Assessment of summer preparedness for the NSW energy market

NSW Chief Scientist & Engineer

November 2018

NSW GOVERNMENT | Chief Scientist & Engineer

The Hon Donald Harwin MLC
Minister for Energy and Utilities
52 Martin Place
SYDNEY NSW 2000

Dear Minister,

Assessment of summer preparedness for the NSW energy market

In October 2018, you wrote to the Honourable Niall Blair MLC, Minister for Trade and Industry, requesting that I chair a panel to assess the adequacy of the state's 2018/19 summer preparedness in relation to the energy market and associated emergency management.

The purpose of the Panel and the review it undertook have particular regard to the Department of Planning and Environment's Summer Readiness Action Plan and the NSW Government's responsibilities and levers in the energy market and emergency management, and to identify any actions for emerging risks in 2018/19 summer and beyond.

The Panel and secretariat consulted with the Australian Bureau of Meteorology (BOM), the Australian Energy Market Operator (AEMO), network operators and jurisdictions on their summer readiness. The Panel examined issues including:

- Estimates of unserved energy (USE) and other information sources to examine the likelihood of a Lack of Reserve event
- Weather and climate effects that could impact supply and demand over the coming summer
- Systems and protocols that are in place to respond and manage the electricity system over the coming months in particular the summer readiness plans of the Department of Planning and Environment (DPE) and the Australian Energy Market Operator (AEMO).

The Panel concluded that the NSW Government is well prepared for the coming summer, noting that protocols and exercises by the Department of Planning and Environment, other NSW Government agencies and industry stakeholders have improved summer readiness and energy emergency response over the past twelve months.

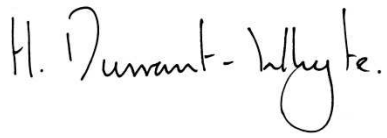
Whilst the overall risk of USE, as assessed by AEMO, is low for NSW for 2018/19 and well within the reliability standard, there is a number of risks that can impact on the security and availability of the electricity system, which the Panel notes have been considered by the relevant industry participants.

In assessing the adequacy of the NSW Summer Readiness Action Plan, the Panel has made several recommendations. The Panel report outlines these recommendations, an assessment of energy margins for NSW in summer 2018/19, assessment of the DPE's

procedures in the NSW Summer Readiness Action Plan and factors that may influence future summer preparation.

I would like to acknowledge the Panel members, Mr Dave Owens and Mr Michael Martinson, for their assistance and contribution into this Review and Report, and the participation of stakeholders.

Yours sincerely,



Hugh Durrant-Whyte
Chief Scientist & Engineer

28 November 2018

FINDINGS & RECOMMENDATIONS

FINDINGS

- The Panel finds that NSW is well prepared for the coming summer, noting that exercises by DPE, NSW Government agencies and industry stakeholders have improved summer readiness over the past twelve months.

- The overall risk of unserved energy (USE)[1] as assessed by AEMO is low for NSW for 2018/19, approximately 0.0002%. The risk of unserved energy is projected to remain low until 2022-23 at which point it is expected to rise to coincide with announced power station closures, including Liddell Power Station (1,800 MW) in 2022, unless further investment occurs in resources beyond those currently committed.

- There are a number of risks that can impact on the security and availability of the electricity system, which the Panel notes has been considered by the relevant industry participants, including AEMO, in preparation of their USE forecasts. These risks include the following:
    - Weather-related events, including temperature, rainfall, storms, floods, heatwave frequency and duration, drought, dam levels, humidity including as a result of climate-related events (e.g. El Niño and the positive Indian Ocean Dipole);
    - The increase in the growth of rooftop photovoltaic (PV) and generation from non-synchronous renewable sources and the impact this may have on maintaining system stability;
    - The need for appropriate transmission planning and development to ensure utility-scale generation is available to replace retiring generation and that this is complemented by distributed energy resources (DER), storage and flexible thermal capacity; and
    - The integrated nature of the National Electricity Market (NEM) and the compounding effect on the stability of the electricity system when weather events or plant outages occur simultaneously in multiple jurisdictions.

- The expected USE, which is measured against the NEM reliability standard[2], is the primary mechanism to signal the market to deliver enough capacity to meet consumer demand for electricity. The reliability standard currently requires that there be sufficient generation and transmission interconnection such that 99.998% of annual demand for electricity is expected to be supplied, equating to a standard of 0.002%. This is considerably higher than the expected USE for NSW in 2018/19 at 0.0002%. However, since the expected USE that is calculated by AEMO is an average representation of the risk of load shedding, the outcomes could exceed the reliability standard where there are particular combinations of weather events and/or plant outages.

- The Panel was advised that the risk of weather events and plant outages has been taken into account by TransGrid and the NSW distribution network service providers (Essential Energy, Endeavour Energy and Ausgrid) and AEMO in their contingency plans in order to maintain the stability and reliability of the electricity system.

[1] The energy that cannot be supplied to consumers, resulting in involuntary load shedding as a result of insufficient levels of generation capacity, demand response or network capability to meet demand.

[2] The reliability standard is set at 0.002% USE per region or regions per financial year, which means that out of 100,000MWh of demand, no more than 2MWh of outage would be allowed.

- The potential effects of drought on the electricity system need to be monitored, particularly in coming summers (2019/20 onwards) if current weather trends persist. The Panel notes that planning has included the potential impact of the Sydney Desalination Plant operation if NSW dam levels fall below 60% (which appears to be imminent).

- The Panel notes the risk of bushfires and the coordination between relevant agencies and industry to prevent and or respond appropriately. Bushfire is a key risk, with IPART, RFS and energy networks continuing to work together on the development of consistent bushfire management plans.

- Should the electricity system come under pressure at times of peak demand and there is risk of the loss of customer load, the NSW Government has strategies and procedures in place to coordinate a response including:
    - Invoke the Government Energy Action Response (GEAR) to pre-emptively reduce demand from Government agencies;
    - Seek to invoke voluntary load reductions from large customers;
    - Declare an electricity emergency; and,
    - If the grid were to go black, Black Start procedures.

- The Panel notes the Concept of Operations (ConOps - EUSFAC) and Standard Operating Procedures (SOPs) have improved the summer readiness over the past twelve months. The Panel was informed through its consultation process that the NSW Government is well regarded for its effective communication and responsibility structures with stakeholders in ensuring electricity supply is maintained or restored.

- Based on information received from stakeholders, including AEMO, TransGrid, the distribution network service providers (DNSPs) and DPE as to their summer preparedness, the NSW Government and the relevant agencies appear well prepared to manage electricity-related incidents or emergencies that arise during the upcoming summer.

RECOMMENDATIONS

Summer 2018/19

Recommendation 1

Given the importance of the Jurisdictional System Security Coordinator (JSSC) in managing electricity-related incidents and the Energy and Utility Services Functional Area Coordinator (EUSFAC) in managing the response to electricity incidents, DPE to develop a succession plan to ensure the stability and continuity of these positions, and to ensure suitably qualified JSSC and EUSFAC, including deputies, are available at all times, and particularly through each summer season.

Recommendation 2

Each relevant Government agency to provide AEMO with, as a priority, a current contact list to be used to maintain or restore the electricity system. Changes to key personnel to be advised to AEMO as and when these occur, with updated contact lists to be provided to AEMO annually by 1 October.

Recommendation 3

That the Government agencies and industry stakeholders expedite the finalisation of procedures regarding operational requests made by NSW RFS Incident Controllers and procedures around informing re-energising activities on days of a Total Fire Ban declarations and/or significant fire activity & forecast.

