REPORT: EFFECTIVENESS OF THE NEM PRUDENTIAL SETTINGS METHODOLOGY

CREDIT LIMIT PROCEDURES

Published: **March 2017**

AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

IMPORTANT NOTICE

Purpose

AEMO has prepared this document to provide information about the effectiveness of the methodology used to determine the prudential settings for Market Participants, as at the date of publication.

Disclaimer

This document or the information in it may be subsequently updated or amended. This document does not constitute legal or business advice, and should not be relied on as a substitute for obtaining detailed advice about the National Electricity Law, the National Electricity Rules, or any other applicable laws, procedures or policies. AEMO has made every effort to ensure the quality of the information in this document but cannot guarantee its accuracy or completeness.

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

Under the National Electricity Rules (NER) (clause 3.3.8(f)), AEMO is required to annually review and publish its findings on the effectiveness of National Electricity Market (NEM) Prudential Settings Methodology. This review assessed:

- The effectiveness of AEMO's prudential settings for market participants in meeting the prudential standard.
- The performance of participant risk adjustment factors (PRAFs), which aim to differentiate the risk between load, generation and reallocation profiles.
- The impact of ancillary service[1] liabilities on market participants and their prudential risk profile.

In 2012, the New Prudential Standard and Framework was implemented in the NEM. It is underpinned by the Credit Limit Procedures (CLP), the methodology by which AEMO determines prudential settings for each market participant. The key aspect of the CLP is the prudential standard. The prudential standard is the value of the prudential probability of exceedance (POE), expressed as a percentage and set at 2%.

This review found that with the inclusion of settlement data up to 30 November 2016, the prudential standard was not met. The level of exceedance above the 2% prudential standard was small (2.1% to 2.6%) for all regions bar Tasmania (5.2%). While the prudential standard was not met in any region, this outcome is to be expected from time to time due to the long–term nature of the target, that is, to keep exceedance below 2% over the life of the NEM. It is also important to note that there was no shortfall in the market.

Preliminary analysis shows that multiple factors contributed to higher electricity prices that then led to this year's exceedance. These may include (but are not limited to) the Basslink outage, interruptions to service resulting from the interconnector upgrade between South Australia and Victoria, higher gas prices and various coal plant outages.

This review also found that PRAFs are working as intended, with Maximum Credit Limit (MCL) requirements appropriately moderated by the relative risk a participant poses to the market. Ancillary service costs were found to be increasing, and for some regions, ancillary service costs may no longer be considered marginal.

In light of the prudential standard not being met, together with continuing volatility in the electricity market and rising ancillary service costs, AEMO has decided to:

1. Re-calculate the volatility factor (VF) percentiles for each region to meet the 2% prudential standard over the life of the NEM, once settlement data for the summer 2017 season becomes available. The new VF percentiles will be published on AEMO's website by the end of June 2017, to coincide with the shoulder 2 MCL review.
2. Undertake a review to more extensively assess the adequacy of the CLP methodology and AEMO's ability to calibrate it to meet the prudential standard. The review will focus on three key areas:
    - Changes in electricity prices.
    - CLP calibration methodology.
    - Treatment of ancillary service costs in relation to prudential settings.

AEMO proposes starting the additional review in Quarter 2, 2017, and will publish a report of its findings on AEMO's website. Market participants will be encouraged to provide feedback through the NEM Wholesale Consultative Forum in Quarter 3, 2017.

[1] Ancillary services are used to manage the power system safely, securely, and reliably. They maintain key technical characteristics of the system, including standards for frequency, voltage, network loading, and system restart processes.

In proposing this review, AEMO is mindful that prudential settings performance needs to be viewed over the long term. Any methodology and procedure changes need to be carefully considered and consulted on.

CONTENTS

1. BACKGROUND 6

1.1 The New Prudential Standard and Framework 6

2. ANALYSIS 10

2.1 Overview 10
2.2 Prudential settings analysis 10
2.3 Participant Risk Adjustment Factors 16
2.4 Ancillary service costs 19
2.5 Further review of CLP methodology 23

3. CONCLUSIONS AND RECOMENDATIONS 26

1. BACKGROUND

1.1 The New Prudential Standard and Framework

The New Prudential Standard and Framework was implemented in 2012, and sits under Clause 3.3 of the NER. Its key features are outlined in AEMO's Credit Limit Procedures (CLP).[2]

Under the CLP, the maximum credit limit for market participants is defined as:

Maximum Credit Limit = Outstandings Limit + Prudential Margin

Where:

- Outstandings Limit (OSL) reflects the level of credit support needed to cover liabilities for all trading periods that have occurred but not yet been paid for, assuming no market participant is failing.
- Prudential Margin (PM) reflects the credit support buffer intended to cover accruing liabilities in the NEM during the reaction period (seven days), which relates to the time it may take to curtail any further liabilities accruing from a failing market participant. (This would generally require the use of Retailer of Last Resort arrangements.)

A key aspect of the CLP is to meet the prudential standard. The prudential standard is the prudential probability of exceedance (POE), expressed as a percentage. This is the probability of a market participant's maximum credit limit (MCL) being exceeded by its outstandings at the end of the reaction period (seven days), after the market participant exceeds its outstandings limit on a given day and has not rectified the breach. The prudential standard is set at 2% (NER Clause 3.3.4A).

In practical terms, this means that the prudential arrangements establish a target of no payment shortfall in the market in 98 out of 100 instances of a retailer defaulting on their market payments, i.e., the retailer exceeds their outstandings limit, subsequently defaults, and is removed from the market. In the remaining two of 100 instances, AEMO would hold insufficient prudential collateral, resulting in a payment shortfall to the remaining market participants who are net creditors in the market (considering both energy and reallocations).

1.1.1 Credit Limit Procedures

The CLP establish the process for determining the prudential settings and calculating the MCL, and hence credit support requirements for market participants to meet the prudential standard.

The key features of the methodology used are:

- MCL calculated over three seasons - summer, winter and shoulder (split into shoulder 1 and shoulder 2).
- MCL accounting for seasonal differences in regional reference prices (RRP).
- MCL accounting for price and load volatility in each region through volatility factors (VFs).
- Use of Participant Risk Adjustment Factors (PRAFs) that express the relationship between regional load and the market participant's marginal loss factor (MLF) adjusted energy and reallocations. This is to adjust the OSL and PM to reflect the market participant's relative risk of their energy profiles.
- Smoothing of changes in market participant MCL requirements over corresponding seasons. The approach considers seasonal data as a continuous series, over the lifespan of the NEM.
- For each region, calculating the level of volatility consistent with the 2% prudential standard, using historical regional load, RRP and relevant time period.

[2] http://aemo.com.au/-/media/Files/PDF/Credit_Limit_Procedures_v2_Final_Determination_1_August.pdf

Table 1 summarises the key features of the CLP.

Table 1 - CLP key features

Feature	Description/value
Definition of standard	Prudential Probability of Exceedance (POE)
Relevant time period for MCL	42 days (35 days outstanding period plus 7 days reaction period)
Measure of standard	2% POE target
MCL	MCL = Outstandings Limit + Prudential Margin
Basis of OSL and PM	Price x load x volatility OSL x 35 days Price x load x volatility PM x 7 days
Variance of MCL over the year	By season
Regions	MCL calculations are regionally based (NSW, QLD,SA,TAS & VIC)
Regional Reference price (RRP) used	Average price from NEM start for applicable season in each region
Volatility Factors (VF)	Volatility factor from NEM start for applicable season in each region
Volatility Factor percentiles	Calculated to meet the 2% prudential standard
Participant differentiation	Participants differentiated by load factor and load profile
PRAF	Express the relationship between regional load/generation and the market participant's marginal loss factor (MLF) adjusted load/generation
Weighting factor – average regional load	70%
Weighting factor – average regional price	10%

The current prudential settings are described in Table 2 to Table 4. They specify the forecast volatility factors and average prices calculated for input to the prudential settings calculations, over the previous four seasonal reviews.

Table 2 – Outstandings Limit Volatility Factor (VFOSLR)

Region	2016 Winter	2017 Summer	2017 Winter	2017 Shoulder 1&2
NSW	1.28	1.43	1.30	1.43
QLD	1.30	1.69	1.31	1.44
SA	1.33	1.80	1.40	1.57
TAS	1.15	1.11	1.16	1.15
VIC	1.30	1.52	1.32	1.31

Table 3 – Prudential Margin Volatility Factor (VFPMR)

Region	2016 Winter	2017 Summer	2017 Winter	2017 Shoulder
NSW	1.46	1.64	1.49	1.34
QLD	1.72	2.99	1.71	1.84
SA	1.78	3.82	1.96	1.88
TAS	1.04	1.11	1.06	1.06
VIC	1.55	2.57	1.58	1.55

Table 4 – Average Price (PR)

Region	2016 Winter	2017 Summer	2017 Winter	2017 Shoulder
NSW	$36.85	$38.05	$40.11	$38.19
QLD	$34.09	$49.63	$37.31	$35.22
SA	$43.20	$48.14	$47.52	$39.65
TAS	$46.39	$42.83	$47.48	$43.71
VIC	$35.33	$35.36	$38.15	$32.09

Table 5 specifies the regional Volatility Factor Percentiles consistent with the 2% prudential standard as calculated for input to the prudential settings calculations.

