NSW GOVERNMENT | Chief Scientist & Engineer

Assessment of preparedness of the NSW energy market: 2023/24

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NSW GOVERNMENT Chief Scientist & Engineer

The Hon Penny Sharpe
Minister for Energy
52 Martin Place
SYDNEY NSW 2000

Dear Minister

Assessment of preparedness for the NSW energy market: 2023/24

In September 2018 the (then) Minister for Energy and Environment requested I provide advice on the risks within the national electricity market (NEM) with a focus on the approaching summer. Since then, each year, I have been asked to provide an annual assessment of the NSW energy market. In accordance with the Terms of Reference, the advice considers risks to NSW for the coming 12 months, with a focus on the approaching summer.

The 2023/24 assessment was undertaken by an Expert Panel chaired by me, with Dr Darren Saunders (Deputy Chief Scientist & Engineer) as Deputy Chair, Mr Neville Henderson (former commissioner of the Australian Energy Market Commission) and Professor Emeritus David Hill (Professor of Electrical Power and Energy Systems, Monash University). The Office of the Chief Scientist & Engineer (OCSE) provided Secretariat support and report drafting was provided by OCSE.

The Panel received briefings and presentations from NEM stakeholders including state government agencies, the Bureau of Meteorology, network utilities and generators in NSW to understand issues including:

- energy and emergency events that occurred over the past 12 months (Nov 2022 – Oct 2023) and their impacts
- emerging risks and vulnerabilities for the electricity systems and markets
- NSW Government and the energy sector preparedness and future planning for the coming 12 months (Nov 2023 – Oct 2024)

While the NEM is undergoing a significant transition to renewables, there is risk to the energy market as older, baseload coal-fired generators close. Stakeholders provided assurances that while this poses a longer term vulnerability for electricity supply, the NSW energy market is currently well prepared for the coming summer. The Panel agrees with this assessment, barring unexpected coincident or compounding events occurring.

The Panel provides recommendations to the NSW Government to support the energy market over the coming 12 months.

Yours sincerely,

H. Durrant-Whyte.

Hugh Durrant-Whyte
Chief Scientist & Engineer
3 November 2023

Acknowledgement of Country

The Expert Panel and Office of the Chief Scientist & Engineer acknowledge the Traditional Owners of Country throughout NSW and recognise their enduring connection to the lands and waters in which we work and live. We pay our respects to Aboriginal and Torres Strait Islander people and to Elders past and present.

The Assessment was written on Gadigal Land of the Eora Nation, with recognition that the team consulted with stakeholders working and living across Aboriginal cultures and lands and pay our respects to all Traditional owners.

Executive Summary

The scope of the 2023/24 Assessment is to identify any emerging risks to the energy system over the next 12 months, inclusive of summer and winter periods, with an analysis of the work undertaken by the NSW Government and market stakeholders in responding to identified risks in previous reports.

This complements related work in the NSW Government that examines medium- to long-term policies and opportunities, such as the NSW Government Electricity Supply and Reliability Check Up (2023) and the NSW Decarbonisation Innovation 2023 Study.

2023/24 Preparedness Assessment

Overall, stakeholders indicated that they are well prepared for the coming 12 months. Preparations and risk mitigation actions included consideration of the possible impacts of El Niño and other climate drivers, the potential for bushfire (amongst other natural hazards), and increased understanding and response to potential constraints on supply chains for thermal fuel (coal, gas and other liquid fuels) and critical assets/equipment.

However, the Expert Panel notes that risks facing the National Energy Market (NEM) and NSW energy stakeholders are no longer limited to just the summer period, but increasingly include the shoulder and winter periods. This is reflected in conversations with stakeholders, where the risk to energy provision in the winter of 2024 and beyond will become more pronounced if higher demand scenarios (with subsequent increased fuel consumption) occur in summer 2023/24.

Climate and bushfire outlook

- The Bureau of Meteorology (BOM) declared an El Niño and positive Indian Ocean Dipole (IOD) in September 2023. The former is expected to peak mid-summer and last through autumn and the latter until at least December.
- The combined impact of El Niño and IOD increases the chance of higher temperatures, (both minimums and maximums) across most of Australia through summer. Frequent heatwaves are of concern across all NEM states, although El Niño tends to bring shorter duration heatwaves.[1]
- Extreme heat can affect both energy infrastructure and peak demand. Higher minimum (night-time) temperatures could skew the demand period as consumers use air conditioners past typical peak times when renewables (especially solar) have shut down.
- Most of NSW and the NEM states are predicted to be drier than average for November. Although hotter conditions are expected over summer, there will be an average chance of median rainfall for most of NSW.
- If the effects of hotter temperatures co-occur with other, less predictable extreme weather events, such as severe thunderstorms, localised flash flooding or an East Coast Low, the energy system could be strained further.
- Bushfire risk has increased due to above-average rainfall for the past three years leading to an increase in vegetation fuel loads across the state.
- Spring conditions are contributing to early fire risks in parts of NSW. September brought below or far below average rainfall for almost all of NSW and some of the warmest September days on record,[2] leading to several days of high fire danger.

[1] BOM, per comms, 20 Oct 2023.
[2] BOM. (2023). *Australia in September 2023 (bom.gov.au)*.

- Parts of NSW, particularly in the northern half, are at increased risk of grass and bushfires during spring 2023. Southern and western NSW are at average risk for spring.[3]
- The summer bushfire risk outlook will be released by the National Council for fire and emergency services (AFAC) in late November. Given forecast heat, lower than average soil moisture and corresponding drying trends from El Niño, summer may bring a higher-than-average risk of grass and bushfires across most of NSW.

ESOO outlook and managing supply risks

- The Australian Energy Market Operator's (AEMO) 2023 NEM Electricity Statement of Opportunities (ESOO) forecast the expected unserved energy (USE) in NSW to be below the Interim Reliability Measure (IRM) of 0.0006% in 2023/24, provided resources and demand are as expected. However, AEMO does forecast a risk of USE above the IRM in South Australia and Victoria, thereby potentially reducing the supply available to NSW via the VIC-NSW interconnector.
- AEMO highlights an elevated risk of involuntary load shedding should there be a coincident and compounding combination of generator outages, weather events, limited fuel and water supply, and high maximum demand.
- Stakeholders also noted that an increasing reliance on interconnectors during periods of high demand could also increase reliability risks, especially if the high demand coincides with extreme weather events. This could potentially lead to deratings of the interconnectors or supply shortfall if demand is high in other states.
- There are significant mid-term supply risks, with forecasted USE in NSW above the reliability standard of 0.002% in 2025-26 following the planned retirement of the Eraring Power Station. The ability to maintain adequate reliability and security is dependent on significant generation and transmission developments, with the Expert Panel highlighting the additional need for orchestration of consumer energy resources (CER) and demand side participation (DSP) uptake.
- AEMO's 2023 Gas Statement of Opportunities (GSOO) forecasts peak day shortfalls from 2023 in southern regions of NSW if high residential, industrial and commercial gas demand coincides with a high requirement for gas-powered electricity generation, which is most likely to occur in winter. Moderation of electricity demand, or the use of diesel in dual-fuel generators, could potentially reduce these shortfalls. Short-term (2023-24) shortfall risks are also minimised by the completion of several committed infrastructure and supply projects, as well as demand flexibility.

Supply chain vulnerability and forecasts

- Stakeholders were generally satisfied with the availability and stockpiles of coal and gas for the coming 12-month period. However, one risk is the short- to medium-term coal security for Mt Piper, given that there is an expected shortfall in production from Centennial Coal's Springvale site due to issues related to mine flooding. The Expert Panel understands that there is ongoing communication with the NSW Government and other stakeholders regarding this issue.
- Some stakeholders also highlighted potential gas shortfall risks in the winter should the coming summer require high levels of gas-powered electricity generation. This is especially relevant given NSW's reliance on other states for gas supply, with a lack of bulk gas storage in NSW.
- Longer term, significant reliability risks above the reliability standard may arise, should there be limited fuel availability for thermal generators, as indicated by AEMO's 2023 ESOO. Stakeholders noted that while the short-term forecast is relatively benign, global political and

[3] Australasian Fire Authorities Council. (2023). *Seasonal Bushfire Outlook Spring 2023*.

climactic volatility had the potential to quickly result in unforeseen shortfalls and reliability risks.

- Within the NEM, more extreme peaks and troughs in the demand profile across each day require increasing flexibility with more ramping of generators, including coal-powered stations primarily designed as baseload generators. The risk of major failures and unplanned outages will increase as these generators get closer to retirement and are placed under considerable thermal strain from cyclic ramping loads.
- Stakeholders reported that workforce sickness absenteeism returned to 2019 (pre-COVID) levels and were not expected to cause major disruptions to operations in 2023-24. While post-COVID supply chain constraints were still being felt, stakeholders reported that these constraints were well understood and proactively managed through longer term advance planning and the maintenance of stockpiles of critical assets and equipment.
- In December 2022, the federal government implemented a temporary price cap on the supply of regulated gas of $12 per GJ in response to prices jumping significantly (surpassing $50 per gigajoule at the end of May). On 18 July 2022, Sydney reached a near-record of $59.49 per GJ. However, wholesale gas prices have since decreased to an average of $10.41 per GJ in Q3 2023, and stakeholders generally did not have concerns regarding the application of the price cap in the next 12 months.
- Stakeholders reported that there were fewer interruptions in coal supply in the lead up to winter 2023 than was the case in 2022, and that generally there are no foreseen problems with coal supply coming into 2024. However, reports of ongoing issues with coal supply at Mt Piper remain.
- In December 2022, a coal market price emergency was declared where the NSW Minister for Energy was granted responsive power. This resulted in the price of black coal sold to generators being capped at $125 per tonne in NSW. Coal generators were also required to reserve a proportion of future coal production to supply NSW coal generators and were to prioritise delivery to generators with low stockpiles which took pressure off supply. Although prices have since dropped and supply problems are not anticipated in the next 12 months, the coal market price declaration remains in effect until June 2024.
- There is significant concern over the shortage of skilled workers in the energy sector. A competitive market results in high turnover and low retention of workers. Stakeholders identified an increasing need to grow the underlying pool of workers through activities such as apprentice campaigns, graduate programs and skilled migration.

Generation and transmission infrastructure status

- Based on discussions with stakeholders, the Expert Panel had concerns regarding the overall reliability of thermal generators as they move towards end of life and the impact of this on market resilience. This is of particular concern due to the shifting nature of demand and availability of renewables to market (i.e. daytime generation by solar).
- The Expert Panel is also concerned by actual and expected delays to new generation and the transmission infrastructure required to mitigate against the increased reliability risk following the expected retirement of several thermal generators.
- Stakeholders also noted that an increasing reliance on interconnectors during periods of high demand could also increase reliability risks, especially if the high demand coincides with extreme weather events potentially leading to equipment deratings.

NSW Check Up

- The NSW Electricity Supply and Reliability Check Up ('Check Up'),[4] published in August 2023, examined current policies and programs and identified risks and steps for NSW Government to deliver the NSW Electricity Infrastructure Roadmap ('Roadmap') and transition to a decarbonised electricity sector.
- The Check Up noted the Roadmap's support for large generations projects, long duration storage projects like pumped hydro and major new transmission projects carry cost, engineering and timeframe risks.
- The scheduled closure of Eraring in 2025 and infrastructure construction issues were two key risks highlighted in the Check Up.
- Most of the Check Up's findings relate to current challenges with impacts that will play out over the coming years but addressing them requires an immediate focus and coordinated approach.
- Although Eraring is expected to operate in the market over the next 12 months, any unexpected failures or maintenance issues this year could be complicated by the cost/benefit of its scheduled closure. The Panel is aware that the NSW Government is in discussions with Origin about Eraring's retirement in 2025.
- In noting these discussions, a number of stakeholders expressed their significant concerns around the ongoing discussions between the NSW Government and Origin Energy about the extension of Eraring beyond 2025, particularly the need for transparency and the potential influence these decisions may have on future market decisions and investments.
- The NSW Government issued its response to the Check Up in September 2023,[5] in which it accepted all but four of the Check Up's 54 recommendations. The Government outlined alternative approaches to meet the intention of the four unaccepted recommendations.

Future power system

- The Expert Panel emphasised that there are important issues beyond the 12-month horizon covered by this report. These will have a significant impact on energy security, sustainability, affordability and the overall resilience of the NEM, and therefore actions towards these issues will need to begin in the next year.
- There continue to be concerns over adequate skilled staffing throughout the energy sector, as epitomised by the current recruitment actions of the Energy and Utility Services Functional Area (EUSFA) within the Office for Energy and Climate Change (OECC). There is a need to focus on capacity building in traditional energy sector skills (network engineers) and innovative skills to supply the labour force to support the transition. Moreover, skills-building actions for the sector need to start immediately given the timeframes for training (for example, university coursework of four years).
- Social licence is an ongoing focus of many stakeholders, with particular importance in securing new transmission projects to support the renewable transition. Customers need to have confidence that the transition is beneficial, affordable and achievable. The development of the transmission network to support the construction of Renewable Energy Zones (REZs) brings challenges and opportunities for local communities impacted by these developments.

[4] Marsden Jacob Associates. (2023). *NSW Electricity Supply and Reliability Check Up*. Prepared for NSW Treasury, Office of Energy & Climate Change.
[5] Office of Energy and Climate Change, NSW Treasury. (2023). *Electricity Supply and Reliability Check Up: NSW Government Response*.

Recommendations

Recommendation 1: The NSW Government should note that the NSW energy market is entering a period of increased risk from coincident or compounding events in 2023/24. Agencies with responsibilities in this sector (including OECC and EUSFA) should continue to actively monitor and prepare for unexpected weather and/or energy events.

While the outlook for 2023/24 and through 2024/25 is generally satisfactory,[6] reliability, security and resilience will come under pressure if there are shortages in fuel supplies (gas and coal) to power stations, prolonged high temperatures, and/or coincident failures of large generators and major transmission elements, particularly interconnectors. Major weather events (bushfires, severe storms and localised floods), depending on when these occur, could quickly result in shortages in energy supply.

The situation could be exacerbated if these events were to occur coincidently in NSW and neighbouring jurisdictions, thereby reducing supply available to NSW via the interconnector(s).

The outlook for 2025/26 and beyond will be of concern, with forecast reliability gaps arising due to the planned retirement of Eraring Power Station, delays to commissioning of renewable generators and major transmission builds and the potential for higher forced outage rates of the ageing coal fleet. Further, the dependence of NSW generators on gas from other jurisdictions, in the absence of deep storage, could have implications beyond winter 2024 and longer term if they are required to operate for longer durations. Gas supply to the NSW gas-fired power stations mainly comes via the East-Coast Gas Pipeline from Longford in Victoria. The operation of these stations would be compromised if the pipeline was interrupted and/or as gas supplies from Longford are curtailed.

Recommendation 2: The NSW Government should expedite the recruitment of junior emergency management positions within EUSFA and focus on their current recruitment actions. EUSFA should also explore novel and ongoing training opportunities for staff, including 'shadowing' opportunities in an emergency setting with other jurisdictions.

This will provide a pathway to retain skilled individuals who understand the requirements and communication lines during emergencies within the energy sector or the factors that have an impact on it. This recruitment is critical and should also be supported by adequate and ongoing training.

The Expert Panel understands that the staffing and recruitment issues facing EUSFA are endemic in the energy sector more broadly, where there is fierce competition for a limited pool of skilled professionals.

These staffing issues were previously highlighted in the NSW Chief Scientist & Engineer's *Assessment of summer preparedness for the NSW energy market* in 2018, where Recommendation 1 outlined that the (then) NSW Department of Planning and Environment (DPE) '*develop a succession plan to ensure the stability and continuity of these positions, and to ensure suitably qualified JSSC and EUSFAC*[7]*, including deputies, are available at all times, and particularly through each summer season*'.

The Panel is concerned that failure to address Recommendation 2 of this report could hamper any future response if an energy emergency occurs. The Panel also notes that the energy market is transforming at a rapid rate, underscoring the need to foster new skill sets and increase understanding of the complexity of the system to match this transformation.

[6] Reliability is expected to be within the Interim Reliability Standard: AEMO. (2023). *2023 Electricity Statement of Opportunities*.
[7] Jurisdictional System Security Coordinator and Energy and Utility Services Functional Area Coordinator

Recommendation 3: That the NSW Government, specifically the OECC, take immediate action in response to the findings on future power planning (Chapter 5), noting that the reliability risk in NSW is forecast above the reliability standard in 2025-26.

Specifically, the Expert Panel recommends that:

1. the NSW Government should work with the Commonwealth and other jurisdictions to progress actions towards skills development, including the recommendations from reports like the Commonwealth Government's Jobs and Skills Australia report, and support the creation of employment opportunities that will arise during the energy transition
2. the NSW Government, through the Energy and Climate Change Ministerial Council (ECCMC), should engage with universities to support the establishment of Centres of Excellence for the vocations needed to support the energy transition
3. A review of regulatory arrangements for Consumer (or Distributed) Energy Resources (CERs) and community battery storage be undertaken, with the goal of maximising their contribution to the energy transition
4. the NSW Government should undertake work to improve the consumer experience and to increase confidence that the transition is beneficial, affordable and achievable
5. the NSW Government examine mechanisms to reduce regulatory and planning complexity to speed up energy transition development as a whole-of-system approach
6. the review of the current transmission planning arrangements in NSW include a review of transmission regulatory arrangements.
    - the Expert Panel notes Recommendation 18 from the Check Up Report regarding the review of current transmission planning arrangements in NSW, and advice on the best approach to ensure coordination between the Roadmap bodies. Noting that this recommendation was accepted by the NSW Government, the Panel Recommends that a review of transmission regulatory arrangements be included to ensure that the achievement of the Roadmap is not compromised.
    - the review should include an assessment of whether the current RIT-T arrangements, including proposed changes to the NER, will impact the timely delivery of strategic transmission projects or whether an alternative RIT-T process should be implemented
    - the Panel Recommends that a review of the transmission regulatory arrangements should assess whether strategic transmission projects be subject to the RIT-T or bypass the RIT-T.