Recommendation 4

That the Government (IPART, NSW RFS and EPA), TransGrid and generators formalise a coordinated process for review of plans related to environmental impacts around generators and transmission infrastructure.

Summer 2019/20

Recommendation 5

That the Department of Planning and Environment coordinate exercises and annual reviews, including on the Jurisdictional Load Shedding Guidelines (JLSG) and emergency powers/procedures, prior to the start of the 2019/20 summer and each summer thereafter.

Medium to Longer Term Considerations

Recommendation 6

The NSW Government to engage with the AEMC's Reliability Panel, AEMO and the AER to assess whether the current NEM reliability framework, including the reliability standard, remains an appropriate measure for customers in NSW moving forward, and to continue engagement as relevant in the future.

Recommendation 7

The NSW Government to ensure its transmission strategy is implemented to ensure sufficient transmission infrastructure is available to meet the needs of the market.

Recommendation 8

The NSW Government, through its involvement in the COAG Energy Council and other Commonwealth agencies, to support the streamlining of regulatory processes, including the RIT-T, to ensure the timely delivery of efficient transmission infrastructure.

1. PANEL REPORT

The NSW Minister for Energy and Utilities has established a Panel, chaired by the NSW Chief Scientist & Engineer, to review the state's summer preparedness, in particular the readiness of the energy market, and the state's emergency management systems as they relate to energy supply for the 2018/19 summer and to give early advice on future summers.

This report of the Panel discusses initiatives that are in place to prevent, manage, and respond to conditions over the summer period in NSW as they relate to the National Energy Market, with a focus on those levers that NSW Government possesses. The findings and recommendations for additional work are also provided.

The request for the Panel's advice followed the completion of the Initial and Final Reports of the Energy Security Taskforce, delivered in May 2017 and December 2017 respectively, chaired by the former Chief Scientist & Engineer Professor Mary O'Kane AC, and including Mr Brian Spalding and Mr Dave Owens APM who is also a member of this Panel.

1.1 WHAT APPROACH WAS TAKEN IN DEVELOPING THE REPORT?

The Panel brought together to examine summer preparedness was chaired by Professor Hugh Durrant-Whyte (NSW Chief Scientist & Engineer), and included Mr Michael Martinson (Principal & CEO of Economic Activity Pty Ltd; former Group Manager Network Regulation, Networks NSW; former Regulatory Workstream Leader of the Network Reform Program, NSW Treasury) and Mr Dave Owens APM (Managing Director, Risk-e Business Consultants Pty Ltd; former Deputy Police Commissioner and State Emergency Operations Controller). The Panel was supported by secretariat functions drawn from the Office of Chief Scientist & Engineer.

The Panel wrote to AEMO, TransGrid, Essential Energy, Endeavour Energy, Ausgrid and IPART seeking information on preparations for summer 2018/19, including any new initiatives or approaches that have been introduced since December 2016, and any other observations in relation to summer readiness including for future years.

Members of the Panel and secretariat received a summer briefing from the Bureau of Meteorology (BOM), and conducted face-to-face meetings or teleconferences with other stakeholders including AEMO, TransGrid, the Distribution Network Service Providers (DNSPs) and the NSW Environment Protection Authority (EPA). A number of discussions occurred with the Department of Planning and Environment (DPE), in particular the Energy and Utility Services Functional Area Coordinator (EUSFAC), as well as discussions with staff from the Victorian Department of Environment, Land, Water and Planning, and from the Queensland Department of Natural Resources, Mines and Energy.

1.2 WHAT ARE THE NSW ENERGY SUPPLY AND DEMAND FORECASTS FOR SUMMER 2018/19?

An important aspect in considering the NSW's summer preparedness is understanding risk – in this context, the risk of energy supply not meeting consumers' demand.

The AEMO Electricity Statement of Opportunities (ESOO) provides a 10-year forecast for electricity supply reliability in the National Electricity Market (NEM). The expected unserved energy (USE) is an annual average representation of the risk of load shedding, which is

measured against the NEM reliability standard[3], and is the primary mechanism to signal the market to deliver enough capacity to meet consumer demand for electricity. The reliability standard currently requires that there be sufficient generation and transmission interconnection such that 99.998% of annual demand for electricity is expected to be supplied.

The overall risk of USE as assessed by AEMO is low for NSW for 2018/19 at a level of approximately 0.0002% (Figure 1), meaning there is a low likelihood for the need for load shedding. The risk of USE is projected to remain low until 2022-23 at which point it is expected to rise to coincide with announced power station closures, including Liddell Power Station (1,800 MW) in 2022, unless further investment occurs in resources beyond those currently committed as discussed further in Section 1.5 below.

It is important to note that USE is not a target to secure reliability (AEMO, 2018c). Rather, USE is "*an annual average representation of the risk of load shedding, using a range of statistically variable inputs. The actual occurrence of load shedding in a given year can be lower than or over the standard. Outcomes can be considerably higher than the standard with particular combinations of weather events and plant outages*" (AEMO, 2018c).

The 2018 ESOO forecasts some risk of supply disruption in NSW for the summer of 2018/19 "*due to the correlation of effects of extreme weather on both supply and demand*", but noted the expected level of USE[4] in NSW remains below the reliability standard (of 0.002%).

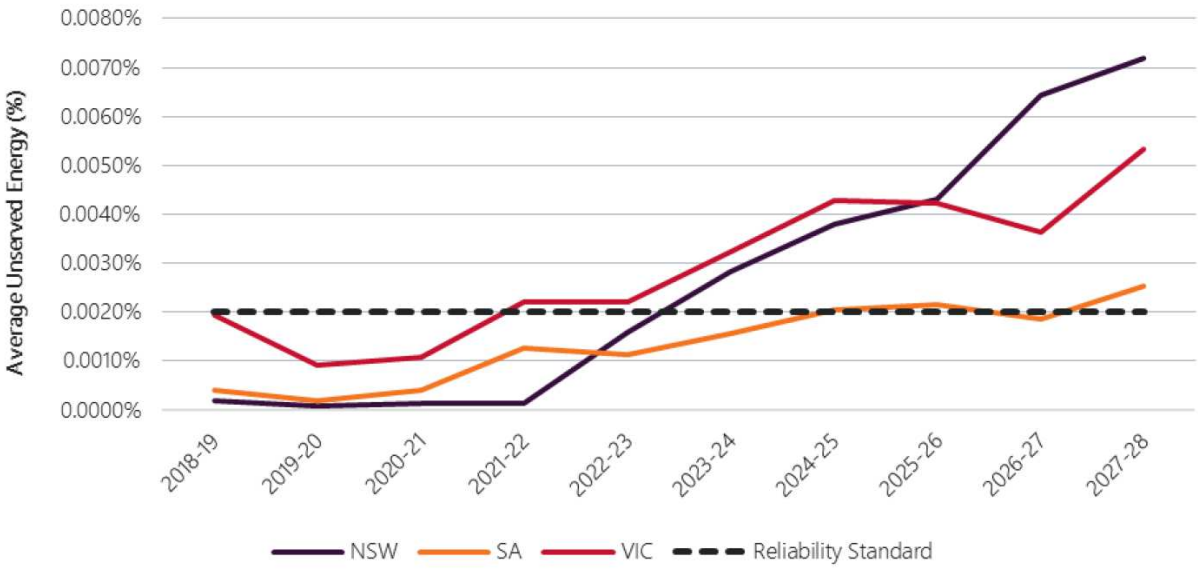


Figure 1: Figure from 2018 ESOO - Forecast USE outcomes (neutral demand, only existing and committed projects)

[3] The reliability standard is set at 0.002% USE per region or regions per financial year, which means that out of 100,000MWh of demand, no more than 2MWh of outage would be allowed.
[4] USE, as defined by AEMO, is the "*is energy that cannot be supplied to consumers, resulting in involuntary load shedding (loss of customer supply), as a result of insufficient levels of generation capacity, demand response, or network capability, to meet demand*" (AEMO, 2018 ESOO)

A satisfactory energy supply/demand relationship for NSW over the coming months is also reflected in the forecast data from the Medium-Term Projected Assessment of System Adequacy (MT-PASA), which shows that Demand50 (an average demand forecast with a 50% Probability of Exceedance [POE]) is well below the supply (scheduled generation, plus the 50th and 90th percentile of intermittent generation)(Figure 2).

