AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

Energy Adequacy Assessment Projection

November 2019

Important notice

PURPOSE

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ACKNOWLEDGEMENT

AEMO acknowledges the support, co-operation and contribution of market participants in providing data and information used in this publication.

VERSION CONTROL

Version	Release date	Changes
#1	30-11-2019	None

Executive summary

The Energy Adequacy Assessment Projection (EAAP) forecasts electricity supply reliability in the National Electricity Market (NEM) over a two-year outlook period. The EAAP complements AEMO's other reliability assessments such as the Medium Term Projected Assessment of System Adequacy (MT PASA) and the Electricity Statement of Opportunities (ESOO), with a primary focus on the impact of energy constraints on reliability in the next two years.

Potential energy constraints include, but are not limited to, water availability, for hydro generation and as cooling water for thermal generation during drought conditions, and constraints on fuel supply for thermal generators.

For water availability, participants submit input used in EAAP that considers three different rainfall scenarios:

- Low rainfall – based on rainfall between 1 July 2006 and 30 June 2007 for all regions except New South Wales. New South Wales is based on rainfall between 1 June 2006 and 31 May 2007.
- Short-term average rainfall – based on the average rainfall recorded over the past 10 years.
- Long-term average rainfall – based on the average rainfall recorded over the past 50 years, or the longest period for which rainfall data is available, if less than 50 years.

Key insights

Based on the information provided by participants, this November 2019 EAAP highlights that:

- The impact of drought conditions on mainland reservoir levels is unlikely to significantly affect reliability in the coming summer, even if low hydro inflow conditions continue.
- Energy limitations supplied by some thermal generators related to fuel supply have no impact on the level of projected unserved energy (USE) observed in any region in the next two years.

This is because there is sufficient flexibility remaining for energy-limited resources to be used effectively to avoid shortfalls at times of high demand.

However, supply scarcity risks remain this summer, primarily attributable to forecast extreme temperatures, bushfire risks, and the deteriorating reliability of some ageing thermal generation:

- There remains a risk of USE in Victoria in 2019-20, particularly under peak demand conditions. To ensure that the reliability standard is met, AEMO has identified additional reserves which can be made available through Reliability and Emergency Reserve Trader (RERT) reserve contracts.
- Although some risk of supply shortfalls also exists in New South Wales and South Australia, the level of USE is within the reliability standard[1].
- Negligible USE is forecast in Queensland or Tasmania.
- The forecast level of USE declines slightly in Victoria and New South Wales in 2020-21, due to the addition of committed renewable generation.
- The forecast level of USE increases in South Australia in 2020-21, due to the retirement of Torrens Island A units.

[1] The reliability standard specifies that expected USE should not exceed 0.002% of total energy consumption in any region in any financial year.

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1. Introduction

1.1 Purpose and scope

The Energy Adequacy Assessment Projection (EAAP) report provides information on the impact of potential energy constraints on supply adequacy in the National Electricity Market (NEM) across the two-year study period. Potential energy constraints include, but are not limited to, the impact of depleted water storages during drought conditions and constraints on fuel supply or cooling water available for thermal generation.

In this report, AEMO calculates expected unserved energy (USE) for each region under three rainfall scenarios and assesses this projected USE against the reliability standard. The reliability standard specifies that expected USE should not exceed 0.002% of total energy consumption in any region in any financial year.

AEMO implements the reliability standard using forecasts and projections over different timeframes. AEMO uses the following processes that each serve a slightly different purpose and therefore use slightly different inputs and approaches:

- Electricity Statement of Opportunities (ESOO), to provide market information over a 10-year projection to assist planning by existing and potential generators and market participants, published at least annually.
- Energy Adequacy Assessment Projection (EAAP), to forecast USE for energy constrained scenarios over a two-year projection, published at least once every 12 months.
- Medium Term Projected Assessment of System Adequacy (MT PASA), to forecast USE over a two-year projection, published on a weekly basis based on participants' best expectation of generation availability and outage scheduling.
- Short Term Projected Assessment of System Adequacy (ST PASA) to forecast capacity reserve over a six-day projection, published at least daily.

More details on each of these processes is in the Reliability Standard Implementation Guidelines[2] (RSIG).

1.2 Scenarios

For the November 2019 EAAP report, AEMO assessed the potential for USE under three different rainfall scenarios in accordance with the EAAP Guidelines[3]. Each scenario was modelled for the period October 2019 to September 2021. The three scenarios are described below:

- Low rainfall – based on rainfall between 1 July 2006 and 30 June 2007 for all regions except New South Wales. New South Wales was based on rainfall between 1 June 2006 and 31 May 2007[4].
- Short-term average rainfall – based on the average rainfall recorded over the past 10 years.
- Long-term average rainfall – based on the average rainfall recorded over the past 50 years, or the longest period for which rainfall data is available, if less than 50 years (depending on the data available to participants).

Information such as natural inflows, energy constraints, and the level of hydro storage reservoirs at the start of the EAAP modelling horizon is provided by participants through their Generator Energy Limitation Framework (GELF) submissions for each scenario.

[2] For more on PASA and the RSIG, see https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Data/Market-Management-System-MMS/Projected-Assessment-of-System-Adequacy.

[3] At http://www.aemo.com.au/-/media/Files/Stakeholder_Consultation/Consultations/Electricity_Consultations/2016/EAAP/EAAP_Guidelines.pdf.

[4] The inflows into the major hydro schemes in 2006-07 were impacted by severe drought.

2. Methodology and assumptions

2.1 Methodology

The EAAP is based on a probabilistic, time-sequential model that simulates hourly Monte Carlo simulations to determine potential future supply shortfalls for the three rainfall scenarios, taking account of any other energy limitations provided by participants. This model also accounts for uncertainties in unplanned generator outages and weather-sensitive demand and supply from intermittent resources.