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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.[8] In 2018, the CSE was again requested 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.[9]

In September 2019, the (then) 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. The Office of the NSW Chief Scientist & Engineer (OCSE) has submitted annual assessments for 2019/20,[10] 2020/21,[11] 2021/22,[12] and 2022/23.[13]

The 2023/24 Assessment reviews the risk to the supply of electricity for the next 12 months (November 2023 to October 2024) and complements other work undertaken by or for the NSW government, including,

- NSW Electricity Supply and Reliability Check up[14] (and the NSW Government response[15])
- Net Zero Plan Stage 1: 2020-2030[16]
- NSW Decarbonisation Innovation Study[17]

The Assessment, through consultations with federal government and state agencies, network operators and generators, sought to understand issues including events through the past 12 months (2022-23), energy preparedness, future planning and emerging risks to the electricity system and markets. The full scope for the 2023/24 Assessment is found in the TOR at Appendix 1.

1.1 Assessment process

The Expert Panel was established and included:

- Professor Hugh Durrant-Whyte, NSW CSE and Chair
- Dr Darren Saunders, Deputy CSE and Deputy Chair
- Mr Neville Henderson, former commissioner of the Australian Energy Market Commission and member of previous Assessment Expert Panels
- Professor Emeritus David Hill, Professor of Electrical Power and Energy Systems, Monash University and member of previous Assessment Expert Panels

OCSE provided Secretariat and drafting support.

In undertaking the work, the Panel received briefings and presentations from NEM bodies including Australian Energy Market Operator (AEMO), Australian Energy Market Commission (AEMC) and the Australian Energy Regulator (AER), state government agencies (NSW, Queensland, Victoria, South

[8] 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.
[9] OCSE. (2018). *Assessment of Summer Preparedness for the NSW Energy Market. 2018/19.*
[10] OCSE. (2019). *Assessment of Summer Preparedness for the NSW Energy Market. 2019/20.*
[11] OCSE. (2020). *Assessment of Summer Preparedness for the NSW Energy Market. 2020/21.*
[12] OCSE. (2021). *Assessment of Summer Preparedness for the NSW Energy Market. 2021/22.*
[13] OCSE. (2022). *Assessment of preparedness of the NSW Energy Market: 2022/23*.
[14] Marsden Jacob Associates. (2023). *NSW Electricity Supply and Reliability Check Up*. Prepared for NSW Treasury, Office of Energy & Climate Change.
[15] NSW Government, Office of Energy and Climate Change. (2023). *Electricity Supply and Reliability Check Up: NSW Government Response*.
[16] NSW Government, Department of Planning, Industry and Environment. (2020). *Net Zero Plan Stage 1: 2020-2030*.
[17] OCSE. (2020). *NSW Decarbonisation Innovation Study Scoping Paper*.

Australia), 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 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 a review of 2022/23, including climate, the NEM and gas supply
- Chapter 3 – provides an assessment of forecasted risk and preparedness of the NSW energy sector (and the broader NEM), including climate and bushfire risk, review of the ESOO and GSOO, and supply and demand forecasts
- Chapter 4 – provides a summary of the NSW Electricity Supply and Reliability Check Up
- Chapter 5 – provides an overview of the future power system and potential risks

2 Review of 2022/23

The Assessment of preparedness of the NSW Energy Market 2022/23 found that:

- Risks facing the NEM are no longer limited to just the summer period, but increasingly in the shoulder and winter periods, with the market suspension in June 2022 reflecting the heightened reliability risk across the year.
- The June 2022 market suspension, as declared by AEMO and in effect for 10 days, was due to a confluence of events[18] which made it impossible to continue operating the spot market while ensuing a secure and reliable supply of electricity for consumers. Collaboration between AEMO, AEMC, AER, generators, emergency reserve providers, network service providers and jurisdictions enabled this series of events to be effectively managed without involuntary customer load shedding.
- As the energy market transitions, the incidence and cause of Lack of Reserves (LOR) is likely to change. It will be important for the Energy and Utility Services Functional Area (EUSFA) and the Jurisdictional System Security Coordinator (JSSC) to develop an understanding of these potential causes and understand what LORs are likely to progress to LOR3s.
- An understanding of where cascading failures can occur is needed to inform the government before load is shed and/or market intervention is required as part of future resilience measures.
- There is a high strain on the energy system as fuel stockpiles continue to diminish and the thermal generators move towards end of life, where critical decisions are required around their repair and/or retrofit to ensure future availability and supply.
- There is lack of labour and experts in both traditional skills (including technical expertise in traditional energy systems including engineers, technicians and operators, electrical systems, mechanics and instrumentation) as well as innovative and emerging skillsets for renewables transition (such as technical expertise in renewable energy technologies like solar panels, wind turbines and energy storage systems).
- Australia's power system is becoming increasingly complex and the transition from coal-fired generation to renewables requires a highly coordinated approach to capability and resource planning, particularly when considering thermal generation retirement and location of new transmission lines overlayed by a rapid timeframe.
- 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 to manage energy supply during an emergency/crisis. The ACCC's primary responsibility is to ensure that individuals and businesses comply with Australian competition, fair trading, and consumer protection laws. Coordinated efforts between AEMO and industry participants are needed and would remove the need for potentially regular approaches by AEMO to the ACCC for authorisation of conduct during the energy transition.

The sections below examine the energy market and actions that have occurred since delivery of the last report, as it is important to understand the events and conditions leading into 2023/24.

[18] See *2022/23 Assessment of the NSW Energy Market* for full explanation. In short, 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.

2.1 Response to prior assessments and inquiries

2.1.1 2022/23 Assessment recommendations

A progress update on 2022/23 Recommendations was provided from EUSFA in October 2023. Overall, the recommendations are completed and/or well progressed (see Table 1).

Table 1. Recommendations from the Assessment of Summer Preparedness of the NSW Energy Market: 2022/23

Recommendation	Comment	
Recommendation 1 That the EUSFA and emergency services (State 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 Distributed Network Service Providers (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	EUSFA comment	EUSFA now have access to 'Indji' platform – a Transgrid product which gives access to transmission lines and assets in great detail. There are also platforms such as *Fires Near Me* and *Hazards Near Me NSW* which are public and allow quicker opportunities to re-energise after de-energising. Permissions for wide data sharing between privately owned organisations remains a challenge for a continuous or 'live' feed. The data sharing is more attuned to an emergency event or 'as required' which has shown to be effective as part of recovery.
	Expert Panel comment	The Panel notes that this should form an ongoing work program that looks towards new developments and ensures appropriate access to market stakeholders, including methods that allow for this access, while not compromising consumer privacy.
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), which 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).	EUSFA comment	Energy Operations have representation on National Energy Emergency Management working group (NEEMWG), National Electricity Market Emergency Management Forum (NEMEMF), National Gas Emergency Response Advisory Committee (NGERAC), National Oil Supplies Emergency Committee (NOSEC), Climate Sustainability Working Group (CSWG) and all Trusted Information Sharing Network (TISN) sector groups. A relevant response to the Recommendation from the 2021/22 OCSE Assessment, as published in the 2022/23 OCSE Assessment, is below. 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.

Recommendation	Comment	
• 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).		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 needs to consider the age of the retiring equipment and modification and refurbishment costs relative to the cost of new equipment, and the cost of alternative emerging technologies including grid forming inverters.
	Expert Panel comment	The Panel notes the actions above, in conjunction with the NSW Government Electricity Supply and Reliability Check Up. There remain concerns from stakeholders that speak to this recommendation, outlined in Chapter 5 of this report.
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	EUSFA comment	<u>Renewable Energy Sector Board</u> 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.

Recommendation	Comment	
		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 on regional NSW, including the Hunter, Central Coast, Illawarra, Far West, Southwest, New England and Central West regions. • road, rail and port infrastructure required in the regions specified above to promote export opportunities for generation, storage and network technology.
	Expert Panel comment	The Panel notes the actions undertaken above. However, as iterated in Chapter 5 and as symbolised by the current recruitment actions by EUSFA (Section 3.5), stakeholders still have significant concerns on the skills availability in the short, medium and long term. Skills availability concerns centre on the magnitude (i.e. workforce size) needed to deliver and maintain the transitioning NEM, in regards to the full labour force (construction and maintenance) and the highly specific skills required (including traditional electrical engineering skills that are currently in short supply and the development of future skills requirements, such as increasing cybersecurity knowledge).
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 ageing thermal generation fleet and associated risks, including, but not limited to maintenance requirements, potential increased outages and unreliability as	EUSFA comment	OECC meets monthly with coal-fired generator owners and operators to discuss stockpiles and any operational and supply challenges. Threshold values have been established through the Coal Price emergency intervention measures by NSW with monthly reports being sent to AER as the regulator. In addition, where Conduct is authorised by the ACCC for AEMO to conduct meetings to coordinate maintenance activities in NSW, a senior officer (OECC/EUSFA) will be invited to attend.
	Expert Panel comment	The Panel notes that thermal generators are in good communication with state-based representatives, including OECC and EUSFA. This should be continued.

Recommendation	Comment	
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.		
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 remove the need for potentially regular approaches to the Australian Consumer and Competition Commission (ACCC) for authorisation of conduct during the energy transition.	EUSFA comment	EUSFA have advocated for this be considered. We are aware that changes to the current legislative arrangement are constricted based on the long list of changes in the work plan. The support for the ACCC authorisation will continue and has been effective to date. NSW has made a submission to the ACCC to advocate for the authorisation to continue in its current form.
	Expert Panel comment	The Panel notes the above steps taken by EUSFA.

2.2 Climate and extreme weather

In 2022, NSW experienced the wettest spring on record (i.e. since 1900), with rainfall inland of the Dividing Range two to four times the spring average. This resulted in flooding in the southern Murray Darling Basin including many inland towns in NSW. Three major climate drivers likely contributed to the unusually wet conditions prior to and during spring 2022, including an active La Niña phase of the El Niño-Southern Oscillation, a negative Indian Ocean Dipole event and a persistent positive phase of the Southern Annular Mode.

Both summer and winter of 2022/23 had particularly mild conditions, with a cool and dry summer and warm winter, resulting in fewer extreme climate related instances for the energy sector.

Over summer 2022/23, NSW experienced cooler and drier-than-average conditions. The average rainfall total for summer was 108.1 mm. Mean daily minimum temperatures were cooler than average for most of the state, apart from the Far West and along the southern and central coasts. For NSW, average minimum temperature was 0.61°C below the 1961-1990 average, which was the coolest summer since 1995–96, with December being particularly cool.[19]

The NSW rainfall total for winter 2023 for NSW was 80.6mm, 28.2% below the 1961-1990 average; however, rainfall was above average for the far west of the state with several sites experiencing their highest winter daily rainfall on record during early June when a strong cold front connected to tropical moisture crossed the state.[20]

The state minimum temperature for winter 2023 was 1.15°C above average, the tenth warmest on record and the warmest since 2016. Many sites had their highest winter mean daily maximum temperature on record or for at least 20 years.[21]

2.3 NEM operational review

2.3.1 Electricity supply and demand

Operational demand across the NEM declined to its lowest Q1 (1 January to 31 March 2023) average since May 2005 (Table 2).[22] Growth in distributed photovoltaics (PV) continued, reaching a new Q1 output record. This has driven down operational demand, reflecting resumption of growth rates of high distributed PV installation after a slowdown in 2022. Operational demand in the evening has lifted slightly, particularly in Queensland and New South Wales which experienced warm February and March conditions and periods of extreme temperatures. NSW reached its lowest operational demands for any Q1 (Table 2).

[19] BOM. (2023). *New South Wales in Summer 2023*.
[20] BOM. (2023). *New South Wales in Winter 2023*.
[21] Ibid.
[22] In AEMO terminology, demand refers to electrical power requirement in MW (or GW).

Table 2. Average quarterly NEM operational demand (MW) and average NEM wholesale spot prices (per MWh) for Q1 2021 to Q2 2023, with lowest and highest averages (respectively) since 2005 for comparison. Source: AEMO (2021-23)[23]

Period	Average NEM operational demand (MW)				Average NEM wholesale spot prices (per MWh)			
	2021	2022	2023	Lowest average[24]	2021	2022	2023	Highest average
Q1	21192	21506	21181	21181 (2023)	$36	$87	$83	$130 (2019)
Q2	21805	21932	21717	21455 (2020)	$85	$264	$108	$264 (2022)
Q3	21854	22414	21270	21270 (2023)	$58	$216	$63	$216 (2022)
Q4	19876	19431		19431 (2022)	$52	$93		$93 (2022)

By Q2 2023 (1 April to 30 June 2023), growth in PV output decreased the average NEM operational demand to the second lowest Q2 average since 2005, despite the highest underlying demand for Q2 since 2016. Demand did increase outside of distributed PV generation hours, driven by cooler weather, particularly in May.

Multiple minimum demand records were set in Q2 2023, with NSW reaching an all-time record low of 4,101 megawatts (MW) at 1300 hrs on 9 April 2023, with distributed PV accounting for 43% of the region's underlying demand across the half-hour. Maximum demand declined slightly relative to Q2 2022 to 32,320 MW (-0.2%). No NEM regions reached new quarterly maximum demand records in Q2 2023 and NSW's rose by 2% relative to last Q2.

Despite Liddell's retirement in April, Q2 2023 saw a net lift in average black coal-fired availability of 373 MW. However, there was a 95 MW reduction in output to 10,121 MW, the lowest Q2 level since 2001. This reflected lower utilisation rates as both black- and brown-coal fired units reduced daytime output in response to lower daytime operational demand and displacement by lower-priced variable renewable energy (VRE) offers. The Liddell power station in the NSW Upper Hunter region was retired in April 2023 in preparation to repurpose the site into an industrial renewable energy hub. Liddell's exit from the NEM saw a loss of 1.5 gigawatts (GW) of dispatchable generation and marks the first of five coal station exits in the next 10 years, which will result in the loss of 8.3 GW of dispatchable generation.

The impact of Liddell's retirement was mitigated by nearly 2.5 GW of renewable generation. This included 1.2 GW of solar and 0.6 GW each of wind and batteries. Increased renewable capacity saw generation from solar and wind increased in Q1 and Q2 2023 compared to 2022. This was largely driven by newly connected or commissioning units. Instantaneous penetration of renewable energy peaked at 65.8% this quarter, a Q1 record and 4.4 percentage points higher than the previous record for any Q1.

In Q3, a new all-time record low minimum demand in the NEM of 11,393 MW was set on 17 Sep 2023 at 12:30 hrs. The average Q3 operational demand of 21,270 MW was the lowest Q3 average since 2005, when Tasmania joined the NEM.

Wholesale spot prices across the NEM averaged $83/megawatt hour (MWh) in Q1 and $108/MWh in Q2 2023, the second highest Q2 average price on record.[25] Within Q2, prices increased to average

[23] AEMO. (2021-23). *Quarterly Energy Dynamics (QED)*.
[24] Since Tasmania joined the NEM in 2005.
[25] The highest Q2 average was Q2 2022 at $264/MWh.

$154/MWh in May before falling to half that in June. Prices then decreased 41% to $63/MWh in Q3 2023, which was a 71% decline compared to Q3 2022.

Lower thermal coal prices and fewer fuel supply restrictions were seen this quarter than in Q2 2022, largely impacted by generator bidding behaviour. Black coal-fired generation availability increased this quarter, driven by lower planned and unplanned outages in NSW, despite retirement of the remaining Liddell units in April (see below). As a result, coal-fired generators offered more volume at lower price bands.

2.3.2 Gas supply and demand

Driven by lower usage for gas-fired generation and lower AEMO market demand, gas demand decreased by 5% during Q2 2023 compared to Q2 2022.[26] East coast wholesale gas prices significantly declined from record levels 12 months ago, averaging $14.21 per gigajoule (GJ) for this quarter. A shift in domestic gas supply, driven by declining production from gas fields is underway, with aggregate Longford production decreasing by nearly 25 petajoule (PJ) compared to Q2 2022 and daily production levels also decreasing. Wholesale gas prices continued to fall in Q3 2023 to an average of $10.41 per GJ.[27]

NSW does not currently have any of its own gas production and is a net importer from South Australia via the Moomba-Sydney Pipeline and Victoria via the Eastern Gas Pipeline. The eastern states gas market is undergoing a significant structural change in recent years with the potential introduction of liquefied natural gas (LNG) production and overseas import capability and the development of unconventional gas sources.[28] However, despite increasing production commitments, gas supply continues to decline faster than projected demand (discussed further in Section 3.2). Projected new supply from the Port Kembla Energy Terminal remains dependent on the uncertain commencement of the Floating Storage and Regasification Unit (FSRU), which is now expected to commence in 2026.[29] Accordingly, NSW is likely to remain a net importer of gas from South Australia and Victoria for the next few years.

2.3.3 Energy market incidents

Compared to previous financial years, NSW experienced a lower overall energy demand in 2023/24, due to a cooler summer and milder winter. However, despite a lower overall demand, there was an increase in Lack of Reserve events (LORs) in 2022/23 (97 actual and forecasted events) compared to the previous financial year (93 actual and/or forecasted events in 2021/22, excluding those that occurred during the market suspension in June 2022).[30] Both the Expert Panel and stakeholders interpret this ongoing rise in LORs each year as an indication of growing complexity within the system, driven by the increasing penetration of VRE in the NEM. The Panel notes that the June 2022 market suspension also highlights an ongoing risk that a similar confluence of events could occur within the NEM.