Table 5 – Volatility Factor Percentiles

Region	Volatility Factor Percentile	% Prudential Standard
NSW	88.9%	2%
QLD	94.6%	2%
SA	96.5%	2%
TAS	71.1%	2%
VIC	94.5%	2%

1.1.2 Reviewing the Maximum Credit Limit under the Credit Limit Procedures

AEMO performs MCL reviews for the summer, shoulder (1 and 2) and winter seasons every year. The 2014 Summer MCL review was the first conducted in accordance with the CLP, and was effective on 28 November 2013.

To date, thirteen MCL reviews have been conducted. Reviews completed after the 2016 ‘Effectiveness of the NEM Prudential Settings Methodology Report' are listed in Table 6.

Table 6 - Recent MCL reviews

Reviews	Review Effective Date
2016 Summer	1 December 2015
2016 Shoulder 1	5 April 2016
2016 Winter	3 May 2016
2016 Shoulder 2	1 September 2016
2017 Summer	1 December 2016

The analysis contained in this report includes settlement data up to 30 November 2016 (end of 2016 Shoulder 2). It does **not** include data from the 2017 summer season (1 December 2016 to 31 March 2017) as at the time of publishing, the data set for this season is incomplete.

1.1.3 Carbon price repeal

After the repeal of the *Clean Energy Act 2011* (CEA) that took effect on 1 July 2014, AEMO amended the CLP. These amendments were implemented in the 2014 Shoulder 2 MCL review, where we:

- Adjusted the historical RRP.
- Recalculated the VF percentile for each region to meet the 2% prudential standard over the life of the NEM.
- Recalculated the regional average prices and volatility factors for the 2014 Shoulder 2 season using the new VF percentiles and adjusted RRPs.
- Conducted the 2014 Shoulder 2 MCL review using new regional average prices and volatility factors.

The new VF percentiles have been used in all MCL reviews since the 2014 Shoulder 2 MCL review, and will be used in all future MCL reviews until the calculation factors are reviewed according to the CLP review process.

Information related to the CLP on carbon price repeal can be found at:

http://aemo.com.au/Stakeholder-Consultation/Consultations/Credit-Limit-Procedures-V2-Consultation

2. ANALYSIS

2.1 Overview

This review assessed the effectiveness AEMO's prudential settings in meeting the prudential standard and the corresponding efficiency of the methodology. It found that:

- After the inclusion of settlement data up to 30 November 2016, the prudential standard over the life of the NEM is currently not met.
- The current exceedance is above the 2% prudential standard in all NEM regions.
- The level of exceedance above the 2% prudential standard is relatively small (2.1% to 2.6%) over the life of the NEM, for all regions bar Tasmania (5.2%).
- While the prudential standard was not met, there was no shortfall in the market.
- The prudential settings are set by AEMO so that the prudential standard is met for the NEM over the long term. Market conditions can change from year to year, leading to a higher rate of exceedance in any particular year. The 2016 year has seen a significant shift in electricity pricing that has led to the prudential standard not being met. It is yet to be determined whether this is a one off confluence of events, or a more permanent shift in the energy market (see section 2.5 for a further discussion).
- When compared to a year with a similar outstandings profile (2010), market participants provided significantly less credit support to meet their prudential obligations.
- Other than providing more security deposits and guarantees to deal with higher outstandings, market participant behaviour in 2016, in relation to prudentials, was very similar to previous years.
- The level of market participant outstandings in 2016 was not higher compared to other high price time periods over the life of the NEM, such as from 2007–2010. However the MCL levels, and consequently the credit support held by AEMO, were significantly lower.

This review also looked at the effectiveness of PRAFs as well as assessing whether the magnitude of ancillary service liabilities has changed, potentially altering prudential risks. It found that:

- PRAFs are working as intended, with MCL requirements appropriately moderated by the relative risk a participant poses to the market.
- Ancillary service costs are increasing, and for some regions, ancillary service costs may no longer be considered marginal. Consequently, the exclusion of ancillary service costs when considering market participants prudential settings may no longer be appropriate.

2.2 Prudential settings analysis

To calculate the level of actual prudential exceedance, AEMO analysed available prudential data for the latest year (2016) and the entire life of the NEM, starting from 1999 (except for Tasmania starting in 2006). Data included for 2016 is: 2016 summer, 2016 Shoulder 1, 2016 winter and 2016 Shoulder 2. It does not include data from summer 2017 (1 December 2016 to 31 March 2017).

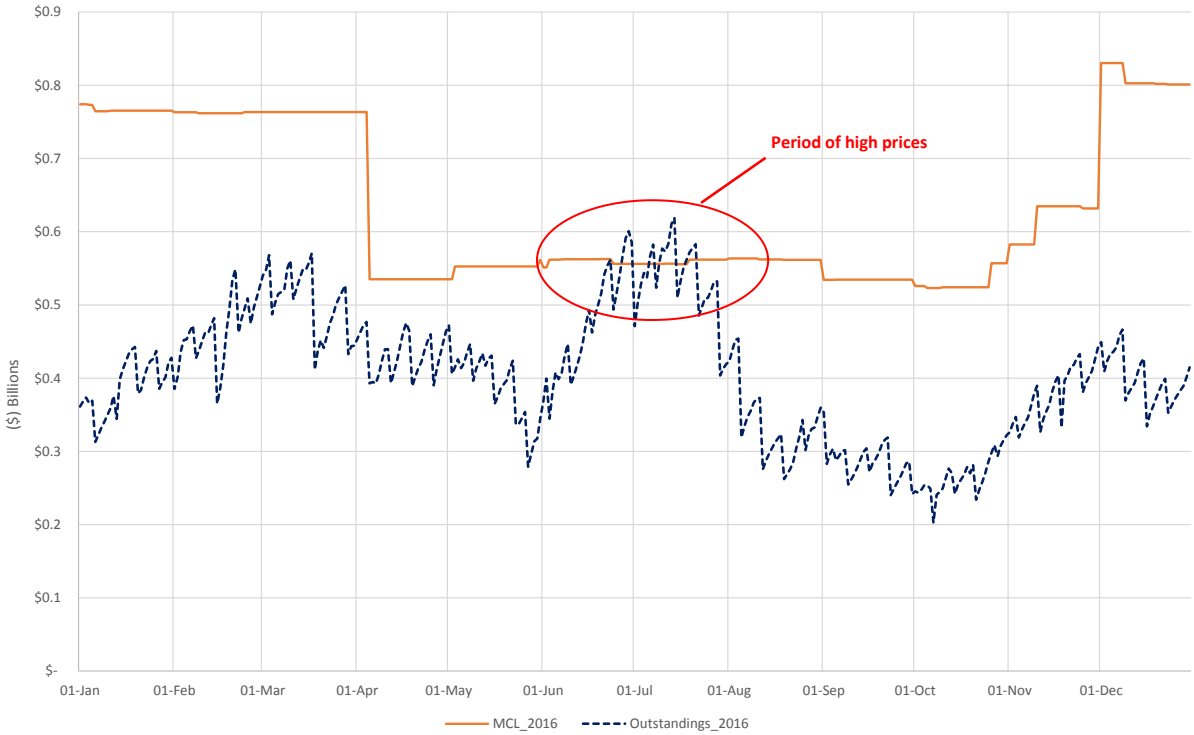
To give context to the analysis, Figure 1 shows the aggregate actual MCL and outstandings for market participants in 2016. As can be seen, there is a period, from mid-June to mid-July, where the outstandings are above the actual MCL a number of times. These were critical time periods influencing the rates of prudential exceedance in 2016.

Preliminary analysis indicates that the key factors leading to high electricity prices (and high outstandings) in those key time periods include the following:

- Basslink outage (20 Dec 2015 to 13 June 2016).

- Network outages which limited energy flows from VIC to SA across the Heywood interconnector (July 2016).
- Various plant outages across black and brown coal.
- Higher gas prices increasing the price at which gas-powered generation bid into market.

