deliver benefits in practice as well as in theory.

[27] Energy Networks Association, *Unlocking Value for Customers - Enabling New Services, Better Incentives, Fairer Rewards*, 4 October 2016.

Network business models

The regulatory framework arguably offers greater rewards for network businesses that adopt capital intensive network solutions over operating cost intensive DER solutions. The difficulty of resolving this issue is demonstrated by the number of current relevant reviews, which includes the AEMC's Contestability of Energy Services Review[28], the AEMC's Electricity Network Economic Regulatory Framework Review[29], and the AER's consultation on the Demand Management Incentive Scheme.[30]

As the new model emerges, it would be worthwhile to consider whether today's DNSPs are appropriately structured to take on new grid management and market functions.

The term distribution system operator (DSO) refers to the entity that is responsible for maintaining the distribution system and making investment decisions. The DSO function currently resides with DNSPs, however it could be undertaken independently of the entity responsible for owning and maintaining distribution network assets (the DNO).

A market structure that features an independent DSO is still in its formative stages. The idea has been proposed, but not yet adopted, in the United States.[31] A recent UK Parliamentary review of low carbon network infrastructure concluded that policy makers should keep the governance of distribution networks under review, and be prepared to separate distribution networks' operation from their ownership if the joint provision of DSO and DNO functions proves to have a negative impact on consumers.[32]

Grid architecture to support provision of grid support services by DER

New communication platforms need to be put in place to enable DER to provide grid support services to network businesses and AEMO. These platforms could evolve organically, with DER service providers engaging bilaterally with multiple buyers, or a central platform could be developed to control and optimise DER.

There are a range of complex factors to consider when deciding how the regulatory framework could best enable and incentivise the efficient orchestration of distributed energy resources. Table 2 below considers some of the relevant factors associated with different grid architecture models.

[28] Contestability of energy services - demand response and network support. Available at: http://www.aemc.gov.au/Rule-Changes/Contestability-of-energy-services-demand-response

[29] http://www.aemc.gov.au/Markets-Reviews-Advice/Electricity-Network-Economic-Regulatory-Framework

[30] http://www.aer.gov.au/networks-pipelines/guidelines-schemes-models-reviews/demand-management-incentive-scheme-and-innovation-allowance-mechanism

[31] See, for instance, Wellinghoff, J. Tong, J. and Hu, J. (2015) The 51st state of Welhuton, 27 February 2015. The 51st State. Available at: http://www.sepa51.org/phaseII/Welhuton_51stState_Addendum.pdf and Rahimi, F. and Mokhtari, S., 2014. From ISO to DSO: imagining new construct--an independent system operator for the distribution network. *Public Util. Fortn*, *152*(6), pp.42-50.

[32] House of Commons Energy and Climate Change Committee Low carbon network infrastructure First Report of Session 2016–17, June 2016.

Table 2

Shared platform	Distribution management systems	Commercial platforms
DER controlled using a central platform	DNSPs control local DER using enhanced DMS	DER controlled by DER service providers

• Facilitates optimisation between different DER services
• DER service providers interact with a single common platform
• Level playing field for new entrant DER service providers
• Control remains with system operator
• Risk that central platform is cumbersome & slow
• AEMO could control centrally or NSPs could be enabled to dispatch DER for local grid support
  • If former, require systems for DNSPs to advise AEMO of DN needs
• Commercial platforms are likely to be deployed outside shared platform
	• Evolution of existing DNSP systems
	• DER service providers interact with multiple DMS platforms
	  • Scope for a common protocol
	• DNSPs could dispatch DER on behalf of AEMO
	  • Require systems for AEMO to advise DNSPs of FCAS needs
	  • AEMO could delegate SO responsibilities to DNSP
	• Timeliness & interface risks associated with multiple systems
	• Fits well with independent DSO model
	• Price/service risks arising from monopoly service provision
	• Commercial platforms are likely to be deployed in addition to DMS (eg for retail hedge)
		• Permits superior products to emerge through competition rather than picking winners
		• Costs associated with multiple competing platforms
		  • Risk of redundancy
		• No regulatory action required; organic development
		• DER service providers responsible for co-ordinating multiple DER services
		• Less scope for co-optimising different DER services
		• AEMO/NSPs reliant on commercial players to dispatch DER on their behalf
		• Needs to integrate with SO at some level
		• Timeliness & interface risks associated with multiple systems

In these early stages of DER market development, it is difficult to know what the optimal grid architecture should look like. This dynamic environment suggests that we should exercise caution before adopting any model that requires a large investment in inflexible grid architecture. Given the uncertainty surrounding the best way forward, there may be merit in promoting an incremental approach to the development of grid architecture to support DER markets.

