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CLEAN ENERGY COUNCIL

Monday, 6 March 2017

Professor Alan Finkel AO
Chief Scientist
Office of the Chief Scientist
Lodged Electronically: NEMSecurityReview@environment.gov.au

Dear Professor Finkel,

RE: Independent Review into the Security of the National Electricity Market

The Clean Energy Council (CEC) is the peak body for the clean energy industry in Australia. We represent and work with hundreds of leading businesses operating in solar, wind, energy efficiency, hydro, bioenergy, energy storage, geothermal and marine along with more than 4,000 solar installers. We are committed to accelerating the transformation of Australia's energy system to one that is smarter and cleaner.

We welcome this review and believe it can play a crucial role in demonstrating that Australia can transition toward a zero-emission electricity sector, while both ensuring energy security and affordability of power for Australian consumers. We are hopeful that this review can identify the key elements of a national strategy to manage this transition, as well as the policies and reforms that will ultimately deliver these three outcomes most efficiently.

We trust that this submission assists the panel in its deliberations and welcome continued discussion of this complex and increasingly important issue.

Please contact me for any queries regarding this submission.

Sincerely,

Kane Thornton

Executive Summary: Ensuring a secure clean energy system

The drivers of change

Two critical factors are driving the transformation of the Australian electricity sector. First, there is bipartisan political support for Australia's commitment to the Paris climate agreement and a minimum national carbon reduction target of 26-28 per cent by 2030. The Australian electricity sector is a substantial contributor to Australia's overall carbon footprint, and can therefore be expected to make a substantial contribution to this abatement target. In the longer term, it should be expected that Australia will require a zero-emissions electricity system by the middle of the century as part of the global response to climate change.

Secondly, Australia's existing fleet of power generators are old and getting older. It is estimated that more than 70 per cent of existing coal-fired power plants are at or beyond their planned operating life. Irrespective of climate change imperatives, these generators will need to be replaced in the decades to come.

Addressing both of these factors is essential. Further, this must be done in a manner which also ensures energy security and affordability for consumers.

We recognise the importance of energy security and believe renewable energy and battery storage together can play a major role in securing our future energy supply. This can be further enhanced by leveraging the sophisticated technology and management systems available to maximise the effectiveness of both renewable energy and battery storage, along with stronger interconnection and demand side response. A range of market reforms will be necessary to fully leverage these opportunities.

Delivering a zero-emission, secure and affordable energy system is achievable.

Australia has a very strong foundation on which the transition of our energy system can be managed successfully. A stable and robust energy system with strong institutions and regulatory frameworks combined with a competitive energy market and strong private sector investment has positioned Australia well to effectively manage this transition.

Further, Australia has some of the best clean energy resources in the world that should ensure we continue to enjoy a competitive advantage in energy in a carbon-constrained world. Australia must accelerate the deployment of new energy infrastructure in preparation for the closure of ageing energy assets. This will ensure Australia achieves its global carbon commitments while ensuring a secure energy system.

New technology

The technology exists to deliver a secure and zero-emission electricity system.

Rapid technological innovation has resulted in a significant reduction in the cost of renewable energy generation over the last decade. The economic and environmental benefits will continue to increase over time, as further technological advances in battery and storage technology put downward pressure on power prices and improve both the reliability and security of our electricity supply.

Hydro power, bioenergy, wind and solar power are now proven and commercial technologies. As the market evolves and price signals change, the business case and levels of deployment of these technologies is expected to increase. Obviously the resource and energy market dynamics vary throughout Australia, and therefore the competitiveness of these technologies as solutions will also vary.

There are however a vast array of technologies and solutions that continue to emerge and develop, both technically and commercially. Others can be retrofitted or implemented with existing energy assets or infrastructure.

There is no single solution for Australia's future energy needs. Taking a portfolio approach incorporating a range of different technologies and solutions brings with it many benefits. These solutions include:

- Battery storage which is reducing in cost dramatically and has wide applications behind-the-meter and at utility and grid scale
- Exciting developments in new energy generation from wave, ocean and geothermal resources
- Technology which can support the operation of the network, through providing inertia and rapid frequency response
- Upgrades and enhancements to Australia's existing hydro power generation assets and the development of new hydro power, including pumped hydro storage
- Synchronous condensers that can be implemented on existing synchronous generators to provide system support
- Stronger interconnection between physical regions of the NEM and an enhanced transmission system to allow greater resilience while maximising the value of some of Australia's best renewable resource regions.

Taking advantage of these solutions however requires the right mix of market signals and regulatory frameworks. Australia has world-leading renewable energy research and development, strongly supported by the efforts of the Australian Renewable Energy Agency, Clean Energy Finance Corporation, CSIRO and our universities. These bodies should continue to play an important role in testing, demonstrating and accelerating these solutions.

Long-term planning

Although the energy transformation is already well underway, careful planning will be critical to achieve the nation's commitments. The absence of a clear transition strategy and strong

investment and divestment signals is slowing and distorting the investment decisions required to support a secure electricity system.

Fundamental to managing this transition is a clear long-term energy strategy that can guide investment decisions, regulatory and market reforms.

21st century energy market and regulatory framework

Australia's energy market and regulatory framework were designed many decades ago and are now out-dated. Energy market reform has not kept pace with technological development and the increased deployment of renewable energy (and now battery storage, which brings its own complexities). This process must be accelerated through initiatives and cooperation at the national level.

Comprehensive reform is required to deliver a zero-emission electricity sector, incorporating market design, ancillary service design and incentives, new investment signals and market transition planning.

Current market settings for these services were designed around the performance of gas and coal generation technologies and capabilities. As our electricity markets transition away from older technologies they will be replaced with clean energy technologies, and energy storage technologies in the longer term. These 'inverter-based' generators can deliver frequency management services within very short timeframes – crucial to delivering a secure energy system – but the current Frequency Control Ancillary Services settings have not activated this capability.

There is a clear opportunity to modernise the Frequency Control Ancillary Services regime to tap into the rapid response capability of modern electricity generation and storage technologies. In addition, inverter-based wind, solar and storage technologies are also capable of providing fast-acting responses to extreme grid events and can act to stabilise the power system after these events. These technologies are not providing this service because the expectation to do so has not been set by the market. It is therefore timely to revise the frequency control market to create a high-speed frequency regulation market and appropriate inertia requirements. We welcome the ongoing prioritisation of this from AEMC and AEMO.

Institutions and governance

The pace of change is accelerating across the energy sector and this change needs to be managed efficiently and effectively. This requires governance arrangements that will anticipate the future evolution of the energy market, ensure the review and refinement of current market arrangements in a timely and efficient manner and the streamlining of decision-making. This is necessary to ensure that key institutions have the mandate and resources necessary to fulfil their growing set of priorities.

The necessary reforms are complex. They must be carefully considered and planned to deliver the desired outcomes by providing both investment and divestment signals. Failing to develop the policy framework and design the market for any major transition will limit the efficiency of the transition and ultimately impede longer-term success. The effective transition of the Australian electricity sector towards a zero-emissions sector can be delivered through:

1) A transparent and structured phase-out of Australia's most carbon-intensive electricity generation
2) The accelerated deployment and development of proven and emerging renewable energy technologies
3) Greater energy productivity, delivered through improved energy efficiency, energy conservation, smarter use of electricity and implementation of supporting technologies.

Investment-grade policy

One of the biggest risks to energy security in Australia is the lack of new generation investment as our existing generation fleet phases out. Long-term investment-grade policy is necessary to ensure this new private investment is made in a timely manner.

The current Renewable Energy Target (RET) is the key policy driving new investment in renewable energy across Australia. The recent review of the RET was a challenging period for the sector, and it has taken several years to rebuild investor confidence. In 2017, the RET will deliver more than 2.5 GW of new power generation capacity, $5.6 billion of private sector investment and create some 3,150 jobs in large-scale projects alone, demonstrating unprecedented levels of private sector investor appetite for renewable energy.

This investment will only continue with clear, long-term policy settings that are targeted to deliver on the nation's emissions abatement objectives. Investors in the nation's energy infrastructure are looking to governments to establish stable policy settings in the next two to three years that will deliver for the next two to three decades.

Emission reduction mechanisms that focus on the emissions intensity of generation (such as an Emissions Intensity Scheme or a simple price on carbon) may be effective at phasing high-emissions generation out of the market. However, large withdrawals of generation capacity will lead to short-term but significant displacement of the supply-demand balance driving energy costs upwards unless new zero-emissions generation capacity is built within the generation withdrawal timeframe. This outcome is likely to be detrimental to the objective of achieving a planned transition.

As the cost of renewable energy declines, so does the necessity for additional policy and financial support. The business case for new renewable energy investment increasingly relies on future projections for wholesale electricity prices. It is expected that in the future, renewable energy will be commercial based solely on revenue from wholesale energy output over the 15+ year life of the project. Such projections however are complex given uncertainties in relation to:

- Future energy demand, including the impact of electrical vehicles, broader economic conditions or the impact of a changing manufacturing sector
- Expectations about the retirement of coal generation, including the nature and extent of future carbon policy
- Wholesale energy market drivers, including the cost and role of gas.

These factors create long-term uncertainty about future wholesale electricity prices that could negatively impact the business case or confidence in new investment. This may therefore warrant a continued policy mechanism (such as the RET) beyond 2020 in order to ensure there is sustained new investment and generation.

Our clear preference is for strong long-term national policy. In the absence of this, state and territory governments have played an important role in providing investment certainty. Crucially these policies fill a void in the post-2020 policy settings. We welcome initiatives to harmonise state/territory policy with commonwealth policy, but this must ensure strong and long term renewable energy policy beyond 2020.

Summary of recommendations

- **This 'trilemma' objective of a zero-emission, secure and affordable energy system is achievable.** However, it will require the modernisation of the electricity system grounded in a reasoned debate about the need for change and an understanding of the technological capability available. It also requires the recognition of Australia's massive competitive advantage in renewable energy resources and the potential for significant economic benefit to be derived from accessing free renewable resources and developing the exportable capability to integrate these technologies with the existing power system. The roles of the Australian Renewable Energy Agency and the Clean Energy Finance Corporation will be pivotal in enabling this long-term national economic benefit.
- Although **the energy transformation is already well underway**, careful planning will be critical to achieve the nation's commitments. **Investors in the nation's energy infrastructure are looking to governments to establish stable policy settings in the next 2-3 years that will deliver for the next 20-30 years.** The legal and governance arrangements around the market should be used to achieve this outcome by setting a clear objective to balance the trilemma.
- The key market institutions have the capability and oversight role to deliver the trilemma in line with emissions abatement targets at the lowest cost**. A change to the National Electricity Objective and other legislative arrangements should be explored in order to create a framework that allows the energy market's institutions to plan a market to deliver energy market reform to balance the trilemma.**
- **The capability of the market's institutions to consider and plan for technological change must be expanded**. An agile market is needed and a clear mandate must be placed on these institutions to assess and plan for technological change that could enable the trilemma to be met more efficiently. This mandate must be supported by a funding source and a new advisory role in partnership with the CSIRO. Mechanisms in place on overseas markets should be considered here.
- **An increase in the diversity and scale of renewable energy sources will be necessary to ensure downward price pressure is adequate to hedge against increased gas prices.**
- A far more flexible electricity market will be required to operate on a zero-emissions basis. **Mechanisms such as shorter market settlement arrangements that achieve flexibility through demand-side management and energy storage of all forms will be valued in the future and need to be encouraged immediately.**
- **Renewable energy and energy storage technologies have the capability to deliver system security services but market mechanisms or related rules have never created this expectation.** This must change immediately with the creation of system security services that are independent to conventional generators which might be expected to withdraw from the market in the medium term. Transmission planning should be utilised to deliver these outcomes.

- The National Electricity Market is an outlier in an international context where other markets have realised that the settings and practices applied here could jeopardise power system security and taken alternative design choices to avoid this risk. **A major review of the market's renewable energy forecast and frequency management mechanism is required to bring the scheme up to international best practice and better integrate the fast-acting capability of new energy storage technologies.**

- Through the deployment of Distributed Energy Resources consumers are now active investors in electricity infrastructure. Yet these assets are not planned and tend to be woefully underutilised in a grid or power system-supporting role. Tariff reforms are intended to address this. **However tariff reforms will only produce significant efficiency gains where customers can access DER technologies through which they can manage risk.** In addition, a clear lack of coordination and consistency in the **setting of standards to connect small and mid-scale distributed energy resources needs to be addressed to ensure these investments are efficient.**

Contents

1 Guiding principles

The CEC believes that a 2030 electricity market would have characteristics that are closely aligned to some of the scenarios set out by the CSIRO in their recent Future Grid Forum update report[1]. This includes the following key elements:

- An effective emissions abatement mechanism for the electricity sector that drives out high emission generation sources to achieve a minimum 30-50% reduction of emissions in the electricity sector by 2030 (in line with the Rise of the Prosumer scenario).
- Achievement of current renewable energy targets set by both state and federal governments. A renewable energy target that continues to support investment in large scale renewable energy far beyond 2020, and with a diversity of different technologies.
- Distributed solar PV growing linearly with past trends to supply around 10% of total energy, deployed on around 50-60% of homes and businesses (slightly underperforming both scenarios).
- Electric vehicles continuing to grow in popularity. Although not quite ubiquitous, they are the predominant form of new car sales.
- Energy storage playing a significant role in 'behind the meter' applications, and in use in some fringe of grid applications for network support. Large scale storage is deployed with renewables to smooth output and providing ancillary services.
- Engaged consumers are tapping into a vibrant market where energy service providers optimise their systems to maximise the value to the customer and tap into network support and ancillary service markets. Network businesses are competing in these markets too.
- Large users are able to procure reliable and affordable renewable energy from the market or bi-lateral contracting channels.

