PARLIAMENT OF THE COMMONWEALTH OF AUSTRALIA

Powering our future

Inquiry into modernising Australia's electricity grid

House of Representatives Standing Committee on the Environment and Energy

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Chair's Foreword

Australia is a big country. A big country requires big thinking, big projects and big commitments. This can involve processes that are difficult to negotiate, cumbersome to work through and necessitate listening to a multitude of voices.

The story of the current national electricity grid is part of that narrative. The national electricity grid has been described as one of the largest machines in the world. Based on infrastructure that was built throughout the twentieth century, and with an energy market born out of the micro-economic policy reforms of the 1990s, the grid has seen state authorities cooperate to ensure that a reliable and secure source of energy is available to the residents of the national energy market states and territory—Queensland, New South Wales, Australian Capital Territory, Victoria, South Australia and Tasmania.

However, in recent times it has become increasingly apparent that modernising this essential piece of infrastructure is necessary to future-proof the grid. The reliability of the grid at times of peak demand has become of particular concern. Consumers are also concerned about recent increases to their electricity and gas bills. The challenges posed by Australia's climate change commitments have seen a change to the energy mix, with renewables now more prevalent.

The energy trilemma relates to three issues, being the need to meet Australia's climate change commitments under the Paris Agreement, ensuring the supply of stable energy so that the 'lights don't go out', and mitigating rising electricity costs. Australia is not alone in this work. Every major economy in the world is encountering the same trilemma and working out ways to meet this triple-challenge.

Clearly, modernising the electricity grid is a big project for a big country. And whilst there is a plethora of views on what is the best way forward, this Committee has earnt itself a special place in the discourse due to the consensus nature in

which we have conducted our business. The Committee travelled to all of the national energy market states on the mainland, and wherever we went we were congratulated on the consensus-based approach we were taking to this very important task of reviewing the electricity grid.

Australia is famous for its nation builders—for those amongst us who courageously identify the time for new infrastructure to enable Australia to continue to grow and take advantage of our abundance of natural resources.

In the case of energy policy, increasingly these natural resources are sunshine and wind. The nation building required relates to the grid itself—ensuring that the transmission lines and interconnectors are up to the task of carrying Australia and its electricity needs into the coming decades of the 21st century. The lessons we learn have the potential to be exported around the globe.

This report canvasses these important issues and makes timely recommendations that seek to ensure that Australia is not left behind in the electricity revolution that is occurring all around us.

I thank my fellow members on the Committee for their collegiate diligence in considering the issues raised during the course of the inquiry. The Committee was fortunate in the assistance it received from submission makers and witnesses who provided a strong evidence base which informed our deliberations. I would also like to thank the staff of the secretariat for so ably assisting us in our work.

Andrew Broad MP

Chair

Membership of the Committee

Chair

Mr Andrew Broad MP

Deputy Chair

Mr Pat Conroy MP

Members

Hon Warren Entsch MP

Mr Trevor Evans MP

Mr Luke Howarth MP

Mr Craig Kelly MP

Mr Peter Khalil MP

Ms Anne Stanley MP

Supplementary Member

Mr Adam Bandt MP (from 10/5/17)

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Mr Dylan Raymond (from 15/5/17 to 18/8/17)

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Ms Kathleen Blunden (from 18/7/17)

Ms Sarah Brasser (to 11/8/17)

Terms of reference

The House of Representatives Standing Committee on the Environment and Energy will inquire into and report on the adequacy of the current electricity transmission and distribution networks to support Australia's future needs, giving particular consideration to:

1. the means by which a modern electricity transmission and distribution network can be expected to ensure a secure and sustainable supply of electricity at the lowest possible cost;
2. the current technological, economic, community and regulatory impediments and opportunities to achieving a modern electricity transmission and distribution network across all of Australia, and how these might be addressed and explored; and
3. international experiences and examples of electricity grid modernisation in comparable jurisdictions.

List of abbreviations

AC	Alternating current
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
ARENA	Australian Renewable Energy Agency
CEFC	Clean Energy Finance Corporation
COAG	Council of Australian Governments
DC	Direct current
ESB	Energy Security Board
FCAS	Frequency control ancillary services
HVDC	High-voltage direct current
Hz	Hertz
MW	Megawatt
MWh	Megawatt hour
NEM	National Electricity Market
NEO	National Electricity Objective
PV	Photovoltaic
RET	Renewable Energy Target
RIT-D	Regulatory Investment Test for Distribution
RIT-T	Regulatory Investment Test for Transmission

RO	Reliability option
SWER	Single-wire earth return
tCO_2e	Tonne of carbon-dioxide equivalent
VSC	Voltage source converter

List of recommendations

Recommendation 1

3.142 The Committee affirms the importance of resolving policy uncertainty in relation to emissions reduction in the electricity sector. The Committee commends to the House the establishment of a stable and enduring mechanism for scalable emissions reduction in the electricity sector, with appropriate notice given for changes in targets.

Recommendation 2

3.146 The Committee recommends that the Minister for the Environment and Energy, through the Council of Australian Governments Energy Council, investigate new market, non-market, and regulatory, approaches to maintaining an adequate level of flexible, dispatchable capacity in the National Electricity Market.

Recommendation 3

3.151 The Committee recommends that the Minister for the Environment and Energy, through the Council of Australian Governments Energy Council, investigate new market, non-market, and regulatory approaches to maintaining an adequate level of system security services in the National Electricity Market.

Recommendation 4

3.163 The Committee recommends that the Minister for the Environment and Energy, through the Council of Australian Governments Energy Council, identify and implement changes to improve the responsiveness of the rule-making process in the National Electricity Market.

Recommendation 5

3.168 The Committee recommends that the Minister for the Environment and Energy, through the Council of Australian Governments Energy Council, authorise the Energy Security Board to provide a briefing to the Committee every six months, until otherwise agreed by the relevant committee. The briefings should provide information on the state of the National Electricity Market, progress implementing the recommendations of the Finkel review that have been accepted by the Council of Australian Governments Energy Council, and any other relevant matters.

Recommendation 6

4.65 The Committee recommends that the Minister for the Environment and Energy, through the Council of Australian Governments Energy Council, undertake a review of past and current subsidies and incentive schemes to inform the design of future schemes to ensure they are appropriate for a modern electricity grid.

Recommendation 7

4.66 The Committee recommends that, independent of the Regulatory Investment Test for Transmission (RIT-T) process, the Australian Energy Market Operator be funded to undertake further feasibility studies to ascertain whether:

- additional interconnectors are required on the grid and, if so, where; and
- additional transmission is required in certain areas of the grid, including appropriate planning for renewable energy zones.

The Committee also recommends that the relevant rules, including the RIT-T process, be reviewed to take into account:

- future expansion of the base for generating electricity; and
- emissions reduction in the electricity sector.

Recommendation 8

4.67 The Committee recommends that system security services necessary for grid stability be ascribed a value that encourages investment in those services, with the Australian Energy Market Operator provided with the authority to

take any steps necessary to ensure that there is a sufficient supply of system security services available.

Recommendation 9

4.108 The Committee recommends that the Minister for the Environment and Energy take to the Council of Australian Governments Energy Council a proposal that all of the National Electricity Market states refer reliability regulation to the Australian Energy Market Operator, in keeping with the Victorian approach, and operate under the customer value of reliability model.

Recommendation 10

4.109 The Committee recommends that the Minister for the Environment and Energy audit large scale industrial manufacturing processes to identify short-term and long-term opportunities for demand response and energy efficiency.

The Committee expects that these opportunities will result in possible future revenue streams for industry and may avoid the need for investment in additional generation and transmission capacity.

Recommendation 11

4.110 The Committee recommends that the Minister for the Environment and Energy update resources that promote energy efficiency in small industry and businesses.

Recommendation 12

4.111 The Committee recommends that the Australian Energy Market Commission review any rules preventing users at the edge of the grid from being serviced via alternative means, whilst safeguarding reliability requirements and associated customer protections.

Recommendation 13

4.131 The Committee recommends that the Australian Energy Market Operator work with retailers to ensure bills are dynamic, providing customers with control over how much information they receive in relation to cost and usage.

Recommendation 14

4.132 The Committee recommends that the Australian Energy Market Operator:

- review how grid costs are recovered with a view to improving equity; and
- address how consumer led initiatives are affecting the use of the grid and the potential effects this has on users remaining on the grid who are unable to access these options;

without discouraging the uptake of renewable energy.

Recommendation 15

4.133 The Committee recommends that the Australian Energy Market Operator investigate the benefits of virtual power plants and other trading platforms that may have an effect on demand management and consider how they can be incorporated into the electricity grid to assist with stability.

Recommendation 16

4.160 The Committee recommends that the Minister for the Environment and Energy review the Australian Energy Market Operator's current planning role with a view to incorporating a distribution planning role that enables planning along the National Electricty Market. In the alternative, the Committee recommends the establishment of a new independent planning body for the National Electricity Market.

The Committee also recommends that the Australian Energy Market Operator, utilising its current transmission planning functions, consider the establishment of renewable energy zones.

Recommendation 17

5.26 The Committee recommends that the Australian Energy Market Operator review the mechanisms available to achieve appropriate generation capacity, including capacity markets, greater generation and enhanced planning.

Recommendation 18

5.54 The Committee recommends that the Australian Energy Market Operator consider the appropriateness of a roll out of smart meters to all National

Electricity Market users, ensuring that the costs of installation are borne by the beneficiaries with issues of equity accounted for.

Recommendation 19

5.61 The Committee recommends that the Australian Energy Regulator review concerns about rebidding practices in New South Wales during 2017.

Recommendation 20

5.69 The Committee recommends that the Australian Energy Market Commission expedite the introduction of a five minute settlement period in the National Electricity Market, so that this rule change commences sooner than 2021.

Recommendation 21

5.70 The Committee recommends that the Australian Energy Market Commission and the Australian Energy Market Operator consider the implications of real-time settlement in the National Electricity Market, and immediately commence consultation with industry, with a view to expediting any possible future rule change to this effect.

Recommendation 22

5.76 The Committee recommends that the Australian Energy Regulator review the issue of vertical integration in the generation sector and market concentration in the generation sector, with a view to considering ways to ensure that standalone retailers have sufficient access to risk management products and fairly priced wholesale electricity.

Recommendation 23

5.87 The Committee recommends that the Australian Energy Market Commission conduct reviews of the Regulatory Investment Test for Transmission, the Regulatory Investment Test for Distribution and the Rules relating to

- investment in more interconnectors with a view to capturing benefits of additional interconnectors to non-adjacent states; and
- new connections to the grid.

Executive summary

Driven by a changing mix of electricity generation and the emergence of a range of new technologies, Australia's electricity system is undergoing a period of significant transition. Notwithstanding the challenges involved in this transition, modernising the electricity system presents a range of opportunities to improve security, reliability, affordability and to contribute to Australia's .

Since the mid 20th century, Australia's electricity grid has featured state-wide grids that were administered centrally by public statutory authorities. The Snowy Scheme saw the first inter-state connection in 1959. The Council of Australian Governments introduced the National Electricity Market—a wholesale spot market for the price of electricity in Queensland, New South Wales, the Australian Capital Territory, Victoria, South Australia and Tasmania. The market incorporates 40,000 km of transmission lines and cables and supplies million customers.

The National Energy Market is oversighted by the Council of Australian Governments' Energy Council. The Council oversees the three national market institutions responsible for the operation of the national energy markets, being the Australian Energy Market Commission, the Australian Energy Market Operator and the Australian Energy Regulator. The Council also sets the policy framework within which these institutions operate.

This inquiry heard that a lack of policy certainty is impacting on the operation of the National Electricity Market, as a lack of certainty has an impact on investment. The policy certainty required relates to a mechanism to achieve emissions reduction in the electricity sector. The electricity sector is capital intensive and a lack of policy certainty has undermined investment in the sector.

In addition, the changing nature of the electricity system has prompted the need to consider new approaches to maintaining reliable electricity supply. It is important that the national market institutions are responsive to the need to maintain an

appropriate level of flexible and dispatchable capacity in the electricity system. It is also important to note that achieving a stable and reliable supply of electricity has price implications for consumers. In that context, mindfulness of the benefits of managing demand and energy efficiency mechanisms becomes increasingly important.

The bidirectional nature of the electricity grid is becoming ever more apparent. As consumers generate power via solar photovoltaic, they are seeking to return energy to a grid that was built with a view of only ever supplying electricity.

Given the rapidly changing nature of the generation, transmission and use of electricity the importance of a responsive planning and regulatory regime has been made clear. Reform is necessary in relation to achieving guaranteed capacity, incentivising change in relation to demand response as well as tariff reform. Reform could drive innovation such as investment in more interconnectors and new connections to the grid.

Working together to explore these issues in consensus-based fashion has enabled this Committee of parliamentarians to move beyond the rhetoric related to energy generation and explore the ever-important issues of transmission and distribution. The recommendations contained within this report are focused on achieving a modernised electricity grid that meets the needs of modern consumers, whilst balancing Australia's environmental obligations and maintaining the stability and reliability of the grid as we move into a 21st century that will depend on electricity as much as ever.

1. Introduction

1.1 Like many countries around the world, the electricity system in Australia is undergoing a period of significant transition, driven by the changing mix of electricity generation, the emergence of a range of new technologies, and government policies for emissions reduction. Recent events—including price volatility and load shedding associated with extreme weather events, and the announcement of the closure of a number of baseload power stations—have highlighted the need for this period to be managed effectively.

1.2 While there are challenges involved in this transition, modernisation of the electricity system also presents a range of opportunities—from improving the security, reliability, and affordability of the electricity supply, to contributing to Australia's emissions reduction commitments.

1.3 These issues affect households and businesses across the country, and, as such, this is an important area of policy for the Parliament to consider.

Related inquiries

1.4 In 2016—2017, Australia's Chief Scientist, Dr Alan Finkel AO, chaired an Expert Panel that conducted an independent review of the national electricity markets.[1]

1.5 The review proposed a blueprint to increase energy security and reliability in the future, with four key outcomes: increased security, future reliability, rewarding consumers, and lowering emissions. A key recommendation was the adoption of a clean energy target, which would mandate energy retailers

[1] A Finkel AO, 'Independent Review into the Future Security of the National Electricity Market ', *Department of the Environment and Energy,* June 2017.

to provide a certain percentage of their electricity from low emissions generators.

1.6 At the time of writing the COAG Energy Council, which is chaired by the Commonwealth's Minister for the Environment and Energy, the Hon. Josh Frydenberg MP, has adopted 49 of the 50 recommendations. The outstanding recommendation related to the Clean Energy Target. The COAG Energy Council referred the Finkel Report to an Energy Security Board, with membership including:

- Kerry Schott AO (Independent Chair)
- Clare Savage (Deputy chair, Business Council of Australia)
- John Pierce (AEMC Chair)
- Audrey Zibelman (AEMO CEO)
- Paula Conboy (AER, Chair)

1.7 On 13 October 2017, in response to a request from the Minister for the Environment and Energy, the Energy Security Board recommended the establishment of a requirement on electricity retailers to meet their load obligations with a portfolio of resources with a minimum amount of flexible, dispatchable capacity and an emissions level consistent with Australia's international emissions reduction commitments.[2]

1.8 In addition to the Finkel Report there is a wide ranging body of contemporary reviews and inquiries into the various aspects of this policy area.[3]

The current inquiry

1.9 While the Committee is aware of the range of contemporary reviews and inquiries in this policy area, the Committee's role as a conduit between the community and the Australian Parliament provided it with a unique opportunity to engage stakeholders at all levels on the issue of the transformation of the electricity system. It also provided an opportunity for

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2 Energy Security Board (ESB), 'ESB advice on retailer reliability, emissions guarantee, and affordability', < http://www.coagenergycouncil.gov.au/sites/prod.energycouncil/files/publications/documents/Energy%20Security%20Board%20ADVICE....pdf> viewed 6 November 2017.

3 For a list of current and recent reviews and reforms see: A Finkel AO, 'The Preliminary Report of the Independent Review into the Future Security of the National Electricity Market ', *Department of the Environment and Energy*, December 2016, p. 59-62.

this important policy area to be examined by a multi-party group of Parliamentarians.

1.10 On 27 February 2017, pursuant to standing order 215(c) the Committee resolved to examine the 2015—16 annual report of the Department of the Environment and Energy, inquiring into and reporting on the adequacy of the current electricity transmission and distribution networks to support Australia's future needs.

Conduct of the inquiry

1.11 The inquiry was advertised on 28 February 2017. Submissions were invited from a range of stakeholders on the issues of the transformation of the electricity system.

1.12 The Committee received 58 submissions which are listed in Appendix A. The Committee also received 13 exhibits, which are listed in Appendix B.

1.13 To gather information about the expectations and concerns of consumers, the Committee launched an online questionnaire on 28 February 2017. This asked households and businesses to share information about how they currently interact with the electricity grid, and about their expectations for the grid in the future. The Committee received 2,900 responses to the online questionnaire, excerpts of which are included in this report.

1.14 The context of the data collected in the questionnaire is important to note. 46 per cent of the respondents indicated that they had installed solar PV. During the inquiry, the Committee heard that one in five Australian households had installed solar PV. The Committee acknowledges that the respondents are not a representative sample, but consider the insights provided by the questionnaire to be both interesting and valuable. The Committee is grateful to everyone who took the time to complete the questionnaire which provided an insight into how consumers are experiencing electricity services in 2017.

1.15 As the issues covered by the inquiry affect households and businesses across a large part of the country, the Committee resolved to undertake a program of public hearings and sites inspections in all of the mainland states serviced by the National Electricity Market. These witnesses are listed at Appendix C.

1.16 Four members of the Committee travelled to Germany and the United States of America during the inquiry. This allowed the Committee to gain firsthand knowledge of electricity grid modernisation in international jurisdictions.

Box 1.1 Committee visit

Learning from the international experience

As part of the inquiry, the Committee considered it vital to draw on examples of electricity grid modernisation in other countries, and discover lessons that could be applied in the Australian context.

Four members—Andrew Broad MP, Pat Conroy MP, Craig Kelly MP, and Anne Stanley MP—undertook a delegation to visit to parts of Germany and the United States. Their comprehensive program of meetings enabled members to learn more about the current electricity market and policy landscape in each country; opportunities and challenges associated with grid transformation and how these have been responded to in each context; and social and cultural considerations including the changing consumer and labour market landscapes.

Delegates were pleased to have secured very productive and insightful meetings with a wide range of stakeholders in the electricity grid modernisation policy space. Throughout their meetings and site inspections, the delegates heard from electricity generators, network operators, technology companies, a mining company, government and non-government planning bodies, regulators, universities, and research bodies.

The visit enabled the Committee to gain genuine insights into different options for responding to changes in electricity generation and usage. Delegates concluded from their visit that other countries are dealing with similar issues to Australia, particularly with respect to the transition to more distributed sources of electricity. The visit also reinforced that Australia, as an island nation, has particular challenges and opportunities. Some of the common themes addressed throughout the visit included network and market planning structures, ways to encourage increased generation capacity, the role of ancillary services and innovative solutions, the role of batteries and other storage solutions, and the importance of structuring the market to provide the required incentives.

Delegates returned to Australia and shared their newly acquired insights with their committee colleagues. Learnings from the visit have made a very strong contribution to the Committee's deliberations and to shaping the conclusions and recommendations in this report.

Scope of the inquiry and this report

1.17 The Committee had a sense of the scope of the issues facing the grid when it adopted the terms of reference in February 2017. The Committee heard evidence in Brisbane that:

> The problems we face have been 10-plus years in the making, and won't be resolved in one parliamentary term.[4]

1.18 Chapter 2 provides an overview of the electricity system within Australia, including the National Electricity Market (NEM), the supply chain components (generation, transmission and distribution, and retail), and the governance of the electricity market. It also notes the current transition that the electricity system is undergoing and the impact this is having on the policy objectives of security, reliability, emissions reduction, and affordability.

1.19 Chapter 3 considers the current policy settings for energy policy as those settings relate to the grid and provides recommendations that have been underwritten by the most frequently heard evidence to the Committee: that the market participants require policy certainty with respect to energy.

1.20 Chapter 4 reviews how network planning has been managed historically, and considers how future planning should be managed. In addition, this Chapter evaluates the types of investments that may be made in to ensure that the grid meets the energy needs of the future.

1.21 Chapter 5 considers the operation of the National Energy Market and proposes some new approaches to existing rules.

1.22 Whilst the terms of reference of the Committee made it plain that the Committee was keen to closely consider the issues of transmission and distribution, the Committee heard evidence that to best manage the modernisation of the grid it would also need to come to a good understanding of the generation of electricity as well.[5]

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4 Mr Jon Stretch, Managing Director and Chief Executive Officer, ERM Power, *Committee Hansard*, Brisbane, 18 August 2017, p. 19.

5 Mr Graham Davies, Director and Principal, Resonant Solutions Pty Ltd, *Committee Hansard*, Adelaide, 1 September 2017, p. 8.

1.23 The Committee was also encouraged to give sufficient weight to sustainability and low emissions when looking to the future of the grid.[6]

[6] Mr Graham Davies, Director and Principal, Resonant Solutions Pty Ltd, *Committee Hansard*, Adelaide, 1 September 2017, p. 8.

2. Background

2.1 This Chapter provides a broad overview of the electricity system within Australia, including the National Electricity Market (NEM), the supply chain components (generation, transmission and distribution, and retail), and the governance of the electricity market.

2.2 The Chapter discusses the current transition that the electricity system is undergoing and the impact this is having on three key energy policy objectives: affordability, reliability and security.

2.3 Finally, the Chapter considers the opportunity that this transition provides to modernise the Australian grid to ensure that we are meeting the need of households and businesses into the future.

History of the electricity system

2.4 In the late 19th century, during the early stages of electricity supply in Australia the majority of the population was concentrated in widely dispersed coastal regions.[7] Subsequently, the electricity industry was developed around the state capitals and rural towns with electricity generation located close to the source of demand.[8]

2.5 Initially, the electricity industry was comprised of private and public enterprises, however, in the earlier 20th century state governments began to

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7 Australian Bureau of Statistics, *A Snapshot of Australia, 1901*, 19 November 2002, p. 1.

8 D Sharma, 'The multidimensionality of electricity reform—an Australian perspective,' *Energy Policy*, vol. 31, no. 11, September 2001, pp. 1093-1102.

own and operate the electricity supply industry.[9] By the late 1940s, electricity infrastructure was primarily owned by the state governments.[10]

2.6 During this time, the revenues generated by metropolitan consumers were utilised to support the construction and operation of rural electrical systems, with Single Wire Earth Return (SWER) lines used extensively to service remote and rural customers.[11]

2.7 The post-World War II period was marked by a rapid expansion of the electricity industry. [12] This led to substantial changes to the electricity grid with some states transitioning from self-contained local and regional power grids to state-wide grids that were administered centrally by public statutory authorities.[13] Moreover, the construction of the Snowy Scheme led to the interconnection of New South Wales and Victoria in 1959.[14]

The establishment of the National Electricity Market

2.8 By the early 1990s state governments started pursuing broad economic reform to ensure Australia's competitiveness in the international market.[15] In the context of the electricity supply industry the Council of Australian Governments (COAG) sought to restructure the industry and to develop a competitive electricity market.[16] This action aimed to separate generation

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9 D Sharma, 'The multidimensionality of electricity reform—an Australian perspective,' *Energy Policy*, vol. 31, no. 11, September 2001, pp. 1093-1102.

10 D Sharma, 'The multidimensionality of electricity reform—an Australian perspective,' *Energy Policy*, vol. 31, no. 11, September 2001, pp. 1093-1102.

11 T A Short, *Electric Power Distribution Handbook*, 2nd edn, CRC Press, USA, 2014, p. 728.

12 F Brady AM, *A Dictionary on Electricity*, The International Conference on Large High Voltage Electrical Systems, France, 1996, pp. 5-6.

13 F Brady AM, *A Dictionary on Electricity*, The International Conference on Large High Voltage Electrical Systems, France, 1996, pp. 5-6.

14 F Brady AM, *A Dictionary on Electricity*, The International Conference on Large High Voltage Electrical Systems, France, 1996, pp. 5-6.

15 Australian Energy Market Commission (AEMC), *National Electricity Market: A case study in successful microeconomic reform*, 2013, p. 12.

16 See: Prof F Hilmer, 'National Competition Policy: Report by the Independent Committee of Inquiry into Competition Policy in Australia', *Independent Committee of Inquiry into Competition Policy in Australia*, 1993; and *Competition Policy Reform Act 1995.*

and retail from monopoly networks (transmission and distribution) within the industry.[17]

2.9 The National Electricity Market (NEM) commenced operation as an energy-only market in December 1998 and coincided with an increase in the privatisation of state-owned electricity enterprises.

2.10 In 2004 the COAG entered into the Australian Energy Market Agreement. The 2004 agreement gave effect to the recommendations in the Ministerial Council on Energy Report of 2003, which set out the legislative and regulatory framework for Australia's energy markets.[18] This meant that electricity, which had previously been the responsibility of the States, was now a shared responsibility coordinated through the COAG Energy Council.

The National Electricity Market

2.11 The NEM is a wholesale spot market for the price of electricity, incorporating 40,000 km of transmission lines and cables and supplying 200 terawatt hours of electricity to businesses and households each year. Supplying 9 million customers with electricity, its total electricity generating capacity is 45,000 MW. Around $7.5 billion is traded in the NEM each year.

2.12 It was of particular interest to the Committee to learn that there is approximately $20 billion of financial derivatives traded each year in the NEM. These contracts assist in the management of pricing volatility.[19]

2.13 Today, the NEM, operated by the Australian Energy Market Operator (AEMO), is one of the world's longest geographically interconnected power systems, spanning from Port Douglas in Queensland to Port Lincoln in South Australia, and across the Bass Strait to Tasmania.[20] It interconnects five regional market jurisdictions: Queensland, New South Wales (including the Australian Capital Territory), Victoria, South Australia, and Tasmania.

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17 AEMC, 'Council of Australian Governments Ministers energy reform agenda', <http://www.aemc.gov.au/Major-Pages/AEMC-work-overview/History-of-energy-market-reform> viewed 12 October 2017.

18 *Australian Energy Market Agreement (as amended December 2013).*

19 Mr Jon Stretch, Managing Director and Chief Executive Officer, ERM Power, *Committee Hansard*, Brisbane, 18 August 2017, p. 18.

20 A Finkel AO, 'The Preliminary Report of the Independent Review into the Future Security of the National Electricity Market ', *Department of the Environment and Energy,* December 2016, p. 3.

2.14 Largely due to distance, Western Australia and the Northern Territory are not connected to the NEM.[21] However, AEMO operates a Wholesale Electricity Market for the South West Interconnected System of Western Australia.[22] This enables retailers to purchase electricity from a generator though the Western Australian electricity market.

Governance

2.15 The Australian Energy Market Agreement, as amended by COAG in December 2013, sets out the regulatory framework for the NEM.[23]

2.16 The COAG Energy Council is made up of federal, state, and territory energy ministers and takes the lead role in monitoring and reforming national energy policy. The Commonwealth Minister for the Environment and Energy is the chair of that Council.[24] The Council oversees the three national market institutions responsible for the operation of the national energy markets including the NEM. These are:

- **The Australian Energy Market Commission (AEMC) —** has two main roles in energy: as the independent rule maker for electricity rules that regulate transmission and distribution networks, and as the provider of advice and reviews at the direction of the COAG Energy Council.[25]
- **The Australian Energy Market Operator (AEMO)**—established in 2009, AEMO operates the NEM and is the national transmission planner. This role involves considering the National Electricity Objective, which involves the:

  > Efficient investment in, and efficient operation and use of, electricity services for the long term interests of consumers with respect to price, quality, safety, reliability and security of supply of electricity, and the reliability, safety and security of the national electricity system.[26]

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21 Australian Energy Market Operator (AEMO), *Fact Sheet: The National Electricity Market,* p. 1.

22 Government of Western Australia Department of Treasury, 'Wholesale Electricity Market', <http://www.treasury.wa.gov.au/Public-Utilities-Office/Electricity-industry/Wholesale-Electricity-Market/> site viewed 12 October 2017.

23 *Australian Energy Market Agreement (as amended December 2013).*

24 Ms Joann Wilkie, Acting First Assistant Secretary, Energy Division, Department of the Environment and Energy, *Committee Hansard*, Canberra, 30 March 2017, p. 3.

25 Mr Richard Owens, Senior Director, Australian Energy Market Commission, *Committee Hansard*, Canberra, 30 March 2017, p. 3.

26 Australian Energy Market Operator, *National transmission network development plan*, December 2016, https://www.aemo.com.au/-

- **The Australian Energy Regulator (AER)** — sets the maximum revenue that the electricity transmission and distribution businesses can recover from customers, whilst also regulating prices for the monopoly elements of the sector. The AER also oversees the operation of the wholesale generation market and retail market to ensure the players are operating according to the market rules and the legislation.[27]

2.17 In addition to the three national market institutions there are a number of state and territory agencies that have some regulatory functions.[28]

2.18 As Australia's energy market increasingly shifts towards renewable energy, a number of agencies have been formed to assist the development of Australian technology that will support this shift. For example:

- **The Australian Renewable Energy Agency (ARENA)**—was established in 2012 by the Australian federal government to manage the government's renewable energy programs and provide support and funding to research in the field.[29] A Commonwealth government agency, ARENA has the role of supporting the development of local renewable energy technology by funding researchers, developers and businesses that have demonstrated the feasibility and potential commercialisation of their project. ARENA has $2 billion to accelerate Australia's shift to a more secure and reliable renewable energy system.[30] By funding innovation from early stage research through to large-scale deployments, ARENA has the character of a planner. What it funds may shape the energy grid of the future.
- **The Clean Energy Finance Corporation (CEFC)**— is an Australian Government statutory authority formed in August 2012 to facilitate increased flows of finance to the clean energy sector through investment activities focused on investment in the renewable, energy efficiency, and

/media/Files/Electricity/NEM/Planning_and_Forecasting/NTNDP/2016/Dec/2016-NATIONAL-TRANSMISSION-NETWORK-DEVELOPMENT-PLAN.pdf, accessed 11 October 2017, p. 13, outlining the national electricity rules.

