

2016–19 ALLOWABLE REVENUE AND FORECAST CAPITAL EXPENDITURE SUBMISSION TO ECONOMIC REGULATION AUTHORITY

SUPPLEMENTAL DOCUMENT TO SUPPORT ADJUSTMENT TO
ALLOWABLE REVENUE AND FORECAST CAPITAL
EXPENDITURE

Submission date:
17 February 2017





IMPORTANT NOTICE

Purpose

This document seeks approval for an adjustment to AEMO's Allowable Revenue and Forecast Capital Expenditure under clause 2.22A.14 of the Wholesale Electricity Market (WEM) Rules. This submission is part of the process to set the level of revenue that can be recovered from market participants for the Wholesale Electricity Market (WEM) Market Operations and System Management functions, and the Gas Services Information (GSI) function, for a three-year period from 1 July 2016 to 30 June 2019.

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EXECUTIVE SUMMARY

On 16 September 2016, AEMO submitted its original Allowable Revenue 4 (AR4) submission to the Economic Regulation Authority (ERA) to cover expenditure from 1 July 2016 to 30 June 2019. The ERA approved most of AEMO’s Allowable Revenue and Forecast Capital Expenditure in relation to the business as usual (BAU) activities for the Market Operations, System Management, and Gas Services Information functions, and the funding requested to transition the System Management functions to AEMO including co-location to a single Perth office.

The ERA deferred its decision on AEMO’s funding requests in relation to the Western Australian Market Reform Program (WAMRP). This was as a result of the uncertainty created when the associated legislative changes were not passed by the WA Parliament in its current sitting and would not be progressed until after the March 2017 State election. However, the WA Government has already enacted various reforms as part of its Electricity Market Review (EMR), including amendments to the WEM Rules that impose or amend obligations on AEMO and require implementation work to give effect to the amendments.

The WAMRP was initiated by AEMO in response to the EMR. With the delays of the underpinning market reform legislation and upcoming WA State election, there is some uncertainty about how the market reform (and associated WEM Rule changes) will be structured. Given this, AEMO has already taken prudent measures to scale down the WAMRP program scope, reduce the resource profile and defer significant components of the planned IT and market readiness expenditure.

A supplementary submission was made to the ERA in early December 2016, taking into account the impact of the required legislation not receiving the required Parliamentary approvals. However, the ERA in its determination stated that it had insufficient time to review AEMO’s supplementary submission.

Given the uncertainty over timing of market reform implementation, however, recognising reform is continuing, AEMO is seeking approval from the ERA for an adjustment to its approved Allowable Revenue and Forecast Capital Expenditure for the AR4 period, in addition to that already approved in the ERA determination of 16 December 2016. The proposed scope of work is as follows:

	Section
Components that are already enacted in the WEM Rules and therefore not subject to any regulatory uncertainty	
Reserve Capacity Mechanism (RCM3)	2.1.1
Reserve Capacity Auction	2.1.2
Data Centre	
Essential technology infrastructure and communications links associated with the dedicated WA Data Centre and required to support the new AEMO Perth office. The office will accommodate the co-location of both market and system operations personnel and market critical systems in the same office ¹	2.2
Power Systems Operations	
System operations design and build work to reduce risk and avoid expenditure on end-of-life Western Power systems - Energy Management System (EMS) and forecasting, including Data Centre requirements to support the systems	2.3
Market development during 2017	
Engagement with the Public Utilities Office on regulatory planning and rule proposal (not rule-making) functions Engagement with stakeholders to support market preparedness and market design understanding	2.4
Market solution design during 2017	
Initial planning, scoping, business and functional requirements, design, change management, IT, and prototyping of market systems to ensure an integrated reform solution can go live in 2019	2.5

¹ The ERA approved the move to a single AEMO Perth office within the System Management transfer component in AEMO’s original determination. However, the ERA’s approval excluded the necessary supporting IT expenditure required for the data centre (and supporting communication links). This expenditure was included in the WAMRP data centre costs, as both the office move and reform data centre works were to be implemented together and the reform data centre works were the major component. With the deferment of the market systems, the smaller data centre scope for the office move still needs to be funded.



Approval of these components will enable AEMO to proceed with those reforms already in the WEM Rules, such as Reserve Capacity Mechanism (RCM) changes, and other works that are required to proceed irrespective of the wider EMR outcomes (such as the data centre for the single Perth office, and essential systems to support AEMO’s power system operation functions). This funding will also allow AEMO to continue progressing the key reform activities, particularly those related to planning and regulatory design (the WEM Rules) required to meet the reform objectives and any revised start date.

AEMO considers this work to be consistent with its functions in the WEM Rules, including the transitional functions in clause 1.20 that were enacted by the Minister for Energy in December 2016:

- a) *to prepare for Wholesale Electricity Market Reform; and*
- b) *to facilitate the implementation of Wholesale Electricity Market Reform (including through transitional measures).*

The financial aspect of this submission encompasses the scope of works outlined above in the following three timeframes:

- July 2016 to December 2016 – actual reform costs incurred.
- January 2017 to December 2017 – forecast costs to implement reform changes already included in the WEM Rules (RCM3 and Reserve Capacity (RC) Auction), data centre to support the Perth office move, system operation critical IT works², market development and market solution design.
- January 2018 to June 2019 – forecast WAMRP operating costs for components deployed prior to January 2018.

Further detailed information on each activity and the requested funding are provided in this submission.

Allowable Revenue

AEMO is seeking approval for supplementary Allowable Revenue funding for the current Review Period of \$2.85M. The breakdown by year is shown in the table below:

Allowable Revenue				
Function	2016-17 (\$000s)	2017-18 (\$000s)	2018-19 (\$000s)	Total (\$000s)
WEM Market Operator	608	515	658	1,781
WEM System Management	491	255	327	1,073
TOTAL	1,099	770	985	2,854

Forecast Capital Expenditure

AEMO is seeking approval for supplementary Forecast Capital Expenditure for the current Review Period of \$11.6M. The breakdown by year is shown in the table below:

Forecast Capital Expenditure				
Function	2016-17 (\$000s)	2017-18 (\$000s)	2018-19 (\$000s)	Total (\$000s)
WEM Market Operator	5,028	2,002	-	7,030
WEM System Management	2,509	2,057	-	4,566
TOTAL	7,537	4,059	-	11,596

² As these critical works will not be completed by end of December 2017, the total cost to implement these works will be identified, however this document only seeks approval of 2017 expenditure.



Indicative Market Fee Impact

The impact of the activities covered by this submission and the impact on market fees will be important information for current and future market participants. The following table details the anticipated annual impact on the indicative market fees as a result of the requested expenditure in this adjustment proposal. These are not in addition to the market fees noted within the original AEMO AR4 submission, but are a component of those.

Market Fee (\$/MWh)			
Function	2016-17 (\$)	2017-18 (\$)	2018-19 (\$)
WEM Market Operator	0.016	0.014	0.017
WEM System Management	0.013	0.007	0.009
TOTAL	0.029	0.021	0.026

Other points to note

Once clarification has been obtained about the underpinning market reform legislation (expected after the WA State election), AEMO intends to make a further adjustment proposal in the third or fourth quarter of 2017 for funding to the end of the current AR4 period, for the implementation of the full market reform program.



CONTENTS

EXECUTIVE SUMMARY	1
1. INTRODUCTION	6
2. SUPPORTING DETAIL	9
2.1 Components already enacted in the WEM Rules	9
2.2 Data Centre to support single AEMO Perth Office	12
2.4 Market development	23
3. SUMMARY COSTS	29
4. STAKEHOLDER ENGAGEMENT	31
5. POTENTIAL ADDITIONAL COSTS DUE TO DELAY IN MARKET REFORM	33
5.1 Business as usual (BAU)	33
5.2 WAMRP	34
APPENDIX A. OFFICE MOVE	35
APPENDIX B. RESERVE CAPACITY MECHANISM	36
APPENDIX C. POWER SYSTEM OPERATIONS TIMELINE	39
APPENDIX D. POWER SYSTEM OPERATIONS – KEY SYSTEM LINKAGES	42
APPENDIX E. COST SPLIT - MARKET OPERATIONS AND SYSTEM MANAGEMENT	46
APPENDIX F. STAKEHOLDER FEEDBACK	48
APPENDIX G. GLOSSARY	50



TABLES

Table 1	Cost Summary – RCM3, Allowable Revenue (\$000)	10
Table 2	Cost Summary – RCM3, Forecast Capital Expenditure (\$000)	10
Table 3	Cost Summary – RC Auction, Forecast Capital Expenditure (\$000)	11
Table 4	Required data links	13
Table 5	Network, compute, and storage equipment	14
Table 6	Cost Summary – Data Centre, Allowable Revenue (\$000)	14
Table 7	Cost Summary – Data Centre, Forecast Capital Expenditure (\$000)	15
Table 8	Cost Summary – Power System Operations, Allowable Revenue (\$000)	22
Table 9	Cost Summary – Power System Operations, Forecast Capital Expenditure (\$000)	22
Table 10	Cost Summary – Market Development, Allowable Revenue (\$000)	24
Table 11	Cost Summary – Market Development, Forecast Capital Expenditure (\$000)	24
Table 12	Cost Summary – Market Solution Design, Forecast Capital Expenditure (\$000)	27
Table 13	Summary Allowable Revenue	29
Table 14	Summary Forecast Capital Expenditure	29
Table 15	Indicative Market Fee Impact	30

FIGURES

Figure 1	Current operational system arrangements	42
Figure 2	Proposed transitional arrangement (Stage 1A) – introduction of e-terra for the SWIS	43
Figure 3	Potential transitional arrangement (Stage 1B) – e-terra taking active control for the SWIS	44
Figure 4	Current thinking for final arrangement (implementation of market reform) – addition of other NEM-style operational systems	45



1. INTRODUCTION

This adjustment proposal relates to a subset of the WA Market Reform Program (WAMRP) work scope requested in AEMO's original submission in September 2016 for the AR4 period. With the delay of components of the EMR related regulatory packages that underpin the market reforms, and the pending WA State election, there is now a level of uncertainty as to when market reform (and associated regulatory changes) will occur and what this will involve. Given this uncertainty, AEMO has already taken prudent measures to revise the overall program approach, to reduce the resource profile, and to defer significant components of planned IT and market readiness expenditure.

As a result, for the duration of the 2017 calendar year and until such time as greater reform certainty is available, AEMO is seeking approval for a subset of the original WAMRP scope encompassing the following areas of activity:

- WEM Rules Changes: EMR components that are already enacted in the WEM Rules and which AEMO is required to implement to avoid non-compliance issues:
 - Third stage of changes to the Reserve Capacity Mechanism (RCM3).
 - The Reserve Capacity Auction.
- Single Perth Office Data Centre Works: The data centre works and communication links required to support the creation of the single AEMO Perth office.
- Power Systems Operations Core Security Management Systems: Critical system management IT systems (Energy Management Systems, Forecasting and Modelling) design and build work to reduce risk and avoid expenditure on end-of-life Western Power provided systems.
- Market Development: EMR market development activities during 2017:
 - Engagement with the Public Utilities Office on regulatory planning and rule proposal (not rule-making) functions.
 - Engagement with stakeholders to support market preparedness and market design acceptance.
- Market Solution Design: EMR market solution planning, scoping, initial solution, design, change management, IT, and prototyping of market systems to ensure that an integrated reform solution can go live in 2019. Without this work, there will be a high risk that a July 2019 implementation date may not be achieved, potentially pushing reform implementation into 2020 to avoid the summer period.

The following sections provide further details on these activities.

Transitional function of preparing for Wholesale Electricity Market Reform

In late 2016, the Minister for Energy inserted a new clause 1.20 into the WEM Rules (which commenced on 10 December 2016) that provides AEMO with the following transitional functions in clause 1.20.1:

- a) to prepare for Wholesale Electricity Market Reform; and
- b) to facilitate the implementation of Wholesale Electricity Market Reform (including through transitional measures).

Wholesale Electricity Market Reform is defined in Chapter 11 of the WEM Rules:

Wholesale Electricity Market Reform: Means any proposed change to the operation of the Wholesale Electricity Market, or the legislative regime applying to the Wholesale Electricity Market (including the Electricity Industry Act, the Regulations and these Rules), that has been endorsed by the Minister (whether or not legislation has been made to implement it). To avoid doubt, this includes the entire reform package set out in the Wholesale Energy and Ancillary Service Report.

Clause 1.20.2 further describes the transitional functions as enabling AEMO to undertake the following activities (without limiting AEMO's discretion in performing its functions):



- a) *procuring, developing, testing and otherwise preparing all systems, tools and procedures necessary or convenient for AEMO to continue to provide services and perform its functions and obligations on and from the commencement of Wholesale Electricity Market Reform; and*
- b) *developing, and consulting about, proposals to change these Rules to accommodate Wholesale Electricity Market Reform.*

Clause 1.20.3 requires the ERA to determine and approve AEMO's Allowable Revenue and Forecast Capital Expenditure (or any reassessment) on the assumed basis that Wholesale Electricity Market Reform will be fully implemented:

When determining and approving the Allowable Revenue and Forecast Capital Expenditure or a reassessment of the Allowable Revenue or Forecast Capital Expenditure for AEMO for all or part of the Review Period from 1 July 2016 to 1 July 2019, the Economic Regulation Authority must determine this on the basis that Wholesale Electricity Market Reform includes the full implementation of the reform package set out in the Wholesale Energy and Ancillary Service Report before 1 July 2020.

In preparing this adjustment proposal, AEMO has considered that Wholesale Electricity Market Reform includes the following proposed changes to the WEM operation that are being advanced by the Public Utilities Office (PUO):

- Transitional reforms to the Reserve Capacity Mechanism that commence on 1 October 2017, being undertaken within AEMO's RCM3 project, for which the amending WEM Rules were gazetted on 31 May 2016.³
- Reforms to the energy and ancillary service markets, which were endorsed by the Minister in July 2016 and are specifically referenced in clause 1.20.3 of the WEM Rules.⁴ AEMO's planned work schedule and budget includes preparatory work required to ensure that these reforms can be implemented in mid-2019, consistent with the current work program of the PUO.⁵ (These reforms include introduction of security-constrained, co-optimised dispatch of energy and ancillary services, separation of the Synergy portfolio for facility-based dispatch, pricing and settlement changes, and modifications to the outage and reliability management processes.)
- Adoption of elements of Chapter 4 of the National Electricity Rules governing power system security, for which a position paper was published in January 2017.⁶ It is expected that these amendments would commence with reforms to the energy and ancillary service markets.
- Development of a Reserve Capacity Auction, which was endorsed by the Minister in April 2016, with the amending WEM Rules gazetted on 31 May 2016 including an obligation for the development of such an auction (clause 4.1.33).⁷ AEMO anticipates that the first Reserve Capacity Auction could occur in 2019.