Figure 1 - Actual MCL and Outstandings (2016)



2.2.1 Calculating the actual prudential exceedance

In terms of the prudential standard, the level of prudential exceedance is indicated by two factors: the OSL exceedance, and MCL exceedance. The prudential POE is defined as the probability that (on a given day) a market participant's outstandings exceed their OSL; and that, following this exceedance at the end of the seven day reaction period, the outstandings exceed their MCL.

AEMO analysed the instances where the OSL was exceeded concurrently with the number of instances at the end of the reaction period that the outstandings exceeded the MCL. This analysis was undertaken for both 2016 and over the lifespan of the NEM. This analysis was conducted separately for each NEM region, and is shown in Table 7 and 8 with a comparison to 2015 values.

Table 7 - OSL and prudential exceedance (2015 & 2016)

Region	OSL Exceedance		MCL Exceedance (at end of reaction period)	
	2015	2016	2015	2016
NSW	1.1%	12.3%	0.3%	11.8%
QLD	8.8%	20.5%	2.2%	14.5%
SA	5.2%	10.1%	1.1%	9.3%
TAS	7.4%	33.3%	7.1%	33.3%
VIC	0.8%	8.2%	0.0%	7.7%

Table 7 shows that the level of prudential exceedance for 2016 (7.7% to 33.3%) was significantly higher for all regions than in 2015 (0% to 7.1%). This reflects the higher prices seen in 2016 compared to 2015, particularly from mid-June to mid-July as highlighted in Figure 1.

Table 8 - OSL and prudential exceedance (Life of NEM)

Region	OSL Exceedance		MCL Exceedance (at end of reaction period)	
	2015	2016	2015	2016
NSW	3.8%	4.3%	1.7%	2.3%
QLD	3.9%	4.9%	1.9%	2.6%
SA	4.4%	4.8%	1.8%	2.2%
TAS	3.0%	5.8%	2.2%	5.2%
VIC	3.6%	3.8%	1.7%	2.1%

Table 8 shows the level of prudential exceedance over the life of the NEM. Again it can be seen that the actual level of prudential exceedance in 2016 is higher (exceeding the 2% prudential standard for all regions) compared to 2015. In Tasmania, the 2% prudential standard was also not met in 2015. This is due to the fact that, even in the absence of high prices or events such as the Basslink outage, the smaller data set for the region (from 2006, instead of from 1999 for all other regions) results in a smaller number of OSL exceedances, leading to the 2% prudential standard not being met.

It is important to note that while the prudential standard was not met, there was no payment shortfall in the NEM. Not meeting the 2% prudential standard does not mean there will be a shortfall in any given year. The purpose of the prudential standard is to provide a target within which AEMO seeks to maintain the risk of loss in the event of market participant default.

The prudential settings are set by AEMO so that the prudential standard is met for the NEM over the long term. Market conditions can change from year to year depending on market changes, (as happened between 2015 and 2016), leading to a higher rate of exceedance in any particular year.

To date, it has been AEMO's expectation that the 2% prudential standard would be met over the long term. However, AEMO believes that once the 2017 summer data is added to this analysis, the rate of exceedance will further increase. For discussion of this issue, including next steps, please refer to Section 2.5.

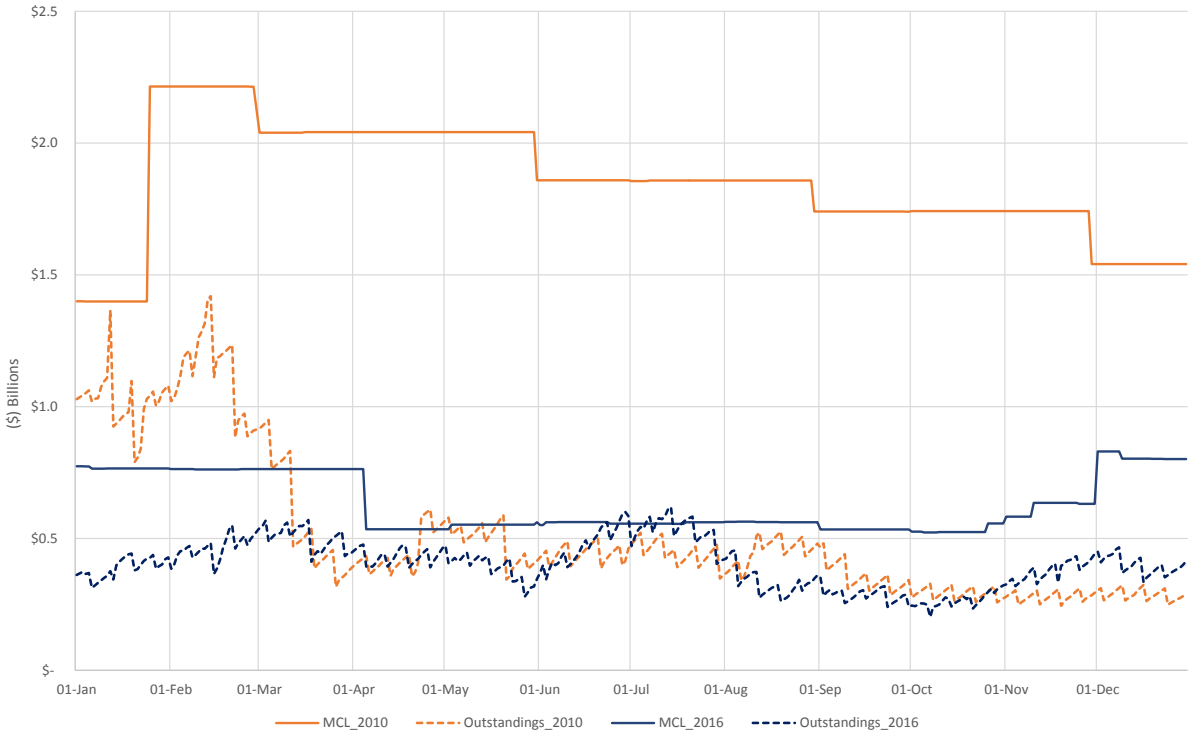
2.2.2 Prudential efficiency

This analysis looked at how the level of aggregate actual MCL has changed between years. This can indicate how efficiently capital (in the form of credit support provided to AEMO by market participants) is used in the NEM to meet the 2% prudential standard.

Analysing the rise or fall of actual MCL amounts alone does not offer a full picture of the efficiency of AEMO's prudential settings. Actual MCL levels change with market changes, i.e. changes in demand and

price. This analysis compares 2016 to 2010 which had a similar outstandings profile, as well as with 2015 to see how the market changed between two subsequent years.

Figure 2 - Actual MCL and Outstandings (2010 vs 2016)



As shown in Figure 2, the levels of outstandings for 2010 and 2016 are very similar (apart from the spike in January to February 2010). However, the actual MCL level in 2016 is significantly lower than in 2010, by an average of over $1 billion[3] over the year. Compared to 2010, the actual MCL level in 2016 covers outstandings more closely, noting that there is a level of exceedance in 2016 (the period responsible for level of exceedance above the 2% prudential standard) in mid-June to mid-July.

Thus for a very similar outstandings profile to 2010, market participants had to provide significantly less credit support in 2016 to meet their prudential obligations. This observation has to be caveated by the fact that the 2% prudential standard was exceeded once the 2016 data was included.

[3] This figure should be considered as indicative only. Due to the comparative nature of this assessment, the actual savings of the new regime had been in place for the 2010 period may have been significantly different to this.

Figure 3 – Actual MCL and Outstandings (2015 vs 2016)