4.5. What other non-market focus areas, such as cybersecurity, are priorities for power system security?

The potential threat to disruption of electricity from a sophisticated targeted cyber attack is demonstrated by the confirmed successful attack against Ukrainian electricity distribution networks in December 2015. Analysis shows this to likely be instigated by a sophisticated nation-state level adversary after at least six months planning and reconnaissance. Electricity supply was lost across multiple dispersed regions followed by degradation in network manageability. A second attack, this time targeted at Ukraine's transmission level infrastructure, was reported in December 2016 although this is yet to be independently verified. The relevant measures outlined in the Ausralia's Cyber Security Strategy should be accelerated and move more rapidly from consultation to practical implementation, including:

- The establishment of Joint Cyber Security Centres to enhance collaboration and capability building between government and industry stakeholders.
- The development and publication of voluntary consensus guide practice guidelines and industry specific standards, particularly for systems of national interest. The US NIST Cyber Security Framework provides a useful model .

- Enhanced speed and automation of threat intelligence sharing amongst local industry, Australian government and international energy peers.
- Greater clarity on roles, responsibilities and protocols in responding to a nationally significant cyber attack and increased scale and tempo of exercises to test and improve response capability at an industry and national level.

4.6. How could high speed communications and sensor technology be deployed to better detect and mitigate grid problems?

Emerging technologies offer major opportunities to improve system security and reliability. For instance, researchers are working on distributed intelligence platforms whereby connected inverters make decisions using their collective computing power. In future there is the prospect that decentralised DER infrastructure could receive and understand information from various sources, make decisions, and execute commands without relying on top-down control hierarchies.[33]

While the NEM has high levels of DER penetration, some DNSPs are still in the early stages of adapting their networks to reflect these changes. Many DNSPs have not installed modern communications systems that allows them to monitor load, voltage and frequency at the lower voltage levels of their networks.

As our power system evolves towards a more distributed structure, it is necessary to establish a framework to ensure that relevant data is collected and made available to system operators. As DER is installed behind the meter, it is often invisible to AEMO and network operators. This lack of visibility affects the system operator's ability to understand the operational impacts of DER on the power system. These issues are discussed in AEMO's report on Visibility of Distributed Energy Resources[34]. Further discussion on this matter can also be found in our response to question 7.4.

The data collection framework should be flexible and take into account which party is best placed to collect the required information and efficiently make it available to those who require it on an as-needs basis (taking into account confidentiality issues). A transparent process should be established to assess what information should be collected and who has access to it. COAG's Energy Market Transformation Project team are exploring some of these issues as part of their consultation on a register of battery storage devices.[35]

4.7. Should the rules for AEMO to elevate a situation from non-credible to credible be revised?

AEMO has the power as outlined in 4.2.3A of the NER to reclassify certain contingencies from non-credible to credible during abnormal conditions. These powers have been used from time to time by AEMO and its predecessors to deal with the increased risks to the network and system security caused by lightning and bushfires. AEMO may also reclassify contingencies for abnormal asset conditions of which it becomes aware. In several cases

[33] Mohler, D. and Sowder, D. "Chapter 23 - Energy Storage and the Need for Flexibility on the Grid" in Jones, L.E., 2014. Renewable energy integration: practical management of variability, uncertainty, and flexibility in power grids. Academic Press, pg 289.

[34] http://aemo.com.au/-/media/Files/Electricity/NEM/Security_and_Reliability/Reports/AEMO-FPSS-program----Visibility-of-DER.pdf

[35] http://www.coagenergycouncil.gov.au/current-projects/energy-market-transformation

where multiple units of a power station are known to be exposed to the failure of one piece of equipment the risk of coincident tripping of those units was classified as credible.

Whenever AEMO reclassifies a contingency, the decision, its reasons and the resulting invoked constraints are published real-time[36]. Historical analytical information is also published[37].

Following a major event in Victoria in 2007, AEMO (then NEMMCO) instituted a rigorous process for reclassifying contingencies[38]. This pre-defines a number of specific environmental conditions for which AEMO should reclassify contingencies and therefore run the network more conservatively. As these decisions affect market outcomes, creating winners and losers, the process aims to ensure consistent and predictable decision making.

AEMO and a number of other bodies have been reviewing the events of 28 September 2016. In AEMO's Preliminary Report, the power to reclassify certain contingencies is outlined and the circumstances leading up to the 28 September 2016 event described[39].

The power to reclassify contingencies is important under certain operating conditions. However it does not provide a framework for the assessment of non-credible contingencies and taking action to mitigate those where the probability is low but the consequences are severe and some pro-active action is cost effective. AEMO supports the work by AEMC considering a Rule change to introduce a new category of risks, *protected events*, and a process to identify and mitigate those.

5. Market Design to Support Security and Reliability

5.1. Are the reliability settings in the NEM adequate?

The preliminary report has correctly distinguished the concept of *reliability* from *security;* concepts that are frequently confused. Historical statistics provided by the AEMC's Reliability Panel[40] show that the NEM has provided good *reliability* throughout its existence, with the reliability standard met in almost all years and regions. Table 3 shows the small amount of demand actually interrupted due to reliability issues.