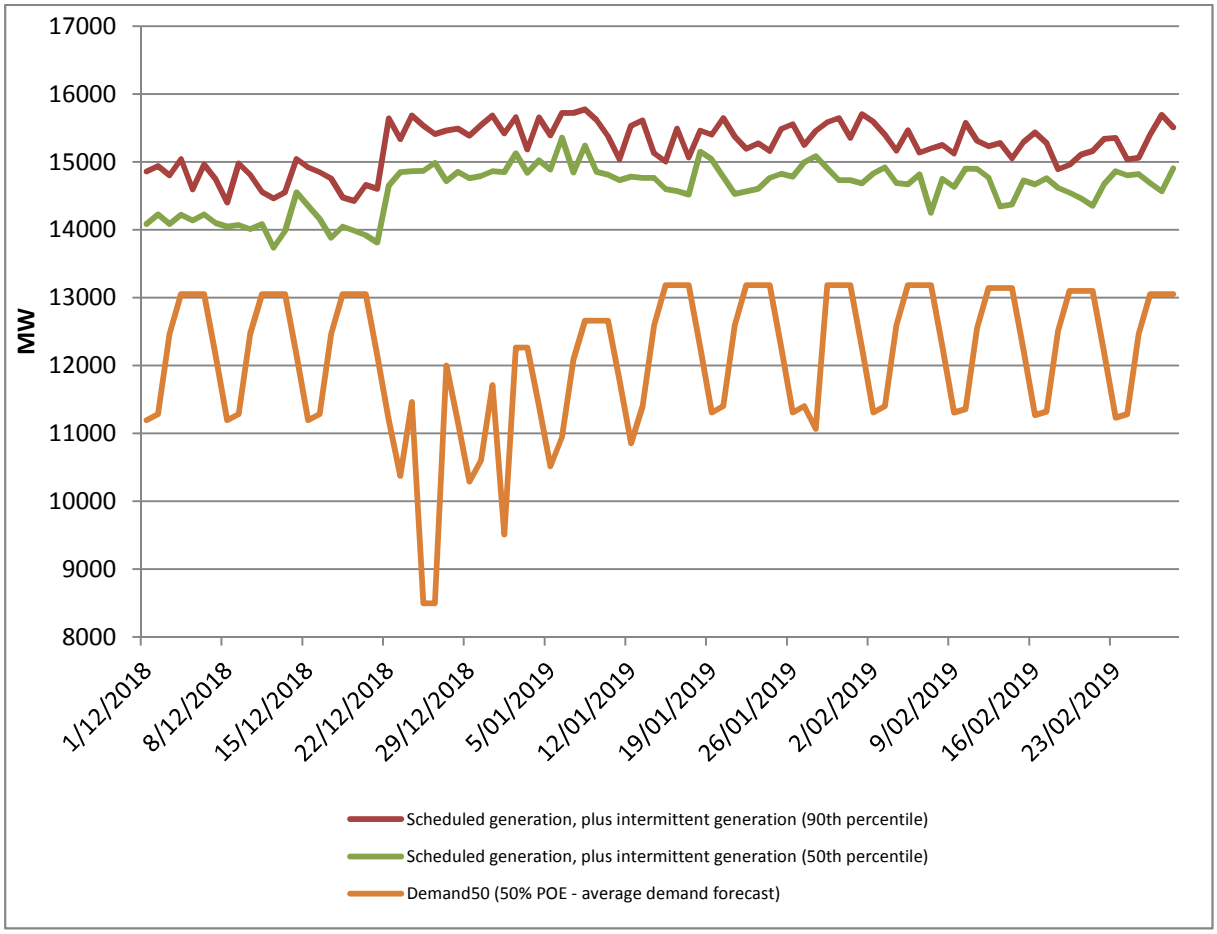


Figure 2: Supply (scheduled generation plus intermittent generation at the 50th and 90th percentile) and Demand50 (50% Probability of Exceedance, average demand forecast) (data generated from AEMO's MT-PASA, 18 November 2018 at 1800[5])

Although there may be instances when the Demand10 (10% POE, or a 1-in-10 year event) exceeds the supply (including intermittent generation), with a NSW operational peak demand of 14,674 MW (POE 10 for 2018/19)(AEMO, 2018b), there are market mechanisms in place to combat this if it eventuates (e.g. reserve capacity, RERT, etc.). It is also worth noting that interconnection to Victoria and Queensland is not factored into the MT-PASA scheduled generation.

1.3 WHAT ARE ADDITIONAL RISK FACTORS TO BE AWARE OF FOR SUMMER 2018/19?

As foreshadowed in the Terms of Reference for the Panel, the adequacy of electricity supply is at heightened risk during extreme weather events, and lost/reduced output of forecast generation, and therefore risk mitigation strategies need to be deployed.

[5] MT-PASA data is available at http://nemweb.com.au/

The forecast USE estimates for NSW in Figure 1 were developed using forecasts of weather and events, however more extreme events or combinations of weather events could affect the actual level of energy supply and demand.

AEMO's Energy Adequacy Assessment Projection (EAAP) examines the impact of potential energy constraints, such as fuel supply and cooling water, on expected levels of USE in the NEM over a two-year period. The May 2018 EAAP indicates that there is a risk of energy supply interruption to NSW (and the other NEM participants) over the next two years, although the EAAP notes that USE will still be below the reliability standard. This risk "…*exists irrespective of the rainfall scenario, and is primarily driven by increased vulnerability to other climatic events such as extended periods of high temperature, corresponding with low wind or solar availability and unplanned generation outages*" (AEMO, 2018d).

AEMO informed the Panel, through its summer readiness presentation and it's Summer Readiness Plan (2018-19), and drawing on BOM data for the broad NEM up to the end of December, that the following outcomes are predicted: an increase in bushfire activity; increased likelihood and intensity of heatwaves; decreased likelihood of widespread flooding; ongoing drought conditions; increase in solar energy and less cloud cover; and a neutral effect on severe storms (AEMO, 2018h).

Long duration and systematic climate patterns, short but extreme weather events, and prolonged or repeated occurrences of weather can all affect the network as well as energy demand and supply, as discussed below.

1.3.1 Climatic conditions

Climatic and weather conditions are key drivers of demand and can also impact energy supply. The Panel received a briefing from the BOM, which has forecasted a warmer than average summer for NSW, with a higher likelihood of dry-air heatwaves. This is a result of increased risk of a 'weak' El Nino (~70%) and a likely positive Indian Ocean Dipole. The outlook for rainfall is showing no indications of a significant deviation from average.

The BOM has indicated that the antecedent conditions will also exacerbate summer 2018/19. Through 2018, NSW experienced the warmest January-October period on record (since records began in 1910) and the 3rd driest January-September period (since 1965). Over recent years, there has also been a trend towards warmer temperatures occurring earlier in the season.

This has led to NSW experiencing an early start to the bushfire season in 2018, with bushfires occurring at Casino, Salt Ash, Port Macquarie and Bega over the July-September period. There is also an 'above normal fire potential' forecasted for the eastern seaboard.