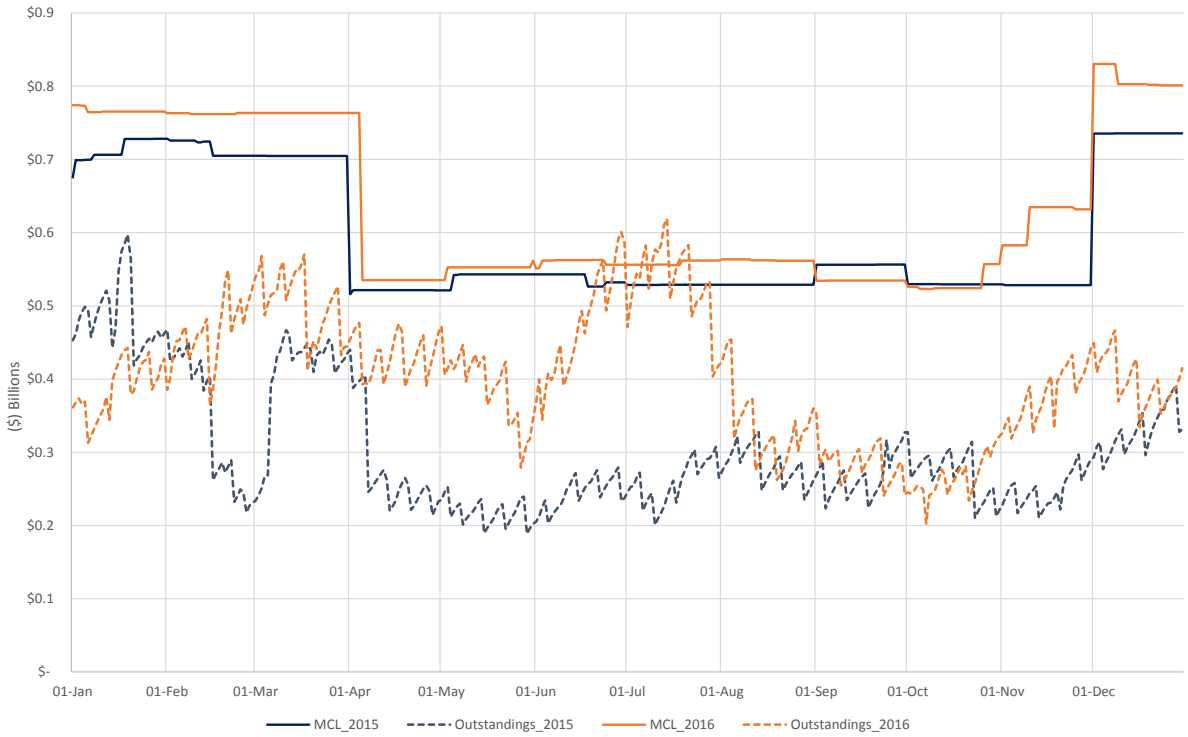


Figure 3 compares the levels of actual MCL and outstandings in 2015 with 2016. The actual MCL levels in these two years are very similar. However, the level of outstandings is significantly higher and more volatile for much of 2016, from March to August and again in November to December. It is difficult to draw any firm conclusions about the efficiency of AEMO's prudential settings from this comparison. On the one hand, the level of actual MCL for 2016 was very similar to 2015 and covered significantly higher outstandings in the NEM. However there were exceedances in mid-June to mid-July 2016 (i.e. outstandings greater than MCL) which have led to the 2% prudential standard not being met.

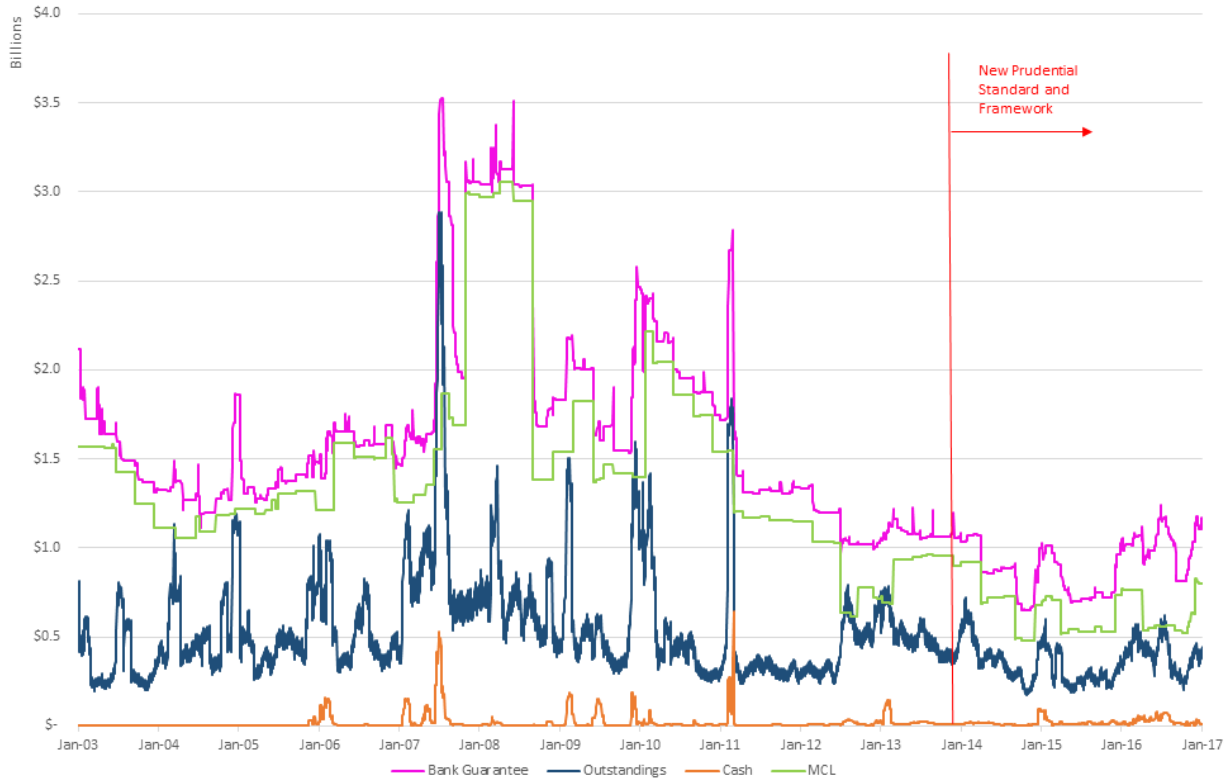
The CLP has been in place for three years. From data gathered to date, we have seen that:

- MCL requirements under the CLP are lower than MCL requirements determined under the previous prudential regime for similar levels of outstandings.
- The 2016 year has seen a significant shift in electricity pricing that has led to the prudential standard not being met. It is yet unclear to AEMO whether this is a one off confluence of events, or a more permanent shift in the energy market (See Section 2.5 for a further discussion).

2.2.3 Participant behaviour

Figure 4 and Figure 5 looks at the levels of MCL, guarantees, cash (in the form of security deposits) and outstandings over different time periods.

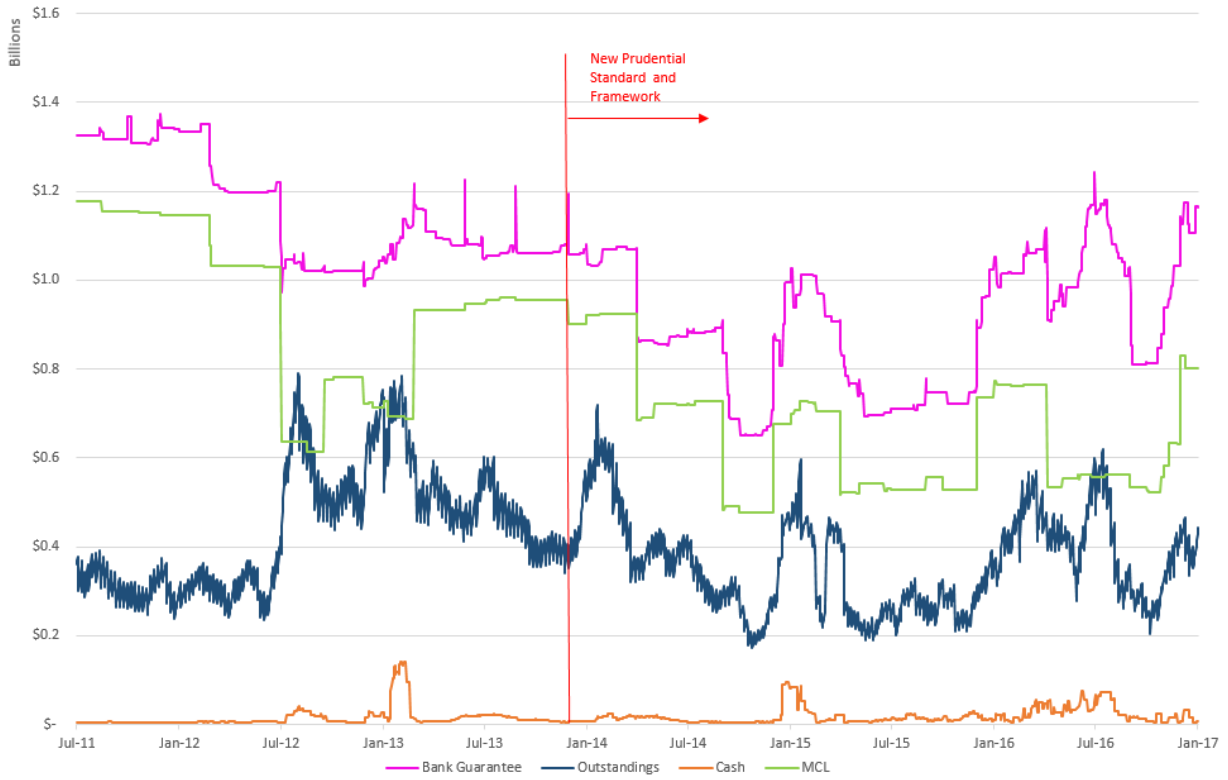
Figure 4 - MCL, guarantees, cash and outstandings (Life of NEM)



Over the life of the NEM, shown in Figure 4, the following observations can be made:

- The level of outstandings in 2016 is by no means high compared to other time periods over the life of the NEM, such as 2007 to 2010. However, the MCL levels (and consequently the credit support held by AEMO) are significantly lower than in those previous high outstandings periods.
- The level of bank guarantees is consistently above the MCL level. This is due to market participants using bank guarantees not only to meet their MCL requirements, but also to increase their trading limits. This additional credit support reduces the likelihood of market participant default, as AEMO has a larger 'buffer' of credit support.
- The amount of voluntary bank guarantees (bank guarantee amounts over the mandatory MCL amount) in 2016 was higher compared to previous years. When prices are volatile, participants tend to provide more long-term, voluntary bank guarantees to mitigate the risk of a trading limit breach and to better manage anticipated trading activities.
- Market participants readily use cash (security deposits) during periods of high outstandings (usually due to transient high prices).

