Review of AEMO's 2019-22 Allowable Revenue and Forecast Capital Expenditure proposal

Economic Regulation Authority

FINAL REPORT

11 June 2019

IES
Intelligent Energy Systems

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1 Introduction

Intelligent Energy Systems (IES) was appointed by the Economic Regulation Authority (ERA) to provide independent technical advice in relation to the efficiency and appropriateness of proposed capital expenditure forecasts provided by the Australian Energy Market Operator (AEMO) for the fifth Allowable Revenue (AR5) period from July 2019 to June 2022.

AEMO is required to submit operating and capital expenditures relating to the provision of Western Australia Wholesale Electricity Market services to the ERA for approval in accordance with clause 2.22A and 1.20.3 of the Wholesale Electricity Market (WEM) Rules. Only capital expenditures (capex) approved by the ERA can be recovered from market participants through market fees which is based on the depreciation and amortisation of the related assets in accordance with generally accepted accounting principles.

The scope of this engagement was focused on the capex component for the Western Australia WEM. This report sets out the approach that IES has adopted to determine whether AEMO's proposed IT projects are in line with the relevant clauses of the market rules and is intended to support ERA in making its determination on the matter.

1.1 Background

AEMO's functions and obligations are defined in clause 2.22A.1 of the WEM Rules which covers market operations, market planning, administration services and system management relating to the WEM. In June 2018, following direction and endorsement from the Minister for Energy, AEMO's role was expanded to include the preparation, facilitation and implementation of the WEM and constrained network access reform program (WEM reform) by October 2022[1]. The revenue required to fund the WEM reform program is recovered through the same Allowable Revenue and Forecast Capital Expenditure framework covering AEMO's business as usual activities and is therefore borne by market participants.

AEMO's AR5 proposal[2] submitted in March 2019 has forecast capex requirements for the WEM over the AR5 period totalling $77 million and is a significant increase over the previous AR4 period of $29 million[3]. The previous regulatory period focused on the integration of system management functions, whereas AR5's driver for investment relates to: (1) the completion of system management system transition from Western Power to AEMO, (2) delivery of the WEM reform package, and (3) rolling out AEMO's Digital Roadmap to ensure the organisation can deliver solutions for the future in an agile and cost-efficient manner.

The WEM reform program accounts for $51.2 million (66%) of the total proposed capex over this period[4]. The Digital Roadmap and the remaining WEM services account for $12.7 and

[1] WEM Rules, clause 1.20. The Public Utilities Office is also tasked with leading this program of work.
[2] AEMO, 2019-22 allowable revenue and forecast capital expenditure submission to the Economic Regulation Authority, March 2019.
[3] AR4 capex of $29m based on estimated actual figures (includes a forecast component to Jun 2019). AEMO's submission in response to the draft decision revises the AR5 capex amount to $78.4 million.
[4] AEMO's submission in response to the draft decision revises this amount to $48.5 million, or 62% of the total.

$13.3 million respectively[5]. While the Digital Roadmap is considered a WEM service, we discuss it separately to the ongoing business as usual WEM services in this report.

The ERA is tasked with assessing AEMO's AR5 proposal with a focus on clause 2.22A.11(b):

> *"the Allowable Revenue and Forecast Capital Expenditure must include only costs which would be incurred by a prudent provider of the services described in clause 2.22A.1, acting efficiently, seeking to achieve the lowest practicably sustainable cost of delivering the services described in clause 2.22A.1 in accordance with these Market Rules, while effectively promoting the Wholesale Market Objectives."*

1.2 Overview of the proposed AR5 capital expenditure

The capex requirements over each of the AR5 financial years range from $25 million to $27 million and is heavily weighted towards WEM reform costs for years beyond FY2020 (see Figure 1). These figures are based on AEMO's original AR5 proposal[6]. Key points relating to the expenditure profile are provided below:

- **WEM services**: There is $13.2 million proposed in AR5 under WEM services (excluding Digital Roadmap) which relates to the provision of market and system operations and related services in accordance to clause 2.22A.1 and specifically includes upgrades or replacements to existing systems that are reaching the end of their lives, and the completion of system management system transition initiatives. The capex requirement in the first AR5 year accounts for $11.5 million and relates to the immediacy of carrying out these activities to minimise operational risks from end-of-life systems. Costs for the balance of the AR5 period amount to $1.7 million and include improvements to operational processes and remediation activities.

- **WEM services - Digital Roadmap**: also falls under clause 2.22A.1 and relates to the provision of a new IT and operational technology platform for the WEM and is intended to consolidate all AEMO's systems under a single common platform. Although the implementation plan spans five years spilling into AR6, the profiling of capex corresponds to the intention of delivering most of the work in AR5 to be ready for implementation of WEM reform requirements and to benefit future capex projects. We note 44% of the total $12.7 million proposed for the AR5 period falls within the first year.

