NSW GOVERNMENT | Chief Scientist & Engineer

Assessment of preparedness of the NSW Energy Market: 2022/23

7 November 2022

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NSW GOVERNMENT Chief Scientist & Engineer

The Hon Matthew Kean MP
Treasurer; Minister for Energy
52 Martin Place
SYDNEY NSW 2000

Dear Minister

Assessment of preparedness for the NSW energy market: 2022/23

This report is submitted in accordance with the Terms of Reference, to provide a yearly assessment of the NSW Energy Market. The assessment was undertaken by an Expert Panel chaired by myself, with Mr Michael Norris, (Office of the NSW Chief Scientist & Engineer) as Deputy Chair, Mr Neville Henderson (former commissioner of the Australian Energy Market Commission) and Professor Emeritus David Hill (from the School of Electrical and Information Engineering at The University of Sydney). Secretariat support was provided by the Office of the Chief Scientist & Engineer (OCSE).

The Panel and secretariat consulted with the Australian Energy Market Operator (AEMO), Australian Energy Market Commission (AEMC), Australian Energy Regulator (AER), Energy Security Board (ESB), Australian Bureau of Meteorology (BOM), network operators and generators to understand issues including:

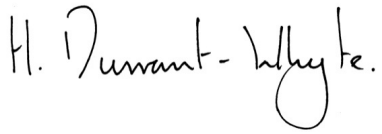
- events throughout the year of 2021/22, including the impact of extreme weather events
- NSW Government and the electricity sector preparedness for the coming year
- future planning and emerging risks for electricity systems and markets
- emerging risks and vulnerability of the supply chain with gas and coal fuel

Although the NEM is undergoing a significant transition of the generation and network sectors, posing risks to the energy market, the Panel have concluded that the NSW Government is currently well prepared for the coming summer in regard to the supply of electricity.

However, there are a number of risks to the system due to the potential impacts of extreme weather (floods and storms), system dynamics with the increased penetration of renewables (both grid-scale and rooftop solar), delayed maintenance and the likelihood of increased outages in the fleet of aging coal-fired generation, and the uncertainty associated the global economic and political situation that could affect the security, reliability and resilience of electricity supply. The NSW Government and the ESB, along with the market bodies, are developing policies and strategies to support the transition, and the Panel have provided complementary recommendations.

The Assessment considers risks over the coming 12-months. However due to global and national uncertainty, such as fuel supplies and longer-term climatic forecasts, further and ongoing work will be needed to completely assess the risks throughout the whole year particular during winter 2023.

Yours sincerely,



Hugh Durrant-Whyte
Chief Scientist & Engineer
7 November 2022

Findings & Recommendations

The scope for the 2022/23 Assessment has been broadened beyond the summer period to consider year-round preparedness and risks to the energy system for the short (next 12 months) and medium (emerging over the next couple of years). This reflects both observations by the Expert Panel that the emerging risks to the secure and reliable supply of energy in the National Energy Market (NEM) are increasingly occurring outside of this summer period. This was exemplified by the confluence of factors that led to the market suspension by the operator in June 2022 and the widespread flooding in the shoulder periods of 2021/22.

Panel observations of 2021/22

NEM review

- Lack of Reserves 1 (LOR1) notices were at an all-time high over the previous 12 months. It was observed by NEM participants that due to their increasing frequency they may not be as useful in isolation as an emergency trigger for actions to be implemented. It was noted that the frequency at which they occur is an inherent part of the nature of the NEM transition towards smaller renewable generation, and that they are designed, for the most part, to stimulate a market response. There may be the requirement in the future to examine alternative frameworks for determining emergency management triggers: for example, indicators for stability and security should be investigated.
- In June 2022, Australian Energy Market Operator (AEMO) announced a market suspension because of a confluence of events made it impossible to continue operating the spot market while ensuing a secure and reliable supply of electricity for consumers. This was the first time that the market operator has suspended the market, with the suspension in place for ten days[1]. The strong collaboration between AEMO, the Australian Energy Market Commission (AEMC), Australian Energy Regulator (AER), generators, emergency reserve providers, network service providers and jurisdictions enabled this series of events to be effectively managed without involuntary customer load shedding. Supply reliability was maintained despite the acute energy and capacity limitations and market issues.
- Some thermal generation (coal and gas fired) had fuel constraints during winter 2022, a driver of which was strong demand for fuel from international markets (as a result of the current political situation in Europe) that resulted in a higher commodity price and decreased domestic supply. Further, coal and gas stockpiles were depleted quickly leading up to and over the winter period due to demand requirements. Further, the Snowy Hydro units were operating in an unusual situation, whereby needing to run continually, but were limited by water authorities in terms of releases to create airspace.

Climate and extreme weather

- Significant flooding was experienced across the eastern states, with northern NSW and SE Queensland being the most severely impacted throughout 2021/22. Climatic drivers that led to this above average rainfall included the persistence of La Niña through summer 2021/22 and a negative Indian Ocean Dipole (IOD). Widespread flooding and rain caused power outages at many properties, as well as major damage to infrastructure, including power lines, power plants, etc.
- As outlined in the NSW Flood Inquiry, the loss of power during the flood events was significant in terms of duration and its compounding effect on other services including telecommunication. A total of 69,603 essential energy customers in Lismore and

[1] A market suspension is when AEMO suspends the trading on its wholesale spot market in all regions of the NEM, under the National Electricity Rules

surrounding regions were affected by power outages for a period between 13 days to 3 months.

- Comments from energy sector stakeholders indicate that there is still not a good understanding of where critical telecommunication infrastructure are located, which could improve emergency response by ensuring the provision/restoration of electricity connections.
- Although the Telecommunications Services Functional Area (TELCOFA) was present at the combat centres and Distribution Network Service Providers (DNSPs) were present at the local emergency centres, commentary from stakeholders indicated that it would be a good proactive step to ensure that there is consistent representation from the telecommunication companies in order for the timely and accurate provision of information (in a similar manner to the DNSP representation at local emergency centres).
- Recommendations were made by the NSW Flood Inquiry to minimise disruption to essential services, including outages which compromise basic communication coverage, and to ensure access to safe water supply and power during flood events.
- The Panel noted that the ongoing consequences of the flood events and rainfall events (including the current saturated environment) have provided ongoing issues around workforce deployment, including access to key infrastructure (such as power plants) and for ongoing maintenance (such as vegetation clearance activities).
- Specifically, energy market stakeholders faced challenges providing services during the catastrophic floods experienced in northern NSW in 2021/22 and 2022/23, in particular obstacles included operator access to assets (for maintenance/restoration) and asset damage as a result of the floods and rainfall. Access to up-to-date resources to assist in emergency response (such as timely provision of flood projections for specific locations) and the ability to triangulate outages (such as via SES data streams) was also reported as a major challenge.

Recommendation 1

That the EUSFA and emergency services (SES and NSW Rural Fire Services (RFS)) work together to ensure that the provision of data and access to data is increased in emergency situations, particularly in relation to re-energisation of assets and the re-energisation of customers (residential and industrial) and flood and/or rainfall data. This could include investigating the ability for DNSPs to have sufficient access to data streams and systems that would facilitate rapid on-the-ground actions (such as the prioritisation of properties/assets experiencing power loss) and to feed data into this system to make it more robust.

Ongoing COVID-19 impacts and influenza season

- Stakeholders reported they were and are well positioned to deal with the ongoing COVID-19 impacts and influenza season. Rapid Antigen Tests have been stockpiled and operational protocols to reduce spread amongst workers are well executed.
- As a result of the impact of COVID-19 on global supply chains, the stakeholders feel well positioned to understand the impact on timelines moving forward. For example, although global politics have further increased lead times on equipment and technical support, stakeholders have been able to factor these into planning and maintenance programs.

2022/23 Preparedness Assessment

- Risks facing the NEM and NSW energy stakeholders are no longer limited to just the summer period, but increasingly in the shoulder periods and winter periods.

- This was reflected in conversations with stakeholders, who saw increased risks to reliability in the shoulder and winter periods, as occurred with the market suspension in June 2022.
- Stakeholders noted increasing concerns about supply risks during the winter period and the importance of assessing those risks. Due to difficulties in forecasting risks over a longer period, it was suggested by some stakeholders that Assessments be updated/re-examined every 6 months.

Climate outlook

- La Niña has been declared by the Bureau of Meteorology (BOM) to return over summer 2022/23, seeing a wet outlook for most of NSW. To date, predictions indicate it will be a less intense and shorter La Niña, ending early January. However, with the antecedent conditions (i.e., already saturated soils), flooding is considered likely across parts of NSW. The Panel observed that recent flooding has occurred in late September and October 2022 and should be considered a likely scenario over summer.

ESOO outlook and managing supply risks

- AEMO's 2022 NEM Electricity Statement of Opportunities (ESOO) does not forecast any regions with expected unserved energy (USE) above the Interim Reliability Measure (IRM) of 0.0006% in 2022/23 provided resources and demand is as expected (AEMO's Central Scenario assumptions).
- However, since May 2022 there has been several LOR events requiring market interventions to maintain reliability and security arising due to a range of coincident events. This significant increase includes an unprecedented 10-day period, between 15 and 24 June 2022, during which a total of 77 LOR declarations were made in NSW and the spot market was suspended in all regions by AEMO.
- As the energy market transitions, the incidence and cause of LORs is likely to change. As has happened recently, LOR1s and LOR2s have occurred but have not led to LOR3s. It will be important for EUSFA and the Jurisdictional System Security Coordinator (JSSC) to develop an understanding of these potential causes and to gain an understanding of what LORs are likely to progress to LOR3s.
- There are electricity supply risks in the next few years. The ability to maintain adequate reliability and security is highly dependent on a host of committed renewables coming on-line according to schedule, transmission being extended to allow connection of renewables and plant closures occurring as planned.
- As the power system becomes more complex and interdependent there is the potential for cascading failures to occur. Appropriate security, reliability and resilience planning is meant to avoid creating situations where cascading failures cause disruption. However, cascading failures can occur and understanding of where cascading failures can lead to widespread disruption is needed which can inform government before load is shed and or market intervention is required as part of future resilience measures.

Supply chain vulnerability and forecasts

- Across stakeholders, concerns were raised about reliance of coal supply and stockpiles. High prices driven by international prices, is putting pressure on domestic prices and supply.
- Stakeholders expressed concerns that next winter is forecasted to have a high strain on the system with diminishing stockpiles and the likelihood of wet coal being delivered due to ongoing flooding and rain events. Energy needs may also be considerable over the wet summer given humidity triggers high air conditioner usage.

- Significant issues identified with import of materials and the timeframes for getting equipment into Australia.
- The transition of the electricity sector is underway, with many stakeholders expressing concern there is a lack of coordination during this energy market transition.
- Recently the Commonwealth, State and Territory Energy Ministers established a National Energy Transformation Partnership in August 2022 to provide a framework for national alignment and cooperative action by governments to support the smooth transformation of Australia's energy sector.

Recommendation 2

That the NSW Government continue to engage with the NEM participants and relevant state and Commonwealth authorities to ensure that there is coordination in the energy market transition. This includes, but it not limited to:

- The NSW Office for Energy and Climate Change (OECC) should stay abreast of progress on energy market and government (states and Commonwealth) initiatives that will support the transition of the NEM (e.g., 'The National Energy Transformation Partnership' initiative by the Commonwealth Government).
- That the appropriate stakeholders are identified and engaged to ensure that complex planning pathways for the energy transition are understood.
- Understand the significant infrastructure build in the Renewable Energy Zones (REZs) that will require coordination of infrastructure upgrades (transport routes, roads, bridges, etc.) and logistics (actual freight movement of large components to site).

Skills shortage

- There are significant concerns over the diminishing pool of labour, staffing and experts in the field. The technology envelope is changing and so is the nature of skills, however there is still a need to retain traditional skills alongside the innovative and emerging skillset.
- A lack of engineers with power system analysis skills was identified as an inhibitor to renewables being able to assess and finalise their connection requirements.
- A major point of vulnerability raised during consultation is unplanned maintenance, with challenges in securing contract workers (especially for short-term outages) to undertake this work given that longer contract work would be more desirable

Recommendation 3

That the OECC should, in conjunction with the energy market participants, continue to monitor skills availability across the energy sector (including but not limited to construction, engineering, apprentices, labour, contractors) and undertake coordinated workforce planning to better understand skills gaps and proactively support the energy workforce.

