ENERGY ADEQUACY ASSESSMENT PROJECTION

FOR EASTERN AND SOUTH EASTERN AUSTRALIA

Published: **March 2016**

AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

IMPORTANT NOTICE

Purpose

AEMO publishes this projection in accordance with rule 3.7C of the National Electricity Rules. This publication is based on information available to AEMO as at 12 February 2016, although AEMO has endeavoured to incorporate more recent information where practical.

Disclaimer

This report contains data provided by or collected from third parties, and conclusions, opinions or assumptions that are based on that data.

Australian Energy Market Operator Limited (AEMO) has made every effort to ensure the quality of the information in this document but cannot guarantee its accuracy or completeness. This publication does not include all of the information that an investor, participant or potential participant in the National Electricity Market might require, and does not amount to a recommendation of any investment.

Anyone proposing to use the information in this publication (including information and reports from third parties) should independently verify and check its accuracy, completeness and suitability for purpose, and obtain independent and specific advice from appropriate experts.

Accordingly, to the maximum extent permitted by law, AEMO and its officers, employees and consultants involved in the preparation of this document:

- make no representation or warranty, express or implied, as to the currency, accuracy, reliability or completeness of the information in this document; and
- are not liable (whether by reason of negligence or otherwise) for any statements or representations in this document, or any omissions from it, or for any use or reliance on the information in it.

EXECUTIVE SUMMARY

The Energy Adequacy Assessment Projection (EAAP) quantifies the impact of potential energy constraints on energy availability for a range of rainfall scenarios, specified in the EAAP guidelines[1]:

- Scenario 1: 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.[2]
- Scenario 2: Short-term average rainfall – based on the average rainfall recorded over the past 10 years.
- Scenario 3: 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).

Despite low hydro storage levels across the National Electricity Market (NEM), this March 2016 EAAP does not project any breach of the reliability standard arising from drought conditions over the next two years. The reliability standard prescribes a maximum of 0.002% of all operational consumption can go unserved for any region in any financial year.

It highlights that in Tasmania:

- Although current hydro storage levels are low (13.9%[3] as at 28 March 2016), hydro, local wind, gas fired and temporary diesel generation is sufficient to meet forecast levels of electricity consumption.
- The reliability impact of the Basslink Interconnector fault, separating Tasmania from the rest of the NEM, has been mitigated through demand management, and by acquiring temporary local generation capacity in excess of Basslink import capability. This EAAP study assumes Basslink will return to service in mid-June 2016, based on Basslink's most recent (29 March 2016) public statement.

The EAAP also provides a more detailed assessment of the likely impact of Low Reserve Conditions (LRCs) flagged in AEMO's weekly Medium Term Projected Assessment of System Adequacy (MT PASA).

The March 2016 EAAP highlights that:

- The LRCs currently reported in MT PASA for South Australia are not expected to result in reliability standard breaches in the next two years.
- There is a 30% chance of some unserved energy (USE) in South Australia in summer 2017–18. On average, approximately 0.001% (179 MWh) of South Australia's electricity consumption requirements would not be met between April 2017 to March 2018. The USE typically occurs at times of high demand with low wind conditions, or when imports are limited.
- On 21 March 2016, AGL announced that it was undertaking a program of inspections and, if required, repairs on all four units at Liddell Power station. At the time this report was published, the outages were to occur over the next two months[4]. AEMO has assessed energy supply adequacy with Liddell out of service during this time and projects sufficient energy supplies in New South Wales.

[1] The guidelines were determined following Electricity Rule Consultation Procedures. Available at: http://www.aemo.com.au/Electricity/Resources/Reports-and-Documents/~/media/Files/Other/electricityops/EAAP_Guidelines.ashx. Viewed: 22 December 2015.
[2] Analysis of this period ensures the lowest rainfall for New South Wales is reflected in the low rainfall scenario.
[3] http://www.hydro.com.au/water/energy-data, Viewed 30 March 2016.
[4] http://aglblog.com.au/2016/03/liddell-power-station-outage/, Viewed 24 March 2016.

CONTENTS

1. ENERGY ADEQUACY ASSESSMENT PROJECTION

1.1 Introduction

The Energy Adequacy Assessment Projection (EAAP) quantifies the impact of potential energy constraints on energy availability for a range of rainfall scenarios, specified in the EAAP guidelines[5] and described below. AEMO identifies potential periods of USE and quantifies projected annual USE that may breach the reliability standard.