This submission is guided by the following principles which are essential in planning Australia's future energy system:

Principle 1. The energy transition is underway.
Opportunities for consumer investments in 'new energy' technologies such as solar PV and energy storage have never been greater and are gaining pace. Increasing costs of electricity, changing tariff structures and rapidly reducing technology costs

[1] Graham, P., Brinsmead, T., Reedman, L., Hayward, J. and Ferraro, S. 2015. Future Grid Forum – 2015 Refresh: Technical report. CSIRO report for the Energy Networks Association, Australia.

are combining to create the ideal conditions for continued adoption of these ‘behind the meter’ technologies.

While closure timeframes for existing coal is unclear – and natural attrition may not be consistent with achieving the emissions abatement necessary to meet our Paris Treaty commitments – these aging assets must be replaced with new generation capacity in advance to maintain energy security. The economics of large scale energy generation have changed substantially in the past decade. New wind and solar are now cheaper than new build coal or gas.

Principle 2. A reliance on a large capacity of synchronous generation cannot be guaranteed in the longer term.

Declining thermal generator margins generally impact maintenance programs leading to lower plant reliability and unexpected plant outages. In other words, the market needs to start planning for lower levels of synchronous generation immediately.

There is an urgent need for energy market reform that redesigns market frameworks to enable new technologies to participate in ensuring energy security. Failing to take these steps will lead to a failing market.

Principle 3. The role of government is to deliver a long-term vision and stable policy framework to guide the market’s institutions to deliver the energy trilemma.

The electricity market was designed 20 years ago and has worked well to encourage billions of dollars of investment since its commencement. A market-based framework should be retained, but must evolve and be reformed to deliver a 21st century energy system.

Principle 4. The role of the energy industry agencies such as the AER, AEMC and AEMO must be clearly articulated and be consistent with achieving the energy trilemma.

The continued treatment of policies that have major influences on the energy market as ‘externalities’ is not sustainable and will ultimately lead to poor outcomes for consumers. For example, while the Renewable Energy Target’s legislated obligations are clearly influencing the energy market, the ability to consider forward-looking market reforms that enable a smooth transition towards these new technologies is limited by the National Electricity Objective’s (NEO) narrow focus.

There is broad recognition of the importance of security, affordability and environmental constraints. It is therefore timely and crucial that these are equally acknowledged within the very objectives of the NEM.

Principle 5. To date, the various reviews space have commenced with an underlying and unwritten assumption that current market frameworks are set and managed without error and are delivering against the NEO. This assumption must be tested.

Indeed, recent analysis by senior CEC members has revealed that the NEM is far from perfect. Its reliance on market mechanisms for Frequency Control Ancillary Services (FCAS) has created perverse outcomes to the detriment of power system security. As far as the CEC is aware, these outcomes do not exist in any other market in the world.

Principle 6. It is critical that the NEM's frameworks deliver levels of certainty required for investor confidence.

The NEM's energy security frameworks are entirely underpinned by commercial investments. The NEM was deliberately designed with this characteristic in mind, with institutions that sat outside of and at arms-length of government and had clear mandates. New drivers for emissions abatement, technological change and an energy transformation have revealed the unsustainability of the current arrangements.

The NEM has not been subject to a comprehensive technical review since 2006[2]. Meanwhile, the generation mix, market characteristics and consumer interactions have changed dramatically over the last 10 years.

A key factor for this review will be the ability to create a strategic market direction that sits at arms-length to short-term political expediency to support the significant investment in energy infrastructure that will be needed in coming decades.

Principle 7. Technology neutrality is of paramount importance.

The NEM has been designed to encourage all technologies to participate where they can. For example, the generator performance standards encoded into Schedule 5.2 of the National Electricity Rules place a minimum obligation to not harm system security. Generation technologies are encouraged to do their best to assist, but can fall back on their technical capability where AEMO permits this. In all cases, AEMO determines the acceptable level of performance.

Technology neutrality is of particular importance in the current climate where attention is focussed on new technologies. While these technologies do clearly have differing characteristics (for example, lower mechanical inertia from non-synchronous generators), it is critical that the NEM's frameworks encourage them to provide an outcomes-based response, in accordance with the essential services the market needs. Similarly, any obligations that are placed on new non-synchronous technologies should equally be placed on new entrant synchronous technologies.

Of course, the treatment of new technologies must be matched with a comprehensive understanding of existing technologies. For example, there is a large unknown in the

[2] http://www.aemc.gov.au/Markets-Reviews-Advice/Reliability-Panel-Technical-Standards-Review#

performance of synchronous generators that were commissioned prior to 2007 under high rates of change of frequency[3].

This submission will discuss the seven key themes which were identified in the Independent Review into the Future Security of the National Electricity Market (Preliminary Report), and provide a vision for the future energy system, which draw upon our guiding principles.

[3] AEMC, System Security Market Frameworks Review Interim Report, December 2016, p. 18.

2 Impacts of new technologies on the energy market

Technological change is inevitable. New or emerging technologies are playing an increasingly active role in the electricity market at both small 'behind the meter' (Distributed Energy Resources, DER) and large ('registered') scales. In this context, the principle of technology neutrality, with a focus on outcomes-based objectives for the market, is critical to the successful adoption and implementation of technological solutions.

Technological change is rampant and will continue to be so for many years to come. In order to ensure that the NEM can capitalise on new technologies, it is important that energy industry agencies understand how new technologies can impact the market. While the CEC commends the Panel's efforts in encouraging knowledge sharing and cooperation between AEMO and ARENA, it is concerning that there is not a formal obligation or framework to facilitate increasing AEMO's understanding of new technologies. Later in this submission, we argue that this review is ultimately being undertaken in recognition of a failure to plan for technological change in the NEM. Placing the market in this position is unsustainable.

[Recommendation: The market institutions must have a clear mandate to assess and plan for new technologies impacting the market. This mandate must be supported by a funding source that allows research and development of new and innovative integration techniques that test the technology-neutral principles of the NEM by assessing performance outcomes, rather than specific characteristics. A new technical and technology exploration advisory role should be established within the market's institutions and a partnership with the CSIRO should be considered to support this need.]

3 Consumers in a changing electricity sector

While the NEM has been designed to deliver on consumer expectations for secure and low cost energy, consumer participation in the market has changed dramatically over recent years, and will continue to do so in the coming years. Recent increases in household electricity costs, coupled with increasing access to subsidies for new energy technologies has led to a very different market than that which was envisaged in the first decade of this century.

The central focus of the NEO is "the long-term interests of the consumers of electricity". These new forces however have highlighted that consumers are now not only interested in a secure and low cost energy supply, they also expect this supply to reduce its environmental impact.

In order to meet their changing needs, it is no longer reasonable to view consumers as a passive construct. They are active investors in electricity infrastructure and have now collectively made significant investments of private capital in the power system. Although this has largely been driven by subsidy schemes for solar PV to date, four key drivers will continue to lead to strong growth in these 'behind the meter' investments: rising electricity bill prices; significant changes in feed in tariffs for customers with solar PV; tariff reform targeting small peak demand time periods and rapidly declining solar and energy storage technology costs. These trends imply that a slow-down of solar PV deployment is unlikely and a strong increase in battery storage deployment in the coming decade should be expected[4].

These assets should be utilised more effectively to support both the local electricity network by deferring investment and supporting solar PV generation uptake, and providing broader power system security and/or essential frequency management services to the market. One example of this includes the recent announcements by Greensync on aggregation and trading platforms which have come about with funding from ARENA.

[Recommendation: Market rules and network investment settings must better consider the aggregation of small-scale DER and encourage enabling technologies in order to deliver long-term benefits to electricity users.]

Customers must be able to use DER technologies to benefit all energy users

Residential customers are currently facing the largest range of energy choice in history. Concurrently, tariff reform processes are well underway and should deliver more equitable outcomes based on customers' utilisation of the grid. The most effective means to ensure that customers can manage their bills in the future is to ensure they have access to technological solutions to do so.

Customers are actively deploying DER technologies and becoming active investors in the electricity infrastructure. In order for these investments to enable them to efficiently control their costs and provide benefits to other customers, they require both network investment deferral (via proposed tariff reforms) and energy or ancillary service market signals.

[Recommendation: reforming tariff structures best delivers benefits to customers when customers have the capability to respond with consumption changes or technology uptake. A program of consumer behaviour monitoring should be established alongside the roll-out of revised electricity network tariffs. Information gathered will be important to inform the need for intervention for some customer classes and future tariff reform exercises.]

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[4] http://www.sunwiz.com.au/index.php/2012-06-26-00-47-40/73-newsletter/419-battery-installations-in-2016-exceeded-6750,-sunwiz-research-finds.html

Consumers can retain, or contract out choice and control

Not all residential customer needs are the same, but most are unlikely to want to get actively involved in the interactions between their 'behind the meter' DER equipment and electricity markets. These technologies will add complexity to a customer's energy use, which may not be well understood or desirable. Retailers and other service providers are well-placed to manage these systems on behalf of these customers. However, the contractual terms under which this occurs is a matter for Australian Consumer Law, rather than the National Electricity Law.

However, measures that enable DNSPs to directly control equipment located 'behind the meter' is a matter already considered by the regulatory frameworks for network investment. Should a DNSP require control to manage demand on their network[5], they are implementing network support mechanisms that the market rules expect are subject to a financial return for the customers involved. The use of DER in this way is contemplated or even encouraged under the NER, but not practiced by DNSPs who generally have little incentive to implement demand management solutions (as demonstrated by low implementation of such solutions).

The CEC has commissioned significant research in this space[6] and would encourage the Panel to consider how the market must evolve to enable this capability.

Industrial customers face unique conditions

Large-scale industrial customers have different needs to residential customers. Large energy users have had a long history of accessing cheap power through a fairly liquid contract market. This liquidity has led to a consumer preference for short-term contracts. These short-term contracts are insufficient to underpin significant generation investment alone. Concurrently, pressures in the gas market[7] have flowed through to electricity futures contract markets, where retailers have hedged against their costs as gas prices move towards the international export parity price, as shown in Figure 1.

This became most evident in mid-2016 in South Australia when gas was in short supply. This situation was compounded by the fact that some large users in South Australia had elected to move away from contracts, and face full spot price exposure. As a result, they were

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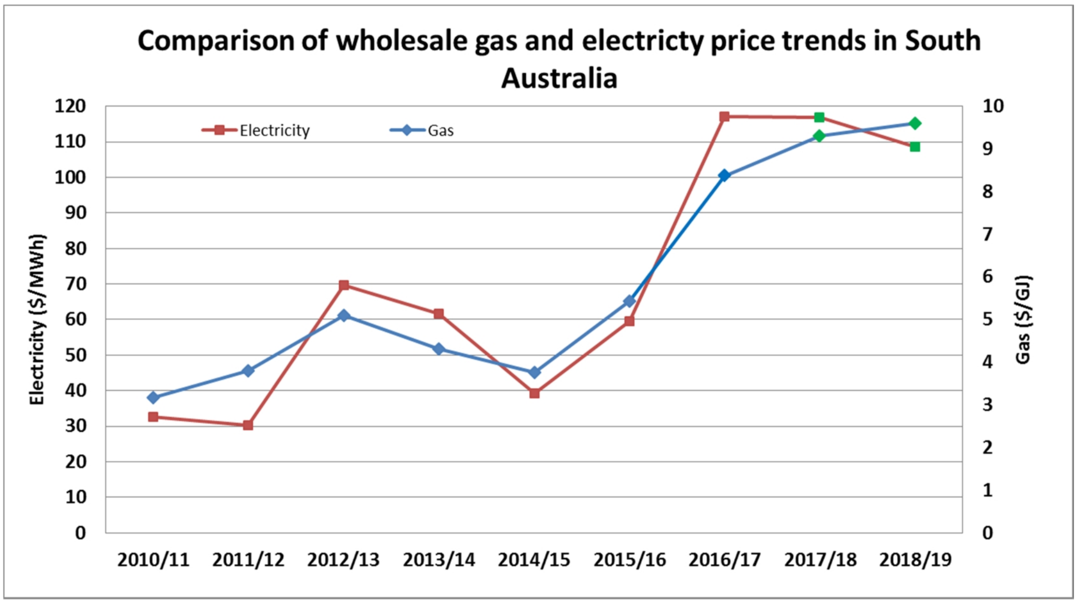
[5] Beyond being able to prevent operation as required for safety reasons.
[6] See: http://fpdi.cleanenergycouncil.org.au/reports/potential-of-embedded-generation.html; http://fpdi.cleanenergycouncil.org.au/reports/value-of-small-scale-generation.html.
[7] Increased gas prices and increased volatility in the wholesale electricity market which is exacerbated by increased gas prices.

exposed to an extreme *price* event (as distinct from *cost*), driven by low fuel diversity and supply in South Australia[8].

Figure 1: Historic and future wholesale gas and power prices in South Australia[9,10,11]



In the absence of a resolution to the combined issues of the gas market and barriers to new generation investment, the challenge for these users is now one of diversifying their energy supply exposure and being able to manage their consumption. Energy from large-scale wind and solar power is now highly competitive with other forms of generation and could provide long-term price certainty for some large users (at least one large user is already investing in solar generation assets[12]).

[Recommend: the Panel should look to address barriers for large commercial and industrial customers accessing renewable energy PPAs. Northern American markets provide a good example of how renewable energy PPAs can work for large customers[13] although uptake has been very slow in the Australian context. Mechanisms applied in overseas markets should be considered and encouraged in the domestic setting.]

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8 CEC, The rise of renewables in South Australia, Briefing paper 1: Current state of play, July 2016.
9 AEMO, Average annual wholesale price data, February 2016.
10 Department of Industry & Bureau of Resources and Energy Economics, Eastern Australian Domestic Gas Market Study, January 2014, page 74.
11 http://www.asx.com.au/asx/markets/futuresPriceList.do?code=BS&type=FUTURE
12 http://reneweconomy.com.au/sun-metals-goes-bigger-solar-plant-hedge-energy-costs-21064/
13 https://www.ft.com/content/e230d280-15e2-11e6-b197-a4af20d5575e

4 The low emissions economy

Following ratification of the Paris Treaty, the Australian Government has committed to a 26-28% emissions reduction by 2030. The electricity industry emits a third of Australia's emissions, consistent with the trend of electricity production being the largest global source of emissions[14]. It is our view that the electricity sector should play a larger role in meeting Australia's emissions reductions commitments.