This could include the exploration and integration of appropriate funding models that better support getting graduates and underrepresented groups, such as women and Aboriginal peoples, trained and into the workforce (e.g., AEMO supported Zema Energy Studies Scholarship program). This could also inform, incorporate and build upon the work undertaken by OECC in workforce development, such as in the RACE for 2030 'RACE for Everyone' program.

Generation and transmission infrastructure status

- There is concern around the transition from coal to renewables, with more coordinated planning required in capability and resourcing, thermal generation retirement as well as location of new transmission lines. Renewable generation proponents questioned the ability of the rural road network to cope with the level of equipment to be transported from port to the Renewable Energy Zones (REZs) during the transition period.
- The development of the transmission infrastructure (interconnectors and links to REZs) will place significant demands on the construction sector and doubts were expressed as to whether the sector could support such a demand.
- Concerns were raised on overall reliability of thermal generators as they move towards end of life and the impact of this on market reliability. Owners face difficult decisions on whether to retrofit and/or repair generators or close early given likely returns in the market with closures imminent.
- Greater consideration of distributed energy i.e., smaller generation, grid-scale batteries, virtual power plants and demand-side management for energy security in addition to energy storage is needed

Recommendation 4

That the NSW Government should, work with energy market participants to understand thermal generation status (generation retirement, stockpile status, maintenance requirements, etc.) and the progress of transmission, with specific reference to (but not limited to):

- The retirement schedule of the aging thermal generation fleet and associated risks, including but not limited to maintenance requirements, potential increased outages and unreliability as plant moves towards retirement and feasibility and costs to continue operation for a year or two.
- The EUSFA undertaking work with generators and other stakeholders to develop threshold values to determine coal stockpile trigger points, enabling a mechanism and/or framework for appropriate actions that would facilitate the generators in increasing their stockpiles in times of high energy demand.

Preparedness activities

- The power system in Australia is increasingly becoming more complex in terms of scale, granularity and temporal behaviour, with new and more diverse equipment. Arguably, this complexity is unprecedented and at a pace ahead of global transition. Many stakeholders feel we are on a compressed timescale, where the future has arrived early and we are not prepared, causing further disruptions to the market.
- The AEMO Operations Technology Roadmap (2021) is aimed at uplifting their operational capability to manage the complex systems of the future and is tied to other AEMO initiatives. This includes the AEMO Engineering Framework that examines operations conditions expected to emerge in the next 5-10 years as well as the AEMO's future state architecture project.
- On several occasions AEMO has sought urgent interim authorisation by the Australian Competition and Consumer Commission (ACCC) to allow AEMO and industry participants to engage in conduct for the purposes of managing energy supply during a crisis or emergency and leading up to these applications for authorisation, there have been events that have caused significant risk to the security and reliability of the energy system.
- To address issues that may impact the safety, security, and reliability of Australia's energy supply during a period when the system is facing significant challenges and risks,

coordination efforts between AEMO and industry participants is needed. This would obviate the need for potentially regular approaches by AEMO to the ACCC for authorisation of conduct during the energy transition.

- If the conduct to be engaged in by AEMO and industry participants was to be included in the National Electricity and Gas Rules, then authorisation of such conduct would not be required.

Recommendation 5

That EUSFA advocate for jurisdictions and the market bodies to explore the suitability of legislative arrangements to allow AEMO and industry participants to coordinate efforts to address issues that may impact the security, reliability and resilience of Australia's energy supply during a period when the energy system is facing significant challenges and risks. This would obviate the need for potentially regular approaches to the Australian Consumer and Competition Commission (ACCC) for authorisation of conduct during the energy transition.

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1 Introduction

In 2017 the (then) Minister for Energy Utilities established the NSW Energy Security Taskforce, chaired by the (then) NSW Chief Scientist & Engineer (CSE) to examine how NSW manages energy security, reliability and resilience, including readiness, planning preparation and response capability to extreme events such as weather. The Taskforce's reports found that NSW is reasonably well placed to deal with risks under normal conditions, but large spikes in demand due to extreme events such as heatwaves pose challenges for the electricity systems. The reports also examined longer-term issues to strengthen resilience of the NSW electricity system.

In 2018 the (then) Minister for Energy and Utilities requested the CSE to chair a panel to assess the adequacy of the state's preparedness in relation to the energy market and associated departmental emergency management for summer 2018/19.[2]

In September 2019, the Minister for Energy and Environment requested that the CSE provide annual expert advice on the risks within the National Electricity Market (NEM) in relation to summer. Annual assessments have been submitted for 2019/20[3], 20/21[4] and 21/22[5].

For the 2022/23 Assessment the scope has been broadened to examine year-round risks to the energy system. The TOR states that while "*summer presents the likelihood of the highest demands, recent events have demonstrated that the energy market needs to be resilient all year. This focus should ensure clarity in communication that risks to energy security and resilience can occur at any time of year and readiness, planning, preparation, and response capabilities may be needed outside of the anticipated high demand events of summer*."

This report updates the 2021/22 Assessment, accounting for market developments, ongoing monitoring and work from national bodies, provides an ongoing assessment of energy preparedness and identifies any emerging risks for NSW and makes recommendations on actions to address any vulnerability identified for summer and beyond for 2022/23. Further, the report considers risks such as COVID-19 and influenza, supply chain vulnerability, transition from summer preparedness to situational preparedness, and Energy & Utility Services Functional Area (EUSFA) preparedness and response to the Australian Energy Market Operator (AEMO) LOR notifications. The full scope for the 2022/23 Assessment is found in the TOR at Appendix 1.

1.1 Assessment process

To undertake the 2022/23 Assessment an Expert Panel (the Panel) was established. The Panel was chaired by Professor Hugh Durrant-Whyte (NSW CSE), with membership including Mr Michael Norris (Office of the NSW Chief Scientist & Engineer (OCSE) and Deputy Chair), Mr Neville Henderson (former commissioner of the Australian Energy Market Commission (AEMC) and member of the 2019/20 and 2020/21 Assessment Expert Panel) and Professor Emeritus David Hill (from the School of Electrical and Information Engineering at The University of Sydney and member of the 2020/21 Assessment Expert Panel). Secretariat support was provided by the Office of NSW Chief Scientist and Engineer (OCSE).

In undertaking the work, the Panel received briefings and presentations from NEM bodies including Australian Energy Market Operator (AEMO), Australian Energy Market Commission (AEMC), Australian Energy Regulator (AER) and the Energy Security Board (ESB), State government agencies (NSW, Queensland), the Bureau of Meteorology (BOM), network utilities, and generators in NSW on their preparedness for the coming year and reflections on last year. A full list of

[2] CSE (2018), Assessment of summer preparedness for the NSW energy market.
[3] CSE (2019), Assessment of summer preparedness for the NSW energy market: 2019/20.
[4] CSE (2020), Assessment of summer preparedness for the NSW energy market: 2020/21
[5] CSE (2021), Assessment of summer preparedness for the NSW energy market: 2021/22

stakeholders consulted is at Appendix 2. The Panel also drew upon a range of reports prepared by AEMO, AER, BOM and others deemed important to the Assessment.

1.2 Structure of this report

- Chapter 2 – provides an overview of 2021/22 and impacts on the energy system throughout the year, this includes responses to prior Assessments, climate and extreme weather, COVID-19 and NEM operations.
- Chapter 3 – provides an overview supply and demand, climate forecasts and extreme weather events, actions by government and the energy market, the status of generation and network infrastructure.
- Chapter 4 – provides an overview on future energy preparedness including potential risks and opportunities.

2 Review of 2021/22

The 2021/22 Assessment found that:

- For many businesses, established summer preparedness programs were a regular part of workstreams. The 2019/20 bushfire season prompted businesses to further enhance programs that were already strong by exposing weak areas (e.g., spares stockpile, communication procedures).
- Electricity business preparations for 2021/22 progressed well, however, several planned generator outages either cancelled or had their scope of works reduced. There was also potential for impact in the post-summer season, where an accumulation of postponed outages could create tightened reserve conditions
- The level of risk management and preparedness for the ongoing COVID-19 situation was good. International and national border restrictions were slowly easing for vaccinated persons making it easier for essential workers. Businesses expressed concerns around the full relaxation of public health restrictions on 1 December 2021 and risks associated with unvaccinated personnel. Adaptation of COVID-19 safety plans and procedures was required, including the use of continual rapid on-site testing.
- NSW generators have had issues with coal supply being tighter than they would like due to higher demand in winter and suppliers choosing to meet export backlogs. Some generators reported that coal stockpile levels were lower than targeted but believed it should have limited impact on 2021/22 summer operations.
- Operational risks faced by renewable generation operators differed from those faced by traditional generators with importance to understand how this impacts the NEM as the renewable transformation accelerates.
- The climate outlook highlighted the potential for increased risk of flooding along the east coast, with risk of severe storms is similar to summer seasons of the previous decade. Northern NSW had above average fire risk due to higher grass loads, and areas of the east coast had below average fire risk due to forested regions still in recovery from 2019/20 fires and being soaked following significant rainfall.
- Several issues were emerging which prompted recognition that there should be a shift in the posture of preparedness from a summer focus to all year-round situational preparedness. These include the continual reduction of daytime minimum demand levels, reliability issues with an ageing coal fleet, variability in renewable generation, tightening of reserve through winter and the increased chance of extreme climate events because of climate change.

2.1 Response to prior Assessments and Inquiries

2.1.1 2021/22 Assessment Recommendations

The Panel received a progress report and update from the EUSFA Team in September 2022 including status of the response to the recommendations from the 2021/22 Assessment (see Table 1). Overall, the recommendations are completed and/or well progressed.

Table 1. Recommendations from the Assessment of Summer Preparedness of the NSW Energy Market: 2021/22

Recommendation	NSW Government Response
Recommendation 1 The Department of Planning, Industry and Environment should lead a review of legislation with relevant agencies to determine gaps in the regulation of safety for emerging gas and electricity technologies such as batteries and hydrogen/electric products at both consumer- and grid scale.	Update (gas aspect): The *Gas Supply Act 1996* (via the *Energy Legislation Amendment Act 2021*) and the *Gas Supply (Safety and Network Management) Regulation 2022* have been updated to ensure NSW's gas safety and technical regulatory framework is ready for future broad-scale adoption of natural gas-hydrogen blends, or hydrogen and other renewable gases, in NSW's gas networks. Update (electricity aspect): The *Gas and Electricity (Consumer Safety) Act 2017* and *Gas and Electricity (Consumer Safety) Regulation 2018* are key to the minimum consumer standards. The act is about to go through a statutory review. DCS is the cluster that are responsible for this legislation.
Recommendation 2 The NSW Government should ensure that NSW Electricity Infrastructure Roadmap developments/framework tie into/enable harmonisation with NEM/work at national level. Work should also be undertaken to assess the feasibility of repurposing parts of coal-fired power stations, that are due to be retired, to provide system services. The NSW Government should work with the plant operators, the ESB and AEMO to assess the feasibility of the retiring plant providing such services.	The NSW Government has a very clear plan set out in its Electricity Infrastructure Roadmap (Roadmap) to keep the lights on, drive prices down and set our State up for success as the world moves to decarbonise. The Roadmap sets out our 20-year plan to deliver the generation, storage, firming and transmission infrastructure we need to power NSW into the future. NSW Government continues to work with the energy market bodies, the Australian and other governments to ensure that the policies and processes adopted through the development of the Roadmap are fit for purpose and compatible with the national regulatory framework. As the Jurisdictional Planning Body for NSW, Transgrid is responsible for system strength remediation for the existing power system. Energy Corporation is working with the energy market bodies to ensure system strength is maintained as the Roadmap and renewable energy zones are rolled out. Further work on the feasibility of repurposing parts of retiring coal-fired power stations has not yet commenced but would need to consider the age of the retiring equipment and modification and refurbishment costs relative to the cost of new equipment, and also the cost of alternative emerging technologies including grid forming inverters.