During the 2022/23 financial year, there were a total of 69 LOR1 declarations in NSW (shown in Figure 1): 31 were forecast LOR1s that were cancelled (due to market response), whilst 34 progressed to an actual LOR1, with four progressing to actual LOR1 without a prior forecast.[31] There were a total of 28 LOR2 declarations: of these, two forecasted LOR2s progressed to actual LOR2s,

[26] Q2 2023 covers 1 April to 30 June 2023: AEMO. (2023). *Quarterly Energy Dynamics Q2 2023*.
[27] AEMO. (2023). *Quarterly Energy Dynamics Q3 2023*.
[28] Northmore Gordon. (2021). *NSW Gas Demand Analysis*. Report for Climate Council of Australia.
[29] AEMO. (2023). *2023 Gas Statement of Opportunities*.
[30] The June 2022 event involved the market suspension by AEMO in order to ensure energy security and resulted in a total of 170 events in the 2021/22 financial year. However, as this was an outlier event, it was not considered in the discussion of overall trends in LORs.
[31] AEMO. (2021 - 2023). *NEM Lack of Reserve Framework Quarterly Reports*.

and one actual LOR2 was declared without prior forecast. No LOR3s, forecasted or actual, were recorded for 2022/23.

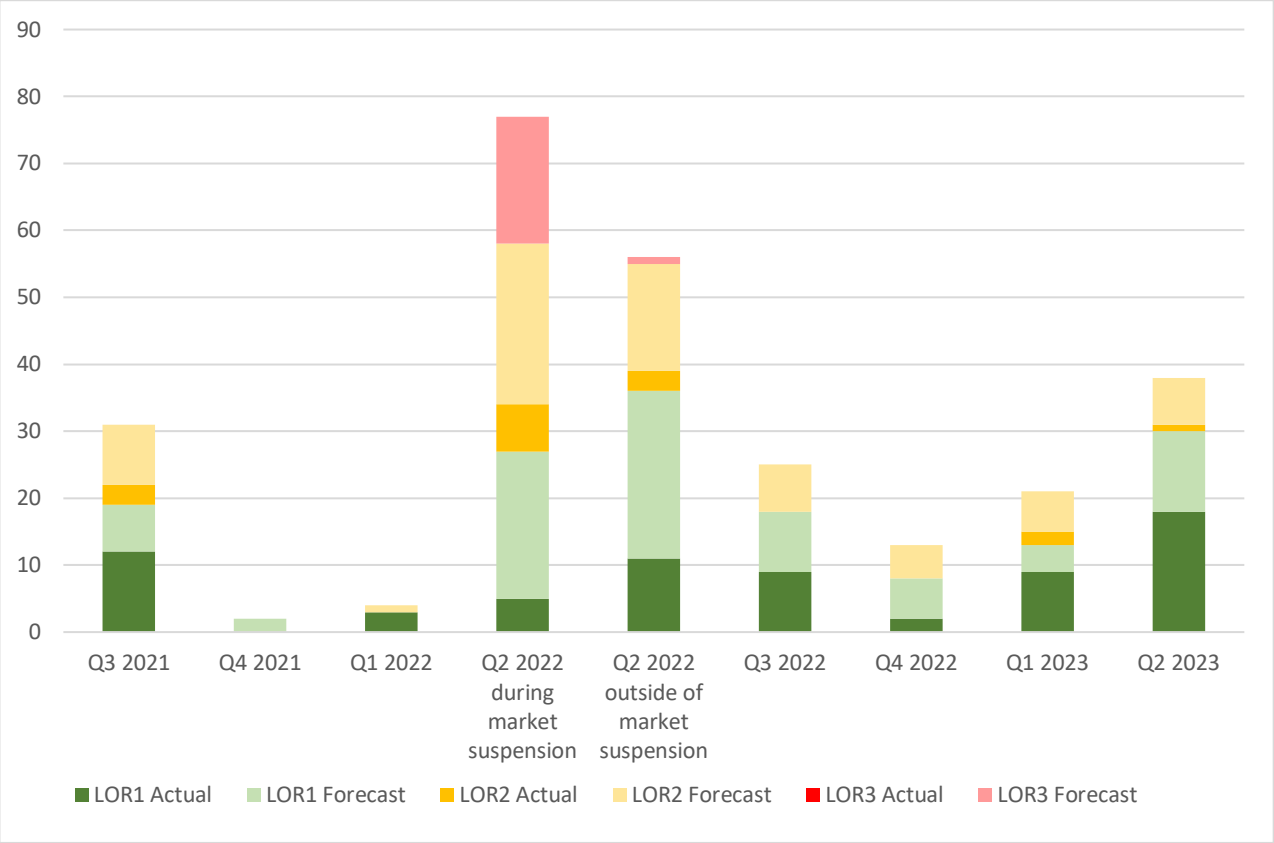

Figure 1. Quarterly comparison of actual and forecasted LOR conditions in NSW, Q3 2021 to Q2 2023. Data source: AEMO (2021-2023)[32]

Specifically for the summer period (Q4 2022 and Q1 2023) there were 34 LORs: 21 LOR1 (11 forecasted, 10 actual) and 13 LOR2 (11 forecasted, 2 actual). This represents a significant increase on the previous summer 2021/22 for NSW (6 LORs: 3 LOR1 forecasted, 2 actual, and 1 LOR2 forecasted, no actual), again following the trend of increasing complexity in the NEM having slimmer margins for LOR conditions. There were no LOR1s that had to be upgraded to LOR2s.

While LORs increased overall in 2022/23, there were also significant increases in forecast LOR1s which did not result in an actual LOR. This indicates that current procedures are sufficient to manage these situations, with forecast LORs adequately serving as a market signal for additional generation, demand reduction and/or other mitigation measures. However, the Panel notes that the market response will be an increasing challenge in the transition to renewables as large amounts of dispatchable capacity (i.e. thermal generation) retire.

AEMO activated the Reliability and Emergency Reserve Trader (RERT) scheme twice in the NEM during the 2022/23 financial year, with both activations in Queensland:

- 5th July 2022 (Queensland) – activated in response to forecast LOR2 condition and forecast 63 MW of short notice reserve

[32] AEMO. (2021 - 2023). *NEM Lack of Reserve Framework Quarterly Reports*.

- 3rd February 2023 (Queensland) – activated in response to forecast LOR2 condition and forecast 115 MW of short notice reserve.

Additionally, AEMO entered into contracts with generators in NSW for the RERT scheme on 16th March 2023 in response to 140 MW of short-notice reserve and forecast LOR2 conditions: despite an actual LOR2 being declared, no reserve was required to be activated.[33]

The number of RERT activations has decreased from the previous two years. It was activated five times in 2021/22 (including three in NSW) and twice in 2020/21 (one of which was in NSW). Historically RERT activations were limited to summer, however 2022/23 continued the trend where the need to activate RERT can occur any time of year.

Market bodies did not express concern about the increase in LOR conditions over the 2022/23 financial year. The increase in LORs is consistent with expectations as the energy market transitions, and the Panel notes it is more important to assess the market and grid behaviour in response to the declaration of LORs.

[33] AEMO. (2023). *Reliability and Emergency Reserve Trader (RERT) End of Financial Year 2022-23 Report*.

3 Assessment of forecasted risk and preparedness of the NEM for 2023/24

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 2023/24.

Recommendation 1: The NSW Government should note that the NSW energy market is entering a period of increased risk to coincident or compounding events in 2023/24. Agencies with responsibilities in this sector (including OECC and EUSFA) should continue to actively monitor and prepare for unexpected weather and/or energy events.

While the outlook for 2023/24 and through 2024/25 is generally satisfactory,[34] reliability, security and resilience will come under pressure if there are shortages in fuel supplies (gas and coal) to power stations, prolonged high temperatures, and/or coincident failures of large generators and major transmission elements, particularly interconnectors. Major weather events (bushfires, severe storms and localised floods), depending on when these occur, could quickly result in shortages in energy supply.

The situation could be exacerbated if these events were to occur coincidently in NSW and neighbouring jurisdictions, thereby reducing supply available to NSW via the interconnector(s).

The outlook for 2025/26 and beyond will be of concern, with forecast reliability gaps arising due to the planned retirement of Eraring Power Station, delays to commissioning of renewable generators and major transmission builds, and the potential for higher forced outage rates of the ageing coal fleet. Further, the dependence of NSW generators on gas from other jurisdictions, in the absence of deep storage, could have implications beyond winter 2024 and longer term if they are required to operate for longer durations. Gas supply to the NSW gas-fired power stations mainly comes via the East Coast Gas Pipeline from Longford in Victoria. The operation of these stations would be compromised if the pipeline was interrupted and/or as gas supplies from Longford are curtailed.

3.1 Climate and bushfire outlook

The forecast conditions into summer will bring hotter maximum and minimum temperatures across all of the NEM states, with heatwaves and corresponding bushfire risks of high concern until at least autumn 2024. Extreme heat can affect both energy infrastructure and peak demand. Higher minimum (night-time) temperatures could skew the demand period as consumers use air conditioners past typical peak times when renewables (solar) have shut down.

While less predictable in the forecasts, if the effects of hotter temperatures occur with other extreme weather events, like severe thunderstorms and localised flash flooding or an East Coast Low (ECL), the energy system could be strained further. As extreme weather events are occurring more frequently, the chance that they will occur concurrently naturally becomes higher. This was seen in September 2023, the driest month on record across Australia, where the south coast of NSW and eastern Victoria had severe bushfires. The fire threat in eastern Victoria quickly turned to flash flood warnings with heavy rainfall and damaging winds hitting the same areas.[35]

[34] Reliability is expected to be within the Interim Reliability Standard: AEMO. (2023). *2023 Electricity Statement of Opportunities*.
[35] SBS News. (2023). *NSW homes and holidaymakers under fire threat as Victoria faces flooding risk.*

3.1.1 Climate drivers

Two key climate drivers, the El Niño Southern Oscillation (ENSO) and the Indian Ocean Dipole (IOD) are in phases that point to a hotter and potentially drier 2023/24 spring and summer for NSW. The BOM declared an El Niño event and a positive IOD in September 2023. El Niño is likely to peak in mid-summer[36] and persist through autumn with a 75-85% chance it will become a strong event.[37] Models are predicting the positive IOD to continue until at least December and be in neutral phase in late summer.

Over spring, the combined impact of El Niño and positive IOD increases the chance for below average rainfall and higher temperatures across NSW.[38] The higher maximum and minimum temperatures are expected to persist until at least autumn 2024.

The Southern Annular Mode (SAM) index was neutral for much of October. The timeframe between positive and negative events can be quite random, each phase lasting for a week to several months. A negative SAM, which occurs more frequently with El Niño, typically brings less summer rainfall and greater chance of spring heatwaves to NSW.[39] Table 3 highlights the difference between the climate driver phases and their effects for this year compared with last year. Australia's climate has also warmed by ~1.47ºC +/- 0.24ºC since 1910, leading to more frequent extreme heat events.[40]

Table 3: Observed or expected climate driver impacts: 2022/23 and 2023/24

Climate driver	2022/23 phases	Observed general impacts	2023/24 phases	Expected general impacts
ENSO	La Niña (to March 23) Neutral	Spring 22: wettest on record; extreme flooding Summer 22/23: mild/cool/dry Winter 23: mild/warm/dry[41]	El Niño (strong) (Sept 23 through Autumn 24)	Spring 23: warmer/drier Summer 23/24: hotter/drier for parts of NSW[42] Winter 24: not yet forecast
IOD	Negative (to Dec 22) Neutral		Positive (Sept 23 to Jan 24)	
SAM	Positive (to Feb 23) Varied		Potential negative persistence	

ECLs can also bring extreme weather to coastal NSW. They are intense low-pressure systems that have the potential to cause high seas, destructive winds and torrential rains along the coast of NSW, southern Queensland and eastern Victoria. There is no evidenced trend about how often they form but every few years usually sees a severe impact storm. Winter usually sees the most ECLs, but winter 2023 was mild with no major systems. An isolated ECL is not factored into the long-range forecasts due to difficulties predicting them in the longer term.

[36] BOM, per comms, 20 Oct 2023.
[37] Global Climate Dashboard. (2023). *2023-24 U.S. winter outlook: wetter South, warmer North.*
[38] BOM. (2023). *The Bureau declares El Nino and positive Indian Ocean Dipole events, 19 September 2023*.
[39] BOM. (2023). *Southern Annular Mode and the Australian climate*.
[40] BOM. (2022). *State of the Climate 2022.*
[41] An exception being Far West NSW, experiencing above average rainfall.
[42] While November is forecast to have below median rainfall for most of NSW, the chance of below median rainfall for NSW for Dec 22 – Feb 23 is more variable (see Figure 3).

3.1.2 BOM long range climate forecasts

The BOM 2023/24 national severe weather outlook summary is in Figure 2. Most hazards, including heat, drought and bushfires are above average likelihood across Australia. While widespread flooding, coastal flooding and tropical cyclone risks are below average, there can be significant variability and/or specific events like an ECL.

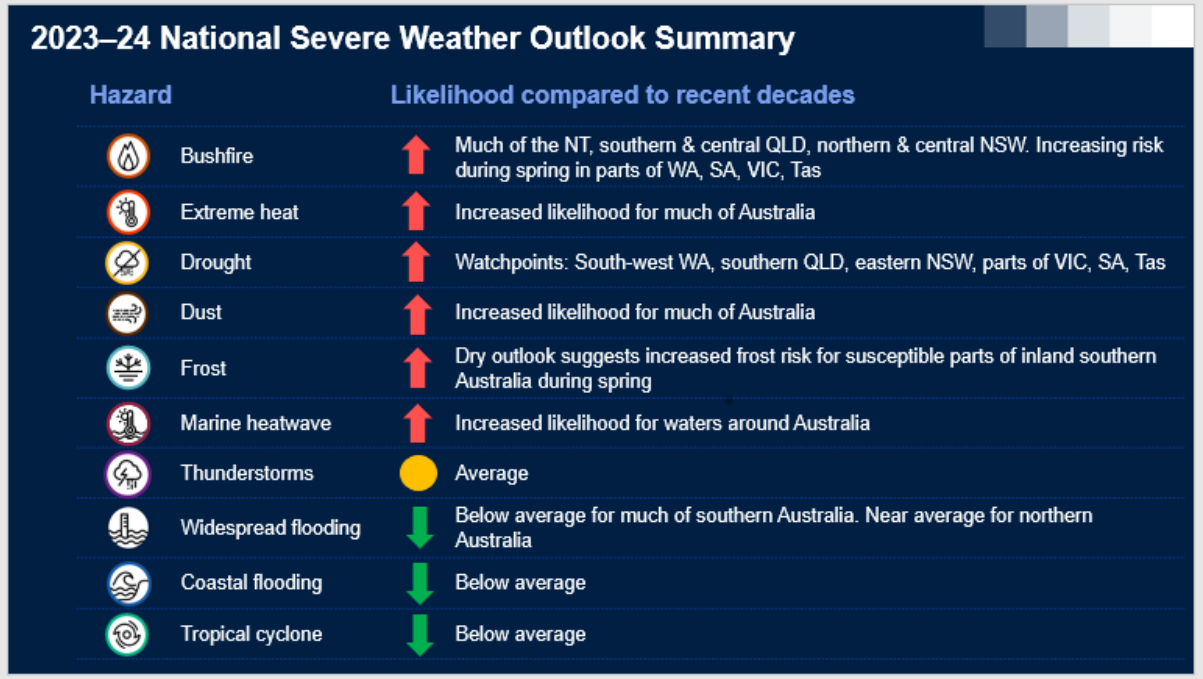

Figure 2: BOM 2023/24 national severe weather outlook summary[43]

The summer climate outlooks for exceeding the medium maximum temperatures and median rainfall for NSW released by BOM are shown in Figure 3 and Figure 4.

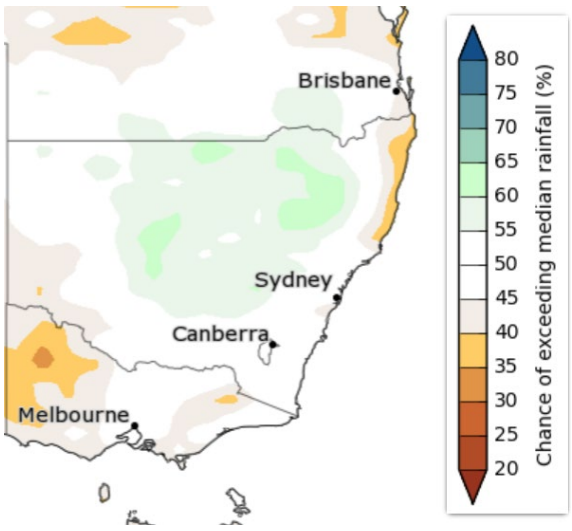

Figure 3: Likelihood of exceeding median rainfall across NSW (Dec 2023-Feb 2024)

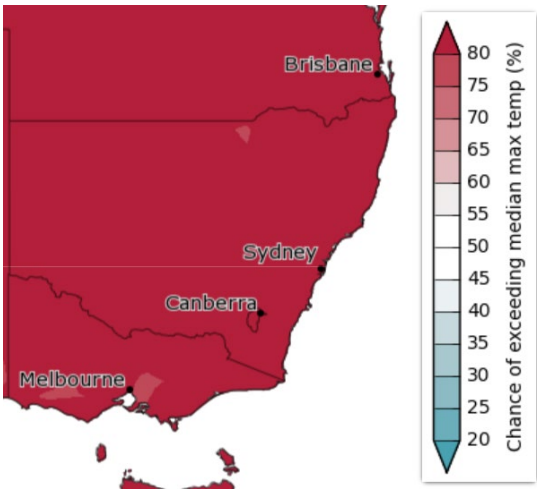

Figure 4: Likelihood of exceeding median maximum temperature across NSW (Dec 2023-Feb 2024)

Source: BOM (2023): **Climate outlooks – weeks, months and seasons (accessed on 5 October 2023)**

[43] BOM. (2023). *Weekly climate hazards – recent conditions and long-range forecasts.* Presentation to OCSE.

