FUTURES OFFSETS ARRANGEMENTS

AEMO STUDY

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AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

IMPORTANT NOTICE

Purpose

AEMO has prepared this document to provide information about the outcomes from AEMO's study on the potential benefits from the introduction of Futures Offsets Arrangements in the NEM which was completed in July 2015.

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EXECUTIVE SUMMARY

Conceptually, Futures Offsets Arrangements (FOA) are prudential arrangements that would potentially allow Market Participants in the National Electricity Market (NEM) to optionally offset their market positions in exchange traded derivatives against their trading position in the NEM, when meeting their prudential liabilities.

In practical terms, this would potentially reduce the maximum credit limit (MCL) requirements for NEM Market Participants. A reduction in MCL requirements will lower capital costs and barriers to entry for intending Market Participants, increase competition and market efficiency, and ultimately reduce costs for end users of electricity.

The AEMC's *Review into the Role of Hedging Contracts in the Existing NEM Prudential Framework*, completed in July 2010, recommended that AEMO should:

1. Re-assess the benefits and the prudential quality of the NEM under FOAs against any changes to the MCL methodology arising from AEMO's review of the prudential framework; and
2. If still appropriate, integrate FOAs into the NEM prudential framework in accordance with the AEMC's recommendations, with necessary amendments, through a Rule change proposal.

This study is based on the AEMC's first recommendation, and looks at FOA implementation under the New Prudential Standard and Framework implemented by AEMO in 2013.

The analysis includes an assessment of (i) the potential benefits of FOAs, (ii) the impact of FOAs on the Prudential Standard and (iii) the costs of implementing FOAs.

The study found that incorporating FOAs into AEMO's NEM prudential framework would:

- Result in average aggregate reductions in total credit support requirements across the National Electricity Market of $45 million to $180 million per year. This represents an aggregate average saving of between $0.3 million to $1.2 million per year for Market Participants.
- Not adversely impact the Prudential Standard, with the prudential probability of exceedance for all regions remaining under 2%.
- Result in benefits that are similar, or only slightly greater than the implementation costs.

The study's findings suggest that FOAs could reduce prudential costs for Market Participants without materially impacting the Prudential Standard, with implementation costs which are comparable with the potential benefits expected to be delivered from the initiative.

However this does mean that the study does not present a clear-cut case to either proceed with, or abandon FOAs. While potential costs savings exist, the benefits are similar, or only slightly greater than the implementation costs. Hence the net benefits from the implementation of FOAs are likely to be marginal.

There are also further risks and practical process and systems hurdles that could have an impact, but are outside the scope of this study. These would need detailed analysis before a Rule change proposal was considered.

To assist in its decision making, AEMO is seeking stakeholder feedback in relation to:

- Current/intending Market Participant appetite for the implementation of FOAs in the NEM.
- Level of Market Participant support for AEMO continuing to undertake work on FOAs in the NEM.

Together with the study findings, the feedback will be used by AEMO to decide whether to proceed with the AEMC's second recommendation and "*integrate FOAs in the NEM prudential framework in*

accordance with the AEMC's recommendations, with necessary amendments, through a Rule change proposal".

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1. RELEVANT BACKGROUND

A Futures Offsets Arrangement (FOA) is a conceptual prudential mechanism whereby a Market Participant in the National Electricity Market (NEM) would be allowed to offset their market positions in exchange traded energy derivatives (i.e. electricity futures contracts) against their trading positions in the NEM, when their NEM prudential exposure is assessed.

NEM participants routinely use electricity futures contracts to manage spot price risk outside the wholesale electricity market. The FOA concept would allow them to potentially use these futures contracts to reduce their collateral requirements within the NEM.

In practical terms, this would mean a reduction in the assessed maximum credit limit (MCL) for Market Participants. A reduction in their MCL - and correspondingly their collateral requirements - would reduce capital costs and lower barriers to entry for Market Participants, ultimately reducing energy costs for end users.

Additionally, the potential for the consolidation of prudential monitoring systems and processes across the spot and forward markets offered by the implementation of FOA may create efficiencies which positively impact new entrants and investment through reduced operational costs, risks and capital requirements[1].

1.1 History of FOAs

To date, several pieces of work have been undertaken by the AEMC, AEMO and other proponents on FOAs as shown in the table below.

[1] See http://www.industry.gov.au/Energy/EnergyMarkets/Pages/EnergyReformImplementationGroupReport.aspx

Table 1 - FOA historical timelines

Date	Action
January 2008	FOA rule change proposal by proponents
January 2009	AEMC determination for FOA rule proposal — rejected proposal and proposed undertaking a review of hedging arrangements
March 2009	Commencement of AEMC's Review into the Role of Hedging Contracts in the Existing NEM Prudential Framework[2] (*Hedging Review*)
March 2009	*Hedging Review* - Working Group established by AEMC to advise Hedging Review - developed 2 models (FOA Model 1 and FOA Model 2)[3]
October 2009	*Hedging Review* - PwC Draft Risk Assessment report
November 2009	*Hedging Review* - AEMO submission to AEMC on PwC Draft Report - criticism of PWC FOA Model
February 2010	*Hedging Review* - PwC Final report recommending implementation of Model 2 with amendments
March 2010	*Hedging Review* - AEMC Draft report released
April 2010	*Hedging Review* - AEMO submission commenting on AEMC draft report
July 2010	*Hedging Review* - AEMC final report
April 2011	AEMO 'Energy Markets Prudential Readiness Review – Final report to the MCE' completed[4]
November 2012	AEMC Final Rule Change Determination – New Prudential Standard and Framework
November 2013	Implantation of revised methodology for MCL calculation & new Prudential Standard (CLP)
Early 2014	AEMO stakeholder consultation on FOAs
July 2014	Presentation of Preliminary FOA Modelling to NEMW-CF

The AEMC's *Hedging Review*, completed in July 2010, was the last major piece of analysis on the use of FOAs. The review looked at a number of issues including the feasibility of incorporating futures prices into the MCL methodology.

In light of the then impending review of the NEM prudential framework by AEMO, the AEMC recommended that AEMO should:

1. Re-assess the benefits and the prudential quality of the NEM under FOAs against any changes to the MCL methodology arising from AEMO's review of the prudential framework; and
2. If still appropriate, integrate FOAs into the NEM prudential framework in accordance with the AEMC's recommendations and with necessary amendments through a Rule change proposal.

The AEMC view was that a change to the method of calculating MCL may impact the benchmark for the prudential quality and the benefits available under FOAs, therefore it was deemed appropriate that the potential introduction of FOAs be re-assessed taking into account AEMO's recommendations on the NEM prudential framework.

1.2 FOA Model 2

The FOA model utilised by AEMO for this study is referred to as FOA Model 2 (refer to Appendix 1 for model description and key features), and was initially developed in 2009 by the Working Group advising the *Hedging Review*.

[2] See http://www.aemc.gov.au/Markets-Reviews-Advice/Review-into-the-Role-of-Hedging-Contracts-in-the-E.
[3] These models are working examples that were provided to PwC to assess the risks associated with the models and to make recommendations on options to enhance the models as part of PwC's assignment.
[4] See http://www.aemo.com.au/Consultations/National-Electricity-Market/Closed/~/media/Files/Other/electricityops/0538-0006%20pdf.ashx

Under this model, the Market Participant provides their initial credit support based on the futures lodgement price (FLP). Variation margins are received by AEMO and treated in accordance with the Security Deposit Arrangements (SDA) when the futures prices exceeds the FLP (with a spot price floor).

In 2010, consultants from PwC recommended that FOA Model 2 (with some amendments) be adopted for FOAs in the NEM. The AEMC amended aspects of PwC's recommendations and the resulting version of the FOA Model 2[5] is the one used for this study.

The key feature of FOA Model 2 is that it is a "voluntary" model. The alternative "involuntary" FOA model is one where a retailer, clearing participant (CP) and AEMO would automatically become parties to the FOA under the Rules and margin payments would be required as firm payments even in the event of termination of the futures contract or default of a party. This model was viewed as being incompatible with the arrangements of central counterparty clearing (CCP), and not pursued. FOA Model 2 is a "voluntary" FOA model, whereby margin payments are not assumed to be received by AEMO, so any prudential benefit is derived only from the accumulation of margin payments received during the outstandings period.

1.3 Stakeholder consultation

AEMO has been discussing FOAs as a concept with stakeholders over the past few years. There has been some interest from Market Participants in the concept, as a way of managing/reducing their MCL based collateral requirements. However, to date there hasn't been a strong call from Market Participants to implement FOAs.

AEMO gauged Market Participants appetite for FOAs prior to undertaking this study. As shown in Table 2, there were a variety of views expressed by participants for and against the introduction of FOAs.

[5] When talking about FOA Model 2 henceforth it will be referring to the amened FOA Model 2 that was in the Appendix B of the AEMC's Final Report for the *Hedging Review*, http://www.aemc.gov.au/Media/docs/Draft%20Report-e621fba6-9753-4887-958b-28f763432019-0.PDF.

Table 2 - Stakeholder views

Reasons for supporting FOAs	Reasons for not supporting FOAs
It is seen to be an attractive proposal as it reduces collateral requirements. Prudential collateral is a hurdle for expanding businesses as it ties up cash through cash backed guarantees.	Participants who do not currently participate in futures contracts and don't intend to use them in the future see no benefit in FOAs.
Reallocation offerings are expensive and FOAs would provide a more cost effective option.	Participants with an operational preference for using reallocations do not see as much value in FOAs.
Even if they don't currently use futures contracts, several Market Participants intend to do so in the future.	Concerns over how FOAs would be integrated into the current prudential processes prevent participants from fully supporting the initiative.
Futures are considered to be less risky than reallocations because they are not exposed to individual counterparties.	The potential to increase market risk due to the use of FOAs concerns participants.
	Correlation of spot price changes to futures margin payments may favour the use of FOAs.
	Concerns over the complexity and risks of buying and selling futures contracts may prevent participants from fully utilising FOAs.
	Participants are concerned that under FOAs, money from margin payments may not sufficiently cover large spot price spikes.

AEMO presented the draft FOA modelling findings to stakeholders through the NEM Wholesale Consultative Forum (NEMW-CF) in July 2014. This study is to be presented to the NEMW-CF and the results be used as a basis for further discussions with stakeholders on FOAs.

AEMO will incorporate the feedback from stakeholders in its decision on whether to proceed with any Rule change/implementation process for FOAs.

2. KEY CONCEPTS

To understand the work undertaken by AEMO for this project, it is necessary to have a clear understanding of:

- the concept of futures offsets;
- the prudential framework under which AEMO and all Market Participants operate; and
- electricity futures contracts and the way they are used by NEM Market Participants.

2.1 Futures offsets arrangements

An FOA is an arrangement whereby a Market Participant would lodge their electricity futures contracts with AEMO, allowing for a reduction in a participants MCL relative to the contract specifications.

The Market Participant would then make cash payment to AEMO of amounts equivalent to electricity futures variation margins occurring above a prescribed futures contract price in relation to electricity futures contracts that have been specified to be subject to the arrangement.

2.2 The New Prudential Standard and Framework

The New Prudential Standard and Framework (the *Framework*) was implemented in 2012, and is located under Section 3.3 of the National Electricity Rules (NER). The new Framework replaced the previous NEM prudential regime, outlined in AEMO's Credit Limits Methodology based on a standard of reasonable worst case.

The key concepts of the Framework, outlined in AEMO's Credit Limit Procedures[6], are:

- Market Participant credit support requirements; and
- The Prudential Standard.