Recommendation	NSW Government Response
Recommendation 3 The NSW Government should continue to progress regulation or requirements for relevant market organisations to have better visibility, control and protection of DER assets, including protection from cyber security threats, in alignment with the assessment of the legislative elements in Recommendation. This should include: i. a review of the requirements around installation processes to assess the levels of procedural compliance and ensure that DER information is provided to DNSPs. ii. ensuring the DNSPs are able to obtain sufficient information on the installations.	OECC is progressing the development of a potential NSW DER Strategy. The scope of the proposed strategy is in the process of being finalised but presently it aims to clarify the NSW Government's role in facilitating the safe, equitable and efficient investment in, operation and use of DER within NSW. It is also intended that the strategy clarifies the requirements and regulations needed to have better visibility, control and protection of DER, balancing the needs of customers, market players and the grid. The scoping paper has been shared with several regulatory and governance bodies including the DNSPs for their comment. We are in the process of collating the responses and seeking executive approval on the final scope for the NSW DER Strategy. We are aware of the issues raised in Recommendation 3 on compliance and adequacy of information on DER as we experience these on our programs. We intend that these matters are addressed in the NSW DER Strategy. Please also note that the strategy will also align with the ESB's DER Implementation plan to determine the optimum pathway for NSW.
Recommendation 4 In anticipation of the release of the rule change package on SAPS and associated developments (including, but not limited to, the AER ring-fencing guideline review), that: iii. the EUSFA continues to support the DNSPs in utilising SAPS in emergency situations iv. the NSW Government continue to support DNSPs as they progress SAPS and microgrid models for rural and/or remote locations, as a way to effectively ensure the reliability, affordability and security of electricity whilst also providing a pathway to decarbonisation outcomes.	<u>Update (a):</u> EUSFA continue to support DNSPs deploy temporary power solutions to customers impacted by unplanned outages during incidents and emergencies. This support leverages the NSW emergency management arrangements and the connection with other agencies to facilitate access and coordination to install temporary power solutions to a customer's premise. <u>Update (b):</u> The NSW Government is progressing the necessary regulatory amendments to adopt the national SAPS framework that commenced on 1 August 2022. Separately OECC is engaging and consulting with DNSPs and other stakeholders on potential longer-term enhancements as to how NSW applies the national SAPS framework.

Recommendation	NSW Government Response
Recommendation 5 The NSW Government should consider the workforce planning needs as the grid increases in system complexity and digitalisation, such as through the NSW Electricity Infrastructure Roadmap and the Net Zero Plan.	The NSW Government has a range of initiatives underway to ensure that workforce planning needs are met as the grid increases in system complexity and digitalisation. Update: Renewable Energy Sector Board The Renewable Energy Sector Board has developed a plan for the NSW renewable energy sector which sets out how to cost-effectively maximise the use of local goods and services, employment of local workers and opportunities for apprentices and trainees in the construction and operation of the Electricity Infrastructure Roadmap. The plan also includes advice to the NSW Government on building the capacity and capability of the renewable energy sector in NSW, including addressing skills and labour gaps in the market. The Minister for Energy has approved the plan. In the NSW Government's response to the NSW Renewable Energy Sector Board's advice, NSW Government supports, or supports in principle, all 15 of the Board's recommendations relating to building the capacity and capability of the renewable energy sector in NSW. The Employment, Skills and Supply Chains: Renewable Energy in NSW report informed the plan's workforce planning considerations by: • developing a detailed understanding of renewable energy supply chains, employment and skills • identifying opportunities and barriers to building local capacity and employment • recommending actions to realise these opportunities. Electricity Infrastructure Jobs Advocate The Minister for Energy appointed Dr Mark Apthorpe as the first NSW Electricity Infrastructure Jobs Advocate, and Dr Apthorpe commenced in the role in March 2022. The Jobs Advocate's role is to advise the Minister for Energy on: • strategies and incentives to encourage investment, development, workforce development, employment, education and training in the energy sector as New South Wales transitions to renewable energy. His focus will be on regional NSW, including the Hunter, Central Coast, Illawarra, Far West, Southwest, New England and Central West regions of New South Wales. • road, rail and port infrastructure required in the regions specified above to promote export opportunities for generation, storage and network technology.

2.2 Climate and extreme weather

Over summer 2021/22, NSW experienced a wetter than average summer, the wettest since 2011/12. Weather patterns in summer were influenced by La Niña, and the Southern Annular Mode (SAM) which was in the positive phase for most of the season. Temperatures were average

to below average for east of the Great Dividing Range, while western parts of the state experienced average to above average temperatures.

A very dry June across most of NSW was followed by the wettest July in record for central parts of the coast. Western and inland NSW experienced drier than average conditions. Intense rainfall in central parts resulted in major flooding, with more than 85,000 people being displaced. For the state, mean maximum and minimum temperatures were close to average over winter.

2.2.1 Floods 2021/22

Stakeholders faced challenges providing services during the catastrophic floods experienced in northern NSW in 2021/22, in particular obstacles included operator access to assets (for maintenance/restoration) and asset damage as a result of the floods and rainfall. Access to up-to-date resources to assist in emergency response (such as timely provision of flood projections for specific locations) and the ability to triangulate outages (such as via SES data streams) was also reported as a major challenge.

Reflections and learnings on challenges experienced in 2022 floods have been considered and steps taken to address issues. Some key responses reported included:

- Continued strengthening of relationships with SES and the telecommunication providers (with particular emphasis in the local emergency setting)
- Development of an emergency operational response model and information safety sessions
- Reviewed vegetation management plans in light of ongoing access conditions (i.e., saturated ground)
- Improved management and standards of assets
- Memorandum of Understanding (MOU) with DNSPs to publish electrician contacts for customers to ring free of charge to restore energy during flood emergency, thereby accelerating the restoration of energy (by ensuring behind the meter safety)
- Investigating alternative vehicle options to access and inspect assets during and post-floods, such as drones and helicopters

Recommendation 1

That the EUSFA and emergency services (SES and NSW Rural Fire Services (RFS)) work together to ensure that the provision of data and access to data is increased in emergency situations, particularly in relation to re-energisation of assets and the re-energisation of customers (residential and industrial) and flood and/or rainfall data. This could include investigating the ability for DNSPs to have sufficient access to data streams and systems that would facilitate rapid on-the-ground actions (such as the prioritisation of properties/assets experiencing power loss) and to feed data into this system to make it more robust.

2.2.1.1 Response to NSW Flood Inquiry

In March 2022, the NSW Flood inquiry was established and provided a number of findings and recommendations on the planning and preparedness for, response to, and recovery from the 2022 flood events[6].

A number of actions relevant to the energy sector were identified which broadly focused on the minimisation of disruption to essential services, including power outages (which compromise basic communication coverage). It was reported that attendance of essential service personal (in

[6] NSW Government, 2022 Flood Inquiry, Volume One: Summary report, 29 July 2022

particular, from telecommunications providers) at local emergency management centres was varied and inconsistent across the state, which hampered the timely restoration to critical infrastructure during 2022 floods.

Two recommendations were made in the NSW Flood Inquiry to minimise disruption to essential services, including outages which compromise basic communication coverage, and to ensure access to safe water supply and power during flood events, government to:

- ensure there are sufficient redundancy options known and made available (for example, backup diesel generators, deployed temporary telecommunications facilities, etc.) to supply power to essential telecommunication infrastructure, alternative telecommunications infrastructure and water treatment facilities (Recommendation 9)
- ensure that the telecommunication entities, electricity network providers and water treatment managers are using up to the minute, whole of catchment models to inform business continuity planning in the event of flooding (Recommendation 9)
- ensure all essential services are mandatory members of the Emergency Management Committees at state, regional and local levels (Recommendation 9).
- ensure, given the heavy reliance on essential services by community and government during a disaster, essential services loss, redundancy and build back better principles are exercised through emergency management committee processes annually (Recommendation 9).
- essential service infrastructure is situated as much as possible above flood planning level (Recommendation 28)

2.3 Ongoing COVID-19 and influenza impacts

COVID-19 continued to have social and economic impacts across Australia, most notably during the first half of 2022. Local cases of COVID-19 and influenzas spiked during winter 2022. COVID-19 case numbers are now reported to be relatively low.

While COVID-19 restrictions for workers caused some disruption over summer 2021/22 and winter 2022, however these have mostly eased across the state. Previous COVID-19 restrictions last year created challenges for state and international border crossings, impacting the movement of skilled technicians, outage workers and spare parts. Businesses reported adapting well to accommodate some of these residual issues that the pandemic had caused, such as lead times on parts and the movement of international experts/technicians. Planned outages that were delayed over the peak of COVID-19 are now being dealt with by generators.

Stakeholders reported that they continue to proactively implement robust COVID-19 risk management plans, which proved effective over the course of the pandemic. Some actions in place since the start of the pandemic in 2020 includes back-up control centres, regular cleaning protocols, stockpiling Rapid Antigen Tests (RATs) and operational protocols to reduce spread of both COVID-19 and influenza amongst workers.

Stakeholders reported that they continue to stay up to date with the Public Health Orders and NSW and Commonwealth Government advice, but given their ongoing planning and operations, these do not cause major disruptions to operations.

2.4 National Electricity Market (NEM) Operational Review

2.4.1 Supply and Demand

With increased average temperatures well above the average in Q1 2022, increasing average electricity demand in all NEM regions was noted despite La Niña conditions. Along with reduced

availability of gas and coal, and higher prices were influenced by a volatile international energy commodity prices.

Wholesale spot prices averaged $216 per megawatt-hour (MWh) across all NEM regions this quarter – the second highest priced quarter on record after Q2 2022 ($264/MWh), and over three times higher than Q3 2021's average price of $58/MWh[7].

East coast (including NSW) gas prices recorded a similar high, averaging $26 per gigajoule (GJ) over the quarter, a 142% increase from last year's Q3 average of $10.74/GJ and only slightly below Q2 2022's $28.40/GJ. East coast gas prices continued to exceed the ACCC international netback price series in July, coinciding with high demand and an increase in gas-fired generation, before easing in August[8].

The higher prices are attributed to extremely high international prices for traded gas and thermal coal, reduced availability of coal-fired generation and physical fuel supply, and water-based constraints (i.e., floods) at a number of thermal (water inlet/outlet temperatures for cooling) and hydro generators (this includes aspects of both water availability and ability to discharge to produce energy). Outages, bidding changes and fuel supply constraints saw black coal generation's average quarterly output down by 947 MW or 8.5% from Q2 2021 to its lowest Q2 output on record, its share of NEM supply falling 4.8 percentage points to 43%[9].

2.4.2 Energy Market Incidents

2.4.2.1 Market suspension

In June 2022, AEMO announced a market suspension because of a confluence of events made it impossible to continue operating the spot market while ensuing a secure and reliable supply of electricity for consumers. The suspension was in place for 10 days.

These events led to unpreceded challenges operating the NEM and included high commodity process, domestic market price caps, planned and unplanned outages of scheduled generating plant, low output from semi-scheduled generations, and high winter demand conditions. The suspension was a consequence of changes in bidding as the rolling sum of spot prices for the previous seven days in some NEM regions approached the cumulative price threshold (CPT)[10], which would trigger an administered price cap (APC)[11].

Under clause 3.14.3 of the National Electricity Rules (NER), AEMO may declare the spot market to be suspended in a region when any of the following occur:

- The power system in the region has collapsed to a black system
- AEMO has been directed by a participating jurisdiction to suspend the market following declaration by that jurisdiction of a state of emergency
- AEMO determines that it has become impossible to operate the spot market in accordance with the provisions of the NER

AEMO can resume the spot market when none of the three conditions apply and AEMO is satisfied that there is minimal possibility of suspending the market within the next 24 hours due to the same cause.