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36 See http://www.aemo.com.au/Market-Notices

37 http://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Market-notices-and-events/Power-system-reclassification-events

38 See section 11 of http://aemo.com.au/-/media/Files/Electricity/NEM/Security_and_Reliability/Power_System_Ops/Procedures/SO_OP_3715---Power-System-Security-Guidelines.pdf

39 http://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Market-notices-and-events/Power-System-Operating-Incident-Reports

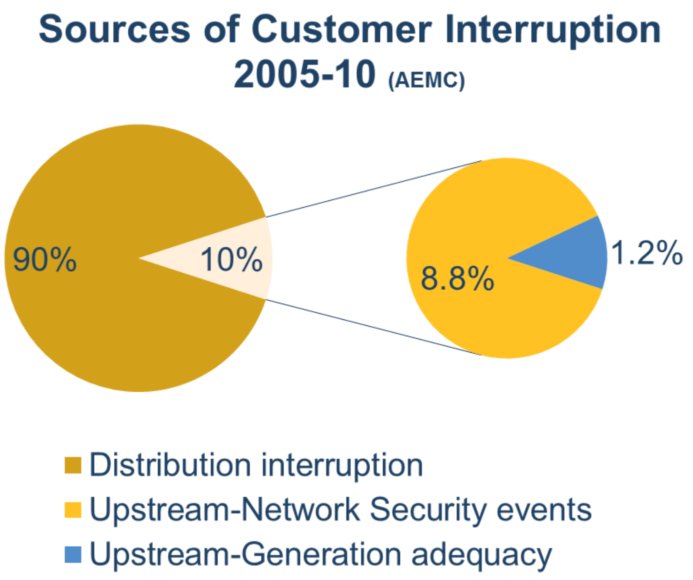
40 http://www.aemc.gov.au/getattachment/bc7bd168-c633-4e4c-801c-0ac5f2467652/Final-report.aspx

Table 3

Year	Queensland (%)	NSW (%)	Victoria (%)	SA (%)	Tasmania (%)
2014-2015	0.0000	0.0000	0.0000	0.0000	0.0000
2013-2014	0.0000	0.0000	0.0000	0.0000	0.0000
2012-2013	0.0000	0.0000	0.0000	0.0000	0.0000
2011-2012	0.0000	0.0000	0.0000	0.0000	0.0000
2010-2011	0.0000	0.0000	0.0000	0.0000	0.0000
2009-2010	0.0000	0.0000	0.0000	0.0000	0.0000
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
10-year average reliability by region	**0.0000**	**0.0000**	**0.00040**	**0.00032**	**0.0000**

Interruptions caused by shortfalls in the reliability of the wholesale market are a relatively small component of customers' total interruptions to supply as shown in Figure 3. The predominant cause of actual interruption is localised events in the distribution network. Of those caused by other reasons, it is predominantly network security. Market settings and capacity rewards can only act upon *reliability* matters, which are caused by generation inadequacy.

Figure 3



The market institutions have contemplated and reviewed the reliability settings a number of times in recent years, work which has been cogniscent of the growth of intermittent generation[41]. The AEMC's Reliability Panel is required to review reliability settings every four years, and recently produced new guidelines for this process[42]. AEMO also completed a major piece of work in estimating the Value of Customer Reliability (VCR) through a widespread survey of the economic impact on customers of interruption[43].

These reviews have tended to reinforce the appropriateness of the current reliability standard and its expression. While there is a negative response when load shedding unfortunately occurs, there would be significant costs to move to a higher standard. In its submission[44] to the 2014 settings review, AEMO indicated that it was reasonably comfortable with maintaining the existing market settings at that time.

A major function of AEMO's Electricity Statement of Opportunities (ESOO) is to forecast regional reliability on the assumption of demand growth and no new entry. The 2016 ESOO[45] forecasts a decline from recent levels of over-supply. It indicates generally adequate reliability, with excursions from the standard in some regions that will require new entry or demand-side response to address. AEMO is separately pursuing the immediate reliability risks in those regions.

Actual customer interruptions in the NEM have been dominated by distribution network issues, and, at the transmission level, by security rather than reliability issues. The distinction is important, as security events generally cannot be addressed by the construction of more generators that would occur by adjusting market settings or providing an explicit capacity payment. Indeed major security events, such as 28 September 2016 and 16 January 2007, occurred when there was more than adequate generation supply available to meet demand.

AEMO supports the Independent Review focussing its attention on measures to ensure the future security of the NEM.

