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# **2016-19 Forecast Capital Expenditure Adjustment Submission to the ERA**

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July 2018

Proposal for an in-period capex adjustment to  
account for new market reform obligations

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# Important notice

## **PURPOSE**

This document seeks approval for an adjustment to AEMO's Forecast Capital Expenditure under clause 2.22A.9 of the Wholesale Electricity Market (WEM) Rules.

## **DISCLAIMER**

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# Executive Summary

AEMO submits this adjustment to Forecast Capital Expenditure for the AR4 period (1 July 2016 to 30 June 2019) under clause 2.22A.9 of the Wholesale Electricity Market Rules (WEM Rules). This capital expenditure (capex) adjustment is required due to recent Ministerial announcements regarding Wholesale Electricity Market (WEM) reforms, and two significant rule changes. The projects associated with the WEM reforms and rule changes drive capex requirements that are more than 10% greater than the AR4 forecast capex amount approved by the ERA to date.

An in-period capex adjustment is requested to provide AEMO certainty that these essential projects will be fully funded. This will enable AEMO to progress projects that are already under way and commence further work during the remainder of the AR4 period to facilitate the State Government's WEM reforms. AEMO estimates an additional \$11.19 million of capex is required to deliver the WEM reform, rule change and associated projects.

Note this proposed adjustment relates to AR4 capex only. No adjustment to allowable revenue or market fees is required for the remainder of the AR4 period. AEMO will not commence recovery of costs from market participants until the beginning of the AR5 period (1 July 2019 to 30 June 2022).

It is also important to note that this capex adjustment submission is a follow up to AEMO's February 2017 AR4 update, which was approved by the ERA in July 2017. The July 2017 ERA determination adjusted revenue and forecast capex to account for several projects AEMO needed to undertake during the AR4 period to support the initial design phase of the previous Government's WEM reforms. These projects were either not included or not approved in the original December 2016 AR4 revenue determination, due to the uncertainty surrounding WEM reforms at the time.

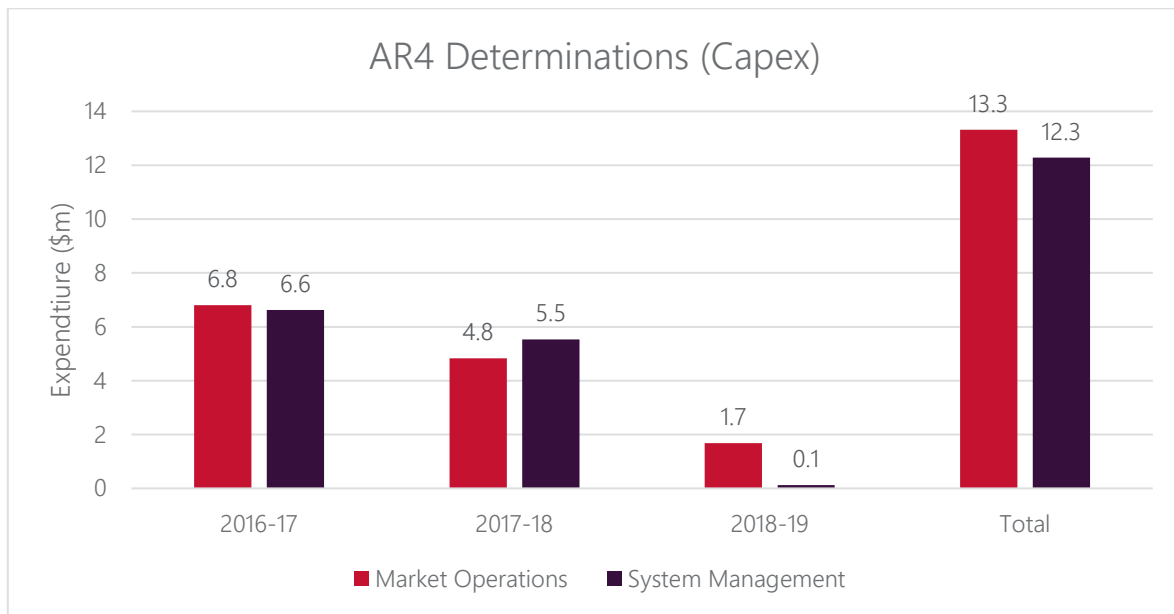
Forecast capex put forward by AEMO in the February 2017 update was limited to that which AEMO considered it would incur regardless of the timing or final detail of the reformed market. It also only covered the period up to the end of December 2017. AEMO did not request expenditure associated with implementing market reforms, instead proposing these costs be deferred until more information about the reforms and the timeframe for their implementation was available. The ERA considered this was a prudent approach<sup>1</sup> and approved AEMO's revenue and capex adjustment in full.

Figure 1 shows the ERA's July 2017 forecast capex determination.

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<sup>1</sup> Para 10, *Application to adjust the Allowable Revenue and Forecast Capital Expenditure for the Australian Energy Market Operator for 2016/17 - 2018/19 - Final Determination*, ERA, July 2017.

Figure 1 Current AR4 determination capex summary (\$ million)



As illustrated in the above chart, the amount of capex approved for 2018-19 is significantly less than in the first two years of the AR4 period.

In the February 2017 update, AEMO signalled it would go back to the ERA with a further in-period adjustment proposal if greater certainty around market reforms was forthcoming. AEMO also highlighted it would require a further in-period adjustment if market reforms were delayed beyond July 2019. This is because AEMO would need to commence previously-deferred work on transitioning its business-as-usual IT systems from Western Power, as well as complete the projects it had already commenced.<sup>2</sup>

Further clarity regarding the timing and design of the proposed WEM reforms has emerged. State Government proposes a constrained network access framework and associated WEM dispatch, security and pricing reforms, which must be in place by October 2022 (the previous Government’s reforms were originally to be implemented by July 2018).

State Government requires AEMO to conduct work to facilitate these reforms and has made WEM Rule changes (specifically to Rule 1.20) that place an obligation on AEMO to do so. The WEM reforms and associated projects will drive costs during the remainder of the AR4 period that are 44% greater than currently approved by the ERA. AEMO therefore requests a forecast capex adjustment to enable it to fund work associated with designing the WEM reforms, as well as complete the transition of several IT systems from Western Power to AEMO so that AEMO will be in a position to deliver future WEM reforms more efficiently.

AEMO seeks a forecast capex increase of \$11.19 million, required to enable AEMO to:

- Commence work on the design and implementation of WEM reforms as directed by the WA Government.
- Complete the Power System Operations (PSO) project, the first phase of which was approved in the February 2017 AR4 update.
- Complete the System Management Systems Transition (SMST) project that achieves IT separation from Western Power in preparation for the WEM reforms.
- Upgrade end-of-life Market Operations IT infrastructure.
- Implement system modifications in response to two recent Rule Changes.<sup>3</sup>

<sup>2</sup> Page 33, *ibid.*

<sup>3</sup> RC\_2017\_06 – Reduction of the prudential exposure in the Reserve Capacity Mechanism and RC\_2018\_01 – New Notional Wholesale Meter manifest error.

AEMO requests the forecast capex associated with these projects be added to the currently approved capex budget to ensure sufficient funding is available for AEMO to deliver these projects and associated market outcomes.

As detailed in the February 2017 AR4 update, the currently-approved forecast includes capex to cover business-as-usual activities until the end of the AR4 period. However, approved capex only includes forecast costs for the PSO project and market reform activities up to December 2017. Both these projects (PSO and market reform) require significant investment during the remainder of the period.

There will be no immediate change in costs to market participants resulting from this AR4 capex adjustment. Market fees for 2018-19 have already been set and will not change mid-year. Any impact resulting from a determination on this proposal will only apply from 2019-20 onwards.

Over the AR4 period, AEMO has recovered 5% less revenue than forecast in the ERA’s July 2017 allowable revenue determination.

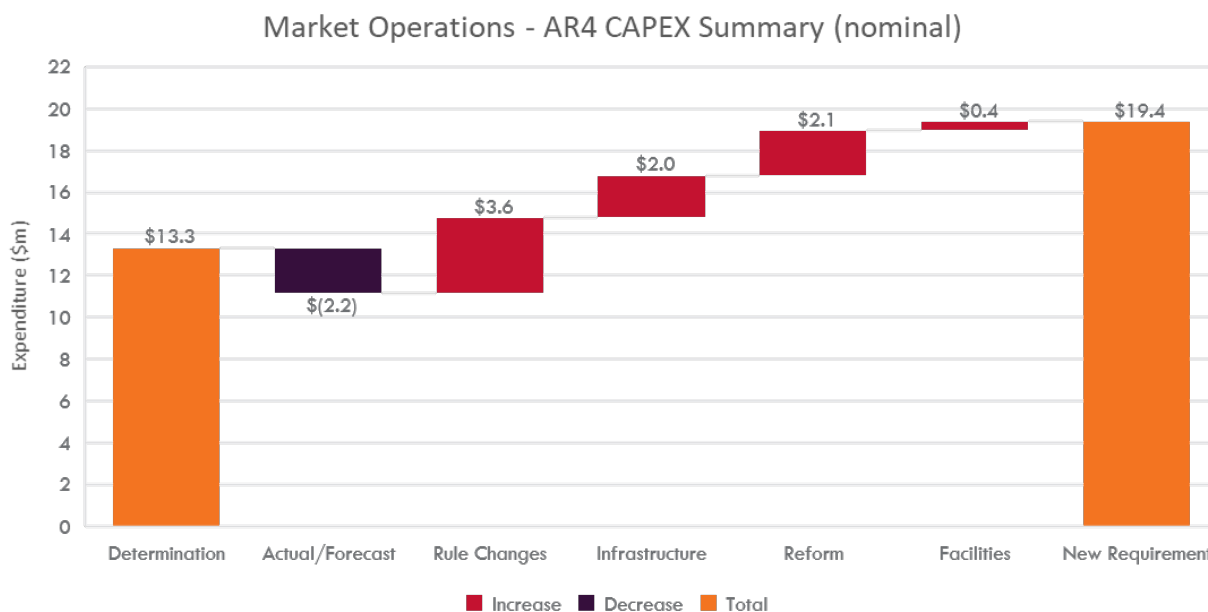
The lower-than-forecast baseline resulting from this 5% saving means the increase required to market fees in 2019-20 to recover the capex adjustment proposed in this submission will be around 12%.

While this is a significant overall increase, the forecast capex proposed is similar to the amounts approved in the first two years of the AR4 period. The estimated 12% increase will establish the new baseline for WEM fees<sup>4</sup>, applying from 2019-20<sup>5</sup>.

The combined 7% net increase (i.e. 5% lower fees actually charged in the AR4 period (i.e. 2016 to 2019) offset by 12% fee impact proposed with this resubmission 2019-20) is lower than CPI benchmark across the 4 years (2016 to 2020).

The following waterfall charts show the forecast capex adjustment required for the AR4 period, split between AEMO’s Market Operations and System Management functions.

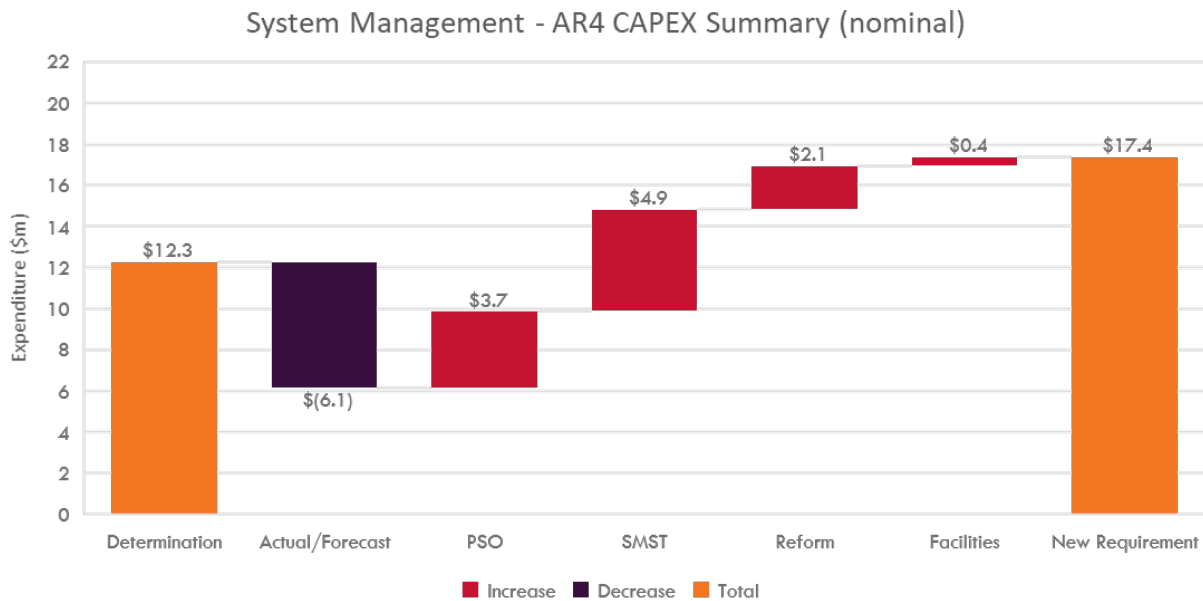
**Figure 2 Market Operations AR4 forecast capex summary (\$ million)**



<sup>4</sup> Combined System Management and Market Operation fees.