Over the subsequent days after the suspension, AEMO worked with generators, emergency reserve providers, network providers and jurisdictions to manage system operations and maintain

[7] AEMO (2022). Quarterly Energy Dynamics Q3 2022
[8] AEMO (2022). Quarterly Energy Dynamics Q3 2022
[9] AEMO (2022). Quarterly Energy Dynamics Q2 2022
[10] The CPT is the maximum price across seven days' worth of trade
[11] The APC is imposed on electricity generators during prolonged periods of high wholesale electricity prices. AEMO is able to trigger the cap when wholesale prices average more than $675 per MWh over a full seven-day period

reliable supply to consumers. Nevertheless, it was determined that the market became impossible to operate as required.

This was the first time that the market operator has suspended the market. The strong collaboration between AEMO, the Australian Energy Market Commission (AEMC), Australian Energy Regulator (AER), generators, emergency reserve providers, network service providers and jurisdictions enabled this series of events to be effectively managed without involuntary customer load shedding.

Supply reliability was maintained despite the acute energy and capacity limitations and market issues. Through the efforts of all involved, involuntary customer load shedding was avoided. AEMO has made comment that they are to review processes used for projecting supply adequacy over the medium term in light of the series of events. The review should identify possesses, modelling and reporting that may assist for these types of circumstances, particularly when factors contributing to fuel constrains emerge[12].

2.4.3 Lack of Reserve (LOR)

As has been the recent trend, there was a significant increase in the number of actual and forecasted Lack of Reserve (LOR) declared across NSW and the NEM for 2021/22 (566 events 166 of these were in NSW) compared to the previous years (130 LOR events across the NEM in 2020 and 2021, 79 of which were in NSW) (Figure 1 has breakdown of LOR1, 2 and 3 events, actual and forecasted for NSW).

A total of 77 LOR declarations were made in NSW and the spot market was suspended for an unprecedented 10-day period, between 15 and 24 June 2022 in all regions by AEMO. Therefore, outside of this event, there was still a considerable increase in the number of LOR declarations (a total of 54 LOR's declared across the NSW).

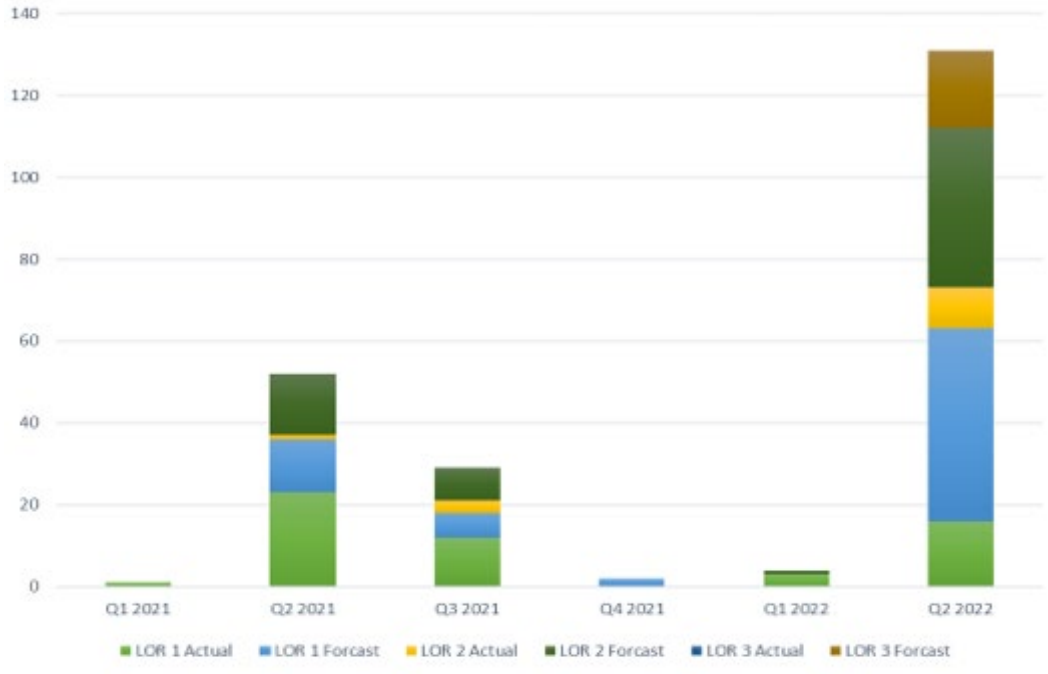

Figure 1: Quarterly comparison of actual and forecast LOR conditions in NSW, Q1 2021 to Q2 2022

Data source: AEMO (2022, 2021)[13]

[12] AEMO (2022), NEM Market suspension and operational challenges in June 2022
[13] AEMO (2022) NEM Lack of Reserve Framework Report 1 April to 30 June 2022

In NSW, there were 6 LORs over the summer period (Q4 2021 and Q1 2022), of these 2 were actual LOR1s and the others were forecasts LOR1s (3) and an LOR2.

This is a significant decrease when compared to the 22 LORs of the previous summer. The lower number of LORS aligned with expectations of shareholders as mild summer conditions and established summer preparedness procedures helped the summer to pass without major incidents.

Across the NEM, during Q2 2022 there were 409 LORs, this was a significant increase in the number of LOR's declared in Q2 2021, 79 which itself had been historically high. The significant number was due to an accumulation of factors resulted in an historic suspension of the spot market in all regions for a 10-day period, during which there were a total of 221 LOR's. The period of market suspension is discussed in Section 2.4.2.1.

Considering only the LOR's declared outside of the market suspension there were a total of 54 LORs declared, with 11 actual LOR1s (25 forecast) and 3 actual LOR2s (15 forecast).

While these are historically high values, they correlate with the significant increase in LOR's identified in the 2020/21 Assessment. While this trend does show an increase in LORs in the 2021/22 year there were significant increases in forecast LOR1s which did not result in an actual LOR indicating that current procedures are sufficient to manage these smaller supply and demand discrepancies. Of more concern is the increase in actual LOR2s which indicate the challenges with generation and supply that will occur as the grid transitions towards renewables and the older fleet of coal generators comes offline. To demonstrate this, during this period one of the Liddell Power Station turbines was retired on short notice placing strain on the NSW energy market due to an unexpected shortfall in reliable generation capacity.

The Reliability and Emergency Reserve Trader (RERT) scheme was only activated a total of five times in the NEM during the 2021/22 financial year (twice in QLD and three times in NSW). This occurred on:

- 1 February 2022 (Queensland) - in response to forecast LOR 2 and forecast LOR3 conditions.
- 14 June 2022 (NSW) - in response to a forecast LOR 3 condition.
- 15 June 2022 (NSW) - in response to forecast LOR 2 and LOR3 conditions.
- 15 June 2022 (Queensland) - in response to forecast LOR2 and LOR3 conditions.
- 17-18 June 2022 (NSW) - in response to a forecast LOR 2 condition.

The previous summer period had seen a total of two RERT events across the NEM, one of these involving the NSW region. All RERT activations in 2019/20 were confined to the summer period.

As outlined in the previous Assessment, market bodies AEMO, AEMC, AER and the ESB did not express any high level of concern about the increased LOR forecasts, and there was a general level of confidence in the ability and process for identifying and declaring LORs. The EUSFA team is notified of the publication by AEMO of LORs by the JSSC or by monitoring market notices. The JSSC has access to intelligence on market status through communication with AEMO and TransGrid, and it is appropriate for the JSSC to be the single point of contact with AEMO.

As the energy market transitions, the incidence and cause of LORs is likely to change. As has happened recently, LOR1s and LOR2s have occurred but have not led to LOR3s. It will be important for EUSFA and the Jurisdictional System Security Coordinator (JSSC) to develop an understanding of these potential causes and to gain an understanding of what LORs are likely to progress to LOR3s. With this understanding it may be possible to define "shallow" LORs (those

AEMO (2022) NEM Lack of Reserve Framework Report 1 January to 31 March 2022
AEMO (2021) NEM Lack of Reserve Framework Report 1 October to 31 December 2021
AEMO (2021) NEM Lack of Reserve Framework Report 1 July to 30 September 2021

that are unlikely to progress to an LOR3) and “deep” LORs (those that are likely to progress to an LOR3) and to define indicators of “shallow” and “deep” LORs.

EUSFA should work with AEMO to identify “shallow” and “deep” LORs. This will assist EUSFA team in preparing to move to a level of alertness and enable improved anticipation of a request by the JSSC to activate protocols such as the Government Energy Action Response (GEAR) or Large Energy User Voluntary Demand Reduction (VDR). At times when uncharacteristic LOR patterns are observed, the EUSFA can seek information from AEMO, through the JSSC, that will provide clarity around the underlying cause.

3 Energy forecast for 2022/23 Forecasts, Risk Assessment and Preparedness

This chapter provides an overview of the forecasted climatic conditions, energy supply and demand forecasts, and the status of and risks to generation, transmission and distribution infrastructure for 2022/23.

3.1 Climate outlook

The bureau of meteorology has declared that the La Niña and negative Indian Ocean Dipole (IOD) will continue in the tropical Pacific and is likely to persist into early 2023. To date, models indicate it will be a less intense and shorter La Niña, returning to El Niño–Southern Oscillation (ENSO)-neutral conditions (neither La Niña nor El Niño) early in 2023. The negative IOD persisting until late spring. The Southern Annular Mode (SAM) is currently in a positive phase and is likely to remain generally positive throughout spring into early summer.

These key climate drivers are forecasted to increase the chance of above average rainfall for northern and eastern Australia during spring and summer. Although it's too early to predict flood risk, given soils are already saturated from this past year's wet weather to date, flooding in parts of NSW is considered likely. This has been evidenced by the recent flooding in NSW in September/October 2022.

Daytime temperatures are likely to be cooler than average across NSW and southern Queensland. Night-time temperatures are likely to be warmer than average across NSW, except for the far north-east corner and southern Queensland.

For the period December 2022 to February 2023, current forecasts for the NSW region predict, dependent on region:

- Low chance of exceeding median maximum temperatures (Figure 2)
- High chance of exceeding median rainfall (Figure 3)

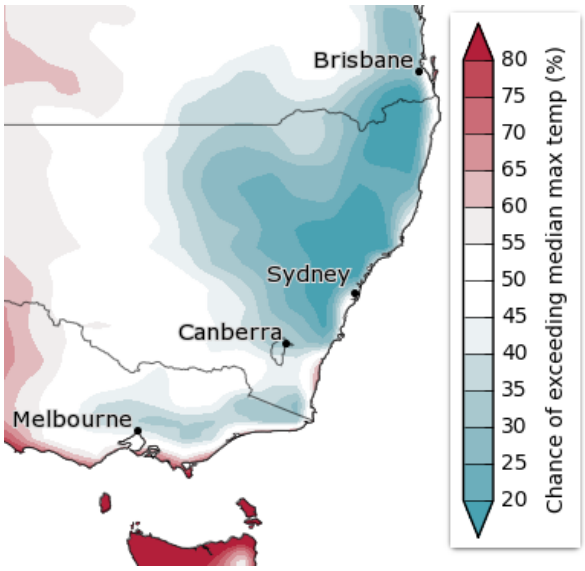

Figure 2: Likelihood of exceeding median maximum temperatures (Dec 2022-Feb 2023)

Source: BOM (2022). Climate outlooks – weeks, months and seasons

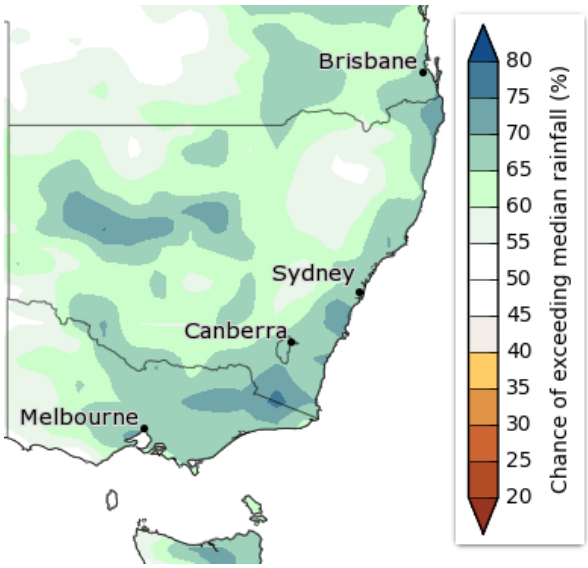

Figure 3: Likelihood of exceeding median rainfall (Dec 2022-Feb 2023)

Source: BOM (2022). Climate outlooks – weeks, months and seasons

Given the forecast conditions, NSW energy businesses are likely to be impacted by flooding in summer and shoulder seasons of 2022/23, dependent on the location of assets. The high potential for humid conditions across NSW may also impact night-time generation loads through summer with higher usage of air conditioners expected.