27 Mr Warwick Anderson, General Manager, Network Finance and Reporting, Australian Energy Regulator, *Committee Hansard*, Canberra, 30 March 2017, p. 3.

28 ACCC, *ACCC inquiry into retail electricity supply and pricing: Issues paper,* 31 May 2017, p. 6.

29 Australian Renewable Energy Agency, 'About', <https://arena.gov.au/about/> site viewed 12 October 2017.

30 Mr Ivor Frischknecht, Chief Executive Officer, Australian Renewable Energy Agency, *Committee Hansard*, Canberra, 30 March 2017, p. 3.

low emissions technology sectors.[31] It has made investment commitments of over $3 billion since its inception. The CEFC considers the grid and transmission infrastructure to be critical to energy transformation.

- **The Energy Security Board (ESB)**—was established following a recommendation of the Finkel Review to coordinate the implementation of the recommendations made in the Finkel Review and to provide whole of system oversight for energy security and reliability to drive better outcomes for consumers. It reports to the COAG Energy Council[32]

The supply chain components

2.19 The supply of electricity to energy customers comprises multiple components. This includes generators selling electricity into the NEM on the wholesale market, the transmission of power from the generators to large industrial energy users and local distribution networks, and the retail energy market that purchases electricity from the NEM and sells it to consumers.[33]

Generation fleet

2.20 A range of generation technologies are used in Australia.[34] This includes coal fired plants, gas powered generators, wind turbines, hydroelectric plants and solar photovoltaic (PV) panels.[35]

2.21 Currently, Australia's electricity demands are predominantly met through the use of fossil fuel generators. In 2015-2016, coal fired plants contributed 76 per cent of the electricity generation in the NEM.[36] These facilities burn coal to create pressurised steam which is then used to drive turbine generators to produce electricity.[37] As a by-product, this process results in emissions being

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31 Clean Energy Finance Corporation, http://annualreport2016.cleanenergyfinancecorp.com.au/, viewed 11 October 2017.

32 COAG Energy Council, 'Establishment of the Energy Security Board', *Media release,* 8 August 2017.

33 Australian Energy Regulator (AER), *State of the Energy Market,* May 2017, p. 22.

34 ACCC, *ACCC inquiry into retail electricity supply and pricing: Issues paper,* 31 May 2017, p. 5.

35 AER, *State of the Energy Market*, May 2017, p. 24.

36 AER, *State of the Energy Market*, May 2017, p. 26.

37 AER, *State of the Energy Market*, May 2017, p. 26.

released into the atmosphere. The electricity sector contributes over one third of Australia's carbon emissions.[38]

2.22 Due to Australia's international commitment under the 2015 Paris Agreement to reduce its carbon emissions, there is a growing focus on renewable generation.[39] Hydro and wind plants utilise water and wind to drive a generator.[40] In comparison, Solar PV directly converts sunlight to electricity rather than relying on a turbine.[41]

2.23 Each form of generation has different features that impact their operating capacity, output levels and costs.

2.24 Coal fired plants take up to three days to start up, resulting in high start-up and shut-down costs.[42] However, once switched on they operate continuously and have low operating costs. Subsequently, coal fired generators tend to bid into the NEM at low prices to ensure dispatch, which enables their plants to keep running.[43]

2.25 Australia's coal-fired generation fleet is aging and parts of it are becoming increasingly unreliable, especially during heatwaves. Even some gas-fired generation has proved unreliable at hot temperatures.

2.26 Hydroelectric plants have low operating costs; however, due to limited water supplies their capacity to operate continuously is restricted. As a result they operate during periods of peak demand, allowing them to benefit from high prices.[44]

2.27 Solar PV and wind power generators are only able to operate if weather conditions are favourable, resulting in intermittent supply. As the Finkel report discussion of new technology solutions for kinetic inertia, synthetic inertia, and fast frequency response makes clear, some renewables can be

38 AER, *State of the Energy Market*, May 2017, p. 26.

39 United Nations (UN), *Adoption of the Paris Agreement 2015*

40 AER, *State of the Energy Market*, May 2017, p. 26.

41 A Finkel AO, 'The Preliminary Report of the Independent Review into the Future Security of the National Electricity Market ', *Department of the Environment and Energy,* December 2016, p. 25.

42 AER, *State of the Energy Market*, May 2017, p. 26.

43 AER, *State of the Energy Market*, May 2017, p. 26.

44 AER, *State of the Energy Market*, May 2017, p. 26.

configured to provide these services and the technology is also evolving rapidly.[45]

Transmission network

2.28 The transmission network is the system of high-voltage transmission lines that carry electricity from generators to large industrial users and local electricity distributors in each region.[46] This network is made up of transmission lines, towers and wires, underground cables, transformers, switching equipment, reactive power devices, and monitoring and telecommunications equipment.[47]

Interconnectors

2.29 Interconnectors are the infrastructure that connects the five regional market jurisdictions of the NEM, allowing electricity to be carried between the states.[48] This is designed to enable more competition and help to match supply and demand for electricity.

2.30 There are currently six interconnectors in the NEM:

- two between Victoria and South Australia;
- one between Victoria and Tasmania (the Basslink);
- one between Victoria and New South Wales; and
- two between New South Wales and Queensland.

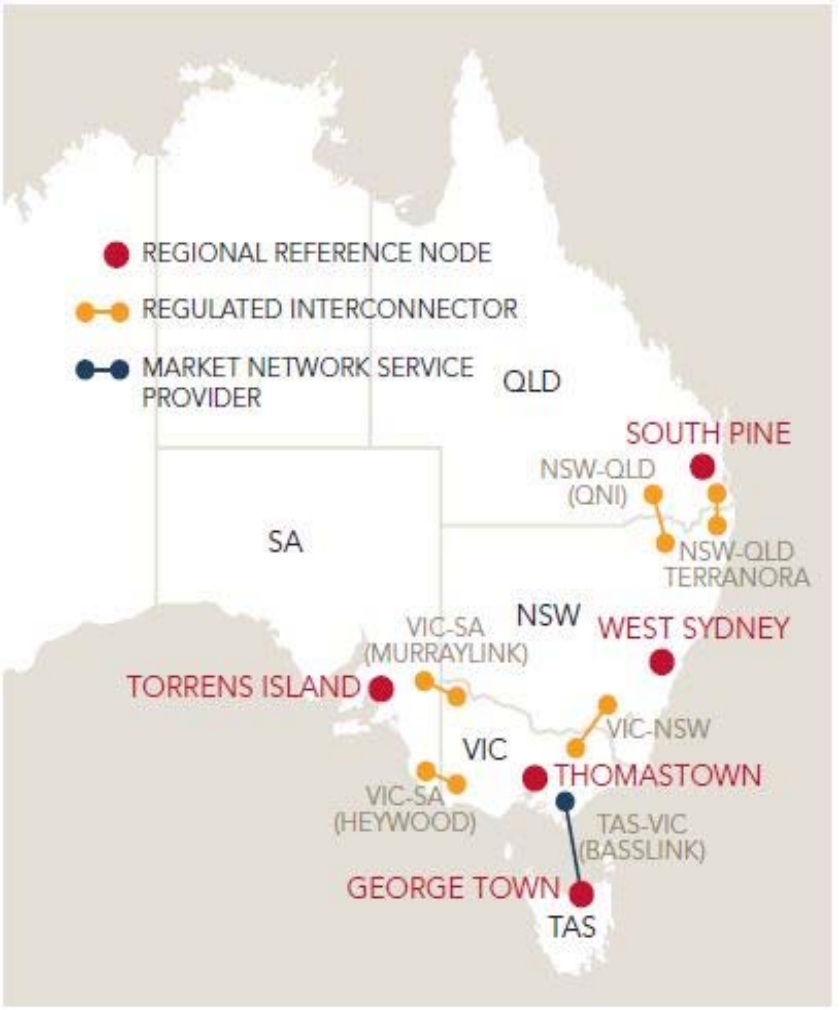
45 Commonwealth of Australia, 'Independent review into the future security of the National Electricity Market: Blueprint for the future', June 2017, Chapter 8, pp. 53, 196–197, <https://www.environment.gov.au/system/files/resources/1d6b0464-6162-4223-ac08-3395a6b1c7fa/files/electricity-market-review-final-report.pdf> viewed 6 November 2017.

46 Australian Energy Market Operator (AEMO), *Fact Sheet: The National Electricity Market,* pp. 1-2.

47 AER, *State of the Energy Market*, May 2017, p. 94.

48 ACCC, *ACCC inquiry into retail electricity supply and pricing: Issues paper,* 31 May 2017, p. 5.

Figure 2.1 Interconnectors in the NEM



Source: AEMO, An Introduction to Australia's National Electricity Market, July 2010, p. 15.

Box 2.1 Australia as an 'energy island'

Australia: the energy 'island'

In addressing issues arising from the evolving energy mix, lessons can be learnt from the practices and experiences of other markets in the world. For example, several countries in Europe and North America are currently modernising their market design and regulatory framework to accommodate growing generation from variable renewable electricity while maintaining the security of their electricity supply to the grid.

While lessons can be learnt from these countries, it must be noted that their experiences differ significantly from Australia. For example, Germany, which has pursued a fairly aggressive renewable energy target, has also benefited from interconnectors with other countries such as France, and Poland, which have a significant reliance on baseload power. Germany also relies on wind and hydro power from Denmark, Sweden, and Austria. In contrast, Australia is an island without interconnectors to other electricity grids. This provides Australia with unique challenges and opportunities.

Distribution network

2.31 The distribution network is the system of low-voltage distribution lines that carry electricity from local electricity distribution substations in each region to homes and businesses. The network comprises poles and wires, substations, transformers, switching equipment, and monitoring and signalling equipment.[49]

Wholesale electricity market

2.32 The NEM is a wholesale electricity market that facilitates the sale of electricity from generators to retailers who then on-sell to consumers.[50] The system works as a spot market, in which power supply and demand is matched instantaneously.[51]

2.33 In delivering electricity, over 300 registered generators bid into the market to dispatch electricity in five-minute intervals.[52] The cheapest bids are chosen first, and then increasingly more expensive bids are selected until enough electricity can be dispatched to meet demand. The dispatch price is determined by the highest priced offer needed to meet demand.[53]Financial settlement is based on the spot price averaged out over a 30 minute period and all successful bidders are paid at this price, despite how they bid.[54] Spot prices are one of the mechanisms that influence investment in generation in

49 AER, *State of the Energy Market*, May 2017, p. 94.

50 AEMO, *Fact Sheet: The National Electricity Market,* p. 3.

51 AEMO, *Fact Sheet: The National Electricity Market,* p .2.

52 AEMO, *Fact Sheet: The National Electricity Market,* p. 3.

53 AER, *State of the Energy Market*, May 2017, p. 24.

54 AER, *State of the Energy Market*, May 2017, p. 24.

the NEM. The level of spot prices (in each five-minute interval) is regulated with the aim of providing an appropriate incentive for generators to participate in the market.[55]

2.34 Within the NEM, electricity production is matched with consumption, and excess generating capacity is reserved in case it is needed.[56] Moreover, transmission limitations are put in place to prevent overloading the network.[57]

2.35 The relationship between wholesale prices and reliability is discussed in Chapter 3 of this report.

Retail

2.36 Retail energy markets are the final link in the energy supply chain and are traditionally the main contact between the electricity industry and customers, such as households and small businesses.[58]

2.37 Retailers purchase wholesale electricity through the NEM and package it with transmission and distribution network services for sale to nearly 10 million residential, commercial and industrial users.[59]

2.38 Together the 'Big 3' Retailers—AGL, Origin and Energy Australia—currently supply 70 per cent of customers in the NEM.[60] Recently second tier retailers have diversified significantly.[61]

2.39 There has been deregulation of the retail electricity markets in Victoria (2009), South Australia (2013), New South Wales (2015), and South East Queensland (2016), meaning that the supply of electricity is via a non-state owned company.[62] The retail electricity markets in Tasmania and the Australian Capital Territory remain regulated.[63]

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55 AER, *State of the Energy Market*, May 2017, p. 24.

56 AEMO, *Fact Sheet: The National Electricity Market,* p. 3.

57 AEMO, *Fact Sheet: The National Electricity Market,* p. 3.

58 AER, 'Retail Markets', <https://www.aer.gov.au/retail-markets> site viewed 10 October 2017.

59 AER, *State of the Energy Market*, May 2017, p. 22.

60 AEMC, 2017 *AEMC Retail Energy Competition Review*, p. iv.

61 AEMC, *2017 AEMC Retail Energy Competition Review*, p. iv.

62 AER, *State of the Energy Market*, May 2017, p. 130.

63 AER, *State of the Energy Market*, May 2017, p. 130.

Current transition in the electricity market

2.40 As in other countries around the world, the electricity system in Australia is entering a significant period of transition. This transition is driven by the evolving mix of electricity generation, increasing adoption of new technologies in the electricity sector, and changing consumer preferences which have influenced patterns of demand.

2.41 Recent events—including price volatility and load shedding associated with extreme weather events and the announcement of the closure of a number of coal-fired power plants—have highlighted the need for this period of transition to be managed effectively.

Changing generation mix (from coal to renewable)

2.42 The current transition in Australia's electricity market is, in part, due to the evolving mix of electricity generation, from traditional, synchronous energy generation (such as coal, gas and hydro) to non-synchronous, variable energy generation (such as wind and solar photovoltaic).

2.43 Coal-fired power plants have provided stable, low-cost energy supply for an extended period of time; however, both the high emissions rates and aging nature of these power plants present challenges. One such challenge is to Australia's international commitment, under the Paris Agreement, to reduce its carbon emissions. Subsequently, coal-fired generators are being retired without replacement, principally due to policy uncertainty, and the installation of renewable electricity generation sources has increased.

2.44 Wind and Solar PV are the most common renewable technologies being installed; however, there are a number of other low-emission electricity generation technologies. These include concentrated solar thermal, geothermal, ocean, wave and tidal and low emission electricity generation technologies such as biomass combustion and coal or gas-fired generation with carbon capture and storage.

2.45 At the same time, the penetration of rooftop PV on residential buildings has significantly increased, with Australia 'currently leading the world with small-scale solar PV installations'.[64] While the rate of installation varies

[64] Ms Elisabeth Brinton, Executive General Manager, New Energy, AGL Energy Ltd, *Committee Hansard,* Canberra, 19 October 2017, p. 6.

across the country, it is as high as one in four in some jurisdictions.[65] It is predicted that this will increase in the future.

2.46 At 7 November 2017, the Australian PV Institute reported that there were 1,746,760 households with solar PV in Australia[66], with the uptake of solar PV by households per state as follows:

Table 2.1 Household uptake of solar PV by state

State	Percentage of households
Queensland	30.7
South Australia	30.1
Western Australia	24.3
New South Wales	15.9
Victoria	14.7
Tasmania	13.3
Australian Capital Territory	13
Northern Territory	11.7

Source: Australian PV Institute (APVI) Solar Map, funded by the Australian Renewable Energy Agency, accessed from pv-map.apvi.org.au on 5 December 2017

Box 2.2 Solar PV and the grid

Committee questionnaire:

46 per cent of respondents reported that they generated electricity at their premises, with 96 per cent of those generating power from solar PV. 93 per cent of this generation was connected to the grid, and 90 per cent generated income, rebate or credit as a result.

2.47 This transition will be discussed in greater detail in Chapter 3.

65 Ms Elisabeth Brinton, Executive General Manager, New Energy, AGL Energy Ltd, *Committee Hansard*, Canberra, 19 October 2017, p. 6.

66 Australian PV Institute (APVI) Solar Map, funded by the Australian Renewable Energy Agency, accessed from pv-map.apvi.org.au on 5 December 2017.

2.48 The changing generation mix is also affecting the availability of services required to maintain the security of the electricity system, as these services have been traditionally provided by large synchronous generators (such as coal-fired plants).

2.49 Implications of the change in the generation mix are discussed in further detail in Chapter 3 of this report.

Technological change

2.50 As outlined above, the last five years have seen a significant increase in new technologies, processes and business models across the entire energy supply chain.[67] The latest advances include low emissions electricity generation technologies, distributed energy resources such as digital metering, rooftop solar photovoltaic (PV) , battery storage systems and electric vehicles, and software for peer-to-peer electricity trading. It is likely that technology advances will continue to impact the electricity supply industry in the future. Some of these technological changes are further discussed below.

Battery storage

2.51 While it is currently new technology, the consumer-driven decision to install home battery storage systems has the potential to significantly reduce the incidence and level of peak demand on the grid if the uptake is efficient and integrated.[68] AEMO has projected that as retail electricity prices increase and the cost of batteries decline there will be a steady growth in battery storage installation after 2021.[69]

2.52 Opportunities for battery storage to support electricity supply during emergency situations are currently being explored in Australia. The South Australian, Victorian and Queensland governments have each announced battery storage initiatives as part of their energy plans.[70] For example, South Australia's Energy Plan aims to deliver 100MW of battery storage during

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67 A Finkel AO, 'The Preliminary Report of the Independent Review into the Future Security of the National Electricity Market ', *Department of the Environment and Energy,* December 2016, p. 12.

68 A Finkel AO, 'The Preliminary Report of the Independent Review into the Future Security of the National Electricity Market ', *Department of the Environment and Energy,* December 2016, p. 14.

69 AEMO, *Market Trends and Outlook in Australia's Electricity Markets,* July 2016, p. 5.

70 AEMO, *Energy Supply Outlook for Eastern and South-Eastern Australia,* June 2017, p. 4.

summer 2017—18 for use in extreme weather conditions that create supply shortfalls that cannot be managed in other ways.[71]

Smart meters

2.53 The installation of smart meters allows network operators to capture and record electricity usage data every five minutes.[72] This allows operators to make decisions about demand in a timely manner, for example if transformers are being overworked operators can replace them prior to them being damaged.[73] Moreover, the data collected can be used to make more accurate predictions about demand.

2.54 Smart metering can also be used to encourage behavioural change among households to reduce overall costs of operating the energy grid.[74]

2.55 As metering technologies become more advanced they will likely provide more detailed consumption information. This has the potential to lead to greater service possibilities for consumers and operators. There are potential privacy concerns in relation to the collection of household data in this manner.

2.56 To date, smart meters have been rolled out in Victoria. Although evidence to the inquiry did not focus on the effectiveness of these meters in driving consumer behaviour change, anecdotal evidence suggests there may be potential for stronger gains in this area too.

Changing consumer preferences and industry

2.57 Changes in the energy market, technology development, concerted efforts to lower emissions, and the lowering cost of distributed energy resources have provided residential consumers with greater incentive to choose how their electricity demand is met and to become active participants in the energy sector. This has led to significant uptake of rooftop solar PV, and it is

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71 AEMO, *Energy Supply Outlook for Eastern and South-Eastern Australia,* June 2017, p. 4.

72 M Abernethy, 'Smart meters providing key data', Financial Review, 14 May 2017, <http://www.afr.com/news/special-reports/energy-future-of-australia/smart-meters-providing-key-data-20170511-gw2ge3 > site viewed 16 October 2017

73 M Abernethy, 'Smart meters providing key data', *Financial Review*, 14 May 2017, <http://www.afr.com/news/special-reports/energy-future-of-australia/smart-meters-providing-key-data-20170511-gw2ge3> site viewed 16 October 2017.

74 D Byrne, 'Australia's Energy Trilemma Explained', 3 July 2017, *Melbourne University,* <https://pursuit.unimelb.edu.au/articles/australia-s-energy-trilemma-explained> site viewed 12 October 2017.

predicted that other distributed energy resources, such as energy storage, will gain popularity as they become more cost-effective in the future.[75]

2.58 In 2015-2016, 1.6 million households in the NEM self-generated electricity through the installation of solar PV, addressing three per cent of electricity needs in the NEM.[76] It is likely that in the future more customers will have the ability to meet their energy needs through self-generation and battery storage.[77]

2.59 These changes have led to different patterns of demand from households and industry. This will be discussed in further detail in Chapter 3.

Challenges and opportunities for future policy

2.60 The modernisation of the electricity grid in Australia provides an opportunity to reconsider what the system should seek to achieve, and how the different priorities of stakeholders should be balanced. Four priorities that have been identified as crucial to ensuring an effective transition, these are:

- **security**—a measure of the ability of the electricity system to continue operating within defined technical limits, even in event of the failure or disconnection of a major system element (for example, a generator or transmission line).[78]
- **reliability**—a measure of the ability of the electricity system to meet customer demand—that is, having capacity available in the right place and at the right time.[79]
- **emissions reduction considerations**—including meeting Australia's climate change commitments under the Paris Agreement. The Paris Agreement includes a commitment to limit global warning to two degrees Celsius above pre-industrial levels with an aspirational limit of

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75 AEMO, *Visibility of Distributed Energy Resources: Future Power System Security Program,* January 2017, p. 2.

76 AER, *State of the Energy Market*, May 2017, p. 22.

77 AER, *State of the Energy Market*, May 2017, p. 22.

78 AEMC, 'System security and reliability',< http://www.aemc.gov.au/Major-Pages/AEMC-work-overview/System-security-review>
viewed 6 November 2017.

79 AEMC, 'System security and reliability',< http://www.aemc.gov.au/Major-Pages/AEMC-work-overview/System-security-review> viewed 6 November 2017.

1.5 degrees Celsius, as well as a commitment to zero net emissions in the second half of this century.

- **affordability**—ensuring that the system provides universal access to electricity services at the lowest practicable cost to consumers.[80]

2.61 Both reliability and security will be discussed in further detail in Chapter 3.

Committee comment

2.62 The recent history of the NEM provides a summary of the opportunities and challenges the national power grid faces as it transforms 20th century infrastructure into a form that will meet the energy needs of the 21st century. As the energy mix continues to evolve, it is clear that both energy policy and energy planning will need to adapt to ensure the grid remains both an efficient and effective way of meeting the energy needs of the consumers and businesses of Australia well into the future.

2.63 These issues are addressed in subsequent chapters of this report.

80 D Byrne, 'Australia's Energy Trilemma Explained', 3 July 2017, *Melbourne University*, <https://pursuit.unimelb.edu.au/articles/australia-s-energy-trilemma-explained> site viewed 12 October 2017.

3. Policy framework

3.1 As discussed in the previous Chapter, the electricity system is in a period of transition. While the terms of reference of the present inquiry focus on the electricity transmission and distribution system, the Committee received a range of evidence about the importance the policy framework across the electricity sector during this transition.

3.2 In particular, the Committee heard concerns that changes in policy and market settings would be required to maintain the security and reliability of the electricity system.

3.3 The Committee also heard that policy uncertainty—particularly in relation to emissions reduction in the electricity sector—had undermined investment in the sector.

3.4 Lastly, the Committee heard evidence that governance and regulation in sector was not well coordinated and not sufficiently responsive to meet the rapid pace of change in the industry.

Changing nature of the electricity system

3.5 This section considers evidence received by the Committee about the changing nature of the electricity system—which is driven by the changing generation mix—and the implications of this change for security and reliability.

Changing generation mix

3.6 The Committee heard evidence that the changing generation mix in the electricity system. This transition is characterised by the gradual withdrawal of coal-fired generation and the increasing penetration of wind and solar photovoltaic (PV).

3.7 In its most recent report of the state of the energy market, released in May 2017, the Australian Energy Regulator (AER) reported on the generation mix in the National Electricity Market (NEM) in 2015–16, summarised here in Table 3.1.[81]

Table 3.1 Generation mix in the NEM in 2015–16

Generation type	Share of registered capacity (per cent)	Share of total output (per cent)
Coal	52	76
Gas	19	7
Hydroelectric	17	10
Wind	7.5	6.1
Other	4.5	0.9

Source: State of the energy market, Australian Energy Regulator, May 2017

3.8 The report highlighted that new investment in generation was predominantly in wind and solar. Of the 2000 MW of capacity added over the five years to 31 March 2017, 80 per cent was wind generation and 12 per cent was solar generation.[82]

3.9 The report explained that, of advanced but not formally committed proposals for new generation, 62 per cent are wind generation, 25 per cent are gas generation, and 11 per cent are solar generation. The report stated that no investment in new coal- or gas-fired generation had occurred since a 240 MW upgrade to the Eraring coal-fired plant in 2013.[83]

3.10 The Committee heard that investment in wind and solar was driven by a range of factors, including the falling cost of the technology and incentives provided under federal and state and territory government policies, including the Large-scale Renewable Energy Target.

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81 Australian Energy Regulator (AER), 'State of the energy market', May 2017, pp. 29–35, <https://www.aer.gov.au/publications/state-of-the-energy-market-reports/state-of-the-energy-market-may-2017> viewed 6 November 2017.

82 AER, 'State of the energy market', May 2017, p. 37, <https://www.aer.gov.au/publications/state-of-the-energy-market-reports/state-of-the-energy-market-may-2017> viewed 6 November 2017.

83 AER, 'State of the energy market', May 2017, p. 38, <https://www.aer.gov.au/publications/state-of-the-energy-market-reports/state-of-the-energy-market-may-2017> viewed 6 November 2017.

3.11 The Committee also heard that in the current investment environment, technologies with relatively short construction times and low capital costs, such as wind and solar, were particularly attractive. In addition, wind and solar (and other forms of renewable generation) are not exposed to carbon risk. The current investment environment is discussed in further detail later in this Chapter.

3.12 Lastly, the Committee heard about the growing penetration of rooftop PV, which is not traded though the NEM. Energy Networks Australia explained that the average penetration of rooftop PV is approximately 15 per cent across Australia, with penetration above 30 per cent in some states.[84]

3.13 This investment is taking place at the same time as the retirement of a number of coal-fired plants, including the 1600 MW Hazelwood coal-fired plant, which was retired on 31 March 2017, with further closures expected as other coal-fired plants reach the end of their design life over the coming decades.

Box 3.1 New technologies

Opportunities presented by new technologies

In Germany members of the Committee heard about highly flexible conventional power plants, which are used as back-up capacity in the German grid. In its meeting with think tank Agora Energiewende, delegates were interested to hear that most black coal-fired plants—subject to their age—can be retrofit to improve their flexibility and response to load. With flexibility becoming increasingly important in the evolving electricity grid, it was interesting to hear that responsiveness can come from surprising sources.

Implications for security and reliability

3.14 As outlined above, the change in the generation mix has been characterised by the displacement of traditional coal- and gas-fired generation with an increasing share of wind and solar generation.

3.15 While the Committee heard that an electricity system with a significantly higher share of wind and solar generation was technically feasible, the Committee was interested in understanding the implications of this transition for the security and reliability of the system.

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84 Energy Networks Australia, *submission 38*, p. 24.

3.16 The Committee was particularly interested in the role of the system operator, the Australian Energy Market Operator (AEMO), in adapting to the changing physical characteristics of the electricity system.

Security

3.17 Security is a measure of the ability of the electricity system to continue operating within defined technical limits, even in event of the failure or disconnection of a major system element (for example, a generator or transmission line).[85]

3.18 Historically, the secure operation of the NEM has relied on services based on the physical characteristics of large synchronous generators, such as coal- and gas-fired generators and hydro generators.[86]

3.19 For example, an important aspect of system security is maintaining the frequency of the electricity system as close as possible to the normal 50 Hz operating frequency.

3.20 The massive rotating components in synchronous generators contribute physical inertia to the electricity system. This property provides the system with the ability to resist changes in frequency that result from imbalances between supply and demand.

3.21 Minor deviations in frequency are automatically corrected by regulation frequency control and ancillary services (FCAS). In the event of a significant deviation (known as a contingency event), AEMO procures contingency FCAS to correct the frequency. Examples of contingency FCAS include generator response and load shedding.[87]

3.22 The higher the amount of inertia in the system, the slower the rate of change of frequency for a given contingency. This provides more time for FCAS to respond in order to maintain the frequency within its prescribed range.

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85 Australian Energy Market Commission (AEMC), 'System security and reliability', <http://www.aemc.gov.au/Major-Pages/AEMC-work-overview/System-security-review> viewed 6 November 2017.

86 Synchronous generators are generators whose operation is synchronised to the operating frequency of the network. In the NEM, which operates at a normal frequency of 50 Hertz (Hz), or 50 cycles per second, the rotating components in synchronous generators spin in step with this frequency.

87 Australian Energy Market Operator (AEMO), 'Fact sheet: frequency control', <https://www.aemo.com.au/-/media/Files/Electricity/NEM/Security_and_Reliability/Reports/AEMO-Fact-Sheet_Frequency-Control---Final.pdf> viewed 6 November 2017.

3.23 In contrast with synchronous generators, wind and solar generators, which are connected to the electricity system through inverters, do not contribute physical inertia.[88] As such, the withdrawal of synchronous generators is reducing the level of physical inertia present in the electricity system.

3.24 Moreover, FCAS is generally provided by synchronous generators, the availability of FCAS may be affected by the changing generation mix.

3.25 Aside from contributing inertia, synchronous generators assist also in voltage control by producing and absorbing reactive power and improve system strength by providing high fault current. However, in Australia these services are not generally provided by wind and solar generators to the extent that they are able to.

3.26 The final report of the Finkel review stated that, while it is difficult to show that the state of system security is decreasing, some warning signs are emerging.[89]

3.27 The Government of South Australia submitted that, with the declining share of synchronous generation in the state, there is an increasing reliance on interconnectors to provide inertia.[90]

3.28 Dr Glenn Platt, Research Program Director at CSIRO, stated that problems associated with a lack of inertia were apparent in some small areas. However, Dr Platt also noted:

> ... we are still quite a while away from dealing with a lot of these inertia problems in most parts of Australia.[91]

3.29 The Committee heard evidence about a range of technologies that are able to provide inertia and other system security services, including synchronous condensers (new or reconfigured from retired synchronous generators), synthetic inertia, battery storage, fast frequency response, and demand response.

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88 An inverter is a solid-state electronic device that converts alternating current (AC) electricity into direct current (DC) electricity.

89 Commonwealth of Australia, 'Independent review into the future security of the National Electricity Market: Blueprint for the future', June 2017, pp. 51–52, <https://www.environment.gov.au/system/files/resources/1d6b0464-6162-4223-ac08-3395a6b1c7fa/files/electricity-market-review-final-report.pdf> viewed 6 November 2017.