2.2.1 Credit support requirements

Clause 3.3.8 (which was introduced into the NER by the Framework) outlined a new way of determining credit support requirements for Market Participants.

Under the Framework, A Market Participant's credit support requirements are determined as a function of their MCL, where:

MCL = Outstandings Limit (OSL) + Prudential Margin (PM)

The OSL reflects the credit support required to cover liabilities for energy consumed but not paid, and assumes that no Market Participant is at risk of its outstandings exceeding its trading limit. The PM reflects the credit support buffer intended to cover accruing liabilities in the NEM during the Reaction Period.

Market Participants who do not meet the approved credit support provider criteria must provide AEMO with approved credit support (in the form of a guarantee from an approved credit support provider) that meets or exceeds the value of their MCL at all times.

The approach to calculating a Market Participant's OSL and PM considers:

- Regional parameters such as estimated regional reference price (RRP) and estimated volatility.
- An estimate of a Market Participant's future load, generation and reallocations.
- A Market Participant's characteristics, through the use of a load-weighted price ratio (LWPR) for load, generation and reallocations.

[6] http://aemo.com.au/Electricity/Settlements/Prudentials

2.2.2 The Prudential Standard

The Prudential Standard means the prudential probability of exceedance (POE), expressed as a percentage. This is the probability of a Market Participant's 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 new Prudential Standard is set at 2% (NER Clause 3.3.4A).

In practical terms, this means that the prudential arrangements establish a target that there will be no payment shortfall in the market in 98 out of 100 instances of a Market Participant defaulting on their market payments, i.e., the retailer exceeds their outstandings limit, subsequently defaults, and is removed from the market. In the remaining 2% of instances, AEMO's inability to collect sufficient funds following that participant's default, may result in a payment shortfall to remaining Market Participants who are net creditors in the market (considering both energy and reallocations).

To ensure the Prudential Standard is met, AEMO uses a "Life of NEM" model. This model treats each region of the NEM as a single retailer and calculates regional volatility factor (VF) percentiles to determining the level of credit support required to meet the 2% Prudential Standard over the life of the NEM. For a more detailed description of the "Life of NEM" model, please see:

http://www.aemo.com.au/Electricity/Settlements/Prudentials/~/media/Files/Other/settlements/Regional_Model_Supporting_Information.ashx

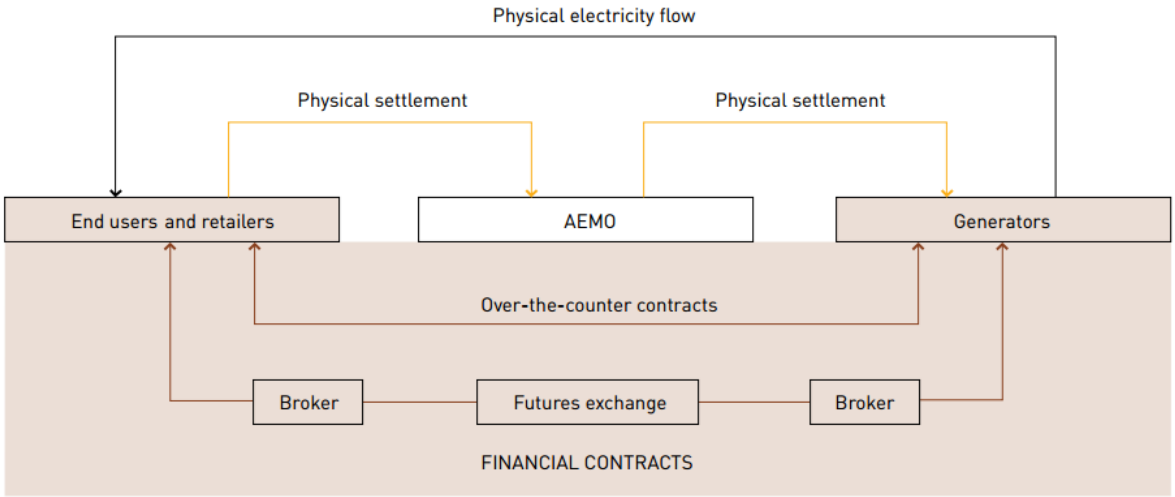
2.3 Electricity futures contracts in the ASX

The concept of FOAs relies on Market Participants being able to use exchange traded derivatives (i.e. electricity futures contracts) to offset their trading position when meeting their prudential requirements.

ASX Energy is a division of the Australian Securities Exchange (ASX) that is responsible for designing, building and supporting exchange traded energy markets. They offer a wide range of derivatives products that allow participants to manage their exposure to the spot markets operated by AEMO.

Figure 1 below is a simplified relationship of the financial flows in the National Electricity Market and financial markets.

Figure 1 - Relationship between the NEM and financial markets[7]



The key concepts used in AEMO's modelling of FOAs, in relation to electricity futures contracts are:

- Quarterly base load futures; and

[7] AER, State of the energy market 2010

- Mark-to-market accounting.

2.3.1 Quarterly base load futures

Quarterly base load futures price data from the ASX was used as the basis of the FOA modelling for this study (to determine the future lodgement price (FLP) and futures contract price on a trading day).

Base load futures contracts are one of the exchange traded derivatives offered by ASX Energy. They represent electrical energy bought and sold in the New South Wales, Victorian, South Australian and Queensland wholesale pool markets[8].

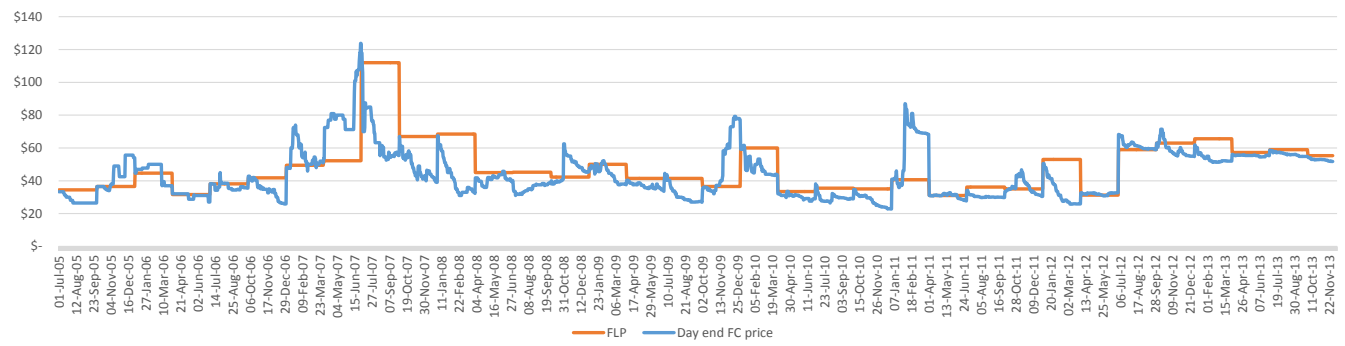
Each contract unit is for 1 Megawatt of electrical energy per hour between 00:00 hours to 24:00 hours each day over the duration of the contract quarter. The minimum price fluctuation of a contract is $0.01 per megawatt hour.

For example, a 90 day quarter might cover the equivalent of 2,160 Megawatt hours and for each cent its price fluctuates in the exchange traded market, the value of the contract changes by $21.60.

The final value of a futures contract for a particular contract quarter will be the arithmetic average of the Wholesale Electricity Pool Market base load spot prices[9] on a half hourly basis over the contract quarter, rounded to the nearest cent.

The comparison of the FLP and the end of day FC price for NSW, over the modelling timeframe, is shown in Figure 2. The end of day FC price is the quarterly base load futures price at market close on a particular date. The FLP is determined by the lodgement date. The lodgement date (as with ex-ante reallocations) is 7 business days prior to the start of a particular MCL season. The FLP is the quarterly base load futures price at market close on the lodgement date.

Figure 2 - FLP vs end of day FC price - NSW 2005 – 2013



Note: The FLP is determined at start of each quarter, while the day-end FC price is a daily futures price

2.3.2 Mark-to-market accounting

Mark-to-market accounting is the basis of how FOAs would be implemented in terms of cash flows between Market Participants, AEMO and the ASX.

Mark-to-market refers to the valuation technique whereby unrealised profit or loss from a derivative position is determined by reference to prevailing market prices. The changes in prices are facilitated through the use of trading margins at a clearinghouse[10].

[8] The transport of electricity from generators to consumers is facilitated through a 'pool', or spot market, where the output from all generators is aggregated and scheduled at five minute intervals to meet demand.
[9] The NEM interconnects five regional market jurisdictions and has independent pricing in each region.
[10] http://www.asx.com.au/documents/clearing/asx-clear-futures-energy-margining-example.pdf

ASX Energy trading margins act like any other derivative product offered through the ASX. They are essentially financial guarantees required by both buyers and sellers. Traders begin with an initial margin in their clearinghouse account and daily fluctuations in the price are marked-to-market daily. If the margin account falls below a required level, a margin call will be issued and the contract holder will have to provide additional funds to cover their margin.

3. STUDY OUTLINE

Having implemented the new prudential *Framework* (see Section 2.2), AEMO is able to fulfil the AEMC's recommendation to assess the benefits and the prudential quality of the NEM under FOAs.

The analysis presented in Sections 3.6 and 3.7 outlines the benefits of FOAs (in terms of cost reductions for Market Participants) as well as the impact of FOAs on the Prudential Standard under a variety of scenarios.

Additionally, an estimate of the break even costs of implementing FOAs was also made (see Section 3.8).

Based on these three areas of analysis, the study findings, provided in Section 5, outline the next steps in the process, including the need for stakeholder feedback.

3.1 High-level assessment of FOA Model 2

Prior to undertaking modelling of the costs, benefits, and effects of FOAs on the Prudential Standard, AEMO undertook a high-level assessment of FOA Model 2 based on a range of criteria (see Table 3).

Table 3 - FOA Model 2 high-level assessment

No.	Criteria	High-level assessment
1	Potential for FOAs to improve (or at least maintain) the prudential quality of the NEM.	✓
2	Potential for FOAs to reduce the cost of capital to trade in the NEM wholesale market.	✓
3	Potential for FOA Model 2 to be compatible with the new CLP process.	✓
4	Conceptually plausible process to ensure FOAs are underpinned by underlying net futures contract position.	✓
5	Conceptually plausible methodology for flow of margin payments arising under the futures contract(s).	✓
6	Conceptually plausible process for the exchange of information and funds between AEMO, Market Participants and clearing participants.	✓
7	Conceptually plausible methodology to manage any risks to the NEM arising from the inclusion of FOAs.	✓
8	Likelihood that Market Participants will use FOAs if allowed under the Rules.	✓

This high level assessment indicated that FOA Model 2 was theoretically implementable within the prudential *Framework*, and could potentially reduce the prudential cost for Market Participants, while mainlining the Prudential Standard.

3.2 Modelling overview

The analysis/modelling undertaken has three specific elements:

1. Reduction in MCL under FOAs.
2. Level of prudential probability of exceedance under FOAs.
3. Cost analysis of FOA implementation.

The reduction in MCL for each MCL season[11] was calculated on an aggregate regional level, by taking into account the financial hedge that a Market Participant have in place from lodged electricity futures contracts on the ASX (see Section 3.6).

The level of prudential probability of exceedance under FOAs (i.e. how the Prudential Standard was affected) was modelled though looking at how FOAs affected the aggregate daily regional outstandings in comparison to the MCL (see Section 3.7).