3.2 Review of key ESOO assumptions

The 2022 NEM Electricity Statement of Opportunities (ESOO)[14] was released in August. The Panel reviewed the ESOO as part of the Assessment and made the following observations for consideration:

- No forecast for any regions with the risk of expected unserved energy (USE) above the Interim Reliability Measure (IRM) of 0.0006% in 2022-23 provided resources and demand is as expected (AEMO's Central Scenario assumptions). However, the risk has increased compared to that shown in the 2021 ESOO[15]. This increased risk arises from higher forecast peak demand and energy consumption, forecasts of higher forced outage rates in generation and transmission and decreased inter-regional peak transfer capability. This risk is somewhat offset by the connection of large amounts of new generation, storage, distributed energy resources (DER) and transmission upgrades.
- AEMO notes that in NSW the supply scarcity risk is very low in summer 2022/23 under system normal conditions with expected USE well below 0.0006%of annual consumption.
- AEMO also notes that supply reliability can be impacted if a combination of outages, fuel supply and weather events were to occur.
- Since May 2022 there have been a combination of coincident events (outages, fuel shortages and wet coal) that have led to several LOR events requiring market interventions to maintain reliability and security.

[14] AEMO (2022), 2022 Electricity Statement of Opportunities
[15] AEMO (2021), 2022 Electricity Statement of Opportunities

- AEMO indicate that the retirement of Liddell Power Station in 2023/24 will be offset by the commitment of new generation particularly the 750 MW Kurri Kurri Power Station.
- The Panel is aware that approval for the underground lateral pipeline to connect the Kurri Kurri Power Station to the Sydney to Newcastle pipeline is yet to be obtained. This project has been classified as State Significant Infrastructure and is still in the assessment stage according to the NSW Planning Portal. Any significant delays in the approval process could increase supply reliability risk in 2023/24
- There are supply risks in the next few years. AEMO has identified a reliability gap for NSW against the reliability standard in 2025/26 when Eraring Power Station is expected to retire. The NSW Government has proposed a number of projects to address this gap such as transmission investments and additional firming capacity but as these are not "committed". The ability to maintain adequate reliability and security is highly dependent on a host of committed renewables coming on-line according to schedule, transmission being extended to allow connection of renewables and plant closures occurring as planned.
- Regarding the reliability outlook over the next five years, AEMO forecasts expected USE to increase above the reliability standard by 2031/32 in all mainland regions. However additional investments are expected to significantly improve the reliability outlook. In NSW these include
    - The HumeLink augmentation which will provide access for Snowy 2.0
    - The Hunter Transmission Project including the Waratah Super Battery and system protection schemes
    - Generation and storage investment including those facilitated through the NSW Infrastructure Roadmap.
- The 2022 ESOO presents a number of sensitivities to analyse the reliability outlook, recognising that assumptions used are subject to a range of uncertainties. These sensitivities highlight that:
    - If Integrated System Plan (ISP) developments progress as planned, the reliability outlook is significantly improved.
    - If demand side solutions progress slower than forecast the need for utility scale supply solutions will be needed
    - Project commissioning delays have the potential to impact the reliability outlook
- It is imperative over the next five years that the NSW Government monitors the status of committed and anticipated projects by interacting with developers and liaison with AEMO in order to get a heads-up on the risk to supply reliability

3.3 Supply chain vulnerability and demand forecasts

3.3.1 Supply and demand forecasts

The 2022 ESOO states that significant challenges have emerged in operating the energy markets in the NEM[16]. As noted in previous sections of this report, a range of coincident events in 2022 have caused forecasted and actual LOR events. This has highlighted the need for a range of market interventions to maintain reliability and system security, particularly in response to extreme weather, fuel availability and high global commodity prices.

Whilst the ESOO states does not forecast any regions in Australia with expected USE above the IRM in 2022/23 (under its Central scenario assumptions), this does not mean there is no risk for

[16] AEMO (2022), 2022 Electricity Statement of Opportunities

consumer outages driven by coincident events (such as emergency events such as weather with simultaneous generator outages, whether planned or unplanned).

Energy consumption is forecasted to increase marginally, driven by new increased commitments to industrial load production (that was not previously forecasted) and the potential for connections of newly electrified loads (such as the increased uptake of Electric Vehicles) This is expected to also translate through to increased peak demands. As a consequence of the increased demand, the NEM will need enough supply capacity or greater demand flexibility to avoid reduction in reliability moving into the future if this trend persists.

In regard to supply, the reliability of coal and gas is predicted to only materially improve from 2021/22. Coal stockpiles are below target reserve levels for some generators, as a result of higher-than-expected winter generation levels and subsequent pricing increases. A number of stakeholders reporting difficulties securing coal supplies over winter given the international demand and export markets, but that this situation is improving. New generation capacity will continue to connect the NEM over 2022/23, with approximately 800 MW of capacity from a range of technologies.

3.3.2 Operational responses to address supply chain vulnerability

3.3.2.1 Consequences of Supply Chain Disruption

Supply chain disruptions are a risk faced by all sectors, and in the context of the energy sector effects all stakeholders from generation through to distribution. Including aspects of maintaining existing plant to the installation of new (primarily, renewables and batteries).

Stakeholders consulted with all appear to understand well the supply chain risks and, to the upmost extent possible, are enacting strategies to deal with these risks that include early planning to understand sourcing and delivery lead times, establishing early contractual relationships with suppliers and building up local spares and/or stockpiles. Unfortunately, as many of the businesses and developers rely on overseas suppliers, many of the supply chain risks are beyond their control.

A report by Deloitte[17] identified the impacts supply chain disruptions to the US electricity supply included increased operations costs, project delays, loss of productivity, increased lead times and customer impact. The report also identified that supply chain disruption led to increased costs and lead times for transformers, wires and cables, and solar PV (Table 2). Whilst the report is from a survey recently conducted in the US, stakeholders interviewed by the Panel advised of similar impacts, which noted that this has increased operational costs and project delays.

Table 2: Impacts of supply chain disruptions on US electricity supplies

	Cost increase	Lead time increase
Transformers	20-100%	100-400%
Wire and cable	20-60%	60-300%
Solar PV	20-30%	30-50%

Source: Deloitte insights (2022) Electric power supply chains: Achieving security, sustainability, and resilience

3.3.2.2 Stakeholder feedback

- The pandemic has significantly impacted the supply chain of power generation and network equipment. Additionally, the Russian invasion of Ukraine has impacted the fuel market. This disruption has impacted the operations of the industry in NSW.
- The generators and networks interviewed all identified supply chain issues, both labour and materials.

[17] Electric power supply chains: Achieving security, sustainability and resilience, Deloitte, 29 September 2022

    - Workforce deployment - occasionally when undertaking major overhauls had to divert labour to address breakdowns, thus lengthening the overhaul.
    - Replacements and spares – if a major breakdown were to occur, particularly on the aging coal-fired fleet, the sourcing of major replacement components could significantly impact their ability to repair the plant and thus compromise system reliability.
    - Generators advised that they had sufficient spares to cover run-of-the mill maintenance.
    - Generators & transmission – Major risk area is serious damage to high voltage (HV) transformers. Transformer manufacture in Australia is limited to distribution size transformers, and replacement of larger size transformers need to be sourced from overseas. With consequential delays from the Russian invasion of Ukraine, and the pandemic, there is a risk to supply reliability.
    - Network equipment - advised that they had adequate stocks of distribution equipment, such as transformers, switch gear and poles, to now be able replenish their networks in the event of bushfires and floods. As previously noted, the DNSPs noted that ongoing rain events and the general 'wet' state of the environment has placed challenges for access to their entire system.
- Operational responses - All participants interviewed understood the supply chain risks and had taken steps to resolve supply chain pressures.
    - Establishing emergency stocks of critical components to address unforeseen demand.
    - Planning all scheduled work and communicating early with suppliers on the timing and delivery of equipment – recognising the need for longer lead times. They had identified suppliers of critical equipment and established contractual arrangements such that to the extent possible they were a "favoured customer".

3.3.2.3 The Transition to Renewables

The transition of the electricity sector is underway. A host of new renewable energy projects are committed or planned. For instance, the New England REZ of 8 gigawatts (GW) is one of at least five committed REZ's planned for NSW. The technical equipment and construction of renewable energy projects can be held up by supply chain issues such as:

- Rising cost of materials and labour shortages (from high level technical expertise to construction) may delay construction. As can occur on infrastructure projects, both of these aspects can lead to disputes between contractors and developers resulting in further delays.
- Overseas suppliers of equipment: whilst assembly of wind turbine drive trains and hubs is taking place in Australia, most of the components come from overseas where demand is very high. The Panel noted that there is the manufacture of blades now occurring locally in Australia.
- Transport of equipment to site: most of the equipment for the New England and Central West REZs will likely be landed at the Port of Newcastle and assembly of the wind turbine (rotor, main bearing, main shaft, gearbox, and generator) is likely to be near the port. The Panel noted that one stakeholder estimated at the height of the construction program to populate the REZs, some 40 turbines per month would be transported from Newcastle to site. Inadequate planning and delivery of transport infrastructure, such as road and bridge upgrades and transport permitting, could significantly delay the transition to renewables.
- Major transmission links are planned for connection of the REZs. The building of these links will be at a time of significant construction works on other infrastructure projects, with a resultant high demand for steel structural components, cables as well as substation equipment (transformers and switchgear). These projects will face supply chain challenges with a potential delay in the projects.

- Electronic control systems: renewable energy generation and storage require control equipment which is becoming increasingly complex (such as microprocessors that sense performance and automatically adjust the machines). Since the pandemic, worldwide, the gap between electronic chip supply and demand has widened on all semiconductors. McKinsey estimates that this gap will likely persist for the next three to five years[18]. Such a shortage could have significant impacts on delivery timeframes for renewables.

Recommendation 2

That the NSW Government continue to engage with the NEM participants and relevant state and Commonwealth authorities to ensure that there is coordination in the energy market transition. This includes, but it not limited to:

- The NSW Office for Energy and Climate Change (OECC) should stay abreast of progress on energy market and government (states and Commonwealth) initiatives that will support the transition of the NEM (e.g., 'The National Energy Transformation Partnership' initiative by the Commonwealth Government).
- That the appropriate stakeholders are identified and engaged to ensure that complex planning pathways for the energy transition are understood.
- Understand the significant infrastructure build in the Renewable Energy Zones (REZs) that will require coordination of infrastructure upgrades (transport routes, roads, bridges, etc.) and logistics (actual freight movement of large components to site).

3.4 Skills shortage

Across sectors, there is a surging demand for labour which has deepened the shortage of skilled workers and, in the context of this report, impacting industry operations. The ongoing effects of COVID-19 along with a challenging economic landscape exacerbated challenges linked to a skills gap in the energy industry that began to emerge in 2020[19]. The energy sector has already been going through a rapid transition, and stakeholders reported they are starting to experience the consequences of the emerging skills shortage. The 2022 Global Energy Talent Index (GETI)[20] report states that as the distinction between individual sectors in the energy industry becomes more blurred, demand for common experience and skills increases.