For the November 2019 EAAP modelling, 900 simulations were performed for each rainfall scenario for both 10% and 50% Probability of Exceedance (POE) demand forecasts. For each of the two maximum demand forecasts, nine historical reference years were used to represent variable patterns of intermittent generation and demand.

The model uses a probability-weighted USE assessment to identify whether expected USE is likely to exceed the reliability standard in each region of the NEM. Expected USE was derived by applying the following weightings to results from the moderate and extreme demand scenarios:

- 30.4% for 10% POE.
- 39.2% for 50% POE.
- 30.4% for 90% POE[5].

2.2 Assumptions

2.2.1 Electricity demand

AEMO used the demand forecast under the Central scenario from the 2019 ESOO for the NEM[6]. This forecast covered the latest assumptions on:

- Economic and population drivers.
- Behaviour trends in households and business consumers.
- Electric vehicle forecasts.
- Current installed capacity and forecast additional capacity from rooftop photovoltaic (PV) and energy storage systems.
- The forecast impacts of energy efficiency.

[5] Weighting attributed to a 90% POE that is assumed to lead to zero USE and therefore not modelled. Any simulations with USE above zero in the 90% POE case are likely to have so much USE in the 50% and 10% POE cases that it would be expected to be identified as exceeding the reliability standard, regardless of whether or not the 90% POE outcomes were modelled.

[6] Forecasts are available at http://forecasting.aemo.com.au/. Select ESOO 2019 from Publications at pop-up menu.

2.2.2 Generation capacity

AEMO has used the latest information on generation commitments in the NEM. AEMO included all scheduled and semi-scheduled and significant non-scheduled generation that exists or is assumed to be committed in the modelling period[7].

The capacity of existing generation is sourced from the MT PASA offers submitted in the week beginning 27 October 2019. In accordance with the EAAP Guidelines, if USE is forecast during periods where the MT PASA offer reflects a planned generator outage, this outage is removed from EAAP, unless specified as inflexible through the participant's GELF submission. The EAAP assessment of USE therefore assumes any planned generation outages that have timing flexibility will be shifted to avoid potential USE.

The committed generation developments included in the EAAP and MT PASA models are summarised in Appendix A2.

2.2.3 Transmission capability

Interconnector information includes, but is not limited to, inter-regional loss factor models and marginal loss factors. Network constraints, which represent technical limits on operating the power system, are expressed as a linear combination of generation and interconnectors, which are constrained to be less than, equal to, or greater than a certain limit. Only network constraints associated with system normal conditions are modelled.

2.2.4 GELF parameters

The GELF parameters are confidential information submitted by scheduled generators designed to include limitations on resources affecting their ability to supply energy, such as inflows into hydro reservoirs, thermal generation fuel supply, and cooling water availability. These parameters are classified into two categories:

- Static GELF parameters, which include:
  - Technical specifications of the power stations, such as power station name, type of power station, number of generating units at the power station, and their capacities.
  - Additional components associated with hydro power schemes, such as maximum and minimum active reservoir storage, the reservoirs to which the tunnels are connected, water utilisation factor for generation and pumping for each generating unit or for the power station, and reservoir connections (for example, upstream reservoir and downstream reservoir).
- Variable GELF parameters, which include:
  - Monthly forecast generation capability and monthly capacity profiles to be submitted by non-hydro power stations.
  - Active reservoir storage at the beginning of the study period, monthly inflows to reservoirs during the study period, minimum reservoir level that can be reached in each month of the study period without violating long-term reservoir management policy, and any other limitations on reservoir capacities or levels that should be considered within the study period to be submitted for hydro power schemes.

Please see EAAP Guidelines[8] for the details of the GELF parameters.

[7] In AEMO's Generation Information page, committed* or Com* projects are projects that are classified as Advanced and have commenced construction or installation. Advanced projects meet AEMO's site, finance, and date criteria but are required to meet only one of the components or planning criteria. Com* projects are assumed to commence operation on 1 July 2021 at the earliest, as per the Reliability Forecasting Methodology Final Report. See Section 5.3 at https://www.aemo.com.au/-/media/Files/Stakeholder_Consultation/Consultations/NEM-Consultations/2019/Reliability-Forecasting Methodology/Reliability-Forecasting-Methodology-Final-Report.pdf.

[8] At http://www.aemo.com.au/-/media/Files/Stakeholder_Consultation/Consultations/Electricity_Consultations/2016/EAAP/EAAP_Guidelines.pdf.