Figure 5 - MCL, guarantees, cash and outstandings (2011 to 2016)



Looking at the past six years in closer detail as shown in Figure 5, the following observations can be made:

- The general behaviour of market participants, in managing their prudentials, has stayed consistent over the years.
- Under normal market conditions, MCL and bank guarantee levels move together. However, in the period from April to August 2016, the level of bank guarantees rose significantly compared to MCL levels. This was due to high prices raising market participant outstandings significantly, meaning market participants had to provide additional credit support when MCL levels are traditionally lower (shoulder and winter seasons). Before the new prudential standard was introduced in 2014, AEMO could revise all market participant MCLs based on updated price and VF calculations, allowing an immediate response to price excursions. By design, the methodology outlined in the CLP does not afford AEMO this discretion.
- The level of security deposits rose in 2016, with market participants using security deposits more frequently to resolve trading limit breaches. As high electricity prices persisted, market participants switched to providing voluntary bank guarantees to mitigate the risk trading limit breaches.

2.3 Participant Risk Adjustment Factors

Participant Risk Adjustment Factors ($PRAF_L$ or $PRAF_G$ or $PRAF_R$) are derived by AEMO using historical data. They are used to reflect the risk of market participants' estimated load, generation and reallocations respectively, relative to that of the regional load.

PRAFs for each MCL review are based on available data from the previous 'like season', and are determined as representative of the market participant's current trading behaviour. Where insufficient

historical data is available, or the market participant's trading behaviour has changed significantly since the previous like season, a more representative range of historical data may be used. Where no data is available, default PRAF values are used ($PRAF_L$ = 1.05, $PRAF_G$ = 0.95).

Table 9 – $PRAF_L$ and $PRAF_G$ definitions and examples

	$PRAF_L$	$PRAF_G$
Definition	• Relationship between regional load and the participant's MLF adjusted load. • Adjusts OSL and PM to reflect relative load risk of participant.	• Relationship between regional load and the participant's MLF adjusted generation. • Adjusts OSL and PM to reflect relative generation risk of participant.
Average PRAF behaviour	• $PRAF_L$ =1.0 • Electricity use matches region electricity use profile.	• $PRAF_G$ =1.0 • Electricity generation matches region electricity generation profile.
Low PRAF behaviour	• $PRAF_L$ = 0.5 • Lower consumption in peak half-hourly periods than off-peak periods. • Lower risk = lower MCL	• $PRAF_G$ = 0.2 • Lower generation in peak half-hourly periods than off-peak periods. • Higher risk = higher MCL
High PRAF behaviour	• $PRAF_L$ = 2 • Higher consumption in peak half-hourly periods than off-peak periods. • Higher risk = higher MCL	• $PRAF_G$ = 2 • Higher generation in peak half-hourly periods than off-peak periods. • Lower risk = lower MCL

The analysis below looks at the actual PRAF values for 2016, for load, generation and reallocations, and the distribution of these PRAF values.

2.3.1 PRAF Values – load, generation and reallocations

Table 10 shows the highest, lowest and average PRAF values for load, generation and reallocations for all regions for 2016. As shown, the average PRAF values under the CLP, for both load and generation, are lower than the average loss factor of 1.05 applied under the previous NEM prudential regime.

Table 10 - PRAF values in 2016 seasons (all regions)

Level	$PRAF_L$	$PRAF_G$	$PRAF_R$*
Highest	6.25	2.50	1.39
Lowest	0.47	0.00	0.92
Average**	1.02	1.00	1.00

* Zero $PRAF_R$ are excluded.
** Average of PRAFs in all regions in 2016 seasons.

Table 11 and Table 12 show load-weighted and generation-weighted PRAFs for all regions for the four 2016 seasons. The average $PRAF_L$ falls between 0.95 and 1.1, while the average for $PRAF_G$ falls between 0.95 and 1.05 for all regions and seasons.

Table 11 - Load weighted $PRAF_L$

Region	2016 Summer	2016 Shoulder 1	2016 Winter	2016 Shoulder 2
NSW	1.01	1.01	1.01	1.00
QLD	1.03	1.04	1.04	1.03
SA	1.01	1.01	1.01	1.01
TAS	1.00	1.00	1.00	1.00
VIC	1.02	1.02	1.01	1.02

Table 12 - Generation weighted $PRAF_G$

Region	2016 Summer	2016 Shoulder 1	2016 Winter	2016 Shoulder 2
NSW	1.00	0.98	1.01	0.98
QLD	0.95	0.97	0.96	0.97
SA	1.01	0.99	1.00	0.99
TAS	0.94	0.97	0.96	0.96
VIC	0.97	0.97	0.98	0.98

2.3.2 Distribution of PRAF values

An analysis of the distribution of all market participant $PRAF_L$, $PRAF_G$ and $PRAF_R$ values is shown in Figure 6, Figure 7 and Figure 8. As shown, 87% of $PRAF_L$ values range between 0.9 and 1.1 and 84% of $PRAF_G$ values range between 0.9 and 1. Also, 97% of the non-zero $PRAF_R$ values range between 0.95 and 1.1.

The average PRAF values under the CLP, for both load and generation, are lower than the average loss factor of 1.05 applied under the previous NEM prudential regime.

This results conforms to AEMO's expectation of PRAF distributions.

Figure 6 - $PRAF_L$ distribution for 2016 (all regions)

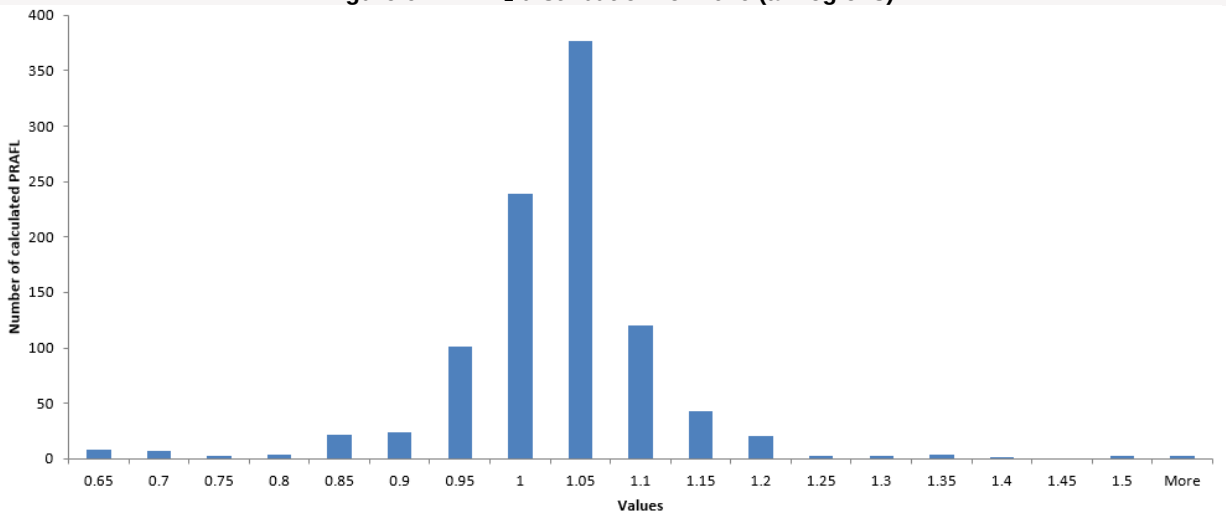


Figure 7 - $PRAF_G$ distribution for 2016 (all regions)