Implementation of Capacity Markets

The Preliminary Report discusses some different market designs used to reward capacity and correctly notes that designing and operating capacity markets can be challenging. AEMO is unique as the only market operator who runs both an energy only market (NEM) and a capacity mechanism with a balancing market (WEM). While AEMO supports the consideration of different market models, we note that any consideration of alternatives needs to take into account the specific context. AEMO notes that the NEM has some specific characteristics which imply that the capacity mechanisms used in other markets can not be readily adopted:

- The NEM has five interconnected regions with diversified demand and supply. For example, as the Tasmanian and Victorian peak demands occur in different seasons, the interconnection between them allows some generation capacity to be shared; in

[41] See for example http://www.aemc.gov.au/Markets-Reviews-Advice/Reliability-Standard-and-Settings-Review-2014
[42] http://www.aemc.gov.au/getattachment/b143b076-45c4-4b08-8296-778d03b5d7c8/Final-Determination.aspx
[43] https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/Value-of-Customer-Reliability-review
[44] http://www.aemc.gov.au/getattachment/900e5130-6a9d-4044-82e2-9e81d96a98ea/MarketReview-Submission-REL0051-AEMO-140410.aspx
[45] https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/NEM-Electricity-Statement-of-Opportunities

effect one generator serves two demand peaks. And whilst the mainland regions are all summer peaking, their peaks are nevertheless diversified to some extent. Designing a capacity sharing mechanism across regions introduces complexity.

- The NEM has a very wide range of technologies of generation and demand-side actions, with large variations in individual reliabilities between them. This makes it difficult to quantify what contribution each makes to system reliability.
- In capacity markets, system obligations are derived from the half-hour of peak demand, on the assumption that all other half-hours will have less severe conditions. However the growth of intermittent generation in the NEM is leading to a future where critical supply/demand conditions will not occur at peak demand times, but at periods of low wind and sun. This is challenging traditional capacity markets internationally.
- The NEM does not provide generators with firm network access and the network's capacity is insufficient to allow all generators to be simultaneously dispatched to meet demand. Instead, generators are "constrained-off" according to the conditions at the time. This means that not all generators can simultaneously provide capacity, and, prior to actual dispatch, there is no certainty as to who will be delivering that capacity to market.

The ability of the future market design for energy and services to attract the investment necessary to drive the transition is a key issue. In considering alternative market designs, AEMO suggests it should also contemplate how the above issues would be addressed.

5.2. Is liquidity in the forward contract market for electricity adequate for the needs of commercial and industrial consumers and, if not, what can be done?

See our response to question 5.4.

5.3. Are commercial and industrial users experiencing difficulties in obtaining quotes for supply?

See our response to question 2.3.

5.4. What impact will an increasing level of renewable generation have on the forward contract market and what new products might be required?

The NEM has reasonably successful exchange traded[46] and bilateral forward markets. These generally trade products of at least one quarter's duration. AEMO understands there is very little trading performed of short-term products, say from one day to a week ahead of present. With the growth of intermittent generation it seems likely that a liquid short-term forward market (STFM) would provide participants with more options to fine tune their contract portfolios on the basis of forecast wind and solar production.

In late 2016 AEMO conducted discussions with participants, government and the AEMC on the prospects for it developing a centrally provided platform for voluntary STFM trading. No material has been published to date, but AEMO can share documentation on it with the Independent Review on request.

[46] https://www.asxenergy.com.au/

5.5. Rule changes are in process to make the bid interval and the settlement interval the same, both equal to 5 minutes. Are there reasons to set them to a longer or shorter duration?

The dispatch and settlement timeframe mismatch is an unfortunate consequence of a simplification decision made at market start. It is well known to distort bidding behaviour and create unintended risks, issues which may become more severe over time given the technological changes underway.

This matter is being analysed in detail through an AEMC rule change assessment underway[47]. As expressed in submission, AEMO is desirous of resolving the issue, and is assisting AEMC with identifying practical means for doing so. Options include simulating 5 minute metering and longer dispatch intervals.

It is also noteworthy that all features of the market design, even those that result from simplifications, create incentives to which participants adjust their businesses. This then creates challenges for those participants when those simplifications are unwound, evidenced by the objections expressed from many participants to the AEMC's contemplation of correcting the mismatch.

5.6. What additional system security services such as inertia, as is currently being considered by the AEMC, should be procured through a market mechanism?

AEMO is working with the AEMC and industry on a range of future system security services such as inertia, fast frequency response, emergency control schemes and services to increase system strength. This work also includes considering the triggers for acquiring and activating the services, which are currently based on power system security criteria[48].

The type of market mechanism required is also being considered. Options include incorporation into the 5-minute central dispatch process, acquisition by AEMO or network service providers under an agreement/contract, or through imposing technical requirements.

5.6.1. How can system security services be used as 'bankable' revenue over a sufficient period of time to allow project finance to be forthcoming?

How providers will obtain sufficient investment certainty will depend strongly on the procurement mechanism used for each service. For example, contracts for services which include availability payments could de-risk investments, although the length of contracts should balance the need for investment certainty with the need to ensure contracts are not so long that they lock out emerging technologies with potentially lower costs in the future. Alternatively, under a market mechanism, consideration should be given to causer pays arrangements that would support or encourage bilateral contracting.

In the near-term, AEMO expects that many services will be provided by existing generators (with incentives only changing short-term behaviours), with a transition to new providers over time as technologies improve and experience with the relevant regulatory and market arrangements increase.