3. Results

Key outcomes

- The EAAP forecasts a risk of USE in Victoria (and South Australia, due to its level of connection with Victoria) in 2019-20, particularly under peak demand conditions. Based on EAAP methodology, assumptions, and inputs, the expected level of USE is below the reliability standard in all rainfall scenarios.
- Due to use of slightly different input assumptions, the EAAP forecast of USE is below the forecast in the 2019 ESOO, and current MT PASA forecasts. EAAP does not consider the risk of delays to the return to service of the Loy Yang A and Mortlake units and assumes that all eight units of Torrens Island are made available this summer. Further, it assumes that flexible outages submitted in MT PASA can be rescheduled if need be.
- However, supply scarcity risks remain this summer under extreme temperatures conducive of 10% POE demand conditions, particularly given recent unreliable performance of some brown coal generators in Victoria, and the risk of bushfires which can impact the power system by reducing transmission capacity.
  - The Bureau of Meteorology (BoM) is forecasting greater than 80% chance of above median maximum temperatures across the NEM for December to February this summer[9].
  - If 10% POE demand conditions were to be realised this summer, the EAAP short-term rainfall scenario projects expected USE of 0.0032% in Victoria, above the reliability standard.
- Based on the information provided by participants, the direct impact of drought conditions on mainland reservoir levels is unlikely to materially affect reliability in the coming summer, even if low hydro inflow conditions continue.
- Although some risk of supply shortfalls also exists in New South Wales this summer, the level of USE is below the reliability standard. Negligible USE is observed in Queensland or Tasmania.
- The limitations on fuel supply that have been provided by participants do not have a significant impact on the level of USE in any region. The fuel limitations submitted by participants are generally over longer periods, such as annual or monthly limits, and, if managed effectively, provide adequate flexibility to allow generation to have fuel available at times of tight supply-demand balance.
- The forecast level of expected USE in New South Wales and Victoria declines slightly in the second year of the modelling horizon under all rainfall scenarios, as a result of more variable renewable energy generation and some relatively small batteries coming online.
- The forecast level of expected USE in South Australia increases in 2020-21 under all rainfall scenarios as a result of Torrens Island A units mothballing after this summer.
  - Note that the temporary diesel generators in South Australia are not included, but may become scheduled generators before the 2020-21 summer period. Their inclusion would help to moderate the impact of the closure of Torrens Island A.

[9] BOM. Climate outlooks – weeks, months and seasons. http://www.bom.gov.au/climate/outlooks/#/temperature/maximum/median/seasonal/0. Accessed 25 Nov 2019.

3.1 EAAP results

The reliability assessment indicates that, under all rainfall scenarios, there is a risk of USE in New South Wales, South Australia, and Victoria over the next two years, mainly during peak summer periods.

This risk is primarily driven by increased vulnerability to climatic conditions such as extended periods of high temperature, corresponding with low wind or solar availability and unplanned generation outages, as already highlighted in the 2019 ESOO[10] and MT PASA[11]. Drought (and energy constraints more generally) is forecast to have a minimal impact on reliability in the two-year outlook, due to the ability of generators to schedule limited energy resources for use at times of highest demand.

It is important to note that this reliability assessment focuses on the impact of energy constraints on expected USE in the next two years in accordance with a methodology and assumptions outlined in the EAAP Guidelines, and does not take into account some of the operational risks that are appropriately considered in the ESOO. Some of these risks are discussed further in sections 3.3 and 3.4. Because of this, the levels of USE projected for summer 2019-20 in this EAAP are lower than those forecast in the 2019 ESOO, and mask some of the risks AEMO is actively managing through procurement of RERT this summer.

Furthermore, the EAAP considers that some outages and plant unavailability that are applied in MT PASA are flexible (based on participant GELF submissions) and are therefore required to be removed from periods of high USE risk.

Energy limitations over the next two years are projected to have the following impact on supply adequacy:

- Under all rainfall scenarios:
  - USE is observed in New South Wales, South Australia, and Victoria over the next two years.
  - The region with the biggest risk of USE is Victoria, with the expected level of USE reaching 0.0012% in 2019-20 and 0.0008% in 2020-21. The slight reduction in USE in the second year is due to a minor reduction in peak demand expectations and commitment of new renewable generation.
  - Forecast USE in New South Wales is relatively low, and reduces slightly in 2020-21 due to the commitment of new renewable generation.
  - Forecast USE in South Australia is relatively low in 2019-20, and increases in 2020-21 due to the closure of all four Torrens Island A units.
    - This assessment does not consider equitable load shedding that may spread load shedding pro rata throughout interconnected regions when this would not increase total load shedding, provided interconnector headroom is available. Due to its interconnectedness with Victoria, South Australia may also be at risk of load shedding based on this equitable load shedding principle.
    - This assessment also did not consider the South Australian emergency diesel generators which are expected to be commissioned as scheduled market generators before summer 2020-21.
- Under short-term, long-term, and low average rainfall scenarios:
  - The low rainfall scenario has the highest USE across almost all regions and years. This increase is mostly due to capacity constraints submitted by Victorian hydro generators. However, the impact of low rainfall conditions is not significant (an increase of 0.00017% and 0.00014% in 2019-20 and 2020-21 respectively).
  - The long-term average rainfall has the lowest USE due to less restrictive capacity constraints over the summer months.
  - Inflows and energy limits have very little impact on expected USE, because energy can be moved to periods where it is needed over this timeframe.

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[10] At https://aemo.com.au/-/media/Files/Electricity/NEM/Planning_and_Forecasting/NEM_ESOO/2019/2019-Electricity-Statement-of-Opportunities.pdf.

[11] Further information on MT PASA can be found at https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Data/Market-Management-System-MMS/Projected-Assessment-of-System-Adequacy.

- Negligible USE is projected in Queensland and Tasmania across any rainfall scenario over the next two years.

The modelling results show the occurrence of USE generally in the months of December-March, with small amounts of USE also occurring in November 2019 in Victoria and very small amounts over winter (June-August) in New South Wales.

The monthly forecast USE for all regions under the three rainfall scenarios is provided in Appendix A1.

Annual USE outcomes are provided in the following tables and in Figure 1.