The cost of implementing FOAs was examined using high level, top down financial analysis where the project break-even costs were calculated based on the known prudential costs savings (see Section 3.8). These break-even implementation costs were then compared of projects of a similar scope to get an idea of the projects feasibility from a costs perspective.

3.3 Key parameters

The key parameters used in the modelling and their definitions are presented in Table 4. Key data sources are presented in Table 5.

[11] MCLs for Market Participants are calculated over 3 seasons, Summer, Shoulder and Winter

Table 4 - Parameter definitions

Parameter	Definition
Prudential Calculations	
R	NEM Region
MCL ($)	maximum credit limit
$MCL_{reduction}$ ($)	maximum credit limit reduction under FOAs
MCL_{FOA} ($)	maximum credit limit under FOAs
OSL($)	outstandings limit
PM($)	prudential margin
$EL_R(MWh)$	estimate of Market Participant's average daily load in region R
P_R ($)	estimate of the average future RRP for each region R
VF_{OSLR}	scaling factor specific to the OSL used to achieve the prudential standard for each region R
VF_{PMR}	scaling factor specific to the PM used to achieve the prudential standard for each region R
T_{OSL} $(days)$	outstandings limit time period (35 days)
T_{PM} (days)	reaction period (7 days)
$PRAF_L$	Participant Risk Adjustment Factor (load) used to adjust the OSL and PM for a Market Participant to reflect their relative load risk and achieve the prudential standard in region R for the Market Participant.
GST (%)	Goods and services tax (10%)
FOA Calculations	
FLP ($/FC$)	Futures lodgement price for the applicable quarter (quarterly base load futures)
$Level\ of\ Coverage$ (%)	The % of total load in a region covered by futures contracts at any one time (refer to Section 3.4)
$Coverage$ (MWh)	Average Daily Load as given by AEMO's Life of the NEM Model[12] x Level of Coverage (%)
FC_t ($/FC)	Futures contract price on a trading day (quarterly base load futures)
FC_{t-1} ($/FC)	Futures contract price on the previous trading day (quarterly base load futures)
$Margin\ Payments$ $(\$/day)$	Daily margin payments to AEMO are a function of the daily change in end of day futures prices and the number of MWh covered by futures contracts.

[12] This is a model that is used to optimise the prudential standard using all available historical data. It aims to maintain the prudential standard based on historical data and future expectations.

Table 5 - Data Sources

Data Input	Source
Maximum Credit Limit Inputs	
VF_{OSLR}	AEMO Life of the NEM Model
VF_{PMR}	AEMO Life of the NEM Model
$PRAF_L$	AEMO Life of the NEM Model
EL_R (MW)	AEMO Life of the NEM Model
P_R ($/MWh)	AEMO Life of the NEM Model
Futures Data	
$FLP(\$/futures\ contract)$	ASX Energy Data Centre
$Level\ of\ Coverage$ (%)	AEMO low, medium, high scenarios (Refer to section 3.4)
Historical Trading Data	
Daily average price ($/MWh)	AEMO's wholesale market system (WARE)
Daily trading amount (MW)	AEMO's wholesale market system (WARE)
Maximum Credit Limit	
MCL_{base}	Calculated as in Section 3.6, from AEMO Life of the NEM Model inputs
MCL_{FOA}	Calculated as in Section 3.6, from AEMO Life of the NEM Model inputs

3.4 Key assumptions

Table 6 presents the key assumptions for modelling of MCL reductions (Section 3.6) and meeting the Prudential Standard (Section 3.7) under FOAs.

Table 6 - Key assumptions – MCL reduction and POE analysis

Parameter	Assumption
General	
Regions	The three NEM regions included in analysis are NSW, QLD and VIC regions (Tasmania has no futures market and SA has very low liquidity limiting is usefulness for analysis).
Timeframe	Modelling completed from July 2005 to December 2013 (approximately 8.5 years) to include different market pricing behaviours, i.e. lower and higher volatility.
Regional aggregation	Modelling does not assess the prudential behaviour of individual Market Participants, rather it outlines prudential outcomes at a regional level.
MCL seasons vs futures quarters	MCL is calculated based on the FLP of the calendar quarter. This means that due to the misalignment of MCL seasons and futures contract quarters, some MCL periods use different levels FLP based offsets in the calculation. The practical effects of this would need to be considered from implementation standpoint.
Cost of guarantees	Assumed to be 2.5% per annum[13].
Credit support	The modelling assumes that the MCL equals to the credit support. This is a conservative assumption as Market Participants regularly provide credit support that is above the MCL.
Carbon pricing	Carbon price inclusive volatility factors were in place from the 2012 Winter MCL period (May 2012). These values came from the life of the NEM model that included a carbon price adjustment factor of $20 per MWh.
Additional risks	Additional risks outlined by the AEMC's *Hedging Review* were not modelled.
FOA feedback effects	Modelling does not take into account any effects of the introduction of FOAs on the volumes of electricity futures traded or electricity futures prices.
MCL reduction average calculations	Average values used are based on a time period of 3075 days, from July 1st 2005 to the end of 30th November 2013.
Futures	
Contracts types	Modelling is limited to quarterly base load futures contracts;
Contract prices	Use of end of day futures prices;
Determination of FLP	The end of day FC price is the quarterly base load futures price at market close on a particular date. The FLP is determined by the choice in lodgement date. The lodgement date (as with ex-ante reallocations) is 7 business days prior to the start of a particular MCL season.
Margin Payments	
Margin payments	Positive margins flow to AEMO to offset the current outstandings. Negative margins are debited from the contract holder's margin account at the ASX.
Return of FOA margin payments	FOA margin payments returned to participants in the relevant settlement week of the final week of the calendar quarter.
Interest on FOA margin payments	No interest was calculated on the FOA margin payments held.
POE modelling	
POE assumptions	POE scenarios were modelled using AEMO's Life of the NEM assumptions.
Extension of modelling timeframe for 2% POE calculation	The POE exceedance data aggregates the observed data in the analysis with the Life of the NEM dataset exclusive of the analytical period. This methodology was used to account for the changes in the futures data in relation to the carbon pricing and its effects of expected price, expected load and volatility factors.

3.5 Futures contract coverage

The results obtained from the three areas of modelling outlined above (Sections 3.6 to 3.8) vary based on the assumptions used regarding the level of futures contract coverage under FOAs. Therefore, to obtain a realistic indication of costs, risks and benefits, an assessment was made on the likely range of futures contract coverage if FOAs were implemented.

In the NEM, 90-95 per cent of the market is covered by financial contracts. This includes over-the-counter (OTC) as well as standardised exchange traded products. According to the Energy Supply Association of Australia's (ESSA) estimates, in 2014, "around 46 per cent of open financial positions relate to OTCs and 54 per cent are via exchange traded contracts"[14].

In an FOA arrangement, a risk minimising Market Participant would likely to lodge only a proportion of their derivative portfolio with AEMO to reduce their MCL. This would allow participants to adapt to changes in market conditions while maintaining a balanced portfolio. As level of futures contract coverage varies across Market Participants and across regions, the portfolios of retailers are likely to differ quite substantially.

For the purpose of this analysis, three scenarios of future contract coverage levels were used: low, medium and high. The definitions for the scenarios are:

- Low FC coverage scenario – over the modelling timeframe it is assumed that 5 per cent of the total load in a particular region is covered by futures contracts. This represents the lower end of futures coverage estimates.
- Medium FC coverage scenario – over the modelling timeframe it is assumed that 10 per cent of the total load in a particular region is covered by futures contracts. This is a mid-range futures coverage estimates.
- High FC coverage scenario – over the modelling timeframe it is assumed that 20 per cent of the total load in a particular region is covered by futures contracts. This represents an optimistic futures coverage estimate.

AEMO believes that the likely FC coverage, if FOAs are implemented, would be between the low and medium scenarios. The high scenario would only occur if there was a significant change in market dynamics. The purpose of that scenario in this study is to illustrate the costs, benefits and effect on prudential quality if FOAs have a larger than expected take-up by Market Participants.

These range of scenarios are considered realistic when taking into account two main factors; the high level of vertical integration that is present in the NEM, and the restriction of the modelling to the three NEM regions of NSW, QLD and VIC.

3.6 Modelling part 1 - reduction in MCL

The first step in evaluating the merits of FOAs is to determine the extent to which FOAs reduce the MCL (as calculated under the *Framework*) and hence costs for Market Participants. Understanding the level of MCL reduction is necessary in order to assess whether there is sufficient savings to participants to outweigh the costs of implementing FOAs.

3.6.1 Modelling outline

Under the *Framework*, A Market Participant's credit support requirements are determined as a function of their MCL, where:

$$MCL = OSL + PM$$

[13] Used average of range of costs (1.5% to 4.0%)from industry sources and the AEMC (2010) 'Review into the role of hedging contracts in the existing NEM prudential framework'

[14] http://www.esaa.com.au/files/140528_esaa_The_electricity_market_and_carbon_tax_repeal.pdf

The OSL and PM components of the MCL are simplified for the modelling undertaken as follows:

$$OSL = EL_R * P_R * VF_{OSLR} * T_{OSL} * PRAF_L * (1 + GST)$$

$$PM = EL_R * P_R * VF_{PMR} * T_{PM} * PRAF_L * (1 + GST)$$

Under FOA Model 2, the reduction in MCL is driven by the difference between the expected regional reference price (P_R) and the prevailing future's market price at lodgement (i.e. the FLP).

This additional (to what is currently specified in the *Framework*) element to the MCL calculation takes into account the financial hedge that a Market Participant has in the form of lodged electricity futures contracts on the ASX. This only effects the OSL calculation, with the PM remaining unchanged.

The formula for MCL reduction is:

$$MCL_{reduction} = MAX[(P_R * VF_{OSLR} - FLP) * T_{OSL} * Coverage, 0]$$

Consequently the MCL incorporating FOAs is:

$$MCL_{FOA} = MCL - MCL_{reduction}$$

For parameter definitions and data sources refer to Table 4 and Table 5.

3.6.2 Modelling outputs

The output from this modelling is the aggregate level of MCL reduction for each region for the modelling time period for each MCL season. This output is then used to calculate the level of aggregate savings per year for Market Participants in terms of reduced costs of meeting their prudential requirements.

3.7 Modelling part 2 - effect on the Prudential Standard

The second step in evaluating FOAs involved modelling FOA Model 2 in relation to the 2% Prudential Standard. The model developed simulated the daily financial flows between AEMO and Market Participants, aggregated on regional level.

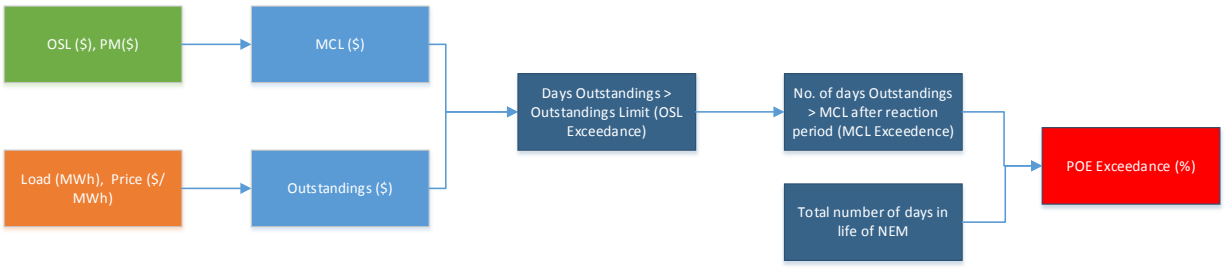
The modelling was used to determine whether the reduced MCL (reduced by taking into account FOAs) was adequate to cover aggregate regional Market Participant liabilities (i.e. outstandings including FC margin payments) in order to meet the 2% Prudential Standard.