<sup>5</sup> Note that the estimated 12% increase will be the revised baseline market fee and does not take into account any adjustments relating to AEMO’s AR5 (2019-20 to 2021-22) proposal, which will be submitted to the ERA in March 2019.

Figure 3 System Management AR4 forecast capex summary (\$ million)



As shown in Figures 2 and 3, the proposed increase in forecast capex (across Market Operations and System Management) is substantially offset by an \$8.30 million under spend against the forecast approved in July 2017. The full capital cost of delivering the above programs is around \$19.47 million, however, a significant portion of this can be funded within the existing budget. This is why AEMO is only proposing a capex adjustment to account for the delta (\$11.19 million).

The lower-than-forecast spend has been achieved by efficient management of budgets to date, only incurring costs that are necessary for business-as-usual activities and deferring investment where prudent to do so (without a deterioration in service).<sup>6</sup> The lower-than-forecast spend was also achieved by initially reducing and ultimately ceasing the previous Government’s reform activity when it became apparent the reforms may not proceed. This approach has enabled AEMO to continue its works program during January to June 2018 (noting that approved forecast capex in the July 2017 AR4 determination only included reform costs up to December 2017 and nominal allowance for rule changes). However, a capex adjustment will be required to enable AEMO to fund the reform and rule change works programs during 2018-19.

A summary of each of the expenditure items shown in Figures 2 and 3 is provided in the following sections.

### WEM reforms

In August 2017, the WA Minister for Energy announced plans to adopt a framework of constrained access to Western Power’s electricity network in the South West Interconnected System (SWIS), with complementary and consequential amendments to the WEM.<sup>7</sup>

The Minister for Energy requested the Public Utilities Office (PUO) to undertake a comprehensive work program to improve the operation of the Wholesale Electricity Market to:

- Enable efficient dispatch of energy and ancillary services, to deliver least cost electricity to customers.

<sup>6</sup> With regard to Market Operations, lower than determined costs have been incurred with the following project areas: WEMS, integration and market development. This has offset higher than determined costs for the office move (from Governor Stirling House to Central Park and the RCM3 project. The net saving is \$2.2 million. With regard to System Management, lower than determined costs have been incurred with software licences and System Management systems. This has offset higher than determined costs for the office move. The net saving is \$6.1 million.

<sup>7</sup> <http://www.treasury.wa.gov.au/Public-Utilities-Office/Industry-reform/Electricity-Sector-Reform-Initiatives/>

- Ensure system security and reliability arrangements are able to accommodate an increasing penetration of renewable energy generators and changes to the profile of electricity consumption.
- Facilitate a more responsive capacity pricing regime, delivering clear signals for the efficient entry and exit of capacity to the market.

These reforms are to be implemented by October 2022.

The WA Government requires AEMO to take a lead role in the design and implementation of the WEM reform, and has gazetted a rule change outlining this obligation.<sup>8</sup> The Minister for Energy has also issued correspondence to AEMO, outlining the activities to be undertaken by AEMO in performing its functions under Rule 1.20. A copy of the 4 July 2018 Ministerial correspondence, which describes AEMO's obligations, is provided in Appendix A.1 of this submission.

Forecast capex for the WEM reform activities during 2018-19 is \$4.28 million, which will be allocated equally between Market Operations and System Management.

### Complete Power System Operations implementation

In its February 2017 AR4 update, AEMO outlined the requirement to commence design and build work on critical IT systems for managing the SWIS, including:

- An energy management system.
- A demand forecasting system to produce short-term demand forecasts.
- A SWIS power system model.

Costs included in the February 2017 AR4 update were to cover the planning, resources ramp-up and early design work necessary during 2016-17 and up to December 2017, to ensure these systems could be in service during 2018-19. Forecast capex for these projects in 2016-17 and up to December 2017 was \$1.75 million.

As highlighted in its February 2017 submission, AEMO requires additional funding to complete this project. Initially AEMO had considered additional capex would be required for all three systems, however, two out of the three projects – SWIS modelling and demand forecasting – have or are very close to delivery within the currently approved allowable revenue amount.

AEMO is only seeking additional funding for the implementation of the energy management system (e-terra). Early design work has been initiated, and the project will enter the design and build phase mid-2018, with a view to being completed by the end of February 2019.

AEMO submits that a further \$3.74 million of forecast capex is required to complete implementation of e-terra. In its February AR4 update, AEMO estimated \$3.04 million was required to complete the Power System Operations components, which is now updated to \$3.74 million in this submission.

### Rule changes

The Rule Change Panel has recently approved two WEM rule changes that require AEMO to carry out significant implementation activities. The changes relate to the reduction of prudential exposure<sup>9</sup> and calculation of the Notional Wholesale Meter<sup>10</sup>.

The reduction of prudential exposure rule change commences on 1 June 2019. In preparation for this, AEMO must make software and code modifications to the Wholesale Electricity Market System (WEMS) and various sub-systems. For example, the WEMS will need to be updated to implement new individual reserve capacity requirement (IRCR) and capacity credit allocation processes, and calculate each market participant's daily prudential exposure.

<sup>8</sup> Clause 1.20.

<sup>9</sup> [https://www.erawa.com.au/rule-change-panel/market-rule-changes/rule-change-rc\\_2017\\_06](https://www.erawa.com.au/rule-change-panel/market-rule-changes/rule-change-rc_2017_06)

<sup>10</sup> [https://www.erawa.com.au/rule-change-panel/market-rule-changes/rule-change-rc\\_2018\\_01](https://www.erawa.com.au/rule-change-panel/market-rule-changes/rule-change-rc_2018_01)

The software changes to the WEMS and its RCM (reserve capacity mechanism) sub-systems will be delivered in two phases:

- Phase 1 – This will deliver the software changes required to implement the reduction of prudential exposure rule change by June 2019. Most of the changes required in Phase 1 will be to AEMO’s WEMS: RCM Operations sub-system and associated interfaces.
- Phase 2 – This will deliver a new WEMS sub-system to improve the responsiveness of the outstanding amount calculation. This project will be included in AEMO’s AR5 submission starting 1 July 2019.

The total cost of implementing the necessary software changes is estimated at \$5.13 million. AEMO forecasts \$3.50 million of this will be incurred during 2018-19 and is included in this AR4 in-period capex adjustment proposal. The remaining expenditure will be incurred during the AR5 period.

The rule change relating to calculation of the Notional Wholesale Meter has a lesser impact on AEMO’s systems. It will require some modifications to the RCM system, IRCR calculation and re-certification. AEMO forecasts these modifications will cost \$0.11 million and will be implemented during 2018-19.

### **System Management systems transition (SMST)**

The delay in market reforms also means it is prudent to proceed with plans to transition legacy System Management IT systems from Western Power to AEMO. When System Management transferred from Western Power to AEMO in 2016, the necessary IT upgrades and development of AEMO in-house systems was deferred on the assumption reforms to the WEM would require new market rules and systems by July 2018. Despite the known deficiencies of Western Power’s System Management applications and infrastructure, the risks associated with maintaining these systems was considered acceptable in the short term.

Given any WEM reforms will now not be in place until October 2022, it is no longer prudent to delay the development of in-house AEMO systems. Rather, it is more efficient to commence the SMST now and complete the technological separation from Western Power so that AEMO has greater control, flexibility and scalability of its systems to accommodate the new market arrangements in four years’ time. The option of bringing systems in house is cost neutral or better than retaining the systems in Western Power.

To ensure an efficient and timely transfer, AEMO proposes that the System Management systems will essentially be replicated by AEMO in-house. The System Management code base will be re-platformed into AEMO infrastructure, and core functionality and database structures will remain the same. This will help minimise potential disruption to market participants.

The overall project cost is estimated at \$5.4 million. Approximately \$4.94 million of this will be incurred during the AR4 period, with the balance being incurred during 2019-20.

It is likely further investment will be required in AEMO’s system management systems during the AR5 period once the WEM reforms have been further refined. Any additional forecast costs will be detailed in AEMO’s AR5 proposal, which will be submitted to the ERA in March 2019.

### **Upgrade end-of-life Market Operations IT infrastructure**

In a similar vein to the SMST project, the delay in WEM reforms has necessitated essential upgrades to Market Operations infrastructure. When AEMO took over responsibility for the WEM from the Independent Market Operator (IMO) in November 2015, it inherited the IMO’s IT infrastructure arrangements, including its lease of data centre space in Malaga.

The Malaga Data Centre hosts the WEMS, the RCM and the Gas Bulletin Board, as well as several test and development systems. The infrastructure within the Malaga Data Centre is nearing the end of its life and is due for refresh and/or replacement during 2018-19.



The infrastructure upgrades were not included in the original AR4 determination due to the potential for IT infrastructure requirements to be further affected by the forthcoming WEM reforms. It was considered prudent to await further clarity around the expected July 2018 reforms to ensure the infrastructure upgrades were fit for purpose.

The WEM reforms have since been deferred to 2022, however, the Market Operations infrastructure in Malaga still needs to be upgraded. Though there is the potential for further infrastructure upgrades arising from the WEM reforms, these will be at least three to four years away and can be accommodated when the next infrastructure life cycle refresh is due in three to four years' time.

AEMO proposes the end-of-life infrastructure be removed from Malaga, and the systems hosted by AEMO's private cloud-based system instead. This will allow several racks within the Malaga Data Centre to be retired by July 2019, reducing the overall data centre costs by around \$0.3 million per year. Making the move to the cloud now also means future cyclical end-of-life upgrades will be able to be delivered more efficiently. AEMO estimates the Malaga Data Centre move will cost \$2.03 million.

AEMO has the resources in place to be able to deliver the infrastructure upgrade quickly, as highlighted by AEMO's July 2018 data centre move from Belmont to Brisbane, which took less than 9 months. Now is the opportune time to undertake this infrastructure upgrade as it will ensure data hosting capacity is in place to support new initiatives such as the SMST and WEM reforms. It would also be advantageous to make this change before key IT resources are deployed on WEM reform implementation.

### New facilities

To undertake the capex projects described in this AR4 proposal, AEMO requires additional resources. During 2018-19 AEMO expects to increase its employee head count by 38, as well as appointing a number of expert consultants to support WEM reforms. AEMO has therefore secured additional office space on the 46<sup>th</sup> floor of Central Park in the Perth CBD. AEMO currently occupies the 45<sup>th</sup> floor of the office tower. The total capital cost for the office fit-out and leasing in 2018-19 is \$0.58 million, while the necessary laptops, phones other end-user equipment will cost \$0.30 million. These costs will be allocated 50:50 between Market Operations and System Management.

## Total costs and impact on market fees

The following tables summarise the revised AR4 forecast capex proposal, which covers investment from December 2017 onwards. The necessary capex adjustment will apply in 2018-19.

As discussed, market fees for 2018-19 have already been set and will not change as a result of this forecast capex adjustment.

**Table 1 Forecast capital expenditure including AEMO proposed adjustment (\$,000 nominal)**

	2016-17	2017-18	2018-19	Total
<b>Market Operations</b>				
Approved (July 2017)	6,807	4,832	1,678	13,317
Actual/Forecast	4,333	5,741	9,306	19,379
Variance	(2,474)	909	7,628	6,062
Proposed adjustment	-	-	-	6,062
<b>System Management</b>				

	2016-17	2017-18	2018-19	Total
Approved (July 2017)	7,337	4,826	120	12,283
Actual/Forecast	2,759	3,472	11,175	17,406
Variance	(4,578)	(1,354)	11,055	5,123
Proposed adjustment	-	-	-	5,123
<b>Total AR4</b>				
Approved (July 2017)	14,144	9,658	1,798	25,600
Actual/Forecast	7,092	9,212	20,481	36,786
Variance	(7,052)	(446)	18,683	11,186
Proposed adjustment	-	-	-	11,186

The following table shows the actual market fees in \$/MWh during 2018-19, and the expected impact on fees during 2019-20 to 2021-22 (the AR5 period).

**Table 2 Estimated impact on baseline market fees during the AR5 period (\$/MWh nominal)**

WEM fee (\$/MWh)	2018-19 (current fee)	2019-20 estimated baseline increase	2020-21 estimated baseline increase	2021-22 estimated baseline increase
Market Operations	0.35	+0.055	+0.055	+0.054
System Management	0.484	+0.047	+0.046	+0.046
Total	0.834	+0.102	+0.101	+0.100
Baseline increase resulting from AR4 adjustment	n/a	+12%	+12%	+12%

It is important to note the increase presented in Table 2 does not include any subsequent adjustments resulting from AEMO's AR5 allowable revenue proposal, which will be submitted to the ERA in March 2019.