³ Gazette notice available at [https://www.slp.wa.gov.au/gazette/gazette.nsf/searchgazette/88678F21CF39740648257FC300220F5A/\\$file/gg089.pdf](https://www.slp.wa.gov.au/gazette/gazette.nsf/searchgazette/88678F21CF39740648257FC300220F5A/$file/gg089.pdf). The amendments commencing on 1 October 2017 are contained in Schedule B Part 3 of the Gazette notice.

⁴ *The Final Report: Design Recommendations for Wholesale Energy and Ancillary Service Market Reforms* is available at http://www.finance.wa.gov.au/cms/uploadedFiles/Public_Utility_Office/Electricity_Market_Review/Final-Report-Design-Recommendations-for-Wholesale-Energy-and-Ancillary-Market-Reforms.pdf. The release of this report was accompanied by a media statement by the Minister for Energy, which is available at <https://www.mediastatements.wa.gov.au/Pages/Barnett/2016/07/New-reforms-to-WA-wholesale-electricity-market.aspx>.

⁵ *The Position Paper on the proposed elements of Chapter 4 of the National Electricity Rules to be incorporated into the Wholesale Electricity Market Rules*, published on 11 January 2017, states that 'Western Australia is also progressing endorsed reforms to the Wholesale Electricity Market contained in the *Final Report – Design Recommendations for Wholesale Energy and Ancillary Service Market Reforms* (published in July 2016) by mid-2019'. The paper is available at http://www.finance.wa.gov.au/cms/uploadedFiles/Public_Utility_Office/Electricity_Market_Review/Position-paper-proposed-elements-of-chapter-4-of-the-NER-to-be%20incorporated-into-WEM-rules.pdf.

⁶ Page 3 of the *Position Paper on the proposed elements of Chapter 4 of the National Electricity Rules to be incorporated into the Wholesale Electricity Market Rules*, available at http://www.finance.wa.gov.au/cms/uploadedFiles/Public_Utility_Office/Electricity_Market_Review/Position-paper-proposed-elements-of-chapter-4-of-the-NER-to-be%20incorporated-into-WEM-rules.pdf, observes that 'the adaption of Chapter 4 of the National Electricity Rules is necessary to enable the implementation of the Australian Energy Market Operator's wholesale settlement and security constrained dispatch system'. Note also that the adoption of elements of Chapter 4 of the National Electricity Rules will require consequential amendments to the Technical Rules. AEMO understands that all EMR reports must be endorsed by the Minister for Energy prior to public release.

⁷ See the *Final Report: Reforms to the Reserve Capacity Mechanism* at http://www.finance.wa.gov.au/cms/uploadedFiles/Public_Utility_Office/Electricity_Market_Review/Reforms-to-the-Reserve-Capacity-Mechanism-Final-Report.pdf and the accompanying media statement by the Minister for Energy at <https://www.mediastatements.wa.gov.au/Pages/Barnett/2016/04/Electricity-reforms-ensure-fairer-system-for-all.aspx>.



- Establishment of a Reliability Advisory Committee, which was proposed in a position paper in February 2016⁸ and acknowledged in a media statement by the Minister for Energy in July 2016.⁹ AEMO anticipates that the Reliability Advisory Committee will begin operation during 2017.

Other points to note

Once clarification has been obtained about the underpinning market reform legislation (expected after the WA State election), AEMO intends to make a further adjustment proposal in the third or fourth quarter of 2017 for funding to the end of the current AR4 period, for the implementation of the full market reform program.

AEMO understands the unapproved BAU portion of AEMO's proposed Allowable Revenue was based on the ERA's analysis of functions previously undertaken by the Independent Market Operator but not transferred to AEMO (including rule-making and parts of the compliance enforcement function) and the ERA applying actuals rather than budget for Supplies and Services in the 2015 – 2016 base year. In terms of AEMO's functions under the WEM Rules, the ERA appears to have taken a more conservative view than AEMO as to the appropriate scope of rule proposal and compliance activities. AEMO is still analysing the basis of this decision and its impact and will justify this expenditure in a future submission if deemed necessary.

⁸ Available at http://www.finance.wa.gov.au/cms/uploadedFiles/Public_Utility_Office/Electricity_Market_Review/3%20February%202016%20-%20Position%20Paper%20on%20Design%20of%20Western%20Australian%20Reliability%20Advisory%20Committee.pdf.

⁹ Available at <https://www.mediastatements.wa.gov.au/Pages/Barnett/2016/07/Local-regulator-to-monitor-WA-energy-markets.aspx>.



2. SUPPORTING DETAIL

2.1 Components already enacted in the WEM Rules

The following two components, Reserve Capacity Mechanism 3 (RCM3) and Reserve Capacity Auction make up the most significant part of the Reserve Capacity Mechanism reforms. A final component – RCM4 – remains to be delivered and will form part of a subsequent AR4 adjustment proposal. Appendix B illustrates the relationship between these three components.

2.1.1 Wholesale – Reserve Capacity Mechanism

Summary

The Reserve Capacity Mechanism (RCM) in the WA WEM is in place to ensure there is sufficient capacity from generation and demand side management to meet forecast demand in the South West Interconnected System (SWIS).

On 31 May 2016, the Minister for Energy made changes to the WEM Rules with commencement dates of 1 June 2016, 1 October 2016 and 1 October 2017.¹⁰ These changes are expected to see the value of the Capacity Credits reduce from \$685M per annum to about \$570M per annum. AEMO's RCM3 project relates specifically to the implementation of systems and processes associated with the changes commencing on 1 October 2017.¹¹

The RCM3 reforms are explained in the PUO's *Final Report: Reforms to the Reserve Capacity Mechanism*¹², and include changes to:

- Calculation of the Reserve Capacity Price in the transitional period prior to the commencement of the proposed new RC Auction.
- Availability and performance requirements for Demand Side Programmes participating in the RCM.
- Performance incentives for capacity providers including a dynamic Reserve Capacity refund regime and revised consideration of facility outages in the certification of Reserve Capacity.

As these amendments to the WEM Rules have already been gazetted and will commence on 1 October 2017, AEMO must implement these reforms to comply with the new rules. AEMO's systems cannot currently support these new rule obligations, and this submission includes allowance for the required changes. Some market participants must also make changes to their internal systems that interface with WEM systems, and require certainty on the required software changes.

To help develop RCM system functionality and support market participant readiness, AEMO has started hosting 'Showcases' with market participants. The Showcases are an opportunity for market participants to provide input regarding the development of the user interface and to gain early visibility of it before final user acceptance testing commences.

AEMO will also host workshops for the Application Programming Interface (used by market participants to integrate their internal systems to the AEMO market systems) and will consult on amendments to RCM market procedures in 2017.

¹⁰ These amendments are detailed in the Government Gazette available at [https://www.slp.wa.gov.au/gazette/gazette.nsf/searchgazette/88678F21CF39740648257FC300220F5A/\\$file/gg089.pdf](https://www.slp.wa.gov.au/gazette/gazette.nsf/searchgazette/88678F21CF39740648257FC300220F5A/$file/gg089.pdf).

¹¹ AEMO has denoted the implementation of the 1 June 2016 and 1 October 2016 amendments as RCM Phase 1 and Phase 2 respectively, which are now complete.

¹² Available at http://www.finance.wa.gov.au/cms/uploadedFiles/Public_Utility_Office/Electricity_Market_Review/Reforms-to-the-Reserve-Capacity-Mechanism-Final-Report.pdf.



Costs

The following costs will cover all aspects of the RCM3 project.

Table 1 Cost Summary – RCM3, Allowable Revenue (\$000)

RCM3 Allowable Revenue (\$000)	Actual to Dec-16	Jan-17 to Jun-17	Jul-17 to Dec-17	Jan-18 to Jun-18	Jul-18 to Jun-19	Total
Supplies and Services – Travel and Training	3	39	-	-	-	42
Planning	30	-	-	-	-	30
Program Cost Allocation	54	-	-	-	-	54
Depreciation	-	-	91	179	331	601
TOTAL	87	39	91	179	331	727

Table 2 Cost Summary – RCM3, Forecast Capital Expenditure (\$000)

RCM3 Forecast Capital Expenditure (\$000)	Actual to Dec-16	Jan-17 to Jun-17	Jul-17 to Dec-17	Jan-18 to Jun-18	Jul-18 to Jun-19	Total
Resources	154	751	167	-	-	1,072
Consultancy	315	921	651	-	-	1,887
Hardware	42	-	-	-	-	42
Software	8	-	-	-	-	8
Program Cost Allocation	234	197	169	-	-	600
TOTAL	753	1,869	987	-	-	3,609

2.1.2 Wholesale – Reserve Capacity Auction

The development of an auction to procure Reserve Capacity was endorsed by the Minister in April 2016, with the amending WEM Rules gazetted on 31 May 2016 including an obligation to develop such an auction (clause 4.1.33). The PUO is currently developing the design of this auction and is scheduled to draft amendments to the WEM Rules by the end of 2017. The PUO released a paper outlining the reserve capacity auction design on 31 January 2017.¹³

AEMO understands that the auction is currently planned to begin operation in 2019. During 2017, AEMO will provide technical advice to the PUO to support the auction design and rule drafting; prepare submissions in response to consultation papers released by the PUO; and document implementation requirements to support the development of a future AR4 adjustment proposal, the finalisation of specific functional and technical requirements, and the future transition to the IT execution phase.

¹³ This paper is available at http://www.finance.wa.gov.au/cms/uploadedFiles/Public_Utility_Office/Electricity_Market_Review/Reserve-Capacity-Auction-Final-Design-and-Implementation.pdf.



Costs

No Allowable Revenue expenditure for the RC Auction has been requested as part of this adjustment proposal. A future AR4 adjustment proposal will contain the balance of the estimate for full design, build and deployment of the RC Auction solution.

Table 3 Cost Summary – RC Auction, Forecast Capital Expenditure (\$000)

RC Auction Forecast Capital Expenditure (\$000)	Actual to Dec-16	Jan-17 to Jun-17	Jul-17 to Dec-17	Jan-18 to Jun-18	Jul-18 to Jun-19	Total
Resources	-	-	50	-	-	50
Program Cost Allocation	-	-	15	-	-	15
TOTAL	-	-	65	-	-	65



2.2 Data Centre to support single AEMO Perth Office

Summary

AEMO's WA office and existing market systems run on systems hosted in two data centres based in WA. With a move to a single AEMO Perth office, incorporating an AEMO stand-alone control room, this adjustment proposal provides for the single infrastructure expenditure to implement the required data centre services to achieve full integration of the WA office with the broader AEMO systems. The office consolidation cannot proceed without the new infrastructure.

The ERA's December 2016 determination of AEMO's Allowable Revenue and Forecast Capital Expenditure (based on AEMO's original AR4 submission) approved costs for the move to a single Perth office to co-locate the market operator and system operator staff. However, costs associated with the data centre services and infrastructure to support the single office were not approved, as they were presented under the WAMRP component of the original submission. Without approval for the data centre component, the single office will not be able to function efficiently. Please refer to Appendix A for further information regarding those elements that were previously approved and those requested in this submission.

Background

The AEMO WA single office project has gained significant benefit by leveraging the recent design work used to successfully relocate AEMO's Queensland Office from Mansfield, including staff, data centre services and infrastructure and associated telecommunications infrastructure to Brisbane. The single WA office adopts AEMO standards for staff collaboration, cyber and physical security, networking, and the hosting of infrastructure.

It implements a control room that uses virtualisation technology hosted in AEMO's data centres which will eventually enable control of the grid in an emergency from other AEMO locations. Operators will have access to the same functionality from a local disaster recovery location, in the event of the Perth office being inaccessible.

The current AEMO data centres in Perth are in a secure third party location that hosts the existing WEM and GSI systems. This facility will be upgraded to host the networking and telecommunications equipment and services for the single office with an appropriate level of redundancy in the event of equipment failure. This upgrade will align the systems and services to AEMO standards used in the Brisbane office design, and include the implementation of:

- Robust connections from the single office to the data centre and wider AEMO.
- Segregation of data traffic for increased security – internet, general office systems, market systems, and real time management systems all run on isolated networks.
- Remote security and equipment management and monitoring, allowing for leveraging of AEMO's wider expertise and sharing of resources across the country.
- Virtualised desktops that allow corporate and external systems to be displayed on control room desks.
- Voice telecommunication systems – installation of specialised equipment in the data centre, connecting to generators to support specialised voice equipment as well as standard desktop voice services in the control room.
- Specialised AV equipment to support the control room.
- Compute and storage (virtual server farm) with sufficient capacity to host standard office infrastructure.

The items to be delivered in 2017 can be classified into three core areas:

- Data and voice communication links.
- Network, computer and storage equipment to support virtual server provisioning.
- Hosting services such as rack space and cabling.



2.2.1 Data and voice communication links

The data communication links connect the office to the AEMO data centre, and the data centre connects to Western Power and other AEMO locations. AEMO has engaged with various telecommunications providers to ensure that the data and voice communications have sufficient redundancy and diversity to maintain service under extreme conditions and with no single point of failure.

Communications in the Perth metro area

The most critical connections between the office and the AEMO data centre, and between the data centre and Western Power, must continue to function in the event of a total power loss impacting either the Perth CBD or AEMO’s data centre locations. This is to ensure that the controllers can continue to access the System Management power operations systems and manage the power system. These communications and data links leverage dedicated (dark) fibre optic cable. This solution is more expensive than other options but provides continuity of service in the event of a major power loss. We have established multiple connections between locations and have reviewed the physical paths to ensure no single point of failure.

Interstate communications

Dark fibre is not a practical solution for long distance interstate communications. The design of the communications links between AEMO’s Perth data centre and east coast data centres achieves the required reliability standard by implementing multiple links between sites, using different carriers for each link and ensuring physically diverse paths and endpoints. AEMO staff have reviewed the chosen carriers and their link paths in detail to ensure maximum availability and no single point of failure (e.g. nominally diverse links that run over different infrastructure by different carriers). AEMO’s Brisbane and Norwest data centres already have redundant links between them so full connectivity is maintained if Perth has a link to either east coast data centre.