3.7.1 Modelling outline

The Prudential Standard, implemented in 2013, sets the prudential probability of exceedance at 2%. This implies that no shortfall of monies collected by AEMO would arise in 98 out of 100 instances of un-remedied retailer default leading to a suspension. In the remaining 2% of cases, as AEMO pays generators for the energy they generate from the funds it receives from the users, generators would bear a shortfall incurred as a result of the default.

To calculate the level of prudential probability of exceedance under the *Framework*, prudential data is analysed over the life of the NEM. The level of prudential probability of exceedance is indicated by two factors: the OSL exceedance, and MCL exceedance. The prudential probability of exceedance (POE) is defined as the probability that (on a given day) a defaulting Market Participant's outstandings exceeds their OSL; and that, following this exceedance at the end of the reaction period (i.e. 7 days), the outstandings exceed their MCL (see Figure 3).

Figure 3 - Calculating POE exceedance



The POE is calculated using **actual data** for the life of the NEM (from 1999 to current) for each *region* by:

- Identifying the *days* where *outstandings* exceeded the OSL (i.e. an OSL Exceedance).
- For these *days*, identifying instances where the MCL is exceeded by *outstandings* at the end of the Reaction Period (assuming no action is taken to rectify OSL breach). The total number of such *days* is referred to as the MCL Exceedance value.
- POE = MCL Exceedance/total number of *days* over the life of NEM.

AEMO conducted POE analysis in its March 2015 report*: Effectiveness of the NEM Prudential Settings Methodology*[15] as shown in Table 7. The data shows that during that time the POE was indeed well within the 2% target for all of the regions.

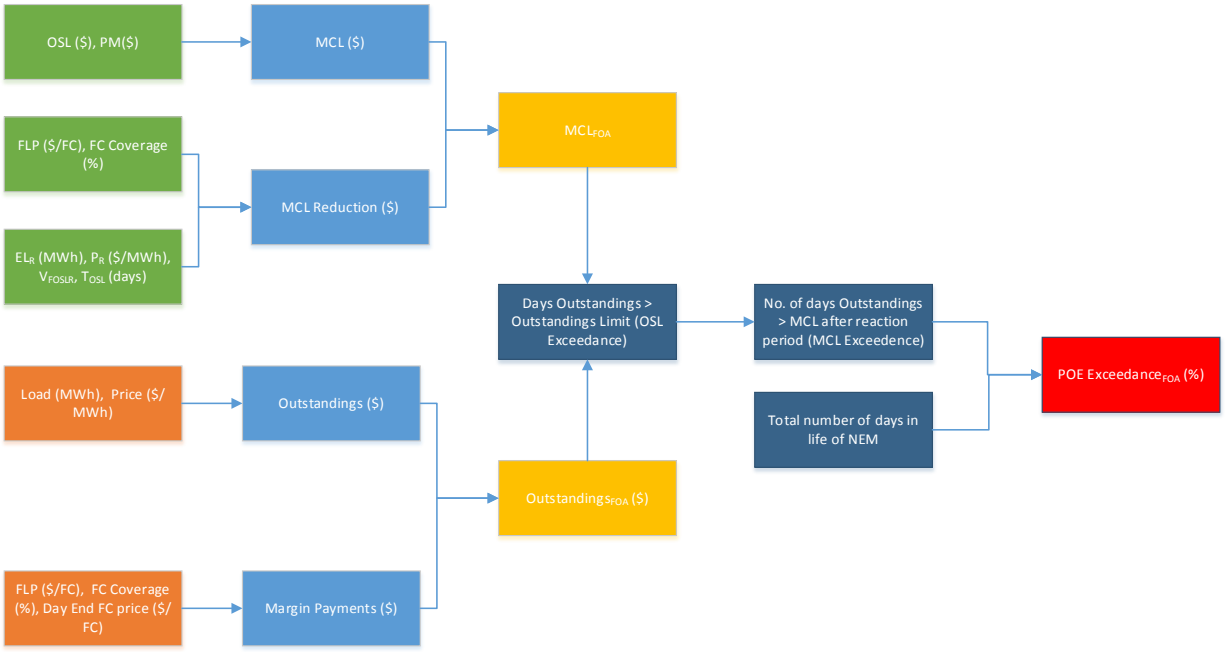
Table 7 - OSL and POE – Life of NEM (2015 Analysis)

Region	OSL Exceedance	Prudential Probability of Exceedance
NSW	4.0%	1.8%
QLD	3.6%	1.8%
SA	4.2%	1.8%
TAS	2.5%	1.7%
VIC	3.7%	1.8%

To understand the effect of FOAs on the Prudential Standard, a similar analysis needs to be conducted, but looking at the reduced MCL i.e. MCL_{FOA} and the level of outstandings with FOAs included i.e. $Outstandings_{FOA}$, as shown in Figure 4 below.

[15] Report can be found at: http://www.aemo.com.au/Electricity/Settlements/~/media/Files/Other/consultations/nem/Credit%20Limit%20Procedure%20v2%202014/Report%20on%20Effectiveness%20of%20Methodology%20in%20Credit%20Limit%20Procedures%20v1.0.ashx

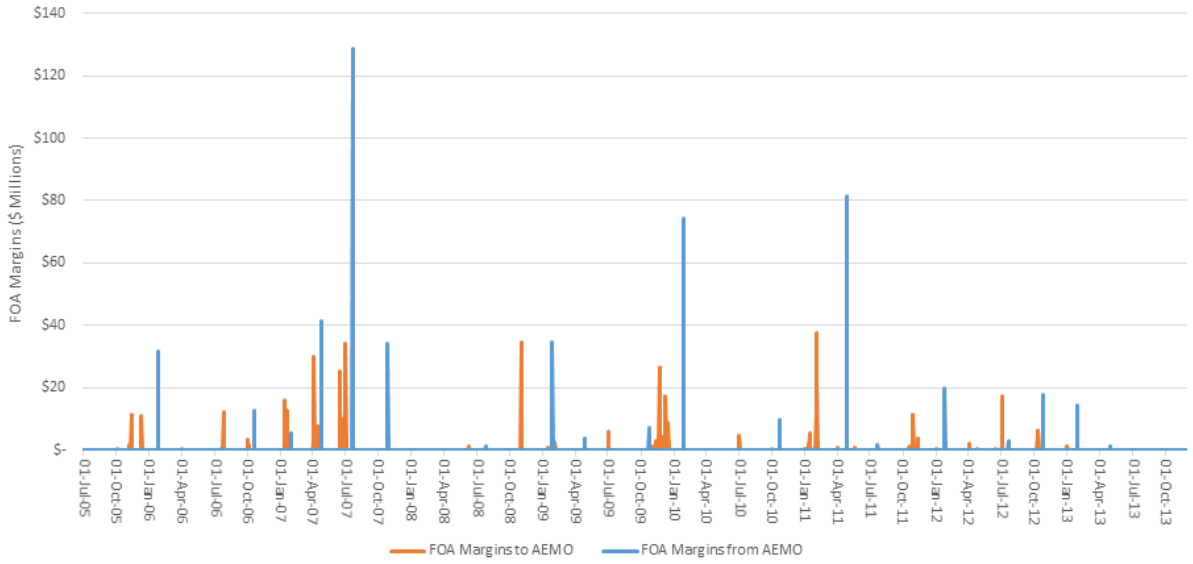
Figure 4 - Calculating POE exceedance for FOA case



A key component of the above model is the calculation of daily margin payments. Market Participants can limit their exposure to the spot market by purchasing futures that have the ability to hedge against price rises. These futures can then be lodged with AEMO, to reduce Market Participant MCL, and also to facilitate the movement of margin payments via the ASX to offset Market Participant outstandings on a daily basis.

An example of aggregate Market Participant daily margin payments over the modelling timeframe is shown in Figure 5.

Figure 5 - Margin payments to and from AEMO (NSW, 10% FC Coverage)



Daily margin payments to AEMO are a function of the daily change in end of day futures prices and the number of MWh covered by futures contracts. Note that the initial price of the futures contract will be the FLP for the given quarter.

$$Margin\ Payments = MAX[(FC_t - FC_{t-1}) * Coverage, 0]$$

For parameter definitions and data sources refer to Table 4 and Table 5.

If electricity prices rise, the positive margins will flow to AEMO and be held as security deposits that are used to offset the current outstandings. If electricity prices fall, negative margins will be debited from the contract holder's margin account at the ASX.

The daily margin payments made to AEMO reduce the aggregate outstandings ($Outsandings_{FOA}$). It is this level of outstandings that is then compared to the reduced MCL (i.e. MCL_{FOA}) to determine if the Prudential Standard is being met.

3.7.2 Modelling outputs

The output from this modelling is the POE for each region modelled, for the base case and FOA cases of low, medium and high futures contract coverage. The change in POE from the base to FOA cases is assessed to determine the effect on the Prudential Standard of including FOAs in the prudential regime.

3.8 Modelling part 3 - break-even costs of FOA implementation

To give context to the benefits calculated, a high level model was developed to determine the break-even costs for FOA implementation based on the expected cost savings.

This approach gives a top down, high level estimate of the break-even costs for FOA implementation. It does not replace a detailed cost estimation for FOA implementation. It is presented to give some context to the costs savings calculated (i.e. MCL reductions), and to allow for a high level comparison of costs vs benefits for FOAs.

3.8.1 Modelling outline

A simple financial model was developed that looked at capital expenditure in comparison to the average aggregate benefits over time. The key assumptions for the financial cost model are presented in Table 8 below.

Table 8 - Key assumptions – costs analysis

Parameter	Definition
Discount rate	5% discount rate used (deemed appropriate for AEMO as a non-commercial entity).
Time period for return on investment	10 years.
Benefits	Average aggregate yearly Market Participant costs savings for low, medium and high FC coverage scenarios (2005-2013), calculated according to methodology outlined Section 3.6.
States modelled	Benefits calculated for the three NEM regions of Vic, QLD and NSW.
O&M costs	AEMO assumption that O&M costs are fixed (not dependent on FC coverage) set at 10% of medium FC coverage scenario benefits.
Capital cost	Modelling output for low, medium and high FC coverage scenarios.
Cost of guarantees	Average costs assumed to be 2.5% per year. Sensitivity testing for costs of 1.5% per year.

A net present value (NPV) calculation was used to determine the break-even capital expenditure for the agreed discount rate. Solving for a NPV of zero by varying the capital costs allows the determination of the range of break-even costs based on FC coverage.

3.8.2 Modelling outputs

The outputs from the financial cost model include a range of break-even costs for FOA implementation at the low, medium and high (5%. 10% and 20%) FC coverage scenarios.

3.9 How are things different now to when the FOA concept was originally proposed?

The original FOA Rule change proposal was bought to the AEMC in 2008, with the AEMC delivering its *Hedging Review* report with its recommendations regarding FOAs in 2010.

Many aspects of the electricity market have been subject to changes over this time. Therefore, to complete the analysis, key aspects of FOAs were reviewed as shown in Table 9, to ensure any changes over the past 5-7 years are accounted for.