90 Government of South Australia, *submission 43*, p. 3.

91 Dr Glenn Platt, Research Program Director, Energy, CSIRO, *Committee Hansard*, Canberra, 30 March 2017, pp. 18–19.

Reliability

3.30 Reliability is a measure of the ability of the electricity system to meet customer demand—that is, having capacity available in the right place and at the right time.[92]

3.31 In the NEM, AEMO is responsible for balancing supply and demand through a centrally coordinated dispatch process, which operates on a five-minute cycle. In this process, AEMO forecasts the expected demand from the transmission grid to determine how much capacity to dispatch.

3.32 Dispatchable capacity can include traditional and new types of generation (for example, coal, gas, hydro, biomass, and solar thermal), storage (for example, pumped hydro and batteries), behind-the-meter resources, additional network capability, and demand response.

3.33 By contrast, an inherent characteristic of wind and solar generation is that its electrical output is intermittent, depending on seasonal and daily weather patterns and local weather conditions (for example, cloud cover). As such, wind and solar generation is non-dispatchable. AEMO forecasts wind and solar generation, and then adjusts the dispatch process accordingly.

3.34 As wind and solar generation makes up a larger share of the generation mix, there will be additional variability in the dispatch process. The increasing penetration of rooftop PV will also introduce additional variability in demand from the network.[93]

3.35 Furthermore, behind-the-meter resources such as rooftop PV are often invisible to AEMO, which limits the availability of technical and operational data to support forecasting and planning.[94]

3.36 These changes imply that generators providing dispatchable capacity will need to be increasingly flexible in order to maintain the reliability of the electricity system. However, some existing generators (particularly coal-

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92 AEMC, 'System security and reliability', <http://www.aemc.gov.au/Major-Pages/AEMC-work-overview/System-security-review> viewed 6 November 2017.

93 This phenomenon is known as the duck curve, due to the distinctive duck-like shape of the net-demand curve in regions with high penetration of rooftop PV. The duck curve is characterised by low demand around midday, as household demand is displaced by output from PV, and a rapid increase in demand around sunset, as output from PV subsides coincident with the evening peak in household demand.

94 AEMO, *submission 47*, pp. 5–7.

fired plants) may not have the capability to rapidly increase or decrease their output to balance system load.[95]

3.37 Notwithstanding the evidence outlined at the beginning of Chapter 4 of this report that historically the NEM has been reliable, in evidence to the inquiry, Ms Audrey Zibelman, Managing Director and Chief Executive Officer of AEMO, explained that, based on current trends, the market operator had identified a potential shortfall in the level of flexible, dispatchable capacity in the NEM.[96]

3.38 In advice provided to the Commonwealth Government[97], AEMO stated that without changes to bring forward new investment in flexible, dispatchable capacity, there was an 'increasing an unacceptable risk' that the NEM would be unable to meet the reliability standard.[98]

3.39 The advice noted that issues associated with increasing levels of variable generation were compounded by the ageing of the generation fleet and increased complexity for generators in managing fuel supplies.[99]

Current investment environment

3.40 As discussed in the previous section, the transition in the electricity system is highlighting the need for new approaches to managing security and reliability. At the same time, modernisation of the electricity grid is an opportunity to achieve better outcomes for consumers, and to reduce Australia's emissions in line with international commitments.

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95 Commonwealth of Australia, 'Independent review into the future security of the National Electricity Market: Blueprint for the future', June 2017, pp. 79, 107–109, <https://www.environment.gov.au/system/files/resources/1d6b0464-6162-4223-ac08-3395a6b1c7fa/files/electricity-market-review-final-report.pdf> viewed 6 November 2017.

96 Ms Audrey Zibelman, Managing Director and Chief Executive Officer, AEMO, *Committee Hansard*, Canberra, 14 September 2017, pp. 9, 14.

97 AEMO, 'Advice to Commonwealth Government on dispatchable capability', September 2017, p. 2, < https://www.aemo.com.au/-/media/Files/Media_Centre/2017/Advice-To-Commonwealth-Government-On-Dispatchable-Capability.PDF> viewed 6 November 2017.

98 The reliability standard is a planning standard that is designed to signal the market to deliver sufficient capacity to meet demand. The standard is measured in terms of maximum expected unserved energy (USE), or the maximum amount of expected demand that cannot be supplied. The standard is currently set at 0.002 per cent USE per region (or regions) per financial year.

99 AEMO, 'Advice to Commonwealth Government on dispatchable capability', September 2017, pp. 13–15, < https://www.aemo.com.au/-/media/Files/Media_Centre/2017/Advice-To-Commonwealth-Government-On-Dispatchable-Capability.PDF> viewed 6 November 2017.

3.41 However, a clear theme in evidence to the inquiry was that the current investment environment in the electricity sector is characterised by a high degree of uncertainty.[100]

3.42 As noted above, there is a wide range of factors contributing to the current investment environment, including rapid technological change, declining technology costs, and changing consumer preferences.[101] In addition, the Committee heard evidence about the lack of liquidity in the contract market.

3.43 The Committee also heard that changes in policy settings and interventions by governments created uncertainty for investors.[102]

3.44 In this context, the following sections consider evidence about the effectiveness of current market incentives for reliability and system security services and the extent of policy uncertainty in the electricity sector, particularly regarding emissions reduction.

Current market design

3.45 The Committee heard evidence that the current market was not providing the right incentives to bring forward investment in flexible, dispatchable capacity and that security services were not appropriately valued.

3.46 One of the main factors influencing investment decisions in the NEM are the reliability settings[103], which are made up of four mechanisms for regulating spot prices in the wholesale electricity market:

- the **market price cap**, which is the maximum price that can be reached in any five-minute dispatch interval (currently $14 000 per MWh);
- the **cumulative price threshold**, which is the maximum total price that can be reached in any week (currently $210 000), after which time the **administered price cap** is applied (currently $300 per MWh); and
- the **market floor price**, which is the minimum price that can be reached in any five-minute dispatch interval (currently -$1000 per MWh).[104]

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100 Mr Paul Hyslop, Chief Executive Officer, ACIL Allen Consulting, *Committee Hansard*, Melbourne, 31 August 2017, p. 18.

101 Mr Paul Hyslop, Chief Executive Officer, ACIL Allen Consulting, *Committee Hansard*, Melbourne, 31 August 2017, p. 18.

102 Mr Kieran Donoghue, General Manager, Policy, Australian Energy Council, *Committee Hansard*, Canberra, 30 March 2017, p. 18; Mr Anthony Wood, Energy Program Director, Grattan Institute, *Committee Hansard*, Melbourne, 31 August 2017, pp. 6–7.

103 Every four years the AEMC Reliability Panel is required to review the reliability standard and the reliability settings. The most recent review was completed in 2014.

3.47 The Committee was told that spot prices played a signalling role in the market, and that the design of the NEM was such that a sustained increase in current and forward prices would provide a signal for investment in new generation capacity to maintain the reliability of the electricity system.

3.48 Throughout the inquiry, the Committee heard a range of evidence about the level of wholesale electricity prices in the NEM.

3.49 In its report on the state of the energy market, the AER stated that wholesale prices rose in every NEM region in 2015-16, with rises of around 50 to 60 per cent in Victoria, New South Wales, and South Australia. The report stated that prices have continued to rise in mainland regions in the first nine months of 2016–17.[105]

3.50 The report also stated that wholesale prices had been extremely volatile since winter 2015, particularly in Queensland, South Australia, and Tasmania:

> Thirty-minute prices exceeded $200 per MWh almost 4000 times in 2015–16, which was an unprecedented number.[106]

3.51 This volatility was attributed, in part, to a tightening of the supply-demand balance due to the closure or mothballing of several coal-fired plants.[107]

3.52 However, the Committee heard high wholesale prices were not resulting in new investment in dispatchable capacity, and that investment in wind and solar generation was being driven by factors outside the wholesale market, such as the Renewable Energy Target.

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104 AEMC, '2018 reliability settings and standard review', June 2017, < http://www.aemc.gov.au/getattachment/8cc57f2e-b6ac-40b4-8288-1a7c40b2b8a1/Information-sheet.aspx> viewed 6 November 2017.

105 AER, 'State of the energy market', May 2017, p. 51, <https://www.aer.gov.au/publications/state-of-the-energy-market-reports/state-of-the-energy-market-may-2017> viewed 6 November 2017.

106 AER, 'State of the energy market', May 2017, p. 51, <https://www.aer.gov.au/publications/state-of-the-energy-market-reports/state-of-the-energy-market-may-2017> viewed 6 November 2017.

107 AER, 'State of the energy market', May 2017, p. 51, <https://www.aer.gov.au/publications/state-of-the-energy-market-reports/state-of-the-energy-market-may-2017> viewed 6 November 2017.

3.53 In evidence to the inquiry, Ms Audrey Zibelman, Chief Executive Officer and Managing Director of AEMO, explained that the market operator had identified that changes in market design were necessary to signal the need for dispatchable capacity:

> ... the current market environment seems to be incentivising new, renewable connections. Our concern is that we need to have signals to get in resources that also provide dispatchable capability.[108]

3.54 Ms Zibelman outlined approaches used in other jurisdictions to encourage investment in dispatchable capacity, including day-ahead markets, capacity markets, auctions, availability markets, and emergency reserves.[109]

3.55 Ms Zibelman explained the common feature of these mechanisms:

> What they do is they provide a revenue stream outside the energy market, so that people have an understanding that they are being paid for availability.[110]

3.56 In advice provided to the Commonwealth Government, AEMO recommended the development of a strategic reserve option for use from summer 2018–19 to summer 2020–21, then development a longer-term approach to retain and encourage investment in new dispatchable capability, to be in place before 2021–22.[111]

3.57 The advice also stated that, in the short term, consideration should be given to new investment to extend the life or increase the flexibility of existing dispatchable resources.[112] For example, the Committee had reference to GE's research in retrofitting coal-fired power plants to help increase power

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108 Ms Audrey Zibelman, Managing Director and Chief Executive Officer, AEMO, *Committee Hansard*, Canberra, 14 September 2017, p. 14.

109 Ms Audrey Zibelman, Managing Director and Chief Executive Officer, AEMO, *Committee Hansard*, Canberra, 14 September 2017, p. 11.

110 Ms Audrey Zibelman, Managing Director and Chief Executive Officer, AEMO, *Committee Hansard*, Canberra, 14 September 2017, p. 11.

111 AEMO, 'Advice to Commonwealth Government on dispatchable capability', September 2017, p. 4, < https://www.aemo.com.au/-/media/Files/Media_Centre/2017/Advice-To-Commonwealth-Government-On-Dispatchable-Capability.PDF> viewed 6 November 2017.

112 AEMO, 'Advice to Commonwealth Government on dispatchable capability', September 2017, p. 4, < https://www.aemo.com.au/-/media/Files/Media_Centre/2017/Advice-To-Commonwealth-Government-On-Dispatchable-Capability.PDF> viewed 6 November 2017.

output, reduce operational and maintenance costs and lower plant carbon footprint through less coal consumption.[113]

3.58 The Committee heard evidence that the proposed change to implement five-minute settlement in the NEM (that is, to align the settlement window with the five-minute cycle for dispatch) would provide a signal to the market to invest in more flexible generation.[114]

3.59 However, Ms Zibelman suggested it would be advantageous to consider the implementation of five-minute settlement in the context of broader changes to market design.[115]

3.60 In addition to concerns about the market failing to encourage investment in dispatchable capacity, the Committee heard that the current market was not appropriately valuing system security services.

3.61 The Committee heard that the market had not assigned an explicit value to system security services such as inertia as, historically, these had been provided effectively at no cost by synchronous generators.

3.62 Ms Michelle Groves, Chief Executive Officer of the AER, explained:

> ... traditionally, we did not value ... separately, the reliability and security services that certain types of generation brought to the market because the majority of the generators in the market brought those services with them; they were just taken as a given.[116]

3.63 Ms Zibelman submitted that there was a need to unbundle energy from the services required to maintain the security of the electricity system:

> What we are finding is that, as the system has evolved, resources such as renewables, unlike traditional generation, may not provide frequency and regulation—other resources. So we have to signal that need to the market

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113 *GE to help increase output and efficiency of EPS's coal-fired power plant in Serbia*, 3 February 2017, at http://www.genewsroom.com/press-releases/ge-help-increase-output-and-efficiency-eps%E2%80%99s-coal-fired-power-plant-serbia-283560, viewed on 7 November 2017.

114 Ms Anne Pearson, Chief Executive, AEMC, *Committee Hansard*, Canberra, 26 October 2017, p. 2.

115 Ms Audrey Zibelman, Managing Director and Chief Executive Officer, AEMO, *Committee Hansard*, Canberra, 14 September 2017, p. 12.

116 Ms Michelle Groves, Chief Executive Officer, AER, *Committee Hansard*, Canberra, 26 October 2017, p. 11.

> essentially to begin to unbundle the energy price to the various components that the system needs.[117]

3.64 In its submission to the inquiry, AGL recommended the establishment of new markets for ancillary services and the opening of the existing FCAS market to new providers:

> The introduction of new ancillary services markets will ensure that users appropriately value services, such as inertia, that had previously been available for free and in surplus.[118]

3.65 AGL also stated that in 2016 it submitted a rule change request to the Australian Energy Market Commission (AEMC) proposing the introduction of a market for inertia.[119]

3.66 Work is being done to address this issue. On 27 June 2017, AEMC published its final report of the system security market frameworks review. The report made nine recommendations for changes to market and regulatory frameworks to support the shift towards new forms of generation while maintaining power system security.[120] AEMO has a future power system security program, where is publishes reports and analysis as it completes work in relation to system security. For example, in August 2017 it published a working paper on fast frequency response in the NEM.[121]

Policy uncertainty

3.67 A strong theme in the evidence to the inquiry was that policy uncertainty—in other words, the lack of stable and enduring policy—has undermined investment in the electricity sector.[122]

3.68 Stakeholders both within and outside the electricity sector identified the lack of a clear mechanism to achieve emissions reduction in the sector as a primary cause of uncertainty.[123]

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117 Ms Audrey Zibelman, Managing Director and Chief Executive Officer, AEMO, *Committee Hansard*, Canberra, 14 September 2017, p. 8.

118 AGL, *submission 30*, p. 4.

119 AGL, *submission 30*, p. 4.

120 AEMC, *Final report: system security market frameworks review*, 27 June 2017.

121 AEMO, *Future power system security program – reports and analysis, https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Security-and-reliability/FPSSP-Reports-and-Analysis* , accessed on 7 November 2017.

122 Energy Networks Australia, *submission 38*, p. 6.

3.69 The Australian Government has made a series of domestic and international commitments to reduce Australia's greenhouse gas emissions. Most recently, in 2015, the Government committed to reducing Australia's emissions by 26 to 28 per cent below 2005 levels by 2030.[124] The Government has also ratified the Paris Agreement, which contains a commitment to limit global warming to 2 degrees Celsius above pre-industrial levels and ideally 1.5 degrees Celsius, as well as a commitment to zero net emissions in the second half of this century, with significant implications for the electricity sector.

3.70 Evidence to the inquiry emphasised the important role of the electricity sector in meeting Australia's commitment to reduce emissions, particularly given the limited ability to reduce emissions in other sectors of the economy (for example, transport and agriculture).[125]

3.71 However, the Committee heard that there is currently no clear mechanism to achieve long-term emissions reduction in the sector. The Business Council of Australia submitted:

> Australia's 2030 emissions reduction target has been set. ... But what has not been set is the signal necessary to support the investment needed for the electricity system to move away from emissions intensive generation technologies and significantly reduce its emissions.[126]

Effect on investment

3.72 The Committee heard that stable and enduring policy settings were particularly important in the electricity sector as electricity infrastructure

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123 For example: Australian Conservation Foundation, *submission 17*, p. 2; Business Council of Australia, *submission 51*, pp. 2–3; Ms Anne Pearson, Chief Executive, AEMC, *Committee Hansard*, Canberra, 26 May 2017, p. 23.

124 Department of the Environment and Energy, 'Australia's 2030 climate change target', <http://www.environment.gov.au/climate-change/publications/factsheet-australias-2030-climate-change-target> viewed 6 November 2017.

125 Electrical Trades Union of Australia, *submission 5*, p. 4; Australian Conservation Foundation, *submission 17*, p. 2; Monash Energy Materials and Systems Institute, *submission 55*, p. 1; Prof. Kenneth Baldwin, Director, Energy Change Institute, Australian National University, *Committee Hansard*, Canberra, 17 August 2017, p. 13; Mr Robert Murray-Leach, Head of Policy, Energy Efficiency Council, *Committee Hansard*, Canberra, 14 September 2017, p. 3.

126 Business Council of Australia, *submission 51*, p. 3.

generally involves capital intensive, long-lived assets, and investment timeframes could be as long as 50 years.[127]

3.73 In its submission to the inquiry, the Clean Energy Finance Corporation emphasised the importance of a stable policy framework for investment:

> ... the most important aspect from an investor viewpoint is a stable 'bankable' policy framework is necessary to promote investor confidence and capital availability and reduce risk, financing costs, and the overall costs of the transition.[128]

3.74 The Committee heard that resolving policy uncertainty in relation to emissions reduction was critical for investment in the electricity sector. Ms Anne Pearson, Chief Executive of the AEMC, explained:

> A market that is in transition needs investment certainty; investment certainty will not come until there is some certainty in emissions reductions policies.[129]

3.75 The Committee heard that, in the absence of policy certainty, businesses were delaying investment decisions.[130] Mr Kieran Donoghue, representing the Australian Energy Council, explained to the Committee that policy uncertainty had affected investment in new generation:

> What we have seen over the last year or two is the beginning of the closure of a number of large older generators and the lack of equivalent generation coming in to replace them. That is fundamentally down to the lack of policy clarity and that no-one knows what they should build.[131]

3.76 Similarly, Professor Kenneth Baldwin, Director of the Energy Change Institute at the Australian National University, submitted that policy uncertainty had stalled investment over the last decade:

> All the industry partners that we talk to say that they have not invested in the last decade because the risk of investing—and this applies to coal generators, gas generators, as well as renewables—is so great in this policy uncertain

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127 Australian Energy Council, *submission 49*, p. 1; Prof. Kenneth Baldwin, Director, Energy Change Institute, Australian National University, *Committee Hansard*, Canberra, 17 August 2017, p. 13; Engineers Australia, *submission 40*, p. 14; Business Council of Australia, *submission 51*, p. 2.

128 Clean Energy Finance Corporation, *submission 36*, p. 4.

129 Ms Anne Pearson, Chief Executive, AEMC, *Committee Hansard*, Canberra, 26 May 2017, p. 23.

130 Mr Richard Owens, Senior Director, AEMC, *Committee Hansard*, Canberra, 26 May 2017, p. 21.

131 Mr Kieran Donoghue, General Manager, Policy, Australian Energy Council, *Committee Hansard*, Canberra, 30 March 2017, p. 15.

> environment that they are not prepared to do it unless they have some sort of a trajectory.[132]

3.77 Mr Matthew Warren, Chief Executive Officer of the Australian Energy Council, explained that the electricity sector is particularly exposed to carbon risk:

> When businesses—I think this applies to all businesses, not just ours—go to build assets that have a carbon risk, and electricity is extremely exposed to this ... the banks will deal with the risk of those emissions in the future. That is an abstract concept, but it is not zero.[133]

3.78 Several stakeholders submitted that the industry was already factoring in a price on emissions when making investment decisions.[134] Mr Warren explained:

> ... the reality is, whether or not the Parliament of Australia monetises a carbon price, it exists, because when we go to banks the shadow price of carbon exists in the financing arrangements for our generation.[135]

3.79 Professor Baldwin suggested that the 'internal price on carbon' in the industry was at least $20 per tonne of carbon-dioxide equivalent (tCO_2e).[136]

Effect on wholesale prices

3.80 Evidence to the inquiry indicated that policy uncertainty had contributed to an increase in the wholesale price of electricity.[137] Based on the differential between forward wholesale prices and the underlying cost of supply, the Australian Energy Council estimated the cost of what it termed 'sustained

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132 Prof. Kenneth Baldwin, Director, Energy Change Institute, Australian National University, *Committee Hansard*, Canberra, 17 August 2017, p. 9.

133 Mr Matthew Warren, Chief Executive Officer, Australian Energy Council, *Committee Hansard*, Melbourne, 31 August 2017, p. 13.

134 Mr Vincent Duffy, Executive Director, Energy and Technical Regulation, Department of the Premier and Cabinet, *Committee Hansard*, Adelaide, 1 September 2017, p. 19.

135 Mr Matthew Warren, Chief Executive Officer, Australian Energy Council, *Committee Hansard*, Melbourne, 31 August 2017, p. 11.

136 Prof. Kenneth Baldwin, Director, Energy Change Institute, Australian National University, *Committee Hansard*, Canberra, 17 August 2017, p. 10.

137 For example: Mr Jon Stretch, Managing Director and Chief Executive Officer, ERM Power, *Committee Hansard*, Brisbane, 18 August 2017, pp. 18–19.

national policy inaction' to be effectively equivalent to a carbon price of $50 per tCO_2e.[138]

3.81 The argument was put to the Committee that higher prices in the wholesale market should act as an economic signal for new investment in the system (see discussion earlier in this Chapter).

3.82 However, the Committee heard that the effectiveness of this signal was undermined by the lack of policy certainty. Mr Paul Hyslop, Chief Executive Officer of ACIL Allen Consulting, explained:

> ... the solution to high prices is high prices, because high prices allow people to bring forward new solutions. They create incentives. I think the problem is that we have such a huge degree of uncertainty around the market.[139]

3.83 By way of contrast, a representative of the Government of South Australia explained that high prices in the wholesale energy market provided a strong economic signal to investors when South Australia entered the NEM in 1998-99.[140] Similarly, the Australian Energy Council noted that investment in new generation occurred in Queensland following the commencement of the NEM.[141]

3.84 The Committee heard that, with appropriate policy settings to encourage investment in the sector, the wholesale price for electricity could quickly stabilise at a lower level.[142]

3.85 The Australian Energy Market Commission also submitted that resolution of uncertainty regarding emissions reduction would assist in the resolution of other issues in the sector.[143]

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138 Australian Energy Council, *submission 49*, p. 1.

139 Mr Paul Hyslop, Chief Executive Officer, ACIL Allen Consulting, *Committee Hansard*, Melbourne, 31 August 2017, p. 23.

140 Mr Vincent Duffy, Executive Director, Energy and Technical Regulation, Department of the Premier and Cabinet, *Committee Hansard*, Adelaide, 1 September 2017, p. 19.

141 Mr Kieran Donoghue, General Manager, Policy, Australian Energy Council, *Committee Hansard*, Canberra, 30 March 2017, p. 17.

142 Mr Matthew Warren, Chief Executive Officer, Australian Energy Council, *Committee Hansard*, Melbourne, 31 August 2017, p. 13.

143 Ms Anne Pearson, Chief Executive, AEMC, *Committee Hansard*, Canberra, 26 May 2017, p. 23.

Effect on transmission and distribution networks

3.86 The Committee also heard evidence that, because government policy affects the evolution of the entire electricity system, policy uncertainty also affects investment in transmission and distribution networks.[144]

3.87 The Clean Energy Finance Corporation suggested that regulatory tests would operate more effectively in an environment with greater certainty regarding emissions reduction. Mr Tim Jordan explained:

> It is a multi-decade transition to a low-carbon electricity system, and a cost-benefit test for transmission that was operating in the context of a set of very clear, long-term policy settings could, in principle, deliver enough investment in transmission that would unlock renewable resources to deliver a lower cost outcome.[145]

3.88 Mr Richard Owens, Senior Director of the Australian Energy Market Commission supported this point:

> If there is a carbon price or some other emissions price, that will be taken into account through [the Regulatory Investment Test for Transmission], and new interconnectors can be built by taking into account the value of that. But at the moment, without certainty as to long-term emissions policy, the market does not know how to price those investments.[146]

3.89 Further evidence relating to transmission and distribution networks is discussed in the Chapter 4 of this report.

Nature of policy certainty

3.90 While the consideration of specific mechanisms for emissions reduction was outside the scope of the present inquiry, the Committee received general evidence from stakeholders about the nature of the policy certainty required in the electricity sector.

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144 Prof. Michael Brear, Director, Melbourne Energy Institute, The University of Melbourne, *Committee Hansard*, Canberra, 17 August 2017, p. 11; Prof. Kenneth Baldwin, Director, Energy Change Institute, Australian National University, *Committee Hansard*, Canberra, 17 August 2017, p. 12.

145 Mr Tim Jordan, Investment Research, Clean Energy Finance Corporation, *Committee Hansard*, Canberra, 26 May 2017, p. 4.

146 Mr Richard Owens, Senior Director, AEMC, *Committee Hansard*, Canberra, 26 May 2017, p. 24.

3.91 As noted above, stakeholders highlighted the importance of establishing a policy framework that would promote investor confidence.[147] Mr Jon Stretch, Managing Director and Chief Executive Officer of ERM Power, explained:

> We need a set of market rules that are going to allow people like us, and other generators, to invest in new technology knowing that the business case is not going to be pulled from underneath them in three years' time when someone has a better idea of how things could run.[148]

3.92 However, Mr Stretch emphasised that he did not consider certainty to mean the absence of any risk, but simply the consistent application of rules beyond the parliamentary cycle.[149]

3.93 The Committee heard evidence that the specific target level of any mechanism for emissions reduction was not particularly important (with respect to the specific issue of policy certainty).

3.94 Instead, stakeholders emphasised that it was important that the mechanism itself would survive a change of government, and that there was a clear process to change the level of emissions reduction target.[150] Mr Donoghue explained:

> ... in principle if you are maintaining the mechanism and there is a clear process and time to adjust, then you should be able to deal with a change in the level of ambition. To be honest, if it turns out you can't then it's not the right mechanism.[151]

3.95 Similarly, Ms Pearson emphasised the importance a stable and predictable approach to any changes in the sector:

> One of the virtues of the governance framework that we have ... is that the way the rules are made and the way they are amended in a predictable way is seen as very positive for investment. ... I would have thought that a

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147 Mr Jon Stretch, Managing Director and Chief Executive Officer, ERM Power, *Committee Hansard*, Brisbane, 18 August 2017, p. 21; Mr Kieran Donoghue, General Manager, Policy, Australian Energy Council, *Committee Hansard*, Canberra, 30 March 2017, p. 18.

148 Mr Jon Stretch, Managing Director and Chief Executive Officer, ERM Power, *Committee Hansard*, Brisbane, 18 August 2017, p. 21.

149 Mr Jon Stretch, Managing Director and Chief Executive Officer, ERM Power, *Committee Hansard*, Brisbane, 18 August 2017, p. 21.

150 Mr Kieran Donoghue, General Manager, Policy, Australian Energy Council, *Committee Hansard*, Melbourne, 31 August 2017, p. 11.

151 Mr Kieran Donoghue, General Manager, Policy, Australian Energy Council, *Committee Hansard*, Melbourne, 31 August 2017, p. 14.

> governance model that provides certainty on an ongoing basis—not that things will never change, but that they will change in a predictable and stable way—is what is important.[152]

3.96 Along these lines, stakeholders emphasised the importance of consensus-based agreement. For example, Mr Graham Davies, Director of Resonant Solutions, told the Committee:

> If we don't get bipartisan support, I still think the industry will move forward, but it will be in a less managed transition, which is ideally what one wants to circumvent.[153]

3.97 The Committee heard that emissions reduction is not currently reflected in the National Electricity Objective (NEO)[154], and, as such, is not explicitly accounted for in decisions or recommendations made by agencies such as the AEMC and the AER.[155]

3.98 Representatives of the AEMC suggested that it was not necessary for emissions reduction to be included in the NEO, as any government policy would act as a constraint on the rulemaking of the AEMC.[156] Mr Owens explained:

> If parliament sets Australia's emissions reduction targets and ways to achieve those then integration means ... us applying the NEO to run the system in the most affordable and efficient way that meets those targets, rather than, for example, having us or the AER make judgements about what Australia's emissions target should be and what the most efficient mechanism is.[157]

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152 Ms Anne Pearson, Chief Executive, AEMC, *Committee Hansard*, Canberra, 26 May 2017, p. 25.

153 Mr Graham Davies, Director, Principal, Resonant Solutions Pty Ltd, *Committee Hansard*, Adelaide, 1 September 2017, pp. 9–10.

154 The National Electricity Objective is to promote efficient investment in, and efficient operation and use of, electricity services for the long-term interests of consumers of electricity with respect to price, quality, safety, reliability, and security of supply of electricity; and the reliability, safety and security of the national electricity system. When considering making a rule, or making a recommendation, the AEMC considers whether the objective would be promoted.

155 Mr Warwick Anderson, General Manager, Network and Finance Reporting, AER, *Committee Hansard*, Canberra, 26 May 2017, p. 16; Ms Anne Pearson, Chief Executive, AEMC, *Committee Hansard*, Canberra, 26 May 2017, p. 20.

156 Ms Anne Pearson, Chief Executive, AEMC, *Committee Hansard*, Canberra, 26 May 2017, p. 20.

157 Mr Richard Owens, Senior Director, AEMC, *Committee Hansard*, Canberra, 26 May 2017, p. 20.

3.99 On the other hand, some stakeholders argued that emissions reduction should be reflected in the NEO.[158] The Australian Conservation Foundation submitted that, currently, regulatory agencies cannot consider the environmental implications of decisions such as rule changes and network pricing determinations.[159]

3.100 Ms Pearson, representing the AEMC, submitted that it was appropriate for objectives for emission reduction to be set by parliaments, due to the value judgements involved, and then the mechanism to achieve those objectives would be integrated into the design of the energy market (also see paragraph 3.117).[160]

3.101 More broadly, the Committee heard evidence that the policy framework in the electricity sector should reflect principles such as technology neutrality[161], while taking into account emissions intensity, and should have sufficient flexibility to enable new technologies and services to emerge.[162]

3.102 Mr Graham Davies, Director of Resonant Solutions, submitted that it was important to consider the electricity system holistically, accounting for the interaction of generation, transmission, distribution, management, and demand, as well as non-electrical inputs.[163]

Concerns about governance arrangements

3.103 In addition to concerns about policy uncertainty, stakeholders expressed concerns about the responsiveness of regulatory reform, as well as the broader governance arrangements across the electricity sector.