Clause 3.9.3C of the National Electricity Rules (NER) defines:

- The reliability standard, which measures the sufficiency of installed capacity to meet demand. It is defined as the maximum USE, as a percentage of total energy (measured in megawatt hours (MWh)), allowable in a region over a financial year. It is currently set at 0.002%.
- The USE that contributes to the reliability standard. This excludes USE resulting from power system security events, network outages not associated with inter-regional flows, and industrial action or acts of God.

AEMO's March 2016 EAAP takes into account information provided by participants, through the Generator Energy Limitation Framework (GELF), as at 12 February 2016.

The analysis covers the period from 1 April 2016 to 31 March 2018, and includes anticipated energy constraints under these three specified rainfall scenarios:

- Scenario 1: 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.[6]
- Scenario 2: Short-term average rainfall – based on the average rainfall recorded over the past 10 years.
- Scenario 3: 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).

1.2 Key modelling inputs and methodology

The EAAP guidelines also specify modelling inputs and assumptions used in the EAAP analysis.

The EAAP uses the following inputs to its forecasting models:

- Existing scheduled and semi-scheduled generation.
- Committed scheduled and semi-scheduled generation.
- Planned increases in capacities of existing scheduled and semi-scheduled generation used in MT PASA.
- Demand profiles consistent with the *2015 National Electricity Forecasting Report* (NEFR) energy and demand projections.[7]

Participants submit confidential information (specifically MT PASA available capacity offers and GELF parameters) which is used in the EAAP modelling process. The generation capacity and variable GELF

[5] Available at: http://www.aemo.com.au/Electricity/Resources/Reports-and-Documents/~/media/Files/Other/electricityops/EAAP_Guidelines.ashx. Viewed: 22 December 2015.

[6] Analysis of this period ensures the lowest rainfall for New South Wales is reflected in the low rainfall scenario.

[7] AEMO. *2015 National Electricity Forecasting Report.* Available at: http://www.aemo.com.au/Electricity/Planning/Forecasting/~/media/Files/Electricity/Planning/Reports/NEFR/2015/Detailed%20summary%20of%202015%20electricity%20forecasts.ashx.

parameters are designed to reflect the current environment of constrained energy, by taking into account all of the following:

- Hydro storage including pump storage.
- Thermal generation fuel.
- Cooling water availability.
- Gas supply limitations.

AEMO uses a market model to forecast two years at hourly resolution for the three rainfall scenarios. This involves using time-sequential Monte-Carlo market dispatch simulations, accounting for uncertainties in generator availability and weather-sensitive demand. In total, 400 simulations are performed for each rainfall scenario using both 10% and 50% Probability of Exceedance (POE) demand forecasts. The model uses a probability-weighted USE assessment to identify any potential reliability standard breaches.

1.3 Differences between MT PASA and EAAP

AEMO runs two processes to implement the reliability standard over a two year period:

1. EAAP, to forecast USE for *energy* constrained scenarios.
2. MT PASA, to forecast peak *capacity reserve* conditions over a two year projection.

These processes use similar inputs, but the methodologies are different, reflecting their different purposes and frequency of projections. Their similarities and differences are described in more detail in the *Reliability Standard Implementation Guidelines* (RSIG).[8]

The MT PASA is run at least weekly and, as part of a broader process, identifies potential capacity shortfalls known as Low Reserve Conditions (LRCs). An LRC is declared if capacity reserves are projected to be inadequate on any given day. Capacity reserves are the difference between the availability participants have offered and expected demand estimated by AEMO. To assess supply adequacy, these capacity reserves are compared against estimated Minimum Reserve Levels (MRLs). This provides a fast and timely assessment of supply adequacy without needing to compute USE explicitly using a large number of Monte Carlo simulations.

Applying MRL in the MT PASA assists to identify potential reserve shortfalls in the NEM. However, given the approximate nature of the MT PASA process, AEMO applies probabilistic studies such as EAAP to confirm the LRC findings of MT PASA before intervening in response to projected shortfalls.

1.3.1 MT PASA projections for South Australia

Since Alinta Energy's October 2015 announcement about the withdrawal of the Northern and Playford B power stations, MT PASA has been projecting LRCs in South Australia over the summers of 2016–17 and 2017–18.