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# 1. Introduction

AEMO submits this adjustment to Forecast Capital Expenditure for the AR4 period (1 July 2016 to 30 June 2019) under clause 2.22A.9 of the WEM Rules. This capex adjustment is required due to recent Ministerial announcements regarding WEM reforms and significant WEM Rule changes, which are driving capex requirements that are more than 10% greater than the capex amount approved by the ERA to date.

This submission is supplementary to AEMO's September 2016 initial AR4 proposal and the subsequent February 2017 AR4 update, which was approved by the ERA in July 2017.

AEMO seeks a capex adjustment of \$11.19 million, required to enable AEMO to commence work on the design and implementation of WEM reforms as directed by the WA Government. The capex adjustment is also required to complete the transition of System Management IT systems operations from Western Power to AEMO and replace end of life WEMS equipment. While these projects are justified in their own right, they also support the implementation of the WEM reforms. Finally, the additional capex enables AEMO to fulfil obligations resulting from two recent WEM Rule changes.

This adjustment applies to capex only. No adjustment to allowable revenue or market fees for the remainder of the AR4 period is required. The consequent adjustment on market fees will not apply until the beginning of the AR5 period (1 July 2019 to 30 June 2022).

AEMO estimates market fees will increase in 2019-20 by around 12% above the current level as a result of this AR4 capex adjustment, noting that the current allowable revenue level is 5% lower than forecast in the ERA's July 2017 determination. This will create a new baseline market fee for 2019-20, and does not take into account any adjustments relating to AEMO's AR5 proposal, which will be submitted to the ERA in March 2019.

## 1.1 Background

AEMO submitted its initial AR4 proposal to the ERA in September 2016. The initial proposal included expenditure to implement systems for a new market design arising from the Electricity Market Review (EMR), which had a planned implementation date of 1 July 2018. However, shortly after AEMO's initial AR4 proposal was lodged, it became apparent that the legislation required to enact the previous WA Government's market reforms would not be in place by the planned date. This created considerable uncertainty as to what the likely market reforms and associated costs and timing would look like.

Recognising the need to ensure the costs recovered from market participants are prudent and efficient, AEMO made a further submission to the ERA in December 2016, advising that in light of the uncertainty surrounding the WEM reforms, AEMO had taken measures to flatten its ramp-up of resources and that it would defer committing to significant expenditure on planned IT and market readiness projects. The submission included an estimate of the expenditure AEMO considered it would incur regardless of the timing or final detail of the reformed market.

Following this advice, the ERA approved most of AEMO's revenue and forecast capex associated with business-as-usual activities and the transfer of System Management from Western Power to AEMO. However, the ERA deferred its decision on forecast capex related to market reform until greater clarity on the likely design and timing of the reforms was available.

To manage the uncertainty around market design and to help mitigate the impact of reform costs on market participants, AEMO adopted an incremental approach to developing the future expenditure programs associated with market reform. As part of the approach, AEMO committed to submitting a number of

supplementary proposals to adjust allowable revenue and forecast capex as the requirements and likely timing of the market reforms become clearer. This incremental approach was deemed prudent by the ERA.<sup>11</sup>

In February 2017, AEMO submitted a supplementary AR4 proposal requesting an adjustment to allowable revenue. The February 2017 AR4 update accounted for the fact that despite the delays in the EMR program, the WA Government had made some changes to the WEM Rules that placed obligations on AEMO to undertake work, including the required changes to the RCM. The February update also included a revised estimate of the expenditure that AEMO would need to incur regardless of the timing or final design of the market reforms. Specifically, the February 2017 update sought funding for:

- Completion of components already enacted in WEM Rules.
- Data centre works and communication links required to create the single AEMO Perth office.
- Power system operations core security management systems – design and build work on critical system management IT systems (energy management, forecasting and modelling system) to reduce risk and avoid expenditure on end-of-life systems provided by Western Power.
- Market development activities during 2017, including:
  - 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 activities during 2017 – EMR market solution planning, scoping, initial solution, design, change management, IT, and prototyping of market systems to ensure that an integrated reform solution could go live in 2019.

The February 2017 AR4 update was based on the latest information available at the time, and only included an estimate of expenditure **up to December 2017**. AEMO signalled its intent to submit a further AR4 update when the direction and timing of WEM reforms is available:

**“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.”<sup>12</sup>**

AEMO also highlighted that its original plan to defer IT infrastructure upgrades and transition of several System Management IT systems until after the outcomes of the EMR are implemented, would likely need to change if WEM reforms were delayed even further:

**“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.”<sup>13</sup>**

Finally, AEMO signalled the need for a future capex adjustment to enable it to complete the proposed changes to the power system operations energy management, forecasting and modelling systems:

**“While commencing in 2017,... [energy management systems, forecasting and modelling] ...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).”<sup>14</sup>**

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<sup>11</sup> Para 139, *Application to adjust the Allowable Revenue and Forecast Capital Expenditure for the Australian Energy Market Operator for 2016/17 - 2018/19 – Final Determination*, ERA, July 2017.

<sup>12</sup> Page 3, *2016–19 Allowable Revenue and Forecast Capital Expenditure Submission to the Economic Regulation Authority*, AEMO, and February 2017.

<sup>13</sup> Page 33, *ibid.*

<sup>14</sup> Page 22, *ibid.*

The ERA approved AEMO’s February 2017 proposal, and acknowledged AEMO’s intent to provide a further AR4 submission regarding forecast expenditure in 2018-19. The ERA’s updated (and current) allowable revenue and forecast capex determinations for the AR4 period are set out in the following tables.

**Table 3 Approved allowable revenue – as per July 2017 AR4 determination (\$,000 nominal)**

	2016-17	2017-18	2018-19	Total
Market Operations	16,224	13,826	14,213	44,264
System Management	17,156	17,344	14,855	49,386
<b>Total</b>	<b>33,380</b>	<b>31,170</b>	<b>29,098</b>	<b>93,650</b>

**Table 4 Approved forecast capital expenditure – as per July 2017 AR4 determination (\$,000 nominal)**

	2016-17	2017-18	2018-19	Total
Market Operations	6,807	4,832	1,678	13,317
System Management	7,337	4,826	120	12,283
<b>Total</b>	<b>14,144</b>	<b>9,658</b>	<b>1,798</b>	<b>25,600</b>

## 1.2 Current situation

As anticipated in the February 2017 AR4 update, further clarity regarding the timing and design of the proposed WEM reforms has emerged. In August 2017, the WA Minister for Energy announced plans to adopt a framework of constrained access to Western Power’s electricity network in the South West Interconnected System (SWIS), with complementary and consequential amendments to the WEM.<sup>15</sup>

The Minister for Energy requested the PUO to undertake a comprehensive work program to improve the operation of the Wholesale Electricity Market to:

- Enable efficient dispatch of energy and ancillary services, to deliver least cost electricity to customers
- Ensure system security and reliability arrangements are able to accommodate an increasing penetration of renewable energy generators and changes to the profile of electricity consumption
- Facilitate a more responsive capacity pricing regime, delivering clear signals for the efficient entry and exit of capacity to the market.

These reforms are to be implemented by October 2022.

The WA Government requires AEMO to take a lead role in the design and implementation of the WEM reform, and has gazetted a rule change outlining this obligation.<sup>16</sup> During 2018-19, AEMO will work with the PUO to refine the WEM and constrained access reform plan, develop new market arrangements, finalise the market design, and develop the necessary technical solutions.

The delay in market reforms also means it is prudent for AEMO to proceed with plans to replace legacy System Management IT systems. When System Management transferred from Western Power to AEMO in 2016, the necessary IT upgrades and development of AEMO in-house systems was deferred on the assumption reforms to the WEM would require new market rules and systems by July 2018. Despite the known deficiencies of Western Power’s System Management applications and infrastructure, the risks associated with maintaining these systems was considered acceptable in the short term.

<sup>15</sup> <http://www.treasury.wa.gov.au/Public-Utilities-Office/Industry-reform/Electricity-Sector-Reform-Initiatives/>

<sup>16</sup> Clause 1.2.0

Given any WEM reforms will now not be in place until October 2022, it is no longer prudent to delay the development of in-house AEMO systems. Rather, it is more efficient to commence the System Management systems transition now and complete the technological separation from Western Power so AEMO has greater control, flexibility and scalability of its systems to accommodate new market arrangements in four years' time.

Similarly, the delay in WEM reforms necessitates upgrades to end-of-life IT infrastructure. This includes consolidating locally-hosted systems into AEMO's private cloud, which will reduce ongoing operating costs and provide greater system market operation security.

In addition to the progress on WEM reforms, the Rule Change Panel has recently approved a number of WEM rule changes (relating to the reduction of prudential exposure<sup>17</sup> and calculation of the Notional Wholesale Meter<sup>18</sup>), which require AEMO to carry out significant implementation activities.

All these developments - the WEM reforms, the rule changes and the IT system upgrades/transitions - require AEMO to undertake significant investment during the remainder of the AR4 period. The February 2017 AR4 update only included forecast reform related costs up to the end of December 2017 over what was previously approved for general business-as-usual capex in December 2016. No amounts to fund these new obligations are included in the currently-approved allowable revenue.

AEMO has managed its budget prudently to date and as a result some of the work has already commenced within approved revenue limits. However, a forecast capex adjustment is required so that AEMO can recover the full costs associated with these market beneficial projects, achieve compliance with the delivery of WEM Rule changes and enable it to progress the WEM reforms during 2018-19 as required by State Government.

As such, this supplementary AR4 proposal details the forecast capex necessary to fund these critical projects. AEMO submits this in-period forecast capex adjustment for approval by the ERA subject to clause 2.22A.9 and 1.20 of the WEM Rules.

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<sup>17</sup> [https://www.erawa.com.au/rule-change-panel/market-rule-changes/rule-change-rc\\_2017\\_06](https://www.erawa.com.au/rule-change-panel/market-rule-changes/rule-change-rc_2017_06)

<sup>18</sup> [https://www.erawa.com.au/rule-change-panel/market-rule-changes/rule-change-rc\\_2018\\_01](https://www.erawa.com.au/rule-change-panel/market-rule-changes/rule-change-rc_2018_01)



## 2. Supporting detail

AEMO seeks a forecast capex adjustment of \$11.19 million, required to enable it to:

- Commence work on the design and implementation of WEM reforms as directed by the WA Government.
- Complete the Power System Operations project, which was approved in the February 2017 AR4 update.
- Complete IT separation from Western Power in preparation for the WEM reforms.
- Upgrade end-of-life Market Operations IT infrastructure.
- Implement system modifications in response to two recent Rule Changes.<sup>19</sup>
- Provide facilities for the personnel required to undertake the above works.

AEMO requests the forecast capex associated with these projects is added to the currently approved capex budget to ensure sufficient funding is available for AEMO to deliver these projects and associated market outcomes. As detailed in the February 2017 AR4 update, the currently-approved capex forecast only includes reform related costs up to December 2017 while the above projects require significant investment during the remainder of the AR4 period.

There will be no immediate change in costs to market participants as a result of this AR4 capex adjustment. Market fees for 2018-19 have already been set and will not be adjusted in-period to account for any increase in capex. The impact of any capex adjustment will result in a new baseline level of market fees, which will apply from 2019-20 onwards.

AEMO estimates the impact on market fees will be a 12% increase to the current (2018-19) fees, applying from 2019-20 onwards.<sup>20</sup> While 12% is a significant increase, it is important to note that it is an increase to a current baseline some 5% lower than forecast in the ERA's allowable revenue determination.

Over the AR4 period, AEMO has recovered 5% less revenue than forecast. Taking into account the annual market fee adjustments in 2016-17 and 2017-18, and the revenue forecast for 2018-19, this 12% increase that reflects the capex resubmission offsets the 5% saving, to a net increase of 7%. The combined 7% net increase is lower than CPI benchmark across the 4 years (2016 to 2020).

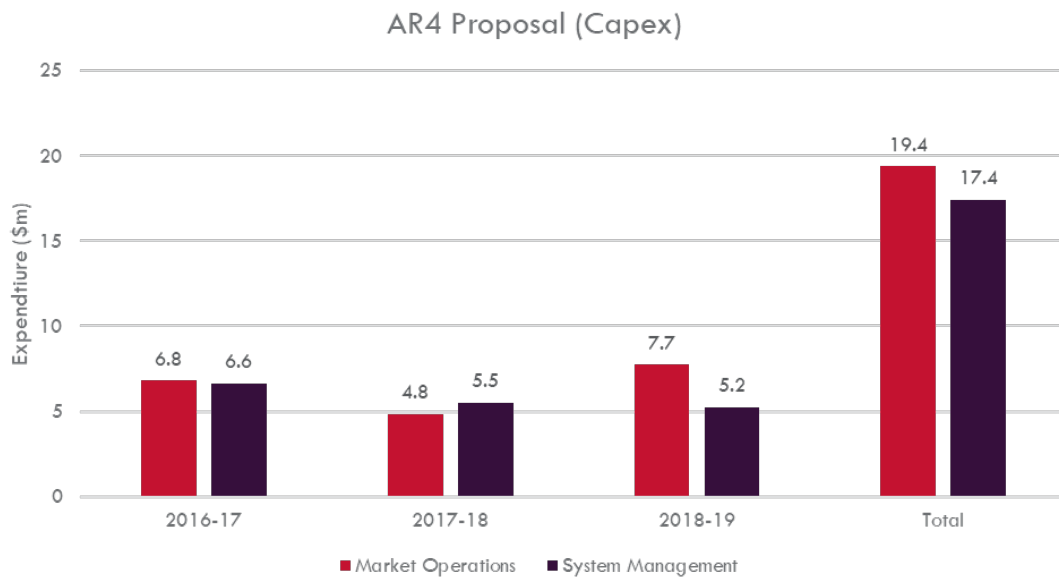
The forecast capex proposed for 2018-19 is also similar to that approved in the first two years of the AR4 period (see Figure 4).