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158 Australian Sustainable Built Environment Council, *submission 12*, p. 2; Engineers Australia, *submission 40*, p. 8.

159 Australian Conservation Foundation, *submission 17*, p. 6.

160 Ms Anne Pearson, Chief Executive, AEMC, *Committee Hansard*, Canberra, 26 May 2017, pp. 19–20.

161 Australian Academy of Technology and Engineering, *submission 31*, p. 6, AER, *submission 50*, pp. 2–3, Mr Jon Stretch, Managing Director and Chief Executive Officer, ERM Power, *Committee Hansard*, Brisbane, 18 August 2017, p. 19.

162 AusNet Services, *submission 27*, p. 4; CSIRO, *submission 33*, p. 2; Engineers Australia, *submission 40*, p. 14; Business Council of Australia, *submission 51*, pp. 3–4; Prof. Kenneth Baldwin, Director, Energy Change Institute, Australian National University, *Committee Hansard*, Canberra, 17 August 2017, p. 12.

163 Mr Graham Davies, Director, Principal, Resonant Solutions Pty Ltd, *Committee Hansard*, Adelaide, 1 September 2017, p. 8; Resonant Solutions Pty Ltd, *submission 11*, pp. 4–5.

Lack of responsiveness

3.104 In evidence to the inquiry, the Australian Energy Market Operator emphasised that the pace of change in the industry has accelerated and that technology and business models are now less predictable than they were at the commencement of the NEM.[164]

3.105 However, AEMO explained that the current process for regulatory decision-making, including industry consultation and implementation and transition periods in some cases, could take 'many years'.[165] While noting the trade-off between the speed of the process and the number of regulatory bodies and agencies involved, AEMO submitted that the current process was not sufficiently forward looking.[166]

3.106 AEMO also submitted that accountabilities and obligations of market agencies were not always clearly defined.[167]

3.107 The Public Interest Advocacy Centre referred to the approved change to implement five minute settlement in the NEM, submitted by Sun Metals Corporation Pty Ltd in December 2015. This was highlighted as an example of the decision-making process lagging behind the pace of change in the sector.[168]

3.108 During the course of this inquiry, in September 2017, the AEMC released a draft determination on the rule change, proposing a transition period of three years and seven months to address concerns raised about the costs and risks of implementing the change.[169] In November 2017, the AEMC announced that five minute settlement would start on 1 July 2021.[170]

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164 AEMO, *submission 47*, pp. 3, 23; Ms Audrey Zibelman, Managing Director and Chief Executive Officer, AEMO, *Committee Hansard*, Canberra, 14 September 2017, pp. 7, 9.

165 AEMO, *submission 47*, p. 23.

166 AEMO, *submission 47*, pp. 2, 23.

167 AEMO, *submission 47*, pp. 22–23. See also: Mr Anthony Wood, Energy Program Director, Grattan Institute, *Committee Hansard*, Melbourne, 31 August 2017, p. 7.

168 Public Interest Advocacy Centre, *submission 32*, p. 2.

169 AEMC, 'Draft rule determination: National Electricity Amendment (Five Minute Settlement) Rule 2017', September 2017, pp. 134–136, < http://www.aemc.gov.au/getattachment/0eb01d4d-2c31-4f53-a32a-77d36726cb18/Draft-determination.aspx> viewed 6 November 2017.

170 AEMC, 'National Electricity Amendment (Five Minute Settlement) Rule 2017 No. 15', November 2017, p. 2, <http://www.aemc.gov.au/getattachment/2ff15971-4a28-4f6f-a753-5ebe8ae84f45/Final-rule.aspx> viewed 4 December 2017.

3.109 Earlier in the inquiry, when questioned about the time taken to consider the rule change, Ms Anne Pearson, Chief Executive of the AEMC, explained that the Commission had carried out industry consultation to understand the implications of the change.[171]

3.110 Ms Pearson also explained that the implementation timeframe was consistent with the approach taken in other electricity markets.[172]

3.111 Further evidence relating to specific changes to market rules is discussed in Chapter 5 of this report.

3.112 More broadly, some stakeholders also suggested that incremental changes were insufficient to address the systemic issues in the electricity sector.[173]

3.113 In its submission to the inquiry, AEMO recommended that higher regulatory instruments should be used to define roles and policy principles with broad expression, with settings within those broad areas to be managed through lower regulatory instruments by agencies such as AEMO and the AER.[174]

3.114 The submission also recommended a process that integrates network planning with required market and regulatory changes. AEMO argued that these changes would result in a decision-making process that was quicker and more transparent and would enable issues to be managed in their entirety.[175]

Jurisdictional issues

3.115 Concerns were also raised with the Committee regarding regulatory inconsistency across jurisdictions.

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171 Ms Anne Pearson, Chief Executive, AEMC, *Committee Hansard*, Canberra, 26 May 2017, p. 21.

172 Ms Anne Pearson, Chief Executive, AEMC, *Committee Hansard*, Canberra, 26 October 2017, p. 11.

173 Public Interest Advocacy Centre, *submission 32*, p. 2; Energy Networks Australia, *submission 38*, p. 25.

174 AEMO, *submission 47*, pp. 23–24.

175 AEMO, *submission 47*, pp. 23–24.

3.116 Mr Owens, representing the AEMC, explained that while there is a national framework in the electricity sector, and a common set of rules in the NEM, not all matters are covered by this arrangement:

> Some matters are in the national framework; some are not. ... state governments still set all of the reliability standards. ... A number of other matters like electrical safety and those sorts of things are still state matters; retail price regulation is also a state matter.[176]

3.117 In particular, Mr Owens noted that emissions reduction does not currently sit within the national framework:

> One of the biggest challenges at the moment is that emissions policy for the energy sector is not part of our national framework. There is no national agreement on emissions policy and that is not within any of the rules that we administer or within the COAG Energy Council process.[177]

3.118 Energy Networks Australia submitted that a lack of regulatory cohesion was one of the most significant challenges to the transition in the electricity sector.[178] Energy Networks Australia argued that Australia was notable among other jurisdictions for the extent of multiple and overlapping regulatory measures, particularly given the size of its population.[179]

3.119 Further to this evidence, Energy Networks Australia submitted that regulatory consistency would become more important as electricity services become more decentralised, and that unnecessary discontinuities between jurisdictions would pose a barrier to entry for new participants in the market.[180]

3.120 Similarly, Mr Ivor Frischknecht, Chief Executive Officer of the Australian Renewable Energy Agency, identified the requirement to obtain a retail license in each state as a barrier to entry for new retailers.[181]

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176 Mr Richard Owens, Senior Director, AEMC, *Committee Hansard*, Canberra, 30 March 2017, p. 13.

177 Mr Richard Owens, Senior Director, AEMC, *Committee Hansard*, Canberra, 30 March 2017, p. 13.

178 Energy Networks Australia, *submission 38*, p. 6; Mr John Bradley, Chief Executive Officer, Energy Networks Australia, *Committee Hansard*, Canberra, 1 June 2017, p. 9.

179 Energy Networks Australia, *submission 38*, pp. 23–24.

180 Energy Networks Australia, *submission 38*, p. 21.

181 Mr Ivor Frischknecht, Chief Executive Officer, Australian Renewable Energy Agency, *Committee Hansard*, Canberra, 30 March 2017, p. 13.

3.121 Stakeholders reflected on other challenges associated with the coexistence of regulation across jurisdictions. The Business Council of Australia submitted that unilateral action by state and territory governments distorted the operation of the NEM.[182] Energy Consumers Australia noted that the experience of consumers differed across the states and territories.[183]

3.122 Other stakeholders emphasised the importance of a nationally coordinated approach to the electricity sector.[184]

Recent policy developments

3.123 This section briefly summarises some relevant policy developments that have occurred during the course of the present inquiry.

Recommendations of the Finkel review

3.124 In June 2017, the final report of the Finkel review was presented to the COAG Energy Council.

3.125 The report included a package of 50 recommendations designed to facilitate an orderly transition in the electricity sector, enhance system planning, and strengthen governance arrangements.[185]

3.126 The report highlighted the impact of policy uncertainty on the sector:

> The uncertain and changing direction of emissions reduction policy for the electricity sector has compromised the investment environment in the NEM. ... It is critically important that there is widespread political and community acceptance of the need for a stable policy framework.[186]

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182 Business Council of Australia, *submission 51*, p. 2. See also: Bureau of Steel Manufacturers of Australia, *submission 39*, p. 3; Mr Anthony Wood, Energy Program Director, Grattan Institute, *Committee Hansard*, Melbourne, 31 August 2017, pp. 6–7.

183 Mr Chris Alexander, Energy Consumers Australia, *Committee Hansard*, Canberra, 30 March 2017, p. 7.

184 For example: Australian Academy of Technology and Engineering, *submission 31*, p. 2; Bureau of Steel Manufacturers of Australia, *submission 39*, p. 4.

185 Commonwealth of Australia, 'Independent review into the future security of the National Electricity Market: Blueprint for the future', June 2017, pp. 21–28, <https://www.environment.gov.au/system/files/resources/1d6b0464-6162-4223-ac08-3395a6b1c7fa/files/electricity-market-review-final-report.pdf> viewed 6 November 2017.

186 Commonwealth of Australia, 'Independent review into the future security of the National Electricity Market: Blueprint for the future', June 2017, p. 75, <https://www.environment.

3.127 In July 2017, the COAG Energy Council agreed to a timeline to implement 49 out of the 50 recommendations, and noted the significance of the final recommendation: to adopt a clean energy target.[187]

3.128 In the course of the present inquiry, stakeholders expressed broad support for the recommendations contained in the report, noting that the detail of the implementation of some recommendations was not yet finalised.[188]

October advice from the Energy Security Board

3.129 As noted in the previous Chapter, in August 2017 the COAG Energy Council announced the establishment of the Energy Security Board (ESB), giving effect to one of the recommendations of the Finkel review.[189] The ESB is responsible for implementation of the recommendations of the Finkel review, and for providing whole-of-system oversight for security and reliability.

3.130 On 13 October 2017, the ESB provided advice to the Chair of the COAG Energy Council, the Commonwealth Minister for the Environment and Energy, recommending that retailers be required to meet their load obligations with a portfolio of resources with a minimum amount of flexible, dispatchable capacity and an emissions level consistent with Australia's international emissions reduction commitments.[190]

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gov.au/system/files/resources/1d6b0464-6162-4223-ac08-3395a6b1c7fa/files/electricity-market-review-final-report.pdf> viewed 6 November 2017.

187 COAG Energy Council, '12th Energy Council Meeting Communique', < http://www.coagenergycouncil.gov.au/publications/12th-energy-council-meeting-communique-includes-11th-meeting-communique> viewed 6 November 2017.

188 Mr Jon Stretch, Managing Director and Chief Executive Officer, ERM Power, *Committee Hansard*, Brisbane, 18 August 2017, pp. 19, 21; Mr Anthony Wood, Energy Program Director, Grattan Institute, *Committee Hansard*, Melbourne, 31 August 2017, pp. 2–3.

189 COAG Energy Council, 'Establishment of the Energy Security Board', *Media release*, 8 August 2017.

190 Energy Security Board (ESB), 'ESB advice on retailer reliability, emissions guarantee, and affordability', < http://www.coagenergycouncil.gov.au/sites/prod.energycouncil/files/publications/documents/Energy%20Security%20Board%20ADVICE....pdf> viewed 6 November 2017.

3.131 On 17 October 2017, the Australian Government announced it had accepted the recommendation of the ESB and would work to implement these changes through the COAG Energy Council process.[191]

Box 3.2 Energy policy

Committee questionnaire:

Sensible and bi partisan energy policy underpins affordability, reliability and energy security. The electricity industry is undergoing a dramatic transformation and it energy policy needs to sustain reliability and affordability while transitioning to a low carbon future.

A key to market reliability is long term bi-partisan approach that takes adequate account of global circumstances. That is the only way to give certainty to private sector financiers. Globally we are heading toward a low-emission electricity market and Australia needs to get on board - or be left behind with a lower productivity economy.

The need for stable energy policy is the prime cause of high prices, as any energy planner will explain. The lack of this position results in very short term or no investment, leading to supply shortages.

I congratulate the Parliamentary committee on their work. I trust they will have an impact on the current political impasse

Committee comment

3.132 The Committee acknowledges the importance of achieving a stable and enduring policy framework in the electricity sector.

3.133 As the electricity system continues to transition, policy certainty is required to ensure there is sufficient investment in the sector, and to ensure that this investment is directed as efficiently as possible, balancing the objectives of security, reliability, and emissions reduction at least cost to consumers.

3.134 This applies across the electricity system, as the policy framework impacts upon generation, transmission and distribution networks, and the environment in which consumers interact with the grid.

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191 Prime Minister, 'National Energy Guarantee to deliver affordable, reliable electricity', *Media release*, 17 October 2017.

3.135 The Committee accepts the evidence that the primary cause of policy uncertainty is the lack of a mechanism to achieve emissions reduction in the electricity sector. The electricity sector is capital intensive and particularly exposed to carbon risk, and the lack of policy certainty has clearly undermined investment in the sector.

3.136 As such, resolving this policy uncertainty—that is, establishing a stable and enduring mechanism for emissions reduction in the electricity sector—is critical to modernising Australia's electricity system in an efficient and orderly manner.

3.137 Moreover, as the electricity sector is a major contributor to Australia's emissions, this will be an important step in Australia meeting its emissions reduction objectives.

3.138 The Committee is aware of the extensive and ongoing debate regarding different mechanisms for emissions reduction. It is not the role of this Committee to endorse any one particular mechanism.

3.139 However, based on the evidence to the inquiry, the Committee makes the following observations:

- Given the capital intensive nature of the electricity sector and the long lifetime of some assets for generation and transmission, investors require certainty beyond a single term of parliament. Therefore, consensus-based agreement on a mechanism for emissions reduction is critical.
- Any mechanism for emissions reduction should be technology neutral, subject to the physical requirements of the electricity system, so that emissions reduction can be achieved at least cost to consumers.
- Any mechanism for emissions reduction should aim to provide certainty for investors, but also be sufficiently flexible so as to not unduly restrict future governments (for example, the mechanism could incorporate a notice period for changes to previously set targets).
- Targets for emissions reduction in the electricity sector should be consistent with Australia's international commitment under the Paris Agreement, which is to limit global warming to 2 degrees Celsius and ideally 1.5 degrees Celsius, as well as a commitment to zero net emissions in the second half of this century. It should be noted that there is a live debate about whether the electricity sector's contribution to emissions reduction should be proportionate or disproportionate.

- Lastly, to mitigate the risk of future uncertainty, any mechanism for emissions reduction should be sufficiently flexible to accommodate changes to other arrangements in the electricity sector.

3.140 The Committee acknowledges the difficulty of achieving consensus-based agreement on this issue. However, the Committee considers that resolving policy uncertainty in relation to emissions reduction in the electricity sector would be of enormous value, both to the sector and to the community more broadly.

3.141 The conduct of this inquiry has made it evident that it is possible for a multi-party Committee to come together in the spirit of consensus to review the policy issues relating to the modernisation of the NEM. Many stakeholders provided positive feedback in relation to the consensus-based approach of the Committee.

Recommendation 1

3.142 The Committee affirms the importance of resolving policy uncertainty in relation to emissions reduction in the electricity sector. The Committee commends to the House the establishment of a stable and enduring mechanism for scalable emissions reduction in the electricity sector, with appropriate notice given for changes in targets.

3.143 Moving beyond this issue, the Committee is of the view that market and regulatory changes may be required to ensure that the security and reliability of the electricity system is maintained over time.

3.144 The Committee wishes to emphasise that Australia's electricity system continues to provide a secure and reliable supply of electricity. However, the system was designed in an environment where electricity was supplied by large synchronous generators. As such, as the generation mix continues to change, market and regulatory changes may be required to accommodate and adapt to the changing physical characteristics of the system.

3.145 The Committee accepts the evidence that the changing nature of the electricity system is prompting the need to consider new approaches to maintaining system reliability. In particular, the Committee supports the consideration of new approaches to maintaining an appropriate level of flexible, dispatchable capacity in the system.

Recommendation 2

3.146 The Committee recommends that the Minister for the Environment and Energy, through the Council of Australian Governments Energy Council, investigate new market, non-market, and regulatory, approaches to maintaining an adequate level of flexible, dispatchable capacity in the National Electricity Market.

3.147 The Committee supports the consideration of approaches including but not limited to capacity markets, day-ahead markets, reverse auctions, strategic reserves, and long-term power purchase agreements.

3.148 Regardless of the approach, the system must recognise the need for—and appropriately value—capacity that is available on demand and able to accommodate the increasing variability in the electricity system.

3.149 The Committee notes that flexible, dispatchable capacity can be provided by a suite of resources, on both the supply side and the demand side, including traditional and new types of generation, upgrades to existing generators, storage, behind-the-meter resources, demand response, and network upgrades.

3.150 Similarly, the Committee accepts the evidence that there is a need to consider new approaches to ensuring that necessary system security services continue to be provided over time.

Recommendation 3

3.151 The Committee recommends that the Minister for the Environment and Energy, through the Council of Australian Governments Energy Council, investigate new market, non-market, and regulatory approaches to maintaining an adequate level of system security services in the National Electricity Market.

3.152 The Committee recognises that system security services—for example, inertia and frequency control—can be provided by a range of existing and new technologies. The Committee is keen to ensure that the true value of these services is reflected in the system.

3.153 The Committee supports the consideration of approaches including but not limited to the establishment of new markets for system security services and a review of connection standards, settings, and obligations for new and existing generators.

3.154 With respect to Recommendations 2 and 3, the Committee supports a technology neutral approach guided by the physical requirements of the system, such that security and reliability is achieved at least cost to consumers.

3.155 The Committee also supports an approach that seeks to enhance, and does not diminish, competition in the markets for energy and system security services.

3.156 The Committee is of the view that AEMO is well placed to provide advice to the COAG Energy Council on appropriate mechanisms for maintaining security and reliability.

3.157 However, the Committee considers that there may be a role for an independent authority in establishing the requirements for dispatchable capacity and system security services. Evidence regarding the role of an independent system planner is discussed in the Chapter 4 of this report.

3.158 With respect to Recommendations 2 and 3, given the pace of change in the electricity system, the Committee considers that these recommendations should be approached with a view to commencing implementation of any changes by the end of 2018.

3.159 The Committee emphasises that these recommendations do not seek to undermine or limit the contribution of variable generation such as wind and solar. On the contrary, establishing appropriate settings in relation to security and reliability will ensure that these technologies can be incorporated into the grid effectively and at least cost.

3.160 More broadly, the Committee is of the view that the governance arrangements in the electricity sector are not sufficiently responsive in an environment characterised by rapid change.

3.161 The Committee is particularly concerned about the length of time taken to consider and implement changes to market rules. The Committee is not confident that the current rule-making process can appropriately accommodate the changes that are expected to occur over the coming years.

3.162 As such, the Committee urges the COAG Energy Council to consider options to expedite the rule-making process.

Recommendation 4

3.163 The Committee recommends that the Minister for the Environment and Energy, through the Council of Australian Governments Energy Council, identify and implement changes to improve the responsiveness of the rule-making process in the National Electricity Market.

3.164 Lastly, the Committee notes that there is an important role for parliamentarians, as the elected representatives of the Australian community, in shaping the policy framework in which the electricity sector operates.

3.165 As such, the Committee welcomes the opportunity that the present inquiry provided to engage with stakeholders in the sector, and to closely examine the transition underway in the electricity system. Given the extent of the changes ahead, the Committee considers it important for the Australian Parliament's energy committee to continue to remain engaged in this important policy area.

3.166 The Committee notes that the Energy Security Board has been established with responsibility for implementation of the recommendations of the Finkel review, and for providing whole-of-system oversight for energy security and reliability. As the ESB was established towards the end of the conduct of this inquiry, this report does not provide an in depth review of the work of the ESB at this time.

3.167 With a view to the future, the Committee considers that the Energy Security Board is well placed to provide the Committee—and through it, the Parliament and the public—with a regular briefing on the electricity system.

Recommendation 5

3.168 The Committee recommends that the Minister for the Environment and Energy, through the Council of Australian Governments Energy Council, authorise the Energy Security Board to provide a briefing to the Committee every six months, until otherwise agreed by the relevant committee. The briefings should provide information on the state of the National Electricity Market, progress implementing the recommendations of the Finkel review that have been accepted by the Council of Australian Governments Energy Council, and any other relevant matters.

3.169 The recommendations outlined in this Chapter are intended to bring about a policy framework that provides greater certainty for investors and is more responsive to the changing nature of the electricity system.

3.170 The Committee is of the view that these changes are essential if the system is to deliver secure, reliable, and affordable electricity into the future, while also contributing to meeting Australia's emissions reduction objectives.

3.171 The Committee considers that these findings are broadly consistent with the recommendations of the Finkel review and complement existing reform processes underway in the electricity sector.

4. Network planning and investment

4.1 This Chapter will note the historical success of the National Electricity Market, and then examine the two main challenges to network planning and investment on the grid: system stability and reliability. The Chapter will also consider the changing relationship consumers are having with the grid. The Committee will propose some options to consider in managing the grid of the 21st century, including increased planning and a focus on investment.

A 21st century grid

4.2 The Committee travelled to each of the mainland National Electricity Market (NEM) states where it heard evidence as to how the grid could be modernised to better meet the challenges of the future.

4.3 The national electricity grid is a complex system of generators, transmission lines, interconnectors, poles and wires. It features a mix of private and public investment, and is increasingly called upon to manage a new and changing power supply.

4.4 Electricity grids have been described as the world's largest machines. Australia's transmission and distribution network infrastructure operates over 900,000 kilometres of wires, synchronising frequency whilst balancing supply and demand instantaneously.[192]

4.5 The management of this grid is changing. It is predicted that by the year 2050, customers will determine more than a quarter of all system investment decisions, to a value of $224 billion.[193]

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192 Mr John Bradley, Chief Executive Officer, Energy Networks Australia, *Committee Hansard*, Canberra, 1 June 2017, p. 1.

193 Mr John Bradley, Chief Executive Officer, Energy Networks Australia, *Committee Hansard*, Canberra, 1 June 2017, p. 1.

4.6 The Committee heard that Australia has an unusual system in that it features the separation of a modest number of middle sized cities separated by very large distances, which means that transmission plays an unusual role in our country, with that role changing significantly.[194] The Committee also heard that whilst investments in generation have largely been left to market participants to determine, transmission has largely been determined by the regulatory system, with that only changing in recent times.[195]

4.7 The Australian Energy Regulator reflected on the success of the NEM:

> … certainly our position at the AER has been that the NEM market model, the underlying economics of it being based on the structure that it has, delivered safe, reliable energy for quite a significant period of time. We saw investment. It may not have been investment in a lot of base load. There was some. But that wasn't necessarily what the market needed at that time. In fact, my recollection of what some of the big investment needs were in the early days of the NEM were some more fast-start peaking plants, because we moved into an increasingly volatile demand response. We saw the increasing penetration of air conditioners et cetera as they became more common as a consumer item. That really led to some very significant changes in the peak. And what we saw then were investment signals and responses by the market, by building faster-start peaking plant.[196]

4.8 The Committee heard that regardless of the changing nature of the generation of electricity, the continuing necessity of a grid was likely due to matters of scale:

> The reason is that there are innate efficiencies in the scale of generation of electricity, whether it's renewable or thermal. While we do see increasing use of distributed generation and storage and dispatch—and that will continue to evolve and change the nature of the operation of the grid—it is still incredibly cost-effective to produce and generate electrons at large scale. Given the nature of cities and industrial processes, it's hard to see that that will be replaced at any time during the 21st century.[197]

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194 Mr Tony Wood, Energy Program Director, Grattan Institute, *Committee Hansard*, Melbourne, 31 August 2017, p. 1.

195 Mr Tony Wood, Energy Program Director, Grattan Institute, *Committee Hansard*, Melbourne, 31 August 2017, p. 1.

196 Ms Michelle Groves, Chief Executive Officer, Australian Energy Regulator, *Committee Hansard*, Canberra, 26 October 2017, p. 8.

197 Mr Matthew Warren, Chief Executive Officer, Australian Energy Council, *Committee Hansard*, Melbourne, 31 August 2017, p. 9.

4.9 However, given that the modern grid is facing new challenges in the form of intermittent variable technologies like renewables, the Committee heard that the grid cannot continue to be operated how it was run in the 20th century.[198]

System stability

4.10 This section of the Chapter will review system stability, sometimes referred to as system security. It will define system stability, noting why it has not historically been a problem faced by the grid. This section will then provide some recommendations as to how we can ensure that system stability is maintained on the grid.

What is system stability?

4.11 As outlined in Chapter 3, system stability, or system security, refers to the physics of the grid whereby the power system is kept stable and operating within technical limits. Through the provision of energy from generators, the elements that deliver this stability include inertia to help the power system manage rapid changes and disturbances. Stability is also achieved by having the tools and information to understand the changing power system, including information to generators' models and data, as well as frequency operating standards and an understanding of how each generator connectsto the system.[199]

System security (stability) services

Frequency response

4.12 Frequency response refers to systems designed to maintain the system at its frequency of 50 Hertz.

4.13 Professor Michael Brear, Director of the Melbourne Energy Institute, University of Melbourne, gave evidence about frequency response adequacy.[200] Work done by the Institute indicated that the grid would

198 Mr Matthew Warren, Chief Executive Officer, Australian Energy Council, *Committee Hansard*, Melbourne, 31 August 2017, p. 10.

199 Ms Anne Pearson, Chief Executive, Australian Energy Market Commission, *Committee Hansard*, Canberra, 26 October 2017, p. 1.

200 Professor Michael Brear, Director of the Melbourne Energy Institute, University of Melbourne, *Committee Hansard*, 17 August 2017, p. 2.

experience issues in relation to frequency response adequacy in the future, regardless of what technology was powering the grid.[201] The Institute also found that there are a number of technologies and services that can provide so-called fast frequency response and play a significant role in supporting frequency control and frequency regulation. These include demand response, energy storage and synthetic inertia (provided by wind and solar, for example), and frequency response could be managed via operational measures in electricity market design.[202]

Synchronous generation

4.14 Synchronous generation is energy generation that maintains inertia on the grid.

4.15 The Committee heard that the science currently suggests that in circumstances where renewable penetration exceeds 40 per cent of the grid, system stability in the form of inertia needs to be addressed, including through planning.[203] Unless addressed by the market operator and the renewable energy industry, this lack of inertia may limit the ability of renewable sources of energy to further penetrate the grid.

4.16 The Melbourne Energy Institute found that the system could securely run with a minimum generation output in the order of 25 per cent of the minimum demand, being four gigawatts, of synchronous generation.[204] The corollary of this is that the system could run securely with up to 75 per cent of asynchronous generation. The Institute noted that different technologies can provide this service and may not be currently utilised. One of the key challenges posed by the reform process is to identify those capabilities and exploit them.[205] In addition to coal-fired power stations, synchronous power

201 Professor Michael Brear, Director of the Melbourne Energy Institute, University of Melbourne, *Committee Hansard,* 17 August 2017, p. 3.

202 Professor Michael Brear, Director of the Melbourne Energy Institute, University of Melbourne, *Committee Hansard,* 17 August 2017, p. 3.

203 Mr Karl Rodrigues, Acting Director, Energy, CSIRO, *Committee Hansard*, Canberra, 30 March 2017, p. 20.

204 Professor Michael Brear, Director of the Melbourne Energy Institute, University of Melbourne, *Committee Hansard,* 17 August 2017, p. 3.

205 Professor Michael Brear, Director of the Melbourne Energy Institute, University of Melbourne, *Committee Hansard,* 17 August 2017, p. 4.

can be provided by pumped hydro, thermal power, batteries or other devices that simulate big, heavy machines.[206]

4.17 Whilst the Committee heard evidence about synthetic inertia, it also heard that 'it is a very brave claim for anyone to say that we don't need mechanical inertia in a modern power system', whether or not that mechanical inertia was provided by coal-fired power stations, thermal power stations or via pumped hydro.[207] The Committee also heard of the advantages of co-locating the pumped hydro storage with renewables.[208]

4.18 The Committee also heard evidence that in order to ensure inertia remained on the grid, it was a service that needed to be paid for to sufficiently incentivise the delivery of inertia as a service.[209]

Timeframes and periods of notice for generator retirement

4.19 The Committee heard evidence that understanding when significant pieces of network infrastructure are likely to be retired from the grid was essential for system stability. The Australian Energy Market Operator (AEMO) gave evidence that in other jurisdictions, a mandated notice period for the closure of infrastructure gives the market operator the opportunity to calculate whether that will compromise reliability or security of the grid. If it will, the market operator can enter into a contract with that generator so that generator may recover its cost and going-forward expense for the period of

206 Dr Glenn Platt, Research Program Director, Energy, CSIRO, *Committee Hansard*, Canberra, 30 March 2017, p. 19.

207 Professor Michael Brear, Director of the Melbourne Energy Institute, University of Melbourne, *Committee Hansard,* 17 August 2017, p. 13.

208 Professor Simon Bartlett, Australian Chair in Electricity Transmission, University of Queensland, *Committee Hansard,* Brisbane, 18 August 2017, p. 6.

209 Mr Oliver Yates, Chief Executive Officer, Clean Energy Finance Corporation, *Committee Hansard*, Canberra, 30 March 2017, p. 19; see also Mr John Bradley, Chief Executive Officer, Energy Networks Australia, *Committee Hansard*, Canberra, 1 June 2017, p. 6; see also Mr Ivor Frischknecht, Chief Executive Officer, Australian Renewable Energy Agency, *Committee Hansard*, Canberra, 26 May 2017, p.11; see also Professor Simon Bartlett, Australian Chair in Electricity Transmission, University of Queensland, *Committee Hansard,* Brisbane, 18 August 2017, p. 7.

time until the market can react.[210] The market operator's funds would be generated by transmission rates.[211]

4.20 Whilst some concern was raised in relation to potential anti-competitive practice and restrictive trade practices, the Committee heard that it was important for planners to know years in advance when particular types of power generation were to be retired from the grid.