Table 4 Required data links

Link from/to	Purpose
Perth Office to Perth data centre – Primary	Primary connection from office to the main data centre
Perth Office to Perth data centre – Secondary	Fallback connection from office to the data centre
Perth to Brisbane (AEMO third party data centre)	Connection to wider AEMO – general office traffic and fallback location for Power Systems hosting
Perth to Norwest (AEMO data centre)	Fallback connection to wider AEMO – general office traffic
Perth Internet	Connection to the internet for control room Disaster Recovery capability
Western Power East Perth Control Centre to Perth Office	Main connection to Western Power for voice and real-time traffic
Western Power Southern Terminal to Perth Office	Main connection to Western Power secondary location for voice and real-time traffic
Telstra IP WAN cloud	Virtual network connection to Western Power – voice and data
Optus IP WAN cloud	Backup virtual network connection to Western Power – voice and data

2.2.2 Network, compute, and storage equipment

The network, compute, and storage is the core equipment located in the data centre racks. It supports critical office functions and provides the capacity to host the production-quality computer systems locally

Table 5 Network, compute, and storage equipment

Item	Purpose
Core switches and routers	The heart of the network allowing all the equipment to talk
Internet Firewall CR remote access	Allows the system operators to remotely access the systems from an alternate location if the office is inaccessible.
BT Voice and RTNet router	Required for control room telephony
BT Voice TNSP located RTNet router	Required for control room telephony
BT Voice RTNet key server router	Required for control room telephony
Rack and Inet switches	Connects the equipment located in the data centre rack (e.g. the telephone equipment, servers) to the network
Office Voice gateway	Required for general office telephone
KVM and serial console	Used for remote management of the network, compute and storage.
Structured cabling and leads	Connects the various datacentre racks leased by AEMO to each other and to the outside world.
Static switch for single supply	A device to transfer power between primary and backup sources quickly ensuring there is no interruption to the supply to equipment
Management Cluster	The management cluster holds all the VMs (servers) that manage the core network services needed by an office, e.g. DNS, DHCP, and Active Directory.
Flash Array	The fast disk storage used by the power systems and the virtual desktops
HW and cluster build	Setting up the server farm and production cluster that will host the power systems and the virtual desktop VMs for the system management workstations

2.2.3 Hosting services

The final item required is the contract with the data centre to provide:

- Rack space and other services related to hosting equipment such as cabling.
- Installation of specialist equipment to monitor the electricity grid.

AEMO is upgrading its current facilities under existing data centre contract arrangements. The current facilities do not have sufficient rack space to accommodate the control room hardware and do not have capacity to support the new office and existing office concurrently; building the new office infrastructure needs to proceed in parallel with continuing to support the existing office. Much of the existing office networking infrastructure is reaching or at end of life and will be retired after the office move is complete. The remaining infrastructure is still required to host existing WEM and legacy systems until the new market systems are deployed, after which they will also be retired.

Costs

Table 6 Cost Summary – Data Centre, Allowable Revenue (\$000)

Data Centre (Market Operator & System Management)	Actual to Dec-16	Jan-17 to Jun-17	Jul-17 to Dec-17	Jan-18 to Jun-18	Jul-18 to Jun-19	Total
Supplies and Services – Travel and Training	2	-	-	-	-	2
Program Cost Allocation	4	-	-	-	-	4
Depreciation	-	-	165	324	654	1,143
TOTAL	6	-	165	324	654	1,149



Table 7 Cost Summary – Data Centre, Forecast Capital Expenditure (\$000)

Data Centre (Market Operator & System Management)	Actual to Dec-16	Jan-17 to Jun-17	Jul-17 to Dec-17	Jan-18 to Jun-18	Jul-18 to Jun-19	Total
Forecast Capital Expenditure (\$000)						
Resources	132	920	96	-	-	1,148
Hardware	-	1,960	-	-	-	1,960
Program Cost Allocation	60	254	20	-	-	334
TOTAL	192	3,134	116	-	-	3,442

2.3 Power systems operations – core system management systems

Summary

As part of the integration of System Management into AEMO, an interim Service Agreement was signed with Western Power to continue to provide access to critical operational systems until 2018 (see Appendix C) to allow AEMO enough time to implement its own systems (leveraging existing licences and capability to the extent possible for WA). Given the expected short-term nature of the Service Agreement, the contract was signed by both parties on the basis of ‘best efforts’ support - essentially on the basis that these systems would be replaced as part of the reforms to the wholesale energy and ancillary service markets.

With deferral of the market reforms, and to mitigate the risks of long-term exposure to aging operational systems, AEMO now proposes staging the introduction of these critical operational systems. The first two systems in focus are the Energy Management System (EMS) and the forecasting system to produce the SWIS short-term demand forecast along with some licences to support SWIS model development.

AEMO uses the GE e-terra EMS platform for managing the power system in all states and territories in the National Electricity Market (NEM). The aim is to adopt this standard to manage the SWIS. This approach will provide several benefits:

- AEMO has significant internal expertise in relation to the e-terra EMS platform.
- AEMO will not need to develop new competencies in relation to legacy systems that will eventually be discontinued.
- AEMO expects to benefit from discounted vendor licensing costs (\$100K's rather than \$1M's for a standalone licence).
- An e-terra EMS platform can be integrated with other NEM-style systems, such as the NEM Dispatch Engine (NEMDE), as part of proposed WEM market reforms, or (if the WEM market reforms do not proceed) as standalone applications.

This will also position AEMO to leverage synergies and economies of scale from having the same energy management systems across all jurisdictions, and the same support processes for these systems. The cost of this migration had previously been included in the WAMRP, as it was packaged for delivery with other power system operations work. This system is, however, not specifically tied to any reform activities and has no market rule change requirements, so the drivers to implement it remain strong despite the delay in market reforms.

In addition to allowing AEMO time to develop the e-terra model of the SWIS and train its operators appropriately, progressing with the introduction of e-terra will also allow Western Power to progress with internal business improvement plans, reduce the Service Agreement costs to AEMO and avoid inefficient investment in significant but short-lived upgrades. See timeline in Appendix C for further information.

Background

SWIS Energy Management System (EMS)

Given the previously expected market reform commencement date of 1 July 2018, implementation of the GE e-terra EMS platform had been characterised as part of the implementation of the Power System Operations (PSO) scope of the market reform, but with a scheduled go-live of January 2018 ahead of the full implementation date of the reform. This early go-live date for e-terra was proposed because of the critical nature of the application. Other potential drivers for this investment (reduced business risk, avoid future costs) were not presented at that time.



As market reform implementation has been deferred, these other drivers have been re-examined and, in some cases, elements of the PSO scope of WAMRP are included here and justified on their own merits.

Currently AEMO, in its role as System Management, is fully reliant on Western Power operational systems to meet its core obligations of ensuring the SWIS is operated securely and reliably. This is provisioned through a Service Agreement between Western Power and AEMO for the Information and Communication Technology (ICT) components of the service.

A primary component of this is use of the Western Power EMS XA/21. This is a critical operational tool and includes provision for:

- Dispatch of Synergy plant.
- Automatic Generation Control (AGC) for implementing Load Following Ancillary Services and general frequency management.
- Issuing of electronic dispatch instructions to market participants.
- Collection and monitoring of System Control and Data Acquisition (SCADA) data.
- Monitoring and control of SWIS elements.
- Security analysis for real-time constraint management and outage processing.
- Offline security analysis and case storage for operational planning and outage approvals.
- Collection of data for settlement, reporting, and compliance monitoring purposes.

Given AEMO has already standardised processes on the e-terra platform to perform similar functions in the NEM, the aim is to leverage the significant expertise AEMO has gained using and supporting this platform rather than developing new competencies in a legacy set of systems.

The implementation of the e-terra platform for the SWIS was originally planned to be completed by January 2018, in preparation for integration with other NEM systems when they were ready to go live. An earlier implementation is still appropriate even with the delay in market reforms and does not significantly impact the costs of the remainder of the WAMRP. Further, AEMO's intent is to use as much of the existing development and test infrastructure as possible throughout 2017 to minimise expenditure and defer larger investments (production hardware, licensing and full recruitment of WA based support personnel) until 2018.

Discussions with Western Power have confirmed it has internal business drivers to minimise its SCADA footprint and improve support efficiency/effectiveness by moving transmission network management functionality currently residing on the XA/21 onto the Power-On-Fusion (POF) platform also currently maintained by Western Power for its distribution network. However, this project cannot begin in full while Western Power must continue to provide AEMO with access to the XA/21 system, restricting Western Power from realising efficiency gains.

Western Power, as a Network Operator in the WEM, will still be obliged to provide real-time data and control signals to the e-terra system from its SCADA system. However, this does not need to be specifically via the XA/21 going forward. The arrangements currently existing in the WEM Rules allow AEMO and Western Power to develop interfaces between control systems without any additional regulatory changes, and so the implementation of an e-terra system is not dependent on the broader EMR reforms.

The XA/21 system was last upgraded by Western Power in early 2016 (the original in-service date was planned for 2015), and Western Power currently has no plan for future upgrades. A delay in the introduction of the new EMS means AEMO will continue to be reliant on the XA/21 system until mid-2019 at the earliest, and more likely into early 2020 (with allowance for parallel operation¹⁴).

By this stage, the current XA/21 will be lapsing significantly in terms of software and hardware currency; although it may still be able to be supported, there are significant risks to maintaining this for prolonged

¹⁴ Parallel operation allows for quick use of an established control system should there be any unforeseen software failures causing loss of critical functions. AEMO would work to minimise this risk of this via thorough user acceptance testing, but parallel operation provides additional risk mitigation.

periods without additional investment due to the nature of these types of systems (i.e. locked hardware/software versioning). The risks are:

- Catastrophic hardware failure.
- Unavailability of spare parts.
- Software cyber security vulnerabilities.
- Lapsing primary vendor maintenance support (i.e. GE).
- Lapsing third party vendor support (e.g. database).

Addressing these risks will require both AEMO and Western Power to arrive at an appropriate commercial arrangement to compensate Western Power for ongoing investment in the XA/21 that Western Power itself may not actually need.

A system upgrade would require significant investment. Western Power has indicated that an upgrade project would need to start by early 2019, were AEMO still requiring its use beyond 2021. To avoid this requires a decision on e-terra implementation within AR4 timeframes. The indicative cost for an XA/21 upgrade provided by Western Power is circa \$6-8M, will take in the order of 2.5 years to complete, and would be a poor outcome for market participants and the market overall if this system were to ultimately be short-lived.

For a smaller investment, progressing with the build of the e-terra platform for the SWIS to be in service by mid-2018 would avoid the need for Western Power to invest in a new version of the XA/21 specifically to meet AEMO's control system needs for the SWIS, and allow AEMO to continue with its plans to embed the new control system and train system operators in its use. AEMO could still continue to use the existing WEM market systems located within Western Power (see Figure 1 and Figure 2 in Appendix D) at no additional cost. Further, this would also allow Western Power to progress plans to replace the XA/21 to reduce overall costs. This arrangement would also still permit AEMO to use the existing WEM market systems located within Western Power with some minimal interfacing changes, and still be placed to support a new market start (see Figure 3 and Figure 4 in Appendix D).

While there are some hardware components in the WA data centre to support introduction of e-terra for the SWIS, the aim is to leverage AEMO's existing data centre infrastructure on the east coast as much as possible to minimise overall costs (including using existing test/development components, and existing PI¹⁵ and networking infrastructure). Data centre costs for the e-terra component are shown in Table 9 below. These components will remain and be re-used for introduction of the reforms to the wholesale energy and ancillary service markets.

Some ongoing operational costs will be incurred by AEMO to support the e-terra solution in WA once it is installed, with annual licence maintenance costs detailed in Table 9 below. Recruitment of a local three-person support team is also required to cover 24x7 operations, leveraging east coast AEMO support teams to minimise the local support footprint. This team will also provide support for other system functionality to WA staff in the future. Estimated operational costs for the three-person support team are in the operating costs estimate for 2018 – see Costs section below. See Appendix C for a timeline.

AEMO recommends, both from an ongoing organisational risk perspective and to avoid unnecessary investment in a system that may become obsolete in the next few years, continuation of the original plan to introduce the e-terra system (mid-2018). This will ensure AEMO has a contemporary, manageable and upgradable platform that can be supported internally to ensure secure and reliable operation of the SWIS as part of its System Management function, which is independent of the needs of Western Power. There are three other benefits of this strategy:

- The delay in the introduction of the market reforms will require an extension of the existing Service Agreement with Western Power. By September 2018, this is estimated to cost about \$285K per month (guaranteed only for six months, beyond which the cost must be renegotiated between AEMO and Western Power at commercial terms). Removing the reliance on the XA/21 system prior to this will reduce the service charges with Western Power moving forward, and help

¹⁵ Historical SCADA reporting capability, also used for interfacing to other market and security applications

minimise the risk of an increased cost due to commercial negotiations. Western Power has conservatively estimated the cost saving to be about \$300K per annum.

- A new EMS can take several months to bed in, with many of the advanced applications requiring significant effort to ‘tune’ before they become operational (previous introduction of the XA/21 took about 12 months, albeit this was a larger step change than the move to e-terra). This is a key reason for seeking to introduce the e-terra platform before new market go-live. Continuing with the planned timeframe allows more time to bed in and tune the system with the fall-back in XA/21 still being available. It also allows more time to train new operators on using the new control system and becoming familiar with new advanced security management features.
- The introduction of the new e-terra platform brings with it a range of operational data reporting tools. When these are available, it will be possible to introduce interfaces to existing WEM market systems to remove reliance on data feeds from Western Power (e.g. real-time SCADA data). This will also help reduce the overall service charge payable to Western Power and allow AEMO to independently manage transparent data flows to the market.

SWIS demand forecast

Demand forecasting is another key operational system for which AEMO is currently wholly reliant on Western Power to provide for the SWIS. AEMO currently uses the same forecasting platform as Western Power (Itron Metrix). The original intent was for AEMO to establish its own SWIS demand forecast by early 2018, to feed the market trial environment and support market readiness activities in preparation for new market start.

Since the original Allowable Revenue submission, AEMO has learned from the demand forecast software vendor (Itron) that it intends to remove support from the current version of the demand forecast software in 2018. This is the version that Western Power currently provides to AEMO under the Service Agreement.

A delay to this component would mean continued reliance on Western Power hardware, and support from Western Power in maintaining the demand model. Given recent advice from the vendor, an upgrade will be necessary to enable support to be maintained. This will require an investment of funds in 2017, payable by AEMO to Western Power, to facilitate the upgrade.

Previous upgrades to major software releases have taken about six months to complete, consuming both IT and business resources with an estimated cost circa \$300K. If AEMO was unable to proceed with its own SWIS demand forecast project, AEMO would be seeking approval to invest these funds in 2018 with Western Power to upgrade the existing forecast system. AEMO is looking to avoid this and instead invest funds in the creation of an upgraded demand forecast model on its own hardware platforms rather than continuing to rely on Western Power.

Some hardware and licensing components will be required to support introduction of a SWIS demand model. However, like the e-terra proposal, AEMO’s aim is to leverage its existing data centre infrastructure on the east coast as much as possible to minimise overall costs (including use of existing test/development components). The data centre costs for the demand forecast component are shown in Table 9 below. While the bulk of this investment will be re-usable for the later introduction of the full reforms to the wholesale energy and ancillary service markets, some components may need to be re-purposed and re-commissioned on higher capacity multi-purpose hardware. This will also require some small-scale interfacing work to be done to ensure new AEMO demand forecasts can be fed into existing WEM market systems (using existing interfacing technology). AEMO intends to leverage its existing enterprise licence with Itron, at no additional cost for the WA component of its Metrix software.