5.6.2. How will generators and retailers mitigate price risk in such a market?

Historically, there has not been significant contracting or hedging for ancillary services, which likely reflects the traditionally low cost of these services. Nevertheless their design provides a

[47] http://www.aemc.gov.au/Rule-Changes/Five-Minute-Settlement
[48] http://www.aemc.gov.au/Markets-Reviews-Advice/System-Security-Market-Frameworks-Review

structure that permits hedging, and this has been implemented in some circumstances[49]. In the future, participants may elect to contract more with service providers, or, depending on the causer pays arrangements, explore strategies to minimise their exposure. AEMO is currently considering cost recovery arrangements for these services, with a focus on transparent structures that provide actionable price signals.

6. Prices Have Risen Substantially

6.1. What additional mechanisms, if any, could be implemented to improve the supply of natural gas for electricity generation?

Improving the supply of gas for electricity generation can be considered through:

- Policies that provide an incentive to explore, develop and commercially produce natural gas.
- Mechanisms that support the efficient allocation of gas throughout the economy in response to price signals.

Well-functioning wholesale markets need to be supplemented by upstream competition in supply to support the efficient allocation of gas. Without policies to support the continued development of Australia's gas resources, market mechanisms will only be so effective in improving gas supply for electricity generation.

Over the last several years, a number of GPG stations have made the decision to on-sell their gas supply positions in response to high wholesale gas prices. This means some GPG operates on the basis of purchasing short term gas supplies. These generators benefit from efficient gas supply and transportation markets that are able to dynamically respond to changing conditions.

GPG will generally make a decision to run in response to current or expected prices in the NEM with a lead time as short as a few hours or even less. One of the key challenges is procuring short term pipeline capacity to transport the gas. This can negatively impact liquidity and undermine efficient pricing in the gas commodity markets.

In this respect, AEMO supports the decision by the Energy Council to implement the AEMC's recommendations from the East Coast Gas Review[50] to facilitate the secondary trading of pipeline capacity, including:

- Exchange-based trading for pipeline capacity.
- A day-ahead auction for unutilised pipeline capacity.
- Standardisation of key contractual terms and conditions for capacity.

AEMO considers that these arrangements will assist the efficient allocation of short-term capacity which may benefit generators who are looking to use the gas markets or bilateral deals to optimise their portfolios over the short-term.

[49] See http://www.economicregulator.tas.gov.au/domino/otter.nsf/8f46477f11c891c7ca256c4b001b41f2/97e4adbba60232f0ca2576f0001a0fd4?OpenDocument

[50] http://www.aemc.gov.au/Markets-Reviews-Advice/East-Coast-Wholesale-Gas-Market-and-Pipeline-Frame

AEMO considers these recommendations should be implemented as quickly as possible and will be supporting the Gas Market Reform Group[51] through this process as required.

6.2. What are the alternatives to building network infrastructure to service peak demand?

It is a requirement when conducting Regulatory Investment Tests for Transmission and Distribution (RIT-T and RIT-D) that network planners seek out and give equal weight to non-network solutions. In its Victorian transmission planning role, AEMO takes this requirement very seriously. For example, AEMO is presently conducting a RIT-T to increase capacity in the western Victorian grid to accommodate an expected rapid increase in large-scale renewable energy generator connections. AEMO has released a request for proposals to resolve the expected congestion through non-network means, and is particularly interested in whether utility-scale storage or load-shifting may offer economic alternatives to augmenting lines[52].

6.3. What are the benefits of cost reflective prices, and could the benefits be achieved by other means?

AEMO considers that a shift towards more cost reflective pricing will lead to efficiency benefits as consumers will respond to price signals reflecting real system costs rather than flat average tariffs. The cost of meeting peak demand is costly, with much of the network and generation assets needed to supply these periods only. With growth in distributed energy resources, peak grid demand times are shifting but remain critical. Cost reflective pricing, such as demand tariffs supported by smart metering, would better signal to customers the true cost of consuming electricity at all times and provide a business environment in which specialist competitive providers can assist customers in taking advantages of them. Obvious opportunities exist for controlling larger, flexible loads, such as hot water heating and pool pumps, and in time managing air-conditioning and small-scale storage.

Given the right regulatory environment, service providers will be able manage these appliances without requiring customer interaction. If the tariffs are truly cost-reflective, the consumption can be timed to moderate both distribution grid peak demand and reduce customer exposure to high wholesale prices. This then in-turn assists market-wide reliability and the NEM's secure transition to a low emissions future.

Cost-reflective pricing also provides efficient incentives for installing small-scale solar and storage, and encourages solar orientation to maximise output at time of peak demand

Network companies are generally supportive of implementing efficient tariffs, but have faced resistance to their implementation. It is important that tariff changes are explained to customers, but having done that, it is then essential that governments allow introduction of efficient, yet fair, pricing structures. AEMO notes that Energy Networks Australia (ENA) lists the introduction of fair, cost reflective pricing under an "opt-out" model as one of the key milestones in its Electricity Network Transformation Roadmap prepared with the CSIRO[53].