The National Skills Commission has developed a Skills Priority list as an annual review of the national skills needs of Australia[21]. For 2022, it was noted that apprentice-trained technicians and trades workers remain in shortage and are of particular concern for the future, with data indicated that employers are having difficulty filling vacancies for positions that require an apprenticeship training pathway. A key finding from the report was that occupation shortage were most acute in 'Professional occupations', requiring higher level qualifications and experience. The shortage is estimated at 39% in 2022, up from 19% in 2021. The GETI 2022 has identified insufficient education and training as the biggest driver of this worsening shortage within the energy sector.[22]

The Panel noted the feedback below from stakeholders,

- There were a number of concerns identified as immediate
  - The diminishing pool of labour and contractors for critical works (e.g., basic construction, vegetation maintenance workers, etc.)

[18] Mckinsey & Company (2022), Semiconductor shortage: How the automotive industry can succeed
[19] The 2022 Global Energy Talent Index (GETI)
[20] The 2022 Global Energy Talent Index (GETI)
[21] National Skills Commission (2022), 2022 Skills Priority List, Key findings report
[22] The 2022 Global Energy Talent Index (GETI)

    - Unplanned maintenance is a major point of vulnerability, with challenges securing contract workers for these (generally) shorter time periods and where they may already be committed to planned and longer-term shutdowns
- There were also a number of concerns identified as longer-term:
    - The diversity of skills required is changing, and whilst there is a need to both retain traditional skillsets, there is also a requirement to produce new, often multidisciplinary skillsets and innovators
    - Specifically, it was identified that the lack of engineers with power system analysis skills was an inhibitor to renewables being able to assess and finalise their connection requirements
    - There is a growing need around supporting education, as well as in connecting consultancies and universities
    - Declining 'attractiveness' of power engineering courses compared to newer fields such as renewables and information technology

The Panel notes that all of these above concerns suggest that there is a need to assess whether the industry will have access to these critical and new skills, in the quantity that will be required, to cope with a more complex power system.

The Panel sought to understand how stakeholders were addressing these challenges. Across the board it was reported that a renewed focus and investment in training and mentoring, particularly in the field of Science, technology, engineering and math (STEM) is needed to ensure the skills gap is addressed in the medium and longer term.

One important solution is to guarantee high-quality training, strong career development programs, targeted apprentice incentives and dedicated benefits to help enhance careers and bridge the gap. Education and encouraging greater STEM up-take is a cross-sector approach to securing talent to benefit the entire energy sector is required.

It will be critical for the NSW government to support appropriate workforce development, higher education and programs to support the changing energy sector. The Panel noted that there are programs supported by the NSW Government, such as the RACE for 2030 'RACE for Everyone' workforce programs[23], but that there needs to be more work and coordination across the sector.

Recommendation 3

That the OECC should, in conjunction with the energy market participants, continue to monitor skills availability across the energy sector (including but not limited to construction, engineering, apprentices, labour, contractors) and undertake coordinated workforce planning to better understand skills gaps and proactively support the energy workforce.

This could include the exploration and integration of appropriate funding models that better support getting graduates and underrepresented groups, such as women and Aboriginal peoples, trained and into the workforce (e.g., AEMO supported Zema Energy Studies Scholarship program). This could also inform, incorporate and build upon the work undertaken by OECC in workforce development, such as in the RACE for 2030 'RACE for Everyone' program.

[23] https://www.racefor2030.com.au/

3.5 Generation and transmission infrastructure status

3.5.1 Summary of risks identified, and mitigation actions undertaken

Generators are confident that generation infrastructure is prepared for summer 2022/23, while acknowledging the risk of contingent events remain. Generators also made comment that concerns are around winter 2023, given coal supply constraints and learnings from this winter where stockpiles were burnt fast and low.

A key risk raised across the board was risk of increased outages in shoulder seasons (Spring and Autumn) for maintenance that were postponed during the COVID-19 lockdown in subsequent years. However, concerns were raised about staffing these maintenance periods, with contractors already committed to longer-term work.

Table 3 provides a summary of other risk categories (for 2022/23 summer and shoulder seasons) identified by energy businesses that are planned for and mitigated by preparedness activities.

Table 3: Summary of risk categories across the NSW Energy Market

Participant	Mode	Main Risks	Mitigation
Generation – conventional	Coal	Fuel – coal supply	Rebuilding stockpile, exploring alternative sources, planned outages
	Gas	Fuel – gas supply	Gas storage, secure supply
Generation – renewables	Solar	Electrical and mechanical faults	Preventative maintenance schedule
	Wind	Storms and flooding	Vegetation management
	Hydro	Flood and dam spills	Airspace agreements Water collection and storage program
Transmission	-	Storms and flooding	Vegetation management, monitoring and defect management, coordination with telcos and other essential services
Distribution	-	Storms and flooding	Vegetation management, monitoring and defect management, coordination with telcos and other essential services, undergrounding of lines, composite pole program and microgrid trials

3.5.2 Specific issues identified

A number of specific issues have identified for 2022/23. These are outlined below.

3.5.2.1 Coal and gas supply

Coal stockpiles are below target reserve levels for many generators due to a higher-than-expected winter generation levels. Work to restore stockpile levels is underway, however concern was raised in difficulties in securing coal supply due to general supply and price issues, driven by international prices. Despite tightened domestic coal supply, and a ministerial directive to prioritise coal freight (which has since lifted), coal generators are satisfied overall that they have enough coal to meet summer operation requirements, although over the winter period, this may change.

The freight of coal was raised to be of particular concern. Rail closures in 2022 meant energy providers needed to resort to emergency stockpiles, with coal freight unable to traverse certain areas across the state. The Independent Pricing and Regulatory Tribunal (IPART) is reviewing the arrangements governing third-party access to rail tracks in NSW. The NSW Rail Access Undertaking[24] sets minimum terms and conditions and pricing guidelines for rail owners to negotiate access to their rail tracks with businesses, such as train operators.

The ongoing war in Ukraine and associated falls in energy exports (coal, gas and oil) from Russia due to imposed sanctions and gas pipeline supply issues have influenced international energy commodity prices which remain at record high levels. As Northern Hemisphere countries look to build energy stockpiles before winter, they have been forced to seek energy security elsewhere, pushing up prices for liquefied natural gas (LNG) and thermal coal.

3.5.2.2 Impact of rising electricity prices

In the latest Federal Budget, Treasury has assumed that retail power prices will increase by an average of 20% nationally in late 2022, and a further 30% in 2023/24. This energy shock for electricity users is likely to give rise to calls for government/regulatory intervention by consumer and industry groups.

Both the Prime Minister and the Treasurer have been quoted in the media as saying:

- The Treasurer - “any responsible government facing these kinds of price hikes for gas and electricity needs to consider a broader sweep of regulatory interventions than they might have considered in years gone by”[25].
- The Prime Minister - “Intervention into the market. … is something that we will give strong consideration to”. “We’ll be taking the advice of the appropriate departments about appropriate interventions”[26].

Any contemplation of intervention could impact investor confidence at a time when a significant amount of renewable energy resources and firming capacity is being considered and relied upon to cover the exit of coal-fired plant. It will be important for the NSW to understand the scope of any intervention and the likely impacts on investors.

3.5.2.3 Minimum demand

The 2021/22 Assessment discussed the continuing trend downwards of daytime minimum demand. This trend has continued through 2022 as seen in Figure 4. Spring 2022 set new records for minimum operational demand. This was driven by mild and sunny conditions with low weekend demand.[27]

[24] https://www.ipart.nsw.gov.au/Home/Industries/Transport/Rail-Access
[25] ABC News, Australians in for tough financial times as federal budget forecasts declining real wages and high living costs, 25 October 2022
[26] ABC News, Anthony Albanese considering electricity market intervention as federal budget forecasts surging prices, 26 October 2022
[27] AEMO (2022) Quarterly Energy Dynamics Q3 2022

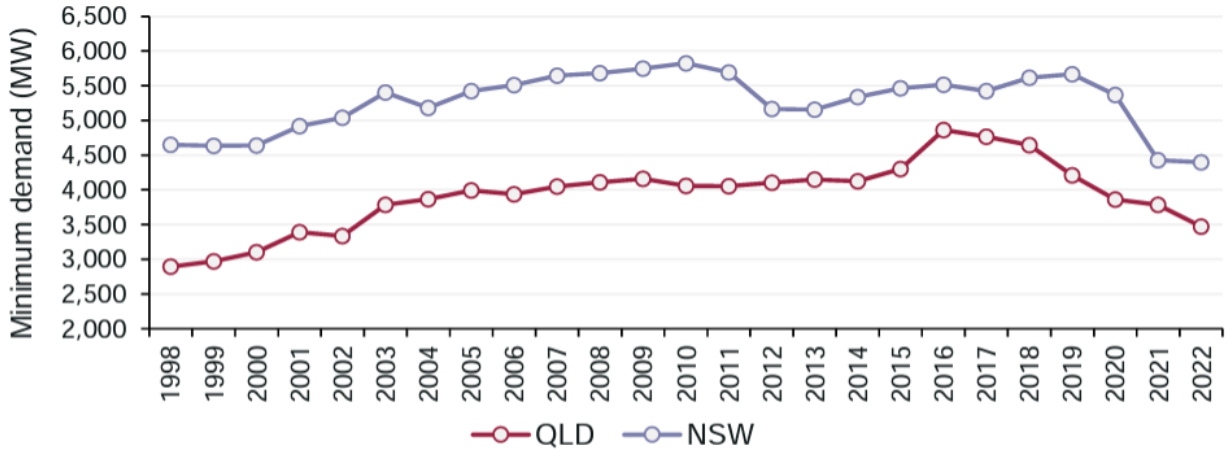

Figure 4: New minimum demand record for NSW and Queensland's lowest demand since 2002

Source: AEMO (2022)[28]

A record minimum demand across the NEM was recorded on Sunday 25 September 2022 (Figure 5). The record of 12,583 MW was 353 MW lower than the previous record in Q4 2021. On the same day NSW also had a record minimum demand of 4,398 MW (27 MW lower than the previous record in Q4 2022). At the time of the minimum demand the distributed PV output accounted for 42% of the underlying demand.

As discussed in the previous Assessment these conditions create both economic and longevity impacts on coal generation.

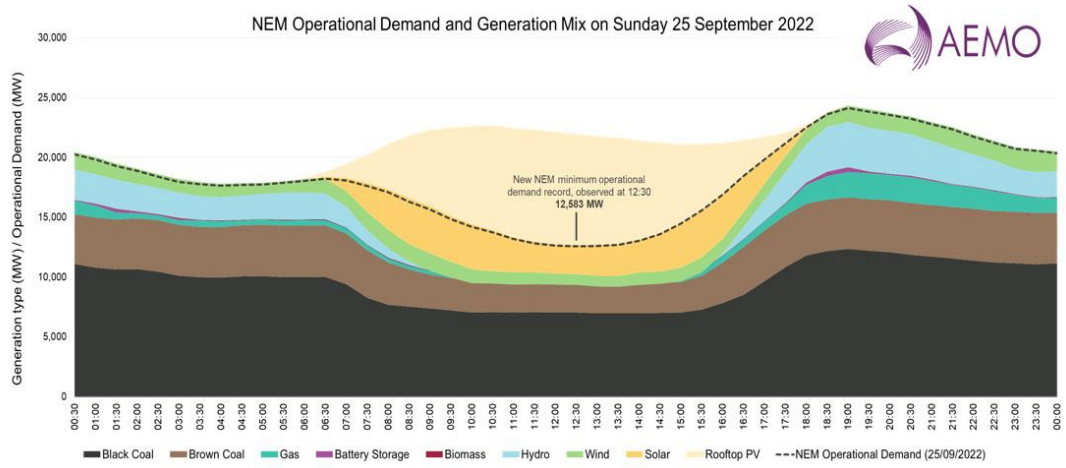

Figure 5: NEM Operational Demand and Generation Mix on Sunday 25 September 2022

Source: AEMO Twitter post 26 September 2022

3.5.2.4 Transmission

Inadequate transmission infrastructure in some regions continues to impact the ability of generators to supply the market.

Solar and wind farms are impacted by network congestion and can experience curtailment during periods of high generation. This risk grows overall as the renewable transition continues and coal generation closes. Further, independencies between stakeholders (i.e., telecommunications, water, transport, electricity) is set to increase and pose a major risk if an adequate plan for a coordinated approach to the transition of energy is not presented. This becomes an increasing issue during stressful situations such as bushfires, floods and the market suspension.