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<sup>19</sup> RC\_2017\_06 and RC\_2018\_01.

<sup>20</sup> Note that the estimated 12% increase will be the revised baseline market fee and does not take into account any adjustments relating to AEMO's AR5 (2019-20 to 2021-22) proposal, which will be submitted to the ERA in March 2019.

Figure 4 Revised AR4 capex forecast (\$ million)



Capex will be recovered through the depreciation and amortisation of the assets created by the above projects in a manner that is consistent with generally accepted accounting principles.

Forecast capex is allocated to AEMO’s Market Operations and System Management functions. The rule change responses and infrastructure upgrades are Market Operations projects, while the PSO and SMST are System Management costs. The forecast costs associated with WEM reform and new office facilities are split equally across both functions, as these projects will require significant input by (and deliver benefits to) both areas of the organisation.

The following waterfall charts show the forecast capex adjustment required for the AR4 period, split between AEMO’s Market Operations and System Management functions.

Figure 5 Market Operations AR4 forecast capex summary (\$ million)

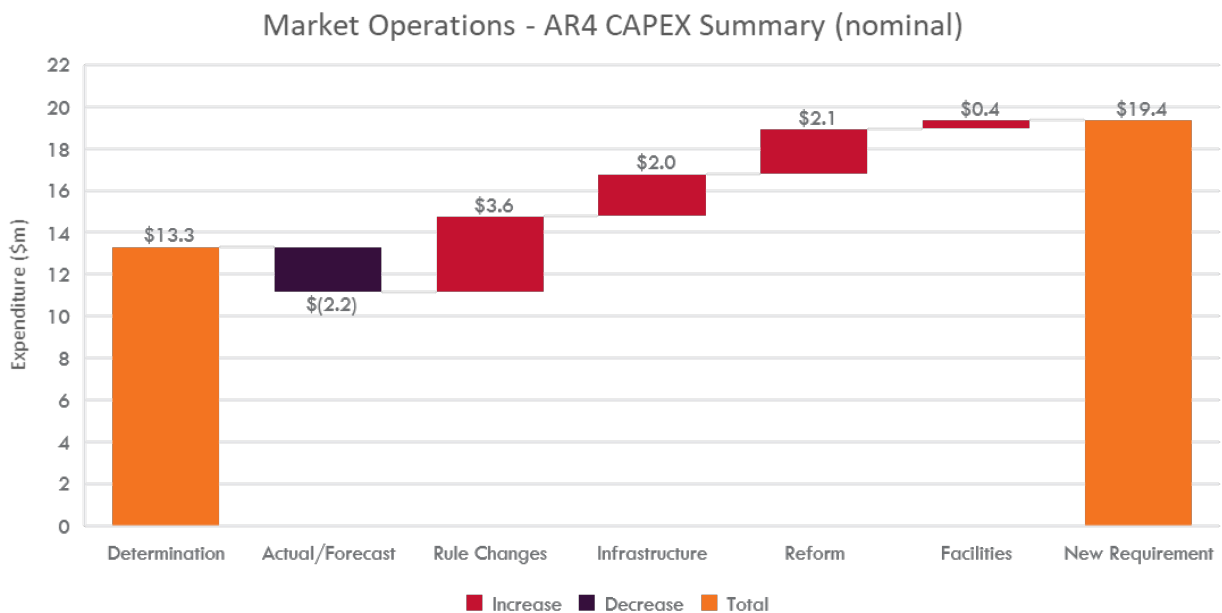
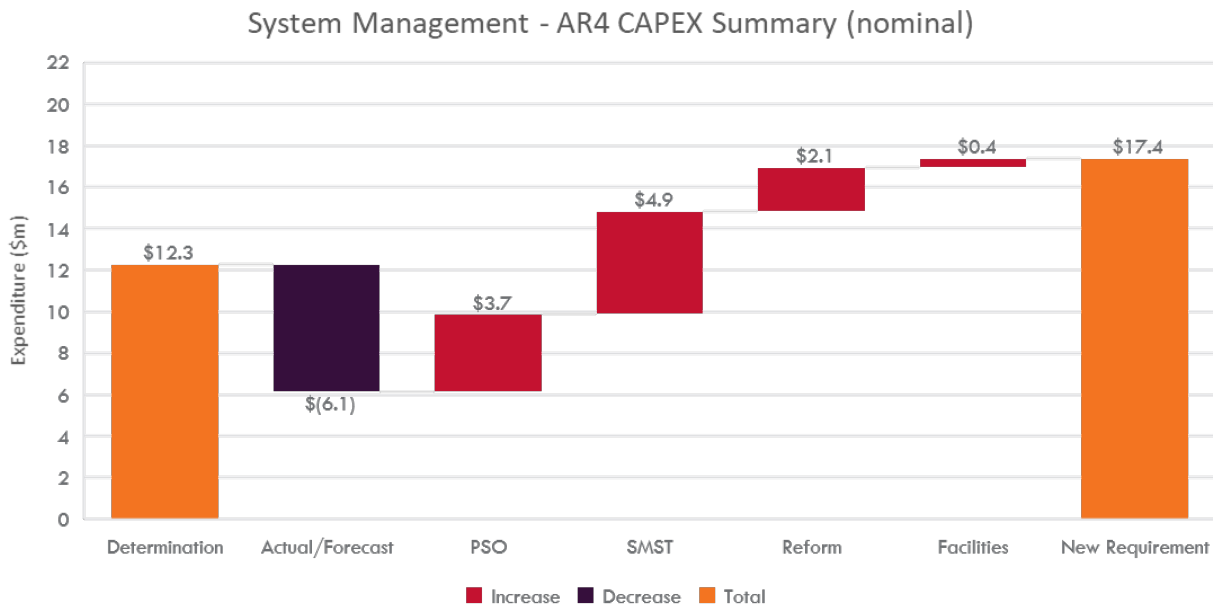


Figure 6 System Management AR4 forecast capex summary (\$ million)



As shown in the above charts, the proposed increase in forecast capex (across Market Operations and System Management) is substantially offset by an \$8.30 million underspend against the forecast approved in July 2017. The full capital cost of progressing the work program over the AR4 period is \$19.47 million, however a significant portion of this can be funded within the existing budget, which is why AEMO is only proposing an adjustment to account for the delta (\$11.19 million).

The lower-than-forecast spend has been achieved by efficient management of budgets to date, only incurring costs that are necessary for business-as-usual activities and deferring investment where prudent to do so (without a deterioration in service).<sup>21</sup> The lower-than-forecast spend was also achieved by initially reducing and ultimately ceasing the previous Government’s reform activity when it became apparent the reforms may not proceed. This approach has enabled AEMO to continue its works program during January-June 2018 (noting that approved forecast capex in the July 2017 AR4 determination only included reform costs up to December 2017 and nominal allowance for rule changes). However, a capex adjustment will be required to enable AEMO to fund the works programs detailed above during 2018-19.

Each of the capex projects are driven by recent external changes. In most cases, the catalyst for requiring this expenditure in 2018-19 is the WA Government’s announcement that WEM reforms will be in place by October 2022. The 2022 timeframe has since been ratified by a recent amendment to WEM Rule 1.20<sup>22</sup>, which places an obligation on AEMO to facilitate the WEM reforms and places an obligation on the ERA to make a determination on expenditure associated with the reform package.

The reform target date either places direct obligations on AEMO to undertake work, or provides clarity on the required life of existing IT systems in order to make decisions on extension, refurbishment or replacement.

The \$3.6 million of capex labelled ‘Rule Changes’ in Figure 5 is required to implement the Rule Change Panel’s recent changes to WEM Rules relating to reduction of prudential exposure and the Notional Wholesale Meter.

Further information on the expenditure items shown in Figures 4 and 5 is provided in the following sections.

<sup>21</sup> With regard to Market Operations, lower than determined costs have been incurred with the following project areas: WEMS, integration and market development. This has offset higher than determined costs for the office move (from Governor Stirling House to Central Park and the RCM3 project. The net saving is \$2.2 million. With regard to System Management, lower than determined costs have been incurred with software licences and System Management systems. This has offset higher than determined costs for the office move. The net saving is \$6.1 million.

<sup>22</sup> Current Wholesale Electricity Market Rules 29 June 2018.

## 2.1 WEM reforms

Since the August 2017 Ministerial announcement regarding the WA energy sector reforms, AEMO has been providing support to the PUO on the scope, potential approach and design of the necessary WEM changes.

The PUO held a series of consultations with stakeholders during 2018, and is planning to accelerate this program of work.

In June 2018, the WA Government amended WEM Rule 1.20, requiring AEMO to prepare for and facilitate the implementation of WEM reforms. The revised Rule 1.20 is presented below.

### 1.20. Transitional function of preparing for Wholesale Electricity Market and Constrained Network Access Reform

1.20.1. The WEM Regulations provide for the Market Rules to confer additional functions on AEMO. Until 1 October 2022, the following additional functions are conferred on AEMO —

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

1.20.2. Without limiting AEMO's discretion in performing its functions, AEMO may undertake any of the following activities in carrying out the function conferred on it under clause 1.20.1 —

- (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 and Constrained Network Access Reform;
- (b) designing, developing, and consulting about, changes to the legislative regime applying to the Wholesale Electricity Market (including the Electricity Industry Act, the Regulations and these Market Rules) to accommodate Wholesale Electricity Market and Constrained Network Access Reform; and
- (c) project management, governance, planning, change management and stakeholder management activities to facilitate implementation of Wholesale Electricity Market and Constrained Network Access Reform.

1.20.3. 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 Periods from 1 July 2016 to 1 July 2019 and 1 July 2019 to 1 July 2022, the Economic Regulation Authority must determine them on the basis that Wholesale Electricity Market and Constrained Network Access Reform will be implemented before 1 October 2022.

1.20.4. For the purposes of clause 2.22A any activity performed by AEMO in carrying out its functions under this clause 1.20 is deemed to be provision of a service described in clause 2.22A.1.

1.20.5. For the Review Period from 1 July 2019 to 1 July 2022 —

- (a) AEMO is not required to submit its proposal for Allowable Revenue and Forecast Capital Expenditure for that Review Period until 15 March 2019; and
- (b) the Economic Regulation Authority is not required to determine AEMO's Allowable Revenue and Forecast Capital Expenditure for that Review Period until 14 June 2019.

The Minister for Energy has also issued correspondence to AEMO, outlining the activities to be undertaken by AEMO in performing its functions under Rule 1.20. A copy of the 4 July 2018 Ministerial correspondence, which describes AEMO's obligations, is provided in Appendix A.1 of this submission.