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[51] http://www.coagenergycouncil.gov.au/current-projects/gas

[52] http://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/Victorian-transmission-network-service-provider-role/Regulatory-investment-tests-for-transmission

[53] http://www.energynetworks.com.au/electricity-network-transformation-roadmap

7. Energy Market Governance

7.1. Is there a need for greater whole-of-system advice and planning in Australia's energy markets?

The existing NEM model includes:

- AEMO providing whole-of-system advice, covering networks, generation and system services (such as FCAS). These advices are used as guidance only.
- Regulated network service providers planning monopoly services.
- Market-facing businesses respond to market signals to plan, invest in and operate their own investments.

As discussed in response to question 1.2, AEMO believes that market-facing investments are the best way to encourage innovation, supported by limited "proof-of-concept" examples.

With respect to the monopoly transmission system, there are effectively two levels of planning:

- AEMO with its NEFR, ESOO and NTNDP, attempt to take a whole-of-system high-level approach to network planning.
- TNSPs (including AEMO as Victorian planner) prepare Annual Planning Reports (APR) and Regulatory Investment Tests for Transmission (RIT-T). Actual investment decisions are made at this level.

The two levels attempt to co-ordinate their recommendations in order to deliver a whole-of-system optimum. Nevertheless such an arrangement has its challenges and boundary issues. For example, AEMO is presently conducting a RIT-T for Western Victoria to deal with a rapid growth in renewable energy in that area[54]. The optimal solution however depends on simultaneous analysis being performed by ElectraNet on potential new interconnectors to Victoria and New South Wales, and in the latter case, by TransGrid on changes to the South-Western New South Wales network. The three analyses are mutually dependent, and co-ordinating towards a nationally optimal outcome is challenging.

There is also a degree of confusion in operational responsibilities between AEMO and TNSPs. The groups attempt to co-ordinate, however historically matters seen as primarily local, such as system strength and voltage, have been lead by TNSPs whereas matters affecting the broader NEM, such as frequency control, have been lead by AEMO.

This somewhat unclear arrangement has operated reasonably well in the past when the physical issues arising in the grid were consistent with history. In the new NEM of asynchronous generation and distributed resources however, new matters have arisen that have both local and national characteristics, and as a result, responsibilities are not entirely clear.

54 http://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/Victorian-transmission-network-service-provider-role/Regulatory-investment-tests-for-transmission

7.1.1. If so, what are the most appropriate governance arrangement to support whole-of-system advice and planning?

The existing governance arrangements have arisen for historical reasons. It is very unlikely that the existing state-based transmission companies could be merged with each other and AEMO. Clearer responsibilities and integrated national planning have been studied previously[55], and a number of incremental improvements have been implemented. The NTNDP itself is an example: AEMO's advice effectively encourages TNSPs to contemplate national matters in their planning.

There does not seem to be many obvious further incremental improvements available.

In some cases where large, discrete new assets with national characteristics are seperable from existing assets (such as a new Victorian to Tasmanian interconnector), it may be possible for these to be planned and contestably sourced by AEMO. However the planning of most national flow paths, including interconnectors, is inseparable from the planning of the existing intra-state networks.

A more radical approach is to centralise all planning and other responsibilities within AEMO, implying AEMO's Victorian role would be mirrored elsewhere. This has been discussed many times previously, but has generally not been taken up due to controversy about whether not-for-profit planning undermines incentive-based network economic regulation.

These are difficult issues and AEMO does not expect the Independent Review to resolve them. AEMO would note, however, that the Victorian arrangements have operated successfully for two decades without obvious evidence of inefficiency.

7.4. Are there sufficient outcome statistics for regulators and policy makers to assess the performance of the system?

AEMO has found that the information available to support technical modelling and assessment of power system performance is progressively becoming less adequate as the transition to new generation and connection technologies continues.

There is currently a broad range of detailed information available in relation to the performance of conventional synchronous generating plant and Alternating Current (AC) transmission infrastructure connected to the power system:

- The provision of technical modelling data is supported by access standards set out in Schedule 5.2 of the National Electricity Rules (NER) for generators, Schedule 5.3 for customers, and schedule 5.3a for Market Network Services.
- Operational information relating to the performance of the NEM and the power system is generally published by AEMO shortly after the day of operation.

In the past, the vast amount of information available in relation to operation of the NEM has been sufficient to support detailed modelling associated with determining the dynamic response and operational limits of the power system, designing new connections, reviewing the implications of operational events, and reviewing spot market performance. The Reliability Panel is also tasked with analysing NEM outcomes annually, to consider the

[55] http://www.aemc.gov.au/Markets-Reviews-Advice/Transmission-Frameworks-Review

effectiveness of various operational processes in its Annual Market Performance Review (AMPR)[56].