[28] AEMO (2022) Quarterly Energy Dynamics Q3 2022

The Panel notes that current grid was designed for one-way flow of the grid from big coal-fired generators to load centres with relatively gentle cycling and now must cope with a vastly different variability. Thus, grid flexibility at HV levels requires urgent development as we move to post-2025 as its too expensive to build a grid that can cope with all possible maximum flows. Planning of the HV grid needs to take account of the significant generation and battery inputs that will occur at the distribution level.

With a period that features shortages of energy ahead, with stakeholders having particular concern over the winter period 2023, levers that overcome this is critically required. Battery and other storage is required but will not be adequate. The capacity market is proposed but it will be under pressure to be decreasingly dependent on thermal plants as they leave the system and favour new technologies. The long-term solution remains to be developed.

Cascading failures occur when a failure in one part of an interconnected system initiates a failure, through overloading in another part of the system. In the transmission sector the potential for cascading failure is allowed for through the provision of redundancy, control schemes that react to limit loading or to shed some parts of the network and thus protect the integrity of the system. In the generation sector a failure of a large generator can cause the loading on other plant to increase and with the aging coal-fired plant increases in load can lead to shut down or significant output reduction.

As the power system becomes more complex and interdependent during the transition of the electricity system there is the potential for an increased probability of cascading failures to occur in both the transmission and generation sectors. An understanding of the generation and propagation of cascading failures and the identification of high-risk areas can inform government before load is shed and or market intervention is required as part of future resilience measures

3.5.2.5 Distribution

With the high penetration of distributed PVs, DNSPs have at times seen reverse power flows during period of high generation from these generators. Most of the distribution networks were not designed for this situation and considerable re-engineering of assets and controls are needed to handle the potential influx of distributed PVs.

One promising lever in the various balancing and service markets is grid and demand side flexibility or demand management. A voltage control solution to demand response (DR) was implemented at Endeavour Energy, as well as solutions within R&D including microgrids, virtual power plants, load aggregators, and electric vehicles as mobile storage.

3.5.2.6 Wind generators

Social licence is arguably the biggest issue exemplified by the concerns that were raised during stakeholder consultation that communities were losing areas of wilderness and agricultural land as more farmland is acquired for transmission or wind turbines.

Fears were raised about infrastructure development being subject to supply chain issues, transportation (e.g., trucks carrying turbine blades), and staff/skill availability. Discussed in detail in Section 3.4.

3.5.2.7 Hydro generation

There are evident issues with providing services in multiple markets with the changing weather system. Globally, it has been reported that variability in precipitation affecting the water system is affecting the effectiveness of hydro generation. Making weather prediction on different timescales a critical part of the energy system.

Going forward with renewables, the energy system will be fully embedded in the weather system, which has proved volatile across Australia. Multi-model energy systems will be critical to expand

methods available and mitigate risk by making sure scenarios for emergencies model all the interactions and policies developed.

3.5.2.8 Solar generators

Electrical or mechanical faults remain the main risk for grid-scale solar generators. Preventative maintenance whereby individual inverter units can be taken offline and maintained during winter daytime hours and mmaintenance of the main transformer for a plant is conducted during the night.

Generation output from solar panels is impacted by extreme temperatures, and rapidly decreases from about 50°C ambient temperature. Solar farms typically have a proportion of over-installed capacity that can provide some buffer as efficiency is impacted by heat. However, high temperature days have not been forecasted for this coming summer.

Recommendation 4

That the NSW Government should, work with energy market participants to understand thermal generation status (generation retirement, stockpile status, maintenance requirements, etc.) and the progress of transmission, with specific reference to (but not limited to):

- The retirement schedule of the aging thermal generation fleet and associated risks, including but not limited to maintenance requirements, potential increased outages and unreliability as plant moves towards retirement and feasibility and costs to continue operation for a year or two.
- The EUSFA undertaking work with generators and other stakeholders to develop threshold values to determine coal stockpile trigger points, enabling a mechanism and/or framework for appropriate actions that would facilitate the generators in increasing their stockpiles in times of high energy demand.

4 Preparedness activities

4.1 Understanding and working with a complex grid

The power system in Australia is increasingly becoming more complex in terms of scale, granularity and temporal behavior, with new and more diverse equipment. Arguably, this complexity is unprecedented and at a pace ahead of global transition. Many stakeholders feel we are on a compressed timescale, where the future has arrived early and we are not prepared, potentially causing further disruptions to the market.

The system interacts with telecommunications, water, gas and transport networks which leaves vulnerabilities during unprecedented events, as seen during recent market suspension and extreme weather events.

There are a number of new dynamic issues for the NEM such as sub-synchronous oscillations, that are currently managed as they appear locally, however as seen in international examples, many cases cannot be properly explained with limited existing analysis tools.

During the process of this review, stakeholder consultations found that AEMO are confident that they can meet these present challenges, largely internally, however suggest that this is an area for universities to look at other longer-term questions.

Internationally, researchers are engaged with these issues, and facing a less ambitious transition, which highlights the need for stronger support of collaboration and active engagement between industry and academic research. This will have benefit in both the short-term, and longer-term (through PhDs and postdocs) to build capacity.

In the 1970-80's, the US Department of Energy ran a program called Systems Engineering for Power following an energy crisis and concerns that the whole grid was not planned and operated in a wholistic way and should operate more efficiently. The program successfully brought together control scientist, engineers, computer scientists, economists etc. into solving problems at hand. With the transition in Australia as momentous as the changes in the USA at this time, there are some critical learnings, including a whole interacting and coordinating system that need to be carried forward for the country and state.

One initiative worth noting, driven by the Australian Council of Learned Academics (ACOLA), and co-lead by AEMO is the need for an Australian Energy Transition Research Plan. Work on this began in 2020. The objective of the Plan is to identify research gaps and subsequently promote research priority for a successful Australian energy transition to net zero carbon emissions, with the purpose of helping to inform and influence the direction, allocation and quantum of research funding in Australia. The first iteration of the Plan identified four critical challenges to the energy and research sector [29]:

1. There is an absence of a scalable and cohesive research agenda
2. We cannot rely solely on international research to address uniquely Australian problems and needs
3. Energy transition is an interdisciplinary challenge
4. Government, industry, research funders and research organisations need to respond in a time scale that is reflective of the urgency and enormity of the issue

[29] ACOLA (2021) Australian Energy Transition Research Plan

4.2 Operation of the future power system

In recognition of the transformation that is occurring in the Australian electricity system, AEMO is undertaking work to enable AEMO to manage the complex systems of the future.

4.2.1 Operations Technology Roadmap

The AEMO Operations Technology Roadmap (the Roadmap) project objective is to identify the system and market operations capability needed by AEMO during the transformative change while maintaining system reliability, security and resilience.

In late 2021, AEMO, CSIRO engaged Electric Power Research Institute (EPRI) and consultants from Strategen, GridOptimize and Hoffman Power Consulting to work with AEMO's NEM and Wholesale Electricity Market (WEM) project team to develop an Operations Technology Roadmap for AEMO. In 2021, EPRI and Strategen carried out work for the CSIRO as part of the Global Power Systems Transformation (GH-PST) initiative.

The Roadmap is aimed at uplifting AEMO's operational capability to manage the complex systems of the future and is tied to other AEMO initiatives such as the Engineering Framework, as well as AEMO's future state architecture project.

4.2.2 Engineering Framework

The Engineering Framework examines six operational conditions expected to emerge in the next five to 10 years as a tool to guide consideration of actions necessary to enable the transformation:

i. Fewer synchronous generators
ii. Ubiquitous roof top solar
iii. Extensive VRE
iv. Widespread energy storage
v. Responsive demand
vi. Structural demand shifts

Stakeholder feedback in early 2022 highlighted a strong desire to understand the specific actions that will be prioritised in the near term to start addressing the most pressing gaps and decisions identified in the Initial Roadmap. In June 2022, AEMO published the priority actions report to catalogue these actions alongside AEMO's commitment to progress each of them during the 2022/23 financial year.

This process identified potential gaps in systems and processes.

Potential Gaps Attributes

- Evolving power system - Identifying impacts to technical attributes as the power system transitions and new operational conditions arise.
- Meeting System Requirements - How technical attributes will be maintained as traditional sources exit and new technology capabilities emerge.
- Planning for transition - Adapting planning and market frameworks to support and enable efficient investments to deliver technical attributes into the future.

Potential Gaps Operability

- Monitoring and situational awareness - Monitoring data and processes for control room awareness of system state and operational risks.
- Modelling system adequacy - Power system analysis and modelling requirements for planning and system operation.
- System management - Ability to operate the power system and manage new operational conditions and requirements as they emerge.

Potential Gaps Integration

- Visibility and understanding – Visibility of new and existing technology for planning and operational decision-making.
- Performance and capability - Device capability reflecting the changing role and nature of technologies in the power system.
- Coordination and management - Architecture to enable many new actors and increasing volume and complexity of data exchange
- Enabling participation - Incentivising technology and consumer participation to provide system-level flexibility and services.

The Engineering Framework is an ongoing, iterative process that requires close collaboration between AEMO and stakeholders. The next steps in the Framework is prioritisation and commencement of new actions. This will involve industry collaboration to address key decisions and convert potential gaps to priority actions.

The above work programs will rely on significant high level technical skills for the work to come to fruition to enable AEMO to manage and operate a power system very different from the system of today. Discussions with AEMO indicate a high level of confidence that they will be able to manage and operate the power system through the transition.

Whilst AEMO may have a high level of confidence, the size of the task should not be underestimated. NSW government through the Energy Ministers Forum should be monitoring AEMOs progress. To this end AEMO should provide regular reports on progress to be considered against the timeline of physical changes in the plant mix and timing of transmission projects. AEMO's progress and the timeline of physical changes needs to be in sync for the transition to occur with minimal disruption to supply and reliability.

4.3 Energy System Planning for the NEM

4.3.1 Generation and Supply Side

In the NEM, investment in generation and supply side initiatives is primarily driven by market signals. The spot and contract market prices inform investors of potential market outcomes which they use to inform investment decisions.

AEMO also provides information via its ESOO which provides technical and market data for the NEM over a 10-year period to inform the planning and decision-making of current and potential market participants.

Whilst the NSW Government does a lot to incentivise investment in firming capacity and renewables, it relies on the private sector to undertake these investments.

However other governments are proceeding to make investments in generation such as the Commonwealth in Kurri Kurri via Snowy Hydro and Victoria's recent announcements to take a 51% stake in renewables. Participants have noted that such actions have the potential to put private sector investment at a disadvantage. Governments generally require a lower return compared to the private sector.

4.3.2 Transmission Investment

AEMO as the national market operator (with some planning function) which through the publication of its Integrated System Plan (ISP), provides a roadmap of transmission development for the NEM. It serves the regulatory purpose of identifying actionable and future ISP projects as well as informing market participants investors, policy decision-makers and consumers.

Transmission planning is undertaken by the state-based transmission entities such as TransGrid in NSW. In Victoria, AEMO is the transmission system planner. Each year the transmission entities publish an Annual Planning Report. The purpose of these reports is to identify an optimal level of transmission investment which will enable service delivery at an efficient cost. Each of the

transmission bodies undertake joint planning with their connected distribution networks and transmission bodies in neighbouring states to develop the overall network in the most efficient manner.

Governments also produce plans for transmission developments. For example, EnergyCo is leading the delivery of the State's first five REZs and critical energy infrastructure, which will underpin the transformation of our energy system. The Draft Network Infrastructure Strategy was published this year[30]. This is intended to create a transmission infrastructure development plan which coordinates within-REZ and downstream network augmentations to enable the most cost-effective building out of renewable generation.

4.3.3 Roles of Other Players

Energy Minister of the Commonwealth, States and Territories work on priority issues of national significance and key reforms in the energy sector. Energy Ministers have oversight of the ESB, AEMC, AEMO and the AER.