Figure 1 Forecast USE range across all rainfall scenarios

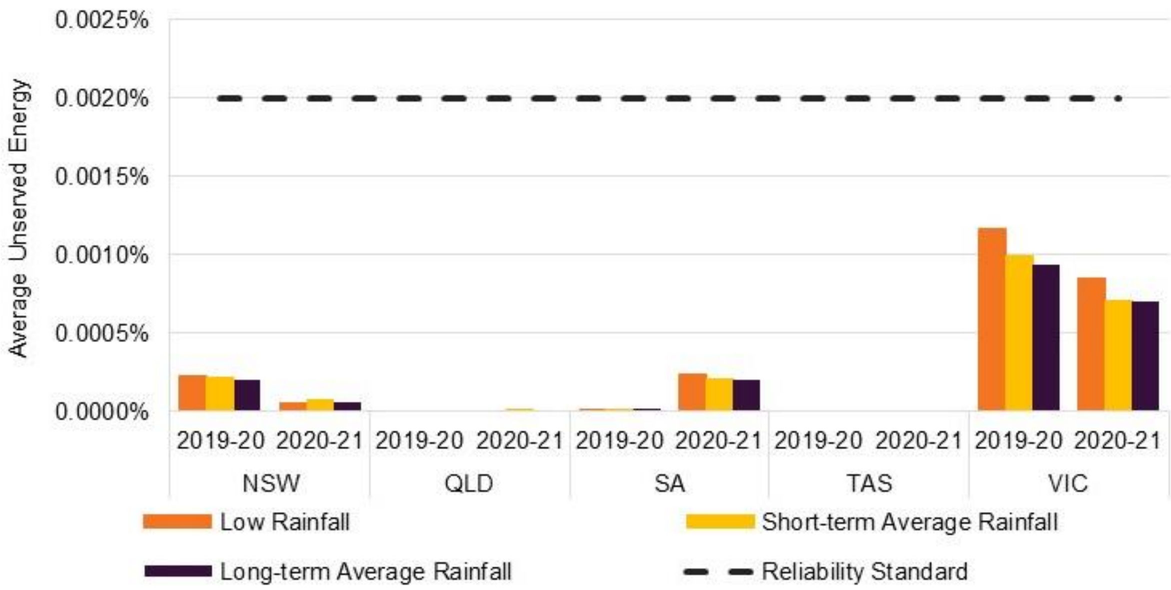


Table 1 Forecast USE in low rainfall scenario

	2019-20 USE		2020-21 USE	
	(MWh)	(% of regional demand)	(MWh)	(% of regional demand)
New South Wales	156	0.00023%	39[12]	0.00006%
Queensland	-	-	-	-
South Australia	2	0.00001%	30	0.00024%
Tasmania	-	-	-	-
Victoria	504	0.00116%	360	0.00084%

[12] The USE is marginally lower under the low rainfall conditions in New South Wales than in the short-term average scenario. This is largely the result of variability in USE outcomes across iterations between the two scenarios which is more noticeable when the expected level of USE is a low value.

Table 2 USE in short-term average rainfall scenario

	2019-20 USE		2020-21 USE	
	(MWh)	(% of regional demand)	(MWh)	(% of regional demand)
New South Wales	151	0.00022%	52	0.00008%
Queensland	-	-	-	-
South Australia	2	0.00002%	26	0.00020%
Tasmania	-	-	-	-
Victoria	431	0.00099%	300	0.00070%

Table 3 Forecast USE in long-term average rainfall scenario

	2019-20 USE		2020-21 USE	
	(MWh)	(% of regional demand)	(MWh)	(% of regional demand)
New South Wales	138	0.00020%	39	0.00006%
Queensland	-	-	-	-
South Australia	2	0.00002%	26	0.00021%
Tasmania	-	-	-	-
Victoria	406	0.00094%	301	0.00070%

3.2 Differences between EAAP and MT PASA

AEMO administers three processes to assess NEM reliability against the reliability standard that focus on a two-year planning horizon:

- EAAP, to forecast USE for capacity and energy constrained scenarios, with a particular focus on the impact of water shortages during drought conditions, or thermal generation fuel supply or cooling water limitations.
- MT PASA, to forecast possible capacity shortfalls incorporating scheduled generation and transmission outages.
- ESOO, to forecast capacity or energy shortfalls over the next 10 years and as the basis for the application of the Retailer Reliability Obligation (RRO).

These processes adopt similar modelling approaches, but use slightly different inputs, reflecting their different purposes and frequency of projections. The main difference between EAAP and MT PASA is that the EAAP is assessed under a range of predefined energy scenarios and is published at least once every 12 months, whereas the MT PASA is based on participants' best expectation of generation availability and is published on a weekly basis.

The MT PASA is an operational planning tool that informs market participants of tight supply conditions and allows them to reschedule planned generation outages to avoid potential supply shortfalls.

The EAAP, on the other hand, assumes that generation and transmission outages will be rescheduled to avoid load shedding unless participants have indicated that the timing of these outages is inflexible.

The similarities and differences of the two processes are described in more detail in the RSIG.

3.2.1 MT PASA projections

The most recent MT PASA result (published on 26 November 2019) shows higher USE than this EAAP Update for the following reasons:

- MT PASA incorporates the impact of transmission outages according to the Network Outage Schedule (NOS), while the EAAP model assumes system normal conditions, assuming any outage can be rescheduled to avoid capacity shortfalls.
- The MT PASA outcomes include the impact of scheduled generation outages which may be flexible. In EAAP modelling, any flexible outages that occur during periods with observed USE are removed. Generation may be unavailable in MT PASA, due to recall times that exceed the required 24 hours, but be considered available for the purpose of EAAP.

3.3 Differences between EAAP and ESOO

The NEM ESOO also provides a reliability forecast to cover the next 10 years that uses a similar methodology to that used in the EAAP. The primary difference between the forecasts is that the EAAP focuses on the impact of low rainfall conditions and other energy limitations on reliability. The similarities and differences of the two processes are described in more detail in the RSIG.