The Paris Treaty means significant changes to Australia's energy supply will be necessary. These changes can be accelerated by clear and decisive action and appropriate policy mechanisms. As electricity generation is the single largest emitting industry, it is likely that the emission reduction 'wins' come more easily from this sector, so it will be expected to do more of the heavy lifting to achieve the 2030 targets. However, investors require clear policy settings to provide confidence in long-lived electricity infrastructure investments. This requires a clear policy path for the electricity sector to achieve deep emissions reductions beyond 2020.

Electricity generation investors are setting the direction

The electricity market requires constant private sector investment to ensure sufficient supply to meet demand. As with any other investments, these rely on visible price signals and seek to reduce risk. There are currently three distinct options for generation investment in the NEM, namely coal, gas or renewables:

1) Investment in coal generation faces significant uncertainty about future returns and potential climate risks on these long-lived assets[15]. Energy sector investors are aware that any meaningful emissions abatement effort in line with the Paris Treaty would require any new coal plant to include carbon capture and storage. This presents significant technological uncertainty and risk. Investments in these technologies are unlikely to come from the private sector.
2) The face of the gas market has permanently changed. Investment in gas generation is challenging due to Australia's major investment in export capability and significant concerns about the gas market[16]. Although major increases in gas prices have been

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[14] Climate Council, Ageing Inefficient and Unprepared, June 2014.

[15] Of note is the Australian Prudential Regulatory Authority recent decision to require company directors to consider the potential for financial risk created by changes to law or technology.

[16] ACCC, East Coast Gas Inquiry Report, April 2016.

forecast for some time (Figure 1), no policy actions have been taken to address the economic impact of this outcome.

In addition, the massive export capacity and volumes of gas now contracted for export will mean that major new gas resources will be unlikely to separate domestic prices from international prices.

This condition reflects a significant policy failing and means that investments in gas generation faces uncertain long term gas costs, which may not be recoverable from the wholesale electricity market. Further, where the sale of gas contracts in international markets appears more lucrative than burning the fuel to sell electricity, this may leave gas generators underutilised despite strong electricity market price signals (as has already been seen in South Australia).

In summary, investment in gas generation is a very risky proposition. In the absence of a significant intervention in the gas market, investments in gas generation will place upwards pressure on prices and may not lead to a well-utilised generation portfolio.

3) Renewable energy generation is currently the most viable and attractive option for investors. This is because visible signals are present for investment at both a federal and state level. Commitments against the Renewable Energy Target's certificate scheme are providing the only firm setting with which to invest in generation in the NEM. The ability for these assets to shield against both fuel contract risks and future carbon abatement risks make them particularly attractive over other forms of generation.

Given the above, investors are already setting the path for the NEM's future generation mix towards a low emissions economy, which will include significant and growing contributions from renewable energy generation, providing competition in wholesale electricity markets.

[Recommendation: the Panel should focus on increasing the diversity of renewable energy generation sources to hedge against increasing gas prices while creating a more flexible market that encourages new energy technologies of all scales to play a supporting role.]

Planning for a low-emissions sector

It is clear that if the electricity sector is to play a role in emissions reduction, Australia will need to design and gradually implement a zero-emission electricity sector in decades to come. Australia is well-placed with a natural competitive advantage in renewable energy resources and deployment opportunities to achieve this. It is the CEC's view that after achieving the Paris Treaty commitments in 2030, a new set of targets will need to be established that will require the electricity market to transition to a zero-emissions system by 2050. This should be planned for over the coming decade.

This will require careful planning and reform of the energy market to ensure an energy system that can facilitate much higher levels of renewable energy and energy storage. However, a well-planned transition must account for the expectation that there will be points in time when regions of the NEM will be operating on a zero-emissions basis (some regions of the NEM are getting close already).

International experience and engineering capability suggests that this is entirely feasible. However, careful planning and reform of the Australian energy market will be crucial to facilitate this and ensure a robust energy system that can deliver on this capability.

[Recommend: Australia has an opportunity to lead the world in enabling the transition to a zero-emissions electricity system while tapping into its natural competitive advantage in renewable energy. The Panel should recognise that this capability will bring a significant opportunity for Australian skills and technologies that will be demanded by other economies in years to come and that the role of ARENA and the CEFC is essential in enabling this long term national economic benefit.]

Mechanisms to plan for zero-emissions capability in the electricity sector

The reforms that are necessary to get there are complex. They must be carefully considered and planned in order to deliver the desired outcomes by providing both investment and divestment signals. Failing to develop the policy framework and design the market for any major transition will limit the efficiency of the transition and ultimately impede longer term success. The effective transition of the Australian electricity sector towards a zero-emissions sector can be delivered through:

4) A transparent and structured phase-out of Australia's most carbon intensive electricity generation;
5) The accelerated deployment and development of proven and emerging renewable energy technologies, and;
6) Greater energy productivity, delivered through improved energy efficiency, energy conservation, smarter use of electricity and implementation of supporting technologies.

Investors in electricity generation assets require a clear and consistent emissions abatement policy that delivers against the Paris Treaty, in order to develop economic models from which to allocate scarce resources. This requires a transparent mechanism to reduce emissions across the sector, and contribute to delivering on the first two transition goals noted above (i.e. push out high emission plants, while pulling in new low and zero emission technologies).

While an Emissions Intensity Scheme (EIS) or similar may deliver on the first 'push' goal, this may not fully deliver on the second 'pull' goal because the investment in new generation may not appear ahead of the closure of old generation. It places significant reliance on a

wholesale market price that will pull in new low and zero emissions generation technologies. The misalignment of timeframes between generator closure (e.g. 6-12 months from announcement) and generator investment (e.g. 2-5 years to commissioning) will likely result in major short-term dislocation of supply and demand that will in turn have ramifications for the Australian economy.

A further concern arises from the fact that around 70% of the NEM's coal generation capacity is now operating beyond its design life[17]. This indicates that there is a danger of a fairly rapid closure of multiple generators and a large capacity, further compounding the risk of price shock.

Such outcomes could prove dangerous to the emissions abatement cause, given the heavy politicisation of this issue. This outcome can only be avoided through a mechanism that pulls low and zero-emission generation into the market ahead of major generator closures. An emissions abatement focus may not be the most efficient solution alone and therefore some form of effective 'pull' policy mechanism may also be required to bring new generation online in a planned manner.

While policy and political instability and change has created some challenges, the Renewable Energy Target has thus far successfully achieved the investment in new renewable energy technologies at a competitive cost to electricity consumers. Some form of policy measure to drive the appropriate level of new investment beyond 2020 may be required to ensure electricity customers are not exposed to price shocks as generator closure tightens supply.

[Recommendation: In order to successfully deliver a planned transition, and avoid significant price impacts on electricity customers, any emissions abatement mechanisms should be coupled with a targeted scheme that brings new investment in zero-emissions generation.]

The current National Electricity Objective allows institutions to work on a basis of comparing cost with other technical and safety objectives. However, it does not allow them to plan for changing market conditions when the conditions are driven by environmental goals. Our experience is that these environmental goals are ignored and considered 'externalities', even when they are anticipated to have a significant impact on the electricity market or the delivery of system security, for which these institutions are accountable.

The energy market's institutions must be provided with a clear directive that enables them to plan and structure the market accordingly. Failing to work within the market's institutional frameworks to deliver this outcome will fail to meet the trilemma in the long term interests of consumers. Section 8 provides a comparison of overseas markets and the NEM along with a recommendation in relation to the National Electricity Objective.

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[17] Nelson, T., et al. Energy-only markets and renewable energy targets: complementary policy or policy collision?, August 2014, page 15.

5 Integration of Variable Renewable Electricity (VRE)

The CEC and its members have been examining this space for some time. We welcome the opportunity to provide a summary of the issues identified by the renewable energy sector around the integration of VRE into the NEM.

There are some points to be made about the discussion around inertia and system security. Firstly, we raise some concerns about the Panel's framing of their discussion on declining inertia being related to the Black System event in South Australia on 28 September 2016. While the performance of particular generators should be questioned, there is no clear relationship between the inertia of the South Australian grid and the events on the day. There is also no evidence that a higher inertial response would have managed the events given the extreme nature of the forces at play.

Secondly, the context of this review is an energy market which only has a 5.4% contribution from new entrant wind and solar generators[18]. While it is important to ensure that these new technologies are properly integrated with the market, the Panel should be sure to also examine the other 94.6% of the generation fleet and their impact on energy security, now and into the future.

Non-synchronous (semi-scheduled) generator participation in FCAS

There is a role for non-synchronous generation to complement FCAS market operations. Modern semi-scheduled renewable generators can be equipped to participate in FCAS markets (by using blade pitch, in the case of wind farms, power converters or similar fast-acting control schemes to either reserve some operating headroom to lift frequency or reduce output to lower frequency). However, until recently FCAS prices have remained historically low while the FCAS market has presented significant information transparency challenges and implementation approaches which do not reflect actual performance. These factors have deterred participation by new entrant semi-scheduled renewable generators, while recent high price events in South Australia appear to be transient in nature and dependent on the reclassification of the Heywood Interconnector as a credible contingency by AEMO. Although there have been a high number of events due to transmission works in Victoria, these are expected to decline in frequency and have not overcome the other entry challenges (set out below).

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[18] Preliminary Report, Figure 3.1.

New entrants to the FCAS markets currently face challenges which inhibit them from participating. For instance, while prices have been high in South Australia, this appears to be related to competition issues. If anything these high FCAS price events over the last 12 months or so have demonstrated that the scale of available capability is not relevant when the market is limited to a few participants[19]. This situation, coupled with the historically low value attributed to FCAS, makes investment unattractive for a new entrant when compared to the energy that could be delivered into the wholesale market.

Additionally, retrofitting frequency control capability to existing wind farms is an expensive exercise (requiring significant control system and software upgrades, if the turbines are capable of providing this service within their manufacturer's operating specifications). Given uncertainty about the market opportunities, uncertainty about high prices coinciding with wind availability, ownership structures of wind farms and thermal generators, commercial arrangements that may have committed their entire generation output and historically low FCAS prices, investment in this capability for existing wind farms is unlikely to come forward.

The CEC also highlights that the FCAS market is plagued with a range of other issues including:

- A 'causer pays' regime which is not reflective of actual wind farm performance. Even if the generator is not operating it would be subject to causer pays penalties, despite clearly making no contribution to FCAS requirements at that point in time (currently under review by AEMO[20] and discussed below).
- Errors in the wind forecasting system that have penalised wind farms[21] (currently a matter under dispute between wind generator market participants and AEMO).
- A highly complex Market Ancillary Services Specification that was specifically designed for thermal generation, rather than asynchronous generation (currently under review by AEMO[22]) and;
- FCAS market participation barriers created by a linkage between retailers and ancillary services (AEMC rule change is complete and commences in July 2017[23]).

It should be noted that AEMO's wind and solar energy forecasting systems have been integrated with the NEM's generator dispatch system (NEMDE) in a way which has

[19] See numerous AER investigations into high FCAS prices in South Australia: https://www.aer.gov.au/site-search/fcas%20prices

[20] https://www.aemo.com.au/Stakeholder-Consultation/Consultations/Causer-Pays-Procedure-Consultation---Factors-For-Asynchronous-Operation

[21] AEMO, Scheduling Error Report: AWEFS unconstrained intermittent generation forecast (UIGF) scheduling errors – 2012 to 2016, February 2016.

[22] https://www.aemo.com.au/Stakeholder-Consultation/Consultations/Amendment-Of-The-Market-Ancillary-Service-Specification

[23] http://www.aemc.gov.au/getattachment/68cb8114-113d-4d96-91dc-5cb4b0f9e0ae/Final-determination.aspx

prevented semi-scheduled generators from providing information on plant operating capability in the dispatch timeframe. This information is critical to enabling these generators to participate in FCAS and this issue is currently being resolved by AEMO[24].

Many of these issues are under review by AEMO and the AEMC and once revised and implemented will enhance competition in ancillary services across the NEM. However, the Panel should not be surprised that these extensive challenges have deterred participation in FCAS by semi-scheduled generators, especially given they may not make an adequate return.

Following sections demonstrate the need for, and set out a recommendation for a fundamental reconsideration of the FCAS regime.

Accurate renewable energy forecasting can play a better role in system management

There are immediate actions which can be taken to support system management. At present, AEMO uses a wind energy forecasting system for system planning (STPASA) and dispatch of wind farms called the Australian Wind Energy Forecasting System (AWEFS). This scheme was developed with little knowledge of the integration of wind generation into the Australian electricity markets. It is most appropriate for long range forecasting, up to 7 days ahead.

However, the AWEFS scheme provides input for short term forecasting in the 5 minute dispatch timeframe, despite not being designed for this purpose. Over the past 6 years, a number of discrepancies and errors have been identified which have incurred significant losses to wind farm generators[25]. The modelled generation outputs from AWEFS (which is where these errors had been originating) are inputted into the dispatch engine, which then calculates the remaining scheduled generation requirements and dispatches accordingly. Disparities between actual wind generation and that modelled by AWEFS appear as an error in generator dispatch volumes, which can then increase the requirements for regulation frequency control ancillary services (FCAS).

The FCAS causer-pays regime works on the basis of comparing the AWEFS 5 minute (dispatch) forecast generation against the actual generation for each wind farm in the dispatch timeframe. Basically, this scheme expects wind farms to adhere to the modelled generation from AWEFS on a 5-minute basis. The inaccuracies in the modelled generation result in significantly overstated FCAS ‘causer pays’ costs are imposed onto wind farms.

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[24] AEMO, Wind and solar energy conversion model guidelines consultation: Final Report and Recommendation, December 2016.

[25] AEMO, Scheduling Error Report: AWEFS unconstrained intermittent generation forecast (UIGF) scheduling errors – 2012 to 2016, February 2016.