In addition to requiring upgrade funds to be paid to Western Power, a delay to the demand forecast component would also extend the service charges AEMO pays via the Service Agreement for this component. More significantly, there are a number of model improvement activities currently on hold due to difficulties in modifying the forecast model within Western Power, including:

- Introduction of an embedded PV model to the demand forecast.
- Improvement of weather services.



- Introduction of regional forecasts for constraint management.
- Development of statistical high/low forecast models.
- Introduction of additional block loads into the demand forecast model.

These key activities must be progressed, not only for AEMO to continue to meet its obligations as System Management in the SWIS, but also to support constraint management, pre-dispatch planning and reliability planning prior to the implementation of the broader market reforms. The introduction of the SWIS demand forecast model in AEMO's systems will allow AEMO to progress these activities in time for market reform implementation, in line with existing NEM methodologies and standards. Having some agility in the forecasting space will also allow AEMO to respond to emerging constraints more effectively, for example the recent Muja bus-tie transformer issues, or adjusting the forecast model to deal with emerging technologies such as the uptake of embedded photovoltaic (PV).

AEMO recommends that the demand forecasting activities within the original Power System Operations Workstream scope are approved to continue with an in-service date of mid-2018.

Other benefits to this include:

- Helping to reduce the overall service charge back to Western Power and allow AEMO to independently manage forecast data flows to the market. In conjunction with the EMS component above, Western Power has conservatively estimated this to be in the order of \$300K per annum.
- Access to AEMO modelling philosophies and processes that can be applied to the SWIS.
- Allowing work to continue on improving demand forecast accuracy (improving balancing price forecasts).
- Making it possible, when the forecast is available, to introduce interfaces to existing WEM market systems to remove reliance on forecast data feeds from Western Power.

SWIS modelling

The introduction of a SWIS power system model is essential for AEMO to begin establishing internal security management and due diligence processes. AEMO already has the necessary analysis software to support this (Powerfactory – Digsilent), but some additional small scale licences are required to extend the use of this system to new users. This cost is shown in Table 9 below and is requested as part of this adjustment proposal for 2017.

Introduction of a SWIS power system model in 2017 provides the following benefits:

- Supports AEMO constraint modelling staff becoming conversant with the SWIS.
- Supports new AEMO staff becoming conversant with the analysis software.
- Supports AEMO conducting a due diligence process on security related information provided by other stakeholders, (such as Security Limits from Western Power).

Data centre implications – EMS / Forecasting

The data centre costs in Section 2.2 include only the costs associated with support of the new single Perth office and control room. To implement the Emergency Management System (EMS)/forecasting systems, the data centre design needs to have its virtual server environment upgraded. Since this cost only relates to the *Power System Operations – core security management systems* it is presented here.

Additional Virtual Server capacity

The single Perth office will rely on infrastructure that leverages the AEMO management cluster, a set of virtual environments hosting core corporate applications and services. Grid systems controlling the electricity network are more critical and are managed to a much stricter quality and availability standard which AEMO implements through its high availability cluster. All of these types of clusters are managed by AEMO central support staff to consistent standards.

The data centre design includes implementation of a basic high availability cluster, but this is not sized for EMS and will require additional equipment, processing power and storage at the data centre, and



additional professional effort to configure the equipment and services and commission them to the necessary service quality.

Implementation of a basic database service

Implementation of the EMS forecasting modules also requires provisioning of database services. There is insufficient capacity in the existing AEMO production database servers to support this, and AEMO has therefore included the provisioning in the data centre of an Oracle database solution that will support the forecasting systems to the same service levels as existing Western Power systems.

Benefits of this approach

AEMO is able to re-use some existing licences and spare capacity in the NEM systems to reduce the overall cost. In future years it will be necessary to migrate to higher capacity hardware, but this approach allows AEMO to progress while minimising the short-term cost until there is greater certainty on the timeline for broader market reforms.

Equipment and software

Support of Power System Operations requires hardware, licences, and professional services to upgrade the data centre network, compute, and storage equipment. The following table identifies the items required in 2017. Costs are in Table 9 below.

Item	Purpose
Additional compute and storage capacity	Forecasting 1 production server, 1 DR server and 1 pre-production server for Oracle database 1 production server, 1 DR server and 1 pre-production server for the Metrix application
Oracle licences	Relational database software to support the forecasting database. These can be reused/upgraded if necessary to support the Market Systems.
Hardware and software build	The professional effort to configure and install the hardware and software.
Development Environment	The existing AEMO EMS and forecast development environments can accommodate the WA development needs.
Itron licences	We are able to leverage AEMO corporate licensing for the Itron software.
PI	The existing NEM PI cluster can support the WA requirements.
Powerfactory	SWIS Modelling – included in costs described above.



Costs

Table 8 Cost Summary – Power System Operations, Allowable Revenue (\$000)

Power Systems Operations Allowable Revenue (\$000)	Actual to Dec-16	Jan-17 to Jun-17	Jul-17 to Dec-17	Total
Planning	11	2	10	23
Supplies and Services – Travel and Training	174	-	-	174
Program Cost Allocation	301	-	-	301
TOTAL	486	2	10	498

Table 9 Cost Summary – Power System Operations, Forecast Capital Expenditure (\$000)

Power Systems Operations Forecast Capital Expenditure (\$000)	Actual to Dec-16	Jan-17 to Jun-17	Jul-17 to Dec-17	Total
Resources	225	-	-	225
EMS - Resources	-	86	40	126
EMS - PSO Licence Costs	-	10	322	332
WA Demand Forecast - Resources	-	94	193	287
WA Demand Forecast - Datacentre components	-	-	350	350
SWIS Models - Resources	-	12	13	25
SWIS Models - PSO Licence Costs	-	-	34	34
Program Cost Allocation	101	117	156	374
TOTAL	326	319	1,108	1,753

While commencing in 2017, as described above these items are forecast to be in service by mid-2018 and as such additional expenditure will be required in 2018 to complete these. The proposed staged approach allows AEMO to defer some of the more significant hardware and licensing costs until 2018. The estimated costs for completion of the Power System Operations components is \$3.04M, (with approximately \$1.8M of this relating to hardware and license purchases). Ongoing operational costs commencing in 2018 are estimated to be \$788k per year (offset by the reduction in Western Power Service Agreement costs identified above).

Please note that remaining Power Systems Operations costs to complete build and deployment (including all hardware and licencing costs) of the full EMS, forecasting and modelling solutions will be included in a subsequent adjustment proposal.



2.4 Market development

AEMO has worked closely with the PUO since late 2015 and has dedicated resources to support the rule and market solution design activity. This has included providing subject matter input into PUO working groups, drafting instructions, position papers and other various instruments of the regulatory program. AEMO has also regularly engaged stakeholders to update them on these activities and provide technical advice and education.

AEMO considers that these activities fit within the transitional functions (in clause 1.20 of the WEM Rules) to prepare for, and facilitate the implementation of, Wholesale Electricity Market Reform. It is AEMO's intent to continue this supporting activity and maintain the existing critical WAMRP resources dedicated to these tasks. AEMO's work schedule and budget have been developed to ensure that WEM reforms can be implemented in mid-2019, as noted earlier in this adjustment proposal.

The team also intends to integrate this market development activity with the market solution design scope of work. This will ensure a two-way information flow such that draft rules and policy can be tested with solution design for feasibility, and then fed into the requirements and solution design as greater granularity and clarity of final market rules is provided.

The two key components of the market development, being rules design and stakeholder engagement, are further detailed below.

Working with the PUO to support market design and drafting of WEM Rules

As the market and system operator for the SWIS, it is prudent that AEMO provides extensive support to the PUO for its detailed design work. This will include technical advice on the feasibility, efficiency, and costs of proposed designs and the drafting of regulations and rules, to ensure an efficient and fit-for-purpose market design. This is consistent with AEMO's transitional functions under clause 1.20 of the WEM Rules.

AEMO subject matter experts (SMEs) have been supporting the PUO (and other stakeholders) during 2016 to provide information and advice where required to support rule design. The PUO continues to work towards the release of various rule design packages during 2017, with rule drafting to follow each design package. This is to support reforms to the wholesale energy and ancillary service markets, the introduction of a capacity auction and incorporation of constraints into the assignment of Capacity Credits, and to continue changes to institutional arrangements.

It is crucial that AEMO is funded to provide subject matter expertise through the WAMRP to assist the PUO to complete the market design activity. This will help to remove ambiguity in market designs, mitigate the risk of inefficient downstream changes and rework, and support future on-time and under-budget implementation of the reforms.

Supporting the consultation process

AEMO will continue to play a key role in consulting with both the PUO and market participants to provide technical advice and information associated with the new market reforms. AEMO has invested considerable resources in the consultation process thus far, and while consultations have been reduced due to the uncertainties of the reform timeframes, AEMO considers that a core stakeholder relations team should be retained. This is to ensure the momentum that has been built and the strong relationships established with key stakeholders continue during the upcoming period of market design and rules development. This also would support Western Power in the development of limit equations to drive dispatch and planning systems, and provide advanced information to participants on the potential impacts of these constraints on the usual dispatch of their facilities.

This will safeguard the significant efforts to date and make sure they result in tangible outcomes throughout the finalising of the reform policy, design and associated market rules.

The facilitation of these reforms will also require training, awareness and advice for market participants on corresponding market processes in the NEM. The ultimate acceptance of the design and readiness of all parties to embrace and participate in the new market will be crucial to its success. This



consultation and education began in 2016 and it is important that it continues during 2017 to maximise the likelihood of a successful transition to the new market in July 2019.

Costs

There is no Market Development Allowable Revenue component for System Management in this section.

Table 10 Cost Summary – Market Development, Allowable Revenue (\$000)

Market Development (Market Operator)	Actual to Dec-16	Jan-17 to Jun-17	Jul-17 to Dec-17	Jan-18 to Jun-18	Jul-18 to Jun-19	Total
Allowable Revenue (\$000)						
Supplies and Services – Travel and Training	10	-	-	-	-	10
Planning	172	-	-	-	-	172
Program Cost Allocation	297	-	-	-	-	297
TOTAL	479	-	-	-	-	479

Table 11 Cost Summary – Market Development, Forecast Capital Expenditure (\$000)

Market Development (Market Operator & System Management)	Actual to Dec-16	Jan-17 to Jun-17	Jul-17 to Dec-17	Jan-18 to Jun-18	Jul-18 to Jun-19	Total
Forecast Capital Expenditure (\$000)						
Resources	374	358	346	-	-	1,078
Program Cost Allocation	169	42	96	-	-	307
TOTAL	543	400	442	-	-	1,385

2.5 Market solution design

Introduction

One of the key challenges that the WAMRP faced prior to the regulatory delay was the requirement to undertake technical build and test of market solutions simultaneously with finalising rules, policies and business requirements.

The delay to wholesale energy and ancillary service market reforms affords the opportunity to establish and finalise these market rules – effectively the market requirements that will need to be underpinned and supported by technical solutions. It is well understood and accepted that the detailed design, build, test, and deployment of these solutions needs to be well-planned and executed and include initial market trials.

Critically, this activity needs to be based on a strong, stable, agreed, and finalised market design. Once finalised, this design provides the foundation on which a technical solution to support the critical processes and functions therein can be delivered.

To facilitate the go-live of the new markets in July 2019, it is important that these detailed market design and early technical activities advance during the 2017 calendar year. This broadly includes the following work.

Documentation of initial procedures to assist finalising rules and prepare for market system designs

Capturing the key components of the new rules and designs into initial, high level process and procedure documentation has two key benefits:

- It allows AEMO to ‘test’ how these rules might be operationalised in the WEM (including comparison with similar procedures, work instructions and established processes in the NEM) and thus supports the iterative rule development process.
- This documentation can be shared and discussed with the users and beneficiaries of the new market (the participants) to gain their thoughts and views. In many cases, participants engaged in the rule development process will require visibility of market procedures and other subordinate instruments in order to understand and assess the proposed market rules. These procedures will also help participants in their own preparation and market readiness for the eventual new market deployment.

In 2017, AEMO seeks to focus on key procedures that are the most complex and introduce the most changes for stakeholders. Initial planning work would also be conducted around assessing the impact of a Frequency Control Ancillary Services (FCAS) market and quantifying ancillary service constraints.

Business and IT requirements

The link between the rules/regulatory activity above and the conversion of these rules into formal, documented business and technology requirements needs to be extremely tight. Essentially, the business requirements relate to how the WEM needs to operate to be an effective and efficient market, and one that is supported by business procedures and technology. This technology will be fundamentally flawed unless it is designed and built upon a solid foundation of clear, concise, and approved requirements.

Capturing and documenting business requirements to fully encapsulate what is needed for the market participants to conduct business, and converting these into technical specifications, is a very challenging activity. As such, this process should not be rushed, and will involve a number of iterations, review and feedback cycles, and endorsements by key stakeholders.

The legislative delay affords AEMO a more sustainable period to extract, capture, and document these requirements using SMEs in AEMO and from market participants. The WAMRP team will collaborate closely with the PUO and market participants to align business requirements and rule design prior to



commencing the detailed IT solution design and build in 2018 (pending passage of amendments to the WEM Rules for progression of the market reform program).

The documentation of requirements will cover functional and non-functional (such as technical or performance-related) aspects, to confirm the ultimate solution will meet stakeholder needs. While the detailed IT implementation has been deferred, the high-level architecture consideration and design will be undertaken along with the business requirements, such that these two critical components remain aligned through to the implementation phase in 2019.

Program wide management of IT solution prototyping/high-level design activity

The absence of a definitive legislative direction has meant that AEMO needs to be prudent in its approach and investment in supporting the EMR. As a result, while key elements such as the regulatory and stakeholder engagement activities will progress (along with those projects already legislated), any full development and deployment of IT solutions associated with these market reforms will now be deferred until that assurance is provided.

This specifically relates to activities such as detailed design, technical development, system and user testing, detailed training, data loads and cutover to the new technical solutions.

These activities are complex, and form significant financial and resource commitment components of any IT-based solution delivery program. To increase the likelihood of delivery success, analysis needs to be part of the delivery approach. This necessitates undertaking preceding activities such as locking down business requirements, testing conceptual solutions with stakeholders (via prototyping) and conducting preliminary analysis of high-level solution designs against these requirements.

It is for these preliminary activities during the latter part of 2017 that AEMO is seeking funding, to minimise implementation risks and costs and to guarantee a greater quality solution for participants.

A key strategy is undertaking requirements definition, high-level architecture and solution design based on the draft rules and market design. It will mean that, once a definitive direction is provided, the team can seamlessly move into detailed design, build, and test. The broad parameters will have been set, with a strong link to market design and therefore participants will have much greater confidence in the ability of these technical solutions to meet their specific business needs.