Stability provided by coal-fired power generation

4.21 Two of the issues relating to the energy trilemma – stable and affordable energy – have been historically addressed on the grid through the supply of coal fired power. This source of power has proven to be a cheap source of energy in Australia, and given that it is continuously produced it had the effect of providing a stable and continuous source of energy onto the grid.

4.22 Following Australia's climate change commitments, this source of power is becoming less viable and as the coal fired production plants reach retirement age there do not appear to be any current plans within the National Electricity Market to replace these coal fired power plants with the same energy source. Whilst historically coal-based sources of power have been expensive to establish, the cost of establishing renewable energy generation is reducing.

The introduction of instability to the grid

4.23 Given Australia's commitments to reducing carbon emissions, and the ageing nature of Australia's coal power fleet, the mix of energy generation in Australia is changing. The increase of solar and wind in the mix will have an impact on the transmission network, which was historically designed to transport large-scale synchronous generation — located close to major energy resources — to load centres.[212] Renewable generation is expected to

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210 Ms Audrey Zibelman, Chief Executive Officer, Australian Energy Market Operator, *Committee Hansard*, Canberra, 26 May 2017, p. 30; see also Mr John Bradley, Chief Executive Officer, Energy Networks Australia, *Committee Hansard*, Canberra, 1 June 2017, p. 7.

211 Ms Audrey Zibelman, Chief Executive Officer, Australian Energy Market Operator, *Committee Hansard*, Canberra, 26 May 2017, p. 30.

212 Australian Energy Market Operator, *National transmission network development plan*, December 2016, https://www.aemo.com.au/-/media/Files/Electricity/NEM/Planning_and_Forecasting/NTNDP/2016/Dec/2016-NATIONAL-TRANSMISSION-NETWORK-DEVELOPMENT-PLAN.pdf, accessed 11 October 2017, p. 4.

connect to the grid in areas with high wind and solar radiation, which tend to be weaker parts of the grid designed to supply only local load.

4.24 It is not only the power sources that are creating instability on the grid. The timing of demand is also having an impact on stability. The demand profile for electricity consumption typically follows a dip during the day with an increase in demand later in the day when workers arrive home and turn on their air conditioning units. Known as the duck curve, Professor Ertugrul from the University of Adelaide described the circumstances creating the electricity usage profile as 'dangerous' because it puts greater demand on balancing the frequency of the grid, which needs to maintain a frequency of 50 Hertz.[213]

Stability whilst being technology neutral

4.25 This section considers the proposition that the NEM would work best by being technologically neutral, empowering the operating body to bring on power and auxiliary services as necessary to maintain system stability and enabling the market to decide which forms of energy it will invest in.

4.26 The Committee heard from Mr Graham Davies, an engineer and an advocate of renewable energy, who outlined that whilst 'renewables, along with ancillary services … offer the most secure, reliable way for electricity going forward … there will still be coal and gas being used as a transition' fuel.[214]

4.27 The Committee heard that a key driver of the investment in renewables had been the Renewable Energy Target (RET), with the RET providing the economic incentive to bridge the gap between the cost of renewables and what people consider normal grid energy prices that come from the wholesale pool.[215] However, the Committee considers it timely to analyse past and current programs in order to learn lessons for future programs.

4.28 The Australian Renewable Energy Agency (ARENA) gave the following evidence in relation to the competitiveness of renewables in the NEM:

> I looked at my app to see what the current market prices are. They range from, in the different states, $67 per megawatt hour to roughly $120 per megawatt

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213 Professor Nesimi Ertugrul, School of Electrical and Electronic Engineering, University of Adelaide, *Committee Hansard*, Adelaide, 1 September 2017, p. 6.

214 Mr Graham Davies, Director and Principal, Resonant Solutions Pty Ltd, *Committee Hansard*, Adelaide, 1 September 2017, p. 8.

215 Mr Vince Duffy, Department of Premier and Cabinet, South Australian Government, *Committee Hansard*, Adelaide, 1 September 2017, p. 16.

> hour. You can get a new wind farm for between $50 and $60 a megawatt hour and a new solar farm for between $70 and $80 a megawatt hour. With these kinds of current prices, and all of the forward prices are above $100, if you got a contract price in the future then why wouldn't you just buy renewables, even without any incentives?[216]

4.29 The Australian Energy Market Commission noted the advantages of operating in a regulatory environment which focuses on a technology neutral approach. Given that the prices of various commodities are uncertain, a model that is technology neutral — such as an emissions intensity scheme — can drive 'whatever the right mix is'.[217] This could involve solar and storage, or solar thermal or pumped hydro,

> But something technology neutral, like an EIS, is likely to give you the best price outcomes not matter what those assumptions are. You cannot model an uncertain future.[218]

4.30 AEMO confirmed that it, too, was 'fuel neutral'.[219]

System reliability through interconnection

4.31 The Committee heard that two ways of balancing intermittent energy generation are storage and greater interconnection. Storage can be a very expensive approach whereas interconnection can be more viable. Increased interconnection is an alternative method of stabilisation. Geographic diversity can also assist in providing reliability, because over larger areas weather conditions are less correlated. Storage can work alongside geographic diversity to deliver energy security and reliability.[220]

Interconnectors

4.32 The grid relies on interconnectors to increase the flow of energy around the NEM. AEMO gave evidence to the Committee that interconnection provides

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216 Mr Ivor Frischknecht, Chief Executive Officer, Australian Renewable Energy Agency, *Committee Hansard*, Canberra, 26 May 2017, p.10.

217 Mr Richard Owens, Senior Director, Australian Energy Market Commission, *Committee Hansard*, 26 May 2017, p. 25.

218 Mr Richard Owens, Senior Director, Australian Energy Market Commission, *Committee Hansard*, 26 May 2017, p. 25.

219 Ms Audrey Zibelman, Managing Director and Chief Executive Officer, Australian Energy Market Operator, *Committee Hansard*, Canberra 14 September 2017, p. 8.

220 Clean Energy Finance Corporation, *Submission 38*, p. 2.

the NEM with the opportunity to take advantage of geographic and time diversity. This also provides the NEM with the opportunity to avoid building redundancy locally in states and create a more national market.[221]

4.33 Interconnectors will continue to play an integral role in the modern grid. However, given the changes to the power sources on the grid the kinds of interconnection might be required change. The Committee heard that in Europe and China, in order to facilitate increasing levels of wind and solar PV energy a new type of transmission interconnection is being utilised, being high voltage direct current (HVDC).[222] This involves the use of voltage source converters (VSC).[223]

Additional connectors

4.34 There is evidence that there would likely be a positive benefit in establishing an additional interconnector.[224] Under the NEM Rules, when a new interconnector is built the cost of that interconnector is borne by the consumers of the states joined by the interconnector.[225]

4.35 Professor Bartlett outlined that Victoria and New South Wales have sufficient interconnection as both states have interconnectors coming from different directions.[226] However, Queensland and South Australia have limited interconnection as they are at the ends of what is a single line of transmission.[227] Professor Bartlett concluded that this will result in the system failing at high power levels, as the system did on 28 September 2016

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221 Ms Audrey Zibelman, Managing Director and Chief Executive Officer, Australian Energy Market Operator, *Committee Hansard*, Canberra 14 September 2017, p. 8.

222 Professor Simon Bartlett, Australian Chair in Electricity Transmission, University of Queensland, *Committee Hansard,* Brisbane, 18 August 2017, p. 2.

223 Professor Simon Bartlett, Australian Chair in Electricity Transmission, University of Queensland, *Committee Hansard,* Brisbane, 18 August 2017, p. 2.

224 Mr John Bradley, Chief Executive, Energy Networks Australia, *Committee Hansard,* Canberra, 30 March 2017, p. 6. and see AEMO *National transmission network development plan*

225 Mr Richard Owens, Senior Director, Australian Energy Market Commission, *Committee Hansard,* Canberra, 30 March 2017, p. 7.

226 Professor Simon Bartlett, Australian Chair in Electricity Transmission, University of Queensland, *Committee Hansard,* Brisbane, 18 August 2017, p. 2.

227 Professor Simon Bartlett, Australian Chair in Electricity Transmission, University of Queensland, *Committee Hansard,* Brisbane, 18 August 2017, p. 2.

in South Australia.[228] He noted that given the amount of synchronous generation that exists in Queensland, an additional interconnector between South Australia and Queensland would build additional system strength and avoid future collapses.[229]

4.36 The Committee heard evidence that for the last five years Queensland and South Australia have had the highest average wholesale prices in the national market.[230] Professor Bartlett argued that this was because

> The way it works, the national market, is that as soon as one of those interconnectors—and if you only have one interconnector, there is only one—reaches its limit, as soon as it constrains, they constrain the market and, they say, no longer can cheap generators from New South Wales and Victoria compete in Queensland if its interconnector is constrained. No longer can cheap generation from Victoria and New South Wales compete in South Australia if its interconnector is constrained.
>
> What happens? The price goes absolutely sky high. It normally runs at about $40 to $100 a megawatt hour. It can get to $14,000 a megawatt hour, and that is why we've had the highest wholesale prices in Queensland and South Australia not just for the last few months but for the last five years.[231]

4.37 Professor Bartlett noted that the solution was additional interconnectors.[232]

4.38 The Committee also heard evidence about the benefits that would flow from connecting the Western grid with the NEM, primarily because of the time difference. Solar power from the west could supplement the requirements

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228 Professor Simon Bartlett, Australian Chair in Electricity Transmission, University of Queensland, *Committee Hansard,* Brisbane, 18 August 2017, p. 2.

229 Professor Simon Bartlett, Australian Chair in Electricity Transmission, University of Queensland, *Committee Hansard,* Brisbane, 18 August 2017, p. 2.

230 Professor Simon Bartlett, Australian Chair in Electricity Transmission, University of Queensland, *Committee Hansard,* Brisbane, 18 August 2017, p. 2.

231 Professor Simon Bartlett, Australian Chair in Electricity Transmission, University of Queensland, *Committee Hansard,* Brisbane, 18 August 2017, p. 2.

232 Professor Simon Bartlett, Australian Chair in Electricity Transmission, University of Queensland, *Committee Hansard,* Brisbane, 18 August 2017, p. 2.

of the east after sunset on the eastern seaboard.[233] The estimated cost is between $2 billion and $2.5 billion.[234]

4.39 More interconnectors could be provided in two ways. The first would involve any market participant, with permission, building a market interconnector that arbitrages price differences. An example of such an interconnector is the Basslink between Tasmania and Victoria, which is leased to Hydro Tasmania.[235] The second type of interconnector is a regulated interconnector, where the proponent — usually a transmission network — carries out a modelling review of the benefits that they believe would accrue to consumers from reducing the price differential between the regions and compare that to the expected cost of the asset. Then, if the benefits exceed the cost and the test is reviewed by the AER, they can go ahead and build it.[236]

4.40 Following this, the Committee heard evidence that the cost of trying to achieve a uniform flat price across the NEM would involve consumers paying for more transmission than they require.[237]

4.41 However, the introduction of additional interconnectors would change the way the grid responds in times of crisis. More interconnectors would enable the grid to take advantage of significant energy resources and infrastructure in remote parts of Australia. For example, a second interconnector in Tasmania, a Basslink interconnector, could take advantage of the 'roaring forties' winds.

4.42 Notwithstanding the possible advantages of greater levels of interconnection, AEMO warned that interconnection does not necessarily solve all challenges, noting that local network and non-network options are also needed to maintain a reliable and secure electricity supply:

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233 Professor Simon Bartlett, Australian Chair in Electricity Transmission, University of Queensland, *Committee Hansard,* Brisbane, 18 August 2017, p. 4.

234 Professor Simon Bartlett, Australian Chair in Electricity Transmission, University of Queensland, *Committee Hansard,* Brisbane, 18 August 2017, p. 4.

235 Mr Kieran Donoghue, General Manager, Policy, Australian Energy Council, *Committee Hansard*, Canberra, 30 March 2017, p. 5.

236 Mr Kieran Donoghue, General Manager, Policy, Australian Energy Council, *Committee Hansard*, Canberra, 30 March 2017, p. 5.

237 Mr Kieran Donoghue, General Manager, Policy, Australian Energy Council, *Committee Hansard*, Canberra, 30 March 2017, p. 5.

- Synchronous condensers, or similar technologies, will be required to provide local system strength and resilience to frequency changes;
- AEMO modelling suggests benefits from augmenting transmission in western Victoria to accommodate over 4 gigawatts of projected new renewable generation capacity.[238]

4.43 Professor Bartlett noted that given the number of coal-fired power stations that will be exiting the NEM in the coming decades, it was important that the synchronous energy that exists within the NEM not become stranded. He argued that this could be achieved through a stronger interconnection system.[239]

Other interconnection plans

4.44 AEMO's *National transmission network development plan* also highlights the advantages of co-ordination and contestability which maximise the benefits of transmission investments across the NEM. AEMO found:

- Modelling shows greater total net benefits when these developments are combined, creating a more interconnected NEM. These benefits are projected to increase as the energy transformation accelerates.
- Geographic and technological diversity smooths the impact of intermittency and reduces reliance on gas-powered generation. Greater interconnection facilitates this diversity and delivers fuel cost savings to consumers.
- A more interconnected NEM can improve system resilience.
- Contestability in transmission should make development more competitively priced, reducing costs for consumers.[240]

4.45 The Committee heard evidence from the South Australian Government that it had allocated $500,000 to co-sponsor with Electranet, the transmission company in South Australia, a regulator investment test for a new

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238 Australian Energy Market Operator, *National transmission network development plan*, December 2016, https://www.aemo.com.au/-/media/Files/Electricity/NEM/Planning_and_Forecasting/NTNDP/2016/Dec/2016-NATIONAL-TRANSMISSION-NETWORK-DEVELOPMENT-PLAN.pdf, accessed 11 October 2017, p. 3.

239 Professor Simon Bartlett, Australian Chair in Electricity Transmission, University of Queensland, *Committee Hansard,* Brisbane, 18 August 2017, p. 3.

240 Australian Energy Market Operator, *National transmission network development plan*, December 2016, https://www.aemo.com.au/-/media/Files/Electricity/NEM/Planning_and_Forecasting/NTNDP/2016/Dec/2016-NATIONAL-TRANSMISSION-NETWORK-DEVELOPMENT-PLAN.pdf, accessed 11 October 2017, p. 3.

transmission interconnector with the eastern states.[241] The links being reviewed included:

- Tailem Bend to Horsham, Victoria;
- Riverland in Berri to New South Wales;
- Port Augusta to Sydney; and
- Port Augusta to Brisbane.

4.46 The most economic appears to be through the Riverland to New South Wales.[242]

Meshing the grid

4.47 The Committee also heard evidence that the current configuration of the grid features a single chain of transmission.[243] It was argued that this makes the Australian grid 'the longest, weakest system in the world running at AC'.[244] Professor Bartlett outlined that where the grid has additional interconnectors and is 'meshed', if one part fails other parts step in immediately.[245]

4.48 In its December 2016 report, *National transmission network development plan*, AEMO outlined that notwithstanding cost, there would be benefit for potential interconnection developments, including:

- A new interconnector linking South Australia with either New South Wales or Victoria from 2021.
- Augmenting existing interconnection linking New South Wales with both Queensland and Victoria in the mid to late 2020s.

Hurdles to greater interconnection

4.49 The Committee heard that in circumstances where transmission lines are weak, there is limited opportunity to transmit generated electricity. The

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241 Mr Vince Duffy, Department of Premier and Cabinet, South Australian Government, *Committee Hansard*, Adelaide, 1 September 2017, p. 15.

242 Mr Vince Duffy, Department of Premier and Cabinet, South Australian Government, *Committee Hansard*, Adelaide, 1 September 2017, p. 15.

243 Professor Simon Bartlett, Australian Chair in Electricity Transmission, University of Queensland, *Committee Hansard,* Brisbane, 18 August 2017, p. 2.

244 Professor Simon Bartlett, Australian Chair in Electricity Transmission, University of Queensland, *Committee Hansard,* Brisbane, 18 August 2017, p. 2.

245 Professor Simon Bartlett, Australian Chair in Electricity Transmission, University of Queensland, *Committee Hansard,* Brisbane, 18 August 2017, p. 2.

Committee heard that, generally speaking, one kilometre of transmission line costs $1 million to construct.[246] Given the costs involved, the Committee heard that the economic signal to an individual company to build additional interconnection may not eventuate. Achieving a balance between market forces and government initiatives was considered imperative.[247]

4.50 The Committee also heard that as energy sources change – for example using hydrogen on a gas line — a DC line presents difficulty as it is not easy to tap into along the line; resulting in the choice of interconnector being a 'tricky' question.[248]

4.51 However, the Committee heard that there did not appear to be a more economical way of transporting energy from renewable energy zones than the existing DC transmission lines.[249]

4.52 An additional problem noted by the Committee was the risk that the cost of building additional interconnectors may not pass the RIT-T test.[250]

- A second Bass Strait interconnector from 2025, when combined with augmented interconnector capacity linking NSW identified above, although the benefits are only marginally greater than the costs.
- A Regulatory Investment Test for Transmission (RIT-T) will be required in each case to fully determine the optimal development to serve consumers.[251]

4.53 The Committee heard that without changes, the Regulatory Investment Test for Transmission (RIT-T) is unlikely to deliver sufficient timely investment in transmission infrastructure to cope with the needs of Australia's future electricity system.[252] The Clean Energy Finance Corporation notes that as

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246 Professor Nesimi Ertugrul, School of Electrical and Electronic Engineering, University of Adelaide, *Committee Hansard*, Adelaide, 1 September 2017, pp. 6-7.

247 Mr Graham Davies, Director and Principal, Resonant Solutions Pty Ltd, *Committee Hansard*, Adelaide, 1 September 2017, p. 9.

248 Mr Graham Davies, Director and Principal, Resonant Solutions Pty Ltd, *Committee Hansard*, Adelaide, 1 September 2017, p. 10.

249 Mr Graham Davies, Director and Principal, Resonant Solutions Pty Ltd, *Committee Hansard*, Adelaide, 1 September 2017, p. 10.

250 Professor Simon Bartlett, Australian Chair in Electricity Transmission, University of Queensland, *Committee Hansard,* Brisbane, 18 August 2017, p. 4.

251 Australian Energy Market Operator, *National transmission network development plan*, December 2016, https://www.aemo.com.au/-/media/Files/Electricity/NEM/Planning_and_Forecasting/NTNDP/2016/Dec/2016-NATIONAL-TRANSMISSION-NETWORK-DEVELOPMENT-PLAN.pdf, accessed 11 October 2017, p. 3.

252 Clean Energy Finance Corporation, *Submission 38*, p. 2.

currently implemented, the RIT-T favours smaller upgrades to transmission capacity and does not adequately consider the option value of proposed new investment, it uses inappropriately high discount rates and does not consider all relevant externalities.[253] In addition, its single-asset focus means it cannot take into account the joint benefits of coordinated augmentations, even when coordinating transmission investments can lead to a more interconnected NEM.[254]

4.54 The Committee also heard that the RIT-T should work in tandem with future planning opportunities and recognise any emissions objective.

System reliability through storage

4.55 As outlined above, the Committee heard that two ways of balancing renewables include storage and greater interconnection. Professor Kenneth Baldwin, Director of the Energy Change Institute at the Australian National University, quantified the cost of balancing renewables through the cost of storage. Noting that guaranteeing supply of electricity at times when renewable sources are not operational was an essential service, Professor Baldwin outlined that whilst renewables cost $50 per megawatt hour, the additional balancing cost is approximately $25 per megawatt hour.[255]

Committee comment

4.56 System stability is essential to the successful operation of the grid in the future. Ensuring sufficient ongoing supply is important. To achieve this, the Committee considers it important that the market mechanisms allow for change and that those mechanisms should be technology agnostic to allow for investment in appropriate technologies.

4.57 The Committee notes that the capped spot price in the NEM, $14 000, was designed to bring in additional investment when required. In circumstances where there appears to be insufficient supply in the market, it would seem to the Committee that this mechanism is not operating as it ought to.

4.58 The Committee considers it appropriate that an assessment be made as to whether the current rules appropriately incentivise investment in infrastructure to capture future benefit.

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253 Clean Energy Finance Corporation, *Submission 38*, p. 2.

254 Clean Energy Finance Corporation, *Submission 38*, p. 2.

255 Professor Kenneth Baldwin, Director of the Energy Change Institute at the Australian National University, *Committee Hansard*, 17 August 2017, p. 4.

4.59 Government schemes and/or subsidies exist to internalise externalities, including emissions.[256] Any future review of the grid should be mindful of the holistic manner in which the grid and the National Electricity Market operate.

4.60 In order to maintain system stability, the Committee considers that a rule outlining an appropriate notice period before the closure of a sizeable generator is important.

4.61 In circumstances where storage alone is an expensive approach to stabilising renewables on the grid,[257] the Committee considers that interconnection should be considered as an additional approach to achieving this outcome.

4.62 The Committee is keen to ensure that the infrastructure and rules are such that new sources of generation are not prevented or discouraged from connecting to the grid. In particular, the Committee is keen to take advantage of Australia's natural resources, including wind and sun.

4.63 The Committee would like to see a framework that enables Australia to take advantage of its energy resources. Whilst the Committee has looked to international jurisdictions to better understand how other nations are responding to the challenges of a modernising energy supply market, the Committee is particularly aware of the unique position Australia finds itself in as an island nation.

4.64 Given that the current RIT-T does not require consideration of how the grid may be expanded in the future, or reduced carbon emissions, the Committee considers it timely for the RIT-T to be reviewed to ensure that this test is not an impediment to proper planning or reducing carbon emissions.

Recommendation 6

4.65 The Committee recommends that the Minister for the Environment and Energy, through the Council of Australian Governments Energy Council, undertake a review of past and current subsidies and incentive schemes to inform the design of future schemes to ensure they are appropriate for a modern electricity grid.

256 Mr Graham Davies, Director and Principal, Resonant Solutions Pty Ltd, *Committee Hansard*, Adelaide, 1 September 2017, p. 11.

257 Professor Blakers, Executive Member, Energy Change Institute, Australian National University, *Committee Hansard*, Canberra, 30 March 2017, p. 6.

Recommendation 7

4.66 The Committee recommends that, independent of the Regulatory Investment Test for Transmission (RIT-T) process, the Australian Energy Market Operator be funded to undertake further feasibility studies to ascertain whether:

- **additional interconnectors are required on the grid and, if so, where; and**
- **additional transmission is required in certain areas of the grid, including appropriate planning for renewable energy zones.**

The Committee also recommends that the relevant rules, including the RIT-T process, be reviewed to take into account:

- **future expansion of the base for generating electricity; and**
- **emissions reduction in the electricity sector.**

Recommendation 8

4.67 The Committee recommends that system security services necessary for grid stability be ascribed a value that encourages investment in those services, with the Australian Energy Market Operator provided with the authority to take any steps necessary to ensure that there is a sufficient supply of system security services available.

Reliability

4.68 This section of the Chapter will review how reliability is delivered to the grid, how this differs depending on the jurisdiction and whether the high levels of required reliability are resulting in disproportionate costs. Forecasting demand and demand management as tools in the guarantee of the reliable supply of electricity are also examined.

What is reliability?

4.69 The Australian Energy Market Commission noted that reliability is about having sufficient capacity on the grid when it is required. A reliable system requires system security and reliable transmission and distribution works.[258]

4.70 The Australian Energy Market Operator gave evidence that Australia's power system operates extremely effectively, with a reliability standard of 99.998 per cent.[259]

4.71 The Committee heard that as the cost of electricity doubled in the last 10 years, reliability had improved. Excluding impacts following floods and cyclones, customers who previously experienced an average of two interruptions a year now experience one interruption each year.[260]

Jurisdictional differences

4.72 Reliability is managed differently by each of the states who have maintained this responsibility, except for Victoria where reliability of the grid is managed by AEMO.

4.73 In Victoria AEMO has a planning process that explicitly looks at estimates of the customer value of reliability so that whenever an investment is made it assesses how this will improve reliability and whether the cost of the reliability is a reasonable impost on the customer. In the other states, it is a matter for the state governments. Within each state there are different standards, with Ausgrid in Sydney required to deliver services with far fewer outages than the country New South Wales area served by Essential Energy.[261]

4.74 As a consequence of the Somerville Inquiry in 2004, the Queensland government significantly increased the reliability standards it imposed on its networks. The New South Wales government subsequently looked at its

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258 Ms Anne Pearson, Chief Executive, Australian Energy Market Commission, *Committee Hansard*, Canberra, 26 October 2017, p. 2.

259 Ms Audrey Zibelman, Chief Executive Officer, Australian Energy Market Operator, *Committee Hansard*, Canberra, 26 May 2017, p. 27.

260 Mr Warwick Anderson, General Manager, Network Finance and Reporting, Australian Energy Regulator, *Committee Hansard*, Canberra, 30 March 2017, p. 13.

261 Mr Richard Owens, Senior Director, Australian Energy Market Commission, *Committee Hansard*, Canberra, 30 March 2017, p. 13.

reliability standards and increased those in line with Queensland.[262] As a result, there is a very prescriptive requirement for reliability in those states, which can result in redundant assets. The "N minus one" test requires the networks in New South Wales and Queensland to guarantee that they can meet peak demand in that geographic area even if a significant part of the system is lost as a result of storm damage or a similar catastrophic event.

Box 4.1 Reliability

Committee questionnaire:

81.5 per cent of respondents rated their electricity service either reliable or very reliable.

Delivery of reliability

4.75 In addition to requiring networks to deliver reliability through infrastructure, the Committee understands that reliability is delivered through the NEM as retailers already use so called 'cap' contracts which act as a de facto capacity market.[263] AEMO announced that it has contracted all the reserve capacity it has calculated that is needed throughout the summer of 2017-18.[264]

Cost of reliability

4.76 The Committee heard evidence that historically around 20 per cent of the capital employed by network businesses was used for around three per cent of time throughout the year. Given that the spend on transmission and distribution was found to be about $5 billion per annum, the Australian Energy Regulator agreed that historically that meant that $1 billion dollars

262 Mr Warwick Anderson, General Manager, Network Finance and Reporting, Australian Energy Regulator, *Committee Hansard*, Canberra 30 March 2017, p. 9.

263 Simon Holmes a Court, 'Back to square one in energy policy: we now have a plan to produce a plan', *The Guardian*, 25 October 2017, https://www.theguardian.com/commentisfree/2017/oct/25/back-to-square-one-in-energy-policy-we-now-have-a-plan-to-produce-a-plan, accessed 25 October 2017.

264 Simon Holmes a Court, 'Back to square one in energy policy: we now have a plan to produce a plan', *The Guardian*, 25 October 2017, https://www.theguardian.com/commentisfree/2017/oct/25/back-to-square-one-in-energy-policy-we-now-have-a-plan-to-produce-a-plan, accessed 25 October 2017.

was spent annually to deal with a few days of electricity demand.[265] The AER gave evidence that it considers the alternative of demand management when making its network investment decisions.[266]

Box 4.2 Reliability – the international experience

Reliability in context: the international experience

Through the delegation to Germany and the United States, the Committee heard about various approaches to ensuring reliability in a modern electricity grid. These included:

- installing much more (in the order of 50 per cent more) capacity than would ever be required;
- setting a reliability benchmark which transmission system operators are required to meet. System operators are paid for performing better than the benchmark, or charged for failing to meet the benchmark;
- creating flexibility on the supply **and** demand sides;
- acquiring and paying for capacity through a capacity market, or a regulated capacity (or flexible capacity) requirement;
- making better use of energy storage, including pumped hydro storage;
- acquiring reserve capacity (a generator on standby, not permitted to bid into the energy only market), with very high financial penalties for any system operator that causes the reserve capacity to be activated - this results in system operators ensuring they acquire sufficient capacity (the reserve capacity in Germany has never been activated and there was a view that the design of the regulatory regime was such that the reserve capacity would never be activated).

Forecasting demand

4.77 One important aspect of delivering reliable energy is accurate forecasting of demand. Mr Ivor Frischknecht, Chief Executive Officer of the Australian Renewable Energy Agency, noted the importance of forecasting:

> It is not only forecasting of demand but also forecasting of supply that is important. If you have a renewable resource like wind and solar, they are obviously not always available, but if you know a day ahead, an hour ahead

265 Mr Warwick Anderson, General Manager, Network Finance and Reporting, Australian Energy Regulator, *Committee Hansard*, Canberra, 26 May 2017, p. 16.

266 Mr Warwick Anderson, General Manager, Network Finance and Reporting, Australian Energy Regulator, *Committee Hansard*, Canberra, 26 May 2017, p. 16.

> or a minute ahead — and your forecasts will get increasingly better as you get closer to the actual time of dispatch — then you can plan for it. You can plan to reduce demand, you can plan to have alternative generation available.[267]

4.78 The importance of forecasting with respect to the modern grid is underlined by the fact that under the previous system, consumers bore the cost. In the new world, consumers now have an option if they don't like the price — install renewables and sometimes batteries. In this context, the Committee heard that

> … you have to be very, very careful to get your forecast right and get those numbers right because if what comes through the line does not look like value for money there are a lot of people that will move.[268]

Unpredictable demand

4.79 The Committee also heard that new usage patterns will make demand peaks unpredictable. Professor Ertugrul, from University of Adelaide's School of Electrical and Electronic Engineering, noted that quick charging an electric bus would take between five and 15 minutes. The power required would be 1, 000 amps, which is the equivalent amount of energy consumed during the same time by 50 households.[269] Given the unpredictably of demand, forecasting becomes important in order to safeguard grid stability.

Unforeseen drop off in consumption – difficulty forecasting demand

4.80 The Committee heard that at the same time the energy companies were investing in infrastructure to deliver reliability, there was an unpredicted downturn in consumption. The Committee heard the factors contributing to the lower than predicted consumption included:

- energy efficiency standards;
- customers responding to price; and
- investment driven by feed-in tariffs for solar.[270]

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267 Mr Ivor Frischknecht, Chief Executive Officer, Australian Renewable Energy Agency, *Committee Hansard*, Canberra, 30 March 2017, p. 11.