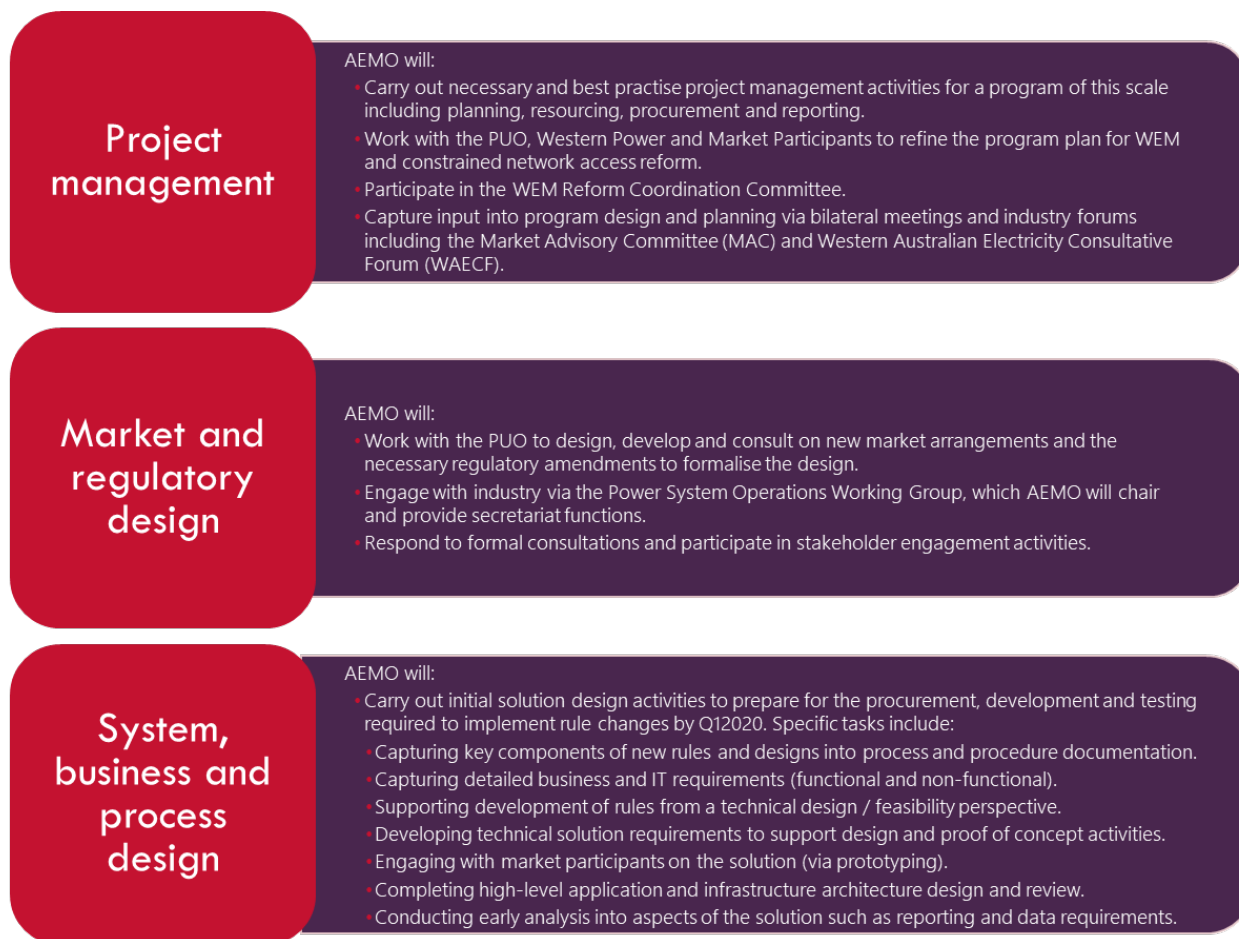
The WA Government has set several key milestones that will drive AEMO's reform activities during 2018-19. Milestones include:

- Legislative amendments for constrained network access to be made by the end of 2018.
- First tranche of WEM Rule changes and associated regulatory amendments to commence mid-2018 and be in place by early 2020
- Implementation of new systems and processes for first tranche of rule and regulatory changes by Q1 2020.

A copy of the PUO's Wholesale Electricity Market Reform Work Program time line<sup>23</sup> is provided in Appendix A.2 of this submission.

Figure 7 summarises the activities AEMO will undertake during 2018-19 to facilitate achievement of these milestones.

**Figure 7 Summary of AEMO WEM reform activities**



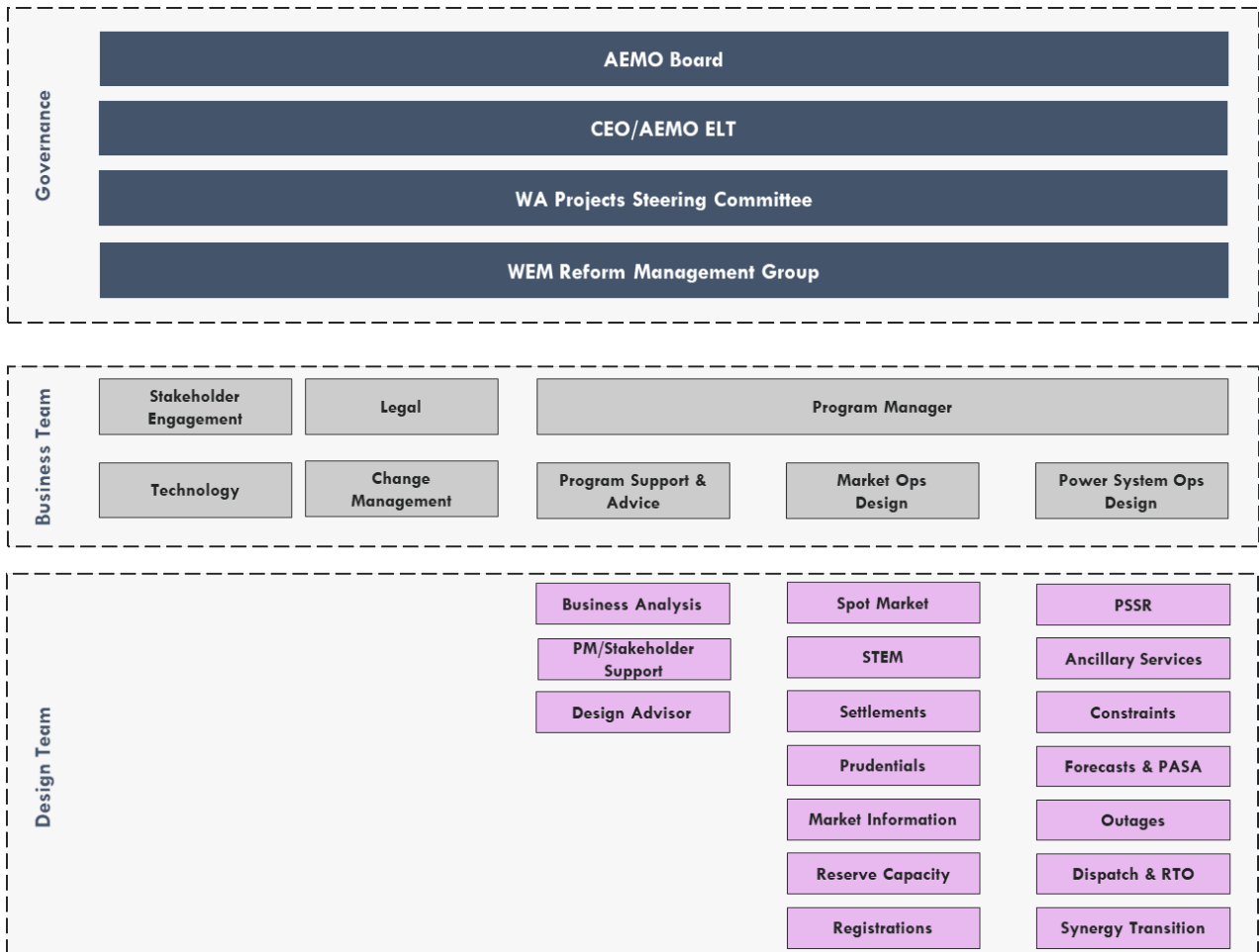
As highlighted in AEMO's previous AR4 submissions, following the delay to the EMR, AEMO took measures to reduce its market reform resourcing until the nature of the WEM reforms (and required resourcing levels)

<sup>23</sup> [http://www.treasury.wa.gov.au/uploadedFiles/Site-content/Public\\_Utility\\_Office/Industry\\_reform/WEM-reform-May-2018.pdf](http://www.treasury.wa.gov.au/uploadedFiles/Site-content/Public_Utility_Office/Industry_reform/WEM-reform-May-2018.pdf)

became more certain. AEMO therefore does not currently have the resources in place to accelerate the WEM reform program as required during 2018-19.

Given the timing and likely workload associated with the reforms has been clarified, it is prudent for AEMO to secure the necessary expertise and resources to facilitate the WEM reforms as soon as possible. AEMO has identified the skills and resources it requires and is confident it can ramp-up its delivery capability quickly. The proposed WEM reform program structure is shown in Figure 8.

**Figure 8 Proposed WEM Reform AEMO governance structure**



Resources will comprise a mixture of AEMO internal labour and external consultants, including technical, legal, IT and regulatory expertise.

### 2.1.1 Summary of AR4 capex adjustment for WEM reform activities

Forecast capex for the WEM reform activities during 2018-19 is \$4.28 million, which will be allocated 50:50 between Market Operations and System Management. Table 5 shows the breakdown of forecast costs and the impact on baseline market fees in 2019-20.

**Table 5 Summary of AR4 capex adjustment for WEM reforms and impact on market fees (\$,000 nominal)**

Market Operations and System Management forecast capex adjustment	Forecast
Resources	4,277
Total	4,277
Impact on baseline WEM fees during 2019-20	+3%

## 2.2 Rule changes

In November 2016 an independent Rule Change Panel was established to undertake the administration and decision-making functions for changes to the WEM Rules and the Gas Services Information Rules. The Rule Change Panel commenced its rule-making functions on 3 April 2017.

Since this time, the Rule Change Panel (and its Secretariat) has reinvigorated the rule change review process and has approved several rule changes. Two recent rule changes require AEMO to incur expenditure to give effect to the new rules:

- RC\_2017\_06 – Reduction of the prudential exposure in the Reserve Capacity Mechanism.
- RC\_2018\_01 – New Notional Wholesale Meter manifest error.

These rule changes and the resulting forecast capex requirements are discussed in the following sections.

### 2.2.1 Reduction of prudential exposure

The Rule Change Panel has amended the WEM Rules to mitigate a prudential risk in the WEM relating to market customers' IRCR obligations.

Prior to the rule change, the credit support held for any market customer with an IRCR, was unlikely to be sufficient to cover all prospective amounts owed to AEMO in the event of a default under section 9.23 of the WEM Rules. In that situation, the defaulting market customer's liability would be recovered from all other non-defaulting market participants.

In May 2018, the Rule Change Panel approved changes to:

- Reduce the period of time an IRCR liability is held by three months.
- Amend the capacity credit allocation process, to allow allocations to be made by market generators and accepted by market customers prior to the market customer incurring the IRCR liability.

The commencement date for these changes is 1 June 2019.

To give effect to the Rule Change Panel's decision, AEMO must make software and code modifications to the WEMS and various sub-systems. For example, the WEMS will need to be able to calculate each market participant's daily prudential exposure. This value will be used to monitor trading activities and ensure participants remain within their limits. The IRCR calculation will also need to be modified and recertified.

The software changes to the WEMS and its sub-systems will be delivered in two phases:

- Phase 1 – This will deliver the software changes required to implement the reduction of prudential exposure rule change by June 2019. Most of the changes required in Phase 1 will be to AEMO's WEMS: RCM Operations sub-system and associated interfaces.
- Phase 2 – This will deliver a new WEMS sub-system to improve the responsiveness of the outstanding amount calculation. This project will be included in AEMO's AR5 submission starting 1 July 2019.

The total cost of implementing the necessary software changes is estimated at \$5.13 million. AEMO forecasts \$3.50 million of this will be incurred in Phase 1 during 2018-19 and is included in this AR4 in-period capex adjustment proposal. The remaining expenditure will be incurred in Phase 2 during the AR5 period.

AEMO has conducted a competitive tender process for this project to ensure the forecast costs are equal to the costs that would be incurred by a prudent provider acting efficiently and seeking to achieve the lowest practicable and sustainable cost of delivering the services. A preferred vendor has been identified and AEMO expects the 2018-19 scope of work will be delivered in full during the AR4 period.

### 2.2.2 Notional Wholesale Meter manifest error

The Rule Change Panel has amended the WEM Rules to correct a manifest error in the method for annually setting and making monthly adjustments to the IRCR. Prior to the rule change, the method did not fully

account for growth in non-interval meters. The calculation of non-interval meter growth has been amended to address this.

The rule change RC\_2018\_01, has a commencement date of 1 September 2018 and will apply to the first IRCR set for the new capacity year commencing 1 October 2018. AEMO must make software and code modifications to the WEMS and various sub-systems.

The impact on AEMO of this rule change is relatively minor, however, it will require some modifications to the RCM system. This includes modification to the database, UI, IRCR calculation, and re-certification. AEMO forecasts these modifications will cost \$0.11 million, and will be implemented during 2018-19.

A competitive tendering process has been conducted to ensure the required changes are implemented for the lowest sustainable cost. AEMO has engaged a vendor to implement the scope of work expected to be delivered prior to the rule change commencement date.

### 2.2.3 Summary of AR4 capex adjustment for rule changes

Capex on both rule changes is allocated to Market Operations only. Table 6 shows the breakdown of forecast costs and the impact on baseline market fees in 2019-20.

**Table 6 Summary of AR4 capex adjustment for rule changes and impact on market fees (\$,000 nominal)**

Market Operations forecast capex adjustment	Forecast
<b>RC_2017_06 – Reduction of the prudential exposure in the reserve capacity mechanism</b>	
Resources	3,500
<b>RC_2018_01 – New Notional Wholesale Meter manifest error</b>	
Resources	112
<b>Total</b>	<b>3,612</b>
<b>Impact on baseline Market Operations fees during 2019-20</b>	<b>3%</b>

## 2.3 Complete Power System Operations implementation

In its February 2017 AR4 update, AEMO outlined the requirement to commence design and build work on critical IT systems for managing the SWIS. The projects included development of the following systems:

- An energy management system.
- A demand forecasting system to produce short-term demand forecasts.
- A SWIS power system model.

Costs included in the February 2017 AR4 update were to cover the planning, resources ramp-up and early design work necessary during 2016-17 and up to December 2017 to ensure these critical systems could be placed in service during 2018-19. Forecast capex for these projects in 2016-17 and up to December 2017 was \$1.75 million.