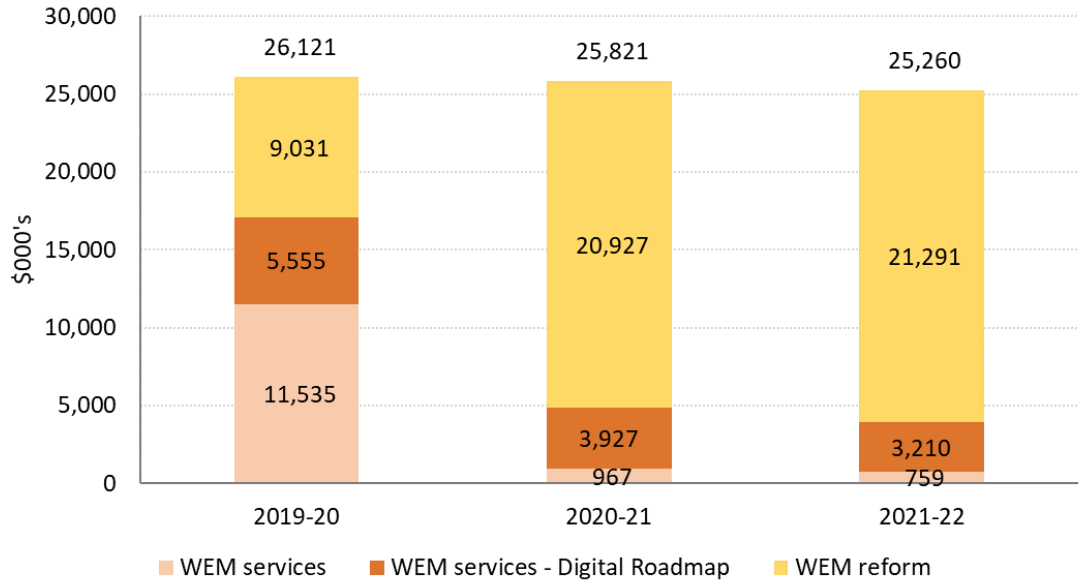
- **WEM reform**: has a proposed cost of $51.2 million with $9.0 million, or 18% of the AR5 WEM reform total, proposed for the first AR5 year. The costs per year increase to $21 million from FY2021 onwards coinciding with the timing of final approvals and ramp up of the implementation phase to deliver the WEM reform program by October 2022[7]. The WEM reform design is yet to be finalised, however, necessary groundwork and

[5] AEMO's submission in response to the draft decision revises these amounts to $13.0 million and $11.6 million respectively.
[6] AEMO has since updated capex requirements as part of its response to ERA's draft decision.
[7] An additional $6.6 million will be required in the first few months of the AR6 period leading up to October 2022. AEMO, 2019-22 allowable revenue and forecast capital expenditure submission to the Economic Regulation Authority, March 2019 (Table 39).

improvements to existing frameworks need to be put in place to meet the deadline. The work has been split into two tranches.

- Tranche 1 relates to components of the WEM reform that are more certain, including power system security and improvements to the ancillary services framework, reform of the reserve capacity pricing arrangements and constraints management work to support a security constrained economic dispatch. This body of work is scheduled and expected to be completed by the end of FY2020. It also accounts for most of the $9 million[8] incurred in this first year.
- Tranche 2 covers implementation of security constrained economic dispatch, constrained network access and other significant market framework and rule changes. A smaller portion of this work will begin towards the end of Tranche 1 in the first AR5 year then ramp up significantly from FY2021 onwards.

Figure 1 Proposed AR5 Capex for period: FY2019-20 to FY2021-22



AEMO has estimated the average AR5 market fee to rise to $1.028/MWh over the AR5 period which represents an 8.7%, or a 3% pa, uplift over the average AR4 fee of $0.945/MWh[9]. Most of the capex incurred in AR5 will not flow through to market fees until after the AR5 period. Depreciation of the asset commences only when the project is complete i.e. costs incurred by market participants are aligned to the actual provision of service. As such, the impact of AR5 capex will continue through to AR6 resulting in a further average uplift of 13.8% over the three-year period.

[8] The exact cost split between Tranche 1 and Tranche 2 was not available.

[9] These capex figures are amortised and depreciated over the life of the capex in accordance with clause 2.22A.11(a) of the WEM Rules and AEMO's Fixed Asset and Intangibles Policy (Version 1.3). These estimates also account for changes in operational expenditure relating to previously approved capex proposals and the impact on scheduled demand from the continued increased of embedded generation in the SWIS.

These figures are based on AEMO's estimate of capex costs which includes a contingency provision but only actual capex outcomes are passed through to market participants through an annual adjustment mechanism.