1.3.2 High impact weather

In discussions with the BOM and other stakeholders, the Panel noted that there is also a focus on sudden or unforeseen weather events, that could potentially have the greatest impact on energy supply for summer 2018/19. For example:

- thunderstorms (expected to be of a similar frequency to last year) that are hard to predict (location and damage potential) and cause localised effects (such as flooding).
- varying wind scenarios and weather fronts that can cause damage to transmission towers and can have implications for generator functioning (e.g. wind generation); and,

- bushfires, in conjunction with climatic conditions and resultant total fire bans, which can have implications for energy supply (during an event) and post-fire (i.e. energy restoration). High temperatures can lead to a derating of network components (such as Basslink), as well as generators including coal, wind and photovoltaics.

An example of potential weather risk is the events impacting the 330kV Queensland-NSW Interconnector (QNI) on 25th August 2018. This occurred when the QNI was supplying approximately 857MW from Queensland to NSW. A suspected lightning strike led to a frequency drop and resulted in a multijurisdictional event which tripped both the QNI and the Heywood Interconnector (between SA and Victoria) and effectively 'islanding' Queensland and South Australia from the rest of the NEM (AEMO, 2018f; AER, 2018). This also resulted in the QNI being classified on the 'vulnerable list' by AEMO whilst investigations are underway (AEMO, 2018f). Lightning strikes in the vicinity (10 km distance) of the QNI, will also lead to a temporary derating to ensure system security.

While across the NEM and NSW widespread flooding is less likely to occur in summer 2018/19 than previous years, localised flooding may occur.

1.3.3 Simultaneous events

As well as high impact individual events, there are also concerns about simultaneous events across the NEM or multijurisdictional events (e.g. such as eastern seaboard heatwaves) that can cause disruptions to the supply/demand balance for multiple jurisdictions and have implications for the interconnectors between states.

For example, a prolonged heatwave event impacting multiple jurisdictions on the eastern seaboard would likely cause high demand across all affected eastern states. This would limit the ability of NSW to secure additional supply through the QNI and/or the Victoria-NSW interconnector to meet demand; and further, could lead to additional demand on the NSW network to supply the other affected states.

AEMO has indicated that there is a risk that the reliability standard will not be met in Victoria during some peak demand conditions, which could have implications for NSW (and the other states) supply/demand balance (AEMO, 2018c).

1.3.4 Long duration or sequential events

Long duration or sequential events, such as heatwaves can affect the level of community response to calls for voluntary demand reduction. For example, feedback from stakeholders identified that the public is more responsive to calls to raise air conditioner temperatures to reduce demand at the beginning of a heatwave period compared with several days into a heatwave.

1.4 HOW ARE RISKS MANAGED IN THE SYSTEM?

1.4.1 Incorporation of risk events into plans

The Panel was advised that the risk of weather events and scheduled plant outages has been taken into account by TransGrid, the NSW DNSPs (Essential Energy, Endeavour Energy and Ausgrid) and AEMO in their contingency plans in order to maintain the stability and reliability of the electricity system. The following risks have been considered by the relevant industry participants, including AEMO, in preparation of their USE forecasts:

- Weather-related events, including temperature, rainfall, storms, floods, bushfires, heatwave frequency and duration, drought, dam levels, humidity including as a result of climate-related events (e.g. El Niño and the positive Indian Ocean Dipole);

- The increase in the growth of rooftop photovoltaic (PV) and generation from renewable sources and the impact this may have on maintaining system stability (with particular reference to early morning non-credible contingencies/low demand periods/'weak' system);
- In the longer term, the need for appropriate transmission planning and development to ensure utility-scale generation is available to replace retiring generation and that this is complemented by distributed energy resources (DER), storage and flexible thermal capacity; and
- The integrated nature of the NEM and the compounding effect on the stability of the electricity system when weather events or plant outages occur simultaneously in multiple jurisdictions. The August 2018 QNI Interconnector event (Section 1.3.2) highlights the integrated nature of the NEM and the risk that an event in one or more jurisdictions can have a cascading effect in others (including NSW).

1.4.2 When does load shedding occur?

There are two scenarios that could lead to load shedding: a sudden event (i.e. loss of multiple generators, loss of key transmission infrastructure, etc.) or reliability load shedding (to maintain system frequency and inertia).

The response to a sudden event is focused on recovery – that is, restoring generation post-event. This process is largely automated and involves AEMO/network operators/generators, with the NSW Government communicating with the Responsible Officer (RO – currently sits with TransGrid) and coordinating emergency response services.

Reliability load shedding is used when there is a projected shortfall in supply that cannot be met (e.g. a Lack of Reserve [LOR] 3 scenario). There are mechanisms in place by AEMO to deal with forecasted and actual LOR events, including market mechanisms (generator bid-ins) and ultimately the Reliability and Emergency Reserve Trader (RERT).[6] The Panel was informed that there is approximately 130MW RERT available for these situations. Communication between the industry stakeholders and the NSW Government in this scenario is via the Jurisdictional System Security Coordinator (JSSC).

It is worth noting that AEMO entered into reserve contracts for a total of 118 MW in NSW this year on the 7th and 8th June 2018, due to a forecasted LOR2 (AEMO, 2018g).

The JSSC also advises AEMO on both sensitive and priority (top, medium and low) loads for NSW which are then translated into the load shedding guidelines for TransGrid and the distribution businesses.

1.4.3 Role of generators, network operators and AEMO

The basic roles of these entities are to provide reliable and secure supply of energy to consumers. Their functions remain relatively unchanged since 2017, and a description of these roles can be found in the NSW Energy Security Taskforce (EST) Reports in 2017 (NSW CSE, 2017b, 2017a).

[6] RERT consists of reserve, typically procured from either: customer load that can be curtailed and restored on demand (for example, large industrial load or a group of smaller aggregated loads); or generation capacity which is not otherwise available to the market.

1.4.4 NSW Government role

The NSW Government role in the state emergency management system and the electricity emergency management system is described in the NSW EST Reports in 2017 (NSW CSE, 2017b, 2017a).

The NSW EST Initial and Final Reports in 2017 made a number of recommendations for improvements to the processes and systems for NSW in responding to electricity emergency events to improve the resilience and responsiveness of the system. Many of the NSW Government levers and systems described in the following sections have been developed and enhanced by the Government in response to the EST reports (see Figure 3, page 16).

1.4.4.1 NSW Government levers

Should the electricity system come under pressure at times of peak demand and there is risk of the loss of customer load, the NSW Government has strategies and procedures in place to coordinate its response including:

- Invoke the Government Energy Action Response (GEAR) to pre-emptively reduce demand from Government agencies;
- Seek to invoke voluntary load reductions from large customers, including state-owned corporations;
- Seek voluntary demand reductions by community through communication campaigns; and,
- Declare an electricity supply emergency.

The relevant guidelines and protocols interlink and assist the Government's response should an energy emergency occur by providing a consistent and coordinated approach across agencies and emergency responders.

1.4.4.2 Summer preparedness plan for NSW Government

At a high level, the NSW Summer Readiness Action Plan is a series of documents, procedures and exercises that support and provide guidance to DPE (Energy and Utility Services Functional Area [EUSFA]) for operational and emergency functions for the summer period. They are envisaged to be updated in an ongoing fashion. The Plan includes a portfolio of:

- AEMO and NSW Government joint initiatives;
- Procedures and exercises including a range of standard operating procedures;
- Electricity Supply Emergency Sub Plan;
- Demand reduction initiatives such as the NSW Government Energy Action Response protocol and exercises;
- Communication, stakeholder engagement and media material; and,
- A range of guidelines such as the Jurisdictional Load Shedding Guidelines.