The forecast warming effects over summer from the El Niño and positive IOD extend to the rest of Australia. For November to January, minimum temperatures are forecast to be above median for all of Australia. Maximum temperatures are around twice as likely than normal to be unusually warm for most of Australia.[44] El Niño tends to bring shorter duration heatwaves, but their intensity and frequency may be extreme.

November is predicted to be dry, but summer (Dec to Feb) forecasts are more varied. There is a 60-80% chance in November for below median rainfall for all the NEM states – South Australia, Victoria, Tasmania, central and western NSW and most of Queensland. Rainfall outlooks for NEM states over summer are more variable, with most of eastern Queensland, south-eastern Victoria and much of Tasmania predicted to be drier than usual.[45]

The thunderstorm risk across NSW is average for 2023/24, which could bring localised flooding or a spark risk for bushfires in dry areas.

Spring conditions in NSW have been characterised by extremes, with several October days bringing snow flurries to the mainland Alps and polar winds followed by unseasonal hot, dry days. This has created instances of bushfires coinciding with local flooding in parts of NSW. The extreme variations being experienced during spring are due to opposing air masses (hot from North and cold from South) making their way over the state, causing variable weather and strengthening the jet stream which rapidly moves the weather patterns.[46]

3.1.3 Bushfire risk

On bushfire risk, above average rainfall for the past three years during La Niña conditions in NSW led to an increase in grass and vegetation growth and fuel loads.

Early spring conditions are contributing to increased fire risks. September brought below or far below average rainfall for almost all of NSW and some of the warmest September days on record[47] leading to several days of high fire danger.

Areas at increased risk of grass and bushfire during Spring are in red in Figure 5. High grass loads in the central and north-western parts of NSW can lead to fast spreading fires in dry, windy conditions. High forest fuel loads are present in some areas not affected by the 2019-20 bushfires. Soil moisture and low rates of curing have led to some areas of the state, particularly the southwest, experiencing a normal spring bushfire outlook.[48]

Figure 5: Spring 2023 bushfire outlook for NSW; Red = increased fire risk (Source: AFAC Spring 2023 Seasonal Bushfire Outlook)

[44] BOM. (2023). *Climate outlook for November to February*.
[45] BOM. (2023). *The Bureau declares El Nino and positive Indian Ocean Dipole events*.
[46] ABC News. (2023). *Fire and ice — why is Australia's spring weather so changeable?*
[47] BOM. (2023). *The Bureau declares El Nino and positive Indian Ocean Dipole events*.
[48] National Council for Fire and Emergency Services. (2023). *Seasonal Bushfire Outlook Spring 2023*.

Although the area-based summer outlook from the National Council for fire and emergency services (AFAC) won't be released until late November, the forecast heat and potential drying trends from El Niño into summer may continue to bring a higher-than-average risk of grass and bushfires across much of NSW. Root zone soil moisture was below or well below average in September for most of NSW compared with 1980-2022 levels.

The forecast climate and bushfire conditions may bring a level of unpredictability for energy infrastructure, supply and demand. NSW energy businesses and infrastructure may be impacted by fires or extreme weather events during summer and the shoulder seasons of 2023/24. The forecasted higher temperatures across the state over summer will likely lead to high energy demand during peak periods, which could strain supply. Energy demand may also be higher during hotter night-time periods after solar systems are off. This will be particularly pronounced if extended or widespread heatwaves occur.

3.2 Review of key ESOO and GSOO assumptions

The 2023 NEM Electricity Statement of Opportunities (ESOO) was released in August.[49] The Expert Panel reviewed the ESOO as part of the Assessment and made the following observations for consideration:

- The risk of expected unserved energy (USE)[50] in NSW is forecast to be below the Interim Reliability Measure (IRM)[51] of 0.0006% for 2023-24 and 2024-25 in the ESOO Central scenario (Figure 6). However, AEMO forecasts a risk of expected USE above the IRM in South Australia and Victoria for 2023-24. Relative to the 2022 ESOO, the risk of USE in NSW has increased due to higher forecasts of max demand (discussed further in Section 3.2.1), reduced contribution of the NSW Peak Demand Reduction Scheme, higher unplanned outage rates, reduced consumer energy resources (CER) orchestration and modelled derating of short duration storages.
    - The NSW Peak Demand Reduction Scheme provides a financial incentive to households and businesses to reduce electricity consumption during hours of high peak demand in summer.[52]
    - AEMO derated short duration (< 7.5 hour) storage capacities by 10-50%, as the 2022 ESOO "*likely over-optimised the availability for shallow storage devices to operate with perfect foresight at the precise time of peak demand*".

[49] AEMO. (2023). *2023 Electricity Statement of Opportunities.*
[50] Unserved energy (USE) is energy that cannot be supplied to consumers when demand exceeds supply, resulting in involuntary load shedding (loss of customer supply) in the absence of market interventions. Expected USE is the calculated weighted-average USE forecast over a wide range of simulated outcomes.
[51] The Interim Reliability Measure (IRM) is a measure of expected USE no more than 0.0006% of energy demanded in any financial year. Under reliability forecasts consistent with the IRM, consumers should expect larger USE events (on average 10% of average regional demand for five hours) at a frequency of one event every 10 years.
[52] NSW Climate and Energy Action website. (2023). *Peak Demand Reduction Scheme.*

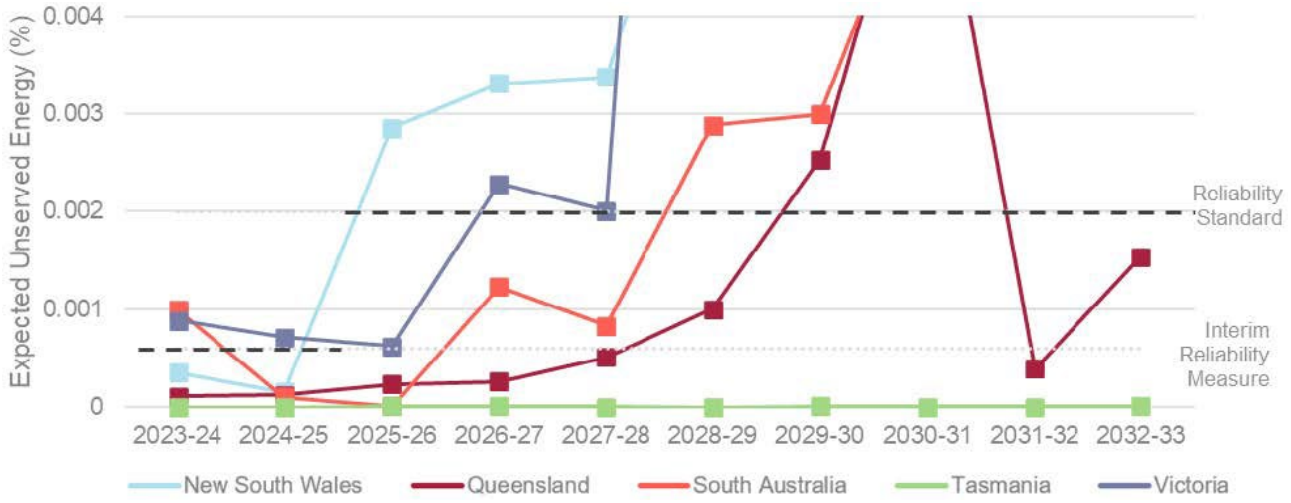

Figure 6: Expected unserved energy (%), ESOO Central scenario, 2023-24 to 2032-33. Source: ESOO 2023[53]

- The Panel notes that major system interruptions tend to be localised and quite extensive within a short period of time. This is not always accurately expressed within the current reliability indices.
- AEMO notes that there is an elevated risk of involuntary load shedding if a combination of generator outages, weather events including low wind availability, limited fuel and water supply and high maximum demand were to occur simultaneously.
    - Projected El Niño weather patterns in the coming summer (see Section 3.1) increase the chance of demand occurring at the upper range of the maximum demand forecast. However, the impact of the heightened risk of bushfires during El Niño events (including disruption to power infrastructure) was excluded from the ESOO's reliability analysis.
    - Based on the above assessment and the fact that NSW has experienced high demands in 'milder' climate scenarios over the last year, the Panel notes that the portrayed scenarios may be conservative and that there is an increased risk to supply if the coming summer is hotter and/or there is increased bushfire activity compared to risks portrayed in the ESOO scenarios. The Panel also reiterates their previous concerns that coincident and/or multijurisdictional events continue to be one of the primary risks to the security and resilience of the energy sector, particularly given the El Niño forecasts for 2023/24.
- AEMO's Energy Adequacy Assessment Projection (EAAP) forecasts expected USE within the reliability standard for the Central and Low Rainfall scenarios for all regions for summer 2023/24. However, the Low Thermal Fuel scenario demonstrates significant reliability risks above the IRM in NSW, if severe fuel shortfall events arise. This scenario models coincident thermal fuel shortages or supply chain interruptions across all NEM thermal generators simultaneously, based on participant-provided energy limits for a one-in-10-year fuel unavailability scenario. As such, AEMO notes it "*does not reflect an expected outlook*" for 2023-24 but highlights the importance of maintaining the availability of thermal fuels for energy production.
    - The Panel notes that stakeholders indicated sufficient fuel supply and stockpiles for the coming summer (discussed further in Section 3.4).

[53] AEMO. (2023). *2023 Electricity Statement of Opportunities.*

Given the increasing importance of electricity from gas generation and the identified Low Thermal Fuel reliability risks in the ESOO, the Panel also reviewed the 2023 Gas Statement of Opportunities (GSOO), released in March 2023,[54] and made the following observations from this report and discussions with stakeholders:

- Under the Orchestrated Step Change GSOO scenario,[55] AEMO forecasts shortfalls on days of peak gas demand (peak day shortfalls) from 2023 in southern regions if high demand for electricity from gas generation coincides with high residential, commercial and industrial demand, further exacerbated if overlayed with extreme weather conditions.
    - AEMO notes that deep and shallow storages remain 'critical' to meeting peak day demand, as well as adequate supply from Queensland (and in particular uncontracted supply from LNG exporters being made available on peak demand days).
    - Peak day shortfall risks could be avoided through moderation of electricity demand (including through RERT or curtailment) or through the use of diesel and other alternate fuels in dual-fuel generators.
    - In the longer term, forecasted supply is declining faster than demand, such that AEMO forecasts annual domestic supply gaps from 2027.
- AEMO projects that winter demands for electricity from gas generation will grow over the next decade. Due to the lower levels of sunshine in winter and during periods of low wind, firming support from gas generation will become increasingly important, especially following the retirement of coal generation. This may place further stress on gas supplies and infrastructure as electricity from gas generation increasingly competes with other gas demands.
    - AEMO notes that, should winter demand and weather conditions coincide to extreme levels, significant filling of storages such as Iona over summer periods is 'critical' to mitigating the risk of winter shortfalls.
    - The Panel notes that, should electricity from gas generation be required to satisfy peaks in the summer (especially once renewables have exited during solar dusk to evening), this may prevent adequate filling of storages during summer, exacerbating the risk of winter shortfalls.
- To minimise 2023/24 shortfall risks in NSW, AEMO indicates that committed infrastructure and supply projects must be completed on time. These include the Stage 1 and 2 upgrades of the Southwest Queensland Pipeline and the Moomba-Sydney Pipeline and maintaining the availability of shallow storages at Dandenong and Newcastle. However, AEMO notes that demand flexibility is likely to be the best solution for these forecast short-term supply shortfall risks.[56]
- Regarding longer term gas supply adequacy, AEMO notes several uncertainties that are impacting project timelines and their likelihood of completion. These include the Russia-Ukraine conflict, ongoing impacts from COVID-19, stringent regulatory approvals, market uncertainty around the federal price cap and mandatory code of conduct (the impact of which was not included in AEMO's modelling for the GSOO), and inflation and financing concerns:
    - Higher inflation has increased borrowing costs, with some project costs not keeping pace with long-term gas price projections.
    - Financing for natural gas projects may be increasingly 'unpalatable' due to environment, social and governance (ESG) policies limiting investor exposure to fossil fuels.

[54] AEMO. (2023). *2023 Gas Statement of Opportunities.*
[55] The Orchestrated Step Change scenario is the most likely scenario and is similar to the Step Change scenario identified in AEMO's 2022 Integrated System Plan and 2023 ESOO (as the Central scenario).
[56] AEMO. (2023). *2023 Gas Statement of Opportunities.*

  - Competing investment interests for renewable gases, such as clean hydrogen projects in the US and the EU, may lead to Australia being a less appealing investment option for renewable gas projects.
- AEMO notes the proposed Port Kembla Energy Terminal is no longer considered to be an anticipated project due to insufficient contracted capacity or demand needed to commit to the Floating Storage and Regasification Unit (FSRU). As a result, supply gaps are forecast six years earlier (relative to the 2022 GSOO).
- AEMO modelled a number of sensitivities impacting gas reliance. The 'Disorderly Coal Exit' scenario, modelled as the 'worst case' level of gas reliance to maintain reliability, observed triple the gas consumption in the year following Eraring's potential closure in 2025. The 'Dry Year' scenario, modelling extended drought conditions affecting rainfall inflow to large hydro schemes as observed in the 'millennium drought' of 2006-07, forecasts increased gas generation of 30-50%.

3.2.1 Supply and demand forecasts

Similar to previous years, the 2023 ESOO notes that increasing variability in daily operational consumption patterns in the NEM is likely to make the system increasingly challenging to operate. Maximum operational demand is forecast to grow in all NEM regions over the next 10 years (Figure 7), largely driven by strong business and residential electrification and strong EV uptake. While there has been continued strong uptake of CER (such as distributed PV), these generally have a much lower impact on maximum demand, as they instead tend to offset operational demand in the early to mid-afternoon. This causes maximum demand to generally fall in the early evening when there is little to no generation from PV. It is also important to note that as all jurisdictions expect increased demand, the additional supply provided by interconnection is contingent on each jurisdiction having surplus.

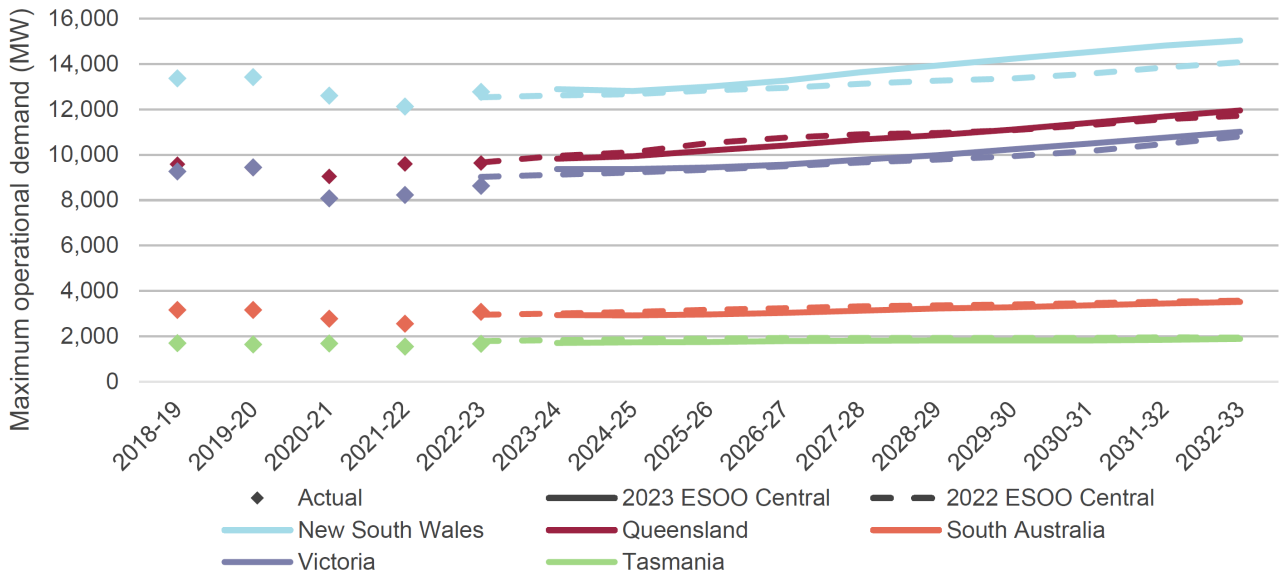

Figure 7. Actual and forecast regional annual 50% POE maximum operational demand, 2023 ESOO Central and 2022 ESOO Central scenario, 2018-19 to 2032-33 (MW). Source: ESOO 2023[57]

In NSW, higher prices contribute to a relatively flat demand outlook in the next four years, followed by strong growth in the overall 10-year outlook period (Figure 7) primarily due to the Business Mass

[57] AEMO. (2023). *2023 Electricity Statement of Opportunities*.

Market (BMM) sector[58] as well as the commencement of the NSW legislated Renewable Fuels Scheme policy in 2024. Stakeholders indicated that the expected hotter and drier conditions this summer could elevate demand in NSW, which may pose challenges should this higher demand coincide with low VRE availability and/or low scheduled generation and network outages.

Minimum demand is forecast to rapidly decline over the next four years in all mainland NEM regions (including NSW) primarily due to the continued uptake of distributed PV outpacing the growth in underlying demand. Notably, the ESOO Central scenario forecasts minimum operational demand in NSW to be most likely during the shoulder season throughout the 10-year horizon, reinforcing the shift from the need for summer preparedness to a year-round focus. The level of minimum operational demand in the NEM recently hit a record low of 11,009 MW on Sunday 29 October, 2023 (Figure 8), with renewables supplying 67% of total NEM demand at 1:30pm.[59] NSW also set a record low level of operational demand of 3,719 MW.