AEMO highlighted in its February 2017 submission that additional capex of approximately \$3.04 million would be required to complete the build and deployment of these systems during the second half of the AR4 period (January 2018 to June 2020).<sup>24</sup>

The ERA approved the proposed forecast capex and allowable revenue adjustment, noting that these new systems are necessary for AEMO to be able to undertake its SWIS obligations in a cost effective manner, and

<sup>24</sup> Page 22, 2016–19 Allowable Revenue and Forecast Capital Expenditure Submission to the Economic Regulation Authority, AEMO, February 2017.



that the proposed costs were reasonable. The ERA also noted that the remaining costs to complete the 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.<sup>25</sup>

AEMO has made considerable progress on the PSO project. Initially AEMO had considered additional capex would be required for all three systems, however two out of the three projects have been or will be delivered within the currently-approved allowable revenue amount.

The SWIS modelling system (Powerfactory) has been implemented and has been rolled out to WA users. The demand forecasting system, which is based on the Metrix system used in the NEM, is in the final stages of an upgrade and implementation, having successfully tested conversion of the database from Oracle to SQL.

Both of these projects have been progressed or delivered efficiently and within the budgets forecast in the February 2017 AR4 update. This included executing an opportunity to convert the database from oracle to SQL. As a result, no further funding is being requested for these two PSO projects in this submission.

AEMO is only seeking additional funding for the implementation of the energy management system. Design work has been initiated, and the project will enter the build phase mid-2018, with a view to being completed by the end of February 2019.

AEMO submits that a further \$3.74 million of forecast capex is required to complete implementation of the energy management system.

Further information on the energy management system is provided below.

### 2.3.1 Energy management system

AEMO currently relies on Western Power's energy management system, XA/21. The XA/21 system is used for:

- Dispatch of Synergy plant.
- Automatic generation control 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.

AEMO must discontinue using the XA/21 platform for the following reasons:

- XA/21 cannot interface with many of AEMO's dispatch and planning systems, so it will need to be replaced before any market reforms that rely on AEMO's generator dispatch systems are implemented.
- The existing systems will be reaching end-of-life by 2019 and therefore the maintenance costs are likely to increase.
- Western Power intends to stop using XA/21 so any maintenance or upgrade costs would be fully allocated to AEMO.

As accepted by the ERA and its technical consultant Geoff Brown and Associates (GBA) in the ERA's July 2017 determination, AEMO intends to replace the XA/21 system with the GE e-terra EMS platform it uses in the NEM.

In the ERA's July 2017 determination, GBA notes:

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<sup>25</sup> Para 78, *Application to adjust the Allowable Revenue and Forecast Capital Expenditure for the Australian Energy Market Operator for 2016/17 - 2018/19 – Final Determination*, ERA, July 2017.

**“AEMO’s use of the same software platforms that it currently uses in the eastern states, will result in savings in licensing and development costs. These savings are significant. For example, an indicative cost for upgrading Western Power’s existing XA/21 energy management system is \$6-8 million whereas the capital cost through to implementation of the replacement e-terra platform proposed by AEMO, is forecast to be \$3.21 million (excluding overheads).”<sup>26</sup>**

Early works on the e-terra transition have been completed, and the necessary data link between AEMO and Western Power is in the final build and testing stage.

AEMO forecasts an additional \$3.74 million to implement e-terra. These costs will cover the following activities:

- Migration from Western Power’s XA/21-based system to AEMO’s e-terra based system
- Transformation of the SWIS network model, design of displays and development of an inter-control centre communications protocol between AEMO and Western Power.
- Connection to AEMO’s existing PI cluster for historical data retention.
- Building a dispatcher training simulator environment for WA controllers.
- Storage and retention of network model saved cases for offline use.
- Test, pre-production and production environments.
- Building disaster recovery capability.

The \$3.74 million required capex adjustment is approximately \$0.7 million more than the high-level estimate provided in the February 2017 AR4 update. This is a result of an increase in hardware costs (\$0.46 million) and an increase in resourcing costs (\$0.24 million). The higher hardware costs are due to additional capacity required for dedicated production, test and development systems which was identified through the detailed design phase of the project. The higher resourcing costs are due to an extension of the project timeline as a result of difficulties in resourcing the very specialist skillset required. The complexity of the project also means external resources are required to implement the system, which has also contributed to the higher forecast costs. These additional requirements were only determined after detailed design was completed. However, AEMO has been able to offset this increase to some extent with a reduction in internal IT costs for this project.

AEMO has now secured the resources to deliver the e-terra solution, and submits that the full migration to e-terra will be completed during 2018-19, subject to approval of this allowable revenue adjustment by the ERA. The total cost remains less than the alternative option that was outlined in the February 2017 AR4 update.

### 2.3.2 Summary of AR4 capex adjustment for PSO completion

Capex on all three PSO projects is allocated to System Management only. Table 7 shows the breakdown of forecast costs associated with completing the PSO and the impact on baseline market fees in 2019-20.

**Table 7 Summary of AR4 capex adjustment for completing the PSO projects and impact on market fees (\$,000 nominal)**

System Management forecast capex adjustment	Forecast
Resources	1,620
Hardware	1,420
Software	680
Other	20
<b>Total</b>	<b>3,740</b>

<sup>26</sup> Para 88, *ibid.*

System Management forecast capex adjustment	Forecast
Impact on baseline System Management fees during 2019-20	4%

## 2.4 System Management systems transition

Western Power's System Management function transferred from Western Power to AEMO in October 2016. As part of the transfer, a service agreement was set up between AEMO and Western Power to enable AEMO to use the existing System Management IT systems so AEMO can continue to perform all functions within the WEM Rules until it could establish IT systems of its own. Key functions provided by the Western Power IT systems include:

- Dispatch.
- Outage management.
- Planning and forecasting.
- Data provision and reporting.

At the time of the System Management transfer, the then WA Government's EMR was ongoing. The proposed EMR reforms were expected to deliver new market rules and systems by July 2018.

Given the market reforms would likely require new IT systems to be developed, AEMO took the prudent approach of retaining Western Power's System Management IT systems in the short term, with a view to implementing new fit-for-purpose systems when the new market design was known. Although there are known deficiencies in the Western Power systems, it was considered that any risks could be sufficiently managed over the 20 month period that the systems were expected to remain in place.

However, the delays in the EMR, coupled with the fact WEM reforms are now not scheduled to be in place until October 2022, means it is no longer prudent to delay the development of AEMO's in-house systems for a further four years. The current services agreement with Western Power expires on 30 September 2018 with a six-month extension clause to the end of March 2019. Extending significantly beyond March 2019 would require considerable investment in these IT systems as they are approaching end of life and end of usability, and the service charges to AEMO would need to be re-negotiated.

AEMO therefore proposes to move all remaining System Management IT functionality from Western Power to AEMO by late 2019. Undertaking this work now enables AEMO to become independent from Western Power's IT function and build knowledge of the systems within its own IT function. This means AEMO will have greater control over its critical IT systems, as well as being better placed to modify and enhance these systems to accommodate WEM reforms when they are implemented in 2022 (and beyond).

A further advantage of AEMO taking control of the System Management IT system now, is that if there are any delays in the WEM reform program, AEMO will be able to manage and assess the impacts to systems itself rather than continue to rely on (and pay for) IT services from Western Power.

The total cost of ownership of bring these systems in-house to AEMO, rather than retaining systems within Western Power, assuming their acceptance to continue to provide these services, has been estimated as at least cost neutral or better by progressing with the preferred option.

To ensure an efficient and timely transfer, AEMO proposes that the System Management IT systems will be replicated by AEMO in-house. The System Management IT systems code base will be re-platformed into AEMO infrastructure, and core functionality and database structures will remain the same. This will help minimise potential disruption to market participants.

At this early stage the SMST will essentially be a 'copy and paste' of the existing System Management IT systems. Where feasible, the critical deficiencies identified with the current system will be addressed. While there are significant additional improvements that can be made to the systems, however, AEMO considers it to be prudent to wait until the market reforms are bedded down before investing in further substantial

changes. This approach will give opportunity for AEMO to better understand how the systems can be enhanced, as well as testing requirements with market participants and allow time for more detailed understanding of IT system requirements for the WEM reform.

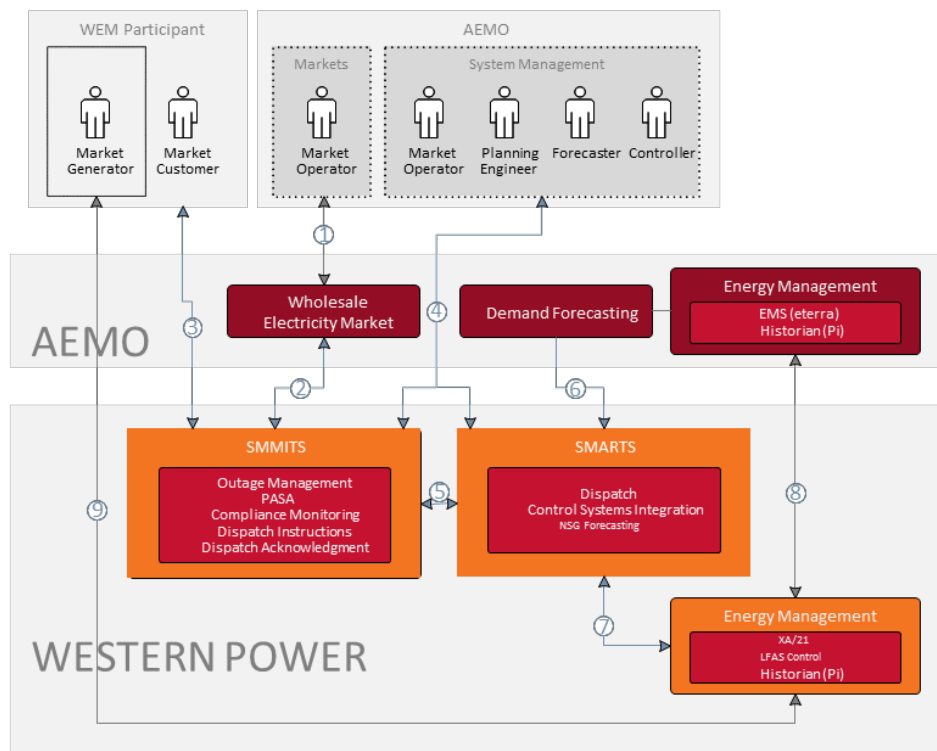
Numerous options were considered for the SMST project, such as physically moving the systems, outsourcing to a third-party vendor until the end of 2022, purchasing off the shelf products or redesigning completely. It was determined that the only feasible options were to either to retain the systems within Western Power, or to end the arrangement with Western Power and bring in-house using a strategy of “copy, paste, re-platform” into AEMO environments.

The SMST project will proceed on the basis the PSO project will be delivered in full. The SMST project can only be fully implemented once key elements of the PSO project (such as PI database) are in place.

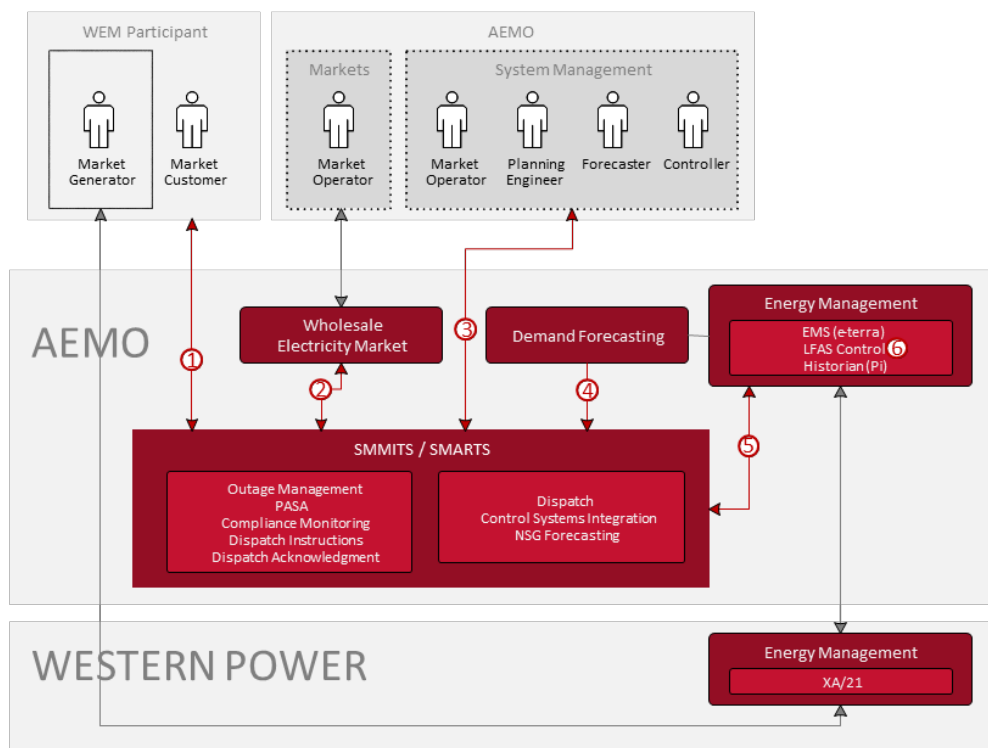
The following diagram illustrates the future state of system management IT systems by the end of 2019.