The Panel notes the Concept of Operations (ConOps) and Standard Operating Procedures (SOPs) has improved the summer readiness over the past twelve months (See Figure 3 for how they fit into the emergency management and energy emergency management processes). The Panel was informed through its consultation process that the NSW Government is well regarded for its effective communication and responsibility structures in relation to ensuring electricity supply is maintained or restored.

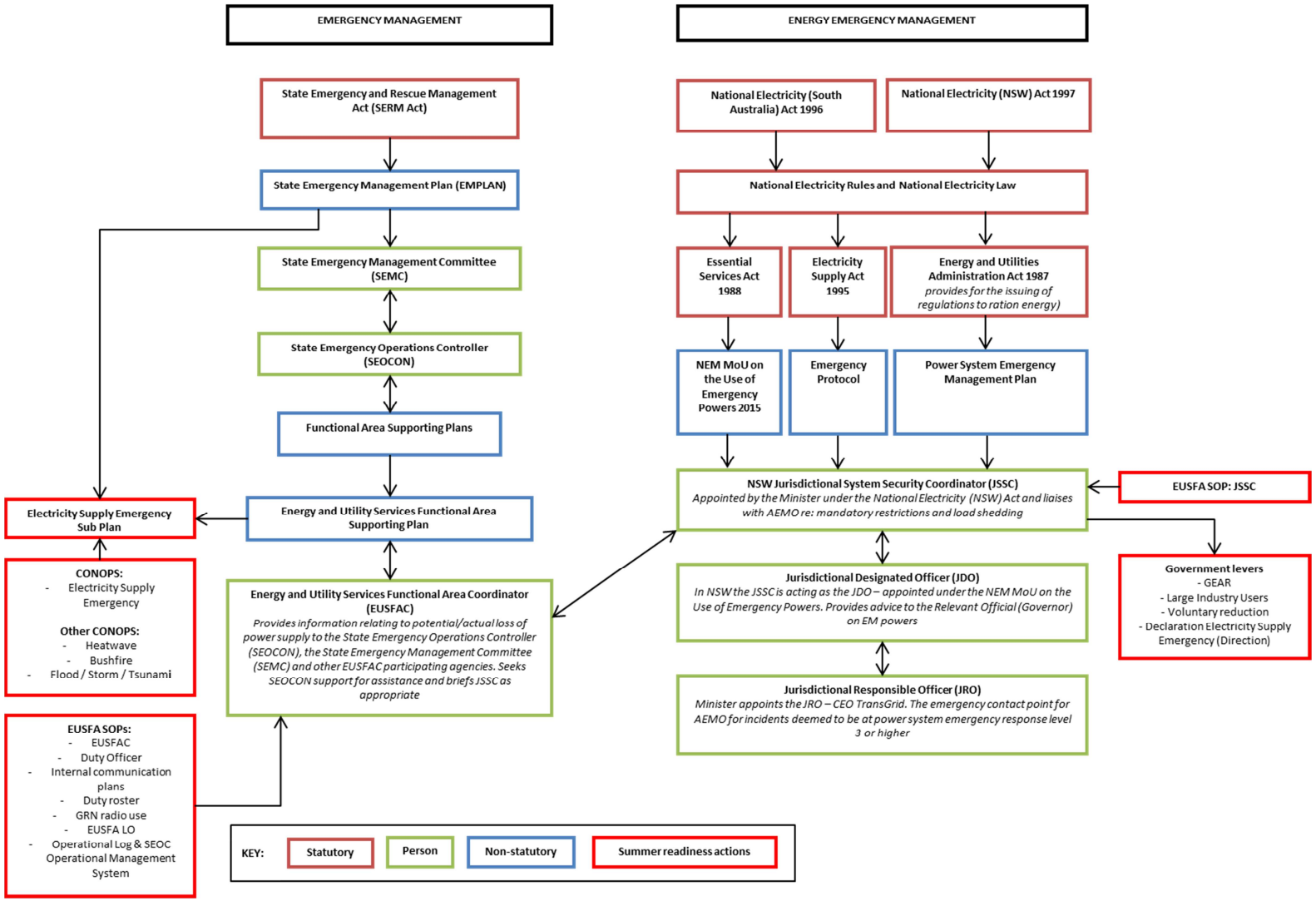


Figure 3: Emergency management and energy emergency management processes, with updates since the NSW Energy Security Taskforce (NSW CSE, 2017b)

Communication plans and materials have been developed as part of the NSW Summer Readiness Action Plan. This material is aimed at different media outlets, including radio, social media and printed ads, and includes simple and easy to understand pictographics. Some of this builds on the experience that the NSW Government had in 2017, with the Minister's request for the community to reduce energy demand.

Based on the Panel's review of NSW Summer Readiness Action Plan material and information received from stakeholders, including AEMO, TransGrid, the distribution network service providers (DNSPs) and DPE as to their summer preparedness, the NSW Government and the relevant agencies appear well prepared to manage any electricity-related incidents or emergencies that arise during the upcoming summer.

1.4.4.3 Emergency Management arrangements in NSW related to the energy system

The *State Emergency and Rescue Management Act 1989* (SERM Act) sets out the general legal and governance framework for emergency management in NSW. The New South Wales State Emergency Management Plan (EMPLAN) sets out the State level approach to emergency management, the governance and coordination arrangements and roles and responsibilities of agencies.

The EMPLAN also sets out key principles that underpin emergency management arrangements in NSW. These are aligned to nationally-recognised and agreed concepts and approaches that are fundamental to managing emergencies, and include:

- The Comprehensive approach (Prevention, Preparation, Response & Recovery)
- The All Hazards approach
- The All Agency approach

As defined in the SERM Act, Functional Areas are business units within NSW Government agencies that perform specific emergency management functions and provide a category of services involved in the preparations for an emergency. In the case of energy supply, the Functional Area is the Energy and Utility Services Functional Area (EUSFA) in the NSW Department of Planning and Environment (DPE) and as coordinated by the Energy and Utility Services Functional Area Coordinator (EUSFAC).

A Supporting Plan to the EMPLAN for energy was developed in 2004 (subsequently updated in 2017) pursuant to the SERM Act. The Energy and Utility Services Supporting Plan (EUSPLAN), like other Supporting Plans, outlines the arrangements by which the Functional Area will coordinate the support services allocated in the EMPLAN. Specifically, the EUSPLAN outlines the coordination arrangements for managing severe and sudden disruptions to the supply of energy and utility services due to a severe, widespread or unexpected disruption, resulting in an emergency.

In 2017, the failure of critical infrastructure (including electricity supply) was identified as a priority hazard that posed a significant risk to NSW in the 2017 State Level Risk Assessment (SLERA). The SLERA supported the development and maintenance of an Electricity Supply Emergency Sub Plan to ensure that NSW was in a position to prevent, prepare for, respond to and recover from a major disruption to the State's electricity supply. DPE, as the Functional Area responsible for energy, commenced the development of the Electricity Supply Emergency Sub Plan (the 'Sub Plan') that was completed and signed off by the State Emergency Management Committee in August 2018. The Sub Plan provides for the emergency management arrangements of significant electricity supply disruptions in NSW. It also identifies DPE as the Combat Agency for the control and coordination in such an emergency.

Current arrangements exist under the Sub Plan including that, upon its activation, DPE appoints the Jurisdictional System Security Coordinator (JSSC) as the Electricity Incident Controller (EIC) who is responsible for the control and coordination of the black system or electricity supply emergency management measures. The EIC will consult with the State Emergency Operations Controller (SEOCON) who will coordinate the consequence management for the response to the electricity supply emergency or black system. The Electricity Supply Emergency Sub Plan can be enacted with other Sub Plans (i.e. Heatwave Sub Plan).