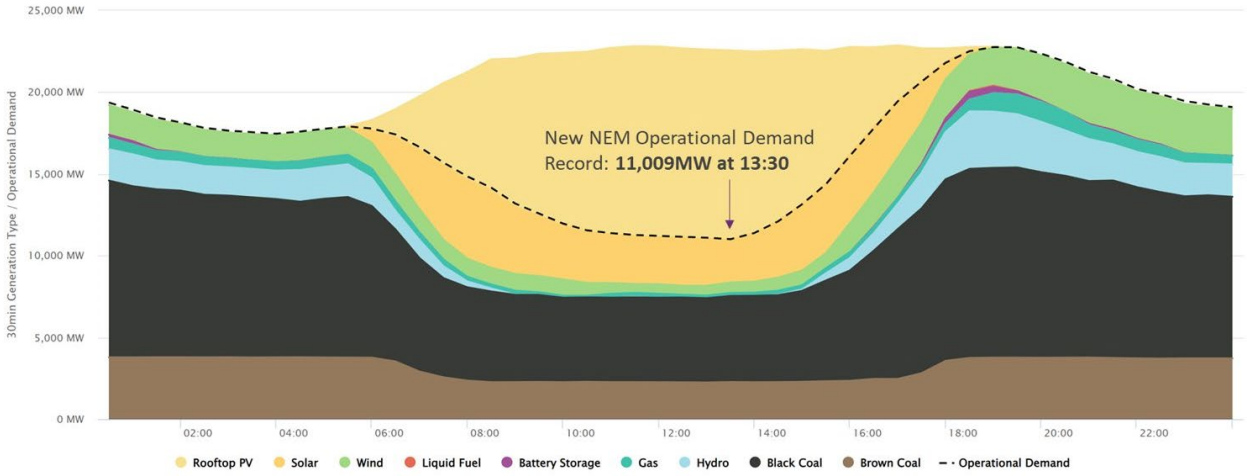

Figure 8. NEM Operational Demand and Generation Mix on Sunday 29 October 2023. Source: AEMO, 30/10/23.

The more extreme demand peaks and troughs across each day necessitate increasing flexibility in the NEM (resulting in negative prices, discussed further in Section 3.4.3) which are placing greater ramping requirements for generators, including on coal-powered stations primarily designed to operate as baseload generators. This results in significant additional thermal strain on these generators which could potentially lead to an increase in outages and/or catastrophic failures, discussed further in Section 3.3.

This is graphically represented in the 'Duck Curve' of electricity demand from the grid on days when solar energy production is high and demand in the grid is low (Figure 9). The Duck Curve highlights the potential for power system instability as the grid attempts to cope with extreme changes in demand across different parts of the day, with particular reference to the impact of the intermittent renewable generation. As shown in Figure 9, more solar energy is exported to the grid during daylight hours, ramping up to the majority of generation that fulfils demand in the middle of the day. Stakeholders have commented that this 'belly' of the Duck Curve has effectively become a 'renewable trench' and has placed different requirements on the network once the evening peak arrives (after solar has started to drop off, i.e. dusk).

[58] The Business Mass Market sector includes all industrial and commercial users, apart from large industrial loads and loads associated with the production of hydrogen.
[59] Giles Parkinson. (29 Oct 2023). *Rooftop PV takes a bite out of everyone's lunch as minimum demand records tumble again*. Article for Renew Economy; @AEMO_Energy, Twitter/X post on Oct 30 2023.

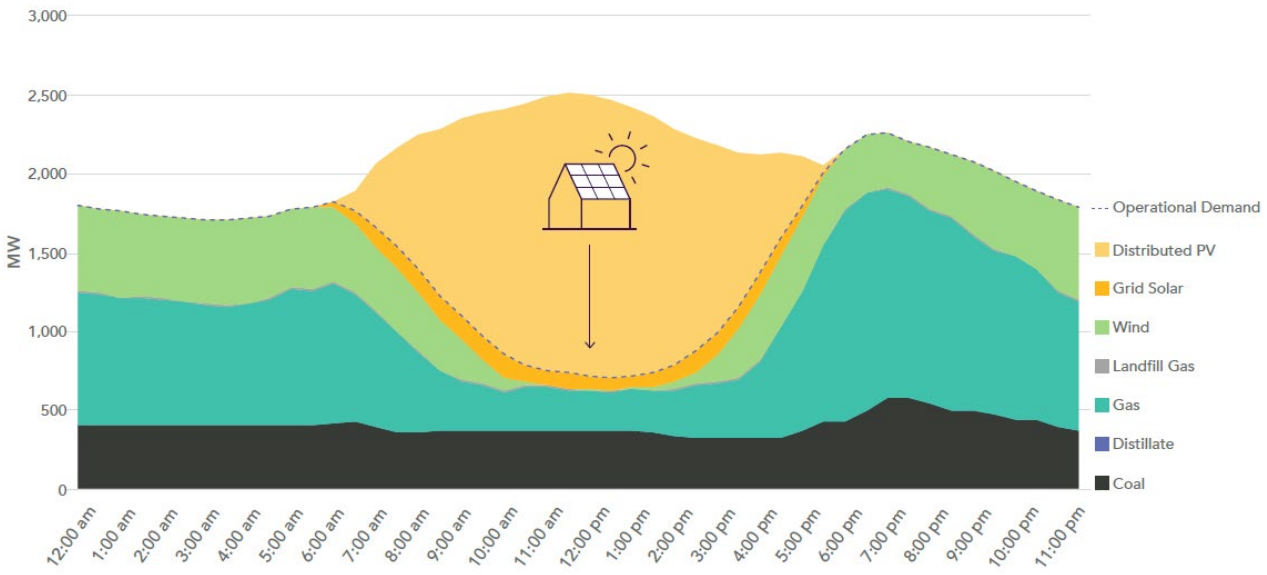

Figure 9. Graph representing minimum operational demand as consumers generate more of their own electricity through solar, it drives down demand for grid-scale generation. Source: AEMO Minimum operational demand factsheet

Stakeholders also noted that an increasing reliance on interconnectors during periods of high demand could also increase reliability risks, especially if the high demand coincides with extreme weather events potentially leading to equipment deratings. Network testing of the QLD-NSW Interconnector (QNI) Minor Upgrade is currently underway, with AEMO assuming an increase in capacity of approximately 150 MW (in the northerly direction) during summer 2023/24, and a total of 250 MW (in the southerly direction) by June 2024.[60] However, as above there are still residual concerns if multiple jurisdictions are subject to the same (i.e. east coast heatwave) or different simultaneous events that would reduce the ability to rely on interconnectors for additional supply.

While the ESOO forecasts the NSW supply scarcity risk for 2023-24 to be within the IRM, the EAAP Central and Low Thermal Fuel scenarios indicate significant reliability risks in NSW above the IRM and reliability standard respectively if there is limited fuel availability for thermal generators. While stakeholders this year were generally satisfied with their stockpiles and supply of coal and gas, maintaining the availability of thermal fuels will be increasingly essential for the reliability of the NEM in future years. Some stakeholders were concerned over NSW's lack of bulk storage for LNG, highlighting our reliance on other states for gas supply. Any constraints to gas in other jurisdictions could therefore potentially lead to curtailments in NSW. Additionally, some stakeholders indicated that high gas usage during the summer period, if required to satisfy higher demand, could potentially lead to gas shortfalls in the winter.

With the expected constraints to new generation and transmission capacity (see Section 3.3), several stakeholders indicated a potential greater role for distribution network-level load control mechanisms going forward to manage demand, such as distributed energy resource management systems (DERMS), the use of load control circuits for residential hot water and EV charging, as well as load reduction via voltage management in distribution networks. The Expert Panel notes that the NSW Government should support any efforts in this space to ensure increased local energy resilience.

[60] AEMO. (2023). *2023 Electricity Statement of Opportunities (ESOO)*; Note that Transgrid expects inter-network testing to be completed with availability of the full increased capacity "by summer 2023-24": Transgrid. (2023). *Transmission Annual Planning Report 2023*.

3.3 Generation and transmission infrastructure status

3.3.1 Generation

AEMO indicates that coal generation reliability continued to demonstrate "historically poor performance last year, consistent with recent historical trends,"[61] and notes that, while planned maintenance, coal quality expectations and other generator investments are expected to improve coal plant reliability in the medium term, generators are anticipating a longer term trend of decreasing reliability. While stakeholders indicated to the Expert Panel that their coal generators were generally in good condition and were being well-maintained, fast cyclic ramping loads place considerable thermal strain on critical equipment (such as boilers). This will likely increase risk of unplanned outages and major failures if preventative inspections and maintenance are not increased. The Panel has similar concerns regarding the gas generation fleet, which is primarily designed to operate as peaking generation but is increasingly being run more frequently and with greater intensity.

Another related issue is the question of OEM support of equipment such as coal generator turbines. Some stakeholders noted that it was becoming increasingly difficult to source OEM maintenance and support as the manufacturers of this equipment move out of thermal generation into renewables, with many stakeholders indicating that this will reach criticality from 2027 onwards. It will likely continue to become harder to source equipment and technical support for thermal generators, especially as the waning pool of OEM support workers may focus more on providing support to their respective domestic markets.

In the coming years, several coal generators in the NEM are expected to retire (as detailed in Table 4), with the risk of USE in NSW forecast to increase above the reliability standard (0.002%) in 2025-26 following the expected retirement of the Eraring Power Station (2800 MW).[62] Consistent with concerns expressed in previous reports[63] with the retirement of thermal generation units (such as Liddell), the Panel continues to see a short-term risk to energy supply if a catastrophic failure was to occur in plant nearing retirement, where the economics would not be favourable for a return-to-market. This is of heightened concern given the tighter demand/supply balances over the coming years.

[61] AEMO. (2023). *2023 Electricity Statement of Opportunities (ESOO).*
[62] AEMO. (2023). *2023 Electricity Statement of Opportunities (ESOO).*
[63] OCSE. (2021). *Assessment of Summer Preparedness for the NSW Energy Market. 2021/22.*

Table 4. Summary of expected coal generation retirement, average unplanned outage rates, capacities and expected closure dates

Generator type	Average unplanned outage rate (%)[64]		Generator	Capacity (MW)	Last year's expected closure date	Current expected closure date
	Full	Partial				
NSW black coal	6.31	31.46	**Eraring Power Station**	2880	Aug 2025	Aug 2025, pending discussions between Origin and the NSW Government
			Vales Point Power Station	1320	2029	2033
			Bayswater Power Station	2715	Outside of ESOO horizon (>10 years)	2033
			Mt Piper Power Station	1420	Outside of ESOO horizon (>10 years)	
VIC brown coal	7.75	11.56	**Yallourn Power Station**	1450	2028	2028
			Loy Yang A	2210	Outside of ESOO horizon (>10 years)	
QLD black coal	6.75	12.86	**Callide B Power Station**	700	2028	2028

The Panel acknowledges stakeholder indications that the discussed risks are well understood and preventative works are being undertaken. Nonetheless, the Panel still considers the risk to energy supply is heightened by ageing equipment, limited capital and investment appetite for maintenance and upgrades of thermal generators, as well as the financial feasibility of repairing units close to retirement.

Approximately 650 MW of additional VRE generation is expected to be operational this summer in NSW relative to last summer. Over 2023-24, 716 MW of solar farm projects and 250 MW/500 MWh of battery storage projects are expected to become operational (Table 5). However, the Panel is concerned by actual and expected delays to new generation and transmission infrastructure projects, which would otherwise mitigate against the increased reliability risk following the retirement of thermal generation. As detailed in Table 5, the Tallawarra B Power Station (320 MW) is now expected in Jan 2024, and the Kurri Kurri Power Station (750 MW), which was previously expected to commission in Dec 2023, is now expected in 2024-25. The Snowy 2.0 pumped hydro scheme (2,040 MW / 350,000 MWh) has also been delayed by 3-4 years and is now expected in Dec 2029.

[64] AEMO. (2023). *2023 Inputs, Assumptions, and Scenarios Report.*

Table 5. Summary of the largest generation projects expected to commission in NSW in the next 10 years, with capacities and expected commissioning dates

Type	Project	Capacity (MW)	Date expected last year[65]	Date currently expected[66]
Gas	Tallawarra B Power Station	320	Oct 2023	Jan 2024[67]
	Kurri Kurri Power Station	750	Dec 2023	2024-25
Pumped hydro	Snowy 2.0	2,040 MW / 350,000 MWh	Between 2025-26 and 2026-27	Dec 2029
Solar	Various projects including Avonlie Solar Farm, New England Solar Farm and Wyalong Solar Farm	716		2023-24
Battery	Waratah Super Battery	850		Partial availability in 2024-25
	Various other projects including Capital Battery, Darlington Point Energy Storage System and Riverina Energy Storage System 1 and 2	250 MW / 500 MWh		2023-24

3.3.2 Network augmentation

Several network augmentation projects are also expected to enter service in 2023-24 (as detailed in Table 6), including the QNI Minor Upgrade and Stage 1 of Project EnergyConnect. AEMO forecasts that additional 'actionable' investments, alongside significant CER orchestration, demand side participation (DSP) uptake, and generation and storage investment facilitated through the federal Capacity Investment Scheme and NSW Electricity Infrastructure Roadmap, would significantly improve the reliability outlook in NSW to below the IRM beyond 2025-26.

[65] AEMO. (2022). *2022 Electricity Statement of Opportunities.*
[66] AEMO. (2023). *2023 Electricity Statement of Opportunities.*
[67] AEMO. (2023). *NEM Generation Information September 2023*.

Table 6: Summary of committed, anticipated and actionable transmission and network augmentation projects in NSW in the next 10 years, with expected increases in network capacity and commissioning dates

Project	Description	Expected increase in network capacity[68]	Date reported as expected[69]
Queensland-New South Wales Interconnector (QNI) Minor Upgrade (in service, with network testing progressing)	Uprating of the existing 330 kV Liddell-Tamworth lines and installation of new support equipment and capacitor banks at Tamworth, Armidale and Dumaresq substations	150 MW (QNI northerly direction)	Feb 2024
		145-245 MW (QNI southerly direction)	Jun 2024
Wagga Wagga Capacitor Bank (committed)	A new 330 kV 100 megavolt amperes reactive (MVAr) capacitor bank at Wagga Wagga	30 MW (VNI southerly direction); 75 MW (VNI northerly direction)	July 2023
Project EnergyConnect (committed)	A new interconnector between Wagga Wagga, NSW and Robertstown, SA via Buronga	Stage 1: 150 MW	Jul 2024
		Stage 2: 800 MW	Oct 25-Jul 26
Waratah Super Battery Network Augmentations and SIPS control project and transmission (committed)	Various network augmentations and transmission line upgrades	Up to 910 MW increase between central NSW and Sydney, Newcastle and Wollongong	Jul-Aug 2025
HumeLink (actionable)	500 kV transmission upgrade connecting Project EnergyConnect and the Snowy Mountains Hydroelectric Scheme to Bannaby	2,200 MW between south NSW and central NSW	2026-27
Central West Orana REZ Transmission Link (anticipated)	Various transmission lines, transformers and synchronous condensers	At least 3,000 MW of increase in network capacity in CWO REZ	Sep 2027 (commenced mid-2020)[70]
Hunter Transmission Project (actionable)	Various transmission lines and network augmentations between Eraring and Bayswater	5,000 MW between central NSW and Sydney, Newcastle and Wollongong	Dec 2027
New England REZ Transmission Link (actionable)	Transmission lines connecting new substation hubs to network between Bayswater and Tamworth-Armidale line	2,400 MW increase in New England REZ	Sep 2028
VNI West (actionable)	New 500 kV transmission line connecting Western Renewables Link with Project EnergyConnect	1,669 MW (VNI southerly direction); 1,935 (VNI northerly direction)	2029-30

[68] AEMO. (2023). *NEM Transmission Augmentation Information August 2023*.
[69] AEMO. (2023). *2023 Electricity Statement of Opportunities (ESOO).*
[70] The seven-year timeframe between commencement and completion of the Central West Orana REZ transmission link exemplifies the duration of new transmission construction projects.

The Expert Panel notes that several of the above transmission projects are needed for the commissioning of the new generation projects discussed above in Section 3.3.1. However, the construction of new transmission infrastructure in the NEM often faces significant delays due to regulatory hurdles, environmental challenges and community opposition. As one example, stakeholders noted that even if Snowy 2.0 had not been delayed by 3-4 years, it would still be reliant upon the as yet non-existent HumeLink 500 kV transmission upgrade, which has been besieged by social licence concerns.[71]

While large-scale greenfield transmission projects are undeniably valuable in the long term, the Panel contends that there are inherent risks in relying solely on these projects to address short-term reliability concerns in NSW. A combination of non-transmission resilience developments and a renewed focus on gaining social licence and consumer buy-in (discussed in Section 5) is likely to offer a more dependable solution for short-term energy security.

Although not transmission or network augmentation, the Panel notes the ongoing work undertaken by Tomago Aluminium smelter to increase their flexibility to provide demand management (such as via RERT) to the changing needs of the market.

3.4 Gas and coal market interventions

3.4.1 Gas

Wholesale energy prices in the NEM are primarily a function of energy supply and demand, as well as the underlying cost of operating the existing generation fleet. With thermal generation still forming the bulk of this fleet, wholesale prices are particularly susceptible to increases in the cost of coal and gas. For example, following the Russian invasion of Ukraine in 2022, the price of coal and gas surged due to both formal sanctions and informal avoidance of Russian exports. This led to significant increases in generator fuel costs,[72] resulting in unprecedented wholesale spot prices in the NEM discussed in last year's report.[73]

Likewise, the current Israel-Hamas war could also threaten global energy security, with spill over effects potentially disrupting gas production and causing major shipping difficulties. In the wake of these recent conflicts, European natural gas futures increased by 14%, reflecting wider uncertainty amidst fears of an intensifying conflict.[74] The increase in natural gas prices was partly attributed to Israel's closure of a large offshore production platform in missile range of Gaza, and because a pipeline in the Baltic was damaged.