AEMO has already been working to address some of these issues and the CEC supports efforts to improve the integration of renewable energy with accurate and fit-for-purpose forecasting systems. The increasingly important role that wind and solar will play in the energy market implies that small flaws in the forecasting schemes will become significant issues over time.

[Recommend: a comprehensive review of wind and solar energy forecasting is undertaken with an aim to benchmark the NEM's arrangements against international best practice and produce a scheme that is fit-for-purpose in the context of the NEM's dispatch scheme.]

The role of aggregators in energy and ancillary services

The role of aggregators is important for understanding the potential small generators provide to enhance system security, and the barriers they currently face. Significant advancements have been made with the completion of rule changes that allow[26] and reduce barriers to[27] participation in the energy and ancillary services markets by small generator aggregators. Aggregators are the fastest and most feasible means for large volumes of DER to participate in the energy and ancillary services markets. The role they play will become increasingly important from an energy integration of new technologies perspective. Business models[28] already exist to provide this function with a reliance on 'behind the meter' DER and internet-based communications. Regulation is slowly catching up.

Aggregators also offer an enhanced ability to control and forecast generation and demand that will assist in the management of power system security.

[Recommendation: Given the importance of aggregators and recent changes to enable their growth, a clear program should look to track the development of this segment to gain an understanding of any barriers to continued development that may emerge.]

Capability of VRE and energy storage to provide ancillary services to the power system

Non-synchronous generation has the capability to support power system security. Currently, the market design does not call on non-synchronous forms of generation to provide ancillary services to support power system security beyond the generator performance standards negotiated with AEMO and the local NSP at the time of connection. This should not be considered a reflection of the incapacity of new technologies to provide these services.

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[26] AEMC, Small Generator Aggregator Rule Change: Final determination, November 2012.
[27] AEMC, Demand response and ancillary services unbundling rule change: Final determination, November 2016.
[28] See Reposit Power and GreenSync business models.

Wind generation

Wind turbines are able to provide inertia to the system. Wind turbines are frequently cited as being 'decoupled' from the grid frequency, and therefore not able to provide inertia to the system. This is misleading. Modern wind turbine generators incorporate highly sophisticated electronics and control systems that are capable of transferring their inertia to the system, assisting in arresting changes in frequency when triggered by a system disturbance.

To achieve this, the wind turbine generator can draw upon the kinetic energy stored in the generator and rotating blades to provide a boost of power once the fault is detected, and this higher output can be sustained for a short period. The power injection acts to arrest the change in frequency following a disturbance and the precise response can be shaped to suit the local grid requirements[29]. Figure 2 shows how this response works conceptually at the generator level.

Quebec has been paving the way with wind turbines to provide this capability. Although wind penetration in the Canadian province is below that of South Australia, Quebec established a standard that demanded an 'inertial' response from wind turbines in 2006. The first of these systems were installed in 2011 and were tested when a major transformer failure led to the loss of 1600 MW of generation. In this instance, the response from the fleet of wind turbines was as expected and comparative to the synchronous generators online at the time[30].

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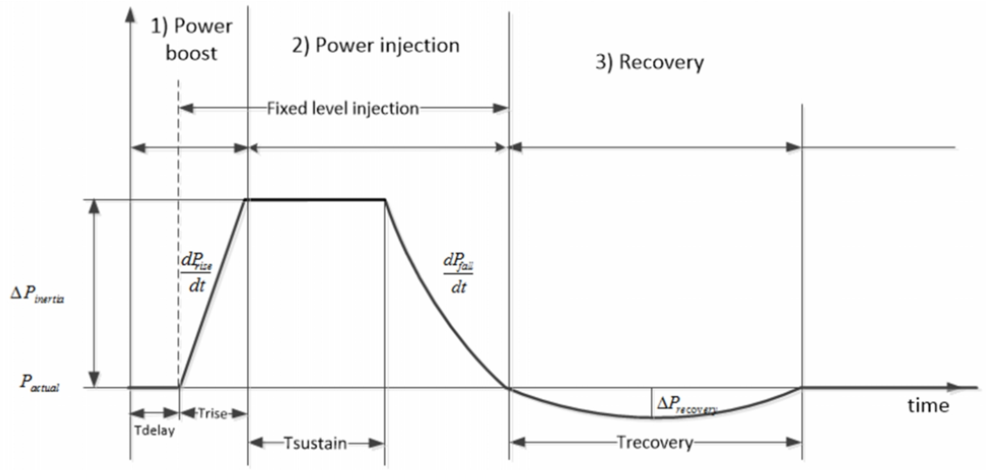
[29] Miller, N., Pagic, S., Diverse Fast Frequency Response Services in Systems with Declining Synchronous Inertia, 15th International workshop on Large-Scale Integration of Wind Power, November 2016.

[30] P. Fairley, IEEE Spectrum, Can synthetic inertia from wind turbines stabilise grids?, November 2016, accessed at http://spectrum.ieee.org/energywise/energy/renewables/can-synthetic-inertia-stabilize-power-grids.

Figure 2: Conceptual fast frequency response from a wind turbine[31].



T_{delay}: Adjustable initial delay.
T_{rise}: The time it takes to reach the needed boost level. The rate of power change is adjustable.
$T_{sustain}$: Adjustable maximum boosting time.

One of the challenges faced with this approach is that drawing power from the rotating blades slows their rotation, leading to a recovery period of reduced power output after the fault. The recovery period can depend on how fast the blades are rotating before the event.

All generation technologies have to recover after a major disturbance in the system. The grid operator in Quebec is working towards improving its technical standards to better manage operation during this period. Wind turbine suppliers are responding with even more sophisticated generator performance solutions[32]. These lessons could easily be translated to the Australian context.

Solar PV generation and storage

Solar PV and storage can also support power system security. Solar PV and energy storage inverters are static devices which have no rotating parts, from which extra energy can be drawn when needed. However, the solid state nature of power inverters provides these systems with an ability to switch and change operation almost instantaneously. Where storage is included or where generation is available, the energy injection is highly controllable.

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[31] Vestas, Wind Power Plant Frequency Control to Support the Penetration of High Levels of Renewable Sources, presentation by Antonio Martinez, March 2016.

[32] Australian Energy Market Operator, International Review of Frequency Control Adaptation, October 2016, page 95-105.

This 'Fast Frequency Response' (FFR) technology works by continuously measuring frequency. Where the rate of change of frequency (RoCoF) exceeds a pre-set limit, these devices can inject or absorb power rapidly in an effort to arrest the frequency change.

Inverter-based or solid state devices can respond to a frequency event very quickly if triggered. As with fast frequency response from wind turbines, the response can be tailored to suit Australian grid conditions. However, technical challenges are present in the measurement of the frequency deviation[33]. On one hand, a fast detection in the order of 100ms is possible and is needed to quickly suppress a frequency change. On the other, detecting the change too quickly may lead to a disproportionate response to a minor disturbance or erroneous triggering.

Although there are no examples of FFR being applied at scale in overseas grids, initial trials and procurement mechanisms have been put in place on some grids to draw this technology into the market. These solutions must form an integral part of the future design of Australian grids. The CEC supports the Panel's recommendations to deploy demonstration projects to gain a better understanding of these technologies in the Australian context.

[Recommendation: the Panel should recommend that AEMO and the AEMC closely track the development and implementation of both fast frequency response capability from both wind turbines and storage systems in the NEM.]

Conventional synchronous technologies have a history of creating technical challenges in the NEM

Risk to grid security should not only be discussed in the context of non-synchronous generation. While the changing nature of generation in the NEM creates new challenges, it is important that the Panel does not lose sight of the fact that the generation fleet is predominately composed of traditional generation technologies. Only 5.4% of the installed capacity is renewable[34]. While the transition to renewable energy is consuming the vast majority of the present focus, system security weaknesses relate to all forms of generation as shown by:

- The unexpected and detrimental performance of major generators in South Australia during synchronous separation events in 2004 and 2005[35];
- The performance of thermal generation during the South Australian separation event on 1 November 2015[36];

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[33] Australian Energy Market Operator, Future Power System Security Program Progress Report, August 2016
[34] Review page 20.
[35] National Electricity Code Administrator, Report into power system incident on 14 March 2005 in South Australia, 2005.

- The well-documented performance of synchronous generation during the black-start process following the 28 September 2016 system black in South Australia, and
- The unexpected outages of two thermal generators in South Australia on 8 February 2017, which led to significant supply constraints, AEMO instructing load shedding to be applied to around 30,000 South Australia customers, followed a control scheme error that shed an additional 60,000 customers unnecessarily.

Incentives for poor frequency control are a design aspect of the NEM

There is an opportunity to improve the design of the FCAS market to improve system security. Significant concerns have been raised about the performance of synchronous generators under varying frequency conditions. It has become apparent that the market's reliance on FCAS has delivered incentives to de-tune the power system's frequency control (both in a contingency-response and steady-state sense)[37], which can be at the expense of system security.

How synchronous generators respond to frequency change

Synchronous generators depend on speed *governors* which control the fuel flow into the generator's prime mover to keep the electrical rotational speed within a designated range. In the case of the NEM, this speed range translates to the nominal 'normal operating frequency band' of 50 Hz (+/- 0.15 Hz). In traditional power system design, governor action is continuously enabled and holds frequency tightly to the nominal standard. However, over time governors in the NEM have pushed the outer bounds of the normal operating frequency band.

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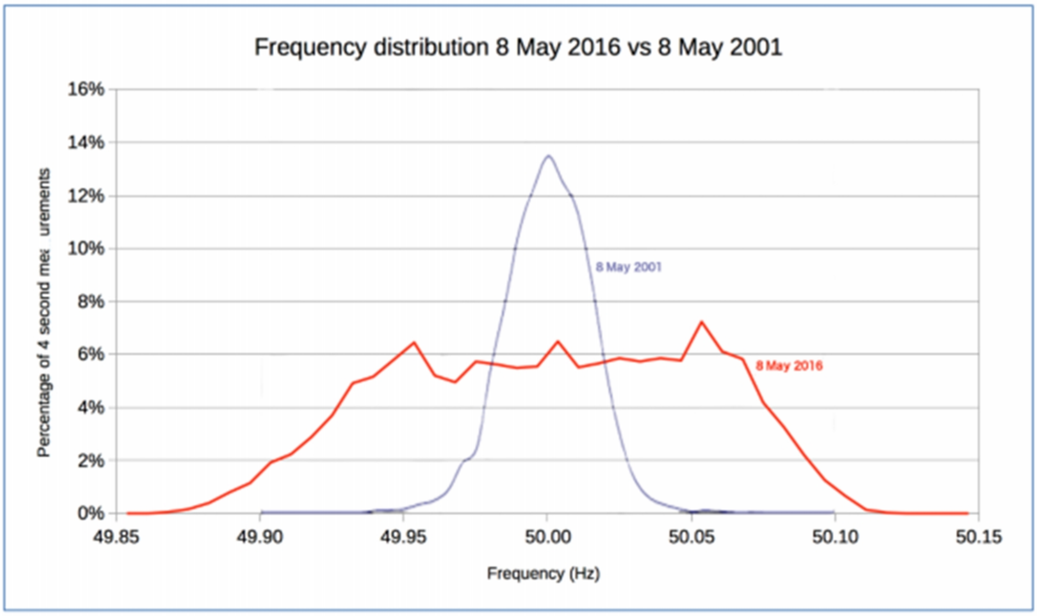
[36] AER, Report into market ancillary service prices above $5000, February 2016, page 8-9.
[37] K. Summers, Fast Frequency Service – Treating the symptom not the cause, February 2017.

Figure 3 – Frequency distributions for the NEM in 2001 vs 2016[38].



As prescribed by the National Electricity Rules' related Automatic Access Standard, the range at which governors are set to respond is either side of the normal operating frequency bands[39] of 49.85 to 50.15 Hz. This defines a governor 'deadband' at a minimum of +/- 0.15 Hz in the best case scenario. During normal system operation, only regulation frequency control is in place which relies on slow-acting Automatic Generator Control (AGC), which is activated by the FCAS market in lieu of primary generator governor control. As a result, the frequency tends to wander within this 0.3 Hz range around 50 Hz, rather than lock tightly to the nominal reference[40]. These conditions are also evident in AEMO's reporting on frequency monitoring, as shown in Figure 4, with significant increases in the periods that frequency has been measured outside of the normal operating frequency band.

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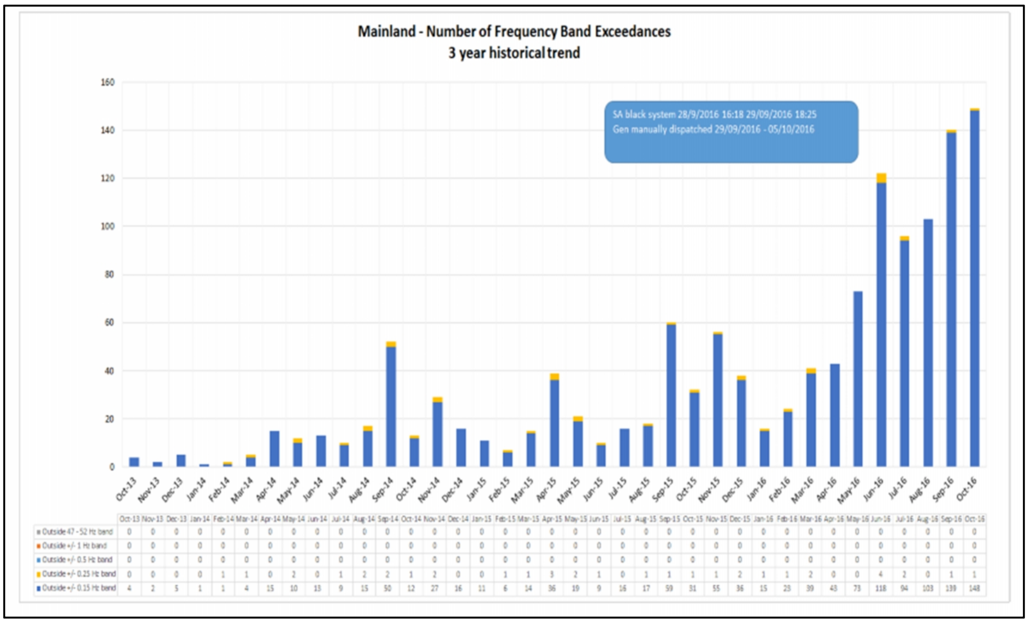
[38] Ibid, page 4.
[39] NER, cl.National Electricity Rules, clause S5.2.5.11.
[40] A broad operating range of frequency around 50 Hz can have an effect on advanced manufacturing processes.