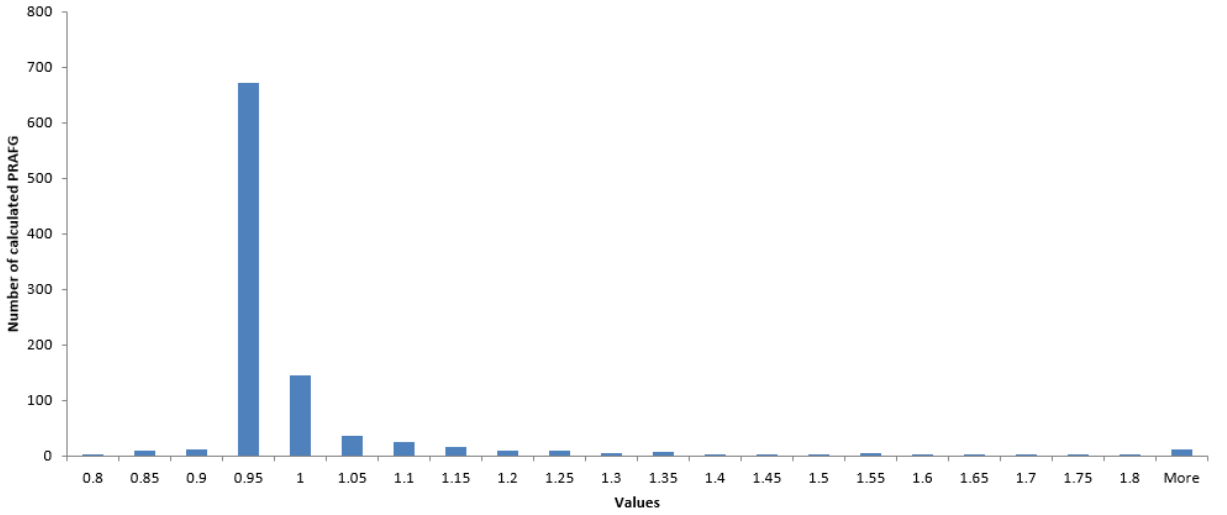
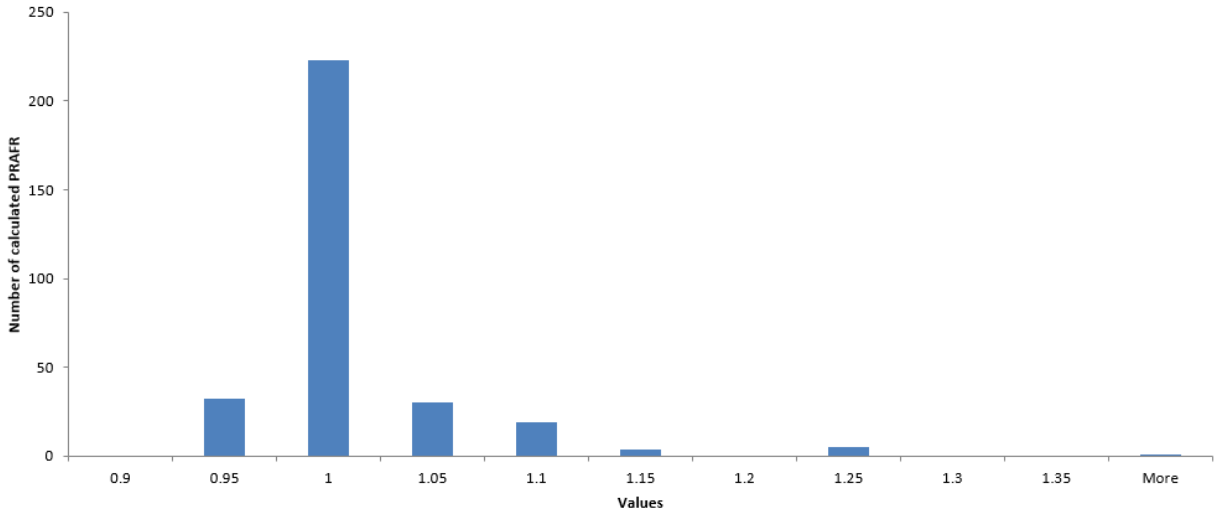


Figure 8 - $PRAF_R$ distribution for 2016 (all regions)



According to the analysis conducted, PRAFs are working as intended, with MCL requirements appropriately moderated by the relative risk a participant poses to the market.

2.4 Ancillary service costs

AEMO procures ancillary services to fulfil its obligation under the NER (Clause 4.3.1). These ensure that the power system is operated in a safe, secure and reliable manner. Ancillary service costs depend on the service price and quantity required at a given time. As these can vary substantially from period to period, costs will also vary widely. The ancillary service payments are paid to the scheduled generator/customer or the contracted market participants, depending on the service type. AEMO then recovers the costs of these services from market participants.

Currently, market participant prudential settings do not consider ancillary service costs, as these are considered marginal compared to energy and reallocation costs. In the case of a default, the credit support held by AEMO for the market participant would be used to pay the ancillary service costs, with these costs not subject to any shortfall.

With the current volatility in the electricity market, AEMO believes it is important to reassess this issue, and ensure that the relative costs of ancillary services remains marginal compared to energy and reallocation costs.

2.4.1 Ancillary service costs analysis

To better understand the changes in the magnitude of ancillary service payments, the analysis below looked at data for regional weekly ancillary service costs and the value of energy purchased.

The total yearly value of energy purchased and ancillary service costs in the NEM for each region are shown in Table 13 and Table 14. As shown, the total value of ancillary service costs per year have risen over time, with the largest rise from 2014 to 2016 in South Australia.

Table 13 – Value of energy purchased in the NEM ($ millions)

Year	SA	NSW	QLD	TAS	VIC	Total
2014	$676	$2,852	$2,721	$471	$1,959	$8,679
2015	$675	$2,690	$2,899	$515	$1,569	$8,349
2016	$1,092	$4,199	$3,787	$977	$2,222	$12,278

Table 14 – Value of ancillary service costs in the NEM ($ millions)

Year	SA	NSW	QLD	TAS	VIC	Total
2014	$4	$49	$9	$21	$9	$92
2015	$38	$29	$9	$18	$9	$102
2016	$51	$43	$18	$18	$18	$147

The ancillary service costs, as percentage of total yearly value of energy purchased, for each region and in total, are shown in Table 15. This shows that the total share of ancillary service costs per year in the NEM over the past three years has not changed, being just above one percent of the total value of energy purchased.

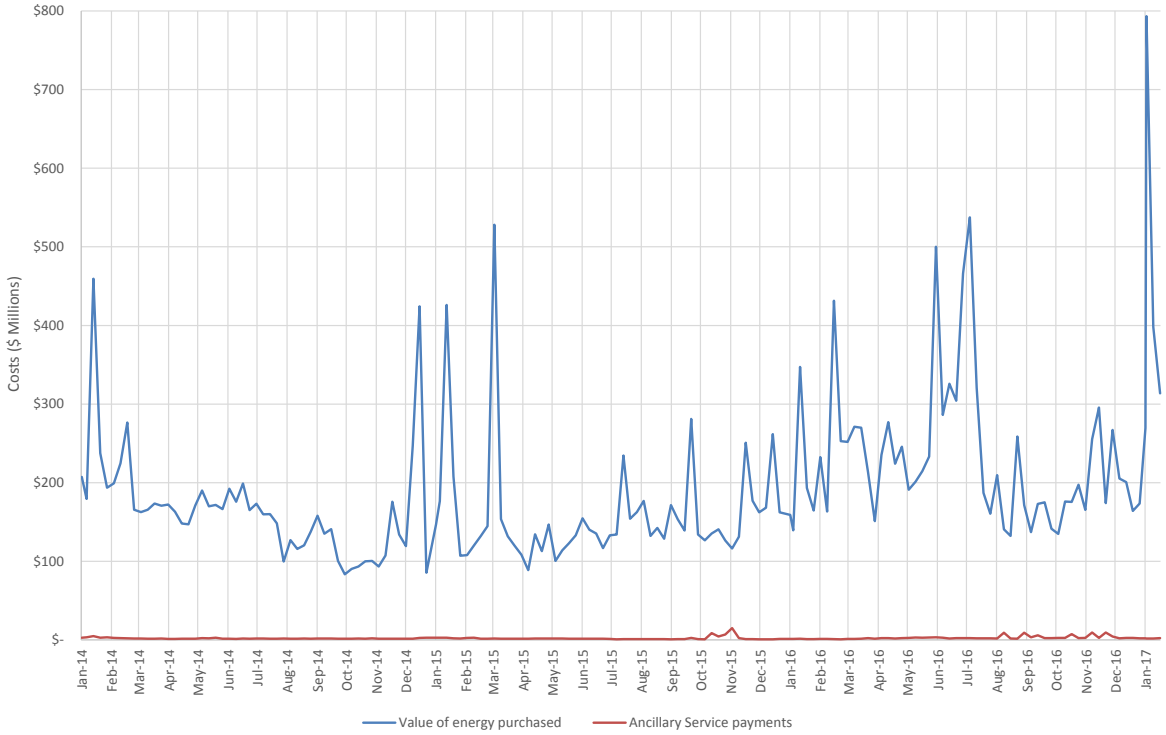
However, as the table also highlights, in South Australia and in Tasmania, the total ancillary service costs over a year represent a significantly higher percentage of total costs (up to 5.6%) than in other regions.