268 Mr Chris Alexander, Director, Advocacy and Communications, Energy Consumers Australia, *Committee Hansard,* Canberra, 30 March 2017, p. 12.

269 Professor Nesimi Ertugrul, School of Electrical and Electronic Engineering, University of Adelaide, *Committee Hansard*, Adelaide, 1 September 2017, p. 2.

270 Mr John Bradley, Chief Executive Officer, Energy Networks Australia, *Committee Hansard*, Canberra, 30 March 2017, p. 8.

4.81 Notwithstanding the importance of forecasting as a tool for managing grid stability, the Committee recognises that forecasting is not a precise science.

Demand response

4.82 Demand response, sometimes referred to as demand management, is having the capacity to remove demand from the grid by agreement. This leads to grid reliability, as the market can have confidence that at times of peak demand there are mechanisms to remove some of that demand rather than just relying on supply tools to meet peak demand.

4.83 The Committee heard evidence that there are opportunities for a market operator to make agreements with industry and/or consumers to assist to reduce demand at times when the grid is struggling to meet demand. The Australian Energy Council noted that the cheapest way of not having a 1,000 megawatt generator running is to use demand by finding customers prepared to shed load and negotiate a mutually beneficial deal.[271]

4.84 Energy Networks Australia agreed that spending $1 billion per annum to manage peak demand that only occurs three or four days a year could be avoided:

> I think there were more efficient ways of us achieving a balance between supply and demand. Part of that comes back to the need to signal the cost of increased demand on the system. That is where our focus around tariff reform and demand based tariffs has been so important, partly because at the moment we do not really reward customers that help beat the peak, so you end up with system investment that is larger than it needs to be. When we look out to the longer term with that network transformation roadmap analysis, that is telling you that, partly through augmentation expenditure to meet peak demand and partly through replacement expenditure, we can avoid $16 billion in network investment.[272]

4.85 Following a change to the National Electricity Rules in 2015, the Australian Energy Regulator (AER) is required to develop a Demand Management Incentive Scheme and the Demand Management Innovation Allowance.

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271 Mr Matthew Warren, Chief Executive Officer, Australian Energy Council, *Committee Hansard*, Melbourne, 31 August 2017, p. 10.

272 Mr John Bradley, Chief Executive Officer, Energy Networks Australia, *Committee Hansard*, Canberra, 1 June 2017, p. 8.

This is focused on distribution network services.[273] If consumers want lower electricity bills, the Committee heard that demand management will play a key role.[274]

4.86 The Committee heard that:

> There is also unfinished business in that there has been a longstanding commitment to review the demand management incentive scheme, which was first proposed in 2012 in the Power of Choice review by the Australian Energy Market Commission … There is a guideline that the Australian Energy Regulator is preparing to undertake and that is, if you like, another piece in providing a more balanced set of incentives, or it should address that concern about the balance of incentives.[275]

4.87 The Committee heard evidence that, when it was being employed, demand response was working well. When asked about an aluminium smelter at Tomago being required to cease using power for a period of time in the summer of 2016/17 in New South Wales, economist and engineer Paul Hyslop told the Committee:

> I am not privy to all the details of the Tomago contract, but my understanding is that, in fact, part of the deal in the price they got in the contract was that they are actually used to shed supply on occasion, when the rest of the system cannot meet that supply. To be frank, from an economics perspective, to shed the smelter once or twice a year for a couple of hours would be a much more sensible thing to do than building another 300 or 400 megawatts of peaking capacity.[276]

4.88 However, the Committee also heard that utilising industry such as Tomago in demand response was not always ideal. The Committee visited Tomago and heard about the consequences to the plant during peak usage shut downs. The Committee also heard from the Energy Efficiency Council that

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273 Dunstan, C., Alexander, D., Morris, T., Langham, E., Jazbec, M., *Demand Management Incentives Review: Creating a level playing field for network DM in the National Electricity Market* (Prepared by the Institute for Sustainable Futures, University of Technology Sydney), June 2017, p. iii.

274 Mr Tim Jordan, Investment Research, Clean Energy Finance Corporation, *Committee Hansard*, Canberra, 26 May 2017, p. 1.

275 Mr John Bradley, Chief Executive Officer, Energy Networks Australia, *Committee Hansard*, Canberra, 1 June 2017, p. 2.

276 Mr Paul Hyslop, Chief Executive Officer, ACIL Allen Consulting, *Committee Hansard*, Melbourne, 31 August 2017, p. 19.

requiring a very large aluminium smelter to reduce its demand is a very bad idea because it can cause setting of the pots in that industrial facility.[277]

4.89 The Committee heard evidence from the Australian Renewable Energy Agency (ARENA) that it was working with AEMO on a demand response initiative.[278]

4.90 The Committee also heard that demand response initiatives should be targeted at particular industries and during specific stages of the production process. During its visit to the United States, the Committee heard of the plan by utility Con Edison to save US$1 billion on infrastructure spending in New York's Brooklyn and Queens neighbourhoods by asking utility customers in 32 US zip codes to sign up to a program which features storage hosted at customer sites which will then be aggregated into a virtual power plant and used to mitigate peak demand.[279]

4.91 The National Electricity Rules provide that once regulated revenue is set, there are incentives for network service providers to limit their spending within each regulatory period. If a network service provider spends less than the amount that the Australian Energy Regulator determined to be an efficient estimate of capital expenditure or operating expenditure, it remains some of the savings and passes the remainder on to consumers through reduced network charges in the next regulatory period.[280] It has been argued that the power of the incentive to undertake capital expenditure is greater than incentives to undertake operating expenditure on non-network options such as embedded generation or demand management programs.[281] It is argued that this influences network business behaviour, leading to a preference to select capital expenditure options over alternatives that rely

277 Mr Robert Murray-Leach, Head of Policy, Energy Efficiency Council, *Committee Hansard*, Canberra, 14 September 2017, p. 2.

278 Mr Ivor Frischknecht, Chief Executive Officer, Australian Renewable Energy Agency, *Committee Hansard*, 26 May 2017, p. 6.

279 Andy Calthorpe, *Green Charge to supply 13MWh virtual power plant for Con Edison in New York*, Energy storage news, 8 November 2016, https://www.energy-storage.news/news/green-charge-to-supply-13mwh-virtual-power-plant-for-con-edison-in-new-york , accessed 4 December 2017.

280 Dr Alan Finkel, Chair of the Expert Panel, *Independent review into the future security of the National Electricity Market – blueprint for the future,* June 2017, p. 130.

281 Dr Alan Finkel, Chair of the Expert Panel, *Independent review into the future security of the National Electricity Market – blueprint for the future,* June 2017, p. 151.

more on operating expenditure, even if the operating expenditure options would result in lower term prices for consumers.[282]

Energy efficiency

4.92 Energy efficiency is another mechanism that can improve the reliability of the grid. It achieves this by promoting infrastructure that does not require as much energy to operate.

4.93 The Committee heard that: 'it's clear that the cheapest form of abatement is energy efficiency[283]. Energy efficiency was also described as the 'first fuel'.[284] The Energy Efficiency Council noted that it was 'the biggest source of new capacity in the market'.[285] Of particular interest to the Committee was the evidence that:

> The capacity just in industrial efficiency identified in Australia is the equivalent of two Hazelwoods. We could be providing two Hazelwoods of demand response. You might have a blackout, or a generator goes down and suddenly you need to provide extra capacity. You can say to all the industrial clients: "We'll pay you to reduce your demand a bit, for a little time." That gives you two Hazelwoods worth of capacity. That is done everywhere else in the world. Australia is a long way behind the rest of the world on this. It is standard practice.[286]

4.94 Indeed, in California, the Committee heard that energy efficiency initiatives had made a significant contribution to lowering electricity demand.

4.95 Furthermore, the Committee heard that energy efficiency will mean that the grid does not need to be made up of such a high percentage of renewables in order to meet the emissions target set out in the RET:

> … if we do not do energy efficiency, we will have to go to at least 70 per cent renewables. If we do sensible energy management, it means we only have to go to 50 per cent or lower—depending on how hard we go. The point is that,

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282 Dr Alan Finkel, Chair of the Expert Panel, *Independent review into the future security of the National Electricity Market – blueprint for the future,* June 2017, p. 151.

283 Mr Jon Stretch, Managing Director and Chief Executive Officer, ERM Power, *Committee Hansard*, Brisbane, p. 21.

284 Mr Robert Murray-Leach, Head of Policy, Energy Efficiency Council, *Committee Hansard*, Canberra, 14 September 2017, p. 1.

285 Mr Robert Murray-Leach, Head of Policy, Energy Efficiency Council, *Committee Hansard*, Canberra, 14 September 2017, p. 1.

286 Mr Robert Murray-Leach, Head of Policy, Energy Efficiency Council, *Committee Hansard*, Canberra, 14 September 2017, p. 2.

> in getting to the emissions target that is set by the government at the moment, the costs will be extraordinarily high if we don't do energy management.[287]

4.96 The Committee also heard that many small businesses were not aware of what new practices or machinery could be adopted to achieve a more energy efficient — and possibly cheaper — outcome. In particular, ageing machinery and appliances could be replaced with more energy efficient products with a view to reducing the amount of energy required.

Box 4.3 Electricity consumption

Committee questionnaire:

85 per cent of respondents reported that they had taken action to reduce electricity consumption in the past three years.

Removing causes of unreliability – off grid

4.97 The Committee heard that there is currently ageing infrastructure that involves long transmission lines that might only serve one or two customers. For the network businesses, it may be considerably more efficient, when the line gets to the end of its life, to provide those customers with solar and storage and new technologies, rather than replace the transmission line.[288]

4.98 The Committee also heard evidence that it may be more cost effective to remove communities from the grid that require transmission line to be run through bushfire prone land. The undergrounding requirements of these lines may not compare favourably with providing those customers with solar and storage. However, the rules do not currently provide for off grid approaches in these circumstances.[289]

4.99 It is important to note that, under the current rules and legislation, off-grid customers may not be subject to the states' reliability standards and associated consumer protections.[290]

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287 Mr Robert Murray-Leach, Head of Policy, Energy Efficiency Council, *Committee Hansard*, Canberra, 14 September 2017, p. 3.

288 Mr Richard Owens, Senior Director, Australian Energy Market Commission, *Committee Hansard*, Canberra, 30 March 2017, p. 14.

289 Mr Richard Owens, Senior Director, Australian Energy Market Commission, *Committee Hansard*, Canberra, 30 March 2017, p. 14.

290 Mr Richard Owens, Senior Director, Australian Energy Market Commission, *Committee Hansard*, Canberra, 30 March 2017, p. 14.

Box 4.4 Consequences of being off grid

Committee questionnaire:

I think allowing people to disconnect from the grid is a terrible idea. I fear it will create a two-tier energy situation where those who can afford it (and have adequate solar access on roof) will essentially get unlimited free energy (and via electric cars travel), while those in areas with poor solar access (such as those living in apartments) or poor finances (who cannot afford roof-top solar) will be forced to shoulder the increased costs of maintaining an electricity grid. The grid provides benefits to everyone, not just those whose dwelling connects to it, and I think everyone should pay to maintain the grid, not just those whose dwellings are connected to it.

Removing causes of unreliability – micro grids

4.100 The Committee heard that an alternative to increased amounts of interconnection is the introduction of micro grids, with their own back-up systems. The Committee heard that this could prove to be more economical than increased interconnection on the NEM.[291] The NSW Farmers Association gave evidence indicating that groups of farmers who are located at the end of transmission lines can benefit from setting up a micro grid as they may have differing electricity usage patterns and do not necessarily make demands on the grid at the same time.[292]

4.101 The Committee heard evidence that one alternative to transporting energy from renewable energy zones via existing DC transmission lines, was to consider the use of interconnected microgrids and smaller systems. This would involve creating the energy, storing it in a battery and then dispatching it when required.[293]

Committee comment

4.102 The Committee considers the reliable supply of electricity to be of the utmost importance as part of the service delivery of a modern grid. However, the

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291 Mr Ivor Frischknecht, Chief Executive Officer, Australian Renewable Energy Agency, *Committee Hansard*, Canberra, 26 May 2017, p.11.

292 Mr Ashkan Salardini, Chief Economist, NSW Farmers Association, *Committee Hansard*, Brisbane, 18 August 2017, p. 12.

293 Mr Graham Davies, Director and Principal, Resonant Solutions Pty Ltd, *Committee Hansard*, Adelaide, 1 September 2017, pp. 10-11.

Committee is aware that reliability carries implications for price. The Committee considers it essential that the energy market and policy makers are innovative in pursuing cost effective methods of achieving reliability.

4.103 Given the importance of reliability to the performance of the NEM, the Committee considers it timely to transfer responsibility for reliability from the NEM state governments to AEMO, as Victoria has already done.

4.104 As with system security, the Committee notes the essential nature of system security services to system reliability and considers it appropriate to either ascribe system security services a value that should be paid for within the NEM, or require all generated sources of electricity to provide a certain amount of ancillary services. The provision of a certain amount of ancillary services could be achieved through a contract between a generator and the provider of such ancillary services.

4.105 Given the costs involved in building additional infrastructure that is designed to deliver greater levels of reliability to the NEM, the Committee prefers a more concerted investment in demand response and energy efficiency policy settings. Because the networks have not had a consistent practice of implementing demand response and energy efficiency mechanisms, the Committee considers that demand management should be the coordinated by a national energy planner.

4.106 The Committee acknowledges the expenses involved in operating at the fringe of the grid, and is supportive of innovative approaches to managing the reliable delivery of electricity to those customers in a more cost effective manner which may involve investment in resources other than grid resources. A modern grid needs to facilitate these sorts of innovations.

4.107 Having heard evidence from generators, retailers, users, and the regulatory and operating bodies, the Committee considers that a more interconnected grid, with pumped hydro and co-located renewables may be a key feature of a modernised grid. Another key feature may be a grid which better incorporates demand response techniques which may be a viable alternative to creating more energy.

Recommendation 9

4.108 The Committee recommends that the Minister for the Environment and Energy take to the Council of Australian Governments Energy Council a proposal that all of the National Electricity Market states refer reliability regulation to the Australian Energy Market Operator, in keeping with the

Victorian approach, and operate under the customer value of reliability model.

Recommendation 10

4.109 The Committee recommends that the Minister for the Environment and Energy audit large scale industrial manufacturing processes to identify short-term and long-term opportunities for demand response and energy efficiency.

The Committee expects that these opportunities will result in possible future revenue streams for industry and may avoid the need for investment in additional generation and transmission capacity.

Recommendation 11

4.110 The Committee recommends that the Minister for the Environment and Energy update resources that promote energy efficiency in small industry and businesses.

Recommendation 12

4.111 The Committee recommends that the Australian Energy Market Commission review any rules preventing users at the edge of the grid from being serviced via alternative means, whilst safeguarding reliability requirements and associated customer protections.

Role of consumers

4.112 Consumers are having multiple impacts on the way the grid functions. This section of the Chapter will review how consumer behaviours have led to the grid becoming bidirectional and has reduced the demand on the grid both through demand response and via departure from the grid.

4.113 Much of the planning that is happening on the NEM relates to the increasingly proactive role consumers are playing as not only users but also as generators of energy. As well as implementing rule changes to enable consumer to lead and drive change in the way energy services are provided to them, the AEMC reported that there was uptake of consumer participation in the grid particularly via solar PV.[294]

294 Ms Anne Pearson, Chief Executive, Australian Energy Market Commission, *Committee Hansard*, Canberra, 26 October 2017, p. 2.

Costs and Consumers

4.114 The price of retail electricity bills has doubled in the past 10 years. The Committee heard that the impact of price rises has been acutely felt by retail and business customers.[295] The Committee heard from Energy Consumers Australia that one option for alleviating this impact would be dynamic networking pricing, where customers are invited to change their consumption habits in exchange for cheaper electricity bills.[296] Furthermore, the Committee heard that in order to bring about change, consumers required more access to data to better understand how usage impacts on electricity bills.[297] Energy Consumers Australia was very supportive of the demand side response trials being operated by ARENA and AEMO.[298] Smart meters and other technological devices that can track usage will be important tools moving forward.

4.115 The Chair put the proposition to AGL that at a time when AGL was making a profit of $800 million, consumers were experiencing record high electricity bills.[299] AGL acknowledged that prices are high and noted that one of its responses is to invest in more supply.[300]

4.116 The Committee heard evidence that the 'solution to high prices is high prices, because high prices allow people to bring forward new solutions'.[301] Mr Hyslop observed that policy uncertainty, high gas prices, the movement away from coal and a waiting period before renewable prices come down in

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295 Mr Chris Alexander, Advocacy and Communications, Energy Consumers Australia, *Committee Hansard*, Canberra, 19 October 2017, p. 1.

296 Mr Chris Alexander, Advocacy and Communications, Energy Consumers Australia, *Committee Hansard*, Canberra, 19 October 2017, p. 2.

297 Mr Chris Alexander, Advocacy and Communications, Energy Consumers Australia, *Committee Hansard*, Canberra, 19 October 2017, p. 2.

298 Mr Chris Alexander, Advocacy and Communications, Energy Consumers Australia, *Committee Hansard*, Canberra, 19 October 2017, p. 3.

299 Mr Andrew Broad MP, Chair, Standing Committee on the Environment and Energy, *Committee Hansard*, Canberra, 19 October 2017, p. 10.

300 Associate Professor Tim Nelson, Chief Economist, AGL Energy, *Committee Hansard*, Canberra, 19 October 2017, p. 10.

301 Mr Paul Hyslop, Chief Executive Officer, ACIL Allen Consulting, *Committee Hansard*, Melbourne, 31 August 2017, p. 23.

price further, will keep prices high for some time. However, he predicted that prices would fall significantly in the next two to three years.[302]

4.117 The AER indicated that whilst it collected data on the number of customers claiming hardship, receiving payment plans and being disconnected, there was no capacity for longitudinal monitoring of specific customers.[303]

A bidirectional grid

4.118 As well as drawing power from the grid, consumers now have the capacity to put energy back on to the grid. This follows any generation resulting from infrastructure the consumer may have installed, which is typically solar PV or wind turbines.[304]

4.119 The Clean Energy Finance Corporation gave evidence to the Committee that whilst investing in renewables and storage in advance of coal capacity closure would minimise costs to consumers and maintain energy security, it is smart technology solutions that are important for improving system resilience and lowering costs.[305]

4.120 Bidirectional flow requires smart inverter technology, which assists in managing the voltage for import/export. It also assists with AC/DC conversion. "You need a hybrid of both local or synthetic inertia, and that's what these smart inverters can do".[306] Household batteries sold for the purpose of harnessing energy from solar PV or wind include a smart inverter.[307]

4.121 The relationship between retailer and consumer is becoming more bidirectional, as well. A dynamic and transparent power bill may also be of

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302 Mr Paul Hyslop, Chief Executive Officer, ACIL Allen Consulting, *Committee Hansard*, Melbourne, 31 August 2017, p. 23.

303 Ms Michelle Groves, Chief Executive Officer, Australian Energy Regulator, *Committee Hansard*, Canberra, 26 October 2017, p. 4.

304 Ms Elisabeth Brinton, Executive General Manager, New Energy, AGL Energy, *Committee Hansard,* Canberra, 19 October 2017, p. 5.

305 Mr Tim Jordan, Investment Research, Clean Energy Finance Corporation, *Committee Hansard,* Canberra, 26 May 2017, p. 1.

306 Ms Elisabeth Brinton, Executive General Manager, New Energy, AGL Energy, *Committee Hansard,* Canberra, 19 October 2017, pp. 7-8.

307 Ms Elisabeth Brinton, Executive General Manager, New Energy, AGL Energy, *Committee Hansard,* Canberra, 19 October 2017, p. 7.

use to consumers who either want more or clearer information about the costs that are built into their electricity bill.[308]

4.122 The Committee heard further evidence of the bidirectional nature of the relationship between retailers and consumers when the AER described as a 'very strong focus' its work empowering consumers to make informed decisions about their energy use and to encourage them to engage with the market.[309] The AER reported that it was gratified to have experienced unprecedented levels of traffic to its Energy Made Easy website over the preceding months.[310] The AER is also reviewing the retail pricing information guidelines, which assist consumers to more easily compare offers by standardising how retailers present their offers. The AER also outlined a concerted effort to engage with customers who are not comfortable in the digital space.[311]

Box 4.5 Understanding electricity bills

Committee questionnaire:

One third of respondents indicated that they did not have sufficient information about the components that make up the total price that they pay for electricity.

Behind the meter

4.123 When consumers set up their own electricity generation, these activities are typically referred to as being 'behind the meter'. There are a number of reasons consumers may choose to go behind the meter, including a preference for renewable energy, seeking to minimise how much they spend on electricity in the medium to long terms, and a perceived reliability of supply.

308 Mr Chris Alexander, Advocacy and Communications, Energy Consumers Australia, *Committee Hansard*, Canberra, 19 October 2017, p. 4.

309 Ms Michelle Groves, Chief Executive Officer, Australian Energy Regulator, *Committee Hansard*, Canberra, 26 October 2017, p. 3.

310 Ms Michelle Groves, Chief Executive Officer, Australian Energy Regulator, *Committee Hansard*, Canberra, 26 October 2017, p. 3.

311 Ms Michelle Groves, Chief Executive Officer, Australian Energy Regulator, *Committee Hansard*, Canberra, 26 October 2017, p. 10.

4.124 When considering network planning and investment, the Committee is mindful of the growth of energy being generated off-grid. The Committee heard evidence of the establishment of micro-grids[312] and the incentives for consumers to produce energy behind the meter.

4.125 The Committee also heard evidence that in circumstances where consumers were not able to produce a continuous and reliable source of energy, or where they wished to feed their excess power back onto the grid, there was a continued dependence on the shared national grid. In addition, the Committee heard evidence of the greater cost to individuals who remained on the grid, as they bore the ongoing network costs no longer paid by consumers exiting the grid.[313] Furthermore, the Committee heard that the individuals with the greatest level or socioeconomic disadvantage were the least likely to have rooftop solar PV.[314]

4.126 The Committee heard evidence about virtual power plants, where a group of consumers have their own sources of energy and batteries. AGL gave evidence that customers can achieve $500 per annum in bill savings because a software algorithm optimises the use of solar and battery to the benefit of the consumer.[315]

4.127 The Committee also heard that if forecasting was not properly managed, and the cost to consumers of using the NEM was too high, there was a risk that those consumers who could afford to do so would move behind the grid with implications for those consumers who are left on the grid.[316]

4.128 Given these new ways of using the grid, the Committee considers it important that the costs of interacting with the grid be reviewed. It may be that recovering costs through network charges is regressive in nature.

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312 Mr Steve Whan, Chief Executive Officer, National Irrigators' Council, *Committee Hansard*, Brisbane, 18 August 2017, p. 11.

313 Mr Ashkan Salardini, Chief Economist, NSW Farmers Association, *Committee Hansard*, Brisbane, 18 August 2017, p. 15.

314 Bankwest Curtin Economics Centre, *Power to the people: WA's energy future*, Focus on industry series, no. 2, August 2017, p. 65.

315 Ms Elisabeth Brinton, Executive General Manager, New Energy, AGL Energy, *Committee Hansard*, Canberra, 19 October 2017, p. 7.

316 Mr Chris Alexander, Director, Advocacy and Communications, Energy Consumers Australia, *Committee Hansard*, Canberra, 30 March 2017, p. 12.

Box 4.6 Behind the meter experiences

Committee questionnaire:

My 4.2kW inverter-charger is programmed to run my house from the 6kWh battery bank from 6am till 11pm, (peak & shoulder periods). If the battery state of charge is below 70% it will re-charge from the grid during the "off peak" period. This rarely happens as my daily use does not often discharge the battery that far. Now that I am no longer receiving the TFiT (33-32c/kWh) I am seriously considering disconnecting from the grid so that I no longer have to pay $490+ per year to be able to export six times more power than I import.

60% of our generation capacity goes into a battery bank (20kWh in size), and provides about 99% of our annual energy usage needs.

I do not have batteries, but I do have an electric car: a Nissan Leaf. If I were to place batteries on my house then I would lose my 64c per kWh feed-in tariff to the grid. This special feed-in tariff expires in 2024, at which time I will put in more solar PV and batteries.

We are waiting to see if the price of the Tesla Batteries will come down a bit so we can install our own solar system with battery storage. We will not get panels until the battery is available at a reasonable cost.

Demand response and energy efficiency

4.129 As outlined in the section on reliability above, consumers' participation in the electricity grid also involves reducing demand in accordance with an agreement with a regulator or retailer and purchasing infrastructure that is more energy efficient than the infrastructure it replaces.

Committee comment

4.130 The Committee was interested to hear of the bidirectional relationship between retailers and consumers. The Committee supports dynamic billing and is keen to ensure that each consumer has access to as much clear information as possible in relation to their electricity bill and electricity usage.

Recommendation 13

4.131 The Committee recommends that the Australian Energy Market Operator work with retailers to ensure bills are dynamic, providing customers with control over how much information they receive in relation to cost and usage.

Recommendation 14

4.132 The Committee recommends that the Australian Energy Market Operator:

- **review how grid costs are recovered with a view to improving equity; and**
- **address how consumer led initiatives are affecting the use of the grid and the potential effects this has on users remaining on the grid who are unable to access these options;**

without discouraging the uptake of renewable energy.

Recommendation 15

4.133 The Committee recommends that the Australian Energy Market Operator investigate the benefits of virtual power plants and other trading platforms that may have an effect on demand management and consider how they can be incorporated into the electricity grid to assist with stability.

National planning and governance

4.134 This section of the Chapter notes the evolution of a national approach to energy and electricity planning in Australia. It then reviews the evidence the Committee received about the advantages of more planning, particularly in relation to how these matters are managed in other international jurisdictions, distribution services, ensuring system strength, creating renewable zones, providing certainty, coordination and regulation. Much of the section is a discussion of where and how the market does not successfully drive outcomes on the grid.

Federalism

4.135 Constitutionally, energy is primarily a state matter, but as the Australian Energy Market Commission pointed out 'it was recognised that you cannot

have a national market in a five-minute auction across the entire country unless there is one set of rules'.[317]

4.136 Since 2004 and the signing of the Australian Energy Market Agreement, there is now a shared responsibility that is coordinated through the COAG Energy Council. As noted in Chapter 2, the Commonwealth Minister for the Environment and Energy, the Hon. Josh Frydenberg MP, is the Council's chair.[318]

Status quo planning

4.137 Within Australia, there are a number of agencies tasked with planning certain aspects of the NEM. The authority and responsibilities of these agencies see them take on the character of planners. Outlined in Chapter 2 of this report, these agencies include the Australian Energy Market Commission (AEMO), the Australian Energy Market Operator (AEMO), the Australian Energy Regulator (AER), the Australian Renewable Energy Agency (ARENA) and the Clean Energy Finance Corporation (CEFC).

A lack of planning

4.138 The Committee heard evidence that some decisions that are being made on the NEM would be better made if there was an overall planning body. For example, an 80 megawatt solar project was due to be connected on an already constrained part of the network. The Committee was told that as a result the nearby gas-fired plant would not have been able to export to the grid or would have been 'constrained off'.[319] The Committee heard that whilst this should have been highlighted during the planning stage or during the funding application to ARENA, there was no mechanism to test this issue.[320]

4.139 The Committee heard evidence of the dangers of governments acting as participants in the electricity system in terms of the impact on certainty:

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317 Mr Richard Owens, Senior Director, Australian Energy Market Commission, *Committee Hansard*, Canberra, 30 March 2017, p. 4.

318 Ms Joann Wilkie, Acting First Assistant Secretary, Energy Division, Department of the Environment and Energy, *Committee Hansard*, Canberra, 30 March 2017, p. 3.

319 Mr Jon Stretch, Managing Director and Chief Executive Officer, ERM Power, *Committee Hansard*, Brisbane, 18 August 2017, p. 19.

320 Mr Jon Stretch, Managing Director and Chief Executive Officer, ERM Power, *Committee Hansard*, Brisbane, 18 August 2017, p. 19.

> … governments owning stuff or intervening in ways that are not predictable is very difficult for a market ... The way [AEMO] does that and the rules by which it interacts with the market need to be better defined. The rules now are very different from the rules we used five or six years ago to run this system. So that's going to be the critical issue. How does AEMO do that?[321]

4.140 The Committee also heard that the length of time to receive transmission approval for connection to the grid by a new generator is up to two years in Australia.[322]

The overseas approach to planning

4.141 The Committee heard evidence that the modernisation of Australia's electricity system has also had comparatively less governmental coordination than seen in other jurisdictions, such as New York, California and the United Kingdom.[323]

4.142 The Melbourne Energy Institute gave evidence that planning of the transmission network in the United States is commonly done by independent, not-for-profit organisations, whose objective is secure and reliable low-cost electricity to consumers. The Institute noted that 'genuinely independent, disinterested and good public planning is essential':

> In my view, you need to have fearlessly independent planning and you need to be able to let the wholesale market reform itself quickly and in a technologically neutral way in order to keep building the stuff we want.[324]

4.143 AEMO gave further evidence to the Finkel review about the need for increased planning. An example provided was the market operator and planner PJM, in the United States,[325] which highlighted the importance of

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321 Mr Tony Wood, Energy Program Director, Grattan Institute, *Committee Hansard*, Melbourne, 31 August 2017, p. 6.

322 Mr Tim Jordan, Investment Research, Clean Energy Finance Corporation, *Committee Hansard*, Canberra, 26 May 2017, p. 5.

323 Energy Networks Australia, *Submission 38*, p. 25.

324 Professor Michael Brear, Director, Melbourne Energy Institute, University of Melbourne, *Committee Hansard*, Canberra 17 August 2017, p. 12.

325 Ms Audrey Zibelman, Chief Executive Officer, Australian Energy Market Operator, *Committee Hansard*, Canberra, 26 May 2017, p. 28.

having an operator and planner with a nuanced understanding of the interplay between engineering and economics.[326]

Box 4.7 Transmission planning – the international experience

Transmission planning in context: the international experience

The modernisation of the grid in Germany is driven by a national policy: the Energiewende, or energy transformation. The policy has strong community and industry support, and is backed by political consensus. There has been a significant increase in the proportion of renewables in the German energy sector, over a short space of time. This has presented engineering, policy, and economic challenges.