The USE outcomes provided in the 2019 ESOO for the 2019-20 financial year were higher than these EAAP outcomes. This was mainly due to the following:

- The 2019 ESOO results for 2019-20 considered the possibility of a delayed return to service of Loy Yang A and Mortlake units. The 2019 EAAP did not include these scenarios.
- The EAAP modelling includes the Torrens Island A units that were, at the time of the 2019 ESOO, considered to be mothballed. The 2019 ESOO did provide the results of a sensitivity which included the Torrens Island A units being in service for summer 2019-20.

Since the 2019 ESOO, new generator commitment information has also been updated and used in the November 2019 EAAP. USE outcomes in 2020-21 in the ESOO and EAAP are closely aligned.

3.4 Non-fuel related risks to reliable operation of the power system

The EAAP's primary focus is on the impact of energy constraints, particularly those related to low rainfall and drought conditions, on reliability in the next two years.

In addition to energy constraints, there are several other factors which have the potential to lead to elevated risk of USE, especially during summer 2019-20. AEMO continues to observe greater risk of USE due to high impact 'tail risk' events as detailed in the 2019 ESOO.

3.4.1 Seasonal forecast and forecast record temperatures heighten risk of USE

There is a heightened risk of USE due to extreme weather events this summer, with the BoM forecasting a very high probability that seasonal maximum temperatures for this summer will exceed median maximum temperature observations[13] (see Figure 2).

Coupled with this, the BoM forecast an increase in the number of days when mean temperature is extreme (above the 99th percentile) with 2019 to date already recording the third highest number of days on record (since 1910).

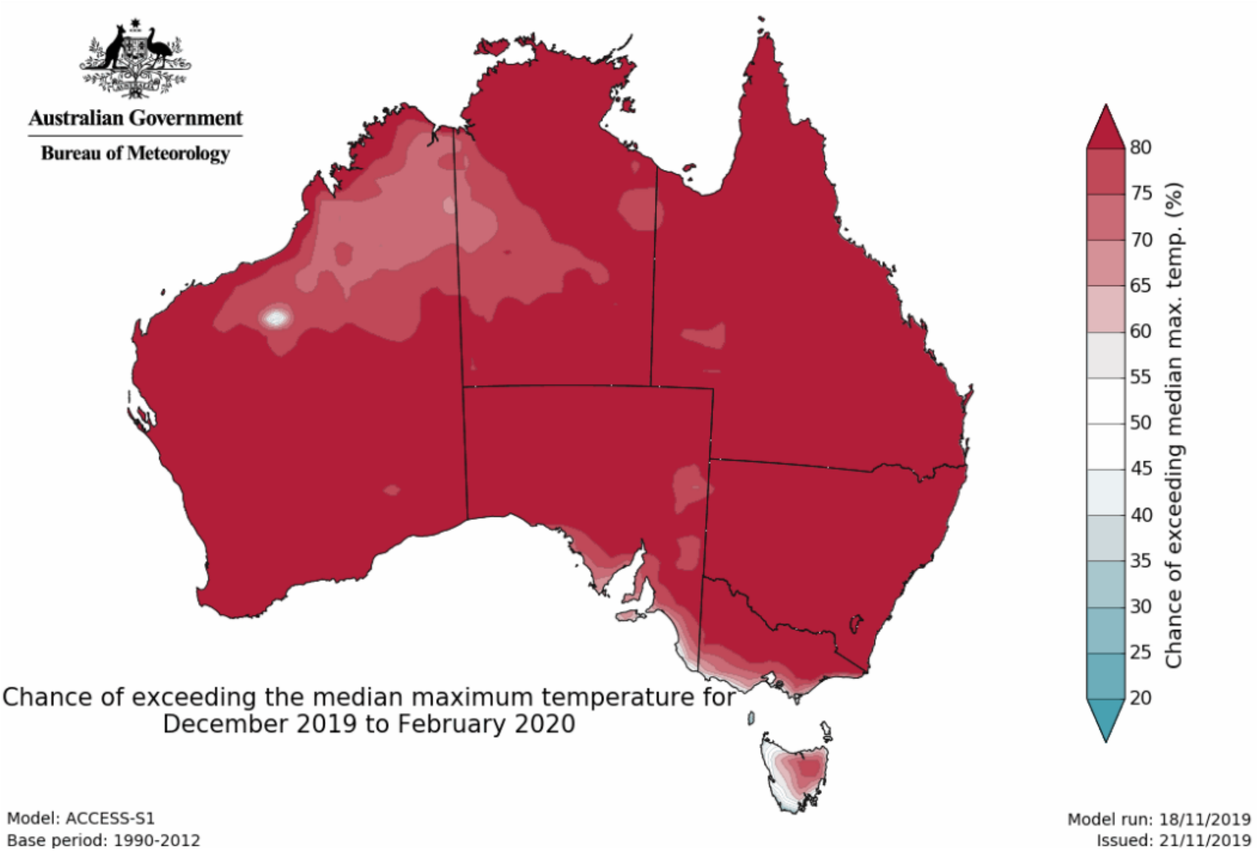
Higher temperatures can lead to higher demand for electricity, putting a strain on the supply-demand balance and increasing risk of USE. Should 10% POE conditions eventuate, the EAAP short-term rainfall

[13] BOM. Climate outlooks – weeks, months and seasons. http://www.bom.gov.au/climate/outlooks/#/temperature/maximum/median/seasonal/0. Accessed 25 Nov 2019.

scenario projects expected USE of 0.0032%, above the reliability standard. The BoM currently predicts a high probability of exceeding median maximum temperatures for the upcoming summer, see Figure 2 below.

Current weather conditions coupled with extended-drought conditions also increase the likelihood of bushfire which can threaten power system reliability by de-rating inter-regional transfer capability during times of high demand.