Table 15 - Ancillary service costs as a percentage of total value of energy purchased

Year	SA	NSW	QLD	TAS	VIC	Total
2014	0.6%	1.7%	0.3%	4.5%	0.5%	1.1%
2015	5.6%	1.1%	0.3%	3.4%	0.6%	1.2%
2016	4.7%	1.0%	0.5%	1.8%	0.8%	1.2%

Figure 9 shows a weekly view of the total value of energy purchased and total ancillary service costs in the NEM over the past three years. As shown, in total, ancillary service costs remain marginal compared to energy costs.

Figure 9 - Value of weekly total energy purchased and ancillary service costs in the NEM (2014 to current)



A comparison of the weekly value of ancillary payments for all the NEM regions is shown in Figure 10. It clearly indicates that South Australia is a significant outlier, with large spikes in the ancillary service payment over two months in 2015, and in significant parts of 2016.

Figure 10 - Value of weekly ancillary service costs in the NEM regions (2014 to current)

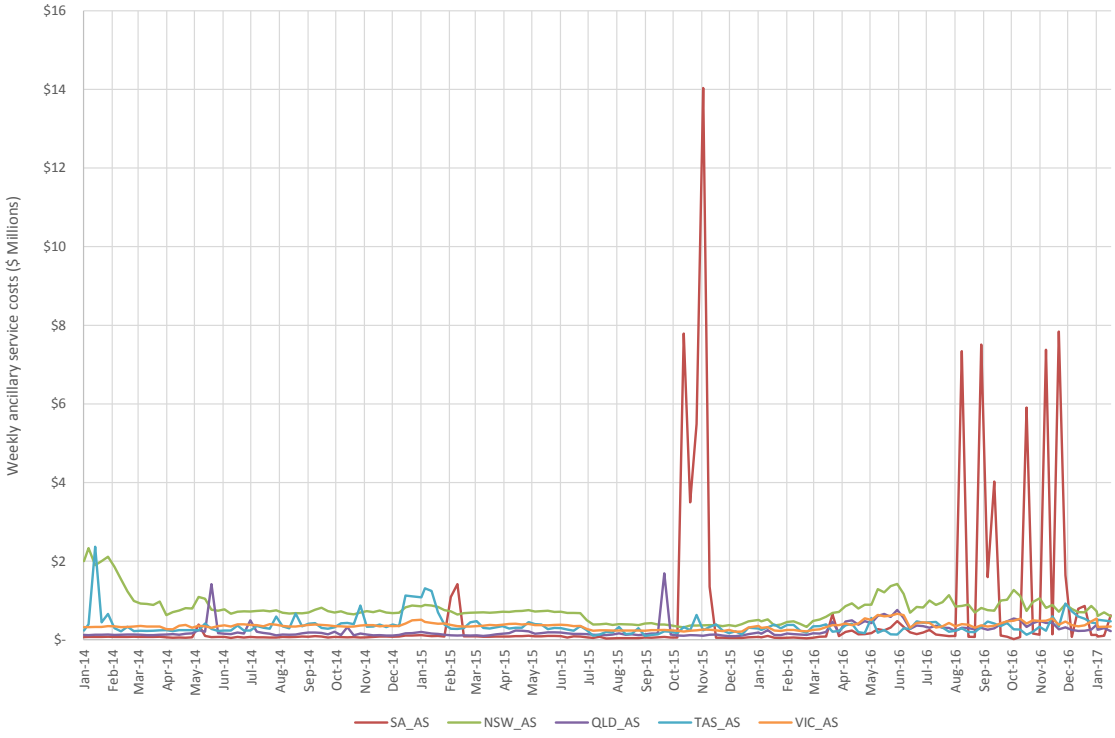


Figure 11 compares weekly ancillary service costs with the value of energy purchased for South Australia. As shown, ancillary services costs, in significant parts of 2016 and a smaller part of 2015, were significant compared to energy costs.

Figure 11 - Value of weekly total energy purchased and ancillary service costs in SA (2014 to current)

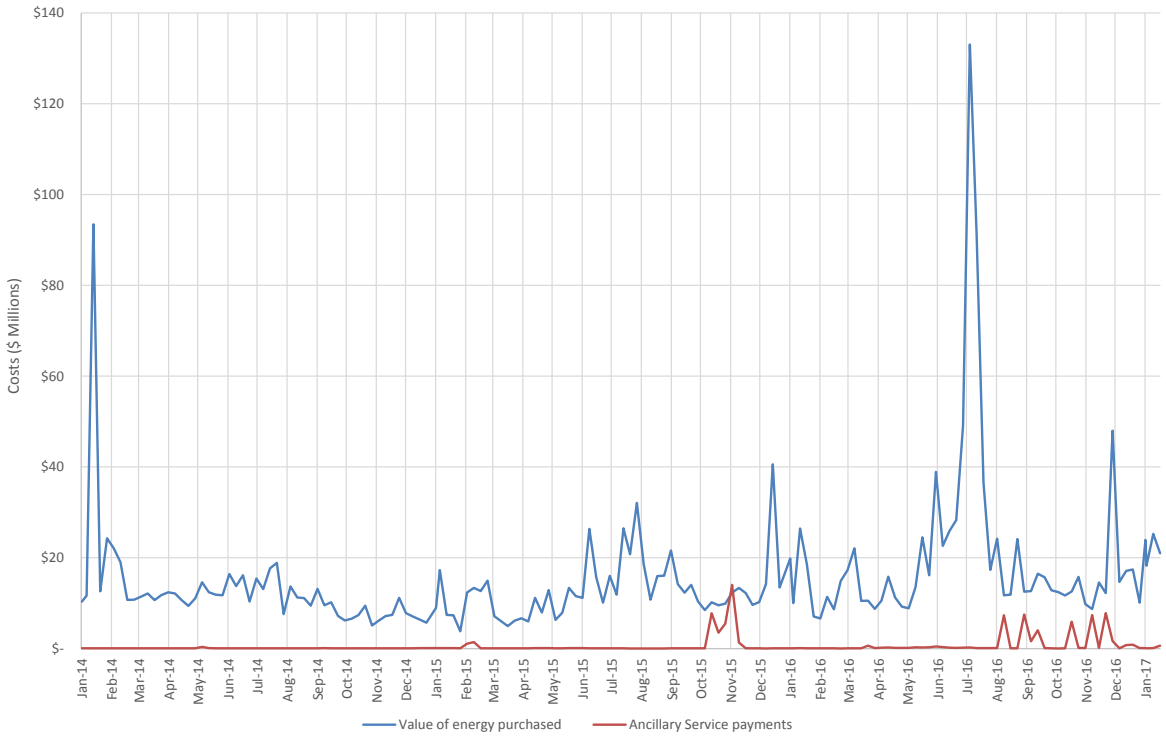
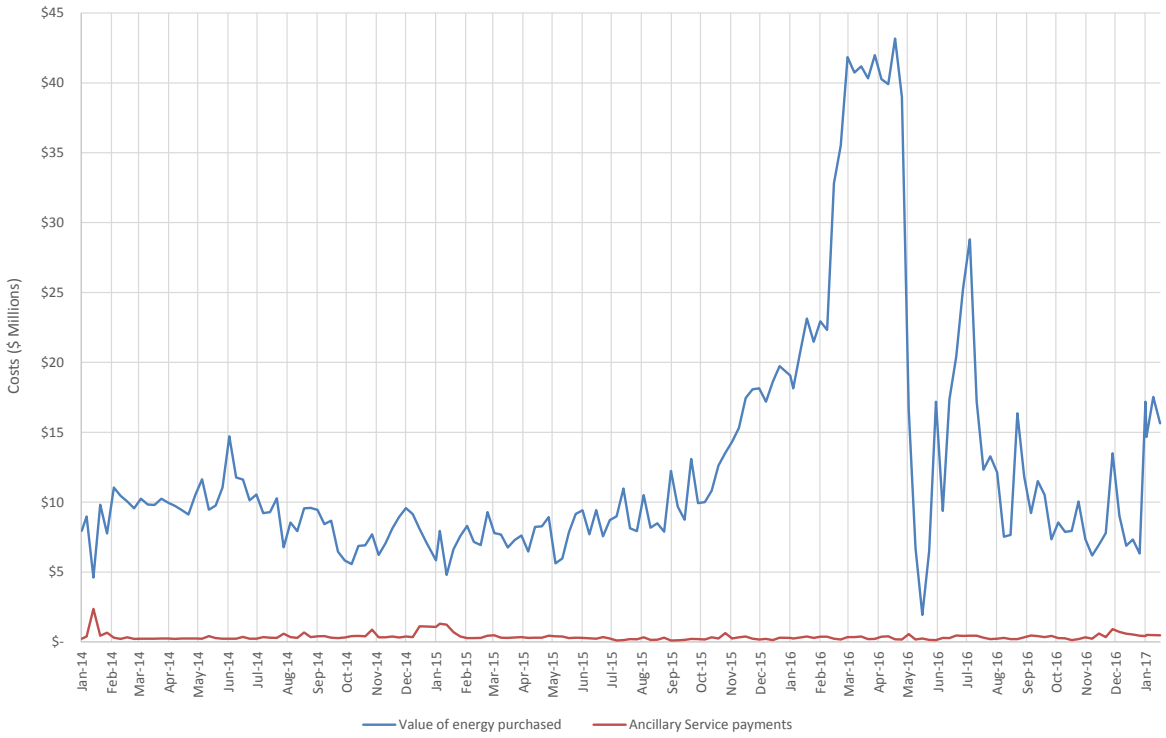