The EAAP analysis indicates that these LRCs in South Australia are not expected to result in reliability standard breaches in the next two years. Nonetheless, the withdrawal of these power stations, and subsequent withdrawal of Torrens Island A from winter 2017, increases South Australia's reliance on wind generation and imports from Victoria. When high demand coincides with low wind generation, plant outages, or low levels of imports, South Australia may experience supply shortfalls.

The Heywood Interconnector between South Australia and Victoria is currently being upgraded. The upgrade aims to increase capacity from a nominal 460 MW to 650 MW in both directions, but the realised capacity may be lower under certain operating conditions. Indicative limits have been used in this EAAP to model the capability of the upgraded Heywood Interconnector and implications of the

[8] http://www.aemo.com.au/Consultations/National-Electricity-Market/~/media/Files/Electricity/Consultations/2015/Reliability%20Standard%20Implementation%20Guidelines%20Final%20Report.ashx

intended capacity withdrawals. A final set of network limits will be available closer to completion of the upgrade later in 2016, which may impact on assessments of South Australia's supply adequacy.

1.4 Basslink Interconnector outage

On 20 December 2015, a fault on Basslink resulted in the separation of Tasmania from the rest of the NEM. At the time the December 2015 EAAP was published, the expected return to service date for Basslink was unknown. Basslink Pty Ltd now estimates that Basslink will return to service in mid-June 2016.[9]

This outage occurred at a time when hydro storage levels in Tasmania were already low, due to prevailing El Niño weather conditions. Consequently, average storage levels have declined to record lows, from 26% as at 22 December 2015[10] to 13.9% as at 28 March 2016.[11] While some storage levels are below the current average, such as Gordon Dam which is currently at 6.2% of full storage, in total there is 2,012 GWh[12] of energy in storage across the Tasmanian Hydro electric scheme as at 28 March 2016. Hydro Tasmania is able to optimise use of multiple generation assets in its portfolio to manage variability in water levels across hydro storages.

In response to this Basslink outage and low hydro storage levels, there have been a number of recent developments in Tasmania which have been considered in this March 2016 EAAP:

- The 208 MW Tamar Combined Cycle Gas Turbine (CCGT) returned to service in January 2016 and is assumed to remain in service at least until the Basslink fault is fixed.
- Hydro Tasmania has committed to returning its Tamar Valley Peaking Plant (58 MW) to service from April 2016[13], to help meet Tasmania's electricity needs.
- Hydro Tasmania, TasNetworks, and other government bodies are installing temporary diesel generation to meet energy demand. A planned total capacity of 200 MW will be progressively installed between March and April 2016.[14]
- Hydro Tasmania has negotiated voluntary commercial load reductions in cooperation with major industrial users, such as Bell Bay Aluminium and TEMCO.[15] As at March 2016, load reduction capability ranges between 35MW and 75MW and will possibly continue to the end of May 2016.

In combination, approximately 566 MW of additional generation capacity and demand management will be added to electricity supply in Tasmania by the end of April. This exceeds the 478 MW Basslink import capacity.

It is also worth noting that, while the EAAP considers energy adequacy across three historic rainfall scenarios, the Australian Government Bureau of Meteorology has forecast that Tasmania is likely to meet or exceed expected average rainfall for the April to June 2016 quarter.[16]

1.5 Change in generation capacity

1.5.1 Availability changes from existing generation capacity

Table 1 lists future changes to existing generating units' availability that are included in the modelling.

[9] http://www.basslink.com.au/wp-content/uploads/2016/03/Media-Statement-29-March.pdf, Viewed 30 March 2016.
[10] http://www.hydro.com.au/water/water-levels-and-flows-map, Viewed 22 December 2015.
[11] http://www.hydro.com.au/water/energy-data, Viewed 30 March 2016.
[12] Ibid
[13] http://www.hydro.com.au/about-us/news/2016-03/energy-supply-plan-update, Viewed 23 March 2016.
[14] Ibid
[15] http://www.hydro.com.au/system/files/www.hydro.com.au/News/Energy_Supply_Plan_Update_-_07_March_2016.pdf Viewed 21 March 2016; and http://bellbayaluminium.com.au/latest-news/bell-bay-aluminium-to-temporarily-reduce-power-consumption/ , Viewed 24 March 2016.
[16] http://www.bom.gov.au/climate/outlooks/#/rainfall/median/seasonal/0, Viewed 24 March 2016.