The AMPR condenses a large proportion of the NEM operational statistics for the previous year and makes high-level observations in relation to spot market and power system management. Spot market analysis is only part of the story however – a full analysis of NEM performance would need to include consideration of the bilateral hedge contracts between wholesale participants and retail contracts with consumers. Any form of analysis that attempts to cover this full scope of physical and financial markets would be very challenging and a compelling case for disclosure of financial market information has not been made to date.

However, current information disclosure obligations do not yet adequately cover new and emerging technologies such as inverter connected plant, and smaller scale distributed energy resources that can in aggregate, have a material impact on the performance of the power system as a whole. By way of example, AEMO's study of the Response of Existing Photovoltaic (PV) Inverters to Frequency Disturbances[57] demonstrates it was only through good fortune that AEMO was able to access information that was barely sufficient to verify that PV inverter settings would be unlikely to result in a major generation loss during a frequency disturbance. In that case, AEMO was able to use Clean Energy Regulator (CER) information on PV inverters that had been collected for non-technical purposes.

As new and distributed technologies increase their presence on the power system, the importance of access to adequate technical information will grow. If not remedied, AEMO and Network Service Providers will impose unnecessarily conservative constraints on the power system to maintain security.

The shortfalls in data availability fall into two categories:

- Static data relating to the technical characteristics of installed facilities at customer premises such as rooftop PV installations, battery installations, and the associated inverter equipment.
- Real-time, or near real-time operational data to monitor the impact of distributed energy resources on the power system, and support operational management of issues as they arise. This effectively involves providing visibility of how devices are used in real-time, to support forecasting and operational planning functions including contingency planning. For AEMO's purposes, real-time operational data aggregated to a nominated point in the distribution network is expected to be adequate.

The issue is one of data management rather than access, as it is not being collected by any entity in the Australian energy industry –particularly the static data. Remedy is likely to require regulatory change broader than the NER, to effect the collection of information across Australia. Provisions are likely to require the support of state and commonwealth governments to establish a policy response.

[56] The 2015 Annual Market Performance Review is at: http://www.aemc.gov.au/getattachment/bc7bd168-c633-4e4c-801c-0ac5f2467652/Final-report.aspx

[57] The Inverter Performance Report was published in April 2016, and is available at: https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Security-and-reliability/FPSSP-Reports-and-Analysis

AEMO has previously raised this challenge in its FPSS Progress Report (August 2016) and AEMO's submission to the SCO Energy Storage Registration Consultation (September 2016)[58].

In January 2017 AEMO published a discussion paper detailing why resolution of this matter should be a priority.[59] AEMO set out the range of information required and a discussion on the implications of not addressing the issue. We urge the review committee to consider the detailed discussion set out in that paper as input to the review.

In relation to addressing this issue of information disclosure, the principles discussed in response to question 7.6 are relevant. Most information exchange and disclosure in the current NEM, with a few exceptions such as the Congestion Information Resource, are specified in detail in the NER. Any changes there require analysis under the full NEM Rule change process, followed in many cases by detailed process and systems design. To allow information disclosure obligations to keep pace with industry changes in the future, it is proposed that the approach discussed in item 7.6 of this submission be adopted. Such an approach would place high level principles in the NER, and empower the institutions to make changes on a continual basis in consultation with industry participants.

7.5. What governance measures are required to support the integration of energy and emissions reduction policies?

7.5.2. Should the NEO be amended?

The existing NEO, being effectively a single economic efficiency based objective with other matters treated as externalities, is well understood by the institutions and guides AEMO's decision making. AEMO would not support the United Kingdom's inclusion of non-specific environmental and social objectives, as it would be unclear to us as to how they would be weighted, nor would AEMO have any expertise in, say, correcting wealth disparity.

The NEM's current framework presumes government will set environmental and social policy, and that the NEM must operate to deliver the most economically efficient outcome constrained by that policy. Where government is capable of doing this clearly and with stability, this will deliver the best outcomes and remains AEMO's preferred approach.

7.6. How can decision-making be appropriately expedited to keep up with the pace of change?

The regulatory framework has to pre-empt investment change. However in the NEM, regulatory change can take upwards of a year to define, and several years to effect. Uncertainty and risk for investors, inefficiency for the market, and risks for power system security can flow from this slow regulatory change.

NEM frameworks have heirachical regulatory layers:

- Legislation managed by the COAG Energy Council.
- The NER managed by the AEMC.

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[58] Reports both available at: https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Security-and-reliability/FPS

[59] AEMO's report on the Visibility of Distributed Energy Resources is at: https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Security-and-reliability/FPSSP-Reports-and-Analysis

- Technical standards and/or guidelines are managed by the AEMC's NEM Reliability Panel.
- Detailed industry procedures are developed by AEMO
- Finally, processes and operational systems developed by AEMO and industry participants.