Table 9 - Past and current key aspects of FOAs

	Past status	Current/Future status	Comment/effect
AEMO Prudentials	Reasonable worst case Prudential Standard.	New prudential *Framework* implemented in 2013 changed MCL calculation and has 2% Prudential Standard.	MCL calculation and assessment of effect of FOAs on prudential quality based on the new *Framework.*
Futures market (NSW, QLD and Vic)	Established futures markets in NSW, QLD and Vic.	Futures market has remained liquid in NSW, QLD and VIC regions.	Modelling completed for NSW, VIC and QLD.
Futures market in SA and TAS	SA - Illiquid futures market. Tas - no futures market.	SA – market remains illiquid and due to its structure likely to remain so into the future. Tas - no futures market.	SA and Tas not modelled.
Market volatility	Issues such as rapidly growing demand and energy policy uncertainty caused volatility in the futures market.	Current low volatility has resulted in the futures market accurately reflecting the expectations of the quarterly prices.	Past volatility captured in the modelling. Difficult to make any predictions on future volatility.
Use of futures contracts	Liquid markets in NSW, QLD and Vic.	Futures contracts use appears to have remained relatively unchanged.	Modelled 5%, 10% and 20% FC coverage allows for a range of results.

From the above, there are no clear reasons seen as to why there would be either an increase or decrease in Market Participant interest in FOAs or the potential success of FOAs in general.

4. RESULTS ANALYSIS

The study looked at the proposed model for implementing FOAs under the new prudential *Framework*. The key outputs were:

1. Reduction in MCL under FOAs.
2. Level of prudential probability of exceedance under FOAs.
3. Costs of FOA implementation.

It was found that incorporating FOAs into AEMO's prudential framework would:

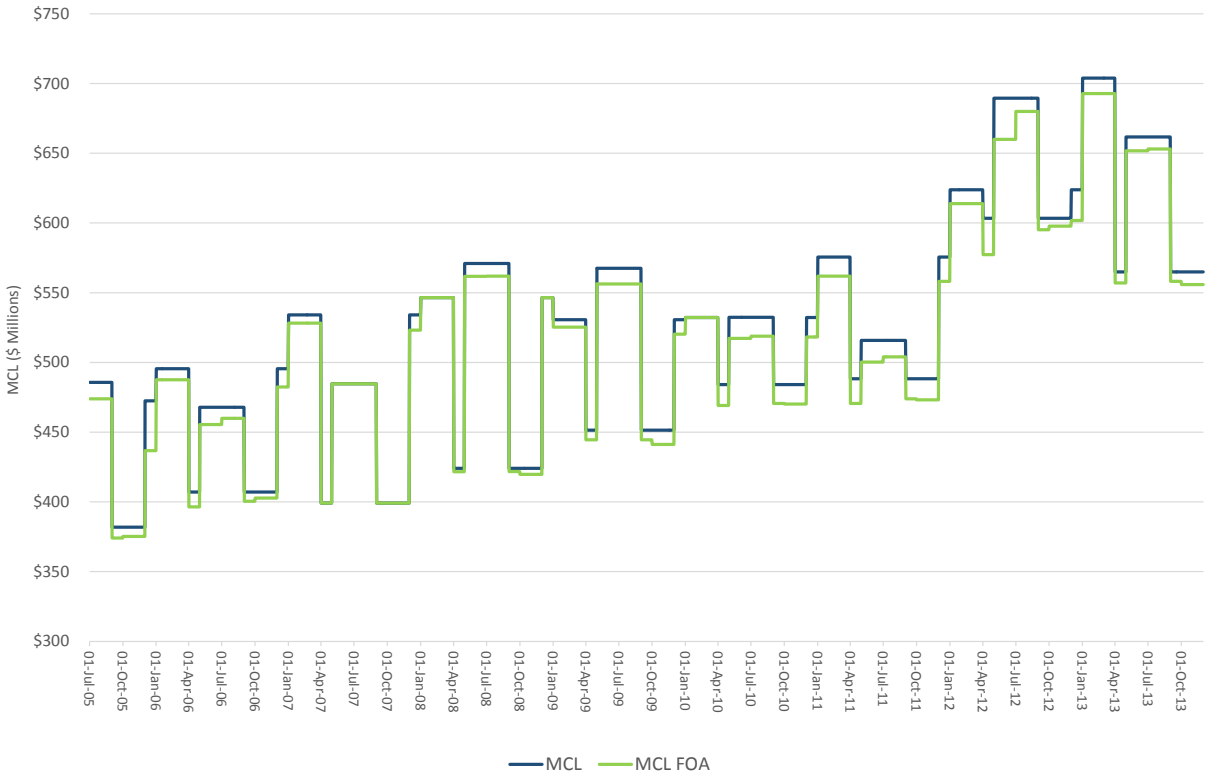
- Result in average aggregate reductions in total credit support requirements across the National Electricity Market of $45 to $180 million. This represents an aggregate average saving of between $0.3 million to $1.2 million per year for Market Participants.
- Have no material adverse impact on the Prudential Standard set at 2% in clause 3.3.4A of the NER, with the prudential probability of exceedance for all *regions* remaining under 2% for the FOA scenarios modelled.
- Result in benefits that are similar, or only slightly greater than the implementation costs.

4.1 Reduction in MCL requirements

The methodology for calculating reduction in MCL requirements is outlined in Section 3.6. The analysis was conducted for three NEM Regions (NSW, QLD and VIC) from 2005 to 2013.

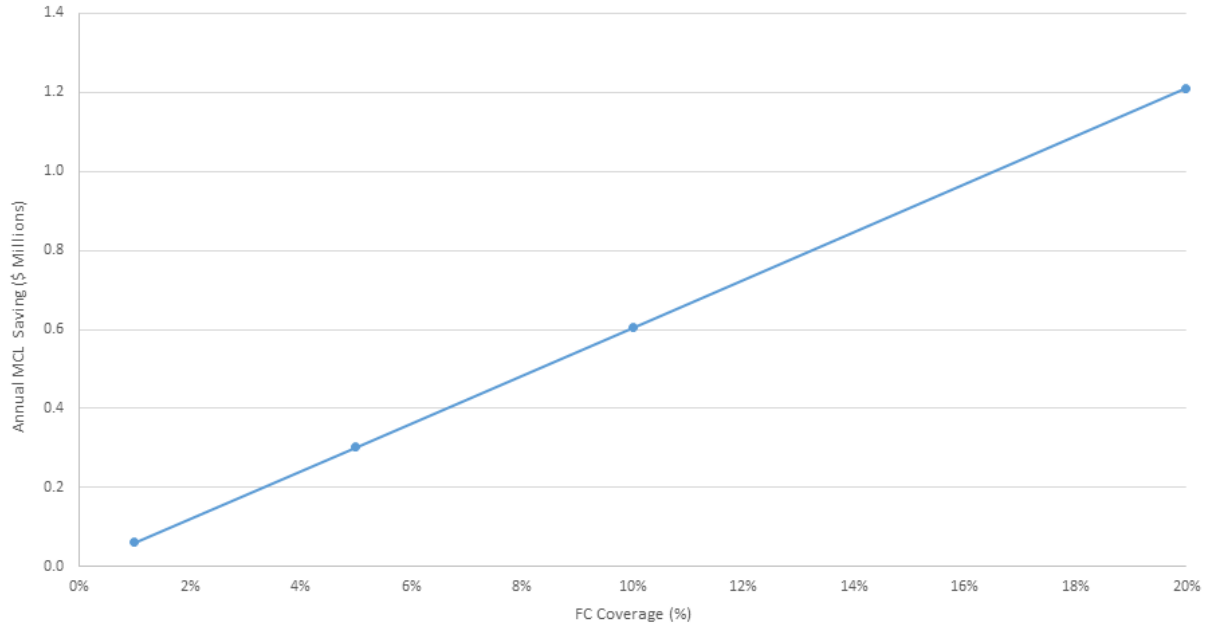
The aggregate MCL reduction for the NSW medium scenario (10% FC coverage) over the modelling timeframe is shown in Figure 6. For most time intervals, aggregate levels of MCL are reduced. When the FLP is lower than the region's volatile price, a participant has a guaranteed income stream that can be used to offset their prudential exposure. This is not the case when the FLP is greater than the region's volatile price – a situation observed in all modelled states during periods of 2007 and 2008. This was a result of uncertainty of supply which pushed up the price of the futures contracts and did not allow for any MCL reduction.

Figure 6 - MCL vs MCL_{FOA} (NSW, 10% FC Coverage).



As shown in Figure 7, there is a positive linear relationship with the level of futures coverage and MCL reduction across all states. That is, as the level of futures coverage increases, MCL reduction and hence the savings to participants proportionally increase. For each 1% in futures coverage, historical data suggests that aggregate MCLs across the three NEM regions would reduce by approximately 0.2%.

Figure 7 - FC coverage vs MCL reduction



The analysis in Table 10 and Figure 8 show the reduction in MCL, per % of FC coverage, as well as results for the low, medium and high scenarios (FC coverage of 5%, 10% and 20%). The table shows the aggregate reductions in MCL per modelled region, averaged over the modelling timeframe.

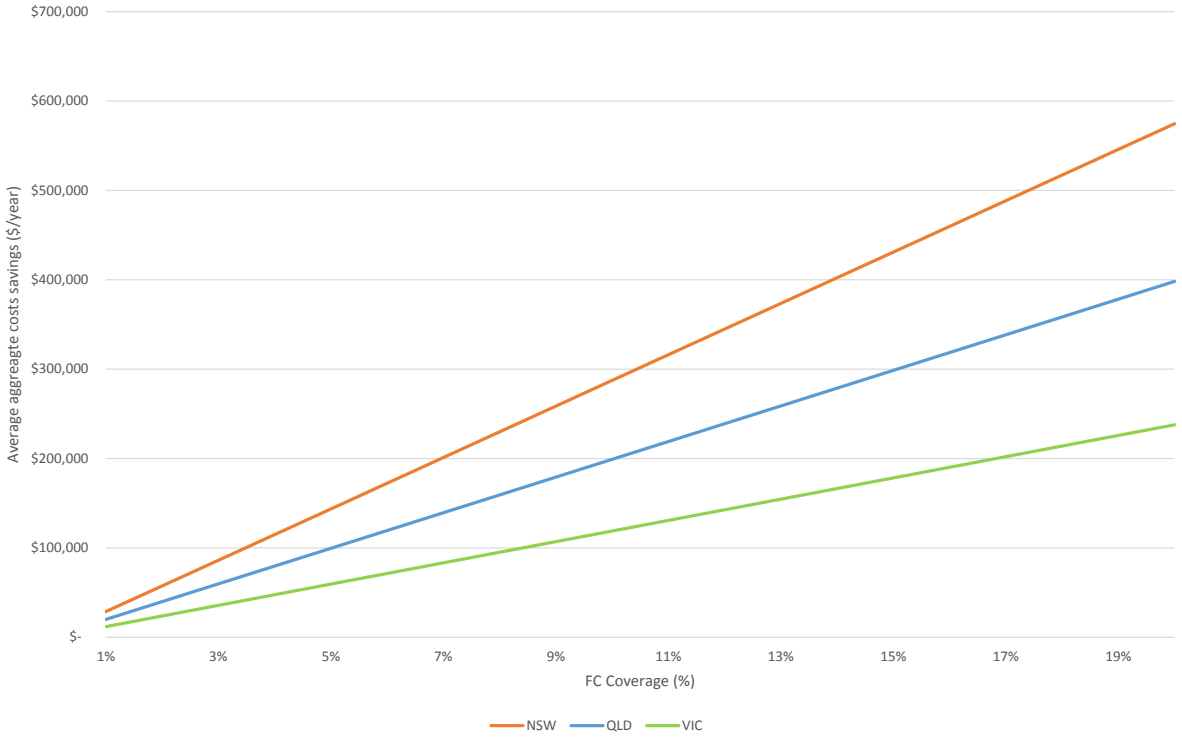
The results show that depending on the FC coverage scenario assumed, MCL is approximately reduced by between $45 million and $180 million if FOAs are implemented across all three states. This varies across regions and is highly dependent on the FLP input values.