Figure 4 – Number of frequency band exceedances for the mainland between 2013 and 2016[41].



	Oct-13	Nov-13	Dec-13	Jan-14	Feb-14	Mar-14	Apr-14	May-14	Jun-14	Jul-14	Aug-14	Sep-14	Oct-14	Nov-14	Dec-14	Jan-15	Feb-15	Mar-15	Apr-15
Outside 47 - 52 Hz band	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Outside +/- 1 Hz band	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Outside +/- 0.5 Hz band	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Outside +/- 0.25 Hz band	0	0	0	0	1	1	0	2	0	1	2	2	1	2	0	0	1	1	3
Outside +/- 0.15 Hz band	4	2	5	1	1	4	15	10	13	9	15	50	12	27	16	11	6	14	36

	May-15	Jun-15	Jul-15	Aug-15	Sep-15	Oct-15	Nov-15	Dec-15	Jan-16	Feb-16	Mar-16	Apr-16	May-16	Jun-16	Jul-16	Aug-16	Sep-16	Oct-16
Outside 47 - 52 Hz band	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Outside +/- 1 Hz band	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Outside +/- 0.5 Hz band	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Outside +/- 0.25 Hz band	2	1	0	1	1	1	1	2	1	1	2	0	0	4	2	0	1	1
Outside +/- 0.15 Hz band	19	9	16	17	59	31	55	36	15	23	39	43	73	118	94	103	139	148

The impact of these broad deadband settings becomes apparent during a system event, and especially under a higher RoCoF (for example, in situations where inertia is low). While inertia acts to resist changes in frequency, the generator governors are the first 'control' response to arrest and rectify the change. In these situations, the speed of actioning the governor response is critical to a secure power system. Delaying or even disabling governor response risks a system collapse.

Response to high RoCoF events

In the AEMC's Power System Security Market Frameworks Review, the Commission applies a stylised example of a RoCoF of 3 Hz per second hitting the extreme frequency bounds (47 Hz) within one second. Applying the NEM's governor deadbands to this scenario estimates that the generator governors would not respond until at least 50 ms – a significant delay when the system only has one second to arrest a frequency change. Of course, this is a stylised example that ignores the actuating steps within the generator plant (such as generator fuel system and drive train responses which differ across the thermal generator fleet). These actions further delay the time it takes to reaccelerate the generating unit to increase electrical output.

[41] AEMO, Frequency Monitoring – three year historical trends, December 2016, ppage 4.

Indeed, 50 ms is only the point at which the unit controls are triggered. Wide deadbands as are applied in the NEM allow more deceleration, requiring more energy and a longer delay to reaccelerate the generating unit. Under a high RoCoF situation, delays in response due to the physical plant properties compound the challenge of arresting the change in frequency. The power system is placed in an unnecessarily precarious position during such events.

Governor control settings for improved system security

The Panel, AEMC and AEMO are all correct in accepting that inertia is the system's initial response to changes in frequency. However, this response must be supported immediately by the primary control response from generator governors. Other markets have recognised this and generally have very tight governor control settings. For example, the National Energy Regulatory Council (NERC) advises market operators in North America to ensure that deadband do not exceed +/- 0.036 Hz, which is applied in the PJM market[42], ERCOT requires a maximum deadband of between +/- 0.017 Hz and +/- 0.036 Hz depending on generator types[43], and EirGrid applies a mandatory deadband within +/- 0.015 Hz in Ireland[44] as does the United Kingdom[45].

Revisiting the previous stylised example and applying settings in line with other jurisdictions finds that a governor control response would be elicited *within* 5-12 ms (as compared to the NEM's response *after* 50 ms). In other words, a change in governor control settings could achieve a significant improvement in performance under high RoCoF conditions at a time when every millisecond counts.

Comparing these international grid codes to the NEM's specifications (i.e. a *maximum* range of +/- 0.015 to +/- 0.036 Hz as compared to a *minimum* range of +/- 0.15 Hz) is alarming and should bring this issue into question given they vary up to a factor of 10. Prior to the creation of the FCAS market, the market rules restricted governor deadbands to a tighter *maximum* of +/- 0.05 Hz (or 49.95 to 50.05 Hz)[46] which is more consistent with international practices.

The outcomes and efficiency of current market frameworks should be questioned

Given the above, it appears that the likelihood for increased extreme frequency events is in fact a design aspect of the NEM. While the National Electricity Rules expects wide deadband settings, these settings are then reinforced by the FCAS market which penalises generators that act to provide tight frequency control.

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[42] PJM, Manual 14D: Generator Operational Requirements, cl. 7.1.1, January 2017.
[43] ERCOT, Nodal Operating Guides, cl. 2.2.7(3), June 2014.
[44] EirGrid, Grid C ode v6, cl. OC4.3.4.1.2, July 2015.
[45] National Grid, Guidance Notes – Synchronous Generating Units, September 2012, page 14.
[46] NECA, Review of Market Ancillary Services – Final Report, June 2004.

In the international context the NEM is an outlier in its very high dependence on synchronous inertia by design. The approach here overlooks what are considered necessary control practices in overseas markets where primary governor response is recognised in other markets as being the critical factor in resisting frequency changes and needs to come online rapidly to do so[47], especially in an environment of decreasing inertia.

Importantly, this aspect of the NEM's design has inflated the perception that there is a shortfall in inertia. While decreasing inertia is a factor as non-synchronous generators increase in the energy mix and thermal generators withdraw, a finely tuned power system is likely to place far less emphasis on these concerns. The premise that current market frameworks are delivering efficient or even appropriate outcomes should be brought into question. The long term interests of consumers would be best met through the more appropriate use of the power system's existing assets.

The slow acting nature of frequency control in the NEM leads to inefficient outcomes for customers because more service is needed due to slow governor and physical plant responses. FCAS causer pays arrangements incentivise poor frequency control, where efficient power system operation requires a scheme that rewards good, fast-acting frequency control responses.

The FCAS regime requires fundamental reconsideration to resolve this issue prior to moving forwards. A major consideration of such a review will have to be the long term resilience created by utilising a wide range of technologies to provide frequency control responses (including wind turbines, energy storage or other inverter-based renewables). However, should they remain unaddressed the current regime's incentives for poor control capability will continue to be translated into frameworks that encourage new technologies. A redesigned FCAS market or mechanism should look to remove incentives for poor control, and create arrangements that reward fast-acting responses from a diverse range of technologies.

[Recommend: a major review of the NEM's frequency response market in light of its performance under frequency excursions in contrast to international markets. The review should be targeted at revising the existing regime to remove incentives for poor frequency control while restructuring the regime to deliver non-synchronous fast frequency response in the 1 second timeframe. The review should also consider additional benefits of retaining frequency within a tight range to encourage advanced manufacturing and processes into the Australian economy.]

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[47] Kou, G. et al., IEEE, Primary Frequency Response Adequacy Study on the US Eastern Interconnection Under high-Wind Penetration Conditions, December 2015, IEEE Power and Energy Technology Systems Journal.

System strength is a localised issue that will require localised solutions

A new framework to improve system strength will be complex. Firstly, while system strength has been highlighted by various works as an issue in regards to the changing nature of generation it is not clearly an issue influenced by clear causes.

Secondly, an additional consideration is the proliferation of residential and commercial scale solar and storage. Any impact on system strength from this additional generation is not captured in the planning regime or connection requirements.

Thirdly, the locational nature of this issue also makes it challenging to address. For example, while unstable generator operation may be experienced in weaker systems, it may only be the performance of those local generators that is affected. In these instances, issues may be resolved in the development of their performance standards. Even if this is addressed, such standards may not resolve or manage issues that relate to the safe operation of the network's protection equipment.

The CEC's view is that system strength is broadly influenced by the changing nature of generation, consumption and consumer expectations. The safe operation of network protection equipment is the primary driver for adequate system strength. This matter is best addressed through transmission planning processes and direct procurement by Transmission Network Service Providers with the costs borne by consumers broadly through transmission charges.

[Recommendation: Transmission planning should be amended to make consideration for solutions that address system strength concerns in light of a changing generation mix.]

Inconsistent and uncoordinated DER connection standards adds cost and impacts system security

There is a role for a new technical framework to ensure consumer choices do not impact affordability and security. Consumers now have unprecedented access to new energy technologies that enable them to manage their energy costs. However, major gaps are present in the interactions between deployment of distributed renewable energy and energy storage technologies[48], local networks and the broader energy market.

DER connections to the grid require defined standards for performance, protection and communications expectations (as applicable) in order to connect efficiently. These standards are disparate and can vary significantly between different Distribution Network Service Providers (DNSPs) with differing advice sometimes coming from different personnel within a

[48] Considered here to be rated between 30 kW and 5 MW.

DNSP. Further, these standards are generally prepared and implemented with little consideration of the system security needs of the broader power system.

The CEC's work in this area has now demonstrated the urgent need and savings in the order of $200 million (NPV over 10 years) can be made by creating a framework within which these standards can be created on a nationally consistent basis with clear obligations on DNSPs and accountability[49]. The major barrier to this framework is the current thresholds for generator registration. AEMO takes a view that it has no role in establishing such standards for generators rated below 5 MW as these generators have a standing exemption from registration with AEMO. Individual DNSPs are then left to create their own standards with no national coordination or lines of accountability.

[Recommendation: Connection processes need to be underpinned by clear and nationally consistent connection standards for generation rated below 5 MW. This should be achieved by:

- *The creation of a framework and associated accountabilities within which to develop nationally consistent grid connection standards for connection of DER. AEMO is the best viable candidate for such an arrangement.*
- *The development of nationally consistent standards for the connection of DER with clear obligations on DNSPs to adhere to these standards, or demonstrate why they cannot adhere to them on every point of departure.]*

Efficient DER integration and consumer choice requires transparent information

A new technical framework to support consumer choices and system security will only be effective if there is sharing of information. The information exchange between DNSPs and DER proponents is insufficient to allow proponents to fully consider and develop technological solutions that can assist the local network and allow these customers to manage their electricity costs. There are a number of reasons why information is key to efficient DER integration. Opportunities to better integrate 'behind the meter' demand management and storage solutions alongside the generator rarely appear because the DNSP does not provide information on the network characteristics and/or limitations to the proponent. Where this information is requested, it can delay or stall the process. Alternatively, where the proponent comes forward with innovative solutions or new technologies, the DNSP may not be familiar with these and reject them without consideration. As a result, proponents simply consider innovative solutions to be too hard or risky and avoid going beyond the simple solutions. Innovation is stifled as a result.

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49 http://fpdi.cleanenergycouncil.org.au/reports/grid-connection-standards-scoping-study.html.

This issue will become increasingly critical where small and medium scale generators and storage systems are providing system security or energy services to the broader energy market (through aggregators or otherwise). The current approach would introduce inefficiencies and may even create barriers to entry by efficient competitors for ancillary services.

Connection processes must be supported by increased access to information that clearly sets out the limitations of the local network at the connection point. This information must be sufficient to afford proponents with the opportunity to design and implement innovative solutions that fit into and maximise the utilisation of and support the local network. To achieve this outcome, the connection process needs to be underpinned by information transparency obligations that can enable consumers and their advisors to develop appropriate innovative solutions.

[Recommendation: In addition to nationally consistent connection standards clear information transparency obligations and information provision timeframes must be placed on Distribution Network Service Providers to ensure that customers and their expert advisors have the ability to innovate to maximise the efficiency of their investments and the utilisation of the local distribution network.]

6 Market designs that support security and reliability

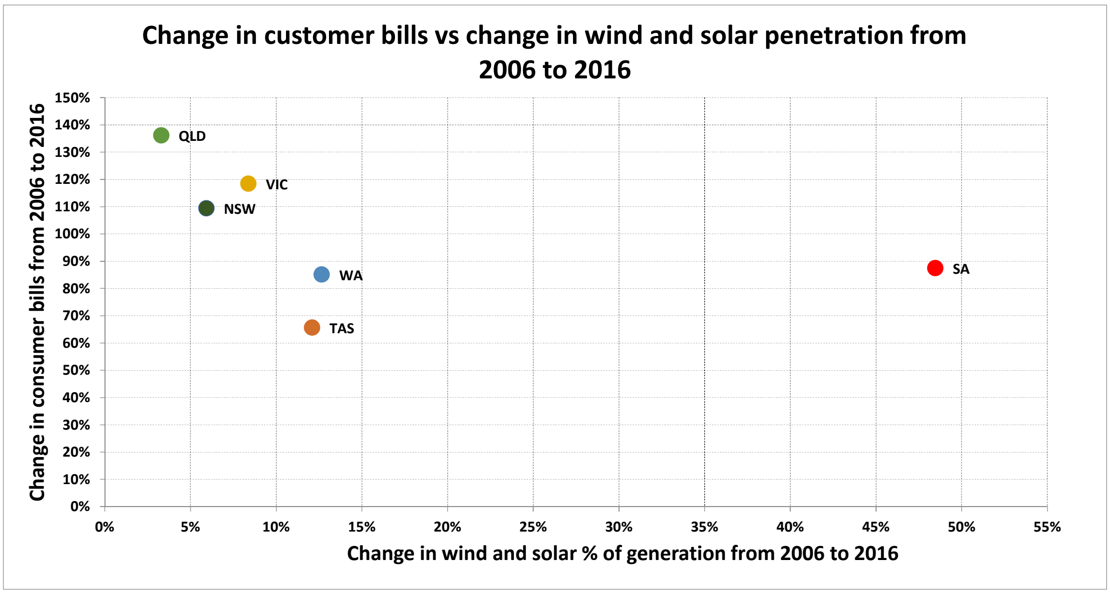
Significant forces are currently influencing electricity prices. Increased gas costs across the gas market and increased wholesale electricity market volatility is leading retailers to increase prices. Additionally, the lack of any coherent long term emissions abatement policies creates additional risk for investors. These elements all place upwards pressure on electricity prices on both the spot and futures markets.