Defining these requirements will also enable participants to determine their IT solution requirements enabling them to proceed with investment justification for their IT programs. This will avoid one of the key stakeholder perceptions of AEMO's original AR4 submission, namely that implementation of some aspects (particularly interfaces) of the NEM systems would represent a backward step, and that this should be discussed and worked through with participants to confirm what is the best approach overall for the industry.¹⁶

Specific tasks that will be undertaken include:

- Supporting the development of rules from a technical design / feasibility perspective.
- Developing technical solution requirements to support the design and proof of concept activities.
- Testing feasibility of rules for WEM (proof of concept).
- Supporting engagement and understanding of solution with market participants (via prototyping).
- Completing high-level application and infrastructure architecture design and review based on new rules and market designs.
- Testing suitability of automated test harness for certification, based on WEM Rules and associated requirements.
- Conducting early analysis into aspects of the solution such as reporting and data requirements.

¹⁶ The previous reform timeframes meant AEMO had limited ability to make significant changes to its NEM systems.



Costs

No Allowable Revenue component is requested for Market Solution Design in this adjustment proposal.

Table 12 Cost Summary – Market Solution Design, Forecast Capital Expenditure (\$000)

Market Solution Design (Market Operator & System Management) Forecast Capital Expenditure (\$000)	Actual to Dec-16	Jan-17 to Jun-17	Jul-17 to Dec-17	Jan-18 to Jun-18	Jul-18 to Jun-19	Total
Resources	-	-	1,050	-	-	1,050
Program Cost Allocation	-	-	292	-	-	292
TOTAL	-	-	1,342	-	-	1,342



2.6 Retail market operations

The WA Minister for Energy announced on 30 September 2015¹⁷ that AEMO would assume the role of retail market operator, currently performed by Western Power.

The WA Government previously intended to effect the conferral of retail market operation functions through the *National Electricity (Western Australia) Act 2016*, but this law was not passed prior to the WA Parliament proroguing in January 2017. AEMO now understands that the PUO is investigating alternative mechanisms through which to confer retail market operations on AEMO through modifications to WA legislation and subordinate instruments.

In order to continue to develop the Market Reform design and achieve an integrated, comprehensive market solution in 2019, it is critical that the other WAMRP components outlined in this adjustment proposal continue alongside the Retail activities.

This adjustment proposal relates to the recovery of costs associated with the performance of AEMO's prescribed functions in the WEM Rules, which do not include retail market operation functions. Consequently, no costs associated with retail market operation are included in this adjustment proposal. AEMO has budgeted retail market operator works across 2017 for similar activities to those outlined in this adjustment proposal for the WEM reforms (including market development, IT high-level design, high-level procedures, and development of business requirements).

¹⁷ WA Minister for Energy media release, "Electricity reform gains momentum", 30 September 2015. Available at: <https://www.mediastatements.wa.gov.au/Pages/Barnett/2015/09/Electricity-reform-gains-momentum.aspx>.



3. SUMMARY COSTS

The tables below summarise AEMO’s proposed adjustments to the ERA’s December 2016 determination of AEMO’s Allowable Revenue and Forecast Capital Expenditure. See Appendix E cost tables for more detailed Market Operator / System Management splits.

Allowable Revenue

Table 13 Summary Allowable Revenue

Supplementary AR4 Submission Allowable Revenue (\$000)	Actual to Dec-16	Jan-17 to Jun-17	Jul-17 to Dec-17	Jan-18 to Jun-18	Jul-18 to Jun-19	Total
Wholesale - RCM 3	87	39	91	179	331	727
Data Centre – Market Operator	3	-	82	162	327	574
Market Development	479	-	-	-	-	479
TOTAL MARKET OPERATOR	569	39	173	341	658	1,781
Power System Operations	486	2	10	-	-	498
Data Centre – System Management	3	-	82	162	327	575
TOTAL SYSTEM MANAGEMENT	489	2	92	162	327	1,073
TOTAL	1,058	41	265	503	985	2,854

Forecast Capital Expenditure

Table 14 Summary Forecast Capital Expenditure

Supplementary AR4 Submission Forecast Capital Expenditure (\$000)	Actual to Dec-16	Jan-17 to Jun-17	Jul-17 to Dec-17	Jan-18 to Jun-18	Jul-18 to Jun-19	Total
Wholesale - RCM 3	753	1,869	987	-	-	3,609
RC Auction	-	-	65	-	-	65
Data Centre – Market Operator	96	1,567	58	-	-	1,721
Market Development	543	200	221	-	-	964
Market Design	-	-	671	-	-	671
TOTAL MARKET OPERATOR	1,392	3,636	2,002	-	-	7,030
Power System Operations	326	320	1,107	-	-	1,753
Data Centre – System Management	96	1,567	58	-	-	1,721
Market Development	-	200	221	-	-	421
Market Design	-	-	671	-	-	671
TOTAL SYSTEM MANAGEMENT	422	2,087	2,057	-	-	4,566
TOTAL	1,814	5,723	4,059	-	-	11,596



Indicative Market Fee Impact

The impact of the activities covered by this submission and the impact on fees will be important information for current and future market participants. The following table details the anticipated annual impact on the indicative market fees as a result of the requested expenditure in this adjustment proposal. These are not in addition to the market fees noted within the original AEMO AR4 submission, but are a component of those.

Table 15 Indicative Market Fee Impact

Market Fee (\$/MWh)			
Function	2016-17 (\$)	2017-18 (\$)	2018-19 (\$)
WEM Market Operator	0.016	0.014	0.017
WEM System Management	0.013	0.007	0.009
TOTAL	0.029	0.021	0.026



4. STAKEHOLDER ENGAGEMENT

Engagement continues to be a key focus for AEMO, including working with stakeholders and market participants, both one-on-one and in forums, to support the successful delivery of effective market reform.

AEMO has reviewed the comments made in submissions to the ERA in response to AEMO's September 2016 Allowable Revenue and Forecast Capital Expenditure submission. A number of preliminary meetings have been held with these stakeholders to discuss their concerns regarding possible changes to market participant fees, perceptions of lower standard systems being implemented, efficiencies in future system management operations, and the overarching approach to implement the EMR reforms. Appendix F outlines AEMO's initial understanding of feedback received to date, and our approach and timing to address this.

There is a need to continue targeted engagement with key stakeholders to further explore specific items of importance and work closely with these organisations to achieve a successful market outcome. This has been addressed in the planned works for 2017.

Based on these preliminary discussions, stakeholders have reiterated support for the WAMRP to continue. Stakeholders have advised that the engagement to date has been valuable and are keen to see and understand more about the overall solution design and implementation approach moving forward. Further clarity regarding policy development, design and the development of rules is critical. However, AEMO recognises the need to progress and engage with stakeholders and the PUO on the overarching reform approach.

Participants also recognised that the WAMRP forums may not have been attended by the most appropriate representatives from their individual organisations, most notably in the technology space. It became apparent that the level of understanding, knowledge, and appreciation of the new market design and the impacts from a technology perspective on participants' IT personnel, were below what is needed. As such, they have requested additional meetings, information and potentially forums between the participant IT individuals and the WAMRP IT team members. This will allow constructive and detailed debate and understanding in relation to the market design and supporting IT solutions that will be implemented.

Participants reiterated comments made to the ERA regarding the need for AEMO to ensure its implementation is efficient, and for consultation with participants on IT implementation, particularly the transition to and interfaces with, the NEM type systems. However, as the bulk of the IT detailed design and implementation work is not included in this adjustment proposal, these comments will be addressed as part of AEMO's reform planning and reflected in a future adjustment proposal.

What is included in this adjustment proposal is funding to cover initial solution design, development of integrated prototypes and documentation of detailed business and functional requirements, to support a possible 2019 market go-live date. AEMO will be seeking the endorsement of market participants for this activity and the requisite funding to allow the ERA to make a positive determination in this regard. This aspect of the program will also allow AEMO to support the participants in understanding the impacts of the new market solutions on their existing in-house IT framework, and the scope, timeframes, activities, resources and funding that each will need to successfully integrate with this design. Without this, the ability of participants to be ready for a mid-2019 market go-live date will face significant delivery and financial risks within this timeframe.

During 2017, the workplan outlined in this adjustment proposal will allow for AEMO to engage participants and ensure a full understanding of their views, concerns and priorities in relation to the WAMRP architecture, from a business and technology perspective. To the extent possible, the team will (subject to market solutions design funding) undertake preliminary design, scoping and financial estimation of potential additional solution functionality. This information will then be fed into a subsequent AR4 adjustment proposal to be delivered to the ERA in late 2017.

Further broader stakeholder support for a staged and scaled back approach in 2017 was sought at AEMO's WA Electricity Consultative Forum meeting on 7 February 2017. Stakeholders did not support



AEMO ceasing its existing reform work, or the full ramp up of the WAMRP. There was also a lack of commitment at the forum to AEMO's proposed middle-ground approach, although one-on-one discussions have provided qualified support. Stakeholders are keen to understand the impact on market fees, and that preliminary changes to systems are not superseded by changes in the future, once the rules have been finalised.

AEMO will continue to engage with stakeholders through the WA Electricity Consultative Forum, which will meet bi-monthly throughout 2017 and will continue to hold WAMRP-specific forums.

Meetings will also be held with individual market participants to discuss the approach to the WAMRP, seeking input on its delivery, and identifying efficiencies which can be expected as a result of implementing new systems and processes.

5. POTENTIAL ADDITIONAL COSTS DUE TO DELAY IN MARKET REFORM

The following potential additional risks (and associated costs) have been identified, but no expenditure has been requested within this adjustment proposal. Until the EMR scope and timeframe have been determined, it is unclear whether these additional costs will be incurred. Moreover, AEMO has determined it is unlikely to need any additional funding in 2017 to address these risks.

5.1 Business as usual (BAU)

As a result of the delay in the implementation of the EMR, AEMO needs to reassess the basis on which it has made decisions relative to the BAU budget for the AR4 period.

The following considerations are relevant:

- The original AR4 BAU budget submission was based on the assumption that the reforms to the wholesale energy and ancillary service markets would deliver new market rules and systems by July 2018.
- A risk assessment was made regarding the reliability of System Management applications and infrastructure based on the assumptions of the real-time market implementation occurring on or before July 2018.
- AEMO considered that, although there are known deficiencies in the application and infrastructure of the System Management systems, the risks are acceptable in the short to medium-term prescribed by the EMR timelines, and a ‘best efforts’ approach to the Service Agreement between AEMO and Western Power was adopted to cover ongoing provision of operational systems in the short term. Minimal remediation allowances were included in the original AR4 BAU budget, focusing on mitigation of the highest risks to avoid over-investing in systems that were expected to be decommissioned after the commencement of the new real-time market reforms.
- The deferral of the real-time market implementation timeframe will result in AEMO being exposed to these risks for a longer period of time, which changes the risk profile significantly. Particular examples of this are detailed below:
 - The application architecture/design and integration components of major System Management applications systems are flawed and brittle, and are subject to failure. Coding standards are causing issues and failures are becoming more regular.
 - System Management systems only represent 5% of Western Power’s application architecture, but in December 2016 – January 2017 these systems represented 50% of Western Power’s high priority outages. AEMO has initiated an independent technical review of the System Management applications and integration components, and once complete, will work with Western Power to develop a remediation program to mitigate the issues apparent in the highest priority components. Should this identify a need for work to be undertaken in the remaining AR4 period a further adjustment proposal will incorporate costings for this.
 - Decisions around deferral of investment in current systems have been made on the basis that the WEM will be reformed in some significant way under the EMR process, and it would therefore be inefficient to over-invest in current systems. If the EMR fails to proceed, or is delayed beyond July 2019 it is likely that AEMO will need to revise its estimates for investment in 2018 and 2019 in current BAU systems accordingly. This is likely to include funding to replace legacy systems, relocate functionality from within Western Power datacentres to AEMO data centres over time and funding to increase support capability and longevity.



5.2 WAMRP

Extension of the start date for the real-time market reforms will potentially result in additional costs associated with working through changes to reform scope and timeframe, rolling off existing resources and mobilising new replacements at a future date. Although AEMO has taken a prudent approach and reduced the size and scope of the original program team, the fact that the timeframe has moved by some 12 months creates an environment for potential overall cost increases for the program.

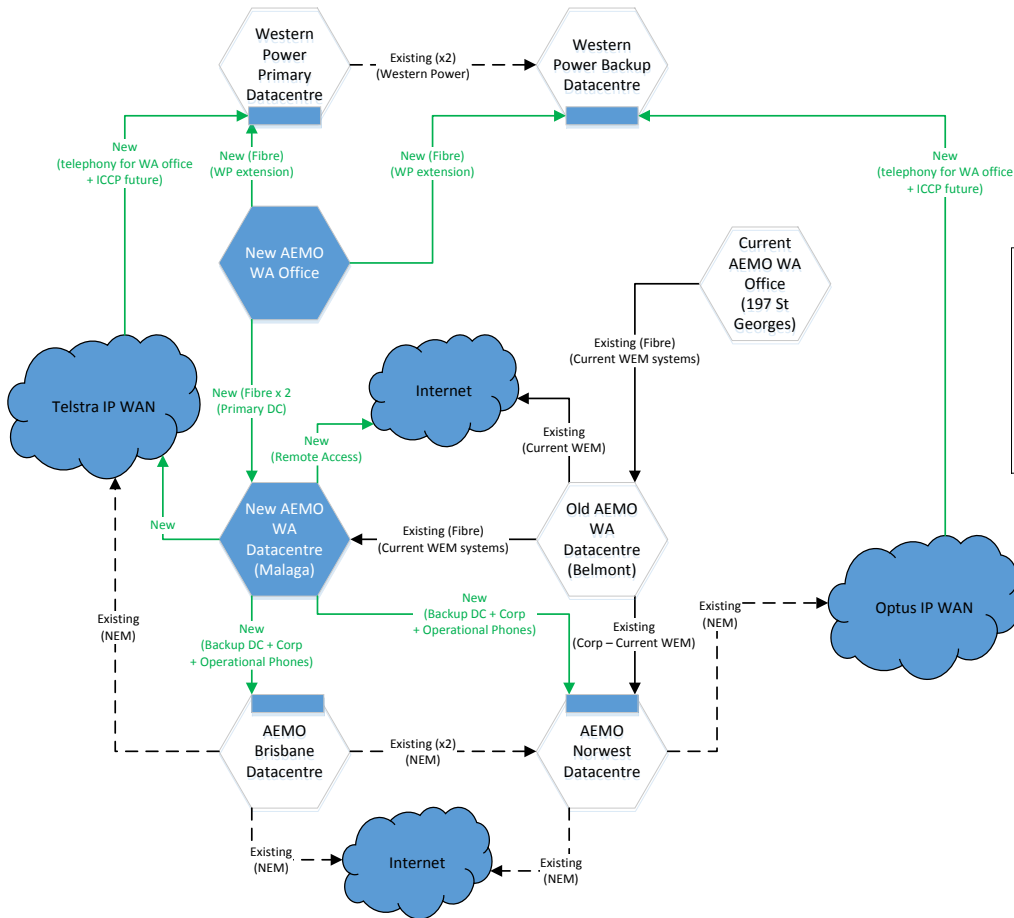
The delay will provide greater opportunity to re-plan the program with a more sustainable activity and resourcing profile and allow the implementation to largely be undertaken after finalisation of the WEM Rules (thus reducing the risk of rework). However, this depends on approval of the market solution design component of this adjustment proposal and, if this is not provided, similar challenges will be faced. The revised workplan and approach described in this adjustment proposal will also allow AEMO to undertake more intensive stakeholder engagement and provide time to incorporate amendments to design and scope based on stakeholder feedback where it can be justified (for example, AEMO notes stakeholders' responses to the ERA's AR4 public consultation, and their preference to retain certain WEM interface capabilities in the new systems).