1.3 Conventions

All monetary figures in this report have been rounded to the nearest $1,000 and are quoted in Australian dollars and are presented on a nominal basis. All references to years are specified on calendar basis unless otherwise stated.

2 Methodology and Approach

2.1 Regulatory Framework

The capex requirements from AEMO, including that of the WEM Reform, have been assessed in accordance to clause 2.22A.11 of the WEM Rules. Under this clause, ERA must include only costs which would be incurred by a prudent provider of the services, acting efficiently and seeking to achieve the lowest practicably sustainable cost of delivering the services. The reference to 'lowest practicably sustainable cost' is particularly important for larger capex projects.

In assessing the proposed capex from a perspective of understanding whether what has been proposed is reasonable, especially given the timeline of the WEM reform program, IES has considered the following questions in our interpretation of what is prudent, efficient and seeking to achieve the lowest practicably sustainable cost:

- Is the capex required in order for AEMO to fulfil its role and obligations? Is there a clear purpose consistent with AEMO's function and obligations and the WEM Objectives? Is this the right time to invest and is there enough certainty to justify the investment?
- What are the benefits of carrying out the project? What are the risks of not undertaking or delaying the project and would AEMO still be considered a prudent provider of services?
- Is it the right solution and are the costs reasonable? Has AEMO canvassed other options within reason? Are costs apportioned to the WEM reasonable and is the depreciation period and timing sensible?
- Is the contingency used reasonable and is the application of it consistent across projects? Are there other considerations here such as compliance and dependencies?

We provide our recommendation of whether to accept or reject the proposed project capex, on a component by component basis and overall, in full. A staged approach was applied in the previous AR4 period requiring AEMO provide several in-period submissions. We agree with AEMO's sentiment that the time and resources associated with a staged approach, along with the uncertainty of funding can disrupt and possibly lead to an increase in capex requirements.

IES recognises the risks and increased costs associated with a staged approach and propose that ERA strike a balance between the effect of higher costs from staged approaches and approving projects that do not fully satisfy the approval requirements. Where possible, IES suggest exploring the alternative of approving a baseline cost for projects that span over multiple years or have project dependencies to at least provide certainty of undertaking design and scoping activities across the entire AR5 period until a later time when more project certainty can be delivered. The remaining capex requirements can then be approved to ensure AEMO has sufficient funding to meet its forward-looking costs.

2.2 Approach

The approach adopted was consistent with previous other engagements whereby IES has been concerned with reviewing capex. The approach is to assess and review provided information, engage in interviews with process owners, and review any additional information or insights in light of responses. Based on this an opinion is formed based on the approval requirements (Section 2.1) and other relevant experience.

The information received includes the following:

- AEMO's public submission and related documents;
- Additional supplementary reports from AEMO which is confidential in nature;
- AEMO's internal policy documents and models such as the Project Concept Estimation Model;
- Where available, detailed discussion and breakdowns of costs;
- Any additional data requests as raised by ERA or IES; and
- Questions and answers via email correspondence or phone calls with relevant AEMO staff.

2.2.1 Reports and references

The key reports and data files on which this review was based are:

1. Wholesale Electricity Market Rules, 11 January 2019 (WEM Rules);
2. 2019-22 allowable revenue and forecast capital expenditure submission to the Economic Regulation Authority, March 2019 (AEMO AR5 proposal);
3. 2019-22 allowable revenue and forecast capex confidential submission, AEMO, March 2019 (AEMO Confidential Submission);
4. AEMO's AR5 CAPEX Summary files[10];
5. AEMO response to ERA's AR5 draft decision, AEMO, 31 May 2019 (AEMO Draft Decision Response);
6. Contingency calculation template, AEMO, 24 May 2019[11];
7. Independent Assurance Report on AEMO's Compliance with the WEM Rules and Market Procedures, Robinson Bowmaker Paul, 12 October 2018 (2018 WEM Audit Report);
8. Technical advice in relation to the efficiency and appropriateness of proposed forecast capital expenditure requested by the Australia Energy Market Operator for the AR4 Period 2016-19, Stantons International, December 2018 (Stantons International AR4 report); and

[10] 20190315 AR5 CAPEX Summary FINAL.xlsx and revisions through to 20190530 AR5 CAPEX Summary FINAL.xlsx
[11] 20190524_AR5_Contingency-Calculator.xlsx

9. And all confidential information and responses to ERA and IES questions.

Project capex figures are based on the original AEMO AR5 proposal unless otherwise stated.

2.2.2 Wholesale Electricity Market ICT Projects

IES has worked with market and system operators in south-east Asia on their ICT requirements from smaller ad-hoc solutions through to market reform and entire systems replacements, similar to what is required of AEMO over the AR5 period. The scope of the implementations includes:

- Market Management System;
- SCADA/EMS/ICCP;
- Monitoring System and power system tools – for ensuring power system is operated in a secure state;
- Centralised Database and replication facilities;
- Medium and Long-Term Projections System;
- Metering System;
- Market participant interface - for submission of bids/offers, standing data, and transfer of market outcomes to participant; and
- Hardware, communications and IT security infrastructure.