To ensure knowledge of the Sub Plan and procedures, a number of exercises were conducted in 2018: DPE, Ministers and the Department of Premier and Cabinet (DPC) undertook a number of authorisation process exercises; and, on 28th June 2018, the State Emergency Management Committee in conjunction with DPE conducted Exercise Lumen Tenebris (a Black Start exercise). The latter exercise sought to use the opportunity of the TransGrid critical incident training to exercise the responsibilities and functions of the State Emergency Operations Centre (SEOC), the JSSC, Jurisdictional Responsible Officer (JRO), the EUSFAC and electricity network participants. This was the largest electricity exercise conducted in NSW.

The Exercise Lumen Tenebris Report made a total of 23 recommendations, of which 12 recommendations related to 'Summer Readiness'. These 'Summer Readiness' recommendations covered;

- Business Continuity plans (all eleven clusters have completed their business continuity plans with a view to energy emergencies, with several undertaking desktop/generator capacity checks);
- Development of additional documents when working in the State Emergency Operations Centre (SOPs, Handover and Concept of Operations documents);
- Positional location of JSSC/JRO;
- Establishment of protocols and procedures between RFS/EUSFAC and Energy providers to re-energise lines and operational requests from RFS;
- A tightening of communications plans and radio usage; and,
- The establishment of emergency service-only fuel supplies.

The majority of these recommendations have been actioned and completed or are in the process of being actioned with finalisation dates established.

The EUSFA has also developed Standard Operating Procedures (SOPs) to ensure that all Energy & Utilities Emergency Management Unit staff are provided with operational and actionable information to ensure that there is a consistent, effective and operationally capable response during an emergency (Figure 3). The SOPs provide guidance on the various roles and functions, including the roles of the Duty & Liaison Officer, along with templates that can be utilised during an emergency. DPE also developed Concept of Operations (CONOPS) for Bushfire, Black Start, Heatwave and other natural disasters (see Figure 3). The purpose was again to provide guidance to Energy & Utilities Emergency Management Unit staff with information on the actions and considerations during a variety of emergencies.

The Energy and Utility Services Functional Area (EUSFA) and Energy Emergency Management team support the JSSC and EUSFAC in events. This team, established for over 12 months, has gained industry and emergency experience through numerous government and industry exercises, operational deployments to RFS Emergency Operations Centres and undertaken extensive stakeholder engagement to ensure strong relationships are in place should an event happen.

Recommendation 1

Given the importance of the Jurisdictional System Security Coordinator (JSSC) in managing electricity-related incidents and the Energy and Utility Services Functional Area Coordinator (EUSFAC) in managing the response to electricity incidents, DPE to develop a succession plan to ensure the stability and continuity of these positions, and to ensure a suitably qualified JSSC and EUSFAC, including deputies, are available at all times, and particularly through each summer season.

Recommendation 2

Each relevant Government agency to provide AEMO with, as a priority, a current contact list to be used to maintain or restore the electricity system. Changes to key personnel to be advised to AEMO as and when these occur, with updated contact lists to be provided to AEMO annually by 1 October.

Recommendation 3

That the Government agencies and industry stakeholders expedite the finalisation of procedures regarding operational requests made by NSW RFS Incident Controllers and procedures around informing re-energising activities on days of a Total Fire Ban declarations and/or significant fire activity & forecast.

1.4.5 Additional actions by the NSW Government

1.4.5.1 Arrangements for additional load due to desalination

The Sydney Desalination Plant produces drinking water for Sydney (when required) by desalinating seawater. This process starts when dam levels fall below 60% (current dam levels are at 61.2%[7]), and the plant uses approximately 46MW at full production (Sydney Desalination Plant, 2018b). It is understood by the Panel that there has been discussions between AEMO and DPE regarding the Desalination Plant, the role it plays in water security and factoring in its energy consumption for summer 2018/19 and beyond.

1.4.5.2 Additional interactions between BOM and NSW Agencies

The BOM is moving to a business model that features end-user focussed products and embedded staff in agencies (including AEMO) to enable better integrated support. BOM staff have been embedded in RFS since 2011, and with the SES from July 2018.

There has also been a regularisation of the interfaces between BOM and EUSFA and AEMO on weather and climatic conditions, including short term events and longer-term forecasting.

1.4.5.3 Environmental Protection Licenses and water cooling

In specific regards to Recommendation 6, Part A from the Initial Report from the NSW Energy Security Taskforce in 2017, that

[7] As of 16 November 2018 (Sydney Desalination Plant, 2018a)

"*…Government support industry and the community to prepare for, manage, and mitigate risks during energy emergencies, including providing guidance on how to reduce demand effectively during peak periods.*

Key initiatives to be considered when implementing Recommendation 6 include:

a. *Government (through the EPA) and generators discussing what options are available to alter operations or put in place technological interventions to minimise potentially harmful environmental discharges to ensure generation does not become unavailable due to EPL requirements under conditions when reserve levels are low…"*

the NSW Environmental Protection Authority (EPA) enacted changes to the Environment Protection Licences of Eraring Power Station that allow AEMO (or a person authorised by AEMO) to direct the licensee (Origin Energy) under the National Electricity Rules to "*…maintain, increase or be available to increase power generation, for system security, the licensee may exceed the maximum operating hours above 35.5°C and the maximum temperature specified in conditions…* " which equates to 37.5°C for up to 307 hours, with an additional 18 hours at up to 38.5°C to avoid potential shortfall of electricity supply during high electricity demand (NSW EPA, 2018). This allows AEMO and the State another opportunity to respond rapidly to frequency changes or shortfall in supply. It should also be noted that this is subject to further monitoring for environmental impacts and is subject to a review of studies undertaken on thermal discharges to Lake Macquarie.

1.4.5.4 Simplified arrangements for a Declaration of an Electricity Supply Emergency

A recommendation of the 2017 EST was for legislative amendments to be put in place so that a Declaration of an Electricity Supply Emergency and compulsory load shedding arrangements did not have to go to the NSW Governor in Counsel for approval (NSW CSE, 2017b). These arrangements have since been amended.

The *Electricity Supply Amendment (Emergency Management) Bill 2017* amended the *Electricity Supply Act 1995* so that the Premier is able to declare an electricity supply emergency if satisfied that the supply of electricity to all or any part of the State is significantly disrupted or that there is a real risk that electricity supply may be significantly disrupted.

1.4.5.5 Rural Fire Services engagement

The NSW Rural Fire Service engages with DNSPs on a range of matters including:

- training in fire-fighting practices;
- protocols to be followed at fire locations including ground and aerial operations;
- information sharing regarding fire and network status;
- arrangements for access to fire ground; and,
- participation with district Rural Fire Services Risk Management Committees.

Recommendation 4

That the Government (IPART, NSW RFS and EPA), TransGrid and generators formalise a coordinated process for review of plans related to environmental impacts around generators and transmission infrastructure.

1.4.6 Actions by BOM, AEMO and the network operators

The BOM has been working across the NEM to improve the interface between the electricity system and weather forecasting capabilities. An ambition in the long-term would be to have a NEM that is as well integrated to weather forecasting as are the aviation and bushfire sectors. The BOM indicated to the Panel that it recognises the embedded meteorological personnel model that BOM is moving towards – closer to customer, two-way exchange of information that leads to a greater understanding of what each partner wants/how they use information – would offer improved long, medium and short term predictive and management opportunities. In addition BOM is also working to develop and deliver products that are easily adopted by customers, which could have particular applications for responsible agencies managing emergencies.