Until recently the ESB was developing a capacity mechanism as part of the implementation of Post -25 reforms. Energy Ministers have instructed Senior Officials to propose options for a framework that delivers adequate capacity, ensures orderly transition, and incentivises new investment in firm renewable energy to ensure the system can meet peak demand at all times.

The ESB is tasked with providing a whole of system oversight through the energy transition and facilitates better planning, coordination and action between governments, Energy Ministers and market bodies (AEMC, AEMO and AER).

AEMC, as the Rule maker and market development advisor, is examining new ways to procure essential system services, how to enable and integrate distributed energy resources, fit-for-purpose frameworks that will deliver timely transmission investment, ways to remove the regulatory burden, and prioritising any rule changes that ensure benefits and protections are afforded to the most vulnerable consumers.

AEMO, the power system and market operator, as discussed in section 4.2 has a considerable work program aimed at ensuring it can operate the power system and market through the energy transition.

The AER, as the economic regulator and rule enforcer, monitors participant behaviour in the electricity and gas markets. It monitors participant bidding, market dispatch and pricing, network constraints and outages, demand forecasting of production and capacity. Its monitoring activities will undoubtedly increase as new markets are implemented, such as for system strength, and will need to be able to interrogate and understand the activities of a number of new generation technologies.

Recently the Commonwealth, State and Territory Energy Ministers established a National Energy Transformation Partnership which is to provide a framework for national alignment and cooperative action by governments to support the smooth transformation of Australia's energy sector[31].

At a government and market body level there is a significant amount of planning being undertaken to achieve an orderly and smooth transition. However, industry participants interviewed by the Panel expressed concern that there didn't appear to be an overall level of coordination. Projects undertaken by say the ESB, AEMO and the AEMC, were understood, but participants were unsure of how these were being coordinated as a whole, leading to a lack of confidence that the transition can be achieved without setbacks and major interruptions to supply.

[30] EnergyCo (2022), Draft Network Infrastructure Strategy. Consulting on a blueprint for transforming the NSW energy sector
[31] Energyministers (2022), National Energy Transformation Partnership

4.4 Coordination during a crisis

As the energy system undergoes significant transition over the next decade, there is the potential for issues to arise that may impact the security, reliability, and resilience of Australia's energy supply. There are a significant number of changes to occur; retirement of coal-fired generation, the significant growth of renewables and the transmission build to connect these renewables. If these changes get out of sync, then security and reliability of supply could be compromised. At such times coordination efforts involving resource and information sharing activities between AEMO and industry participants will be needed to ensure the reliable operation of electricity and/or gas systems

Such coordination efforts may be in breach of Part IV – Restrictive Trade Practices of the Consumer and Competition Act 2010 (Commonwealth) (the CCA) in terms of conduct that may lessen competition.

Over the last few years, AEMO has regularly sought urgent authorisation by the ACCC to allow AEMO and industry participants to engage in conduct for the purposes of managing energy supply during a crisis or emergency:

- On 30 March 2020 AEMO lodged an application for authorisation, including urgent interim authorisation of conduct which had the purpose of managing arrangements during the pandemic. Interim authorisation was granted on 3 April 2020 for some elements of the proposed conduct. On 17 April and 16 July 2020, AEMO narrowed the scope of the proposed conduct and on 17 September 2020, the ACCC issued a final determination granting conditional authorisation until 31 May 2021.
- On 29 June 2021, AEMO applied for urgent interim authorisation to allow AEMO and participants in the gas and electricity markets to work together to support Australia's energy supply and systems during the current supply crisis. On 1 July 2022, the ACCC granted interim authorisation.
- On 15 October 2021, AEMO lodged an application for authorisation, including requesting urgent interim authorisation for conduct in the electricity industry which has the purpose of co-ordinating repairs and maintenance, sharing essential personnel, sharing essential inputs, and sharing information regarding ongoing operation provided the conduct is done for the purpose of ensuring safe, secure, and reliable electricity and to minimise the risk of any outages during the pandemic. On 27 October the ACCC granted urgent interim authorisation and on 23 February 2022, the ACCC granted authorisation until 27 October 2022.
- On 29 June 2022, AEMO lodged an application with the ACCC seeking authorisation for itself and current and future industry participants to engage in conduct relating to coordinating repairs and maintenance, sharing essential personnel, sharing essential inputs, sharing information regarding ongoing operation, deferring non-essential works, and managing system stability. On 1 July 2022, the ACCC granted urgent interim authorisation and on 25 August 2022, the ACCC released a draft determination proposing to grant authorisation until 31 March 2023. Submissions on the draft determination were due by 9 September 2022. The ACCC has indicated that the final determination will be made in September/October 2022.

The ACCC granted authorisation on the basis that certain coordination and information and resource sharing activities, that might not have otherwise occurred, were needed for the benefit of both competition and consumers by minimising the risk of energy outages and ensuring the continued operation and integrity of the NEM.

Leading up to each of the above applications for authorisation, including urgent interim authorisation, there has been several events that have cause significant risk to the security and reliability of the electricity system. As the electricity system transitions there is likely to be many occasions where the electricity system is placed under stress and there are risks to security and

reliability requiring further approaches to the ACCC for authorisation of conduct by AEMO and industry participants which are both costly in resources and could be needed urgently.

If the coordination, resource and information sharing by AEMO and industry participants was allowed for within the legal framework covering the gas and electricity markets, then authorisation of such conduct by the ACCC would not be required in order to cope with a foreseen and actual supply crisis.

Anything that provides for coordination, resource and/or information sharing by AEMO, and industry participants should only be allowed if there is a clear and present threat to supply security, reliability or integrity of the markets and normal actions available to AEMO and/or market participants will not suffice.

Checks and balances could be included, by the AER being satisfied that the threat identified by AEMO would not be likely overcome by normal actions and that the coordination and the sharing of resources and information is appropriate in the circumstances and agreeing to the time frame for the arrangements to apply.

This could be similar to the arrangements whereby the AER considers a request from AEMO for the AER to trigger the Retailer Reliability Obligation (RRO) where it is needed, to support reliability in the NEM. Where AEMO has identified a potential material reliability gap three years and three months out, based on its assessment in the ESOO, AEMO can apply to the AER to trigger the RRO by making a reliability instrument.

Recommendation 5

That EUSFA advocate for jurisdictions and the market bodies to explore the suitability of legislative arrangements to allow AEMO and industry participants to coordinate efforts to address issues that may impact the security, reliability and resilience of Australia's energy supply during a period when the energy system is facing significant challenges and risks. This would obviate the need for potentially regular approaches to the Australian Consumer and Competition Commission (ACCC) for authorisation of conduct during the energy transition.

Acronyms

Acronym	Complete Term
ACCC	Australian Consumer and Competition Commission
AEMO	Australian Energy Market Operator
AEMC	Australian Energy Market Commission
AER	Australian Energy Regulator
BOM	Bureau of Metrology
CCA	*Competition and Consumer Act 2010*
COVID-19	Coronavirus Disease 2019
CSE	NSW Chief Scientist & Engineer
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DCS cluster	Department of Customer Service
DER	Distributed Energy Resources
DNSP	Distribution Network Service Provider
DR	demand response
ENSO	El Niño–Southern Oscillation
EPRI	Electric Power Research Institute
ESB	Energy Security Board
ESOO	Electricity Statement of Opportunities
EUSFA	Energy and Utilities Services Functional Area
EUSFAC	Energy and Utilities Services Functional Area Coordinator
EV	Electric Vehicle
GETI	Global Energy Talent Index
GJ	gigajoule
GW	gigawatt
HV	high voltage
JSSC	Jurisdictional System Security Coordinator
IOD	The Indian Ocean Dipole
IRM	Interim Reliability Reserve
IPART	Independent Pricing and Regulatory Tribunal
ISP	Integrated System Plan
LOR	Lack of Reserve
MW	Mega Watts
NEL	National Electricity law
NEM	National Electricity Market
NER	National Electricity Rules
NSW	New South Wales
OCSE	Office of the Chief Scientist & Engineer
OECC	Office of Energy and Climate Change
OTR	Operations Technology Roadmap
RERT	Reliability and Emergency Reserve Trader
REZ	Renewable Energy Zone
SAM	The Southern Annular Mode
SAPS	Stand Alone Power System
SES	NSW South Wales State Emergency Service
STEM	Science, technology, Engineering, math
WEM	Wholesale Electricity Market

Appendix 1 – Terms of Reference

Terms of Reference for the NSW Chief Scientist & Engineer – 2022-23 Annual Assessment of Preparedness for the NSW Energy Market

Background

In 2017, the Minister for Energy and Utilities established a NSW Energy Security Taskforce to look at how NSW manages energy security and resilience, including readiness, planning, preparation, and response capability to extreme events such as summer weather. The Taskforce released its initial report on 22 May 2017 and its final report on 19 December 2017.

Prior to summer in 2018, 2019, 2020 and 2021, the Minister for Energy requested that the NSW Chief Scientist & Engineer chair a panel to assess the adequacy of the State's summer preparedness in relation to the energy market and associated emergency management and identify any actions to address emerging risks in the approaching summer and beyond.

In all instances the Panel concluded that the NSW Government was well prepared for the approaching summer, noting that protocols and exercises by the Department of Planning and Environment, other NSW Government agencies and industry stakeholders have improved summer readiness and energy emergency response.

NSW is generally well placed to deal with electricity reliability and security risks. However, adequacy of electricity supply is at heightened risk during extreme weather events, such as heatwave conditions, lost/reduced output of forecast generation output and the reliability of ageing thermal generation plants.

The NSW Government is seeking expert advice from the NSW Chief Scientist & Engineer on risks within the national electricity market. This will build on the work of national bodies and focus on opportunities for the NSW Government to take further action to maintain the reliability of supply in the State.

While summer presents the likelihood of the highest demands, recent events have demonstrated that the energy market needs to be resilient all year. This focus should ensure clarity in communication that risks to energy security and resilience can occur at any time of year and readiness, planning, preparation, and response capabilities may be needed outside of the anticipated high demand events of summer.

Scope of review

The review will:

1. provide an assessment by 31 October 2022, that:
    a. synthesises work undertaken by the Australian Energy Market Operator (AEMO) and other national bodies in relation to the supply and demand outlook in NSW, including the adequacy of firm generation, transmission, and demand response
    b. considers national measures, ongoing work by AEMO and other market bodies, and current NSW Government actions, to address energy reliability and security risks
    c. builds on previous NSW Chief Scientist & Engineer assessments of summer preparedness of the NSW energy market and reviews the work completed by the NSW Government in response to the recommendations from those reports
    d. identifies any emerging risks for the 2022/23 period, including summer, and makes recommendations on actions to address any vulnerabilities identified
    e. identifies the emerging risks and makes recommendations on actions to support operational responses that address any supply chain vulnerability with gas and coal

fuel that are apparent in the current environment, using the June 2022 gas and electricity events as a reference

In undertaking this work, an expert Panel as well as staff selected by the NSW Chief Scientist & Engineer will consult with, and consider work being undertaken by, the NSW Government and other relevant organisations, such as power stations, TransGrid, AEMO, the Australian Energy Regulator, the Australian Energy Market Commission, and the Energy Security Board.

Process

The Panel is to provide a report by 31 October 2022 and upon request, provide updates to the review yearly thereafter. There is significant work being undertaken by AEMO. The Panel should draw on this work where possible and focus on areas particularly related to NSW.

Appendix 2 – Stakeholder Engagement

Table 4: List of stakeholders

Name/Organisation
AGL
Ausgrid
Australian Energy Market Commission (AEMC)
Australian Energy Market Operator (AEMO)
Australian Energy Regulator (AER)
Bureau of Meteorology (BOM)
CWP Renewables
Delta Electricity
Edify Energy
Endeavour Energy
Energy Security Board (ESB)
Energy Australia
Energy Consumers Australia (ECA)
Essential Energy
NSW Department of Planning, Industry and Environment NSW Energy and Utilities Functional Area (EUSFA)
NSW Transport, Freight
NSW Telecommunications Authority
Origin Energy
Queensland Government, Energy Emergency
Snowy Hydro
Tomago Aluminium Company
TransGrid