Figure 12 compares weekly ancillary service costs with value of energy purchased for Tasmania. This graph indicates, that unlike in South Australia, Tasmania has not had an uplift in ancillary payments over the past three years. Rather, Tasmania in general, appears to have higher ancillary service costs as a percentage of the value of energy purchased than other regions.

Figure 12 - Value of weekly total energy purchased and ancillary service costs in TAS (2014 to current)



Based on the above analysis, the following observations can be made:

- Overall, the value of ancillary service costs remains small, representing about 1.2% of the total energy costs in the NEM.
- Over the past three years, there has been an increase in total ancillary service costs in the NEM, from $92 million in 2014 to $147 million in 2016. Most of the increase can be attributed to increased costs in South Australia.
- The value of ancillary service costs in the past three years has been significantly higher in South Australia (up to 5.6% of the value of energy) and in Tasmania (up to 4.5% of the value of energy) than in the NEM.
- For some regions, ancillary service costs may no longer be marginal. Further analysis is required to determine whether this trend in increasing ancillary service costs is likely to remain, and whether going forward, ancillary service costs will need to be accounted for in market participant prudential settings. Also, the appropriateness of recovering ancillary service costs also needs to be examined.

2.5 Further review of CLP methodology

This review has found that with inclusion of settlement data up to 30 November 2016, the prudential standard over the life of the NEM is not met. The actual level of exceedance is above the 2% prudential standard, in all regions of the NEM.

The prudential settings for market participants are set by AEMO so that the prudential standard is met for the NEM over the long term. Market conditions can change from year to year (as happened between 2015 and 2016) leading to a higher rate of exceedance in any particular year.

To date, it has been AEMO's expectation that the 2% prudential standard would be met over the long term. 2016 has seen a significant shift in electricity pricing, leading to the prudential standard not being

met. Also, AEMO believes that once the 2017 summer data is added to this analysis, the rate of exceedance will increase.

It is yet to be determined whether this is a case of a confluence of events over one year or a more permanent shift in the energy market. The section below lays out some preliminary analysis around this issue, and AEMO's intended course of action.

2.5.1 Reasons for higher electricity prices in 2016

Preliminary analysis indicates that the current exceedance of the prudential standard is due to multiple factors that have contributed to higher electricity prices in 2016. These may include (but are not limited to) the following:

- Basslink outage from 20 Dec 2015 to 13 June 2016.
- Network outage which limited energy flows from Victoria to South Australia across the Heywood interconnector in July 2016.
- Various plant outages across black and brown coal generation.
- Higher gas prices increasing the price at which gas-powered generation bid into the NEM.

Also, there were heat-wave conditions over the 2017 summer period in multiple regions, increasing electricity prices. These outcomes are yet to be included in the life of NEM model, and are likely to further increase the level of prudential exceedance.

2.5.2 Tools available to manage prudential exceedance

If AEMO determines that changes in the electricity market make it likely that the 2% prudential standard will not be met over the long term, the model governing market participant prudential settings can be recalibrated. Avenues for recalibration include:

- Changing the VF percentiles.
- Changing the weighting factors for the average regional load and the average regional price.
- Introducing a step change in the regional reference price (as was done with the repeal of the carbon price in 2014).
- Changing the capping parameters.

2.5.3 Adjusting volatility factor percentiles to meet the prudential standard

The distribution from one day to the next in the level of outstandings (volatility) is used to establish the point on that distribution consistent with a 2% prudential standard for a given region. This point differs by region and is referred to as the Volatility Factor (VF) percentile. AEMO publishes its calculation of the percentile of the volatility distribution consistent with a 2% prudential standard for each region annually in advance. The VF percentiles were last reviewed in 2014, during the CLP consultation for the carbon price repeal.

The VF percentiles represent one way for AEMO to recalibrate market participant prudential settings to meet the prudential standard. The VF percentiles currently used, together with the recalculated VF percentiles adjusted to meet the 2% prudential standard, are shown in Table 16.

Table 16 Current and adjusted VF percentiles and prudential exceedance (Life of NEM)

Region	Current prudential settings		Adjusted prudential settings	
	VF percentiles	Actual prudential exceedance (life of NEM)	Recalculated VF percentiles	Recalculated prudential exceedance (life of NEM)
NSW	88.9%	2.3%	92.1%	2.0%
QLD	94.6%	2.6%	100%	2.0%
SA	96.5%	2.2%	98.2%	2.0%
TAS	71.1%	5.2%	100%	3.7%
VIC	94.5%	2.1%	94.8%	2.0%

As shown, the prudential standard can be met in all regions (except for Tasmania) by adjusting the VF percentiles. As previously discussed, the smaller data set makes it harder for the prudential standard to be met in Tasmania. This, together with the Basslink outage (20 Dec 2015 to 13 June 2016), is the main reason why the prudential standard cannot be met, even with the VF percentile set at 100% for Tasmania. Preliminary analysis indicates that if the effect of the Basslink outage is excluded, an adjusted VF percentile of 94.2% would achieve the 2% prudential standard in Tasmania.

3. CONCLUSIONS AND INTENDED ACTIONS

This review found that with the inclusion of settlement data up to 30 November 2016, the prudential standard was not met. The level of exceedance above the 2% prudential standard was small (2.1% to 2.6%) for all regions bar Tasmania (5.2%). While the prudential standard was not met in any region, this outcome is to be expected from time to time due to the long–term nature of the target, that is, to keep exceedance below 2% over the life of the NEM. It is also important to note that there was no shortfall in the market.

Preliminary analysis shows that multiple factors contributed to higher electricity prices that then led to this year's exceedance. These may include (but are not limited to) the Basslink outage, interruptions to service resulting from the interconnector upgrade between South Australia and Victoria, higher gas prices and various coal plant outages.

This review also found that PRAFs are working as intended, with Maximum Credit Limit (MCL) requirements appropriately moderated by the relative risk a participant poses to the market. Ancillary service costs were found to be increasing, and for some regions, ancillary service costs may no longer be considered marginal.

In light of the prudential standard not being met, together with continuing volatility in the electricity market and rising ancillary service costs, AEMO has decided to:

1. Re-calculate the VF percentiles for each region to meet the 2% prudential standard over the life of the NEM, once settlement data for the summer 2017 season becomes available. The new VF percentiles will be published on AEMO's website by end of June 2017, to coincide with the shoulder 2 MCL review.
2. Undertake a review to more extensively assess the adequacy of the CLP methodology and AEMO's ability to calibrate it to meet the prudential standard. The review will focus on three key areas:
    - Changes in electricity prices.
    - CLP calibration methodology.
    - Treatment of ancillary service costs in relation to prudential settings.

AEMO proposes starting the additional review in Quarter 2, 2017, and will publish a report of its findings on AEMO's website. Market participants will be encouraged to provide feedback through the NEM Wholesale Consultative Forum in Quarter 3, 2017.

In proposing this review, AEMO is mindful that prudential settings performance needs to be viewed over the long term. Any methodology and procedure changes need to be carefully considered and consulted on.

For any further enquiries, please email: Prudentials@aemo.com.au