In the wake of the wholesale energy price increases in 2022, the Australian Government implemented several market interventions aimed at ensuring the affordability and domestic availability of gas and coal. Following near-record high prices of gas (reaching $59.49 per GJ in Sydney on 18 July 2022),[75] the Australian Government implemented a temporary price cap of $12 per GJ, applying for 12 months from Dec 2022.[76] The aim of this cap is to reduce the cost that power stations and domestic gas users must pay.[77] The government then implemented a Mandatory Code of Conduct for the east coast gas market,[78] which extended the application of the gas price cap until 1 July 2025 and gave the ACCC the power to determine another "reasonable price" in the future.[79] Regulated gas producers and affiliates of regulated gas producers can apply for price cap exemptions aimed at incentivising supply of gas to the east coast gas market.

[71] ABC News. (2023). *Inquiry deems Transgrid's HumeLink energy transmission project will remain above ground*.
[72] AER. (2023). *State of the Energy Market 2023*.
[73] OCSE. (2022). *Assessment of preparedness of the NSW Energy Market: 2022/23*.
[74] Foreign Policy Magazine. (2023). *The Israel-Hamas War Could Upend Global Energy Security.*
[75] AEMO. (2022). *Quarterly Energy Dynamics Q3 2022*.
[76] Contained in the *Competition and Consumer (Gas Market Emergency Price) Order 2022* (Cth).
[77] Griffith University. (2023). *Explaining Australia's energy prices and government intervention.*
[78] Contained in the *Competition and Consumer (Gas Market Code) Regulations 2023* (Cth).
[79] Ibid., s 29.

Other regulatory changes include minor amendments to the Australian Domestic Gas Security Mechanism (ADGSM) aimed at improving efficiency and flexibility in the gas market,[80] as well as regulatory amendments empowering AEMO to better manage gas supply adequacy and reliability risks.[81]

Stakeholders generally did not have concerns regarding the gas market interventions in the next 12 months. Some indicated that the supply constraints experienced in mid-2022 had already resulted in changes to their modelling and gas supply management practices (such as ensuring adequate diesel backup for thermal generators), such that they already considered themselves in a more secure position even without the market interventions. Others noted that their standard business practice was to lock in long-term contracts, which sufficiently mitigated against any potentially significant fluctuations in the market. Some stakeholders viewed the next 12 months as a good opportunity for AEMO to bed down and better understand their new directional powers and related processes.

However, some stakeholders noted that the gas market interventions had effectively slowed producers bringing gas to market, as they instead worked to understand the proposed requirements and exceptions in the code prior to entering supply contracts. This increased the risk to large gas users who had not already locked in supply contracts, which could pose a challenge in winter 2024 if gas supply becomes constrained. More generally, stakeholders expressed an ongoing need for certainty regarding gas policy and market interventions and warned against "knee-jerk" reactions.

3.4.2 Coal

Stakeholders reported that there were fewer interruptions to their coal supply in the lead up to winter 2023 than was the case in 2022. Following the market suspension in June 2022, several coal generators reported a shortage of domestic coal due to flooding and subsequent interruption to rail freight with above average volumes diverted to international export.[82] These events have not occurred during 2023 and therefore it is not predicted that there will be problems with coal supply coming into 2023-24 summer. Further, coal producers in NSW have been required to prioritise coal delivery to generators with low stockpiles.[83]

However, there are ongoing concerns around coal supply to EnergyAustralia's Mount Piper coal-fired station. EnergyAustralia have indicated that it expects to be able to manage the station with existing coal stockpiles and expected demand over the summer 2023/24 period, but potentially lower output might occur if the station (like other thermal baseload generators) is forced into increased and sustained runs over summer and into winter.

During the 2019/20 Assessment, issues around the supply of coal to Station due to geological issues at Centennial Coal's Springvale Coal Mine was raised. EnergyAustralia noted then that there were ongoing issues with the quality of coal produced from the mines, in that the 'stickiness' of the coal impacts the efficacy of the coal milling process that provides pulverised fuel to the boiler furnace.

Although the situation has improved in subsequent years as additional coal (of an improved quality) was sourced, the Expert Panel notes ongoing concerns around the coal supply for Mt Piper in the short-to-medium term: issues of mine inundation for Centennial Coal's Springvale Mine were raised with the Panel and have been aired in the media.[84] The Panel also notes the ongoing dialogue between generators and the NSW Government is continuing and is critical moving into the future, as

[80] Contained in the *Customs (Prohibited Exports) (Operation of the Australian Domestic Gas Security Mechanism) Guidelines 2023* (Cth).
[81] Legislated as part of the National Gas Law in the *National Gas (South Australia) (East Coast Gas System) Amendment Act 2023* (SA), the *National Gas (South Australia) (East Coast Gas System) Amendment Regulations 2023* (SA) and the *National Gas Amendment (East Coast Gas System) Rule 2023* (SA).
[82] OCSE. (2022). *Assessment of preparedness of the NSW Energy Market: 2022/23*.
[83] AER. (2023). *State of the energy market 2023*.
[84] Packham, C. (16 October 2023). *EnergyAustralia warns coal supplies for Mount Piper power station at risk*. The Australian Business Review.

concerns on coal supply is another factor that is not always in the generators control that might lead to energy supply risks.

On 22 December 2022, the (then) NSW Premier declared a coal market price emergency whereby the (then) NSW Minister for Energy was granted power to give direction to respond to the emergency while the declaration was in place. This resulted in the price of black coal sold to generators to be capped at $125 per tonne in NSW. In addition, coal generators were required to reserve a proportion of future coal production to supply NSW coal generators and were to prioritise delivery to generators with low stockpiles. With more supply available at lower offer prices, higher priced capacity is less likely to be required and places a downward pressure on prices. Price caps of this nature are considered highly impactful when attached to black coal because black coal generation is typically the most frequent price setter in NSW. In January 2023 (the first month of the price caps implementation), several generators were seen to offer more capacity into the market at lower prices.[85]

Stakeholders generally did not have concerns regarding the coal market interventions. Some stakeholders indicated that the coal price cap was effective in ensuring domestic supply during periods of high export prices in early 2023 but was less relevant now that prices had dropped again. Stakeholders confirmed that they had successfully procured stockpiles and supply in accordance with the directions but noted that the situation post-Jun 2024 (when the coal market price emergency declaration is set to expire) remains unclear.

More generally, many stakeholders strongly expressed a need for transparency regarding future government interventions in the coal market, especially regarding the retirement of thermal generators.

3.4.3 Negative pricing

Dispatch and prices in the wholesale electricity market are determined by bidding of supply and demand (amounts of energy at prices) in five-minute blocks of time. Negative prices correspond to a period when there is excess supply of energy in the market. In the NEM this is typically in the middle of the day when renewable energy sources such as solar, wind or hydro collectively produce more than the demand and, currently, this excess cannot be stored.

Negative prices or payment in reverse directions (from generators to demand) incentivise wholesale level consumers to increase their demand. Since generators must essentially pay-to-stay online, they are also incentivised to reduce their output as far as possible. They are not seen at consumer level as retailers absorb them into their processes to smooth out peaks and lows of prices (i.e. hedging etc.).

The economic drivers are complicated when we include those outside the spot market and are also influenced by any contract positions that generators may hold for both electricity and fuel supplies.

The hedge position of a generator may determine how it bids. A contract that ensures the generator has an effective fixed price for its output may be marginally exposed to negative prices. Renewable generators that gain income for energy they produce via Large Scale Certificates may be able to operate profitably with negative prices.

Negative prices are a signal to either increase demand or reduce supply. Fast response energy sources (such as solar, wind, peaking generators) can ramp (reduce, increase) and even stop and start in relatively short spaces of time to manage negative price periods. Coal-fired generators were originally designed for steady output and have minimum operating levels (i.e. minimum generation, ‘min-gen’), to keep their combustion and thermodynamic systems ready for dispatch action. Accordingly, generators incur significant costs stopping and starting and some require many hours to restart. This means they prefer to continue generating throughout negative pricing periods as it is overall more cost-efficient. This ensures that they are available to meet the peak demands when the

[85] AER. (2023). *State of the energy market 2023*.

intermittent sources such as rooftop solar and large-scale solar are no longer available. During stakeholder consultation, it was commented that we now have gas- and coal-based peaking generators and that plants are refitting to lower their min-gen levels as far as possible.

The inflexibility of coal-dominated grids to cope with the influx of variable renewable sources such as wind and solar may decline, and a failure could be the initiating event for further market collapses such as the market suspension in June 2022. This concern was expressed by multiple stakeholders consulted.

Coal-fired plants in NSW are all towards the end of (in many cases, an already extended) life, with retirements of major plant happening from this year (Liddell) out to 2040 (Mt Piper) and in between Eraring, Vales Point, and Bayswater (see Table 4 in Section 3.3.1). If recent retirements, such as Liddell, are examples, these plants 'limp' to their end held together by just enough engineering repairs and maintenance, balancing cost with performance and political intervention.

This total change of operating paradigm for coal-fired stations causes enormous stress as their systems cycle through the duck curve or 'solar trench', a particular concern in NSW and Victoria given the predominance of older plants. As baseload generation, where there is a continuous output, were not designed for ramping up and down to meet demand 'spikes' and demonstrates why in parallel to their operation, the market sought gas- and hydro-generation and flexibility in the timing of demand loads (such as hot water) to ensure that these coal generators had some level of demand.

3.5 Skills shortages in the NSW Government

Recommendation 2: The NSW Government should expedite the recruitment of junior emergency management positions within EUSFA and focus on their current recruitment actions. EUSFA should also explore novel and ongoing training opportunities for staff, including 'shadowing' opportunities in an emergency setting with other jurisdictions.

This will provide a pathway to retain skilled individuals who understand the requirements and communication lines during emergencies within the energy sector or the factors that have an impact on it. This recruitment is critical and should also be supported by adequate and ongoing training.

The Expert Panel understands that the staffing and recruitment issues facing EUSFA are endemic in the energy sector more broadly, where there is fierce competition for a limited pool of skilled professionals.

These staffing issues were previously highlighted in the NSW Chief Scientist & Engineer's Assessment of summer preparedness for the NSW energy market in 2018, where Recommendation 1 outlined that the (then) NSW Department of Planning and Environment (DPE) '*develop a succession plan to ensure the stability and continuity of these positions, and to ensure suitably qualified JSSC and EUSFAC*[86]*, including deputies, are available at all times, and particularly through each summer season*'.

The Panel is concerned that failure to address this recommendation could hamper any future response if an energy emergency occurs. The Panel also notes that the energy market is transforming at a rapid rate, underscoring the need to foster new skill sets and increase understanding of the complexity of the system to match this transformation.

As highlighted in a number of reports, including the previous Assessment reports and other government reports (such as those mentioned in Section 5.1), the energy sector is feeling an acute skills shortage that is expected to increase into the future unless addressed.

The Expert Panel notes that the NSW Government is also not immune to the shortage of key skills: the EUSFA currently has two recruitment activities opened. The Panel sees this as a particular risk for energy security and supply in the next 12 months and beyond, as the EUSFA (in supporting the Energy and Utility Services Functional Area Coordinator (EUSFAC) / Jurisdictional System Security Coordinator (JSSC)) is the critical junction between the various market stakeholders (AEMO, transmission network service providers (TNSPs), DNSPs, generators, etc.), the NSW Government and other jurisdictions in emergency situations. The role of EUSFA extends beyond emergency situations, as the strength of any emergency response is based on the exercises undertaken with energy market stakeholders, the relationship and communication channels built with them, and an understanding of the intricacies, resources and levers that can be activated within different areas in the state – all processes that are built over years of engagement. The EUSFA also provides critical analysis and support as energy market issues arise.

As the energy system undergoes transformation towards increased renewables and intelligence within its systems, support needs to be given to ensuring that the skills within an emergency setting transform. Therefore, the Panel sees a practical opportunity for the NSW Government to support the EUSFA via increased recruitment of junior staff, with appropriate aptitude in emergency responses and/or the transforming energy sector, who can be trained to both support the current EUSFA roles and potentially provide a pathway to ensure critical skills and knowledge is retained. This would build

[86] Jurisdictional System Security Coordinator and Energy and Utility Services Functional Area Coordinator

the critical skills needed within EUSFA, if appropriate training opportunities (including exercises with market stakeholders) are provided. The Panel understands that such training may be bespoke and/or involve training from other organisations, so appropriate financial support should be considered.

Another opportunity that should be explored is training with government agencies in the other NEM states. This could include opportunities to 'shadow' jurisdictions (and likewise, bring other jurisdictions in) during emergency situations, thereby providing insight and shared learnings that could result in a more robust energy emergency management response for all.

The shadowing opportunity also enables people to become familiar with those in other jurisdictions which be of immeasurable value when emergencies need to be managed across multiple jurisdictions.

Further, the Panel notes that 'succession planning' has been raised in previous reports as a critical action to ensure that corporate knowledge is not lost.[87] The Panel also notes that additional staffing within EUSFA is important for both the management of fatigue from emergency events (acute, such as the market suspension in June 2022, and long-term, such as the successive years of bushfires in 2019/20 to flooding in 2021/22, 2022/23).

EUSFA has also previously implemented 'surge staffing' to assist in these events, drawing on departmental staff to assist in emergencies.[88] Whilst the Panel still sees great value in this program, this is not a replacement for dedicated staff with the knowledge and relationships with energy market stakeholders.

3.6 Other risks for 2023/24

3.6.1 Ongoing COVID-19 and global supply chain impacts

Previous reports identified the significant impact of COVID-19 on the operation, maintenance and various other activities undertaken by NEM participants.[89] This year, most stakeholders indicated that workforce sickness absenteeism had mostly returned to pre-COVID levels. Some stakeholders indicated that COVID protocols were still being maintained, including regular testing of workers and the use of multiple segregated control rooms, to mitigate any further COVID and/or influenza impacts. Overall, stakeholders indicated that COVID-19 and influenza are not expected to cause major disruptions to operations going forward in 2023-24.

Some stakeholders identified COVID as an additional contributing factor, amongst constant bushfire and flood risk, which has led to considerable fatigue in recent years within the energy sector. Adequate staffing forecasting has become critical.

Another common theme that emerged from stakeholders where COVID-19 was a contributing factor was supply chain constraints on equipment and assets. Whilst lead times increased under the earlier conditions of the pandemic, additional contributing factors at the domestic (consecutive years of floods and bushfire requiring additional asset replacement) and international (such as the conflict in Ukraine) levels have led to additional supply strain stresses. However, all stakeholders consulted indicated that they were aware of these constraints and were proactively managing them through longer-term advance planning and by maintaining stockpiles of critical assets.

3.6.2 Consumer behaviour

The unpredictable behaviour of consumers facing rising cost-of-living pressures in the current high inflation environment represents a further level of uncertainty. High wholesale energy prices, combined with the forecast El Niño weather pattern and subsequent high demand for air conditioning, are expected to put additional pressure on power bills for consumers this coming

[87] OCSE. (2018). *Assessment of Summer Preparedness for the NSW Energy Market. 2018/19.*
[88] OCSE. (2021). *Assessment of Summer Preparedness for the NSW Energy Market: 2020/21.*
[89] OCSE. (2022), *Assessment of preparedness of the NSW Energy Market: 2022/23.*

summer.[90] The AER estimates that electricity bills across NEM jurisdictions have already increased by 9% to 20% in 2022-23 compared to the previous year.[91] It is unclear the extent to which these high cost-of-living pressures will affect electricity demand in 2023-24, but it is possible that rising costs of living may actually increase household energy use as people economise by doing more at home.[92] More broadly, consistently high electricity prices have the potential to jeopardise consumer acceptance of the wider energy transition, with consumers potentially attributing these higher prices to renewables. A remaining lack of political bipartisanship on energy issues was noted by stakeholders as unhelpful in this context.

Emerging trends over the last several years, such as increased working-from-home arrangements (still present today), have shifted how consumers use and engage with electricity. During the COVID-19 pandemic in 2020-21, the stay-at-home orders and working-from-home arrangements saw household consumption of electricity increase by 5.0%.[93]

There continues to be strong consumer demand for CER. From 2022 to 30 Jun 2023, 3.7 GW of rooftop solar was added in the NEM, now totalling over 17 GW of capacity. Additionally, the rated capacity of small-scale battery installations in the NEM increased over 14%.[94] However, stakeholders noted that the use of CER is still rarely coordinated, which increased reliance on larger grid-scale generation and transmission projects.

Consumer education and social licence initiatives will become increasingly important, particularly around the coordinated use of CER. With consumers increasingly becoming active participants in energy markets through distributed PV and behind-the-meter battery installations, several stakeholders identified the need for government-led incentives and consumer education regarding the managed use of these distributed resources. Schemes that need to be considered and evaluated to ensure that grid stability is not threatened by an oversupply of energy from rooftop solar include solar curtailment mechanisms,[95] dynamic operating envelops and solar soaking facilities. Especially with the increasing adoption of EVs, vehicle-to-home (V2H) and vehicle-to-grid (V2G) initiatives have considerable potential to facilitate power system security but are reliant on buy-in from consumers. Several stakeholders noted that the coordinated use of CER, such as with virtual power plants (VPPs), could be an important hedge against the inherent risks and protracted timescales involved in larger grid-scale transmission projects, as discussed in Section 3.3.2.

3.6.3 ACCC draft determination

On 7 Jun 2023, AEMO applied to the ACCC for authorisation on behalf of itself and electricity industry participants, to engage certain coordination and associated information sharing activities relating to outages.[96] In their application, AEMO raised concerns that, as the electricity system transitions from thermal generation to diversified renewable electricity sources, works to maintain and/or upgrade generation and transmission, notwithstanding the information that is available to participants and AEMO, may occur in an uncoordinated way which could pose risks for reliability and security. As aging coal-fired plants near end-of-life, outages of those plants will become less predictable. AEMO sought authorisation until 30 June 2026.