In the United States, policies relating to renewable energy are state-based, and most electricity grids are operated on a regional basis across several states. Delegates visited New York, California, and Washington D.C. to gain an appreciation of the different approaches taken in different states, and to understand some of the cross-jurisdictional issues.

For example, New York State has taken a more market-based approach to grid modernisation. Regulators have been working to establish policies to provide incentives to capital to build the grid of tomorrow. Three key policies include:

1 Locational price signals for distributed energy resources - encourage more DERs in places where they are of most value. For example, at the end of the grid where voltage declines and capital costs for transmission and distribution increase, or in other areas of 'grid constraint'.

2 Changing financial incentives for utilities - moving away from a rate-based model of compensation, to a model where utilities are given the incentives to identify more innovative or 'non-wires' alternatives, such as demand management, energy storage solutions, micro grids, and energy efficiency.

3 Developing robust competitive distribute energy resource markets around consumers - seeking to harness the opportunities presented by significant technological changes in customer behaviour and interaction. Financial incentives for utilities and market rules should be designed in

326 Jeremy Lin, "Modeling and simulation of PJM and northeastern RTOs for interregional planning", *Power and Energy Society General Meeting (PES), 2013, IEEE*

a way that facilitates customer-led initiatives, such as aggregation of solar PV supply, micro grids, and so on.

California, by contrast, has taken more of a mandate-driven approach to grid transformation. California has legislated ambitious renewable energy targets: 50 per cent of electricity from renewable energy sources by 2030, and 100 per cent by 2050. The California Public Utilities Commission has identified its priority over the next 10 years as the effective integration of these sources into the grid. It has an Integrated Resource Planning Process, which will consider the appropriate portfolio of resources and will direct procurement as appropriate, through the mechanism of renewable energy certificates.

Planning and the distribution network

4.144 AusNet Services gave evidence that it envisages a distribution system operator — much like AEMO operates the transmission network — to ensure the appropriate operation of the distribution networks.[327] AEMO gave evidence noting that the management of distributed energy resources needs to be better integrated.[328]

4.145 However, the Grattan Institute did not think there was sufficient evidence to support an increased distribution function for network operator AEMO:

> I think distribution is still the trickier one because we have got much less clarity around the interface between distribution and, even in generation, consumption. I think, for example, the AER is more than capable of dealing with the need for more distribution. I personally do not see any justification right now for changing distribution towards a more interventionist planning role for AEMO or anybody else. The point I made before was that there is a great need to move forward on three or four things in distribution: cost-effective tariffs; the way in which the businesses make the decision between new investment and efficient alternatives; and the boundaries between private sector investment in generation and network investment and how that works.
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> At the moment we have got an issue to deal with: you can refit the activities within the distribution business. It feels like a short-term solution to me, but the long-term solution is yet unclear. So there are all those issues, and there

327 Mr Alistair Parker, Executive General Manager, Regulated Energy Services, AusNet Services, *Committee Hansard*, Melbourne, 31 August 2017, p. 30.

328 Ms Audrey Zibelman, Managing Director and Chief Executive Officer, Australian Energy Market Operator, *Committee Hansard*, Canberra 14 September 2017, p. 7.

> are some very important social issues as well to deal with the essential service characteristics where distribution has a critical role. My view at the moment would be that I would certainly put more power and planning responsibility for causing it to happen in the hands of AEMO for transmission and possibly generation, but I think there is some more work to be done. I think AER, particularly with the additional resources they have been given now, is in a better position to do that.[329]

Planning and system stability

4.146 AEMO gave evidence that it is not only operating a market, but also operating a physical system.[330] Similarly, the Committee heard evidence that part of the national planning needs to pay particular focus to the engineering aspects of the system.[331]

4.147 The Committee heard from witnesses such as Professor Ertugrul, a power engineer from the University of Adelaide, of the importance of coordinating the grid well — of looking at the grid as a whole and the importance of controlling it centrally.[332] He noted that this was particularly important in relation to the stability of the grid so that critical points can be identified and appropriate responses deployed in a timely manner.[333]

Planning and renewable energy zones

4.148 A key role for a planner would be responding appropriately to the new sources of energy entering the grid. AEMO gave evidence to the inquiry that renewable generation is geographically specific. As such, mechanisms for planning would look at the best places to locate these resources, followed

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329 Mr Tony Wood, Energy Program Director, Grattan Institute, *Committee Hansard*, Melbourne, 31 August 2017, pp. 7-8.

330 Ms Audrey Zibelman, Managing Director and Chief Executive Officer, Australian Energy Market Operator, *Committee Hansard*, Canberra 14 September 2017, p. 8.

331 Professor Michael Brear, Director, Melbourne Energy Institute, University of Melbourne, *Committee Hansard*, Canberra 17 August 2017, p. 11.

332 Professor Nesimi Ertugrul, School of Electrical and Electronic Engineering, University of Adelaide, *Committee Hansard*, Adelaide, 1 September 2017, p. 3.

333 Professor Nesimi Ertugrul, School of Electrical and Electronic Engineering, University of Adelaide, *Committee Hansard*, Adelaide, 1 September 2017, p. 3.

by the kinds of grid connections that would optimise that so that costs to consumers are reduced.[334]

4.149 In particular, the Committee notes the Finkel Review recommendation that planning be undertaken in relation to renewable energy zones.

Planning and certainty

4.150 One aspect of a grid planner would be to provide some level of policy certainty. In its December 2016 *National transmission network development plan*, AEMO noted that 'Beyond 2030, the scale and timing of generation mix changes is highly uncertain and largely depends on the decision of coal-fired generators and the ongoing direction of energy policy'.[335] In particular, AEMO noted that the timing of the retirement of coal generation that is likely to reach its technical end of life in the 2030s is crucial to determining future investment in the gas industry. This would have implications for gas supply and reserves.[336]

Planning and coordination

4.151 The Committee heard that in relation to large scale projects, there was a lack of coordination. For example, the Clean Energy Finance Corporation (CEFC) is involved in Genex, which is a pumped storage facility proposed between two gold mines in Kidston, North Queensland. The CEFC has committed to assist in building a solar facility first, and is working with ARENA to develop that into pump storage that complements renewables. CEFC gave evidence that at some point transmission will probably need to be augmented to get the full benefit of that project.[337] Given the inter-reliant aspect of the project, the CEFC gave evidence that:

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334 Ms Audrey Zibelman, Chief Executive Officer, Australian Energy Market Operator, *Committee Hansard*, Canberra, 26 May 2017, p. 28.

335 Australian Energy Market Operator, *National transmission network development plan*, December 2016, https://www.aemo.com.au/-/media/Files/Electricity/NEM/Planning_and_Forecasting/NTNDP/2016/Dec/2016-NATIONAL-TRANSMISSION-NETWORK-DEVELOPMENT-PLAN.pdf, accessed 11 October 2017, p. 5.

336 Australian Energy Market Operator, *National transmission network development plan*, December 2016, https://www.aemo.com.au/-/media/Files/Electricity/NEM/Planning_and_Forecasting/NTNDP/2016/Dec/2016-NATIONAL-TRANSMISSION-NETWORK-DEVELOPMENT-PLAN.pdf, accessed 11 October 2017, p. 5.

337 Mr Simon Every, Head of Government and Stakeholder Relations, Clean Energy Finance Corporation, *Committee Hansard*, Canberra, 26 May 2017, p. 5.

> It is essentially a coordination challenge, getting the transmission provider, project proponents and presumably governments at the state and federal levels to recognise the value that you could unlock by a project proposal. So a body to take the lead and coordinate that is really [important].[338]

Planning and regulation

4.152 The Committee noted that, whilst it is difficult to compare jurisdictions because usage differs depending on the unique climactic circumstances of each jurisdiction, electricity appeared to be cheaper in jurisdictions where retail electricity prices are regulated.[339]

4.153 The Grattan Institute argued for greater planning in the NEM:

> It is demonstrably the case that we have needed to introduce an extra level of planning and regulation in a number of areas. But how far that goes and where we say, "We have now restabilised the system," is the question. The key issue here is about—we have mentioned this already—energy that is renewable and intermittent.[340]

4.154 Furthermore, the AER has engaged with Energy Networks Australia and Energy Consumers Australia to announce a joint initiative to explore collaborative regulatory approaches. They are aiming for improved sector engagement and to identify opportunities for regulatory innovation.[341]

4.155 The Committee heard that changing AEMO's functions with respect to transmission may facilitate better pricing:

> On many occasions the previous management of AEMO had a concept of transmission planner as their role. But all they were doing was identifying an opportunity or a reason that you might want more transmission. They had no capacity to influence whether that was actually delivered or not.
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> …

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338 Mr Tim Jordan, Investment Research, Clean Energy Finance Corporation, *Committee Hansard*, Canberra, 26 May 2017, p. 5.

339 Mr Chris Alexander, Advocacy and Communications, Energy Consumers Australia, *Committee Hansard*, Canberra, 19 October 2017, p. 4.

340 Mr Tony Wood, Energy Program Director, Grattan Institute, *Committee Hansard*, Melbourne, 31 August 2017, p. 4.

341 Ms Michelle Groves, Chief Executive Officer, Australian Energy Regulator, *Committee Hansard*, Canberra, 26 October 2017, p. 3.

> The point that Audrey Zibelman, the new CEO of AEMO, has made is that the market isn't the objective; the market is the mechanism by which we achieve our objectives. If the market isn't doing what we want, because there are barriers to the way it should operate created by whatever circumstances, then the role of government is to fix that.[342]

4.156 AEMO gave evidence about what planning would mean:

> What we want to do is do the analysis to look at all the options so that we can think about where it could be and the market can identify [preferences]. But as you know, having pumped hydro with no transmission means you can't deliver it to where it needs to go. So we have to look at both.
>
> …
>
> This is a system. It was built by engineers after World War II who looked at all these things and made some decisions based on the information at that time and based on the technology at that time.
>
> It is not just a market. We do have to have some planning, because some of these investments take 10 to 12 years to get done, and if we don't identify them and agree that this seems to provide us the greatest amount of optionality they will never get done, because it is very difficult to build something 12 years ahead of time unless government agrees that it is a good idea.[343]

Committee comment

4.157 The Committee is of the view that given the current state of the network, there is scope to explore the appropriateness of a national planner. One avenue that may be explored is broadening the role of AEMO to combine the transmission function with a broader function in relation to distribution, or in the alternative establish an independent planning body.

4.158 The Committee considers that the Australian Energy Market Operator, or a similar independent body, would be well placed to take on the responsibilities of planning for the future of the both the national energy market as well as the national electricity grid. Such a body would have an ongoing planning role, rather than the Energy Security Board which is a

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342 Mr Tony Wood, Energy Program Director, Grattan Institute, *Committee Hansard*, Melbourne, 31 August 2017, p. 7.

343 Ms Audrey Zibelman, Chief Executive Officer, Australian Energy Market Operator, *Committee Hansard*, Canberra, 14 September 2017, p. 17.

body that meets from time to time constituted of representatives from other agencies.

4.159 The Committee agrees with the evidence it heard that the Finkel review was a great starting point, but that experts now needed to operationalise the findings.[344]

Recommendation 16

4.160 The Committee recommends that the Minister for the Environment and Energy review the Australian Energy Market Operator's current planning role with a view to incorporating a distribution planning role that enables planning along the National Electricty Market. In the alternative, the Committee recommends the establishment of a new independent planning body for the National Electricity Market.

The Committee also recommends that the Australian Energy Market Operator, utilising its current transmission planning functions, consider the establishment of renewable energy zones.

344 Mr Jon Stretch, Managing Director and Chief Executive Officer, ERM Power, *Committee Hansard*, Brisbane, 18 August 2017, p. 19.

5. Electricity market reform

5.1 As a wholesale spot market for the price of electricity, the National Electricity Market (NEM) plays an essential role in interconnecting five regional market jurisdictions: Queensland, New South Wales (including the Australian Capital Territory), Victoria, South Australia, and Tasmania. This Chapter will explore issues that the Committee has identified as requiring further consideration when reviewing the operation of the NEM. The issues include:

- capacity mechanisms;
- market based mechanisms for improving flexibility and dispatchability;
- market based demand management;
- tariff reform;
- bidding in the wholesale market;
- five minute settlement in the market;
- market concentration in the generation sector; and
- mechanisms to lower barriers to entry for new generators.

5.2 During the course of this inquiry, the Committee heard from many stakeholders—including Canegrowers, the NSW Farmers Association and the National Irrigators Council—about the real impact that increased electricity prices were having on industry.[345] A particular concern to industry was that electricity market generators were getting a far greater

345 Mr Steve Whan, Chief Executive Officer, National Irrigators' Council, *Committee Hansard*, Brisbane, 18 August 2017, p. 9.

return than is economically justified.[346] The Committee's attention was drawn to the way that the grid assets are priced.[347]

Capacity mechanisms

5.3 This section of the Chapter will review capacity mechanisms, and outline five types of capacity mechanisms:

- Strategic reserve
- Capacity obligation
- Capacity auction
- Reliability option
- Capacity payment

It will then review capacity markets that are currently in operation.

5.4 A capacity mechanism is an administrative measure to ensure the desired level of security of supply by remunerating generators for the availability of resources. A capacity mechanism may be needed to ensure that the provision of reserve generation capacity is economically viable.

5.5 Capacity mechanisms are considered problematic because they risk distorting the electricity market. However, where they exist on a grid such as the NEM the cost-effective concerns are reduced as the mechanism provides for inter-regional and intra-regional participation.[348]

5.6 The introduction of variable renewable energy sources—such as wind and solar—in the electricity mix has led to a growing need for backup generation capacity.[349] In a market with increasing amounts of renewable energy, the profitability of conventional power plants is decreasing for two reasons:

- shorter run times, as for energy only purposes they are not required to the same extent as they were before the advent of renewables; and

346 Mr Steve Whan, Chief Executive Officer, National Irrigators' Council, *Committee Hansard*, Brisbane, 18 August 2017, p. 9.

347 Mr Steve Whan, Chief Executive Officer, National Irrigators' Council, *Committee Hansard*, Brisbane, 18 August 2017, p. 9.

348 Gregor Erbach, "Capacity mechanisms for electricity", *European Parliamentary Research Service*, May 2017, p. 1.

349 Gregor Erbach, "Capacity mechanisms for electricity", *European Parliamentary Research Service*, May 2017, p. 2.

- variable renewables have a low or zero marginal cost, resulting in lower wholesale electricity prices in a competitive market.[350]

5.7 This results in concerns that there is not enough dispatchable generation capacity available to ensure the security of electricity supply.[351] Besides generation resources, energy storage, more interconnectors and demand response can also contribute to reliability of electricity supply.[352]

5.8 There is debate as to whether capacity mechanisms are necessary or whether an energy-only market with time-variant scarcity pricing (based only on supply and demand for electricity) can provide sufficient incentives for the provision of spare capacity.[353]

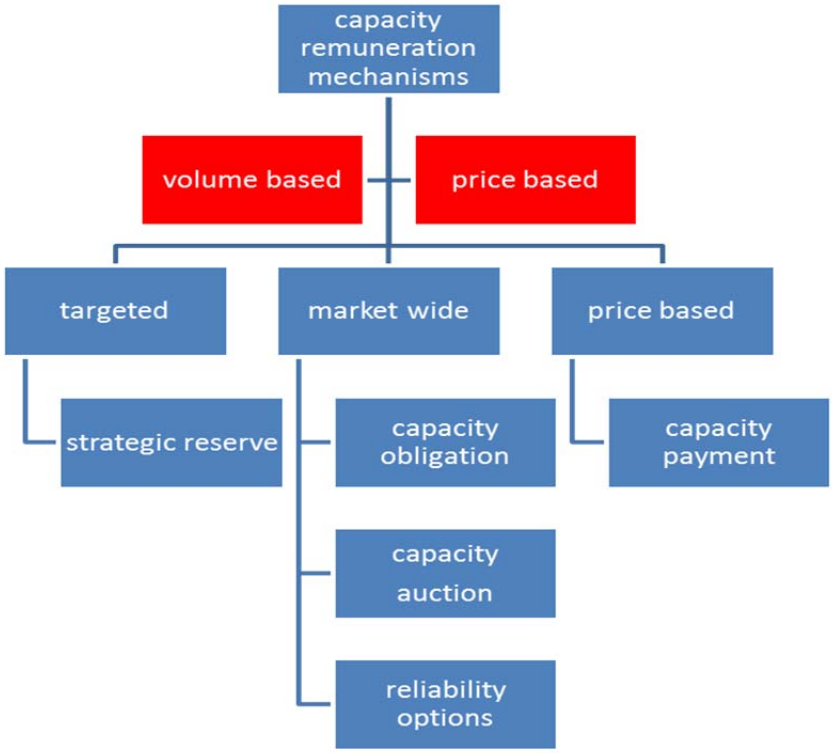
[350] Gregor Erbach, "Capacity mechanisms for electricity", *European Parliamentary Research Service*, May 2017, p. 2.

[351] Gregor Erbach, "Capacity mechanisms for electricity", *European Parliamentary Research Service*, May 2017, p. 1.

[352] Gregor Erbach, "Capacity mechanisms for electricity", *European Parliamentary Research Service*, May 2017, p. 3.

[353] Gregor Erbach, "Capacity mechanisms for electricity", *European Parliamentary Research Service*, May 2017, p. 3.

Figure 5.1 Capacity mechanisms



Source: Agency for the Cooperation of Energy Regulators, "Capacity Remuneration Mechanisms and the Internal Market for Electricity", 30 July 2013, p. 5

5.9 The flow chart in figure 5.1 outlines five types of capacity mechanisms, including price based, and volume based mechanisms. These mechanisms are outlined below.

5.10 It is important to note that in volume-based mechanisms, policy-makers decide on the required volume of capacity and let the market set the price. In price-based mechanisms, policy-makers set the price and let investors decide how much they are willing to invest for a given price. Targeted mechanisms reward only specific plants or technologies, whereas market-wide mechanisms reward all capacity providers.[354]

[354] Gregor Erbach, "Capacity mechanisms for electricity", *European Parliamentary Research Service*, May 2017, p. 3.

Strategic reserve

5.11 In a strategic reserve scheme, some generation capacity is set aside to ensure security of supply in exceptional circumstances, which can be signalled by prices in the day-ahead, intra-day or balancing markets moving beyond a specified threshold. A market operator, such as AEMO, determines the amount of capacity required to be set aside and dispatches it when the circumstances require it. This capacity is typically procured and paid for through a tender process with the costs borne by the network users.[355]

Capacity obligations

5.12 A capacity obligation scheme is a decentralised scheme where obligations are imposed on large consumers and suppliers to contract a certain level of capacity linked to their self-assessed future consumption or supply obligations. The capacity to be contracted is typically higher than the level of expected future consumption and supply. The obligated parties can fulfil their obligation through ownership of plants, contracting with generators/consumers and/or buying tradable capacity certificates. Contracted generators/consumers are required to make the contracted capacity available to the market in periods of shortages. A market for capacity certificates may be established to promote the efficient exchange of these certificates.[356]

Capacity auctions

5.13 A capacity auction scheme is a centralised scheme in which the total required capacity is set several years in advance and procured through an auction by an independent body. The price is set by the forward auction and paid to all participants who are successful in the auction. The costs are charged to the suppliers who charge end consumers.[357]

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355 Agency for the Cooperation of Energy Regulators, "Capacity Remuneration Mechanisms and the Internal Market for Electricity", 30 July 2013, p. 5.

356 Agency for the Cooperation of Energy Regulators, "Capacity Remuneration Mechanisms and the Internal Market for Electricity", 30 July 2013, pp. 5-6.

357 Agency for the Cooperation of Energy Regulators, "Capacity Remuneration Mechanisms and the Internal Market for Electricity", 30 July 2013, p.6.

Reliability options

5.14 Reliability options are instruments similar to call options, where contracted capacity providers (usually generators) are required to pay the difference between the wholesale market price (the spot price) and a pre-set reference price (the strike price). Whenever this difference is positive, the option is exercised. In exchange, they receive a fixed fee, thereby benefiting from a more stable and predictable income stream. Under a reliability options scheme, the incentive for the contracted generator to be available at times of scarcity arises from the high market price and from the fact that, if not available and therefore dispatched, it will have to meet the payments under the reliability option without receiving any revenue from the market.[358]

5.15 The holders of ROs effectively cap their electricity purchase price at the level of the strike price, since whenever the market price increases above this level, the excess will be 'reimbursed' through the payment made under the reliability option. A scheme based on reliability options usually rests on an obligation imposed on large consumers and on suppliers to acquire a certain amount of reliability options, linked to their self-assessed future consumption or supply obligations.[359]

Capacity payments

5.16 Capacity payments represent a fixed price paid to generators/consumers for available capacity. The amount is determined by an independent body. The quantity supplied is then independently determined by the actions of market participants.

Capacity markets in other jurisdictions

5.17 AEMO gave evidence that markets such as New York have a short-term capacity market:

> Every year the New York independent system operator—again the AEMO equivalent—will go out and identify what they need for capacity into the market and procure that separately.[360]

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358 Agency for the Cooperation of Energy Regulators, "Capacity Remuneration Mechanisms and the Internal Market for Electricity", 30 July 2013, p. 6.

359 Agency for the Cooperation of Energy Regulators, "Capacity Remuneration Mechanisms and the Internal Market for Electricity", 30 July 2013, pp. 6-7.

360 Ms Audrey Zibelman, Managing Director and Chief Executive Officer, Australian Energy Market Operator, *Committee Hansard*, Canberra 14 September 2017, p. 11.

5.18 AEMO noted that in Ireland and Texas the market operator operates on a day-ahead basis to identify whether or not there are enough dispatchable resources available and if not the market operator will pay for these resources to come on—paying for operating reserve at a different price to contemporaneous spot price.[361]

5.19 AEMO also gave evidence that PJM, a market operator in the United States, has a capacity market, where they run annual auctions and procure capacity for the next three to five years.[362]

5.20 The Committee heard that the Western Australian market is a capacity market, which is designed to ensure continuous supply. However, the Committee heard that:

> … therein lie some of the challenges, I think, that we face in WA around the future and extent to which we can more efficiently utilise that capacity to put downward pressure on prices.[363]

5.21 One of the challenges with a capacity market is that the pricing involves a large, fixed cost all year long whether that capacity is required or not. The large fixed cost removes some of the volatility out of the marginal operating costs. It becomes quite arbitrary whether the capacity is ever utilised.[364] It also has the effect of removing an incentive to provide capacity when there is a real opportunity to make substantial amount of money – during period of high demand. As such, there may not be sufficient incentive to provide capacity on days of high demand.[365]

Five minute settlement resulting in an increased need for a capacity market

5.22 The Committee heard that in circumstances where a five minute settlement rule was to be introduced, which would put pressure on those forms of energy that are slower to get moving, an 'obvious compromise' would be to

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361 Ms Audrey Zibelman, Managing Director and Chief Executive Officer, Australian Energy Market Operator, *Committee Hansard*, Canberra 14 September 2017, p. 11.

362 Ms Audrey Zibelman, Managing Director and Chief Executive Officer, Australian Energy Market Operator, *Committee Hansard*, Canberra 14 September 2017, p. 11.

363 Professor Alan Duncan, Director, Bankwest Curtin Economics Centre, *Committee Hansard*, Adealide, 1 September 2017, p. 22.

364 Mr Vince Duffy, Department of Premier and Cabinet, South Australian Government, *Committee Hansard*, Adelaide, 1 September 2017, p. 18.

365 Mr Vince Duffy, Department of Premier and Cabinet, South Australian Government, *Committee Hansard*, Adelaide, 1 September 2017, p. 18.

introduce a capacity market for reserve peaking capability, or introduce a day ahead market.[366]

5.23 AEMO noted that it could operate a reserve obligation market by designing a capacity market, bringing it through the Energy Security Board and then on to COAG Energy Council for approval.[367] In circumstances where auctions were required, AEMO would seek to run them in 2018.[368]

Committee comment

5.24 The Committee heard that certain environments favour the introduction of measures to ensure capacity, in particular an influx of renewables and a move to five minute settlement. Notwithstanding concerns that capacity markets can result in consumers paying for idle power stations in order to safeguard against blackouts, given the current growth of the renewable sector, and the approved rule introducing a five minute settlement period, the Committee considers it timely that various capacity mechanisms be considered for the NEM.

5.25 The Committee particularly notes the proposal of the Energy Security Board to ensure dispatchability and AEMO's evidence to the Committee as to how it would introduce a reserve obligation market.

Recommendation 17

5.26 The Committee recommends that the Australian Energy Market Operator review the mechanisms available to achieve appropriate generation capacity, including capacity markets, greater generation and enhanced planning.

Prioritise the inclusion of flexible dispatchable resources

5.27 Dispatchable generation refers to sources of electricity that can be dispatched at the request of power grid operators or plant owners according to market needs. Notable forms of non-dispatchable energy are tidal power, wave power, solar power, and wind power.

366 Mr Jon Stretch, Managing Director and Chief Executive Officer, ERM Power, *Committee Hansard*, Brisbane, 18 August 2017, p. 20.

367 Ms Audrey Zibelman, Managing Director and Chief Executive Officer, Australian Energy Market Operator, *Committee Hansard*, Canberra 14 September 2017, p. 11.

368 Ms Audrey Zibelman, Managing Director and Chief Executive Officer, Australian Energy Market Operator, *Committee Hansard*, Canberra 14 September 2017, p. 11.

5.28 Dispatchable resources that are flexible are resources that have the capability to rapidly increase or decrease their output to balance system load[369], within 15 minutes according to AEMO.[370]

5.29 The Australian Renewable Energy Agency (ARENA) gave evidence that the NEM does not currently price inertia. This is because historically it was provided for free by big spinning turbines, powered by coal fire, gas and hydro. ARENA noted that renewables and batteries are able to provide inertia, but it does not come for free when the system is installed. ARENA argued that renewables and batteries could be encouraged to do so either through regulation or an incentive mechanism.[371]

5.30 In relation to synchronous condensors, which could provide inertia previously provided by thermal and conventional generation, the Committee heard evidence that General Electric was in discussions to provide such a condenser to the NEM. In particular, the Committee heard evidence that as AEMO is responsible for ensuring the system is run in a secure manner, AEMO would be an appropriate body to be liaising with General Electric in relation to such a purchase.[372]

5.31 The Committee heard evidence that dispatchability— a resource previously taken for granted— needed to be priced. The Australian Energy Council noted the AEMO evidence that in Ireland dispatchable generators can now sometimes earn more from providing system security services than from energy.[373]

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369 Commonwealth of Australia, 'Independent review into the future security of the National Electricity Market: Blueprint for the future', June 2017, pp. 79, 107–109, <https://www.environment.gov.au/system/files/resources/1d6b0464-6162-4223-ac08-3395a6b1c7fa/files/electricity-market-review-final-report.pdf> viewed 6 November 2017.

370 Ms Audrey Zibelman, Managing Director and Chief Executive Officer, Australian Energy Market Operator, *Committee Hansard*, Canberra 14 September 2017, p. 9.

371 Mr Ivor Frischknecht, Chief Executive Officer, Australian Renewable Energy Agency, *Committee Hansard*, 26 May 2017, p. 6.

372 Mr Vince Duffy, Department of Premier and Cabinet, South Australian Government, *Committee Hansard*, Adelaide, 1 September 2017, p. 17.

373 Mr Kieran Donoghue, General Manager Policy, Australian Energy Council, *Committee Hansard*, Melbourne, 31 August 2017, p. 14.

5.32 The Committee also heard about the importance of implementing a strategic reserve to facilitate dispatchable demand response in the wholesale energy market.[374]

Committee comment

5.33 The Committee considers it essential that dispatchability is maintained in the NEM. Whilst the Committee notes that the COAG Energy Council's Energy Security Board has proposed that retailers guarantee a level of dispatchability, the Committee considers that market mechanisms— such as reverse obligation auctions— could also be considered.

Demand response

5.34 As outlined in Chapter 4, demand response, sometimes referred to as demand management, involves having the capacity to remove demand from the grid by agreement. This leads to grid reliability, as the market can have confidence that at times of peak demand there are mechanisms to manage some of that demand rather than relying on supply tools alone.

5.35 ARENA gave evidence that there was inadequate incentive for demand response. Noting that it was working with AEMO to try and inform the rule maker as to what might be needed in order to optimally incentivise demand response, ARENA noted that when compared with international jurisdictions Australia was not as innovative.[375]

5.36 ARENA also provided evidence that demand response incurs some costs, including:

- Sales cost – attracting the interest of a company or individuals with respect to demand management;
- Contract cost – signing an agreement with that company or those individuals to implement demand management;
- Metering system cost – so that the system can be monitored and managed; and

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374 Mr Matthew Grover, Manager, Market Development, EnerNOC, *Committee Hansard*, Canberra, 14 September 2017, p. 5.

375 Mr Ivor Frischknecht, Chief Executive Officer, Australian Renewable Energy Agency, *Committee Hansard*, 26 May 2017, p. 6.

- Training cost – to run through the process to ensure that when the demand management process was to be implemented, it was properly executed.[376]

5.37 ARENA also highlighted current inefficiencies with the demand response framework, whereby AEMO was not empowered to sign demand management agreements that exceeded nine months.[377]

5.38 The Committee heard evidence that the most economical approach to addressing the ageing coal-fired fleet was a combination of demand management in conjunction with renewables —wind and solar —as well as storage, being batteries and pumped hydro.[378]

5.39 The Committee heard concerns that the Australian Energy Market Commission (AEMC) had removed a demand response mechanism in 2016 without proposing a replacement.[379]

5.40 The Committee heard evidence as to the importance of the AER's Demand Management Incentive Scheme being expedited and becoming operational as quickly as possible.[380]

Tariff reform

5.41 The Energy Network Association has outlined that there is strong consensus from industry, government and customer advocates that the current pricing frameworks are outdated and do not reflect the changing ways consumers use the electricity network. Notwithstanding the classes of customers who have access to peak and off peak usage charges, the Association noted that some customers are charged for how much energy they use, regardless of when they use it. As well, the real driver of network costs is the maximum electricity demand at a point in time. As customers are using the electricity network in increasingly different ways, the tariff structures are now

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376 Mr Ivor Frischknecht, Chief Executive Officer, Australian Renewable Energy Agency, *Committee Hansard*, 26 May 2017, p. 7.