Table 10 - Aggregate average MCL reduction under FOAs

FC coverage	NSW ($/year)	QLD ($/year)	VIC ($/year)	TOTAL ($/year)
1%	$4,415,198	$2,946,830	$1,631,168	$8,993,197
5%	$22,075,992	$14,734,151	$8,155,841	$44,965,985
10%	$44,151,984	$29,468,303	$16,311,682	$89,931,970
20%	$88,303,969	$58,936,606	$32,623,365	$179,863,939

Additionally, based on historical data, the greatest beneficiaries of an FOA arrangement would be participants in the NSW market, followed by QLD and Victoria.

Figure 8 - Aggregate MCL reductions, state comparisons



The savings to Market Participants represented by the above MCL reductions is calculated based on an estimated cost of credit support. For this analysis credit support costs were assumed to be 2.5%[16]. Similar to the MCL reduction, the savings are highly dependent on the FLP as well as the cost of borrowing.

[16] Used average of range of costs (1.5% to 4.0%)from industry sources and the AEMC (2010) 'Review into the role of hedging contracts in the existing NEM prudential framework'

The analysis in Table 11 shows the reduction per percentage of FC coverage as well results for low, medium and high scenarios corresponding to FC coverage levels of 5%, 10% and 20%. The results shown are an aggregate reduction in MCL per region averaged over the modelling timeframe.

Table 11 - Aggregate average Market Participant prudential costs reduction under FOAs

FC coverage	NSW ($/year)	QLD ($/year)	VIC ($/year)	TOTAL ($/year)
1%	$28,728	$19,905	$11,881	$60,514
5%	$143,638	$99,526	$59,406	$302,570
10%	$287,276	$199,051	$ 118,812	$605,139
20%	$574,552	$398,103	$ 237,624	$1,210,279

The results show that depending on the FC coverage assumed, aggregate savings for Market Participants of approximately $0.3 million to $1.2 million is achieved per year if FOAs are implemented.

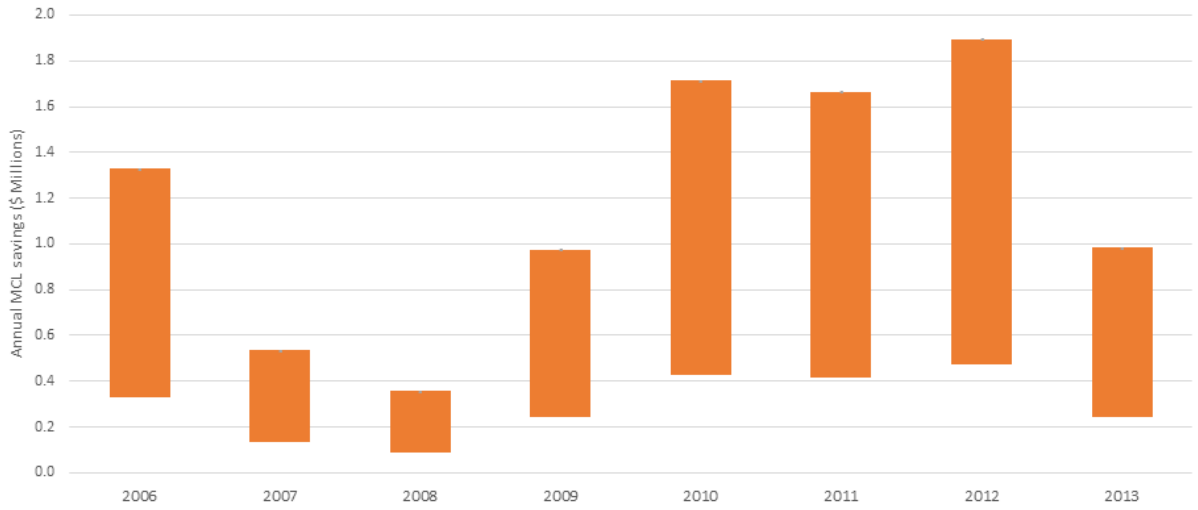
The analysis in Table 12 presents the Market Participant costs savings as a percentage of the total MCL requirements. This shows that if FOAs are average prudential costs savings for Market Participants would range between 1% and 3% per year.

Table 12 - % aggregate average Market Participant prudential costs reduction under FOAs

FC coverage	NSW (%/year)	QLD (%/year)	VIC (%/year)	TOTAL (%/year)
1%	0.2%	0.2%	0.1%	0.2%
5%	0.9%	0.9%	0.7%	0.8%
10%	1.7%	1.8%	1.4%	1.7%
20%	3.5%	3.7%	2.8%	3.3%

The above analysis represents average aggregate savings over the modelling timeframe. However, it is also worth noting that according to the modelling, the MCL reductions (and hence savings to Market Participants) can vary greatly from year to year, depending highly on futures contract and historical electricity prices. As shown in Figure 9, annual aggregate savings can be as low as $89,000 (as was the case in 2008 for the 5% FC coverage scenario) or can be as high as $1.8 million as was the case in 2012 for the 20% FC coverage scenario.

Figure 9 - Annual savings range 5% to 20% FC coverage[17]



[17] 2005 excluded from chart as data only represented 6 months

The variance between years is driven by the difference between the FLP and the MCL price input calculations. If the FLP is less than the $\boldsymbol{P_R}$ multiplied by the $\boldsymbol{VF_{OSLR}}$, a participant that holds the futures contract for the duration of the MCL period are guaranteed a revenue stream that can be used to hedge against their prudential exposure. High futures prices observed during 2007 and 2008 resulted in lower levels of MCL reductions and ultimately lower levels of savings.

Going forward, savings are expected to be similar to those from 2010 to 2012. This is likely because there is currently an increased level of price certainty in the market. Uncertainly in market outcomes, such as that observed in 2007 and 2008, generally results in futures price volatility. The current relatively stable state of the NEM suggests that futures prices are more likely to reflect market outcomes. Future savings to participants under an FOA scenario will therefore likely to be driven by the price differential between the volatility adjusted regional reference price $(P_R * VF_{OSLR})$ and the FLP.

4.1.1 Other observations

There are some other observations around the MCL reduction modelling that are worth noting, including:

- There is no MCL reduction at times when the FLP is greater than the expected volatile price. Historical time periods (i.e. some periods in 2007/2008) where this has occurred, lowered the average MCL reduction.
- If futures prices accurately reflect observed outcomes, Market Participants can guarantee an income stream that will be able to offset their outstanding positions. Therefore, it can be expected that a net savings to Market Participants would be observed.

4.2 Probability of exceedance

The methodology for calculating the effect of FOAs on the Prudential Standard is outlined in Section 3.7.

The analysis used NEM historical data to simulate the three FOA scenarios and the associated cash flows that would have occurred, if FOAs had been in place from July 2005 to November 2013. Positive margin payments from end-of-day futures prices were used to reduce the market's aggregated level of outstandings. These outstandings ($Outsandings_{FOA}$) were then compared to the Outstandings Limit (OSL) and reduced MCLs (MCL_{FOA}) to assess the prudential POE for each region.

The POE outcomes for the three FC coverage scenarios over the three regions modelled, are shown in Table 13. As shown, the prudential POE remains below 2% for all regions under all scenarios.

Table 13 - POE values under FOA scenarios

FC Coverage	NSW	QLD	VIC
No FOAs case[18]	1.80%	1.80%	1.80%
5%	1.73%	1.66%	1.70%
10%	1.61%[19]	1.64%	1.61%
20%	1.35%	1.46%	1.57%

The design of FOA Model 2 attempts to reduce any additional risk to the market. This is reflected in the outcomes as seen, whereby the Prudential Standard of 2% is maintained in all scenarios and the prudential POE is reduced from the base case.

[18] Based on AEMO analysis in March 2015 report: *Effectiveness of the NEM Prudential Settings Methodology*
[19] See Section 4.2.1 for worked example.

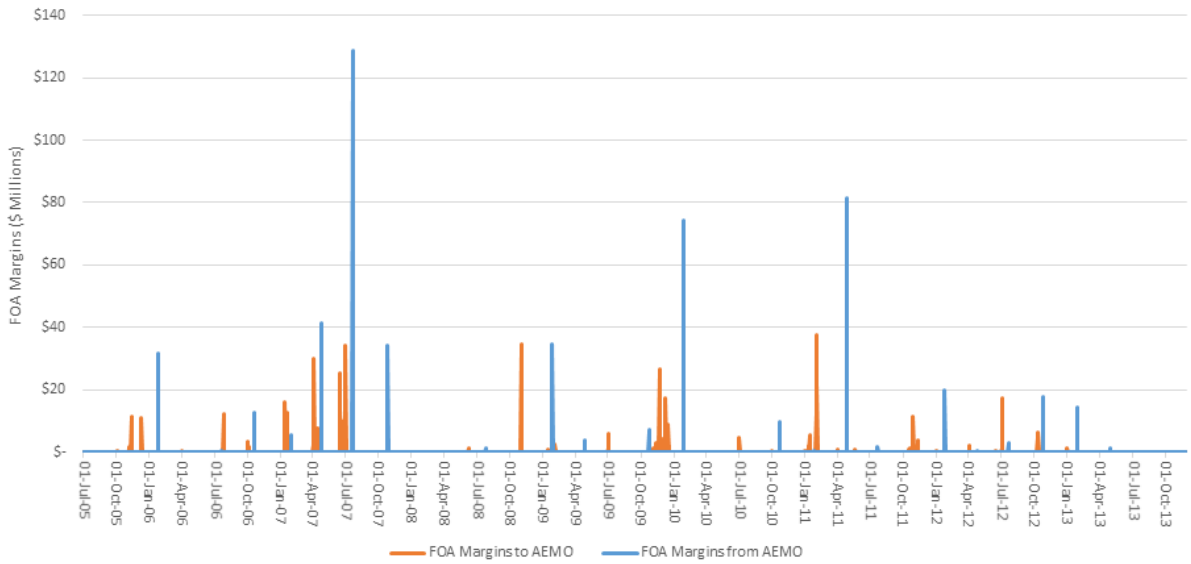
Additionally, as shown in the results and can be expected from a theoretical viewpoint, when the level of futures coverage increased, the prudential POE decreases. This is due to the linear scalability of margin payments and the potentially large payoffs that futures positions can bring when prices rise.

4.2.1 Calculating the POE – an example

As an example of the prudential POE calculation, the NSW medium scenario is examined below. Under the medium scenario, the number of futures contracts purchased by the market is equivalent to 10% of the expected level of energy consumption.

Figure 10 shows the margin payments that flow to and from AEMO under this scenario. They are determined by the daily fluctuations in price at the exchange, and are then incorporated into the aggregate outstandings and then compared the aggregate MCL levels for the POE calculation.