[90] Sydney Morning Herald. (2023). *Summer to heat up power prices, cost-of-living pressures.*
[91] AER. (2023). *State of the Energy Market 2023*.
[92] ABC News. (2023). *Australians likely to use more energy to stay in and save money.*
[93] Australian Bureau of Statistics. (2023). *Energy Account, Australia, 2020-21 financial year.*
[94] AER. (2023). *State of the Energy Market 2023*.
[95] AEMO. (2023). *AEMO CEO speech at AFR Energy and Climate Summit 2023.*
[96] AEMO. (2023). *Application for interim and final authorisation under s88(1) of the Competition and Consumer Act 2010 (Cth)*.

On 12 October 2023, the ACCC issued a draft determination which rejected AEMO's application to coordinate maintenance in the aging coal-fired plants on the basis it was anti-competitive.[97] In arriving at its determination, the ACCC cited reforms recently implemented, soon to be implemented and those being contemplated by AEMC, which will further assist AEMO to manage the scheduling of outages during the transition. These reforms relate to changes to ST PASA (implemented in July 2025), MT PASA (9 Oct 23) and Improving Security Frameworks (end of 2025).[98]

The ACCC is caught between competing imperatives to maintain free markets and actions that may benefit the electricity system, and the Panel is of the view that these do not always align. Particularly, a reliance on changes to the National Electricity Rules (NER), which are yet to be implemented and yet to be proven to assist sufficient coordination, may not be sufficient to reduce risks to reliability and security.

The Panel recommends that the NSW Government should work with AEMO in its response to the draft determination, highlighting the fact that during the transition unforeseen events are likely to occur and the need for the requested coordination will arise if the proposed market mechanisms (rule changes) do not deliver. The requested authorisation for coordination serves as a precautionary arrangement until AEMO and participants have more experience with the transition.

[97] ACCC. (2023). *Draft Determination: Application for authorisation AA1000643 lodged by the Australian Energy Market Operator in respect of coordination and information sharing for the purpose of scheduling System Works in the National Electricity Market*.

[98] Projected Assessment of System Adequacy (PASA) is the principal method of forecasting the adequacy of the NEM to stay within the reliability standard, with two timeframes; Short Term (ST) PASA covers six trading days from the end of the trading day covered by the most recent pre-dispatch schedule; Medium Term (MT) PASA covers 24 months (AEMO)

4 NSW Electricity Supply and Reliability Check Up

The NSW Electricity Supply and Reliability Check Up[99] (the 'Check Up') was delivered to OECC in August 2023. The purpose of the Check Up was to examine current policy and programs to deliver the NSW Electricity Infrastructure Roadmap (the 'Roadmap') and identify risks and additional steps that NSW needs to take to ensure a reliable supply of clean, affordable energy into the future.

The Check Up was necessary given intensified global competition for investment, acute supply chain constraints and skills shortages, and some apparent regulatory, planning and community issues. The Check Up is a forward-looking document. The Expert Panel notes that in discussions with stakeholders, all have concerns about the coordination and delivery of the transition of the energy sector with regard to the above factors.

Most of the Check Up's findings relate to current challenges with impacts that will play out over the coming years, particularly with the scheduled closure of Eraring Power Station in 2025 and infrastructure construction issues. The Check Up acknowledges that addressing these and other issues requires an immediate focus and coordinated approach if NSW stands a chance of meeting upcoming targets.

The Check Up noted that the Roadmap's support for large generation projects, long duration storage projects (such as pumped hydro) and major new transmission projects carry cost, engineering and timeframe risks. The Check Up acknowledged that 2030 is close in energy market terms. It recommended that the Roadmap Intergovernmental Steering Committee (RISC) should oversee a whole-of-government approach to the Roadmap implementation.

The key findings of the Check Up are:

- The new renewable generation target of 12 GW can be met, but there is uncertainty about the timeframe under which it will be delivered.
- The long duration storage target of 2 GW by 2030 is unlikely if it is based on pumped hydro; additional technologies and sources may be needed to supply needed long-duration storage.
- The outcome of a firming Long-Term Energy Service Agreement (LTESA) tender will be announced in November 2023 (AEMO website), with proponents submitting over 3.3 GW of total capacity with an AEMO tender size of 930 MW.
- It is expected that the initial energisation of the Central-West Orana region REZ (CWO REZ) will occur in 2027/28 after construction begins in around 12 months. The first stage of the New England REZ (NE REZ) is anticipated to be complete by the end of the decade.
- The scheduled closure of Eraring in 2025 brings risks, as speeding up the build of infrastructure in that timeframe is unlikely and costs could be felt by consumers. Managing capacity exit and entry to balance reliability and supply, affordability and emissions reduction needs a multi-faceted approach.

The Check Up recommended the need for a formal NSW mechanism to bring transparency and scrutiny to exit decisions by major energy market suppliers. The new Energy Security Target Monitor (ESTM) would oversee the Energy Security Target (EST) and entry and exit of new capacity in NSW.[100] It recommends that NSW develops a Responsible Exit Policy that requires suppliers providing over 600 MW of firm generation to submit their exit plans to the ESTM three years prior.

The Check Up brought up risks to the community's acceptance of energy transition if costs are passed to consumers. Most consumers' current understanding of the Roadmap is low. There may be social license issues with major infrastructure projects and land use conflicts. A coordinated

[99] Marsden Jacob Associates. (2023). *NSW Electricity Supply and Reliability Check Up*. Prepared for NSW Treasury, Office of Energy & Climate Change.
[100] The current ESTM is AEMO. The Check Up recommends that the ESTM be transferred to a NSW agency by 1 July 2024, which the NSW Government accepted.

approach by the Energy Corporation of NSW (EnergyCo) for the REZs is needed which includes genuine engagement and a consistent and equitable approach to community benefits.

Global and national skills shortages create a serious challenge for the delivery of the Roadmap and the REZs. The Check Up recommended that Essential Energy's apprenticeship program in regional NSW be expanded. Social license for the transition may be enhanced in regions if people can participate in opportunities for training and employment and other broader social outcomes.

The Check Up outlines 54 recommendations across three themes:

1 Timely and cost-effective electricity sector transition
2 Residual Risks of Eraring closure
3 Enhancing local community support, workforce readiness and supply chains

4.1 NSW Government response

The NSW Government issued its response to the Check Up in September 2023.[101] All but four recommendations were accepted, for which the Government outlined its alternative approach to address the intention of the recommendations. The response can be found here.

In summary, across the first policy-related theme, the NSW Government will:

- make the energy transition a formal, strategic whole-of-government priority across portfolios through an intergovernmental steering committee, the RISC, that contributes to the NSW Secretaries Board and the Strategy Committee of Cabinet
- appoint the NSW Department of Climate Change, Energy, the Environment and Water (DCCEEW)[102] as the Energy Security Target Monitor to focus on exiting generation from the NSW market
- support EnergyCo's capabilities to lead the delivery of financial closure of the Central West Orana REZ in 2024, as well as the Waratah Super Battery and procurement of the Hunter Transmission Project. EnergyCo will continue infrastructure planning, engagement and access scheme development for other REZs.
- support the Energy, Climate Change & Sustainability Group within DCCEEW to oversee governance, policy and coordination across government
- support AEMO Services Limited's continued role in running generation and long-term storage tenders.

Risks from the closure of Eraring are a key section of the Check Up recommendations. Over the next 12 months, Eraring is expected to operate in the market (as it has in previous years). However, the Expert Panel does see a short-term risk if Eraring experiences any failures or maintenance requirements that put it offline during critical periods. It is expected that repairs on any failures over the next 12 months could be constrained by the cost/benefit given its planned retirement (discussed previously in Section 3.3). The Panel is aware that the NSW Government is in discussions with Origin about Eraring's retirement in 2025. In noting these discussions, a number of stakeholders expressed their significant concerns around the ongoing discussions between the NSW Government and Origin Energy about the extension of Eraring beyond 2025, particularly the need for transparency and the potential influence these decisions may have on future market decisions and investments.

The NSW Government notes that it is accelerating new firming infrastructure in partnership with the Commonwealth's Capacity Investment Scheme to assure reliable supply to customers with Eraring's proposed closure.

[101] OECC. (2023). *Electricity Supply and Reliability Check Up: NSW Government Response*.
[102] The NSW Department of Climate Change, Energy, the Environment and Water will be operational from 1 January 2024.

New renewable generation, storage and corresponding infrastructure is needed to replace the retired coal plants. The Government will develop the Consumer Energy Strategy to enable integration of consumer technologies (rooftop solar, batteries, electric vehicles) into the mix, and unlock other available capacity in the network.[103] In addition, the response noted that NSW needs long duration storage and the progress on pumped hydro has been slower than hoped. Gas peaking plants will play a part to firm renewables in the transition, with access to reliable sources of gas of importance on this front.

Finally, the response accepted all recommendations made in the Check Up related to community support, workforce readiness and supply chains. The Government will continue the work of the Jobs Advocate and Renewable Energy Sector Board on local workforce development. EnergyCo will set up offices to increase local recruitment. The recommendation to expand Essential Energy's apprenticeship program was accepted. EnergyCo, the NSW Department of Planning and Environment (DPE) and REZ generators will establish coordinated approaches to community engagement and benefit sharing.

[103] The Review is not aware of a release date for the Consumer Energy Strategy.

5 The future power system

The NEM is transforming at an unprecedented rate, with increased uptake of CER and the large penetration of non-synchronous renewable generation. The Expert Panel notes feedback from stakeholders that there are considerations beyond the 12-month horizon that will have a significant impact on energy security, sustainability, affordability and the resilience of the NEM, with a need for the immediate implementation of proposed actions.

The following section introduces common themes from stakeholders to create tangible outcomes to ensure that the system can transition consistent with the aspirations set out by state and federal jurisdictions. A number of these points are also featured in The NSW Electricity Supply and Reliability Check Up and commentary is provided below.

Recommendation 3: That the NSW Government, specifically the OECC, take immediate action in response to the findings on future power planning (Chapter 5), noting that the reliability risk in NSW is forecast above the reliability standard in 2025-26.

Specifically, the Expert Panel recommends the actions within this Chapter (with the Panel recommendations italicised and also summarised in the executive summary).

5.1 Skills development

In response to a recommendation in the 2022/23 energy assessment regarding the need for skills and workforce planning, the EUSFA detailed (in Section 2.1.1) work performed over the past 12 months. This includes reports by the UTS Institute for Sustainable Futures and the Renewable Energy Sector Board and actions taken by the NSW Government in its response to the Board report.[104]

Despite progress, stakeholders repeatedly raised skills development as a significant and urgent issue for the transition of the NEM. Concern stems from a lack of concerted efforts and initiatives that are visible to stakeholders.

5.1.1 Significant shortage of skilled workers

There continues to be a significant shortage of skilled workers due to the high demand for labour needed for industry operations and the broader renewable transition. New semi-skilled roles required for the energy transition include solar technicians, household electrification advisers, battery and cell manufacturers and electric vehicle repair technicians.

Outside of the energy sector there are a multitude of major infrastructure projects in all jurisdictions which will require large skilled workforces.

Many stakeholders identified the competitive market for skilled workers (such as grid connection engineers) as a significant challenge, in some cases reporting a ‘historical low’ in the retention of workers. This was compounded by some concerns that Australia was losing its appeal within a highly competitive international market. Some stakeholders expressed frustration in what seemed to be a ‘net zero approach’ to worker movement in the energy sector, with employees ‘churning’ between various businesses and government agencies rather than a growth in the pool of workers. Particularly in the context of emergency management activities, some voiced concern that constant

[104] UTS Institute for Sustainable Futures. (2022). *Employment, Skills and Supply Chains: Renewable Energy in NSW*; OECC. (2022). *NSW Renewable Energy Sector Board’s Plan*; OECC. (2022). *Response to the Renewable Energy Sector Board’s advice to the NSW Government to build the capacity and capability of the NSW renewable energy sector.*

movement could potentially result in the loss of knowledge networks and key contacts between various agencies, which can be crucial in an emergency.

Stakeholders were generally more confident in the availability of labour for critical works such as vegetation maintenance activities, which was a particular concern in last year's report. Several were increasing their development of in-house capabilities and expertise to avoid reliance on contractors, while others reported that they had sufficient longer-term contractual arrangements providing adequate capacity.

Some stakeholders believed that the worker shortage situation was made worse by potential excessive duplication of labour required to satisfy the sometimes-significant regulatory hurdles and requirements, such as for the connection of new generation to the grid.

Overseas experience suggests that in the current highly competitive market, there will need to be a greater focus on developing worker skills and capacities rather than relying on those with pre-existing high-level skills. Several stakeholders reported success with their apprentice campaigns and graduate programs, with some believing this to be a key part of ensuring workforce capacity in the coming years. Network businesses that are investing significantly in training such as apprentice programs are concerned that such activity may not be allowed for in regulatory revenue determinations.

To better understand the workforce needs for Australia's transition to a clean energy economy, the Australian Government commissioned Jobs and Skills Australia (which replaced the National Skills Commission) to produce the Clean Energy Generation study and report. Released on 3 October 2023, it made 50 recommendations aimed at ensuring Australia has the skills and workforce required for the transition.[105] The Panel reviewed the report as part of the Assessment and made the following observations for consideration:

- Preliminary modelling by Jobs and Skills Australia suggests that demand for workers in clean energy occupations is expected to exceed supply in the next decade. A report prepared for the NSW Department of Planning and Environment[106] indicates that total employment in the electricity industry in NSW will fluctuate between 14,000 to 22,000 over the next 15 years with peaks in 2025 to 2030 reflecting construction activity on transmission and renewable generation. Other jurisdictions undertaking development of REZs report a similar level of workforce activity.
- Electricians lead the occupational gap, with an identified likely need for around 32,000 more electricians than is currently expected in the next seven years. Other occupations, including 'nearly all the building and engineering trades that are critical to the construction and maintenance of renewable energy', are also likely to experience shortfalls. The Clean Energy Council estimates 450,000 construction jobs are required across Australia to meet the 43% emission reduction and 82% renewable generation targets in the NEM by 2030.[107]
- The report also identified 38 'critical occupations' required for the transition having additional specific skills or experience and taking longer to train, including technicians and trades workers, labourers, professionals and managers. Demand for these 38 occupations is expected to increase by around 15% in the next seven years, an increase of almost 240,000 workers.
- To address these concerns, the report calls for a "*harmonised education, training and migration system with a step change in how we train trades and technical workers"*. This includes a dramatic increase in the capacity of the vocational education and training (VET) system to support a greater number of tradespersons, as well as a well-designed and fit for

[105] Australian Government. Jobs and Skills Australia. (2023). *The Clean Energy Generation: workforce needs for a net zero economy.*
[106] UTS Institute for Sustainable Futures and SGS Economics and Planning. (2022). *Employment, Skills and Supply Chains: Reviewable Energy in NSW*.
[107] Clean Energy Council. (2023). *Jobs Report Guides Future for the Clean Energy Workforce.*

purpose skilled migration program. The report also highlights the need to address barriers in the energy sector particularly for women, people with disability, First Nations peoples and culturally and linguistically diverse (CALD) Australians.

The Panel acknowledges a number of reports have made recommendations in this space and many stakeholders have taken action. It recommends that the NSW Government should work with the Commonwealth and other jurisdictions to progress actions towards skills development, including the recommendations from reports like the Jobs and Skills Australia report, and support the creation of employment opportunities that will arise during the energy transition.

5.1.2 Advanced education and research is needed

In many parts of the energy transition there is a need for both graduate and postgraduate level expertise across engineering and associated sciences. Australia has world-leading expertise at scale in solar PV and scattered experts in other areas, but not holistically across areas of research and education to support such a major transition. Further, new educational models to give faster 'micro-credentials' targeted to particular needs should be considered. One area of concern is the systems aspect where stability, security, reliability and resilience all need new methods for high VRE systems and there seems to be little recognition of this need. The dependence on consultants will not be an adequate solution into the future.

Besides the need for skills in areas such as advanced grid integration studies, there is a general lack of international level expertise for other exercises such as assessing proposals and thought leadership on new paradigms (i.e. key leadership for the large-scale, coordinated engineering solutions required for the future network). This is clearly appreciated internationally, with countries also experiencing a major energy transition supporting major centres of research and advanced training (e.g. The Danish Technical University, Imperial College London, Strathclyde University, Georgia Tech, University of Illinois, Washington State, to name a few). These all have power and energy systems groups with 5-10 full professors leading major programs of research, educating PhD students and researchers, as well as graduate education with industry input. By comparison, the Australian industry clearly needs more graduates, but engagement with universities is lacking.

A major benefit of university engagement is the access to international practices which arise from research collaboration and professional involvement in task forces and working groups such as in the International Council on Large Electric Systems (CIGRE) and the Institute of Electrical and Electronics Engineers (IEEE). This is a 'chicken and egg' problem that can only be solved by funding centres with research and industry stakeholders which have the mandate to look beyond the status quo. This approach was effective for developing the legacy system.

The Panel recommends that the NSW Government, through the Energy and Climate Change Ministerial Council (ECCMC), should engage with universities to support the establishment of Centres of Excellence for the vocations needed to support the energy transition.

5.2 Non-transmission resilience

The energy transition has been described as having two parts: decarbonisation (i.e. of decarbonising the high voltage grid using VRE, REZs and associated transmission expansion) and harnessing Consumer (or Distributed) Energy Resources (CERs or previously called DERs). During the Panel's consultations, it was concluded that this second transition needs to be progressed more quickly especially given the delays in the first. Distributors are experiencing rapid uptake of CERs (solar, batteries and EVs) within their networks but were concerned that the value of such resources to the overall electricity system is not being addressed or adequately recognised.