Industry consultation is included in each layer, taking upwards of 6-months in each case. Furthermore, once a policy change is sufficiently defined, transitional arrangements are often legitimately required to allow industry stakeholders to adjust their trading and risk management portfolios prior to a change taking effect.

The trade-off inherent in this arrangement is that involving more regulatory levels can provide additional checks and balances against vesting too much authority in a single body or agency, but at the cost of efficiency and speed of change.

However industry change is taking place at an increasing pace, with technology and business models far less predictable than they were at NEM commencement. An effective response to this rapid industry evolution requires innovation in the management of regulatory reform.

One way is to use the upper regulatory levels to define roles and policy principles with broad expression rather than detailed definition. Detailed adaptation of processes or settings within that broad policy space could then be managed and driven by agencies directly involved in managing the issues that are changing. AEMO would argue this approach paradoxically provides more policy certainty, while details are under constant review.

Some NEM frameworks are more aligned with this principle than others, and there are numerous that could be considered. By way of example, consider AEMO's power system security responsibilities.

In current framework, AEMO is able to make changes to a range of operational practices, including procedures for intervention, management of system restart, specifications for participation in existing frequency control ancillary services (FCAS), procurement arrangements and settlement mechanisms for FCAS. However, other important elements of the power system security framework do not have clear roles defined in legislation or the NER, such as:

- Responsibility is not assigned for monitoring the adequacy of technical network access standards as currently set down in Schedules 5.2, 5.3 and 5.3a of the NER (for generators, customers, and market network services respectively). Access standards for some equipment, such as distributed generation, are not currently covered by the NER, and responsibilities are uncertain. AEMO suggests there is a need for a clear responsibility for monitoring the adequacy of current access standards, and driving changes to them through a process of constant review and adaptation at a detailed technical level. The current process has not delivered any change to the NER based technical performance standards since 2007. AEMO recommends detailed technical specifications should be moved from the NER into a sub-ordinate instrument.
- No agency has been assigned responsibility for tracking emerging operational risks in relation to the power system, and promoting adaptation to the overall system security framework. AEMO is developing a detailed discussion of this matter in its submission

to the AEMC's Rule change consultation on Emergency Frequency Control Schemes[60].

Work of the above type is closely aligned with other responsibilities of AEMO and Networks (NSPs), and it is often posited that there is nothing to stop these parties from pursuing them. However, they require dedication of expert resources, funding, and often the ability to access information from other businesses. Therefore in practice, in the absence of a clear obligation, the work is not progressed as an area of focus.

AEMO suggests there are opportunities to streamline the adaptation of NEM frameworks by defining high level principles in the NER, and obliging relevant industry agencies such as AEMO in collaboration with NSPs, to continually adjust settings within the policy framework. If well designed, the majority of adaptation could potentially:

- Be driven at the most detailed regulatory level, in direct consultation with industry, rather than requiring a series of changes at each individual regulatory level.
- Provide increased confidence and focus through being driven by an ongoing responsibility, in contrast to the current relatively passive process that relies on lodgement of a Rule change without any agency having a responsibility to track risks and changes.
- Result in a transparent process of monitoring and assessment rather than making step changes following occasional investigations triggered in response to issues that have not been addressed.

By way of example, the technical access standards could be taken out of the NER and placed in procedures kept under constant review by AEMO (as part of its power system security role) in consultation with industry stakeholders. The process could leverage existing analyses such as investigations of power system events, connection negotiations, national planning studies and trends in daily operational management. Appropriate checks and balances would need to be considered. Any concerns in relation to checks and balances could be built into the process through oversight and review at a higher level, as an alternative to relying on serial changes at multiple levels.

8. Preliminary Report Appendix

AEMO wishes to clarify a discussion about wind energy disconnection following a short voltage dip in the Preliminary Report's appendix. On Page 50 it is noted:

> "With wind energy, the requirement to disconnect in the case of a fault following a short voltage dip was found to be a threat to system security in Europe about 10 years ago. This problem was due to the way it was configured to operate. By requiring fault ride through (FRT) capabilities from VRE power plants, this issue of single voltage dips has been since resolved, as shown by the Spanish example where occurrences of VRE generators disconnecting after a voltage dip have been reduced to zero."

Similar FRT requirements for wind turbines also exist in the NEM. All large NEM windfarms have always had this capability. The ability to ride through a single dip was not the matter of concern in the system black event of 28 September 2016. As discussed in page 30 of the

[60] http://www.aemc.gov.au/Rule-Changes/Emergency-frequency-control-schemes-for-excess-gen

Preliminary Report, nine wind-farms exceeded a pre-set limit for the number of ride-through reponses, a limit of which AEMO was previously unaware.

The presentation of this matter in the appendix has caused some media confusion that the pre-set limit issue was historically resolved in Europe. AEMO's investigations suggest there are no explicit rules in Europe dealing with the pre-set limit, with the exception of Denmark. It is worth noting that the number of faults in South Australia on 28 September 2016 exceeded the Danish limit.