Given the above, caution should be taken in accepting the tendency to look to renewable energy as the driving force for price increases. There is a long history of analysis showing that increasing renewable energy reduces wholesale prices in a market that predominately prices energy at the short run marginal cost of supply. In addition renewable energy should not be blamed for a tendency for generation from other fuel sources to recover their operating costs during periods of low renewable generation (as was seen in South Australia during the middle of 2016[50]).

[50] Melbourne Energy Institute, Winds of Change: An analysis of recent changes in the South Australian Electricity Market, August 2016, page 29.

The increasing attention to the perception that renewable energy penetration leads to increases in prices for consumers is misguided. Figure 5 was derived from the CEC's database on renewable generation and a recent report released by the Australian National University[51] (commissioned by News Corp Australia), and shows that the largest price increases have occurred in those states where wind and solar growth has been the lowest relative to other generation.

Figure 5: 2006–2016 growth in renewable energy penetration as a fraction of generation vs growth in consumer power prices.



The design of the National Electricity Market is intended to encourage continuous, timely and appropriate investment in electricity generation infrastructure. Although the realities of electricity generation are changing permanently, the electricity market must continue to deliver on these outcomes. The CEC sees that it must continue to deliver on the following characteristics:

- Firmness of supply and appropriate financial arrangements that can underpin large industrial consumption needs;
- Market arrangements that support flexible generation or demand responses (such as energy storage of any scale and load switching);

[51] Phillips, B., Household Energy Costs in Australia 2006 to 2016, February 2017.

- Sufficient liquidity in contract markets to enable medium and large customers to efficiently contract supply;
- Alignment between customer expectations of supply and the long-term needs of investors in energy infrastructure.

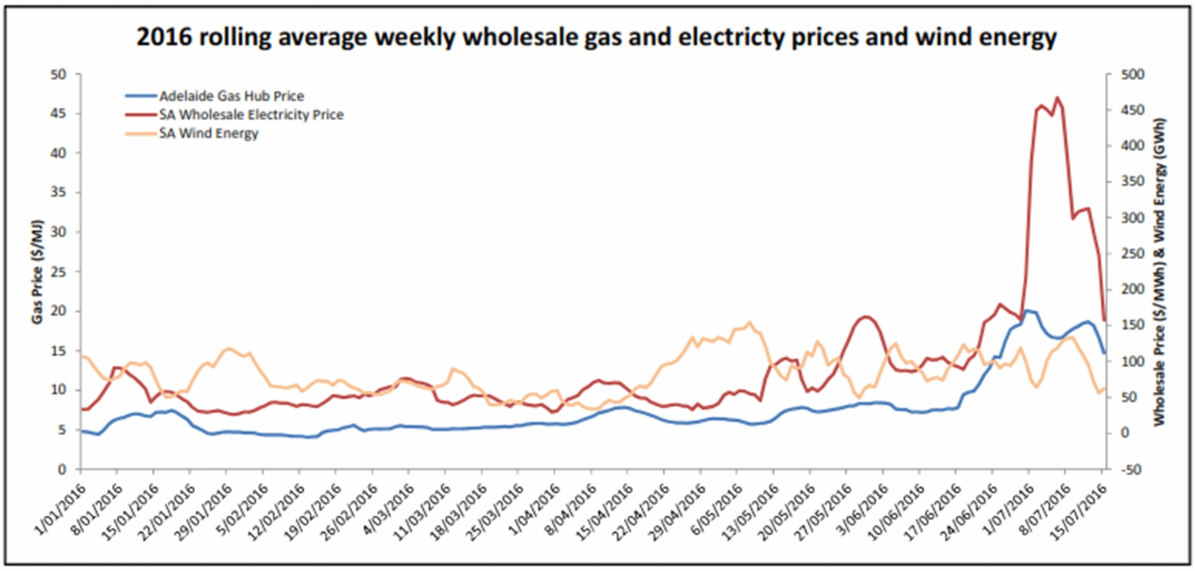
In this context, the CEC highlights the following concerns and opportunities with the current market designs.

The wholesale market is focussed on the supply-side

Historically, wholesale market arrangements have looked to supply, where average price increases were expected to bring new large thermal generation online, and an increasing frequency of short high price spikes were expected to bring new peaking plants online. Such an arrangement was dependent on generators making competitive offers based on their short-run marginal cost.

This largely remains the paradigm today. However, the introduction of zero short-run marginal cost generation has meant that average prices are declining where wind and solar dominate and thermal generators scramble to recover their costs by when wind and solar generation is low (Figure 6).

Figure 6: Interplay between wind generation, wholesale prices and gas prices in South Australia during the first half of 2016.



Should the current market arrangement remain unchanged, these relationships can be expected to strengthen across the NEM as older thermal plants retire. However, in this paradigm, the flexibility of both generation and demand will be key to responding to and managing price volatility. Energy storage can play a significant role here.

Demand-side responses must not be ignored and need to be encouraged. The lack of this capability in the NEM became clearly evident during the heat wave of early February this year. While some demand-side response was implemented, it was with done so on emergency terms and reluctantly through social pressure (via a media campaign). Given an expectation for increasing extreme heatwaves in Australia, the lack of a vibrant demand-side market will be at the detriment of system reliability and potentially security.

In the absence of a coherent mechanism to deliver demand response (which has been rejected by the AEMC[52]), market reforms such as the 5 minute settlement rule change will encourage this flexibility into the market. Although complex to implement and challenging to the existing market construct, the benefits of a more flexible market that would result from the alignment of dispatch and settlement timeframes will be considerable.

[Recommendation: The panel should consider the merits of changing the settlement regime to align settlement and dispatch on a 5 minute timescale. Demand side participation mechanisms in other markets should also be investigated and considered in their application here.]

Financial markets need to adapt to allow customers to invest in renewable energy

One of the main benefits of a vibrant and flexible demand side participation market is the creation of mechanisms that can respond to volatile prices. Either at the large scale with pumped hydro or battery storage (or similar) or at the small scale with distributed battery storage of demand response, these actors will become increasingly important to support a liquid contract market by providing a physical hedge from which retailers can offer firm supply contracts.

Note previous recommendations in relation to large customers.

Essential "ancillary" services must be procured from diverse sources

The CEC has previously demonstrated the urgent need for an overhaul of the FCAS regime to support and deliver the essential services needed to operate a power system from both

[52] AEMC, Demand response mechanism and ancillary services unbundling rule change: Final determination, November 2016.

new and old technologies. This market must begin to encourage fast acting frequency response capabilities in order to bring new technologies into the mix. Current design of the frequency control measures are outdated and need to be brought into line with global standards for grid operation.

The CEC expect that the consideration of new ancillary service markets for services such as inertia and system strength[53] are a natural evolution of a market which cannot rely on the inherent characteristics of older synchronous plants that will increasingly be displaced by non-synchronous generation. Although analysing these changes is a matter for the AEMC's review, there are some specific characteristics that such arrangements must consider:

- As the generation mix changes it becomes less reasonable to expect conventional generators to provide the service, considering that they may not be generating at all times. Indeed, a capability to operate on a zero-emissions basis expects that these services are procured independently of conventional generators.
- Providing inertia services through contracts for synchronous generators or generator dispatch systems will either
    - create opportunities for these generators to exercise market power in the wholesale market, or;
    - distort the efficiency of dispatch, should new rules prevent such generators from setting the wholesale price.
- Conceptually, minimum baselines of inertia will be required to support system security. However, such baselines are dependent on accurate knowledge of the RoCoF withstand capability of generators commissioned prior to 2007. This is currently not available to AEMO[54] and would require a significant testing regime of these generator units to identify this capability (such a process has recently been completed in Ireland). The lack of information on the performance of these generators means they may be unreliable as a source of inertia to support system security[55].
- Inertia and system strength are intrinsically linked, with the former considered a global service and the latter a local service. Both services can be provided by synchronous generators or condensers.

Given these issues, inertia services should be provided through interaction with AEMO and TNSP planning processes. TNSPs should be obliged to procure these services with the costs borne by consumers. AEMO's role should be to ensure that these services are structured accordingly with the right balance between mechanical synchronous inertia and fast frequency response from inverter-based generators or energy storage.

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[53] Note that system strength was discussed earlier.
[54] AEMC, System Security Market Frameworks Review Interim Report, December 2016, page 18.
[55] AEMO, International Review of Frequency Control Adaptation, page 29, October 2016.

[Recommendation: the creation of new obligations in TNSPs to procure inertia services from providers at locations in the network where system strength issues are arising or are expected to arise, while ensuring that AEMO has a role in ensuring that new fast frequency responses are integrated within the frequency response market.]

7 Rising electricity prices and achieving affordability

It is recognised that any market design and energy generation mix must ensure affordability is achieved for consumers. The CEC refers back to the data in Figure 5 to demonstrate that electricity price increases are not specifically linked to renewable energy penetration in any Australian state. Although the CEC does not have a view on the appropriate financial consumer protection mechanisms for governments to deploy, direct actions which support energy efficiency is key. It is recommended that energy efficiency improvement actions be taken immediately to assist consumers.

Beyond this first step, there are clear opportunities for new technologies to improve affordability. The uptake of solar PV and energy storage technologies has the potential to better manage power costs. While these investments are not always immediately viable, there are now solar retailers that can install on a lease basis with no up-front costs, while still making a saving on bills.

[Recommendation: consider mechanisms that enable consumers (such as renters and vulnerable consumers) to access technologies that can reduce and control their consumption through energy efficiency and DER measures. This may include taking measures to ensure that leasing programs are accessible to government and multi-tenancy housing.]

Energy affordability is also relevant for small to medium enterprises (SMEs). Consumption is relatively inelastic for these customers so they need to look towards deploying new technologies behind the meter to better manage their usage. The CEC has undertaken significant work in this area, and finds there are material challenges for SME investments in new DER technologies[56]. While these challenges tend to be commercial in nature there remain significant efficiency gains and opportunities for innovation that can be addressed by creating nationally consistent grid connection standards and clearer information about the local network conditions (as recommended previously).

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[56] Entura, Analysis of Demand-Side Management Opportunities, October 2016.

8 Effective energy market governance

The Preliminary Report pointed out that effective market governance is integral for successfully transitioning towards a clean and resilient energy sector. The CEC notes that although the recent review of energy market governance was completed in October 2015[57], this review was not set in the context of the dramatic technological change underway or expected in the coming decade. It is clear that a whole-of-system view of governance is required to achieve a transition to the Paris Treaty commitments and a zero-emissions capability.

The NEM's governance arrangements of a separation between market operator, rule-maker and regulator is unique, and it can be questioned whether these arrangements are ideal for managing the transition towards an energy system with increased renewable generation. The following section makes a comparison of governance arrangements in the NEM, and indicates some areas which may be an impediment to effective management of a future NEM. An extensive review of governance arrangements in key overseas markets is provided in Appendix 2.

Market objectives

If the electricity market is to contribute to emissions reduction, it must have an incentive or directive to do so. In Section 4, the CEC outlined the need to revisit the NEO due to the inability to plan the transition without alignment between energy and environmental policy objectives. It is anticipated that this alignment will give accountability to market governance bodies to plan for a reduced emissions network.

Reforming the NEO is only one means by which to achieve this alignment. While other markets may not specifically include an environmental or emissions abatement objective, they tend to be complemented by specific legislation or policy goals that achieve this. For example:

- New York States Independent System Operator undertakes strategic integrated transmission planning that considers and informs various emissions abatement, renewable energy and social policies[58];
- an objective of the Electricity Reliability Council of Texas is to facilitate insights into future electricity technologies which implies planning for low and zero emissions technologies[59];

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[57] Vertigan, M., Review of Governance Arrangements for Australian Energy Markets: Final Report, October 2015.

[58] New York State Independent System Operator, 2015-2019 Strategic Plan, 2015.

- amongst others the Irish[60,61] and Texas markets[62] rely on a regulator that sits within a government department and legislative framework that considers both energy and climate change mitigation objectives;
- the Spanish market drives innovation by promoting cost-neutral market reform solutions[63], and;
- European Union member markets tend to draw on European or local legislative frameworks to deliver renewable energy and emissions abatement[64].

The only comparable mechanism in the NEM is the Renewable Energy Target, which sits outside the market's institutions by placing an obligation on a particular segment of market participant (retailers). In relation to the RET no formal obligations rest with the Australian Energy Market Commission or Operator which promotes a bias towards the status-quo in these organisations. The NEO is the obvious means to resolve this, but other mechanisms should also be explored by the Panel.

Incentives on AEMO are not aligned towards technological change

AEMO's role in the NEM is to ensure power system security. This role is guided by the NEO, which focusses on consumers. However, AEMO receives its funding from market participants[65], who can be large market players, due to the prevalence of 'gentailers' in the NEM. While supporting AEMO's activities, these funding arrangements make no provision for adaption or innovation. Further, AEMO's governance arrangements may create a bias toward status-quo rather than innovation and adaption to technological change.

This structure has been found to be unique compared to overseas markets. Although there are cases where equivalent parties are charged fees to support the market operator, these operators have specific objectives to consider and adapt to technological change, or have access to direct project funding from government to explore and adapt to new technologies. These mechanisms are absent in the NEM.

See previous recommendation in Section 2 on positioning the energy market institutions to understand technological change.