To this end, the *Panel recommends that a review of regulatory arrangements for CERs and community battery storage be undertaken, with the goal of maximising their contribution to the energy transition.*

Panel observations to support such a review include:

- Stakeholder focus is on transmission network initiatives at the expense of potentially economic options in the distribution network.
- Annually, approximately 3GW of capacity is being added to the NEM via rooftop PV (this is equivalent of approximately one large thermal generator, like Eraring, per year).
- There are solutions to the minimum demand problems for older plants using batteries, solar soaking, pre-cooling, EV charging strategies, but Australia is generally immature when it comes to harnessing and developing these technologies in practical terms.
- DNSPs are starting to realise they have opportunities for harnessing CERs but are hampered by a number of issues, not least of which is access to data and a legacy tendency to limit the demand-side. Rather than exploiting their full potential, the impact of CERs on the grid is instead being limited, as indicated by AEMO's call for a switch-off mechanism to control all the rooftop PV in the NEM.[108]

One particular example is the difference in network use charges at transmission level and distribution level (TUOS vs DUOS)[109], which limits the storage capability for CERs and community batteries and their ability to participate in grid services and provide further resilience for consumers. The future grid can harness CERs in new structures like microgrids and virtual power plants (VPPs) which are in trial stages. Alongside these developments we can expect new types of retailers and aggregators which provide boutique services and products. While there are social licence issues in using household equipment effectively as part of the electrical infrastructure, a lot of work is being done internationally on how to incentivise engagements. Also of concern is the competitive advantage given to batteries connected to the transmission network, that do not pay TUOS, compared to batteries within the distribution network that pay TUOS and DUOS.

There were comments that distributors and retailers are getting a stronger sense of their potential for providing energy and services using CERs and wish to act more independently in terms of serving customers. Distributors still have limited access to real-time information on customer-owned resources that are behind the meter, which could be used to optimise network configurations and thus improve the capacity of their networks.

Distributors are concerned about the significant amount of work required for the energy transition and how this can have a coordinated trajectory. Again, they see workforce issues as they observe a scarcity in electrical system engineers and a limited pool of network engineering, procurement and construction (EPC) contractors. Distributors were also not confident that the energy transition is being coordinated effectively. Further, in R&D terms, there are many issues to solve. In developing new CER/VPP structures, there will be a need to examine which arrangements are economic in an Australian context. For example, in embedded networks where it is envisaged many houses will come together, there is a need to put an embedded manager/controller in place with algorithms to make appropriate decisions. To do this would necessitate a minimum number of participants (i.e. engineering and economics would determine what is viable). This type of investigation should then influence regulation and rule development, where there is the confluence of both an engineering, science-based determination, and an economic appraisal.

5.3 Social licence and consumers

The development of the transmission network to support the development of REZs brings challenges and opportunities for local communities impacted by these developments.

In a recent Committee for Economic Development of Australia (CEDA) presentation, Daniel Westerman (AEMO CEO) observed that "*regional and rural communities are being asked to shoulder*

[108] Renew Economy. (2023). *Rooftop solar switch-off: Why and where it's being used – and where it's headed*.
[109] Transmission use of system (TUOS) and distribution use of system (DUOS) charges are fees applied to customers for provision of shared transmission network and distribution network services, respectively.

the burden of construction and hosting transmission, while the benefits are shared with populations hundreds of kilometres away, even interstate".[110]

Social licence is particularly important in securing new transmission projects that are required to support the transition to more renewables. Many projects are being delayed because of a lack of community acceptance of the routing of transmission lines.

There is a risk of failure to achieve the energy transition unless consumers support it. Consumers are now faced with significant changes to their lifestyles, homes and vehicles and are facing rising energy prices.

Research undertaken by Ernst and Young (EY) indicated that nearly half of Australian consumers do not understand the actions and investment they can make to be more sustainable.[111] Even when consumers engage with their energy providers or others in the sector, it is often a confusing and fragmented experience. This is against a background that the energy transition that we are now embarking on is the largest and most complex change to the electricity sector.

EY's research indicated that just 38% of consumers in Australia had confidence in the affordability of their energy, and just 36% had confidence in the stability of their energy provider. The study noted that while nearly a third (30%) of Australians believe they are in 'energy poverty', they are unlikely to pay a premium for eco-friendly energy.

Concerns about energy affordability, amid ongoing likely increases in project costs fuelled by regularly reported infrastructure cost over-runs, will make it difficult for the energy sector (industry and government) to increase consumer confidence that the energy transition is achievable and is affordable. Consumers are told renewables are cheaper in the long run but are now being hit with electricity price increases with little prospect of easing.

As the market transitions to more grid-scale renewables, battery storage and CER, problems may potentially arise in the power system because of unforeseen interactions of new technologies. There may be a tendency for the media to blame new entrants or the system operators for bad outcomes. An increase in such observable problems can affect the acceptance of the energy transition and associated social licence needed. Power systems must be seen as 'one big machine', in that security and electricity prices reflect how all participating generators in the NEM, not just the new entrants, interact with network operators in accordance with the NER.

The Expert Panel recommends that the NSW Government should undertake work to improve the consumer experience and to increase confidence that the transition is beneficial, affordable and achievable. The overall approach to dealing with the local community, including those within the NER, needs to be reviewed. This may also involve considering whether approaches outside of current regulatory arrangements are needed to improve community acceptance of vital transmission links.

5.4 Systems engineering

The energy transition is a nation-building engineering project to achieve new social outcomes, set to replace a system that has been developed over 100 years. The prior development had to overcome many serious challenges for the efficient and secure operation of the whole electrical system, such as various stability (synchronism, oscillations, voltage collapse) and control problems (frequency, voltage, preventive, emergency, black start control). This was based on a whole-of-system view in research by universities and utilities shared internationally through organisations such as CIGRE and IEEE. Australia with its unique 'stringy' grid needed to be an active contributor. To illustrate, one major overseas program in the late 1970s to early 80s was called Systems Engineering for Power

[110] AEMO. (2023). *AEMO CEO speech at CEDA Rewiring the Nation: Transmission – the vital link to net zero*.
[111] Certified Management Accountants (CMA Australia). (2023). *Why consumer sentiment could stall the clean energy transition*. EY CEO Imperative Series.

funded by the US Department of Energy to boost research needed to make the whole power system more efficient. Similar programs were funded in Europe and the UK.

What is being done in the next few years in Australia is much bigger in scope, and at a faster rate. There is no clear pathway to achieve the research and coordination needed and manage stability and control problems. New hard-to-explain oscillations between converter-based resources are already being seen, and research on control structures is in early stages and lacks scale.

There are economic, social and environmental aspects which bring a correspondingly diverse set of skilled participants. The legacy power system in Australia was built largely by engineers employed by state governments overcoming the huge physical, material and systems issues. Markets were added after the system was built as a way to dispatch power in a competitive framework rather than by a simple algorithm with visibility of generator characteristics, as was done previously. The hope for market-based mechanisms was that they would not only operate the system, but also help plan the system (i.e. Regulatory Investment Test for Transmission (RIT-T)). This has arguably not been as successful as hoped.

Despite the serious discussion around pros and cons of market mechanisms (such as whether frequency control should be left to markets or simply be a control problem), especially in a system moving towards zero marginal cost renewable energy, the dominant paradigm to solve issues in our existing regulatory structures still remains market-based. This is reflected in the absence of researchers or engineering leaders at most management and industry meetings.

The development of NEM-based regulatory entities (AER, AEMC, AEMO) occurred in a past steady-state situation but may not be optimally fit for purpose during a transition to a totally new system. We are now seeing several new state-based entities (such as EnergyCo in NSW) and various Federal Government interventions adding complexity. The question of how to coordinate the overall energy transition project smoothly from one system to the future grid remains unanswered. Many stakeholders during consultations expressed concern with the number of agencies needed for connection approvals, the longer delays involved and the increasing complexity overall. The coordination issue also relates to the above discussion on skills development and harnessing CERs.

The Panel recommends that the NSW Government examine mechanisms to reduce regulatory and planning complexity to speed up energy transition development as a whole-of-system approach.

Without such an approach, it can be argued that the setting of emissions, prices and reliability goals lack integrity. More critically, it is not clear how we can be sure the lights will stay on in the future transition period. Consideration should be given to some form of Australian energy security authority coordinating with state-based entities, informed by experts including engineering leaders at the highest levels. In other countries this includes inviting overseas experts to fill gaps as needed.

5.5 Reform of transmission regulation framework

The timely completion of transmission network augmentations to support the development of renewable generation in REZs is essential for the energy transition. Most of the renewable developments in the NSW REZs are focused on the end of this decade, which in engineering terms is not far away. The risk of late delivery is very real, and timeframes may not align to the exit of coal-fired generation.

Considering the above risk, the Panel is concerned that the current transmission planning and regulatory arrangements are no longer fit-for-purpose and need a critical review. While the outworking of the arrangements will not be felt in the next 12 months, work needs to start now to ensure fit-for-purpose arrangements are put in place to support the energy transition.

To this end, the Panel recommends:

1. *That the review of the current transmission planning arrangements in NSW include a review of transmission regulatory arrangements.*

The Panel notes Recommendation 18 from the Check Up Report regarding the review of current transmission planning arrangements in NSW, and advice on the best approach to ensure coordination between the Roadmap bodies. Noting that this recommendation was accepted by the NSW Government, the Panel Recommends that a review of transmission regulatory arrangements be included to ensure that the achievement of the Roadmap is not compromised.

2. *The review should include an assessment of whether the current RIT-T arrangements, including proposed changes to the NER, will impact the timely delivery of strategic transmission projects or whether an alternative RIT-T process should be implemented.*

The rationale for the Panel arriving at the above recommendations is set out below.

Major transmission projects to support the REZs take many years to come to fruition. For example, in June 2020, ARENA committed $5 million in funding to TransGrid to conduct a detailed feasibility study for the Central-West Orana REZ Transmission Project with project completion now scheduled for September 2027. With the Project EIS exhibition being extended until 8 November 2023, there is the risk that project completion could be delayed beyond September 2027. However, new transmission infrastructure is required to enable private investors to develop renewable generation projects in the CWO REZ.

The AEMC has recently completed its Transmission Planning and Investment Review. It has made recommendations to improve the regulatory frameworks to support efficient investment in and timely delivery of major transmission projects. The AEMC asserts that these recommendations will help protect consumers against significant increases in future electricity prices as the transition to net zero takes place. The areas in which the AEMC has made recommendations are:

- economic assessment process
- clarifying arrangements for TNSPs consideration of social licence
- financeability risk
- emissions reduction – aligning NER with inclusion of emissions reduction in the national energy objective
- feedback loop
- improving the workability of AEMO's feedback loop as a consumer safeguard
- clarifying the regulatory treatment of concessional finance under the NER
- enabling the AER to perform a targeted review of capex of completed Integrated System Plan (ISP) projects

In each of these areas, the AEMC is progressing rule change proposals or is expecting these in late 2023. It is essential that these are progressed in a timely manner.

Various stakeholders have raised concerns about the delivery of transmission projects.

- Even with the changes to the framework proposed by the AEMC, essential transmission augmentations may still be delayed. The proposed amendments to the RIT-T will still add years to a transmission project.
- The delivery of the NSW Electricity Infrastructure Roadmap involves some eight entities: Transgrid, three appointed entities (Consumer Trustee, EnergyCo and the AER) and four advisory bodies. Concern was raised by stakeholders that each of the entities may not work to the same timetable and are also likely to have different risk appetites. This may lead to a lack of consensus in decision making which can result in delays, compromise outcomes, distract from the best value result and confuse accountability for delivery.
- Also as noted in the Check Up Report, stakeholders commented that there was a lack of clarity in relation to the multiple agencies involved in transmission infrastructure planning in NSW. There is potentially a role for a single coordinating authority to coordinate the delivery of the roadmap while retaining individual agency responsibility and accountabilities.

  - A pertinent example is the Sydney Olympics Coordination Authority NSW (OCA), a public administration body that achieved the challenge of coordinating the Sydney Olympic Games in 2000. The body was legislated in 1995,[112] when the construction program was behind schedule, and was tasked with organising the construction program of all venues and the coordination of NSW Government activities required for the Games.[113] The successful coordination role of the OCA is considered to be a key factor that contributed to the success of the Games.[114]
  - The energy sector is currently facing challenges demanding a similar level of coordinated effort and timely responsibility. The OCA illustrates the potential for a coordinated approach to the management of complex projects within set deadlines, while still maintaining individual agency responsibility. Above all else, it also demonstrates the value of having a clearly identified leader as the coordinating body.
- There is concern over AER's favouring of least-cost solutions in its revenue determination process at the expense of higher cost projects which are favoured by the community.
- Energy Networks Australia (ENA) is concerned that the proposed financeability rule changes will not provide investors with sufficient confidence to commit to actionable ISP projects in a timely manner.
- ENA also highlight concerns raised by stakeholders regarding the necessity of all of the regulatory approval steps, in the context of nationally significant projects identified in AEMO's ISP. ENA note that some jurisdictions have bypassed the RIT-T for strategic projects or are considering initiatives to do so.
- It is noted that EnergyCo has the responsibility for planning the location of REZs and for contracting and overseeing the suppliers delivering the transmission network infrastructure to the REZs. The NSW Electricity Roadmap is structured to provide checks and balances to EnergyCo's decisions through the involvement of the Consumer Trustee and its advisory bodies. Considering the need to achieve timely delivery of transmission augmentations for the REZs, and considering that there is independent oversight by the Consumer Trustee, *the Panel recommends that review of the transmission regulatory arrangements should assess whether strategic transmission projects should be subject to the RIT-T or bypass the RIT-T*. In doing this assessment the review should consider approaches being adopted in other jurisdictions.

In June 2022 an Electricity Networks Commissioner was appointed in the UK and tasked with providing advice to Government on how to reduce the time it takes to deliver transmission infrastructure in Great Britain. The Commissioner has now delivered his report as a letter to the Secretary of State.[115] The conclusion was that while current length of time taken to build new electricity transmission, from identification of the need to commissioning, was 12-14 years but it could be done in half that time. However, the Panel notes, this transition time still needs to be faster and reducing time on strategic projects is critical, where a focus should be placed on streamlining processes. The Panel also notes that in many ways this should be faster in Australia, given the increased complexity that the UK system has in comparison to the NEM. Similarly, the Victorian Government is introducing new legislation into the Victorian Parliament in early 2024 to establish the Victorian Transmission Investment Framework with Victoria undergoing a 'once-in-a-generation' energy transition, although the proposed timeframe is not currently known.[116]

[112] *Olympic Co-ordination Authority Act 1995* (NSW).
[113] Olympic Co-ordination Authority. (2001). *Olympic Co-ordination Authority Annual Report 2001.*
[114] Lenore Coltheart. (2001). *Making the Magic: an outline history of the Olympic Coordination Authority NSW*. Report for the Olympics Coordination Authority.
[115] Electricity Network Commissioner. (2023). *Letter to the Secretary of State UK.*
[116] Victorian Government. (2023). *Victorian Transmission Investment Framework Final Design.*

Acronyms

Acronym	Complete Term
ACCC	Australian Consumer and Competition Commission
AEMO	Australian Energy Market Operator
AEMC	Australian Energy Market Commission
AER	Australian Energy Regulator
AFAC	Australia and New Zealand National Council for fire and emergency services
BOM	Bureau of Meteorology
CER	Consumer energy resources
DER	Distributed energy resources
DNSP	Distribution network service provider
DPE	NSW Department of Planning and Environment
DSP	Demand side participation
EAAP	Energy Adequacy Assessment Projection
ENSO	El Niño–Southern Oscillation
ECL	East Coast Low
ECCMC	Energy and Climate Change Ministerial Council
ESOO	Electricity Statement of Opportunities
ESTM	Energy Security Target Monitor
EUSFA	Energy and Utilities Services Functional Area
EUSFAC	Energy and Utilities Services Functional Area Coordinator
EV	Electric Vehicle
FSRU	Floating Storage and Regasification Unit
GSOO	Gas Statement of Opportunities
IEEE	Institute of Electrical and Electronics Engineers
JSSC	Jurisdictional System Security Coordinator
IOD	Indian Ocean Dipole
IRM	Interim Reliability Reserve
ISP	Integrated System Plan
LNG	Liquified natural gas
LOR	Lack of Reserve
NEM	National Electricity Market
NER	National Electricity Rules
OCA	Sydney Olympics Coordination Authority
OECC	Office of Energy and Climate Change
PASA	Projected Assessment of System Adequacy
PV	Photovoltaic
RERT	Reliability and Emergency Reserve Trader
REZs	Renewable Energy Zones
RFS	NSW Rural Fire Service
RIT-T	Regulatory Investment Test for Transmission
SAM	Southern Annular Mode
SES	NSW State Emergency Service
USE	Expected unserved energy
VRE	Variable renewable energy

Appendix 1 – Terms of Reference

Terms of Reference for the NSW Chief Scientist & Engineer – 2023 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 each year since 2018 the Minister for Energy has 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 Office of Energy & Climate Change, other NSW Government agencies and industry stakeholders have improved 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 3rd November 2023, 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 the current NSW Government actions to address energy reliability and security risks, including the NSW resources available to respond to these 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 next 12-month period, including summer and winter, and makes recommendations on any immediate actions to address any vulnerabilities identified.

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, Distribution Network Service Providers, AEMO, the Australian Energy Regulator and the Australian Energy Market Commission.

Process

The Panel is to provide a report by 3 November 2023 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 7: List of stakeholders

Name/Organisation
AEMC
AEMO
AGL
Ausgrid
AER
BOM
Marsden Jacob Associates (Cameron O'Reilly, Associate Director, led the Check Up)
Delta Electricity
Department of Energy, Environment and Climate Action, Victoria Government
Edify Energy
Endeavour Energy
EnergyAustralia
Energy Governance and Operations, Department of Energy and Public Works, Queensland Government
Essential Energy
Grattan Institute
Origin Energy
Snowy Hydro
Squadron Energy (formerly CWP Renewables)
Tomago Aluminium
Transgrid