Figure 2 Chance of exceeding median maximum temperature for December 2019 to February 2020



3.4.2 Increased risk of USE if outages at Mortlake and Loy Yang are extended

As outlined in the 2019 ESOO, the unplanned outages of two major power stations – Loy Yang A2 (500 MW) and Mortlake 2 (259 MW) – increase the risk of USE if the outages extend into Quarter 1 2020. Both units have an announced return to service date in December 2019. Previous analysis by AEMO pointed to likelihood of some extension to the outage periods. With December approaching, both AGL[14] and Origin Energy[15] have publicly expressed confidence that these units will be returned to service on schedule.

The EAAP therefore does not include any extension to outage periods, beyond what is advised by relevant participants in their MT PASA submissions, as per the EAAP Guidelines. Any outage extensions, should they still occur, would increase supply scarcity risk beyond what is forecast in this year's EAAP.

3.4.3 Reliability of plant returning to service

Generating units returning to service after extended outages can, on occasion, require an extended re-commissioning process to ensure pre-outage levels of control, stability, and reliability are established.

[14] See https://www.agl.com.au/-/media/aglmedia/documents/about-agl/investors/webcasts-and-presentations/2019/2019investordaypresentation.pdf?la=en&hash=B9D0757D530146268A77117AD4459050.

[15] See https://www.originenergy.com.au/content/dam/origin/about/investors-media/origin_2019_ibd_final_asx.pdf.

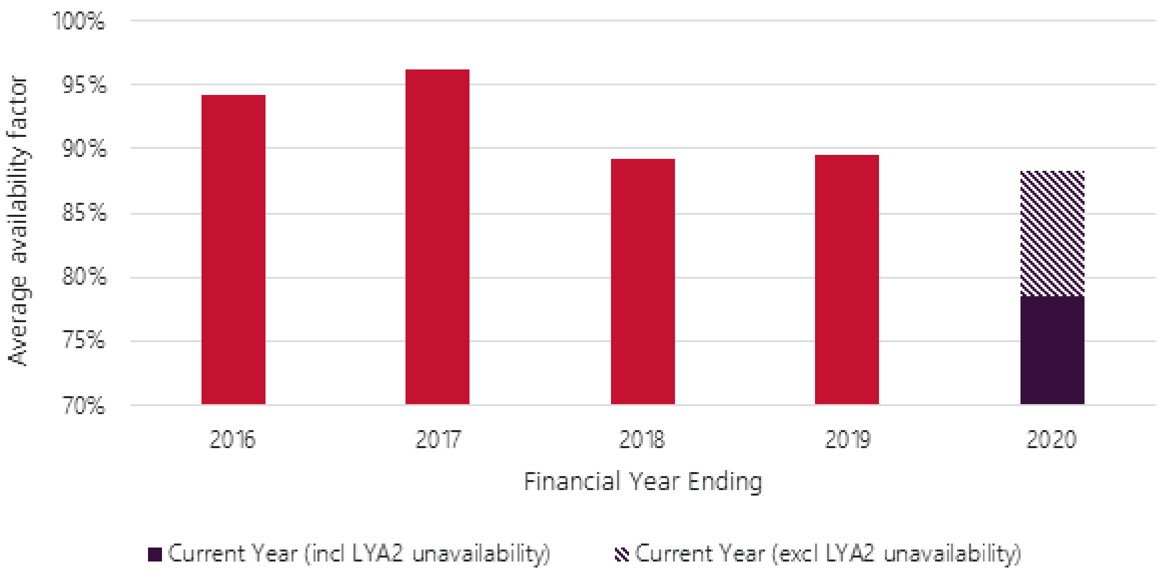
If the units returning to service after an extended outage require repeat commitments and de-commitments, or even further periods offline for any length of time during summer, this situation could materially increase the risk of USE.

This risk has not been captured in this EAAP assessment, which is primarily focused on the impacts of energy constraints associated with drought or other fuel restrictions.

3.4.4 Reliable performance of the remainder of the fleet

Financial year-to-date performance trends of some of the NEM baseload fleet, if continued into summer 2019-20, will increase the risk of USE. Victoria is forecast to experience the highest levels of USE of the NEM regions, and is also heavily reliant on the Victorian brown coal fleet to meet demand. In recent years, the average availability factor of the Victorian brown coal fleet has been in decline, with analysis of the last three years of performance showing a 8% reduction in availability when compared to the same period in 2016-17, even after adjusting for the extended outage of Loy Yang A2. If the extended outage of Loy Yang A2 was also included in this assessment, availability year-to-date would be at 78% which is an 18% reduction compared to 2016-17.

Figure 3 Availability of the current Victorian brown coal fleet (1 July to 18 November, FY16 to date)



Note: Current Victorian brown coal fleet refers to Loy Yang A, Loy Yang B and Yallourn power stations. Analysis based on market availability.

A1. Detailed results

The tables below show the monthly USE in each of the rainfall scenarios modelled.