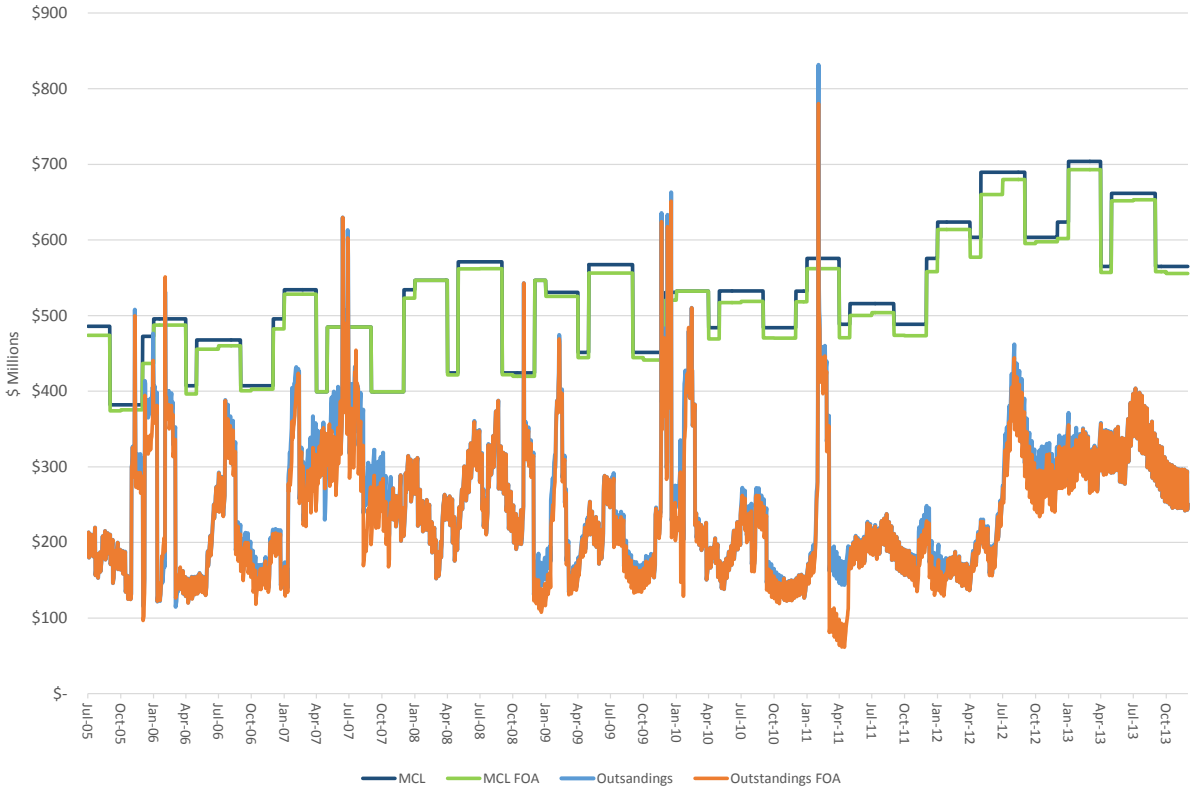
Figure 10 - FOA Margin Payments to and from AEMO (NSW, 10% FC coverage)



As noted in Section 3.7, the MCL reduction from FOAs is based on the FLP for a given calendar quarter. The FLP also forms the basis for margin payments. This construction allows for a proportional decrease in MCL requirements when margin payments are greater. This increases the likelihood that aggregated outstandings will reduce the risk of exceedance and attempts to maintain the current Prudential Standard.

Figure 11 shows the MCL levels as well as the outstandings levels under the FOA and base scenarios. As shown, the aggregated MCL_{FOA} is in general lower then MCL base case. Additionally, the aggregated level of outstandings in the FOA case ($Outstandings_{FOA}$) is generally lower than the base case.

Figure 11 - POE Scenario: Base case and NSW 10% FOA Case



To arrive at the prudential POE, the relationship between MCL_{FOA} and $Outsandings_{FOA}$ is examined on a daily level. As shown in Table 14, for this analysis, the number of days the OSL is exceeded (OSL Exceedance) and the number of days the MCL is exceeded at the end of the reaction period (MCL Exceedance) is calculated.

The POE is then the percentage of days the MCL Exceedance represents over the life of the NEM.

Table 14 - POE calculation (NSW, 10% FC coverage)

Variable	Outcome
Total no of days in life of NEM (days)	5479
OSL Exceedance (days)	169
MCL exceedance (days)	88
OSL Exceedance (%)	3.08%
MCL exceedance (%) (POE)	1.61%

4.3 Costs of implementation

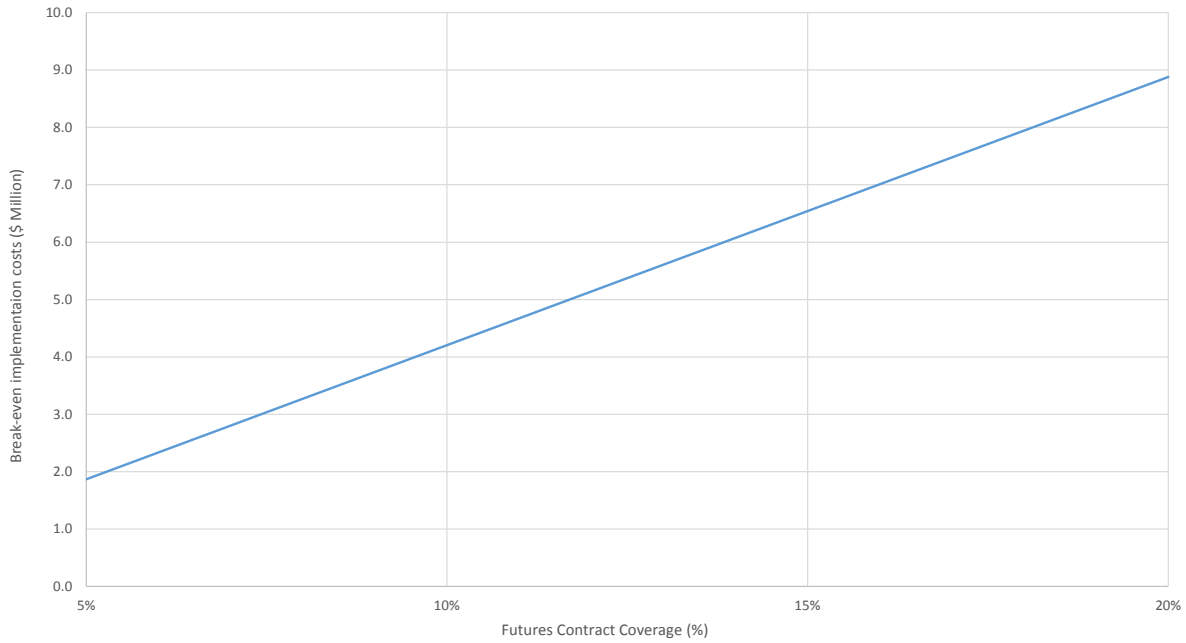
The focus of this project has been chiefly on the possible MCL reductions, and hence costs saving to Market Participants from the implementation of FOAs as well as the effect FOAs on the Prudential Standard.

To complement the benefits and risk analysis, a high level estimate was also made of the break-even costs (refer to Section 3.8 for methodology discussion) for FOA implementation. This analysis does not replace a detailed cost estimation for FOA implementation. Rather, it is presented to give a context to the costs savings calculated (i.e. MCL reduction), and to allow for a high level comparison of costs vs benefits for FOAs.

The break-even costs for FOA implementation are shown in Figure 12. They vary linearly with FC coverage. That is, the higher the level of FC coverage is, the more cost effective the implementation of FOAs, such that:

- At 5% FC coverage the break-even implementation costs are approximately $2.0 million.
- At 20% FC coverage the break-even implementation costs are approximately $9.0 million.

Figure 12 - High level break-even cost estimates



FOA implementation would include a Rule change process, changes to the Credit Limit Methodology, as well as system changes to both back-end and front-end IT systems requiring significant design, development, testing and deployment activities.

As a point of comparison, the implementation costs for the Gas Supply Hub project (broadly similar in scope to FOA implementation) was between $2.0 million to $2.5 million.

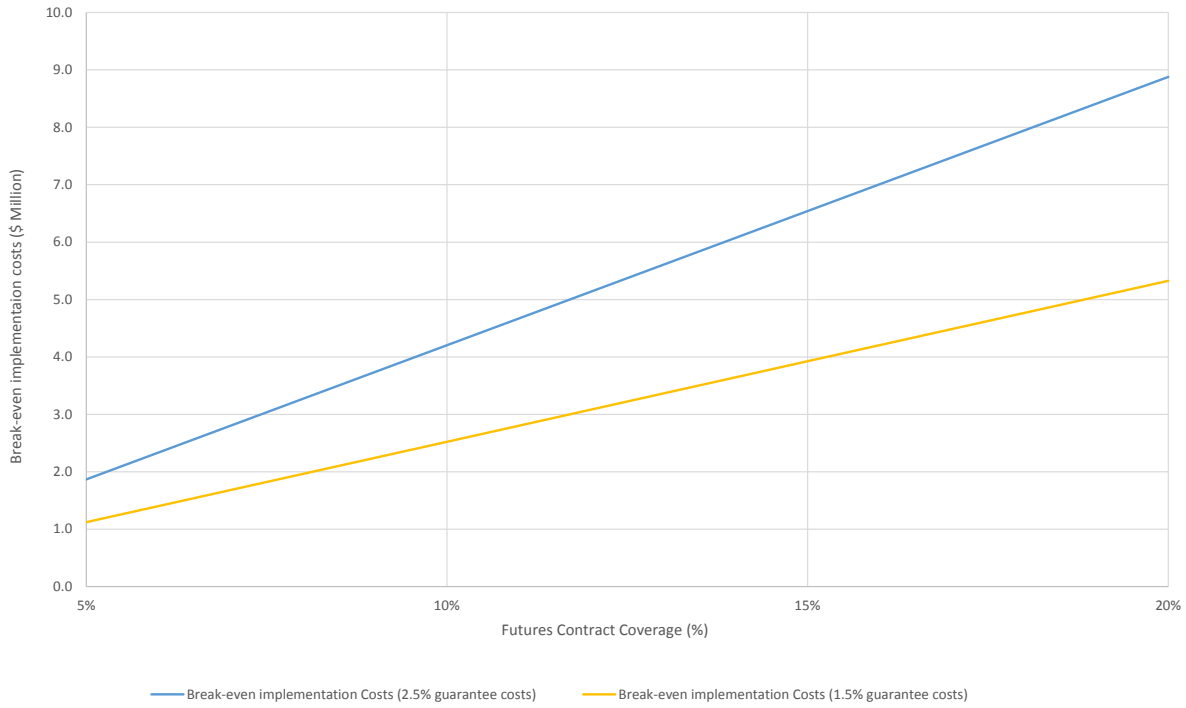
Thus, looking at the more likely FC coverage scenario (i.e. 5% FC coverage) the high level break-even analysis suggests that the benefits are similar, or only slightly greater than the implementation costs.

4.3.1 Sensitivity testing - cost of guarantees

For calculating the benefits in Section 4.1 (i.e. costs savings form MCL reductions) the cost of guarantees was set at 2.5% per year (based on a figure between the 1.5% to 4.0% per year quoted from industry sources and the AEMC).

A more conservative assumption on the cost of guarantees was also tested. For this sensitivity test, the cost of guarantees was set at 1.5% per year. The result of this adjustment on the cost analysis is shown in Figure 13.