Reviewing resources (mix, number, and assignment) has been a key planning activity since the 16 December 2016 ERA determination and subsequent feedback. The potential exists, should resources become unavailable, for additional costs and delays to be incurred in sourcing, on-boarding, and training replacement staff and/or external consultants onto the project. The sooner regulatory certainty can be provided, the better AEMO's position to minimise this exposure will be. Although this adjustment proposal and its underlying approach seeks to minimise possible delay to the new market go-live, the delay has contributed to this risk. The IT execution tasks in particular that have been delayed until 2018 could slip further, should there be any unforeseen impacts on the reform schedule or approval of the reform budget. This in turn this creates potential for delays in delivery of the WAMRP to late 2019 (or, to avoid deploying just prior to a summer period¹⁸, potentially to the first half of 2020).

¹⁸ As the reform program will introduce significant changes to all of AEMOs market and system operations, deployment during the higher load summer period would be a high risk implementation.



APPENDIX A. OFFICE MOVE



Current AR4 approved budget (approved as part of 16th Dec 2016 determination):

- \$3.2M over 3 years
- Covers both existing WEM and “new” WEM links

This submission:

- Datacentre component is seeking coverage for provision of hardware [redacted] located at the various datacentres to support communications along “new” links.

APPENDIX B. RESERVE CAPACITY MECHANISM

AEMO's WAMRP includes three phases of changes to the RCM:

- RCM3, comprising works to implement amendments to the WEM Rules that commence on 1 October 2017.
- RCM4, comprising consequential changes to RCM systems and processes that will arise due to the reforms to the wholesale energy and ancillary service markets.
- RC Auction, being the implementation of an auction for the procurement of Reserve Capacity.

This appendix explains the basis of, and distinction between, these three phases.

RCM3

There is a significant excess of capacity in the WEM (23% forecast for the 2016–17 capacity year), which represents a substantial cost to the market. The WA State Government introduced a number of reforms to the RCM during Phase 2 of the EMR, to:

- Increase the responsiveness of the existing RCM to changes in the level of excess capacity.
- Reduce the cost of the excess capacity borne by consumers, and provide stronger signals to the sector for efficient delivery of capacity to the market over the longer term.
- Provide for an auction once the market reaches the earlier of:
 - 2021 (for the 2024-2025 capacity year).
 - Excess capacity reduces to a predetermined level (nominally 5-6%) based on an AEMO forecast.

On 31 May 2016, the Minister for Energy made a number of amendments to the WEM Rules with commencement dates of 1 June 2016, 1 October 2016 and 1 October 2017.¹⁹ AEMO's RCM3 project relates specifically to the implementation of systems and processes associated with the amendments that commence on 1 October 2017.²⁰

The RCM3 reforms are explained in the PUO's *Final Report: Reforms to the Reserve Capacity Mechanism*²¹, and include changes to:

- The calculation of the Reserve Capacity Price in the transitional period prior to the commencement of the proposed new RC Auction.
- Availability and performance requirements for Demand Side Programmes participating in the RCM.
- Performance incentives for capacity providers including a dynamic Reserve Capacity refund regime and revised consideration of facility outages in the certification of Reserve Capacity.

As these amendments to the WEM Rules are already gazetted and will commence on 1 October 2017, AEMO must implement these reforms to comply with the new rules.

The objectives of AEMO's RCM project (RCM3) project are to:

- Ensure AEMO meets its regulatory obligations under the WEM Rules by delivering the required system and procedural changes by 1 October 2017 to remain compliant.
- Be prepared for market reform by developing the changes in a way that minimises rework.
- Ensure internal and external participant education and operational readiness in preparation for 1 October 2017 implementation.

Two options were considered to deliver the system changes to meet AEMO's regulatory obligations by 1 October 2017:

¹⁹ These amendments are detailed in the Government Gazette available at [https://www.slp.wa.gov.au/gazette/gazette.nsf/searchgazette/88678F21CF39740648257FC300220F5A/\\$file/gg089.pdf](https://www.slp.wa.gov.au/gazette/gazette.nsf/searchgazette/88678F21CF39740648257FC300220F5A/$file/gg089.pdf).

²⁰ AEMO has denoted the implementation of the 1 June 2016 and 1 October 2016 amendments as RCM Phase 1 and Phase 2 respectively, which are now complete.

²¹ Available at http://www.finance.wa.gov.au/cms/uploadedFiles/Public_Utility_Office/Electricity_Market_Review/Reforms-to-the-Reserve-Capacity-Mechanism-Final-Report.pdf.



- Option 1: Implement changes within the current WEM system framework, with a view to re-implementing these functions in NEM systems for July 2018 (original implementation date for market reform).
 - This option would have involved modification of existing WEM market systems to cater for the RCM reforms.
 - The RCM functions are tightly coupled with the existing WEM market systems that support broader functions of the WEM. Any changes to the current system will have limited / no reusability when integrating the NEM systems into the WEM, as was originally planned for July 2018.
 - This approach would have required the system changes to support the RCM reforms to be re-implemented in the NEM systems, resulting in significant duplication of cost, effort and risk. AEMO decided not to proceed with this option.
- Option 2: Extract the RCM into a discrete component, with a view to future integration with NEM systems, as was originally planned for July 2018.
 - This option involves the extraction of functionality that supports the revised RCM processes into a standalone module, to reduce the required effort associated with integrating this functionality into the NEM systems.
 - This approach was considered to require greater upfront cost and effort than Option 1, but estimated to result in an overall reduction in cost, effort, and risk due to the reusability of the new RCM module that will be produced as an outcome of this project.
 - This also has the advantage of making changes to systems to improve processes for improved efficiencies, compliance and useability by stakeholders.
 - This option was approved by the AEMO Board, is underway, and is on target for 1 October 2017.

RCM4

The reforms to the wholesale energy and ancillary service markets, published by the PUO in the *Position Paper: Design Recommendations for Wholesale Energy and Ancillary Service Market Reforms*²², will result in consequential changes to the RCM.

These consequential changes include, but are not limited to:

- Consequential effects on RCM capacity certification processes and refund calculations resulting from changes to facility registration classes.
- Revisions to the calculation of Individual Reserve Capacity Requirements resulting from the adoption of the 'settlement by difference' model for wholesale market settlement and the abolition of the Notional Wholesale Meter.
- RCM settlement processes, which will need to change due to the proposed shift to weekly market settlement.

Clause 1.20 of the WEM Rules requires AEMO to prepare for and facilitate the implementation of Wholesale Electricity Market Reform, including the entire reform package set out in the Wholesale Energy and Ancillary Service Report. AEMO's preparatory activities during 2017 will include the provision of support to the PUO for its detailed market design work and rule drafting, documentation of high level process and procedure documentation and the provision of technical advice and education to stakeholders.

²² Available at http://www.finance.wa.gov.au/cms/uploadedFiles/Public_Utility_Office/Electricity_Market_Review/Position-paper-Energy-Market-Operations-and-Processes.pdf. Note that this document is specifically referenced in the WEM Rules using the defined term 'Wholesale Energy and Ancillary Service Report'.



Reserve Capacity Auction

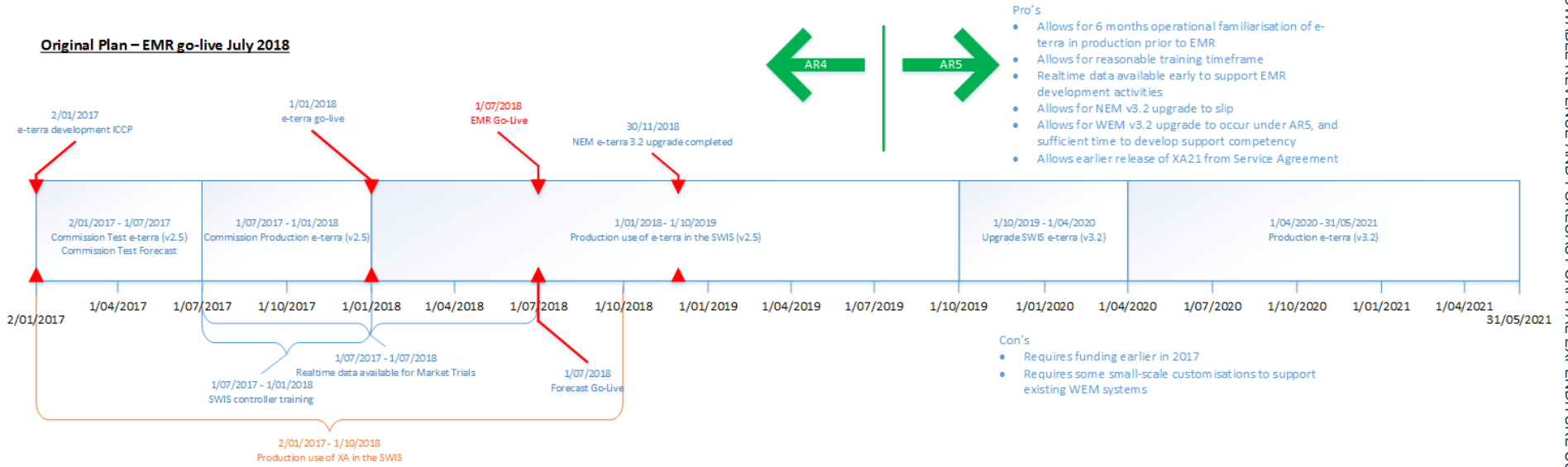
The development of an auction for the procurement of Reserve Capacity was endorsed by the Minister in April 2016, with the amending WEM Rules gazetted on 31 May 2016 including an obligation for the development of such an auction (clause 4.1.33).²³ The PUO is currently developing the design of this auction and is scheduled to draft amendments to the WEM Rules by the end of 2017.

AEMO is assuming that the auction will commence operation in 2019. During 2017, AEMO will:

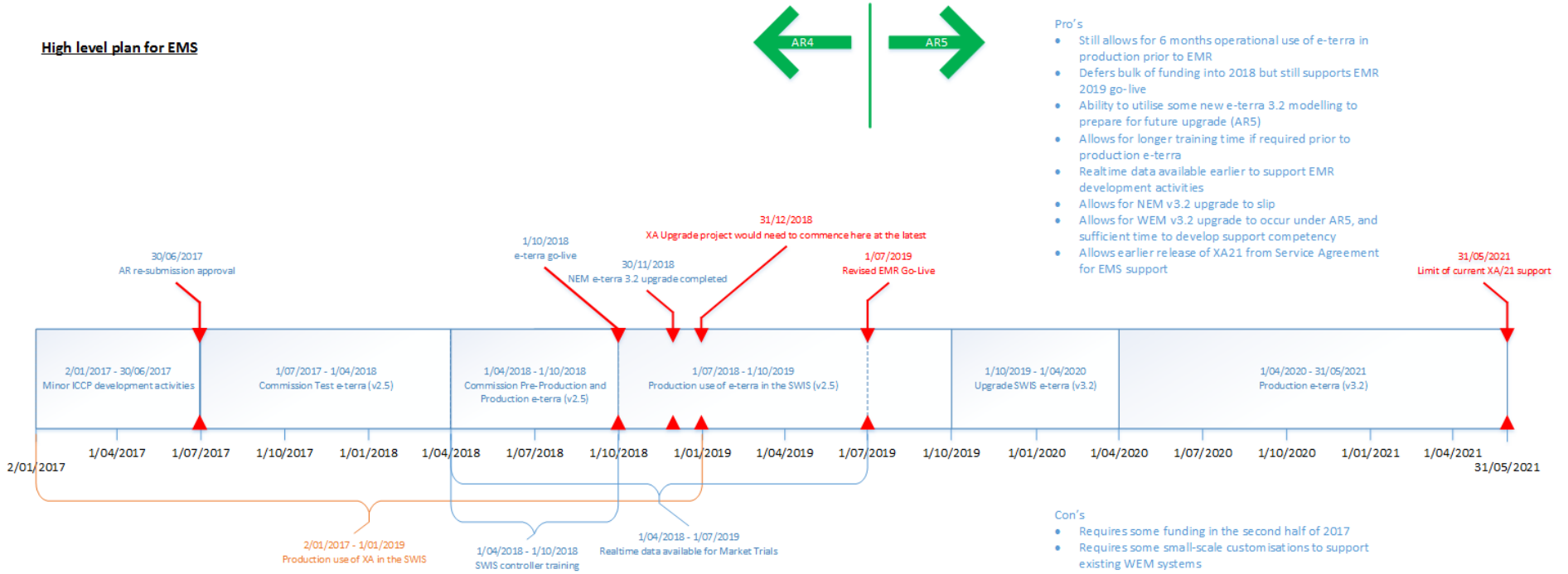
- Provide technical advice to the PUO to support the auction design and rule drafting.
- Prepare submissions to consultation papers released by the PUO.
- Document implementation requirements to support the development of a future AR4 adjustment proposal, finalisation of specific functional and technical requirements and the future transition to the IT execution phase.

²³ See the *Final Report: Reforms to the Reserve Capacity Mechanism* at http://www.finance.wa.gov.au/cms/uploadedFiles/Public_Utility_Office/Electricity_Market_Review/Reforms-to-the-Reserve-Capacity-Mechanism-Final-Report.pdf and the accompanying media statement by the Minister for Energy at <https://www.mediastatements.wa.gov.au/Pages/Barnett/2016/04/Electricity-reforms-ensure-fairer-system-for-all.aspx>.