Table 4 Monthly forecast USE in low rainfall scenario, MWh

Month	New South Wales	Queensland	South Australia	Tasmania	Victoria
Oct-19	0.0	0.0	0.0	0.0	0.0
Nov-19	0.0	0.0	0.0	0.0	3.1
Dec-19	53.8	0.0	0.0	0.0	0.2
Jan-20	55.9	0.0	0.8[16]	0.0	410.1
Feb-20	46.4	0.0	0.8	0.0	86.7
Mar-20	0.0	0.0	0.0	0.0	3.6
Apr-20	0.0	0.0	0.0	0.0	0.0
May-20	0.0	0.0	0.0	0.0	0.0
Jun-20	0.0	0.0	0.0	0.0	0.0
Jul-20	0.0	0.0	0.0	0.0	0.0
Aug-20	0.0	0.0	0.0	0.0	0.0
Sep-20	0.0	0.0	0.0	0.0	0.0
Oct-20	0.0	0.0	0.0	0.0	0.0
Nov-20	0.0	0.0	0.0	0.0	0.0
Dec-20	11.0	0.0	0.0	0.0	0.0
Jan-21	7.8	0.0	21.5	0.0	264.5
Feb-21	19.4	0.0	8.2	0.0	93.5
Mar-21	1.1	0.0	0.0	0.0	2.4
Apr-21	0.0	0.0	0.0	0.0	0.0
May-21	0.0	0.0	0.0	0.0	0.0
Jun-21	0.0	0.0	0.0	0.0	0.0
Jul-21	0.1	0.0	0.0	0.0	0.0
Aug-21	0.0	0.0	0.0	0.0	0.0
Sep-21	0.0	0.0	0.0	0.0	0.0

[16] The USE is marginally lower under the low rainfall conditions in South Australia than in the short-term average scenario. This is largely the result of variability in USE outcomes across iterations between the two scenarios which is more noticeable when the expected level of USE is a low value.

Table 5 Monthly forecast USE in short-term average rainfall scenario, MWh

Month	New South Wales	Queensland	South Australia	Tasmania	Victoria
Oct-19	0.0	0.0	0.0	0.0	0.0
Nov-19	0.0	0.0	0.0	0.0	1.7
Dec-19	54.7	0.0	0.0	0.0	0.4
Jan-20	56.9	0.0	1.5	0.0	339.3
Feb-20	39.2	0.0	0.7	0.0	84.4
Mar-20	0.0	0.0	0.0	0.0	5.3
Apr-20	0.0	0.0	0.0	0.0	0.0
May-20	0.0	0.0	0.0	0.0	0.0
Jun-20	0.0	0.0	0.0	0.0	0.0
Jul-20	0.1	0.0	0.0	0.0	0.0
Aug-20	0.0	0.0	0.0	0.0	0.0
Sep-20	0.0	0.0	0.0	0.0	0.0
Oct-20	0.0	0.0	0.0	0.0	0.0
Nov-20	0.0	0.0	0.0	0.0	0.0
Dec-20	13.5	0.0	0.0	0.0	0.0
Jan-21	13.1	0.0	18.2	0.0	230.0
Feb-21	21.9	0.0	7.4	0.0	69.5
Mar-21	3.4	0.0	0.0	0.0	1.0
Apr-21	0.0	0.0	0.0	0.0	0.0
May-21	0.0	0.0	0.0	0.0	0.0
Jun-21	0.2	0.0	0.0	0.0	0.0
Jul-21	0.0	0.0	0.0	0.0	0.0
Aug-21	0.0	0.0	0.0	0.0	0.0
Sep-21	0.0	0.0	0.0	0.0	0.0

Table 6 Monthly forecast USE in long-term average rainfall scenario, MWh

Month	New South Wales	Queensland	South Australia	Tasmania	Victoria
Oct-19	0.0	0.0	0.0	0.0	0.0
Nov-19	0.0	0.0	0.0	0.0	0.9
Dec-19	37.7	0.0	0.0	0.0	0.0
Jan-20	44.2	0.0	1.7	0.0	313.7
Feb-20	55.5	0.0	0.7	0.0	85.6
Mar-20	0.0	0.0	0.0	0.0	6.2
Apr-20	0.0	0.0	0.0	0.0	0.0
May-20	0.0	0.0	0.0	0.0	0.0
Jun-20	0.0	0.0	0.0	0.0	0.0
Jul-20	0.2	0.0	0.0	0.0	0.0
Aug-20	0.0	0.0	0.0	0.0	0.0
Sep-20	0.0	0.0	0.0	0.0	0.0
Oct-20	0.0	0.0	0.0	0.0	0.0
Nov-20	0.0	0.0	0.0	0.0	0.0
Dec-20	13.1	0.0	0.0	0.0	0.0
Jan-21	12.9	0.0	19.2	0.0	223.9
Feb-21	12.0	0.0	6.6	0.0	75.1
Mar-21	0.8	0.0	0.0	0.0	1.7
Apr-21	0.0	0.0	0.0	0.0	0.0
May-21	0.0	0.0	0.0	0.0	0.0
Jun-21	0.0	0.0	0.0	0.0	0.0
Jul-21	0.0	0.0	0.0	0.0	0.0
Aug-21	0.1	0.0	0.0	0.0	0.0
Sep-21	0.0	0.0	0.0	0.0	0.0

A2. Generation developments

Table 7 below shows the new generation developments included in the EAAP model in all scenarios. Some generators have holding point constraints applied, so may not be able to reach their maximum capacity at the dates given.