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[59] Magness, B. Future Directions for ERCOT, ERCOT Market Summit, March 1, 2016.
[60] IEA, 2012. Energy Policies of IEA Countries: Ireland 2012 Review, International Energy Agency, France.
[61] Department of Communications, Climate Action & Environment, www.dccae.gov.ie/en-ie/about-us/Pages/DCENR - State Bodies.aspx, Accessed February 2017.
[62] ERCOT, Market Rules, www.ercot.com/mktrules, Accessed February 2017
[63] EU European Commission, 2014. EU Energy Markets in 2014, European Commission, Belgium.

[64] EU European Commission, Renewable energy directive, https://ec.europa.eu/energy/en/topics/renewable-energy/renewable-energy-directive, Accessed on February 2017.

[65] AEMO, Board and governance, www.aemo.com.au/About-AEMO/Board-and-governance, Accessed February 2017.

Strategic planning initiatives

It does not appear that innovative forward-planning by the market operator is encouraged in the current NEM framework. Although AEMO has been undertaking strategic planning initiatives, these are reactive in nature and tend to respond to changing influences on the market, rather than strategic long-term planning. AEMO does undertake the long term transmission planning function in the NEM, which tends to react to the implications of policy settings, rather than considering the opportunities available by aligning transmission planning with potential policy options.

The New York State System Operator (NYISO) has a similar organisational arrangement to AEMO, with both organisations being partly governed by market participants. However, the two organisations have different approaches to strategic planning. The New York State Independent System Operators empowered to undertake comprehensive strategic planning on a rolling five year basis against clearly outlined objectives. These processes include advancing technologies, achieving public policy initiatives, undertaking research and development (as supported by legislation), better integrating renewable energy and distributed energy resources[66] and achieving the objectives of the Reforming the Energy Vision initiative[67].

66 New York State Independent System Operator, 2016-2020 Strategic Plan, 2016.

67 New York State Independent System Operator, 2017-2021 Strategic Plan, 2017.

9 Appendix 1 – Responses to the consultation questions

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

There is a need to mandate and empower AEMO and other market institutions with the role to continuously assess and test anticipated new technologies and to ensure that the existing system is aligned to achieving best practice operational outcomes. The CEC believes that similar frameworks applied to overseas jurisdictions should be applied in the NEM.

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

Competitive markets are the most effective means to achieve this outcome.

1.3 What other electricity innovations are you aware of that may impact the market in the future?

There are a wide range of technologies and solutions under development in Australia and globally that can play a significant role in Australia's energy future. Predicting exactly which ones may be technically or commercially more effective is very difficult. There is a clear role for selective financial support for such emerging technologies through bodies such as ARENA or CEFC in order to deliver benefits to customers through the technologies that may prove viable in the future.

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

Customers with new energy technologies are well situated to work with agents (such as aggregators) that may control their generation in order to maximise the value it delivers. Alternatively, customers can opt not to do this, thus fully retaining choice and control. Existing consumer protections are in place to manage these scenarios.

2.2 How do we best meet the needs of vulnerable and hardship consumers?

Schemes that meet this need should avoid duplication of existing welfare arrangements such as Centrelink (for example).

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

Large customers face particular concerns with access to reasonably priced supply contracts a high priority. Futures contract markets are now subject to major gas price increases and this is having a significant impact on the wider economy. The Panel should look to address barriers for large commercial and industrial customers accessing renewable energy PPAs including encouraging mechanisms applied in overseas markets and making information available on the choices available for medium-large customers it manage electricity costs.

2.4 How can price structures be made more equitable when consumers are making different demands on the grid according to their electricity use and their investments behind the meter?

While the introduction of reformed tariffs is required to properly reflect customer demands on the power system and a more equitable outcome for consumers and incentives for investment for DER technologies (notwithstanding the potential for average price rises). However, a major mismatch exists in the appropriate valuation of the benefits provided to the system by behind the meter technologies. Addressing this mismatch by appropriately valuing benefits from DER would also assist in addressing (but not fully resolve) equitability issues.

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

Consumers should be able to readily access data on their consumption where this is available, or nominate a third party service provider to access this data.

3.1 What role should the electricity sector play in meeting Australia's greenhouse gas reduction targets?

While the electricity sector should be looking to achieve a 30-50% reduction of emissions in the electricity sector by 2030 it is critical that reforms recognise that this implies periods of time where regions of the market will be operating on a zero-emissions basis. This capability must be planned for immediately.

The CEC's view is that after meeting the Paris commitments in 2030, a new set of targets will need to be established that will require the electricity market to transition to a zero emissions target by 2050.

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

Gas fired electricity generation currently plays a key role in the Australian energy market. While this generation source was expected to play a crucial role in facilitating the transition of the energy sector, changes in the Australian gas market have presented serious limitations on this role. The panel may consider these substantive policy and market issues that might deliver a greater role for gas generation.

However, the Panel should also focus on increasing the diversity of renewable energy generation sources to hedge against increasing gas prices while creating a more flexible market that encourages new energy technologies of all scales to play a supporting role.

3.3 What are the barriers to investment in the electricity sector?

Policy uncertainty can have a massive impact on investor confidence. For example, following the instigation of the review of the renewable energy target in 2013 investment in renewable energy in Australia fell by 88% in one year[68] and the sector suffered significant job losses.

Across the Australian economy there is now a shared view[69] that the lack of clear commitment on measures to reduce emissions in electricity sector is the largest inhibitor to investment in the sector. Policy uncertainty and major market failures have crippled investment in non-renewable energy generation assets.

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

Investors in generation technologies now require a nationally consistent emissions abatement policy that is at least consistent with the Paris Treaty and are expecting that decisions made in the coming 2-3 years will set the emissions abatement direction for the next 10-30 years. Within this policy framework it is crucial there are policy mechanisms which both signal and manage the closure of Australia's oldest and most carbon intensive generation while also providing investment confidence to deliver new investment in zero emissions generation.

Because a decarbonising electricity sector requires the immediate planning for capability to operate with zero emissions the mechanism must be facilitated through the energy markets institutions with a clear directive that enables them to plan and structure the market accordingly. The National Electricity Objective should be revisited to achieve this.

3.5 What is the role for low emissions coal technologies, such as ultra-supercritical combustion?

An emissions abatement mechanism would be unlikely to consider ultra-supercritical coal (USCC) as playing an active role. In the absence of carbon capture and storage these technologies are only marginally lower emission than the NEM average when black coal is used (brown coal is higher) so would be unlikely to make a difference to emissions abatement efforts. In addition the financing risk associated with investment in coal technologies; long-lived nature of these investments and limited opportunities for black coal in SA and Vic all challenge such investments. Further, USCC is higher cost that wind and solar so would place upwards pressure on prices across the NEM, increasing the cost of any emissions abatement strategy to achieve our Paris commitments.

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?

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[68] Clean Energy Council, Clean Energy Australia 2014, July 2015, page 20.
[69] https://www.cleanenergycouncil.org.au/news/2016/November/joint-statement-on-energy-security.html

See the recommendations set out in Section 4 of this submission.

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

The South Australian region of the NEM is currently subject to constraints that manage security and curtailment of competitive energy sources would increase market power of gas generators in the state. No evidence of the need for curtailment has been provided so such actions are unwarranted. In addition if the NEM has reached a point where this action is required it would reflect a fundamental failing of our market institutions to plan in accordance with an evolving technological landscape. This review should be addressing this fundamental issue, not considering the curtailment of generation without clear evidence to do so.

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

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

The current approach to generator performance standards is adequate to allow negotiations between AEMO the local NSP and generators for new connections. A NEM-wide approach should be taken with a goal to remove any state-based conditions that impose costs for no clear system security benefit. The withdrawal of capacity which may be providing local or global essential services to the grid should be assessed on a case-by-case basis.

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?

Despite the fact that intervening steps to ensure that all market participants contribute to system security by forced participation in markets would indicate a fundamental failing of those markets there are significant failings in the current market designs that must be addressed.

4.4 What role can new technologies located on consumers' premises have in improving energy security and reliability outcomes?

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

In the absence of a coherent and consistent approach to integrating DER with the broader power system, and a lack of responsibility or oversight of these matters by AEMO it is hard to see how these technologies can fully integrate into the power system security frameworks, especially as these technologies will continue to play a larger role in the power system.

The principle of competitive markets should be applied here. The removal of barriers to generator and demand aggregators and aligning market dispatch to settlement will assist in providing appropriate signals for these participants.

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

No comment.

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

Smart grid solutions appear to be a natural evolution of distribution grids. However, investment in networks over the last 5 years has largely focussed on building capacity, which has in turn lead to strong constraints applied by the AER. The deployment of these technologies has been hindered as a response. One area of significant opportunity to be explored is the use of the National Broadband Network for this purpose.

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

No comment.

5.1 Are the reliability settings in the NEM adequate?

The CEC sees no justification for making a change to the reliability settings.

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?

Price volatility needs to be managed by market designs that encourage flexible demand and generator responses from large storage (such as pumped hydro) and from small scale battery storage.

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

While the CEC is not a commercial or industrial customer it is worth noting that renewable energy generators can offer partial hedges against high priced retail contracts and this should be encouraged.

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 forward contract market is exposed to both high fuel costs (especially for gas) and more volatile wholesale prices driven by thermal generators (neither of which is the responsibility

of renewable energy). Large users should be encouraged to mitigate this risk by seeking partial hedges from renewable generators.

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?

Aligning settlement and dispatch to the five minute timeframe will be an important driver to encourage flexible demand, generation and storage into the market which will in turn manage volatility and increase the liquidity of the contracts market.

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?

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?

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

For the reasons described in this submission energy market-based arrangements may not be appropriate to deliver these services. TNSPs should be required to contract for them from service providers in locations that can deliver both inertia and system strength services to ensure power system security and community safety, while building in the capability to operate the market on a zero-emissions basis. AEMO should be involved in these processes to ensure new and emerging technologies are contributing.

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

The face of the gas market has changed. It is not clear that new supply will address the domestic price linkage to international prices.

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

Flexible demand side, DER and energy storage markets are required.

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

Cost reflective price reform is meant to lead to more efficient investment in electricity infrastructure. Such reforms are most effective where customers are able to deploy DER technologies in response to the reforms. Consumers must have access to these technologies and be able to deploy them efficiently.

6.4 How can we ensure that competitive retail markets are working?

6.4.1 What outcomes of competition should we monitor?

No comment.

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

While active, forward-looking planning arrangements might be helpful to enable the transition this is not clearly possible within the COAG-state structure that underpins the NEM. Rather, governments should be encouraged to draw on the planning capability offered by the market's institutions in order to inform their policy choices.

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

Consideration should be made of the New York State model where transmission and system planning is used to inform policy options.

7.1.2 Do the roles of ministers and energy market institutions need further clarification?

This is not clearly of benefit without sufficient changes to the mandates of these institutions.

7.2 What lessons can be drawn from governance and regulation of other markets that would help inform the review?

See Section 8.

7.3 How should the governance of the NEM be structured to ensure transparency, accountability and effective management across the electricity supply chain?

Although the panel should consult on available options to achieve this for the NEM's institutions, the CEC's view is that some elements of AEMO's governance are not aligned to achieving the trilemma. Increased partnerships between the institutions to better understand technological change should also be implemented.

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

In regards to the wholesale market there are likely to be sufficient lagging indicators. However, in relation to the integration of renewable energy these indicators are rarely investigated or explored to understand their performance. The CEC's view is that a number of issues exist that could be addressed to make significant improvements to energy security. These have been set out in this submission.

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

See discussion in Section 8.

7.5.1 Should the AEMA be amended?

The AEMA is not legally binding. Despite already including emissions abatement aims these have not clearly translated into cross-state actions.

7.5.2 Should the NEO be amended?

The NEO is the clearest legal instrument that could deliver on the energy trilemma in light of the long term interests of consumers.

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

There are pros and cons associated with expediting reform. On balance the process is acceptable and should accept that technological change will always be ahead of market reform. However, decision-making processes are not aligned to the objective of transitioning the market to achieve the Paris Treaty commitments by 2030, or to build in zero-emissions capability to achieve longer term emissions abatement objectives, and this leads to risk for investors in electricity infrastructure.

10 Appendix 2 – Review of governance arrangements

10.1 National Electricity Market

Market institutions

As stated in the Preliminary Review, the market and power systems operator is the Australian Energy Market Operator (AEMO). AEMO undertakes additional responsibilities, such as planning the national transmission network, and operating the wholesale gas market and transmission networks in Victoria. The National Electricity Rules are set by the Australian Energy Market Commission (AEMC), who is also responsible for market development. Regulation of the wholesale energy market, transmission and distribution systems, and the retail market is conducted by the Australian Energy Regulator (AER), who is also responsible for enforcing the National Electricity Rules.

Governance structure and funding

AEMO is a membership-based body of 60% Australian government members and 40% industry participant members[70]. AEMO is itself incorporated as a company which does not operate for a profit, and is governed by a Board and CEO. AEMO recoups their operating costs from market participants' fees. The AEMC is governed by a Chair and Commissioners, and is held to account by the COAG Energy Council[71]. The AER is governed by an independent Board of federal and state government representatives, who are appointed by the Governor-General[72].

Objectives of the market institution

AEMO's publicly-stated focus is on the best interests for stakeholders and communities[73]. The AEMC is focused on the strategic development of the energy market for the purpose of providing consumer benefits[74]. It does this by setting the National Electricity Rules and providing advice to relevant market participants and stakeholders. The AER supports the

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[70] AEMO, Board and governance, www.aemo.com.au/About-AEMO/Board-and-governance, Accessed February 2017.

[71] AEMC, Market governance, www.aemc.gov.au/Australias-Energy-Market/Markets-Overview/Market-Governance, Accessed February 2017.

[72] AER, About us, www.aer.gov.au/about-us, Accessed February 2017.

[73] AEMO, Our vision, mission and values, www.aemo.com.au/About-AEMO/Our-vision-mission-and-values, Accessed February 2017.

[74] AEMC, Market governance, www.aemc.gov.au/Australias-Energy-Market/Markets-Overview/Market-Governance, Accessed February 2017.