APPENDIX C. POWER SYSTEM OPERATIONS TIMELINE



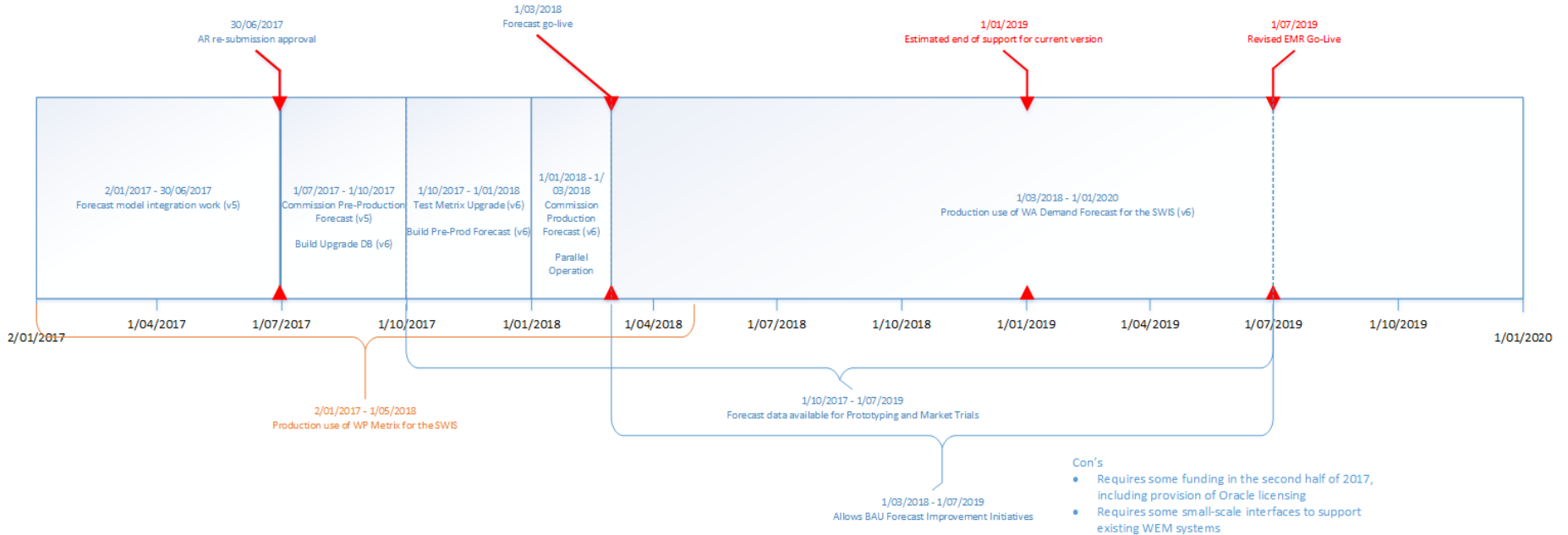
High level plan for EMS



Revised plan for WA Demand Forecast

Pro's

- Utilises existing development environment capability
- Allows work to proceed on moving to supported version of Metrix without impacting EMR date
- Allows BAU forecast improvement initiatives to proceed
- Allows earlier re-release of XA21 from Service Agreement for forecasting support
- Allows sufficient time for new version of Metrix to be stress tested, and bug fixes to be implemented without impacting production



Con's

- Requires some funding in the second half of 2017, including provision of Oracle licensing
- Requires some small-scale interfaces to support existing WEM systems



APPENDIX D. POWER SYSTEM OPERATIONS – KEY SYSTEM LINKAGES

Figure 1 Current operational system arrangements

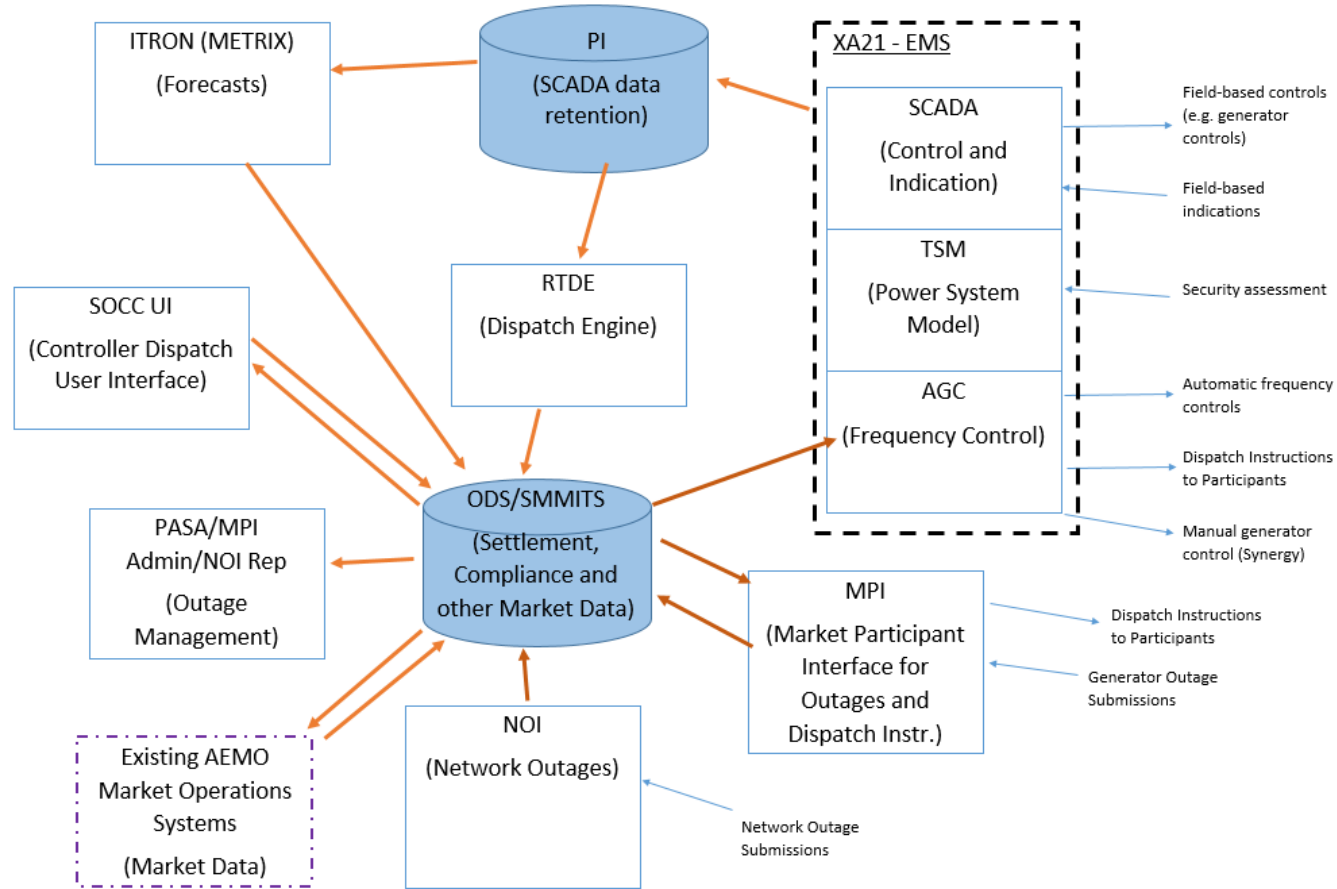


Figure 2 Proposed transitional arrangement (Stage 1A) – introduction of e-terra for the SWIS

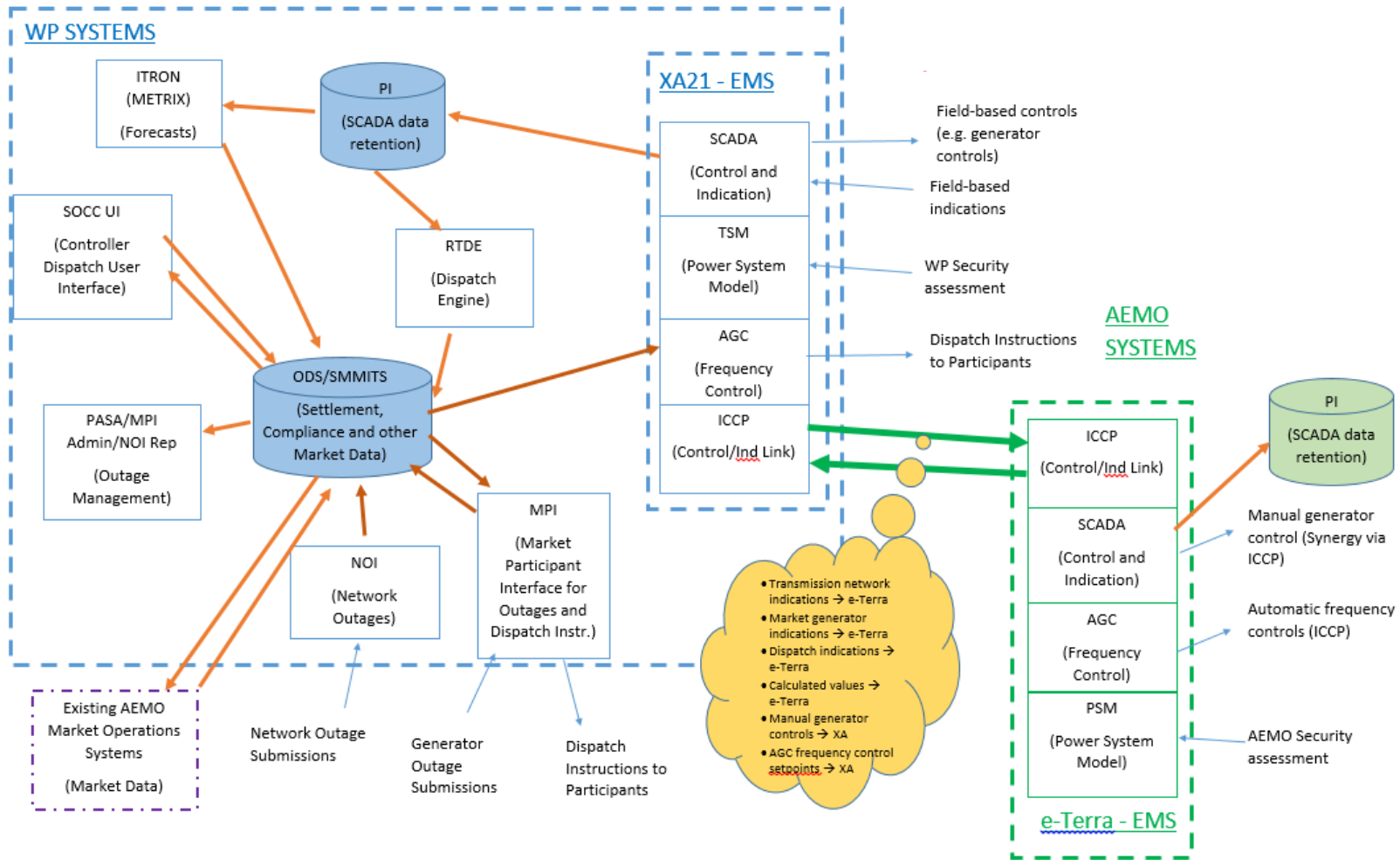


Figure 3 Potential transitional arrangement (Stage 1B) – e-terra taking active control for the SWIS

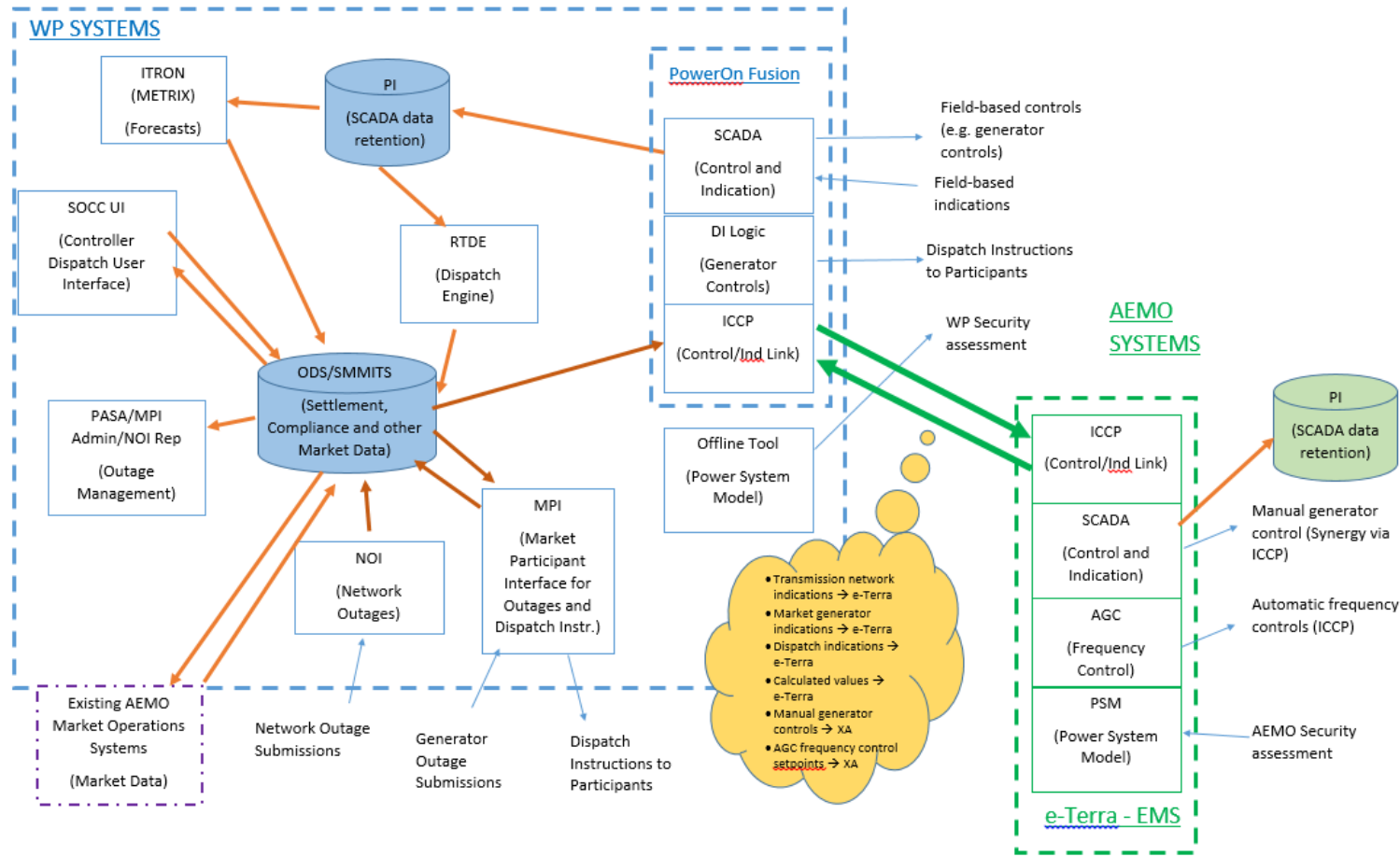
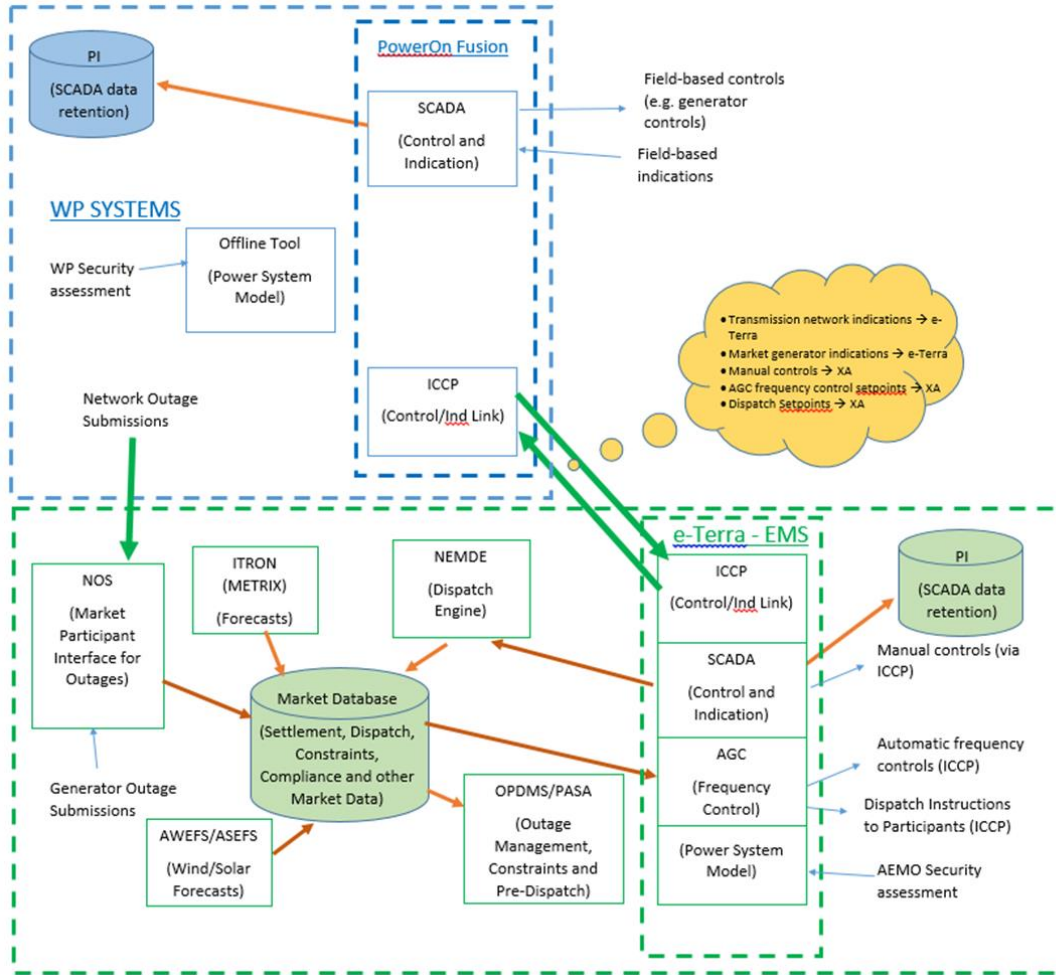