Table 1 Changes in generating plants' availability

Station	State	Capacity (MW)	Outage duration
Torrens Island A	South Australia	480	To withdraw from 2017–18
Pelican Point (Unit 2)	South Australia	239	To withdraw from March 2016 and return to service in October 2016. Unit 1 has been withdrawn since March 2015.
Northern	South Australia	546	To withdraw from May 2016.
Tamar Valley Peaking	Tasmania	58	Returning to service in April 2016

1.5.2 Committed scheduled and semi-scheduled generation capacity

Table 2 lists the committed scheduled and semi-scheduled generating units included in the modelling.

Table 2 Committed scheduled and semi-scheduled generating units

Station	State	Capacity (MW)	Commercial operation date
Ararat Wind Farm	Victoria	240	May 2017
Hornsdale Wind Farm	South Australia	102	November 2016
Moree Solar Farm	New South Wales	56	March 2016

1.5.3 Temporary non-scheduled generation capacity

Table 3 lists the temporary non-scheduled generating units included in the modelling.

Table 3 Temporary non-scheduled generating units

Station	State	Capacity (MW)	Commercial operation date
Catagunya Power Station	Tasmania	24	March 2016
Meadowbank Power Station	Tasmania	24	March 2016
George Town substation	Tasmania	21	March 2016
Port Latta substation	Tasmania	24	March 2016
Other Units – to be confirmed	Tasmania	107	April 2016

1.6 EAAP results

No breach of the NEM reliability standard is projected to arise from energy constraints in any region over the next two years.

USE is observed in regions occasionally under all three rainfall scenarios, but supply levels still meet the reliability standard in all cases.

Appendix A lists average monthly USE results for all regions under all three rainfall scenarios.

Key points from the results are:

- Some USE may occur in South Australia during summer periods under all three rainfall scenarios. In 2017-18, about 0.001% of the state's forecast electricity consumption may not be met. Notably, in January and February 2018, once Torrens Island Power Station A (480 MW) is withdrawn, USE ranging between 59 MWh and 93 MWh is projected (see Appendix A). This USE occurs in approximately 30% of the Monte Carlo simulations, typically at times of high demand, with low wind conditions, or when imports are limited.
- No USE is projected in Tasmania under any rainfall scenario.

- On 21 March 2016, AGL announced that it was undertaking a program of inspections and, if required, repairs on all four units at Liddell Power station. At the time this report was published, the outages were to occur over the next two months. AEMO has assessed energy supply adequacy with Liddell out of service during this time and projects sufficient energy supplies in New South Wales.

The following tables show the average yearly regional energy consumption (in MWh) at risk. All regional demand data is from AEMO's *2015 National Electricity Forecasting Report*.

Table 4 Forecast yearly USE in low rainfall scenario

Low Rainfall Scenario	April 2016 to March 2017 USE (MWh)	April 2016 to March 2017 USE (% of Regional Demand)	April 2017 to March 2018 USE (MWh)	April 2017 to March 2018 USE (% of Regional Demand)
New South Wales	-	-	0.65	-
Queensland	-	-	-	-
South Australia	32.91	0.00025%	178.84	0.00139%
Tasmania	-	-	-	-
Victoria	0.17	-	1.30	-

Table 5 Forecast yearly USE in medium rainfall scenario

Medium Rainfall Scenario	April 2016 to March 2017 USE (MWh)	April 2016 to March 2017 USE (% of Regional Demand)	April 2017 to March 2018 USE (MWh)	April 2017 to March 2018 USE (% of Regional Demand)
New South Wales	0.16	-	0.65	-
Queensland	-	-	-	-
South Australia	30.70	0.00024%	171.84	0.00126%
Tasmania	-	-	-	-
Victoria	0.03	-	0.80	-

Table 6 Forecast yearly USE in high rainfall scenario

High Rainfall Scenario	April 2016 to March 2017 USE (MWh)	April 2016 to March 2017 USE (% of Regional Demand)	April 2017 to March 2018 USE (MWh)	April 2017 to March 2018 USE (% of Regional Demand)
New South Wales	-	-	0.63	-
Queensland	-	-	-	-
South Australia	30.71	0.00024%	171.73	0.00133%
Tasmania	-	-	-	-
Victoria	-	-	0.71	-

APPENDIX A. DETAILED MONTHLY RESULTS

The following tables show the average monthly regional energy demand (in megawatt hours) at risk.