COAG Energy Council and the Australian Competition and Consumer Commission, and works with the AEMO and AEMC[75].

Market directive

The National Electricity Rules govern the operation and regulation of the NEM, and the AEMC are required to operate with reference to the National Electricity Objective:

> *"to promote efficient investment in, and efficient operation and use of, electricity services for the long term interests of consumers of electricity with respect to – price, quality, safety, reliability, and security of supply of electricity; and the reliability, safety and security of the national electricity system".*

10.2 International examples

10.2.1 New York State, USA

In New York, the energy rules and regulations are defined by New York energy law, with general regulations contained with the New York Code of Rules and Regulations[76]. As the government of New York State is essentially the rule-maker through their energy law, this drives the development and transition of the energy sector. NYSERDA is the primary public corporation which supports the New York State with technical analysis and expertise, and promotes renewable energy and efficiency[77]. NYERSDA are given responsibilities under the Energy Law to, among other things, assist R&D programs into new energy technology and providing recommendations on how to implement new energy technologies[78]. New York State has a clear strategy for transforming their electricity sector, as exemplified by the REV Program. The New York State market operator (NYISO) has an objective to consider public policy requirements when investing in their transmission networks, such as renewable integration, as outlined in FERC Order 1000[79].

Market institutions

The operation of the electricity grid, wholesale power market and transmission network in New York is the responsibility of the New York Independent System Operator (NYISO). NYISO is also responsible for the technological advancement and long-term planning of the

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[75] AER, About us, www.aer.gov.au/about-us, Accessed February 2017.

[76] US Legal, New York Energy Regulations, https://energylaw.uslegal.com/state-energy-regulations/new-york, Accessed on February 2017

[77] NYSERDA, About NYSERDA, www.nyserda.ny.gov/About, Accessed on February 2017.

[78] NYCRR, Title 21: Miscellaneous, Department of State, Division of Administrative Rules

[79] Makerji R (NYISO), 2014. Planning in a competitive market environment: The New York Story. Harvard Electricity Policy Group 74th Plenery Session, February 27-28 2014, Santa Monica, CA.

power system. The Federal Energy Regulatory Commission (FERC) is an independent regulator, and the primary body which regulates the NYISO and sits within the United States Department of Energy.

Governance structure and funding

NYISO is collectively governed by an Independent Board of Directors and market participants.

In August 2016, NYISO requested an amendment to its financing arrangements from FERC, with the current financing arrangements requiring NYISO to recover 72% of their operating costs from loads and 28% of their operating costs from generators. At times there is a shortfall, when forecasted demand is higher than the actual, and in these situations the NYISO recover the difference from certain non-physical market participants in transmission.

NYISO has received federal funding for specific projects.

Objectives of the market institution

NYISO's 2015 – 2019 Strategic Plan outlined the key objectives for the operator, namely:

- to provide system reliability and a market design which encourages efficiency, customer value and new investment,
- provide transparency and authoritative information to stakeholders on key issues, and
- plan for the future power system in terms of reliability, cost and environmental considerations.

It is also an objective of NYISO to have a strong planning function and implement its Comprehensive System Planning Process (CSPP), which is a tool used to guide investment decisions around expansion of the transmission network and grid infrastructure. As determined by FERC Order 1000, the CSPP must prioritise maintenance of power system reliability and economic needs, as well as consider investments in transmission driven by public policy requirements. Interestingly, the CSPP helps define policy outcomes, as the process allows policymakers to identify and evaluate which proposals best achieve their objectives, which include fuel diversity, renewable integration and environmental policy goals.

One of the key strategic initiatives involving collaboration with NYISO for 2017 – 2021 is the Reforming the Energy Vision (REV) Market & System Integration initiative. The overall REV strategy has a purpose to align New York energy markets and regulations to allow for increased penetration of local power generation and improved reliability incorporating clean energy.

10.2.2 Texas, USA

The Texas Administrative Code (TAC) are the rules for all the state agencies in Texas. The TAC was made by the Texas Legislature, however the Secretary of State does not enforce the TAC[80]. Different state agencies are assigned responsibility for rule-writing and interpretation of the relevant titles within the TAC. Relevant to the energy market in Texas, the PUCT implements legislation and rules under the TAC, which allows for the Electric Service Rules (Chapter 25) to be implemented by PUCT[81]. These are the rules which are relevant to electric service providers. The purpose and scope of the rules focus on service reliability and cost. However, Rule §25.173 defines a Goal for Renewable Energy[82], which requires a certain amount of renewable capacity to be installed over a timeframe. The Texas market operator, ERCOT, is governed by a Board of Directors and market participants[83], yet they are subject to government accountability through the oversight of the state agency, PUCT.

Market institutions

The independent system operator in Texas is the Electric Reliability Council of Texas. ERCOT's primary responsibilities revolve around reliability, market efficiency, open transmission access and consumer choice. ERCOT is subject to jurisdictional oversight from the Texas legislator and Public Utility Commission of Texas (PUCT).

Governance structure and funding

ERCOT is governed by a board of directors.

System administration fees (SAF) are the major source of funds for ERCOT. These fees are paid by electric service providers. The SAF financially covers ERCOT's core functions. The North American Electric Reliability Corporation (NERC) provides reliability services for ERCOT, and charges them accordingly. ERCOT pays for these services from revenue from market participants. ERCOT will also receive revenue from other minor services provided.

Objectives of the market institution

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[80] Texas Secretary of State, Welcome to the Texas Administrative Code, www.sos.state.tx.us/tac/, Accessed February 2017.

[81] Public Utility Commission of Texas, Rules and Laws. www.puc.texas.gov.au/agency/rulesnlaws. Accessed February 2017.

[82] Public Utility Commission of Texas, Electric Substantive Rules – Chapter 25: § 25.173 - Goal for Renewable Energy, www.puc.texas.gov/agency/rulesnlaws/subrules/electric/25.173/25.173ei.aspx

[83] ERCOT, April 2016. Financial statements: Years ended December 31, 2015 and 2014.

ERCOT's publicly-stated vision is to facilitate grid and market development through leadership and insight into future electricity technology, markets and reliability[84].

Market directive

ERCOT have market rules which are developed by electricity industry participants and reviewed by PUCT. The PUCT also have rules under the Texas Administrative Code relevant to the electric sector, specifically the Electric Substantive Rules (Chapter 25). The purpose and scope of PUCT's rules falls within their agenda to regulate electric utilities and support consumer protection, competition and free market operation.

10.3 European countries

Over the last 10 years, neighbouring European countries have begun to couple their markets to trade electricity across national borders. The EU energy market legislation, the Third Energy Package, addressed the functioning of the internal electricity market in the EU[85]. This legislation enabled the establishment of national regulatory authorities for EU member states, and the Agency for the Cooperation of Energy Regulators, which allows the regulatory authorities to work together, with the aim of progressing towards a single, liberalised EU energy market.

10.3.1 Republic of Ireland and Northern Ireland

In Ireland, the Trading and Settlement Code provides the rules for market operation. The scope of the Code covers market efficiency, competition, transparency and consumer interests in price, quality, reliability and security. Responsibility for any amendments to the rules largely lies with the TSC Modifications Committee[86], which is comprised of the market operator, market participants and regulatory authorities. Decisions on TSC Modifications are made by the TSC Modifications Committee and the SEM Committee. The SEM Committee consists of members of the Commission for Energy Regulation (CER - who regulates the market operator), Utility Regulators and independent members, and the CER ultimately sits under the State Agency of the Department of Communications, Climate Action and Environment. The SEM Committee is the ultimate decision-making authority on the SEM. The TSC Code itself does not identify renewable development as a key objective, however the market operator, SEMO, states that the market is intended to deliver both economic and social benefits. Ireland has been seen to make significant public investment in energy R&D

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[84] ERCOT, Vision and mission, www.ercot.com/about/profile/vision

[85] EU European Commission, Market legislation, https://ec.europa.eu/energy/en/topics/markets-and-consumers/market-legislation

[86] SEM Committee, Trading and Settlement Code, https://www.semcommittee.com/trading-and-settlement-code, Accessed February 2017

and clean technology innovation[87]. The policy incentive driving the R&D sector is a definite objective of decarbonisation for societal benefit. Transmission system operators and networks are responding, by increasing investment for a smarter network system.

Market institutions

The Republic of Ireland and Northern Ireland share a single wholesale electricity market, called the Single Electricity Market. The market operator is the Single Electricity Market Operator (SEMO), and is a combined enterprise between the Republic of Ireland's Transmission System Operator (TSO), EirGrid, and Northern Ireland's TSO, SONI. This arrangement is unique in that it is a wholesale pool market which operates across jurisdictions with two currencies. The market is regulated through a combined effort by the Commission for Energy Regulation (CER) and the Utility Regulator (UREG), representing both regional jurisdictions.

Governance structure and funding

EirGrid Group are a state-owned company, which also owns SONI, and is governed by Board of Directors. SEMO covers their OPEX and CAPEX by charging fees and tariffs to market participants[88].

Objectives of the market institution

SEMO states that the market is intended to deliver both economic and social benefits[89].

Market directive

The market rules are provided by the Trading and Settlement Code, which is focused on efficiency, price, quality, reliability and security.

10.3.2 Spain

Spain underwent energy market reform, and approved the Electricity Directive which aligned Spanish law with the EU Third Package directives, while accounting for Spain's particular ability to integrate renewables. The Spanish market operator, OMIE, operates according to Spanish electricity law, which has recently amended to include the EU directives for the internal electricity market, which focuses on integrating national electricity markets based on

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[87] IEA. 2012. Energy Policies of IEA Countries: Ireland 2012 Review.

[88] SEM Committee, 2016. Single Electricity Market Operator (SEMO) Revenue Requirement: Price control commencing 1 October 2016 – Consultation Paper, SEM-16-023.

[89] SEMO, About SEMO. www.sem-o.com/About SEMO/Pages/default.aspx, Accessed February 2017

EU regulations, and building new cross-border transmission. OMIE is a private enterprise[90]. Although working towards an EU goal, regulators remain national. The National Commission of Markets and Competition (CNMC)[91] is the independent market regulator and national regulatory authority for the electricity market. Although the CNMC is independent, it sits under the Ministry of Economy and Competitiveness and it plays a role in evaluating the National Electricity Network Development Plan, which is formulated by the Ministry of Industry, Energy and Tourism.

Market institution

The Spanish electricity market has been combined with the Portuguese market, which has resulted in the creation of the Iberian Electricity Market (Mercado Ibérico de la Electricidad (MIBEL)). The MIBEL has various market operators:

- the spot market is operated by the Spanish arm of the Operator of the Iberian Energy Market (OMIE);
- the futures market operated by the Portuguese arm of the Operator of the Iberian Energy Market (OMIP),
- the Electric Market Operator (OMEL) is the agency responsible for economic management and bidding processes in the market.

The market regulator is the National Commission for Market and Competition (CNMC), who independent of the government, yet subject to parliamentary control. The CNMC has public and private scope, and is its own legal entity. There is only one TSO in Spain, which is privately-owned.

Governance structure and funding

OMIE is a company which belongs to the MIBEL business group, subject to regulation, and co-owned by companies OMIE and OMEL. It is governed by a Chairman and Board.

OMIE shares are equally owned by OMEL and OMIP. OMEL is the Spanish-owned company. OMEL’s capital shares are owned by energy companies and financial institutions, with energy companies only allowed to hold 40% of the total capital stock.

Objectives of the market institution

The company’s publically-stated focus is customer service and shareholder value.

Market directive

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[90] OMIE. www.omiees/en/inicio

[91] IEA, 2015. Energy Policies of IEA Countries: Spain, 2015 Review.

As the electricity market operator, OMIE is regulated by Spain's Electricity Sector Law 24/2013, on the Electricity by Decree 2019/1997, of 26 December, which organises and regulates the electricity generation market. In 2013, Spanish electricity law was amended as part of an electricity market reform package. A new regulatory framework was implemented that stated that "no new costs shall be introduced into the electric power system without an equivalent revenue increase or cost reduction".

10.3.3 Germany

In Germany, EU directives on renewable energy have been implemented into law, and regulated by the Energy Industry Act. Germany is the strongest example of energy market governance encouraging a technological transformation of the energy market, with their energy shift driven by the Energiewende[92], which commits decision-makers to shifts the energy system towards renewable energy and their integration to the grid, new storage and grid technologies and energy efficiency. A specific organisation exists to help achieve the technical and political success of the Energiewende, called Agora Energiewende[93]. As the federal government in Germany is responsible for implemented energy market reform, it supports a strong and well-organised R&D research agenda for implementing new technologies into the market, with multiple departments contributing to the energy research agenda. The government ministry, BMU, is responsible for the market adoption of renewables. Germany does not have a market operator. The two major markets for German market participants to trade in are the European Energy Exchange and the European Power Exchange. Germany is a key player in the pursuit of the Third Energy Package for a single internal electricity market in the EU.

Market institution

The power sector is federally regulated in Germany. Regulation is conducted by the Federal Network Agency (BNetzA) and the Federal Cartel Office (BKartA). BNetzA manages development of the electricity market, and BKartA protects market competition. The two power exchanges in Germany are the European Energy Exchange and EPEX SPOT.

Governance structure

The regulatory agencies chiefly fall under the jurisdiction of the Federal Ministry of Economic Affair and Energy (BMWi).

Objectives of the market institution

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[92] Agora Energiewende, 2015. Report on the German power system, version 1.01, Germany.

[93] Agora Energiewende. https://www.agora-energiewende.de/en/

The federal regulated authorities focus is on maintaining market competition and promoting market liberalisation. In the last 5 years, BNetzA has become responsible for progressing the expansion of high voltage transmission networks.

Market directive

The relevant regulation is the Energy Industry Act. European climate and renewables directives have been implemented into German law, which would include the European Renewable Energy Directive for Germany to provide 18% of the gross final energy consumption by 2020, as well as higher renewable energy targets specified in the German Renewable Energy Act (EEG).