The network operators undertake annual network planning and assessment, particularly moving into the summer period, to understand network vulnerabilities or risks (such as lack of capacity or overloading). Key issues that were identified or actions undertaken by stakeholders for the coming summer, and as noted by the Panel, were:

- Bushfire risk preparedness: this includes two aspects:
    - pre-bushfire inspections of assets and their vulnerability to bushfire, including bushfire simulators, Light Detection and Ranging (LiDAR) based vegetation surveying and implementation of bushfire risk prioritisation categories
    - asset defect identification and rectifying actions, including pole inspection programs, and system operations and field protocols for total fire ban days (to minimise the risk of field-based operations initiating a fire)
- capacity forecasting and analysis, with joint planning between TransGrid and the DNSPs
- strategic asset management reviews
- engagement and communication across the energy sector (AEMO, network operators and governments including the EUSFAC), including participation in industry forums and joint exercises.

AEMO, as the energy market operator, undertakes and coordinates a number of activities for summer preparedness (see below).

1.4.6.1 AEMO Summer Readiness Plan

Annually, AEMO publishes a Summer Readiness Plan to actively manage heightened risks to power system operations across the NEM. The plan is developed in collaboration with generation and transmission network providers, governments, and relevant agencies, and takes into account inputs such as (AEMO, 2018h):

- Thermal generation outages and changes to these outage rates over recent time (there has been an increase in forced outages that reflects the aging fleet (AEMO, 2018c));
- Reduction of generation output during hot weather events;
- Assessment of the contribution of intermittent generation sources;
- Assessment of transmission infrastructure – how it functions, including with reference to line ratings and major interconnectors and how they are impacted by hot weather events, bushfires and unplanned outages;
- Modelling of battery storage.

On 16 November 2018, AEMO published the 2018-19 Summer Readiness Plan which responds to projected risks identified in AEMO's 2018 ESOO; and identifies activities AEMO has undertaken, and will undertake, to secure the power system during the 2018/19 summer (AEMO, 2018h). These include:

- Ensuring supply meets consumers' summer energy demand, at peak times and extreme weather events – noting that 2,100MW of increased capacity has entered the market in 2018 and is available for the coming summer. Specific initiatives include:
    - Securing short and medium term reserve resources through the RERT to reduce reliability and security risks, in particular in Victoria.
    - Supporting networks and generators to minimise planned outages; to identify and mitigate risks of unplanned outages at times of high summer demand; to identify and mitigate risks to fuel supply, including by improving visibility of gas transmission pipeline, production and Transmission Network Service Providers (TNSP) maintenance programs; and coordinating a Gas Supply Guarantee exercise to practice business processes required in a gas shortfall.
- Improving AEMO's operational and forecasting systems and processes to better manage increased uncertainty of supply, demand and reserve. Specific initiatives include:
    - Improving reserve management systems including the Forecasting Uncertainty Measure (FUM) (operational on 30 November 2018) and dynamic Lack of Reserve (LOR) system (introduced in February 2018), enabling a reduction in reserve requirements.
    - Increasing sampling of real-time rooftop PV system data to improve the accuracy of short term forecasting.
    - Improving demand forecasting systems by retraining models and increasing data feeds from weather stations.
    - Collaborating more closely with weather service providers to improve the speed and suitability of weather information for power system operators.
    - Providing additional training and resources for control room and support staff.
- Identifying risks and testing contingency plans and communications processes. Specific initiatives include:
    - Conducting joint emergency exercises to test and update response procedures, through the National Gas Emergency Response Advisory Committee (NGERAC) and National Electricity Market Emergency Management Forum (NEMEMF).
    - Conducting state-specific energy planning exercises with state governments and TNSPs to ensure operational and communications alignment.
    - Hosting weekly summer readiness outlook briefings throughout summer with government, TNSP and AEMO representatives – covering short term forecast weather conditions, supply, demand, outages and other risks.
- Engaging with government and industry stakeholders to establish working groups and to communicate and deliver the aforementioned activities, including with the NSW EUSFAC on a regular basis.

Overall, the Panel finds that NSW is well-prepared for the coming summer, noting that protocols and exercises by DPE, NSW Government and industry stakeholders have improved summer readiness over the past twelve months.

1.5 WHAT ELSE COULD BE DONE TO PREPARE NSW FOR FUTURE SUMMERS?

Critical to minimising impacts to customers and community is review and exercise of guidelines and protocols. This is acknowledged in the NSW Summer Readiness Action Plan. The Panel however would particularly stress the importance of up-to-date procedures and officers' experience in managing load shedding events. As such, regular (annual) reviews of procedures and exercises, including of the Jurisdictional Load Shedding Guidelines, should be required.

> **Recommendation 5**
>
> *That the Department of Planning and Environment coordinate exercises and annual reviews, including on the Jurisdictional Load Shedding Guidelines (JLSG) and emergency powers/procedures, prior to the start of the 2019/20 summer and each summer thereafter.*

The reliability that customers experience is a combination of the service provided by generators, transmission networks and distribution networks. Most of the outages, however, that customers experience are due to issues on the distribution networks and are managed through the normal operations of the distributors in consultation with TransGrid and AEMO (NSW CSE, 2017a).

Distribution businesses are obligated to provide a safe, secure and reliable supply to consumers to ensure a reliable supply of electricity. While the level of reliability experienced by customers can vary for different areas of the network, reliability on average is at a high level. There are a number of factors that can lead to unplanned outages, which distribution networks have limited control over. This includes factors such as animals or birds coming in contact with wires, or extreme weather such as storms, which may bring lines down.

The costs of improving current average levels of reliability can be significant and it would be neither practical nor acceptable from a customer pricing perspective to attempt to remove all outages on the distribution networks.

Therefore, in preparing its findings and recommendations, as a starting point the Panel has reviewed information prepared by AEMO relating to the forecast unserved energy that suggests sufficient generation and transmission is available to meet forecast demand in NSW for the next three to four years.

In summary:

- As highlighted in the AEMO Electricity Statement of Opportunities (ESOO) and as illustrated in Figure 1, in the medium to longer term, investment in resources beyond those that are currently committed will be required to maintain reliability within the standard in Victoria, New South Wales, and South Australia after the announced retirements of the Torrens Island A Power Station (480 MW between 2019 and 2021) and Liddell Power Station (1,800 MW in 2022). The level of USE is projected to increase significantly without further NEM development.
- For NSW, the retirement of the Liddell Power Station, when considering only existing and committed projects, is forecast to result in USE being higher than the NEM reliability standard without additional development.

- As noted by AEMO in the 2018 ESOO (page 9) and as identified in AEMO's 2018 Integrated System Plan (ISP), the reliability gap could be closed by a portfolio of resources including utility-scale renewable generation, storage, distributed energy resources (DER), flexible thermal capacity and transmission.

When considering the range of generation, storage and transmission investments, which in combination may meet the reliability, security and emissions requirements in the NEM at lowest cost, the effect is a projected substantial reduction in the level of USE to below the reliability standard, as illustrated in Figure 4 below.