A.1 Low rainfall scenario

Table 7 Forecast USE in Low rainfall scenario, MWh

Month	NSW	QLD	SA	TAS	VIC
April 2016	-	-	-	-	-
May 2016	-	-	1.88	-	-
June 2016	-	-	-	-	-
July 2016	-	-	-	-	-
August 2016	-	-	-	-	-
September 2016	-	-	-	-	-
October 2016	-	-	-	-	-
November 2016	-	-	22.54	-	-
December 2016	-	-	-	-	-
January 2017	-	-	2.88	-	0.17
February 2017	-	-	5.61	-	-
March 2017	-	-	-	-	-
April 2017	-	-	-	-	-
May 2017	-	-	-	-	-
June 2017	-	-	-	-	-
July 2017	-	-	-	-	-
August 2017	-	-	-	-	-
September 2017	-	-	-	-	-
October 2017	-	-	-	-	-
November 2017	-	-	10.72	-	-
December 2017	-	-	0.13	-	-
January 2018	0.65	-	64.30	-	1.30
February 2018	-	-	100.40	-	-
March 2018	-	-	3.29	-	-

A.2 Medium rainfall scenario

Table 8 Forecast USE in Medium rainfall scenario, MWh

Month	NSW	QLD	SA	TAS	VIC
April 2016	-	-	-	-	-
May 2016	0.16	-	2.09	-	-
June 2016	-	-	-	-	-
July 2016	-	-	-	-	-
August 2016	-	-	-	-	-
September 2016	-	-	-	-	-
October 2016	-	-	-	-	-
November 2016	-	-	20.89	-	-
December 2016	-	-	-	-	-
January 2017	-	-	2.33	-	0.03
February 2017	-	-	5.39	-	-
March 2017	-	-	-	-	-
April 2017	-	-	-	-	-
May 2017	-	-	-	-	-
June 2017	-	-	-	-	-
July 2017	-	-	-	-	-
August 2017	-	-	-	-	-
September 2017	-	-	-	-	-
October 2017	-	-	-	-	-
November 2017	-	-	10.38	-	-
December 2017	-	-	0.11	-	-
January 2018	0.65	-	61.55	-	0.80
February 2018	-	-	96.54	-	-
March 2018	-	-	3.26	-	-

A.3 High rainfall scenario

Table 9 Forecast USE in High rainfall scenario, MWh

Month	NSW	QLD	SA	TAS	VIC
April 2016	-	-	-	-	-
May 2016	-	-	1.96	-	-
June 2016	-	-	-	-	-
July 2016	-	-	-	-	-
August 2016	-	-	-	-	-
September 2016	-	-	-	-	-
October 2016	-	-	-	-	-
November 2016	-	-	20.97	-	-
December 2016	-	-	-	-	-
January 2017	-	-	2.33	-	-
February 2017	-	-	5.45	-	-
March 2017	-	-	-	-	-
April 2017	-	-	-	-	-
May 2017	-	-	-	-	-
June 2017	-	-	-	-	-
July 2017	-	-	-	-	-
August 2017	-	-	-	-	-
September 2017	-	-	-	-	-
October 2017	-	-	-	-	-
November 2017	-	-	10.38	-	-
December 2017	-	-	0.11	-	-
January 2018	0.63	-	60.89	-	0.71
February 2018	-	-	97.09	-	-
March 2018	-	-	3.26	-	-

APPENDIX B. MEASURES AND ABBREVIATIONS

Units of measure

Abbreviation	Unit of Measure
GWh	Gigawatt hours
MW	Megawatts
MWh	Megawatt hours

Abbreviations

Abbreviation	Expanded Name
AEMO	Australian Energy Market Operator
CCGT	Combined Cycle Gas Turbine
EAAP	Energy Adequacy Assessment Projection
ESOO	Electricity Statement of Opportunities
GELF	Generator Energy Limitation Framework
LRC	Low Reserve Conditions
MRL	Minimum Reserve Levels
MTPASA	Medium Term Projected Assessment of System Adequacy
NEM	National Electricity Market
NEFR	National Electricity Forecasting Report
NER	National Electricity Rules
POE	Probability of Exceedance
RSIG	Reliability Standard Implementation Guidelines
USE	Unserved energy

Glossary

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

Term	Definition
Low Reserve Conditions (LRC)	When AEMO considers that a region's reserve margin (calculated under 10% Probability of Exceedance (POE) scheduled and semi-scheduled maximum demand (MD) conditions) for the period being assessed is below the Reliability Standard.