Figure 9 Current and future state (by end 2019) of AEMO and Western Power system management systems

## Current state



## Future state



Completion of the PSO and SMST projects will result in the complete separation of AEMO System Management from Western Power, meaning AEMO's IT function will be self-sufficient when it comes to IT upgrades and system modification. This places AEMO in the best position to be able to give effect to the forthcoming WEM reforms, as well as any subsequent enhancements.

#### 2.4.1 Summary of AR4 capex adjustment for 2018-19 SMST costs

Capex on the SMST project is allocated to System Management only. Table 8 shows the breakdown of forecast costs associated with the SMST and the impact on baseline market fees in 2019-20.

**Table 8 Summary of AR4 capex adjustment for the SMST project and impact on market fees (\$,000 nominal)**

System Management forecast capex adjustment	Forecast
Resources	4,026
Hardware	898
Other	12
<b>Total</b>	<b>4,936</b>
<b>Impact on baseline System Management fees during 2019-20</b>	<b>5%</b>

The overall project cost is estimated at \$5.4 million. Approximately \$4.94 million of this will be incurred during the AR4 period, with the balance being incurred during 2019-20.

It is likely further investment will be required in AEMO's system management systems during the AR5 period, once the WEM reforms have been further defined. Any additional forecast costs will be detailed in AEMO's AR5 proposal, which will be submitted to the ERA in March 2019.

## 2.5 Upgrade end-of-life Market Operations IT infrastructure

In a similar vein to the SMST project, the delay in WEM reforms has necessitated essential upgrades to Market Operations IT infrastructure.

When AEMO took over responsibility for the WEM from the IMO in November 2015, it inherited the IMO's IT infrastructure arrangements, including its lease of data centre space in Malaga. The Malaga Data Centre hosts the WEMS, the RCM and the Gas Bulletin Board, as well as several test and development systems. The Market Operations infrastructure within the Malaga Data Centre is nearing the end of its life, and is due for refresh and/or replacement during 2018-19.

The Market Operations IT infrastructure upgrades were not included in the original AR4 determination due to the potential for IT infrastructure requirements to be affected by the forthcoming WEM reforms. It was considered prudent to await further clarity around the expected July 2018 reforms to ensure the infrastructure upgrades were fit for purpose.

The WEM reforms have since been deferred to 2022, however, the Market Operations infrastructure in Malaga still needs to be upgraded. Though there is the potential for further infrastructure upgrades arising from the WEM reforms, these will be at least three to four years away, and can be accommodated when the next infrastructure life cycle refresh is due in three to four years' time.

AEMO proposes the end-of-life infrastructure be removed from Malaga, and the systems hosted by AEMO's private cloud-based system instead. This will allow several racks within the Malaga Data Centre to be retired by July 2019, reducing the overall data centre costs (though some System Management infrastructure will continue to be hosted at Malaga until 2022).

Moving from the Malaga Data Centre to the AEMO cloud will deliver the following benefits:

- A cost-effective solution that delivers improved performance and reliability. The cloud solution uses existing infrastructure that is already used by AEMO, which means minimal hardware and software will need to be procured.
- Lower operating costs (approximately \$0.3 million reduction per annum). This is due to fewer racks, communication links and software licences required, as well as lower power consumption and cooling requirements.
- Systems will have improved availability running on AEMO cloud with full hardware redundancy across the service stack.
- Improved capacity and scalability to support future programs for the WA systems.
- It will allow switching across data centres without requirements on Market Participants to make configuration changes on their own systems.

Similar to the SMST project, making the move to the cloud now also gives AEMO greater control over its IT systems and means future cyclical end-of-life upgrades will be able to be delivered more efficiently.

AEMO considered refreshing the Market Operations infrastructure at Malaga, however, this was a higher cost option that also has the potential to leave stranded assets in Malaga when WEM reforms are deployed in 2022.

AEMO also looked at the option to merge the Market Operations systems with the System Management systems that will remain at Malaga until 2022. However, this was again a higher costs option than the cloud and does not significantly reduce AEMO’s data centre footprint. It was considered prudent to utilise the available capacity within the private AEMO cloud.

Other cloud options were considered, such as public clouds. However, AEMO considered the security risk, costs, and reduced control (when compared to the AEMO private cloud) meant that these options were less advantageous.

AEMO has the resources in place to be able to deliver the infrastructure upgrade quickly, as highlighted by AEMO’s July 2018 data centre move from Belmont to Brisbane, which took less than nine months. Now is the opportune time to undertake this infrastructure upgrade as it will ensure data hosting capacity is in place to support new initiatives (such as the SMST and WEM reforms). It is also important to make this change now, before key IT resources are deployed on WEM reform implementation.

### 2.5.1 Summary of AR4 capex adjustment for 2018-19 infrastructure upgrade costs

Capex on the Market Operations IT infrastructure upgrade allocated to Market Operations is shown below. Table 9 shows the breakdown of forecast costs associated with the infrastructure upgrade and the impact on baseline market fees in 2019-20.

**Table 9 Summary of AR4 capex adjustment allocated to Market Operations due to IT infrastructure upgrade and impact on market fees (\$,000 nominal)**

Market Operations forecast capex adjustment	Forecast
Resources	736
Hardware	580
Software	716
<b>Total</b>	<b>2,032</b>
<b>Impact on baseline Market Operations fees during 2019-20</b>	<b>3%</b>

## 2.6 New facilities

To undertake the additional capex projects described in this AR4 proposal, AEMO requires additional resources. During 2018-19 AEMO expects to increase its employee head count by 38, as well as appointing a number of expert consultants to support WEM reforms. As a result, AEMO requires additional office facilities and end-user IT equipment (e.g. laptop computers and mobile phones).

AEMO reviewed several options for expanding its facilities and has been able to secure additional office space on the 46<sup>th</sup> floor of the Central Park building in Perth (AEMO currently occupies the 45<sup>th</sup> floor) on very competitive terms.<sup>27</sup> The total capital cost for the office fit-out and leasing in 2018-19 is \$0.58 million and will be allocated 50:50 to Market Operations and System Management.

AEMO considers expanding its offices into the 46<sup>th</sup> floor of Central Park is the most prudent and efficient option, both in terms of cost and the ability to move in to the new facilities quickly. Occupying an additional floor in the same building also offers the benefits of having all AEMO's project teams and employees in the same location, which should promote efficient delivery of the WEM reform initiatives and maximise interaction between project and operational personnel.

The cost of providing additional end-user IT equipment is estimated at \$0.3 million, and will also be allocated 50:50 between Market Operations and System Management. The end-user equipment is procured as a package (e.g. laptops, headsets, mobile phones) and on a bulk purchase arrangement. Hardware costs are incurred as per AEMO's current service arrangements, which was subject to a competitive tender process.

### 2.6.1 Summary of AR4 capex adjustment for new facilities costs

Capex on the new facilities project is allocated 50:50 to AEMO's Market Operations and System Management function. Table 10 shows the breakdown of forecast costs associated with the new facilities and the impact on baseline market fees in 2019-20.

**Table 10 Summary of 2018-19 forecast capex on new facilities and impact on market fees (\$,000 nominal)**

Market operations System Management forecast capex adjustment	Forecast
New office facilities fit out	450
New office facilities leasing costs	130
End user IT equipment	295
Total	875
Impact on WEM fees during 2019-20	1%

<sup>27</sup> The rent for the space is competitive as the landlord agreed to retain the same rent for the 46<sup>th</sup> floor that AEMO pays for existing floors, despite the CBD property market being stronger than when AEMO secured the lease for its existing floors.



# 3. Total costs and impact on market fees

The tables in this section summarise AEMO's proposed adjustments to forecast capex for the AR4 period. This section also includes the indicative impact on market fees.

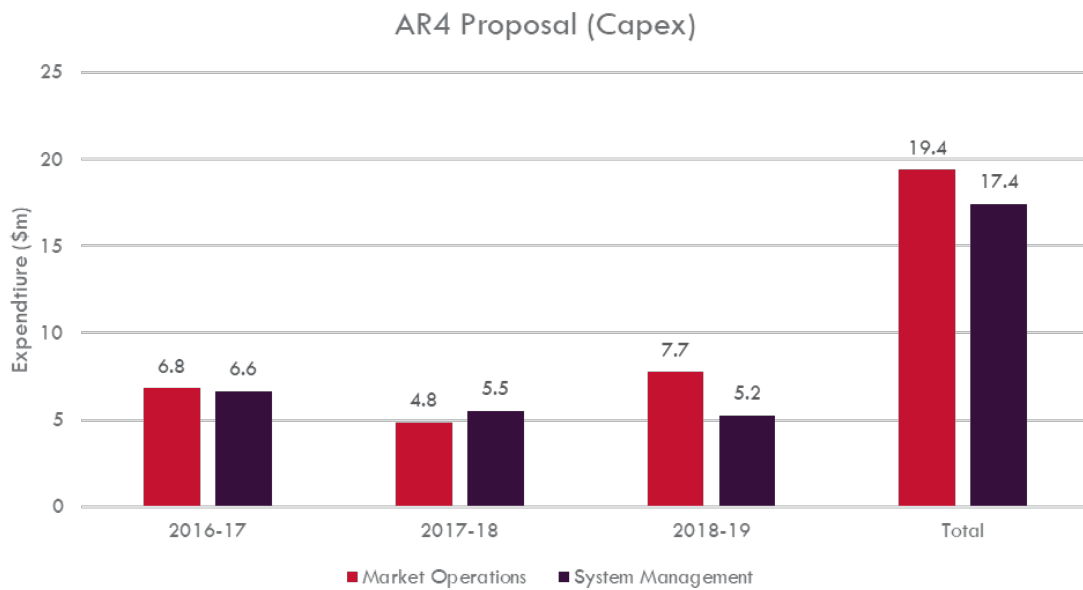
## 3.1 Revised forecast capex

Table 11 Forecast capital expenditure including AEMO proposed adjustment (\$,000 nominal)

	2016-17	2017-18	2018-19	Total
<b>Market Operations</b>				
Approved (July 2017)	6,807	4,832	1,678	13,317
Actual/Forecast	4,333	5,741	9,306	19,379
Variance	(2,474)	909	7,628	6,062
Proposed adjustment	-	-	-	6,062
<b>System Management</b>				
Approved (July 2017)	7,337	4,826	120	12,283
Actual/Forecast	2,759	3,472	11,175	17,406
Variance	(4,578)	(1,354)	11,055	5,123
Proposed adjustment	-	-	-	5,123
<b>Total AR4</b>				
Approved (July 2017)	14,144	9,658	1,798	25,600
Actual/Forecast	7,092	9,212	20,481	36,786
Variance	(7,052)	(446)	18,683	11,186
Proposed adjustment	-	-	-	11,186

The forecast capex proposed for 2018-19 is also similar to that approved in the first two years of the AR4 period, as shown in the following chart.

Figure 10 Revised AR4 capex forecast (\$ million)



### 3.2 Impact on allowable revenue and market fees

The allowable revenue determined by the ERA forms the basis for AEMO’s annual budgets. Market fees are charged based on the volume of energy generated or consumed by market participants and are adjusted each year to reflect the annual budget. Market fees are adjusted annually for surpluses or deficits in revenues arising from differences between forecast and actual expenditure.

There will be no immediate change in costs to market participants as a result of this AR4 capex adjustment. Market fees for 2018-19 have already been set and will not be adjusted in-period to account for any increase in capex. The impact of any capex adjustment will result in a new baseline level of market fees, which will apply from 2019-20 onwards.

As shown in the following table, over the AR4 period, AEMO has recovered considerably less revenue than forecast. Taking into account the annual market fee adjustments in 2016-17 and 2017-18, and the revenue forecast for 2018-19, AEMO estimates a net saving of 5% over the AR4 period.

The combined 7% net increase (i.e. 5% lower fees actually charged in the AR4 period (i.e. 2016 to 2019) offset by 12% fee impact proposed with this resubmission 2019-20) is lower than CPI benchmark across the 4 years (2016 to 2020).

Table 12 Total WEM Allowable Revenue during the AR4 period (\$/MWh nominal)

Allowable Revenue (\$,000)	2016-17	2017-18	2018-19 (current)	Total
Actual	30,704	28,385	30,258	89,347
Determination	33,380	31,170	29,098	93,648
Difference	2,676	2,785	(1,160)	4,301
% Difference	-9%	-10%	+4%	-5%

The following table shows the actual market fees in \$/MWh during 2018-19, and the expected impact on fees during 2019-20 to 2021-22 (the AR5 period).