377 Mr Ivor Frischknecht, Chief Executive Officer, Australian Renewable Energy Agency, *Committee Hansard*, 26 May 2017, p. 7.

378 Mr Graham Davies, Director and Principal, Resonant Solutions Pty Ltd, *Committee Hansard*, Adelaide, 1 September 2017, p. 12.

379 Mr Matthew Grover, Manager, Market Development, EnerNOC, *Committee Hansard*, Canberra, 14 September 2017, p. 5.

380 Mr Matthew Grover, Manager, Market Development, EnerNOC, *Committee Hansard*, Canberra, 14 September 2017, p. 5.

outdated and result in 'big, unintended subsidies from some customers to others'.[381]

5.42 The Australian Energy Regulator (AER) gave evidence to the Committee that it has been working to implement reforms in tariffs to move to more cost reflective pricing so that consumers are better able to make informed decisions about how they use energy and technology.[382]

5.43 The AER gave evidence that consumers do not just pay the spot price, but have overlaid the contract market and the hedges the retailers enter into with the generators to hedge against high spot prices.[383]

5.44 ARENA noted that if there is a solar project and a battery storage is right next door, a company cannot use the public transmission network without paying the full costs of the transmission and distribution network in that entire state. ARENA argued that having transmission and distribution costs that are more reflective of the actual costs of using the system might be a useful reform.[384]

Western Australia

5.45 In Western Australia there is a uniform tariff model for residential households. It combines a fixed and usage charge. The Committee heard:

> Up until 2016 that [fixed] supply charge ran at around 48.6 cents per day. For July 2017, the supply charge had increased by around 95 per cent to 94.9 cents per day. The cost per unit per kilowatt hour for WA is 26.47 cents.[385]

5.46 The Committee notes these prices were not appreciably lower than the NEM prices. It acknowledges that it is quite difficult to compare WA with other jurisdictions, precisely because of the WA uniform tariff.[386] There is also a

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381 Electricity Networks Australia, *Electricity Tariff Reform Handbook – at a glance*, May 2016, pp. 1-2.

382 Mr Warwick Anderson, General Manager, Network Finance and Reporting, Australian Energy Regulator, *Committee Hansard,* Canberra, 26 May 2017, p. 13.

383 Ms Anne Pearson, Chief Executive, Australian Energy Market Commission, *Committee Hansard*, 26 October 2017, p. 7.

384 Mr Ivor Frischknecht, Chief Executive Officer, Australian Renewable Energy Agency, *Committee Hansard*, 26 May 2017, p. 6.

385 Professor Alan Duncan, Director, Bankwest Curtin Economics Centre, *Committee Hansard*, Adelaide, 1 September 2017, p. 22.

386 Professor Alan Duncan, Director, Bankwest Curtin Economics Centre, *Committee Hansard*, Adelaide, 1 September 2017, p. 22.

$500 million per annum government subsidy operating within the WA scheme.

5.47 Furthermore, the Committee heard evidence that in Western Australia, the cost to a typical household based on the current tariff is around $1,800 per year. It was highlighted that this is a much higher impost on low-income households.[387] The impact of this is likely to be compounded following further uptake of renewables, with households that cannot afford to install solar PV left stranded on a grid that they would have an increased burden in funding.[388]

Equity issues on the grid

5.48 One option for reform was proposed by Professor Baldwin, from the Australian National University's Energy Change Institute. Professor Baldwin proposed a system similar to the HECS university loan payment scheme, which would see loans provided to assist households to install rooftop solar PV, batteries and computerised demand management systems in their households, with repayments linked to income levels.[389]

5.49 Furthermore, the Committee heard of existing cross-subsidies that already exist within the NEM. Examples included:

- Households without air conditioning units subsidising those with units, with a value of approximately $700 per annum;
- Households in Queensland with solar PV installed on their rooftops subsidising those without solar PV, with a value of about $200 per annum.
- With air conditioning units, the cross-subsidisation occurs as a result of a lack of cost reflective pricing in the market – owners of air conditioning units are not paying for the fact that they are using those units at times when electricity is trading at the highest prices on the NEM.[390]

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387 Professor Alan Duncan, Director, Bankwest Curtin Economics Centre, *Committee Hansard*, Adelaide, 1 September 2017, p. 22.

388 Professor Alan Duncan, Director, Bankwest Curtin Economics Centre, *Committee Hansard*, Adealide, 1 September 2017, p. 25.

389 Professor Kenneth Baldwin, Director, Energy Change Institute, Australian National University, *Committee Hansard*, Canberra, 30 March 2017, p. 16.

390 Mr John Bradley, Chief Executive Officer, Energy Networks Australia, *Committee Hansard*, Canberra, 30 March 2017, p. 16.

5.50 Providing demand management options to households can lead to savings of up to $600 per annum on energy bills, which the Committee heard could go some way to addressing inequity in the NEM.[391]

Box 5.1 Smart meters

Committee questionnaire:

58 per cent of respondents reported have a smart meter installed at their premises. Of those respondents that did not have a smart meter, 76 per cent indicated that they were planning to install one in the next three years.

Committee comment

5.51 The Committee notes that the current pricing model does not differentiate between consumers and their usage in a nuanced manner. Given the advent of smart meters, it is incongruous to the Committee that those consumers who participate in peak power periods are not financially incentivised not to do so.

5.52 The Committee was heartened to hear that a number of stakeholders have been turning their minds to the issues of inequity on the power grid, and was particularly drawn to concessional loan style repayment approaches, such as those discussed by Professor Baldwin.

5.53 Whilst the Committee acknowledges that a move towards cost reflective pricing involves layers of complexity relating to data security and the roll out of technology such as smart meters, it is of the opinion that it is timely to review cost reflective more closely with a view to providing consumers with better value for the electricity they use—or do not use.

Recommendation 18

5.54 The Committee recommends that the Australian Energy Market Operator consider the appropriateness of a roll out of smart meters to all National Electricity Market users, ensuring that the costs of installation are borne by the beneficiaries with issues of equity accounted for.

391 Mr John Bradley, Chief Executive Officer, Energy Networks Australia, *Committee Hansard*, Canberra, 30 March 2017, p. 17.

AER to examine bidding in wholesale market

5.55 The Committee heard evidence of the importance of looking at the issues of where the grid is open to market manipulation, which engineer Graham Davies identified as one of the key reasons behind spikes in pricing.[392] A rule change in relation to this was considered critical.[393]

5.56 The Committee heard evidence from the Australian Energy Regulator (AER) that, following a whole series of high-priced events over the 2016/2017 summer period, it produced a series of reports that explain some of the circumstances surrounding those high-priced events. AER's view is that the apparent rebidding by generators in Queensland did not breach any of the rules.[394]

5.57 The AER highlighted that if there were concerns about anti-competitive behaviour, it was the Australian Competition and Consumer Commission rather than the AER that had jurisdiction.[395] However, the AER noted that in December of 2016 it was given a new function of looking at the effectiveness of competition in the wholesale electricity market.[396] This new responsibility will require the AER to report every two years on a broad range of issues, including barriers to entry and effectiveness of the wholesale market. The first report is due in December 2018.[397] Following questioning from the Committee, the AER agreed that it was still a constituent part of the Australian Competition and Consumer Competition and will still be a constituent part of the ACCC at the time of reporting in December 2018.[398]

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392 Mr Graham Davies, Director and Principal, Resonant Solutions Pty Ltd, *Committee Hansard*, Adelaide, 1 September 2017, p. 9.

393 Mr Graham Davies, Director and Principal, Resonant Solutions Pty Ltd, *Committee Hansard*, Adelaide, 1 September 2017, p. 9.

394 Mr Peter Adams, General Manager, Wholesale Markets, Australian Energy Regulator, *Committee Hansard*, Canberra, 26 May 2017, p. 17.

395 Mr Peter Adams, General Manager, Wholesale Markets, Australian Energy Regulator, *Committee Hansard*, Canberra, 26 May 2017, p. 17.

396 Mr Peter Adams, General Manager, Wholesale Markets, Australian Energy Regulator, *Committee Hansard*, Canberra, 26 May 2017, p. 17.

397 Mr Peter Adams, General Manager, Wholesale Markets, Australian Energy Regulator, *Committee Hansard*, Canberra, 26 May 2017, p. 17.

398 Mr Peter Adams, General Manager, Wholesale Markets, Australian Energy Regulator, *Committee Hansard*, Canberra, 26 May 2017, p. 17

Committee comment

5.58 The Committee notes that some of the transactions occurring on the grid appear to take advantage of the 5 minute bidding being settled in 30 minute increments. Given the draft rule that will see settlement occur every five minutes, the Committee makes no further comment in relation to this issue.

5.59 Of particular interested to the Committee is whether the market is designed with enough certainty to encourage the types of investment required. Whilst noting concerns that the $14,000 cap could be the subject of market manipulation, the Committee also notes the cap's purpose in attracting new investment onto the grid.

5.60 Nevertheless, the Committee is of the opinion that accusations of 'gaming the grid' compromise the reputation of the NEM and should be thoroughly investigated.

Recommendation 19

5.61 The Committee recommends that the Australian Energy Regulator review concerns about rebidding practices in New South Wales during 2017.

Timely implementation of five-minute rule change

5.62 The Australian Energy Market Commission (AEMC) explained to the Committee why a rule change that was formally requested in December 2015, being the change from 30 minute settlements in the NEM to five minute settlement, was taking so long to consider:

> One of the reasons for the delay was that affected stakeholders said to us, "We cannot really comment and give you feedback on this unless we know, if you are going to make this rule, how you would make it." So we went through a process of designing a mechanism and asking them to provide feedback on that, which they are currently doing. It has taken a while, but I note that, in other markets where five-minute settlement has been introduced, the rule-making time has been, on average, 2½ years, and then there is a period for transition. I am not making excuses, but not only is it a fundamental change to the operations of the spot market but it also has, potentially, some huge impacts on the hedge market that operates alongside the spot market and provides much certainty and risk management in our market. So we really do need to understand the implications.[399]

[399] Ms Anne Pearson, Chief Executive, Australian Energy Market Commission, *Committee Hansard*, 26 May 2017, p. 21.

5.63 Whilst the change to five minute settlement would be to the advantage of newer forms of technology, the Committee heard that most existing participants in peaking and in demand response would be unable to find advantage in a change to five minute settlements.[400]

5.64 The AEMC gave evidence that as at 26 October 2017 it had received close to 40 submissions on this draft rule, with a final draft to be released in November 2017.[401] Some submissions agree with an implementation period of three and a half years, some requested four years and other recommended an implementation period of six years. Some others would like less than three and a half years.[402]

5.65 The AEMC outlined why there would be a three and a half year implementation period, with reasons including that AEMO will need to make a number of changes around how the market is settled and market participants will also have to change a lot of their systems.[403]

5.66 Professor Baldwin noted that in the context of forecasting, the five minute bidding system is:

> basically an outmoded thing that was invented back in the eighties and nineties. It has been totally superseded by technology. If you want to bid into the market with a big battery storage system, you could do so in seconds. Basically, the NEM is unable to take into account advances in technology. You need forecasting for technology as well as the weather.[404]

Committee comment

5.67 In the short term, the Committee supports the move to a five minute settlement and considers that this should happen as soon as is practicable, and in less than three and a half years' time. Whilst acknowledging the importance of stakeholder consultation, the Committee is disappointed with

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400 Mr Jon Stretch, Managing Director and Chief Executive Officer, ERM Power, *Committee Hansard*, Brisbane, 18 August 2017, p. 20.

401 Ms Anne Pearson, Chief Executive, Australian Energy Market Commission, *Committee Hansard*, Canberra, 26 October 2017, p. 11.

402 Ms Anne Pearson, Chief Executive, Australian Energy Market Commission, *Committee Hansard*, Canberra, 26 October 2017, p. 11.

403 Ms Anne Pearson, Chief Executive, Australian Energy Market Commission, *Committee Hansard*, Canberra, 26 October 2017, p. 11.

404 Professor Kenneth Baldwin, Director, Energy Change Institute, Australian National University, *Committee Hansard*, Canberra 30 March 2017, p. 12.

the AEMC's lengthy processes for considering and implementing important rule changes.

5.68 The Committee has had reference to Professor Baldwin's comments that a five minute settlement may be a short lived process as real time settlement will inevitably be introduced.

Recommendation 20

5.69 The Committee recommends that the Australian Energy Market Commission expedite the introduction of a five minute settlement period in the National Electricity Market, so that this rule change commences sooner than 2021.

Recommendation 21

5.70 The Committee recommends that the Australian Energy Market Commission and the Australian Energy Market Operator consider the implications of real-time settlement in the National Electricity Market, and immediately commence consultation with industry, with a view to expediting any possible future rule change to this effect.

Market concentration in the generation sector and vertical integration

5.71 AGL is a good example of a company that participates in the NEM as both a generator and a retailer. Companies that perform both roles are often referred to as 'gentailers'. Other examples of 'gentailers' include Origin and EnergyAustralia.

5.72 The Committee heard evidence that whilst a number of US markets operated in a similar manner to the NEM, there were some key differences. In addition to the size of those markets – PJM and Ercot together annually are about 550 terawatt hours for commercial-industrial, whereas in Australia it is about 85 terawatt hours—there is also diversity in wholesale providers and diversity in retail providers and a deep and liquid wholesale market in both electricity and gas in the US.[405] Australian households—of which there were 9.9 million in 2016[406]— consume approximately 123 terawatt hours

405 Mr Jon Stretch, Managing Director and Chief Executive Officer, ERM Power, *Committee Hansard*, Brisbane, 18 August 2017, p. 18.

406 Australian Bureau of Statistics, 2016 Census QuickStats, http://www.censusdata.abs.gov.au/census_services/getproduct/census/2016/quickstat/036, accessed 5 December 2017.

annually,[407] whereas the US Department of Energy reports that US households consume approximately 1,411 terawatt hours annually, with 125.82 million households.[408] Those figures indicate that US households consume 11,214 kilowatts of electricity per annum, compared with Australian annual household consumption of 8,584 kilowatts.

5.73 The Committee had reference to the Finkel review final report which noted that one of the effects of the existence of 'gentailers' in the system is that they contribute less to the supply and trading of financial instruments, which can be an issue for other market participants.[409] This is because non-vertically integrated retailers have limited access to risk management products.[410]

5.74 In the October 2017 preliminary report into its inquiry into retail electricity pricing, the Australian Competition & Consumer Commission noted that as the demand-supply balance for electricity has significantly tightened, it is difficult for standalone retailers to compete with vertically integrated 'gentailers'.[411] There is also a concern that it may be having an impact on wholesale pricing.[412]

Committee comment

5.75 The Committee notes concerns from market players in relation to vertical integration in the NEM, particularly as it relates to 'gentailers'. In particular, the Committee notes concerns relating to conflicts of interest, limited access to risk management products by other retailers and insufficient price pressure.

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407 Australian Government, Office of the Chief Economist, *Australian Energy Update 2016*, page 10; https://www.industry.gov.au/Office-of-the-Chief-Economist/Publications/Documents/aes/2016-australian-energy-statistics.pdf , accessed 4 December 2017.

408 US Department of Energy, Sales of Electricity to Ultimate Customers – total by end-use sector, 2006 – December 2016, https://www.eia.gov/electricity/annual/html/epa_02_05.html, accessed 5 December 2017; Statista, The statistics portal, Number of households in the US from 1960 to 2016 https://www.statista.com/statistics/183635/number-of-households-in-the-us/, accessed 5 December 2017.

409 Dr Alan Finkel, Chair of the Expert Panel, *Independent review into the future security of the National Electricity Market – blueprint for the future,* June 2017, p. 81.

410 Australian Competition & Consumer Commission, *Retail Electricity Pricing Inquiry – preliminary report*, October 2017, p. 7.

411 Australian Competition & Consumer Commission, *Retail Electricity Pricing Inquiry – preliminary report*, October 2017, p. 82.

412 Australian Competition & Consumer Commission, *Retail Electricity Pricing Inquiry – preliminary report*, October 2017, p. 7.

Recommendation 22

5.76 The Committee recommends that the Australian Energy Regulator review the issue of vertical integration in the generation sector and market concentration in the generation sector, with a view to considering ways to ensure that standalone retailers have sufficient access to risk management products and fairly priced wholesale electricity.

New generation: barriers to entry

5.77 As noted above, the AER noted that in December 2016 it was given a new function of looking at the effectiveness of competition in the wholesale electricity market.[413] This new responsibility requires the AER to report every two years on a broad range of issues, including barriers to entry and effectiveness of the wholesale market. The first report is due in December 2018.[414]

5.78 When asked by the Committee whether the $14,000 per megawatt hour spot cap on the NEM has driven investment, Mr Duffy from the South Australian Government observed that in 1998—99 South Australia entered the market in a fairly tight supply situation:

> Pelican Point [power station, 20 km from the centre of Adelaide, burning natural gas in a combined cycle] was built and Snuggery [power station, near Tantanoola in the Limestone Coast region and is used as a peaking power plant] in the south-east was built. Subsequently, Quarantine Power Station was built and Hallett Power Station was built after we had a very tight summer in 2000—01. The gross energy market did send very strong signals to have investment within South Australia.[415]

5.79 Compared with this clear signalling, Mr Duffy noted that the impact of the current policy environment was to dampen the clarity of signalling:

> Over the last decade, we've had a very different environment for investment, and I don't think it's driven by the gross energy market. I think it's the

413 Mr Peter Adams, General Manager, Wholesale Markets, Australian Energy Regulator, *Committee Hansard*, Canberra, 26 May 2017, p. 17.

414 Mr Peter Adams, General Manager, Wholesale Markets, Australian Energy Regulator, *Committee Hansard*, Canberra, 26 May 2017, p. 17.

415 Mr Vince Duffy, Department of Premier and Cabinet, South Australian Government, *Committee Hansard*, Adelaide, 1 September 2017, p. 19.

> question of having a clear and coherent policy on climate and energy, and having mechanisms to drive investment in that sort of framework.[416]

5.80 Furthermore, the Committee heard that the Rules operated so that a generator can be charged to connect to the network, but the rules forbid the network from applying charges to a generator for just using the network.[417]

Committee comment

5.81 The Committee was pleased to hear that the AER would be reporting biennially on effectiveness of competition in the wholesale market. In a market that once managed price signalling effectively, it would appear there is insufficient certainty to provide the conditions to drive supply.

Sufficient investment in the grid

5.82 As outlined in Chapter 4, there is significant concern that investment in infrastructure relating to modernising the grid through the inclusion of greater levels of interconnection would pass the AER's RIT-T.

5.83 Also outlined in Chapter 4, the Committee heard evidence that new connections to the grid were frustrated by high connection costs that seemed to be unreasonably imposed on new generators, with the result being that existing generators who were already connected to the grid had an advantage.

Committee comment

5.84 The Committee notes that whilst the RIT-T may be operating to restrain investment in modernising projects such as the installation of additional interconnectors on the grid, it is not clear whether this sort of investment should be achieved under the RIT-T or via alternative funding methods.

5.85 The Committee is concerned that the new connections rules currently operating with respect to the grid have the effect of making it difficult for new generators to enter the grid, advantaging the original generators who are already connected to the grid.

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416 Mr Vince Duffy, Department of Premier and Cabinet, South Australian Government, *Committee Hansard*, Adelaide, 1 September 2017, p. 19.

417 Mr Alistair Parker, Executive General Manager, Regulated Energy Services, AusNet Services, *Committee Hansard*, Melbourne, 31 August 2017, p. 29.

5.86 A revitalised RIT-T and RIT-D may drive innovative solutions in the NEM, such as increased transmission lines from the roaring forties where wind power could be harnessed of the north west coast of Tasmania.

Recommendation 23

5.87 The Committee recommends that the Australian Energy Market Commission conduct reviews of the Regulatory Investment Test for Transmission, the Regulatory Investment Test for Distribution and the Rules relating to

- **investment in more interconnectors with a view to capturing benefits of additional interconnectors to non-adjacent states; and**
- **new connections to the grid.**

Box 5.2 The future

Committee questionnaire:

I know enough about the industry to know that the multiple reasons behind high electricity prices and electricity security/reliability are diverse and complex. To achieve anything meaningful, we seriously need to be able to move beyond sound grabs and point scoring.

5.88 This report has sought to capture the issues that were brought to the Committee's attention during the course of this inquiry. The Committee is mindful that the vast majority of the stakeholders noted the importance of policy certainty in encouraging investment in the NEM, discussion of which the Committee has captured in Chapter 3. As noted in Chapter 4, the Committee also heard about the importance of planning, with this Chapter capturing many of the shorter term reforms within the existing market structures proposed by stakeholders.

5.89 The Committee acknowledges that the grid is going through significant transition and is keen to see that its work in this area leads to tangible benefits for Australian households and businesses.

Mr Andrew Broad MP
Chair
5 December 2017

A. List of submissions

1 Mr Daryl Scherger

2 Mr David Coleman

3 The Industrial and Community Energy Group

4 Mr Barrie Hill

5 Electrical Trades Union of Australia

6 Altitude Energy PTY LTD

7 S&C Electric Company

8 Department of the Environment and Energy

- 8.1 Supplementary to submission 8

9 Mr David Gillett

10 Agriculture Industries Energy Task Force

11 Resonant Solutions (Pty) Ltd

12 Australian Sustainable Built Environment Council

13 Northern Alliance for Greenhouse Action

14 Consumer Action Law Centre

15 Deakin University

16 Australian Nuclear Association

17 Australian Conservation Foundation

18 Mr Ray Osterberg

19 Totally Renewable Yackandandah

20 Australian National University Energy Change Institute

- 20.1 Supplementary to submission 20

21 Wimmera Development Association

22 Business Council of Co-operatives and Mutuals

23 U3A Climate Conversations Group

24 Dr Ali Arefi, Dr Farhad Shahnia, and Dr GM Shafiullah

25 Asia Pacific Simulation Alliance

26 Green Building Council of Australia

27 AusNet Services

28 Climate Action Moreland

29 Chamber of Commerce and Industry Queensland

30 AGL Energy Limited

31 Australian Academy of Technology and Engineering

32 Public Interest Advocacy Centre

33 CSIRO

34 Australian Solar Thermal Energy Association

35 Hitachi Consulting

36 Clean Energy Finance Corporation

37 Delta Electricity

38 Energy Networks Australia

- 38.1 Supplementary to submission 38
- 38.2 Supplementary to submission 38

39 Bureau of Steel Manufacturers of Australia

40 Engineers Australia

41 Centre for Energy and Environmental Markets

42 Australian Renewable Energy Agency (ARENA)

- 42.1 Supplementary to submission 42

43 Government of South Australia

- 43.1 Supplementary to submission 43
- 43.2 Supplementary to submission 43

44 Geoscience Australia

45 GreenSync

46 NSW Farmers' Association

47 Australian Energy Market Operator

- 47.1 Supplementary to submission 47

48 Great South Coast Group

49 Australian Energy Council

- 49.1 Supplementary to submission 49

50 Australian Energy Regulator

- 50.1 Supplementary to submission 50
- 50.2 Supplementary to submission 50

51 Business Council of Australia

52 Government of the Australian Capital Territory

53 Energy Consumers Australia

54 Australian Energy Market Commission

- 54.1 Supplementary to submission 54

55 Monash Energy Materials and Systems Institute

56 Melbourne Energy Institute

57 Associate Professor Nesimi Ertugrul

58 Energy Efficiency Council

B. List of exhibits

1 *National Electricity Market: A case study in successful microeconomic reform*, 2013, Australian Energy Market Commission

2 *Power Transformed*, July 2016, Consumer Action Law Centre

3 *Executive summary—Submission to the Independent Review into the Future Security of the National Electricity Market on the Preliminary Report*, December 2017, U3A Climate Conversations Group

4 *NEM 2.0: balancing the energy trilemma—Response to the Independent Review into the Future Security of the National Electricity Market*, March 2017, Public Interest Advocacy Centre

5 *New Energy Options for the Victorian Dairy Industry*, January 2017, Negotiaction

6 *Submission to the Independent Review into the Future Security of the National Electricity Market*, March 2017, Business Council of Australia

7 *Unlocking value for customers: Enabling new services, better incentives, fairer rewards*, August 2016, Energy Networks Australia and CSIRO

8 *Network Pricing and Incentives Reform*, August 2016, Energy Networks Australia

9 *Unlocking value: Microgrids and stand alone systems*, October 2016, Energy Networks Australia and CSIRO

10 *Roles and incentives for microgrids and stand alone power systems*, October 2016, Energy Networks Australia

11 *FutureGrid Project Summary Report*, August 2016, CSIRO FutureGrid Research Project

12 *AER benchmarking and renewable energy roadmap*, August 2017, AusNet Services

13 *In short supply? When and how to build more electricity generation*, September 2017, Grattan Institute

C. List of public hearings

Thursday, 30 March 2017—Canberra

Department of the Environment and Energy

- Mr Stuart Richardson, Acting, Assistant Secretary, Electricity Branch, Energy Division
- Ms Joann Wilkie, Acting First Assistant Secretary, Energy Division

Australian Energy Regulator

- Mr Warwick Anderson, General Manager, Network Finance and Reporting
- Mr Gavin Fox, Director, Strategy and External Affairs
- Mr Scott Haig, Director

Australian Energy Market Commission

- Mr Richard Owens, Senior Director

Australian Renewable Energy Agency

- Mr Ivor Frischknecht, Chief Executive Officer

Clean Energy Finance Corporation

- Mr Oliver Yates, Chief Executive Officer

Australian Energy Council

- Mr Kieran Donoghue, General Manager, Policy

Energy Networks Australia

- Mr John Bradley, Chief Executive Officer
- Mr Garth Crawford, Executive Director, Economic Regulation

Energy Consumers Australia

- Mr Christopher Alexander, Director, Advocacy and Communications

CSIRO

- Mr Karl Rodrigues, Acting Director, Energy
- Dr Glenn Platt, Research Program Director, Energy

Australian National University Energy Change Institute

- Prof. Kenneth Baldwin, Director
- Prof. Andrew Blakers, Executive Member

Friday, 26 May 2017—Canberra

Clean Energy Finance Corporation

- Mr Simon Every, Head of Government and Stakeholder Relations
- Mr Tim Jordan, Investment Research

Australian Renewable Energy Agency

- Mr Ivor Frischknecht, Chief Executive Officer
- Mr Oliver Story, Manager Strategy

Australian Energy Regulator

- Mr Warwick Anderson, General Manager, Network Finance and Reporting
- Mr Peter Adams, General Manager, Wholesale Markets

Australian Energy Market Commission

- Ms Anne Pearson, Chief Executive
- Mr Richard Owens, Senior Director

Australian Energy Market Operator

- Ms Audrey Zibelman, Chief Executive Officer
- Mr David Swift, Executive General Manager, Corporate Development

Thursday, 1 June 2017—Canberra

Energy Networks Australia

- Mr John Bradley, Chief Executive Officer
- Mr Garth Crawford, Executive Director, Economic Regulation
- Mr Brendon Crown, Executive Director, Economic Policy

Thursday, 17 August 2017—Canberra

Australian National University Energy Change Institute

- Prof. Kenneth Baldwin, Director

The University of Melbourne, Melbourne Energy Institute

- Prof. Michael Brear, Director

The University of Sydney, Centre for Sustainable Development

- Prof. Anthony Vassallo, Director

Friday, 18 August 2017—Brisbane

University of Queensland Energy Institute

- Prof. Simon Bartlett, Powerlink Australian Chair in Electricity Transmission

ERM Power

- Mr Jon Stretch, Chief Executive Officer

Agriculture Industries Energy Task Force

- Mr Steve Whan, Chief Executive Officer, National Irrigators' Council
- Mr Ashkan Salardini, Chief Economist, New South Wales Farmers Association

Canegrowers

- Mr Warren Males, Head, Economics

Thursday, 31 August 2017—Melbourne

Grattan Institute

- Mr Tony Wood, Energy Program Director

Australian Energy Council

- Mr Matthew Warren, Chief Executive Officer
- Mr Kieran Donoghue, General Manager Policy

ACIL Allen Consulting Pty Ltd

- Mr Paul Hyslop, Chief Executive Officer

AusNet Services

- Mr Alistair Parker, Executive General Manager, Regulated Energy Services
- Mr Mark Judd, Manager, Community Energy

Friday, 1 September 2017—Adelaide

The University of Adelaide

- Assoc. Prof. Nesimi Ertugrul, School of Electrical and Electronic Engineering

Resonant Solutions Pty Ltd

- Mr Graham Davies, Director, Principal

Government of South Australia

- Mr Vincent Duffy, Executive Director, Energy and Technical Regulation, Department of the Premier and Cabinet

Bankwest Curtin Economics Centre

- Prof. Alan Duncan, Director

Thursday, 14 September 2017—Canberra

Energy Efficiency Council

- Mr Rob Murray-Leach, Head of Policy
- Mr Matthew Gover, Manager, Market Development, EnerNOC Pty Ltd

Australian Energy Market Operator

- Ms Audrey Zibelman, Managing Director and Chief Executive Officer
- Mr David Swift, Adviser, Chief Executive Officer

Thursday, 19 October 2017—Canberra

Energy Consumers Australia

- Mr Chris Alexander, Director, Advocacy and Communications

AGL Energy Ltd

- Assoc. Prof. Tim Nelson, Chief Economist
- Ms Elisabeth Brinton, Executive General Manager, New Energy

Thursday, 26 October 2017—Canberra

Australian Energy Market Commission

- Ms Anne Pearson, Chief Executive

Australian Energy Regulator

- Ms Michelle Groves, Chief Executive Officer
- Mr Warwick Anderson, General Manager, Network Finance and Reporting
- Mr Gavin Fox, Acting General Manager, Wholesale Markets