Figure 4 Current thinking for final arrangement (implementation of market reform) – addition of other NEM-style operational systems





APPENDIX E. COST SPLIT - MARKET OPERATIONS AND SYSTEM MANAGEMENT

For Allowable Revenue and Forecast Capital Expenditure costs included as totals in Section 2, the split between WEM Market Operator and WEM System Management is included in the tables below;

Data Centre – Allowable Revenue

Data Centre (Market Operator) Allowable Revenue (\$000)	Actual to Dec-16	Jan-17 to Jun-17	Jul-17 to Dec-17	Jan-18 to Jun-18	Jul-18 to Jun-19	Total
Supplies and Services – Travel and Training	1	-	-	-	-	1
Program Cost Allocation	2	-	-	-	-	2
Depreciation	-	-	82	162	327	572
TOTAL	3	-	82	162	327	575

Data Centre (System Management) Allowable Revenue (\$000)	Actual to Dec-16	Jan-17 to Jun-17	Jul-17 to Dec-17	Jan-18 to Jun-18	Jul-18 to Jun-19	Total
Supplies and Services – Travel and Training	1	-	-	-	-	1
Program Cost Allocation	2	-	-	-	-	2
Depreciation	-	-	82	162	327	572
TOTAL	3	-	82	162	327	575

Data Centre – Forecast Capital Expenditure

Data Centre (Market Operator) Forecast Capital Expenditure (\$000)	Actual to Dec-16	Jan-17 to Jun-17	Jul-17 to Dec-17	Jan-18 to Jun-18	Jul-18 to Jun-19	Total
Resources	66	460	48	-	-	574
Hardware	-	980	-	-	-	980
Program Cost Allocation	30	127	10	-	-	167
TOTAL	96	1,567	58	-	-	1,721

Data Centre (System Management) Forecast Capital Expenditure (\$000)	Actual to Dec-16	Jan-17 to Jun-17	Jul-17 to Dec-17	Jan-18 to Jun-18	Jul-18 to Jun-19	Total
Resources	66	460	48	-	-	574
Hardware	-	980	-	-	-	980
Program Cost Allocation	30	127	10	-	-	167
TOTAL	96	1,567	58	-	-	1,721



Market Development – Forecast Capital Expenditure

Market Development (Market Operator)	Actual to Dec-16	Jan-17 to Jun-17	Jul-17 to Dec-17	Jan-18 to Jun-18	Jul-18 to Jun-19	Total
Forecast Capital Expenditure (\$000)						
Resources	374	179	173	-	-	726
Program Cost Allocation	169	21	48	-	-	238
TOTAL	543	200	221	-	-	964

Market Development (System Management)	Actual to Dec-16	Jan-17 to Jun-17	Jul-17 to Dec-17	Jan-18 to Jun-18	Jul-18 to Jun-19	Total
Forecast Capital Expenditure (\$000)						
Resources	-	179	173	-	-	352
Program Cost Allocation	-	21	48	-	-	69
TOTAL	-	200	221	-	-	421

Market Solution Design – Forecast Capital Expenditure

Market Solution Design (Market Operator)	Actual to Dec-16	Jan-17 to Jun-17	Jul-17 to Dec-17	Jan-18 to Jun-18	Jul-18 to Jun-19	Total
Forecast Capital Expenditure (\$000)						
Resources	-	-	525	-	-	525
Program Cost Allocation	-	-	146	-	-	146
TOTAL	-	-	671	-	-	671

Market Solution Design (System Management)	Actual to Dec-16	Jan-17 to Jun-17	Jul-17 to Dec-17	Jan-18 to Jun-18	Jul-18 to Jun-19	Total
Forecast Capital Expenditure (\$000)						
Resources	-	-	525	-	-	525
Program Cost Allocation	-	-	146	-	-	146
TOTAL	-	-	671	-	-	671



APPENDIX F. STAKEHOLDER FEEDBACK

Feedback	AEMO Viewpoint
<p>AEMO could seek opportunities for a gradual transition of current systems to the NEM</p>	<p>A key justification of the System Management security management systems (EMS and Forecasting) included in this adjustment proposal is to address this issue. Moving off end-of-life SCADA systems (supported by Western Power) and to a current version of AEMO's e-terra system will provide a lower risk/more gradual path to the full solution in 2019.</p> <p>In regard to the wholesale market, a gradual transition may be unworkable, given the integrated nature of the NEM systems and processes.</p> <p>As a component of the Market Solution Design activity during 2017, the team will evaluate opportunities to support an appropriate transition to new solutions, taking advantage of the delayed implementation timeframe of (circa) 2019.</p>
<p>Might be appropriate to maintain some of the WEM's current technology which may be more advanced than NEM</p>	<p>AEMO understands from various stakeholder engagements that these concerns relate to the web services aspect of Market to Business (M2B) transactions. The proposed EMR design does offer a M2B solution for wholesale market data, however, this implementation will differ from what is currently available in the WEM systems.</p> <p>During the early design phase, the team identified a potential issue with B2M transactions in this regard and had in the original scope a web services interface offering for all B2M wholesale transactions. The existing NEM interfaces will remain supported in the EMR deployment to accommodate existing participants who are active in both markets and also the vendor solutions that are available to support market offering activity.</p> <p>AEMO recognises that some participants have constructed applications that rely on AEMO's systems for long term data persistence and at the present time, this does not fit in with the proposed model. The original design philosophy was to maintain the synergies between the NEM and WEM systems in order to preserve the overall value proposition.</p> <p>The market solutions design component of this submission (if approved), will evaluate potential solutions to address these concerns, undertake a high level scoping, design and financial estimation and, if viable, include in a subsequent AR4 adjustment proposal – expected to be submitted in Q3 / Q4 2017.</p>
<p>Many of the NEM systems are reaching end-of-life and will require major upgrades or replacements within the next 2–3 years</p>	<p>No existing AEMO NEM systems are reaching end of life in the next 2–3 years. Of all the related technologies within the realm of the reform program, the oldest pertain to the RCM and STEM market components in the existing WEM. As part of the EMR program (scoped and costed) both these market components are having completely new technical solutions built to meet the particular requirements of the WEM and ensure they can be integrated into the EMR platform. No significant upgrades or replacements of legacy NEM solutions are incorporated into the program architecture design or this adjustment proposal.</p> <p>The EMR deployment for wholesale systems is proposed to use new hardware and current technology operating systems and database. There will be scheduled lifecycle/maintenance work for the EMR infrastructure and platforms within a 3-5 year period to retain an operating posture on supported platforms.</p> <p>In terms of the applications, the NEM system lifecycle is more along the lines of continuous investment rather than periodic replacement. The NEM systems have two scheduled releases per annum where applications are updated in line for business requirements and re-platforming is in general managed on an opportunistic basis (that is, when there is a requirement to make significant changes to an application that was developed in technology that is now aging). There are as at today a limited number of applications within the NEM that have dependencies on dated technologies, but it is likely that any scheduled remediation work to address these will be completed prior to any EMR deployment. The IT costings within the EMR program of work only pertain to any customisation that is required to support the WA market rules where they differ from those in the NEM and the implementation of those applications into the EMR environments. There is no base licence cost associated with the suite of internally developed applications that AEMO is making available to support WA market reform.</p> <p>Post the EMR deployment, one of the underlying principles of efficiency in the architecture framework is that the costs of any upgrades will be spread across all national market participants. This philosophy is advantageous in as much as WEM participants will benefit in the cost apportionment of shared system upgrades and as such save significantly compared to investing in standalone WEM systems.</p> <p>During 2017 the AEMO team will conduct a small number of IT forums that will further explain and reinforce the roadmap and solution framework and ensure ongoing stakeholder engagement and input into the design process.</p>



Feedback	AEMO Viewpoint
<p>AEMO proposal does not provide sufficient information to determine whether expenditure is prudent or efficient, or whether the systems and processes are the most appropriate for WA</p>	<p>AEMO's original AR4 submission in September 2016 referenced supporting documentation which was not published, but was available for ERA information. The WA Market System Proposal was part of this and contained a large amount of information relating to the underlying efficiency philosophy of utilising NEM systems where appropriate for WA (as opposed to developing bespoke WA WEM market systems which would be significantly more expensive in both establishment and ongoing operational costs).</p> <p>Given the guiding principle of leveraging existing NEM market solutions where possible, a comprehensive options analysis exploring specific standalone WA solutions was not undertaken. AEMO included in our original AR4 submission specific international benchmarking information that in our view highlight the benefits of the NEM leverage from both an implementation cost perspective as well as an ongoing support and maintenance viewpoint.</p> <p>The education and awareness sessions planned for market participants in the IT Forums conducted in 2017, will request feedback and, if amendments are desired by participants, then this may be considered in the market solution design activity.</p> <p>Specifically relating to the process concern, this will be addressed more in the overall market design activity led by the PUO and supported by AEMO. As further clarity is obtained early 2017 from the rule and procedure definition, the Market Solution design activity will aim to ensure that the supporting systems will meet these procedures in the most effective and efficient manner possible.</p>
<p>ERA should scrutinise whether the solution (particularly to apply NEM systems to the WEM) will align operation of the WEM with best practice markets, whilst also reducing implementation costs</p>	<p>AEMO agrees that the ERA should scrutinise costs to ensure that they are consistent with those that would be incurred by a prudent provider of the services, acting efficiently, as required by the WEM Rules.</p> <p>The existing AEMO NEM systems have been successfully servicing markets for many years. It is AEMO's view that the solutions will align well to the WEM market requirements. From an implementation perspective AEMO is comfortable that the cost estimates reflect a prudent fiscal approach that balances risks and costs within the timelines laid down by policy makers.</p>
<p>IT architecture change could compromise reliability, requiring participants to make IT investments</p>	<p>Any participant that has chosen to house an on premise IT system as part of the existing WEM will be required to make changes as part of the market reforms. This is a new market with new rules and it will not be possible to transition to the new market without impacting both participant processes and systems.</p> <p>To the fullest extent possible, AEMO will consider and support participants when evaluating all architectural solutions and take a 'whole of market' view rather than just an AEMO implementation perspective. AEMO will also work with individual IT departments and staff, and lend expertise to ensure participant readiness for the new market.</p> <p>To address the reliability concern, it should be noted that the IT architecture designs proposed for EMR are identical to NEM systems. The NEM systems and supporting processes and capability are operationally mature and have a proven track record of reliability in the NEM, which operates at a 99.999% availability level. AEMO will be leveraging all existing capabilities within the NEM to deliver on EMR, so market participants can expect to receive these same service levels for WEM.</p>
<p>Concern in relation to reliability of data links between WA and the East Coast</p>	<p>This is addressed in the Data Centre component of this adjustment proposal and in Appendix A. The data link infrastructure is robust, with dual links, (each having its own redundancy), and other design components to ensure reliability and redundancy, to mitigate latency risks. As an indicator, communications between AEMO east and west coast presences were not lost during the SA black system event on 28 September 2016.</p>



APPENDIX G. GLOSSARY

Term	Definition
AEMO	Australian Energy Market Operator
AGC	Automatic Generation Control
AR4	AEMO's Allowable Revenue 4
BAU	Business as usual
DR	Disaster Recovery
EMR	(Western Australia) Electricity Market Review
EMS	Energy Management System
ERA	Economic Regulation Authority
EPCC	East Perth Control Centre
ICT	Information and Communication Technology
IMO	Independent Market Operator
MWh	megawatt hour
NEM	National Electricity Market
POF	Power-On-Fusion
PSO	Power System Operations
PUO	(Western Australia) Public Utilities Office
PV	Photovoltaic
RC	Reserve Capacity
RCM	Reserve Capacity Mechanism
SCADA	Supervisory Control And Data Acquisition
SM	System Management
SWIS	South West Interconnected System
WAMR	Western Australia Market Reform
WAMRP	Western Australia Market Reform Program
WEM	Wholesale Electricity Market