**Table 13 Estimated impact on baseline market fees during the AR5 period (\$/MWh nominal)**

WEM fee (\$/MWh)	2018-19 (current fee)	2019-20 estimated baseline increase	2020-21 estimated baseline increase	2021-22 estimated baseline increase
Market Operations	0.35	+0.055	+0.055	+0.054
System Management	0.484	+0.047	+0.046	+0.046
Total	0.834	+0.102	+0.101	+0.100
Baseline increase resulting from AR4 adjustment	n/a	+12%	+12%	+12%

AEMO estimates the impact on market fees will be a 12% increase to the current (2018-19) fees, applying from 2019-20 onwards. While 12% is a significant increase, it is important to note that it is an increase to a current baseline some 5% lower than forecast in the ERA's July 2017 allowable revenue determination.

Note the increase presented in Table 13 does not include any subsequent adjustments resulting from AEMO's AR5 allowable revenue proposal, which will be submitted to the ERA in March 2019.

# Glossary

Term	Definition
AR4	The fourth allowable revenue period – 1 July 2016 to 30 June 2019
AR5	The fifth allowable revenue period – 1 July 2019 to 30 June 2022
Capex	Capital expenditure
ERA	Economic Regulation Authority
IMO	Independent Market Operator
IRCR	Individual reserve capacity requirement
PSO	Power systems operation
PUO	Public Utilities Office
RCM	Reserve capacity mechanism
SCADA	Supervisory control and data acquisition
SMST	System Management systems transition
SWIS	South West Interconnected System
WEM	Wholesale Electricity Market
WEMS	Wholesale Electricity Market System

# A1. Ministerial correspondence



RECEIVED  
4-7-18

**Hon Ben Wyatt MLA**  
**Treasurer; Minister for Finance; Energy; Aboriginal Affairs**

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Our Ref: 69-09173

Ms Audrey Zibelman  
Managing Director and Chief Executive Officer  
Australian Energy Market Operator  
GPO Box 2008  
MELBOURNE VIC 3001

Dear Ms Zibelman

*Audrey*

**PREPARATION AND IMPLEMENTATION OF NEW WHOLESALE  
ELECTRICITY MARKET ARRANGEMENTS**

I am pleased to note that the Australian Energy Market Operator (AEMO) has commenced work to assist the development and implementation of reforms to implement a constrained access model for the Western Power network, and deliver associated and complementary improvements to the Wholesale Electricity Market in Western Australia.

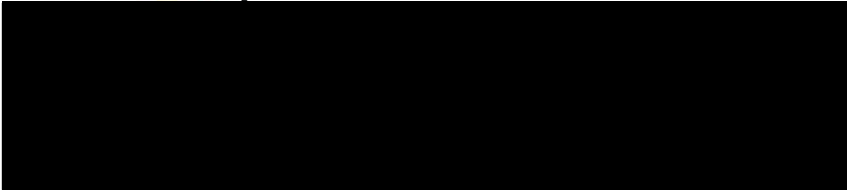
I recognise that AEMO has, and will, incur costs in the design, acquisition and implementation of market and system changes before the new arrangements are reflected in the Wholesale Electricity Market Rules (Market Rules). Accordingly, I have made amendments to Clause 1.20 of the Market Rules to enable AEMO to seek assessment or re-assessment of Allowable Revenue from the Economic Regulation Authority (ERA), to allow recovery of relevant prudently-incurred expenditure through Market Fees.

For the purposes of Clause 1.20 of the Market Rules, I endorse the items described in the attached Schedule, as being activities I consider will require the specific expertise of, and expenditure by, AEMO to deliver the above reform initiatives. I consider that it is reasonable for market participants to fund AEMO's activities in this regard.

To facilitate improved transparency in the next Allowable Revenue Determination for AEMO, I have amended the Market Rules to delay its next Allowable Revenue submission date from 30 November 2018 to 15 March 2019. The associated determination date by the ERA is also changed.

Thank you for your organisations' continuing efforts through this period of market transition.

Yours sincerely



Ben Wyatt MLA  
**MINISTER FOR ENERGY**

30 JUN 2018

cc: Ms Jenness Gardner  
Chief Executive Officer  
Economic Regulation Authority

## PREPARATION AND IMPLEMENTATION OF NEW WHOLESALE ELECTRICITY MARKET ARRANGEMENTS

This Schedule identifies matters and activities endorsed under Wholesale Electricity Market Rule 1.20 to be undertaken by the Australian Energy Market Operator (AEMO) in performing its functions under that Rule, in the period from 1 July 2018 to 30 June 2019. The endorsed changes form part of a broader work program of electricity sector reform being coordinated by the Public Utilities Office.

Under Wholesale Electricity Market Rule 1.20, the AEMO has the functions of:

- preparing for Wholesale Electricity Market and Constrained Network Access Reform; and
- facilitating the implementation of Wholesale Electricity Market and Constrained Network Access Reform (including through transitional measures).

“Wholesale Electricity Market and Constrained Network Access Reform” is defined in the Wholesale Electricity Market Rules as any proposed change to the operation of the Wholesale Electricity Market or related arrangements for network access, or the legislative regime applying to the Wholesale Electricity Market (including the *Electricity Industry Act 2004*, the *Electricity Industry (Wholesale Electricity Market) Regulations 2004* and the Market Rules), that has been endorsed by the Minister for Energy (whether or not legislation has been made to implement it).

For the purposes of Market Rule 1.20 and the description of “Wholesale Electricity Market and Constrained Network Access Reform”, the following changes to the operation of the Wholesale Electricity Market (including relevant changes to the Wholesale Electricity Market legislative regime) are endorsed:

- Assist in the development of regulatory amendments required to enable network access under constraint, including related changes to the Reserve Capacity Mechanism, and including amendments to regulations, rules, procedures and standards.
- Assignment of Reserve Capacity rights – including regulatory, market-facing and AEMO-internal system and procedural changes to support the Reserve Capacity Mechanism in the constrained network access environment.
- Market Registrations – particularly new registration classes or amended existing classes to accommodate new and emerging technologies.
- A new security-constrained dispatch engine for co-optimised energy and ancillary service five-minute dispatch and associated processes, including data exchange and integration of fast-start services.
- New Power System Security and Reliability (PSSR) and Reliability Management arrangements – including design of the operating states framework, management of contingency events, power system reliability, and draft system standards, settings and definitions, governance arrangements and roles and responsibilities.
- Constraints – including reference node determination, technical, operational and regulatory aspects of network and system constraint definition and development, and building of the constraint library.



- Forecasts and Projected Assessment of System Adequacy (PASA) – changes to forecast and PASA methods, governance, rules and procedures to reflect changes to PSSR under system constraint, and development of published pre-dispatch information.
- Outage Management, to reflect the requirements of a security-constrained operating environment.
- Ancillary services standards, requirements and market design, or alternative contract arrangements, under security-constrained economic dispatch, requiring analysis of existing requirements and recommendations for future needs and governance arrangements and identifying how these are linked to other elements of market design.
- Introduction of Facility bidding and dispatch for Synergy portfolio assets, including transitional arrangements.
- New market settlement and prudential arrangements to reflect market design changes, including revised approaches to constrained-on and –off charges and any market– or government-based compensation arrangements.
- New spot market, including co-optimised energy and ancillary service dispatch and facility bidding and consequential changes to the Short Term Energy Market driven by security-constrained economic dispatch.
- Market power mitigation measures.
- Cross-project activities, including changes to the nature, scope and frequency of market information, advisories, monitoring and compliance.

ENDORSED

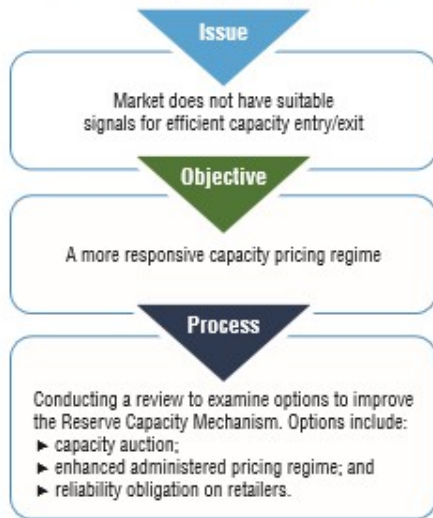
MINISTER FOR ENERGY

22/11/2018

# A2. WEM reform time line



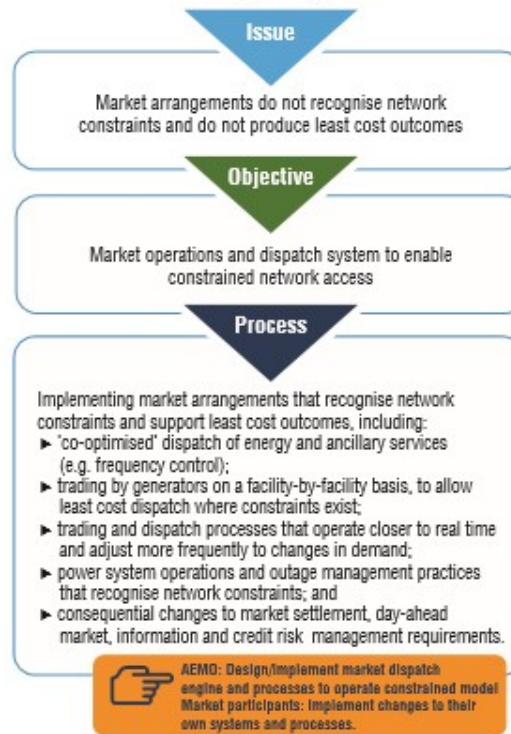
## Reserve Capacity Pricing Review



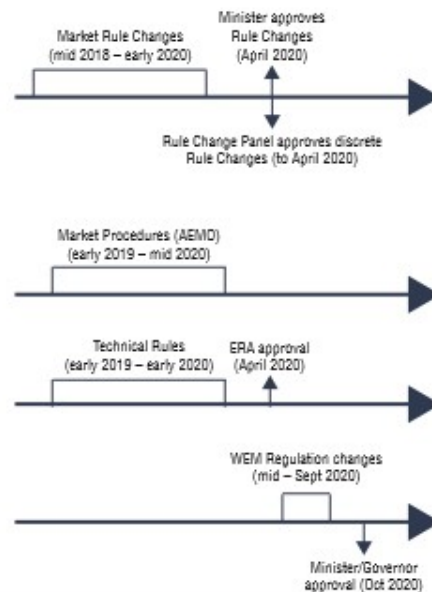
### Indicative Timeframe



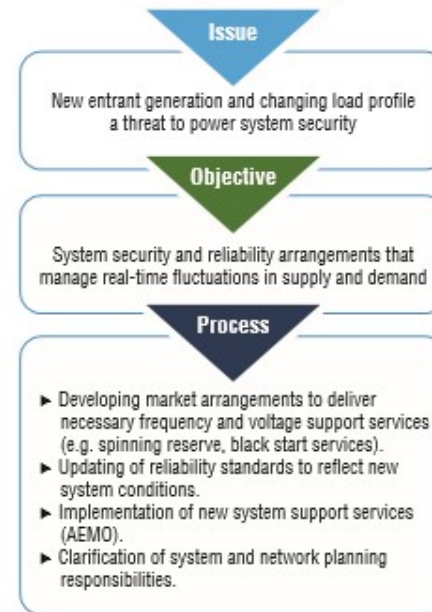
## Security Constrained Market and Dispatch System



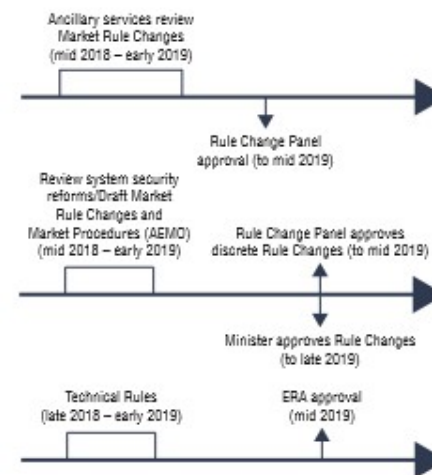
### Indicative Timeframe



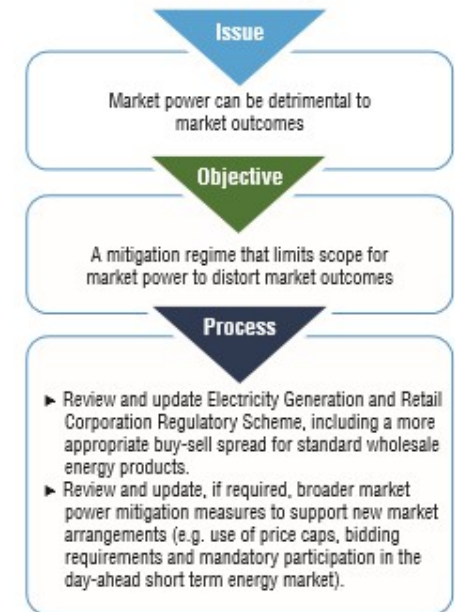
## Power System Security



### Indicative Timeframe



## Market Power Mitigation



### Indicative Timeframe