Table 7 New generation developments

Project	Region	Fuel Type	Unit status	Nameplate capacity (MW)	Full commercial use date
Barker Inlet Power Station	SA	Natural Gas	Committed	210	Dec 2019
Bomen Solar Farm	NSW	Solar	Committed	121	Apr 2020
Bulgana Green Power Hub - BESS	VIC	Battery	Committed	20	Jan 2020
Bulgana Green Power Hub - Wind Farm	VIC	Wind	Committed	204	Jan 2020
Bungala Two Solar Farm	SA	Solar	Committed	110	Mar 2020
Cattle Hill Wind Farm	TAS	Wind	Committed	144	Mar 2020
Cherry Tree Wind Farm	VIC	Wind	Committed	58	Jun 2020
Cohuna Solar Farm	VIC	Solar	Committed*	27	Jul 2021
Coopers Gap Wind Farm	QLD	Wind	Committed	453	Jul 2020
Crudine Range Wind Farm	NSW	Wind	Committed	138	Sep 2020
Darlington Point Solar Farm	NSW	Solar	Committed	275	Apr 2020
Dundonnell Wind Farm	VIC	Wind	Committed	336	Jul 2020
Finley Solar Farm	NSW	Solar	Committed	133	Nov 2019
Goonumbla Solar Farm	NSW	Solar	Committed	70	May 2020
Granville Harbour Wind Farm	TAS	Wind	Committed	112	May 2020
Kennedy Energy Park – Phase 1 - Solar	QLD	Solar	Committed*	15	Jul 2021
Kennedy Energy Park – Phase 1 - Wind	QLD	Wind	Committed*	43	Jul 2021
Kiamal Solar Farm - Stage 1	VIC	Solar	Committed*	200	Jul 2021
Lal Lal Wind Energy Facility - Elaine end	VIC	Wind	Committed	84	Feb 2020
Lal Lal Wind Energy Facility - Yendon end	VIC	Wind	Committed	144	Dec 2019
Limondale Solar Farm 1	NSW	Solar	Committed	220	May 2020
Limondale Solar Farm 2	NSW	Solar	Committed	29	Dec 2019

Project	Region	Fuel Type	Unit status	Nameplate capacity (MW)	Full commercial use date
Lincoln Gap Wind Farm - stage 2	SA	Wind	Committed	86	Aug 2020
Maryrorough Solar Farm	QLD	Solar	Committed	35	Mar 2020
Molong Solar Farm	NSW	Solar	Committed	30	Nov 2020
Moorabool Wind Farm	VIC	Wind	Committed	312	Apr 2020
Murra Warra Wind Farm - stage 1	VIC	Wind	Committed	226	Jan 2020
Nevertire Solar Farm	NSW	Solar	Committed	105	Jan 2020
Oakey 2 Solar Farm	QLD	Solar	Committed	55	Dec 2019
Stockyard Hill Wind Farm	VIC	Wind	Committed	511	May 2020
Sunraysia Solar Farm	NSW	Solar	Committed	200	Jan 2020
Warwick Solar Farm	QLD	Solar	Committed	64	Jun 2020
Winton Solar Farm	VIC	Solar	Committed	74	Jan 2021
Yarranlea Solar Farm	QLD	Solar	Committed	103	Mar 2020
Yatpool Solar Farm	VIC	Solar	Committed	81	Dec 2019

* Committed* projects have been delayed until July 2021.

Measures and abbreviations

Measures

Abbreviation	**Unit of measure**
MW	Megawatts
MWh	Megawatt hours

Abbreviations

Abbreviation	Expanded name
AEMO	Australian Energy Market Operator
EAAP	Energy Adequacy Assessment Projection
ESOO	Electricity Statement of Opportunities
GELF	Generator Energy Limitation Framework
MT PASA	Medium Term Projected Assessment of System Adequacy
NEM	National Electricity Market
NER	National Electricity Rules
POE	Probability of Exceedance
PV	Photovoltaic
RERT	Reliability and Emergency Reserve Trader
RRO	Retailer Reliability Obligation
RSIG	Reliability Standard Implementation Guidelines
USE	Unserved energy

Glossary

This document uses many terms that have meanings defined in the National Electricity Rules (NER). The NER meanings are adopted unless otherwise specified.

Term	Definition
availability factor	Average availability[17] of a power station as a proportion of total capacity.
committed projects	Generation that is considered to be proceeding under AEMO's commitment criteria[18].
committed* projects	Projects that are classified as Advanced and have commenced construction or installation. Advanced projects meet AEMO's site, finance, and date criteria but are required to meet only one of the components or planning criteria.
electrical energy	Average electrical power over a time period, multiplied by the length of the time period.
electrical power	Instantaneous rate at which electrical energy is consumed, generated, or transmitted.
generating capacity	Amount of capacity (in megawatts (MW)) available for generation.
generating unit	Power stations may be broken down into separate components known as generating units and may be considered separately in terms (for example) of dispatch, withdrawal, and maintenance.
installed capacity	The generating capacity (in MW) of the following (for example): • A single generating unit. • A number of generating units of a particular type or in a particular area. • All of the generating units in a region. Rooftop photovoltaic (PV) installed capacity is the total amount of cumulative rooftop PV capacity installed at any given time.
non-scheduled generation	Generation by a generating unit that is not scheduled by AEMO as part of the central dispatch process, and which has been classified as a non-scheduled generating unit in accordance with Chapter 2 of the NER.
operational electrical consumption	The electrical energy supplied by scheduled, semi-scheduled, and significant non-scheduled generating units, less the electrical energy supplied by small non-scheduled generation.
Probability of exceedance (POE)	The probability, as a percentage, that a maximum demand level will be met or exceeded (for example, due to weather conditions) in a particular period of time. For example, a 10% POE maximum demand for a given season means a 10% probability that the projected level will be met or exceeded – in other words, projected maximum demand levels are expected to be met or exceeded, on average, only one year in 10.
Reliability standard	The standard specified in clause 3.9.3C of the NER that measures the sufficiency of installed capacity to meet demand. It is defined as the maximum expected USE, as a percentage of total energy demanded, allowable in a region over a financial year. It is currently set at 0.002%.
Unserved energy	The amount of energy demanded, but not supplied, in a region determined in accordance with clause 3.9.3C(b), expressed as either a gigawatt hours (GWh) total or as a percentage of total energy demanded in that region.

[17] Based on MAXAVAIL

[18] For more information, see AEMO's Generation Information page, at https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/Generation-informationa. Commitment criteria are listed under the Background Information tab.