Figure 13 - High level break-even cost estimates (sensitivity testing)



As shown, with the lower costs of guarantees the break-even cost for FOA implementation are lower than previously. The following observations can be made:

- At 5% FC coverage the break-even implementation costs are approximately $1.0 million.
- At 10% FC coverage the break-even implementation costs are approximately $2.5 million.

The above results suggest that with lower guarantee cost estimates, a higher level of FC coverage would be required for project benefits to outweigh implementation costs.

If it was decided that FOAs were to be progressed towards a Rule change, a more detailed analysis of the implementation costs would be required.

4.4 Modelling limitations

As with any modelling exercise, there are a number key of limitations in the analysis that need to be recognised, including:

- The aggregate nature of the modelling assesses costs and benefits on a regional level. Individual Market Participant risks and benefits cannot be derived from this analysis.
- The modelling uses average FOA coverage levels (5%, 10% and 20%). In reality, levels of FOA coverage may differ markedly across participants by risk appetite and individual cost of borrowing. If FOA is implemented, possible limits may be considered on total (and or individual Market Participant) FOA coverage allowed under the prudential settings.
- The assumptions around the cost of guarantees is key in determining the total costs savings from FOA to Market Participants. The value used (2.5% per year) is an average only, providing an estimate of potential cost savings for the market as a whole. In reality the benefits could be quite different depending on the nature of the Market Participants using FOAs and their actual prudential costs.

- The POE analysis indicates that the market as a whole would be less risky under FOAs. However, there are other risks introduced by FOAs, as identified by the *Hedging Review* (see below), that would need to be assessed prior to FOA implementation, to ensure that prudential quality was not compromised.
- The model looks at aggregate past market behaviour (both in the NEM and the futures markets). Although this can provide useful analysis of FOAs, it is not prospective, that is, it cannot predict how either the NEM or the futures markets will behave going forward. There may be dramatic changes in both that diverge from past trends, altering risk and benefits profiles.
- The transaction costs (i.e. trading of futures contracts) have not been modelled.
- Changes in Market Participant behaviour affecting the NEM or the futures market upon the introduction of FOAs have not been modelled.

The *Hedging Review* identified existing systematic risks under FOAs. These risks and their relationship to the modelling undertaken include:

- Termination and expiry risk - the termination or expiry of a futures contract could have a severe impact on a Market Participants prudential position. The Market Participant could potentially have insufficient credit support, triggering a default event under the Rules. The modelling undertaken in this study assumes that futures will consistently be renewed over time with the quarterly FLP setting the MCL reduction and margin payments.
- Systematic risk of difference between spot and futures prices - due to the temporal difference between spot and futures prices, daily margin payments may not always be able to cover the daily spot market movements. This short term mismatch has the potential to reduce the effectiveness of the reduced MCL levels, particularly at the beginning of calendar quarters when futures prices are less correlated with those of the spot market.
- Unique risks associated with an individual retailer's load profile - this analysis uses futures contracts for which the price is calculated using an equal weighting for each trading interval in the NEM. This is not generally reflective of the load profile a retailer would be faced with. Therefore, there is likely to be a hedging quantity mismatch between the number of futures contracts being used to offset outstandings and the accrued outstandings of participants.

The effect of these systematic risks would need to be analysed/addressed prior to any implementation of FOA.

4.5 Conclusions

The key aspect of the analysis undertaken are (i) the potential benefits of FOAs, (ii) the impact of FOAs on the Prudential Standard and (iii) the break-even costs of FOA implementation.

In these three key areas, the study found that incorporating FOAs into AEMO's NEM prudential framework would:

- Result in average aggregate reductions in total credit support requirements across the National Electricity Market of $45 million to $180 million per year. This represents an aggregate average saving of between $0.3 million to $1.2 million per year for Market Participants.
- Not adversely impact the Prudential Standard, with the prudential probability of exceedance for all regions remaining under 2%.
- Result in benefits that are similar, or only slightly greater than the implementation costs.

Additionally, the findings are subject to the following market influences as found from our study:

- Year on year variability - MCL reductions (and hence savings to Market Participants) can vary greatly from year to year, depending highly on futures contract and historical electricity prices. Over the modelling timeframe, annual aggregate savings were found to be as low as $89,000 (2008, 5% FC coverage scenario) or as high as $1.8 million (2012 - 20% FC coverage scenario).
- Individual Market Participant benefits – the MCL reductions presented here are an aggregate average over the modelling time period per region modelled. Thus there are no solid conclusions that can be drawn on the benefits for any one individual Market Participant.
- Futures contract coverage - the MCL reductions calculated by the study are highly dependent on the FC coverage. The higher FC coverage assumed, the higher the MCL reductions and hence prudential costs savings.
- Regional benefits – based on historical analysis, Market Participants in NSW would derive the most benefits from FOAs. Going forward, it is likely that Market Participants in NSW and Victoria would derive the greatest benefit from the introduction of FOAs as these states have more mature retail markets.
- FOA Model 2 design - by construction, FOA Model 2 aims to minimise the excess default risk added to the market through the FOA process. The modelling has borne this out, confirming that the greater the level MCL reduction, the greater the potential for positive margin payments resulting futures contract price rises and hence the reduction in the prudential POE.
- Cost of guarantees – the assumed cost of guarantees has a significant effect on the cost analysis. If a more conservative guarantee cost estimate is used (1.5% per year as opposed to the average of 2.5% per year) the FOA implementation costs would need to be lower for the project to break-even.
- Additional risks – the modelling makes a number of simplifying assumptions that would need to be further considered, together with the systematic risks outlined in the *Hedging Review*, prior to FOA implementation.

5. FINDINGS

The study's findings suggest that introduction of FOAs in the NEM could reduce prudential costs for Market Participants without materially impacting the Prudential Standard and with implementation costs which are comparable with the potential benefits delivered from the initiative.

This does however mean that the study is unable to present a clear-cut case to either proceed with, or abandon FOAs. While potential costs savings exist, the benefits are similar, or only slightly greater than our high level assessment of implementation costs. The benefits will be at risk of being easily eroded by unexpected implementation issues. Hence the net benefits from the implementation of FOAs would likely be marginal.

There are also further risks and practical process and system hurdles which may impact the market outcomes of FOAs but are outside the scope of this study. These would need detailed analysis before a Rule change proposal to enable FOAs in the NEM is considered.

Accordingly, to assist in finalising its decision on whether to undertake the AEMC's second recommendation and "*integrate FOAs in the NEM prudential framework in accordance with the AEMC's recommendations, with necessary amendments, through a Rule change proposal*", AEMO is seeking feedback from stakeholders to better understand:

- Current/intending Market Participant appetite for the implementation of FOAs in the NEM.
- Level of Market Participant support for AEMO continuing to undertake work on FOAs in the NEM.

Any further analysis undertaken by AEMO on FOAs will be predicated on a significant portion of Market Participants being interested in and expressing support for the implementation of FOAs. Further analysis would seek to review, and where possible model, the following aspects of the initiative in more detail:

- The likely level of FC coverage once FOAs are implemented;
- The cost of acquiring credit support for Market Participants most likely to use FOAs;
- Detailed implementation costs; and
- The additional risks identified by the *Hedging Review*.

In the absence of sufficient stakeholder appetite and support for FOAs in the NEM, AEMO will recommend a decision to not proceed with the Rule change on FOAs at this time.

6. GLOSSARY

Term	Meaning
AEMC	Australian Energy Market Commission
ASX	Australian Securities Exchange
CCP	central counterparty clearing
CP	clearing participant
CLP	Credit limit procedures - developed, published and maintained by AEMO under clause 3.3.8 of the NER.
FC	futures contract
FLP	futures lodgement price
FOA	futures offsets arrangements
LWPR	load weighted price ratio
MCL	maximum credit limit, as defined in clause 3.1.1A of the NER.
MWh	megawatt hour
NEM	National Electricity Market
NEMWH-CF	NEM Wholesale Consultative Forum
NER	National Electricity Rules
OSL	outstandings limit, as defined in clause 3.1.1A of the NER.
PM	prudential margin, as defined in clause 3.1.1A of the NER.
POE	prudential probability of exceedance, as defined in clause 3.1.1A of the NER.
Prudential Standard	set at 2% POE as defined in clause 3.1.1A of the NER.
PwC	Price Waterhouse Coopers
RRP	regional reference price
SDA	security deposit arrangement
VF	volatility factor

7. APPENDIX 1 – FOA MODEL 2

FOA Model 2 was developed by the Working Group established by the AEMC to advise the Hedging Review.

In this model, the Market Participant provides initial credit support based on the FLP. Variation margins are received by AEMO and treated in accordance with the SDA process when the futures prices exceeds the FLP (with a spot price floor).

The accrued positive variation margin payments are held until the end of the quarter (to which the futures contract relates) and is not applied against bills, however the amount can be returned if the futures price falls, provided the Market Participant's initial credit support plus the amount in SDA is greater than the outstandings for energy under FOA and the Market Participant's total outstandings is less than its trading limit.

Table 15 - FOA Model 2 key features

Model 2 Feature	Description
Participant	Retailer-only model.
Basis of FOA	FOA would be based on base load futures contracts (daily volume and FLP) and be region specific.
Registration	Retailer would register the arrangement with AEMO (with AEMO receiving 3rd party confirmation).
Confirmation of underlying contract	Retailer would provide a confirmation to AEMO that there is an underlying futures contract that forms the basis of the FOA.
Termination	Retailer would undertake not to terminate or deal in the underlying futures contract during the term of the FOA, or if it does wish to terminate the arrangement it would provide 10 days prior notice to AEMO.
CCP and CP role	CCP or CP would confirm that a futures contract is in place. The CP would agree that the futures margins arising from that contract will be held in a client segregated account, that those margins would not be netted off against the retailer's other contracts, and that the CP will keep AEMO updated if and when the futures contract is closed (the CP's obligations are to be given effect through an addendum to the futures contract). There would be no firm commitment by the CP not to terminate the underlying futures contract that forms the basis of the FOA or provide any advance notice of such termination.
Bank guarantees	Retailer would provide a bank guarantee based on the FLP and volume covered, and benefit from a reduction to its MCL.
Payment of positive margins	AEMO would receive positive margins arising under the futures contract on a daily basis, to be managed under the Security Deposit Arrangements.
Return of margins	If the futures prices fall, AEMO could return the margins to the Market Participant provided that the total security held by AEMO would still be sufficient to cover the retailer's total outstandings (that is, the Market Participant's total outstandings is less than its trading limit).
Use of funds in the SDA	Value accumulating in the SDA fund would be used as security only and not used for settlement, unless the retailer directs AEMO and AEMO agrees to do so. Any additional funds held in the SDA, when the period to which they apply has passed, would be used as agreed with the retailer or returned to the retailer.

Model 2 Feature	Description
CP financial obligations	CP would not have any financial obligation to AEMO.
Retailer NEM liability	Retailer's outstandings in the NEM (liability) would continue to be calculated based on the spot price (that is, the FOA would not result in a reduction in NEM liability). The expectation is that the bank guarantee based on the FLP plus the margin payments into the SDA arising from movements in futures prices would be sufficient to meet the retailer's outstandings in respect of the energy covered by the FOA.
Timing of NEM prudential supervision processes with respect to default and suspension process	In the event of a failure by a Market Participant to make margin payments to AEMO, the call notice would be issued at 1.00 pm Sydney time. This aligns with the timing of margin payments, allowing the Market Participant to benefit from funds available with respect to futures contracts.