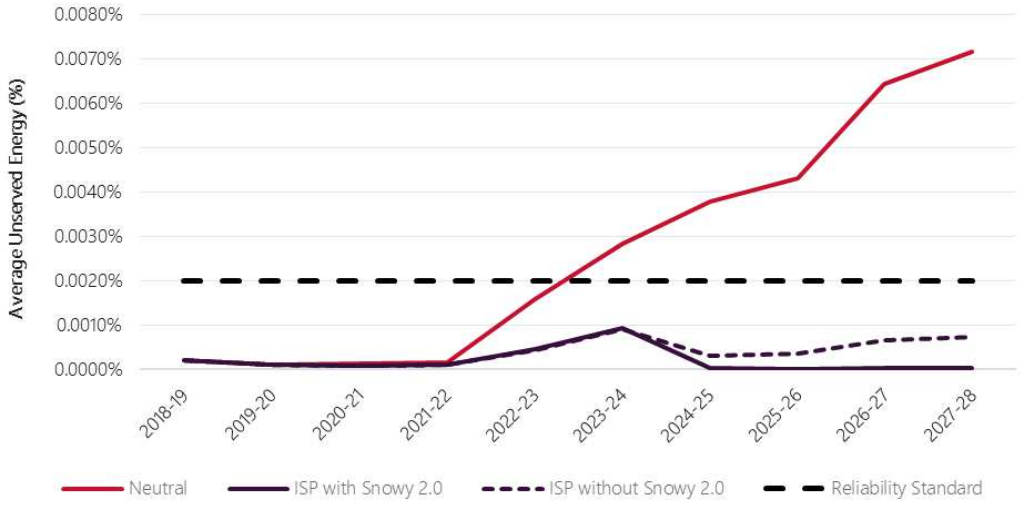


Figure 4: Figure from AEMO's 2018 ESOO (Forecast USE outcomes – Neutral ESOO demand, ISP Neutral development plans), which presents three scenarios: the 'neutral' scenario (no further transmission is built to increase network capabilities) and the AEMO ISP development plans (with/without Snowy 2.0) (AEMO, 2018c)

While Figure 1 highlights that power plant closures have the potential to significantly impact the electricity system in terms of USE and the risk of future load shedding when considering only existing and committed projects, Figure 4 highlights that this impact can be mitigated by a range of additional generation, storage and transmission investments for NSW.

AEMO's Integrated System Plan (ISP) was a key recommendation of the Independent Review into the Future Security of the NEM (the 'Finkel Review'), and is aimed at providing a long-term and nationally-coordinated approach to deliver low energy costs, maintain system security and connect renewable energy resources. Figure 1 uses scenarios from theISP, an optimisation plan that forecasts the requirements for the NEM transmission system for the next 20 years (AEMO, 2018e).

To this end, actions could be considered to ensure future efficient investment in the electricity system occurs in a timely manner and that adequately take account of the reliability impacts on customers in NSW.

The current reliability standard has been in place for many years and appears to have been effective in minimising the level of unserved energy in the NEM. However, given the transformation occurring in the electricity market, it is appropriate to consider whether aspects of the current arrangements, such as the reliability standard, continue to be fit for purpose, and reflect the dynamic and evolving needs of future energy customers in NSW.

The following observation from AEMO highlights the potential issue for NSW of maintaining the current NEM reliability standard (AEMO, 2018a):

> *By way of example, USE of 0.002% for New South Wales in 2022 (forecast based on a neutral growth scenario) is the equivalent to 1,280 MWh, or approximately 644,450 households off supply for one hour, or 107,408 households off supply for six hours. A shorter operational peak results in higher MW at risk (though for shorter duration) and increased probability of load shedding within the USE allowed under the reliability standard. This means the outage impact is likely to be more widespread, affecting more households over the most extreme heat period. The value of customer reliability during a severe and widespread outage is likely to be higher than at other times.*
>
> *Further, increasing extreme temperatures from climate change and urban development means increased health and safety risks from non-supply during these events compared to when the reliability standard was first established.*

Changing customer expectations and the transformation of the energy industry towards a new mix of generation suggests that the existing NEM reliability standard approach may need to be reviewed to assess whether it remains the appropriate standard for reliability moving forward.

It is therefore suggested that the NSW Government engage with the Australian Energy Market Commission's (AEMC) Reliability Panel and other market entities to determine whether the existing NEM reliability standard, and the frameworks to implement this standard, remain appropriate where the operational demand is becoming 'peakier' due to high uptake of rooftop PV and power system reliability is more exposed to the impacts of weather.

Recommendation 6

The NSW Government to engage with the AEMC's Reliability Panel, AEMO and the AER to assess whether the current NEM reliability framework, including the reliability standard, remains an appropriate measure for customers in NSW moving forward, and to continue engagement as relevant in the future.

The Panel noted that future constraints exist not only in power generation, but also in how new generation accesses the grid. To this end, the need for investment in the transmission network, including increased interconnection and connecting new smaller scale renewable generation, is a critical component in ensuring reliable electricity supply following the retirement of existing generation.

In preparing this report, the Panel had regard to the NSW Transmission Infrastructure Strategy, released in November 2018, that is aimed at building on existing programs to reduce household and business energy bills and secure energy supplies to (NSW Government, 2018):

1. Boosting NSW's interconnection with Victoria, South Australia and Queensland, and unlocking more power from the Snowy Hydro Scheme via new transmission infrastructure and Snowy 2.0;
2. Increasing NSW's energy capacity by prioritising and leveraging strategic infrastructure upgrades in the Central-West, South West and New England regions of NSW, which will become a driving force to deliver affordable energy into the future; and

3. Working with other states and regulators to streamline regulation and improve conditions for investment.

The Strategy forms part of the Government's broader plan to make energy more affordable, secure investment in new power stations and network infrastructure, and ensure new technologies deliver benefits for consumers.

Recommendation 7

The NSW Government to ensure its transmission strategy is implemented to ensure sufficient transmission infrastructure is available to meet the needs of the market.

The NSW Government through its NSW Transmission Infrastructure Strategy has signalled its intention to work with other jurisdictions to ensure the Regulatory Investment Test for transmission (RIT-T) and other regulatory processes are 'fit-for-purpose' (NSW Government 2018). The Panel supports his approach.

Recommendation 8

The NSW Government, through its involvement in the COAG Energy Council and other Commonwealth agencies, to support the streamlining of regulatory processes, including the RIT-T, to ensure the timely delivery of efficient transmission infrastructure.

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3. TERMS OF REFERENCE – ASSESSMENT OF SUMMER PREPAREDNESS - 2018

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 weather. The Taskforce released its initial report on 22 May 2017 and its final report on 19 December 2017.

The initial report focused on the actions that could be implemented to deal with reliability and security risks for the 2017/18 summer and the final report looked at the longer-term resilience of the NSW electricity systems.

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

To mitigate the risks the NSW Government has implemented the intent of the initial report and the nine recommendations of the final report. The Department of Planning & Environment will also continue to implement additional programs to enhance security of supply for NSW.

Draft Scope of review

The review will:

1. Assess the adequacy of the State's 2018/19 summer readiness action plan. Adequacy will be assessed in the context of the NSW Government's responsibilities and its levers in the energy market and emergency management.
2. Provide advice on any additional measures that should be taken by the NSW Government to minimise any vulnerabilities identified and/or opportunities for improvements in current practices.
3. Identify any emerging risks for 2019/20 summer and make recommendations on actions to address any vulnerability identified so that proactive actions can be implemented.
4. Provide advice on any additional measures, as relevant, that could be taken by the NSW Government for future preparedness planning.

In undertaking this work, the Panel will have regard to the summer readiness plans of AEMO and other jurisdictions and identify if there are any relevant actions for NSW.

Process

The Panel's advice will be provided to the Minister for Energy and Utilities by 16 November 2018. The advice can be in the form of a letter.

There is significant work being undertaken by the Australian Energy Market Operator, including the preparation of its 2018/19 summer readiness plan. The Panel should draw on this work where possible and focus on areas particularly related to NSW.

Panel members

NSW Chief Scientist & Engineer (Chair)
Mr Dave Owens
Mr Mike Martinson