A reasonable upfront cost for systems that provide these features ranges from USD $15 million to $30 million with labour accounting for around 25% to 40% of the total cost. An allowance of around 10% to 20% of the capex is a reasonable benchmark for annual support and maintenance costs (including software licences). However, these project costs should not be directly compared to the WEM reform program or other AR5 capex projects given the multitude of differences ranging from market design, implementation approach, scope and delivery timeframes. Labour rates have generally been a mix of international rates and rates for the host country within which the project has been implemented and therefore some adjustments need to be considered when comparing to the case of IT projects being implemented in Australia given differences in the cost of labour. Nonetheless they have been provided here for context around typical costs for major ICT implementations of electricity market systems[12].

2.3 Contingency

As part of budgeting and managing complex projects, a contingency is applied on top of the base cost to cover elements of risk or uncertainty. The Stantons International AR4 report

[12] Exact costing at the component level and details are confidential in nature and therefore only approximate ranges have been provided. Furthermore, all market systems are to some degree customised to the specific needs of given the wholesale electricity market.

accepted a contingency range of 15 to 30% as standard whereas the AEMO AR5 proposal provides reasons justifying contingency values starting at 30% and is subsequently adjusted up and down based on individual project requirements. The factors AEMO has incorporated into this contingency value include:

- Timing of the cost estimate relating to whether the requirements are known or to what extent it is uncertain;
- Nature of the project in terms of whether the project is highly customised or a significant departure from its existing systems and capabilities;
- Size and complexity including the time horizon to deliver the project; and
- Any other project-specific considerations such as currency risk.

IES is of the opinion a 30% contingency value is high but not unreasonable particularly in the context of the WEM reform and the Digital Roadmap projects. Labour accounts for a significant portion of the total capex requirement and can vary by 50% based on internal and external resourcing allocations. IES form this opinion based on our professional work with market and system operators in other countries where there is also uncertainty in policy and system design requirements. What is more important is the consistent application of AEMO's contingency methodology and reasons are provided for any adjustments given the element of judgement. Many of the AR5 projects have contingencies at the 30% level and there are three projects with contingencies above 30%[13].

As part of the AEMO Draft Decision Response, AEMO provided its framework and calculations for determining the contingencies on a project basis. The overall contingency value is based on the following:

- Cost Impact: A list of additional costs that might materialise over the course of the project including factors such as shifting from internal to external resources, an expansion or change in scope requiring additional effort requiring additional labour or platform costs, or changes in foreign exchange rates where applicable; and
- Likelihood: The probability that each of the cost impacts might materialise.

The combination of the cost impact and its likelihood determines the overall cost contingency applied to the project. Where applicable, IES has raised concerns where we feel there may be inconsistencies in its application. Part of the consideration around contingency needs to also account for whether there is an increased risk by delaying the project until there is more certainty to derive more accurate cost estimates.

Clause 2.22A.9 of the WEM Rules provides a buffer for AEMO to overspend up to 10% of the total proposed capex without having to seek approval from the ERA. AEMO has stated this

[13] POMAX Settlements Replacement, Enhanced Control Room Tools and RoPE – Phase 2 and Market Operator Interface have contingencies of 37%, 34% and 32% respectively. Contingencies were revised as part of AEMO's response to the ERA draft decision.

additional reserve is only intended to be utilised in exceptional circumstances and that the 10% provision is not a consideration when developing project capex estimates[14].

2.4 General Findings

Where relevant, IES provides general comments on the AEMO AR5 proposal and/or process which ERA may consider for future AEMO allowable revenue and forecast capital expenditure assessments.

[14] AEMO AR5 proposal, page 49.

3 Digital Roadmap

The Digital Roadmap is AEMO's strategic vision whereby all future IT and operational technology systems will be built on a centralised platform. The centralised solution will allow AEMO the ability to consolidate all its data, systems and software platforms at the enterprise level to deliver an efficient, flexible and scalable solution to meet an increasingly complex energy landscape.

AEMO is seeking to rationalise existing legacy systems which are characterised by individual systems that are nearing the end of their lives, are inefficient to maintain, or inflexible and can't be scaled to satisfy expected future requirements. Current systems have been developed in isolation or have been transitioned to AEMO with solutions implemented on an ad-hoc basis requiring a greater number of resources to perform major changes than would otherwise be the case if they were consolidated onto a standard internal platform.

AEMO recognises that with an increasingly complex power system a rethink of how they evolve their technological capabilities to meet a rapidly changing energy landscape is required. The Digital Roadmap has four (4) key work streams and associated benefits:

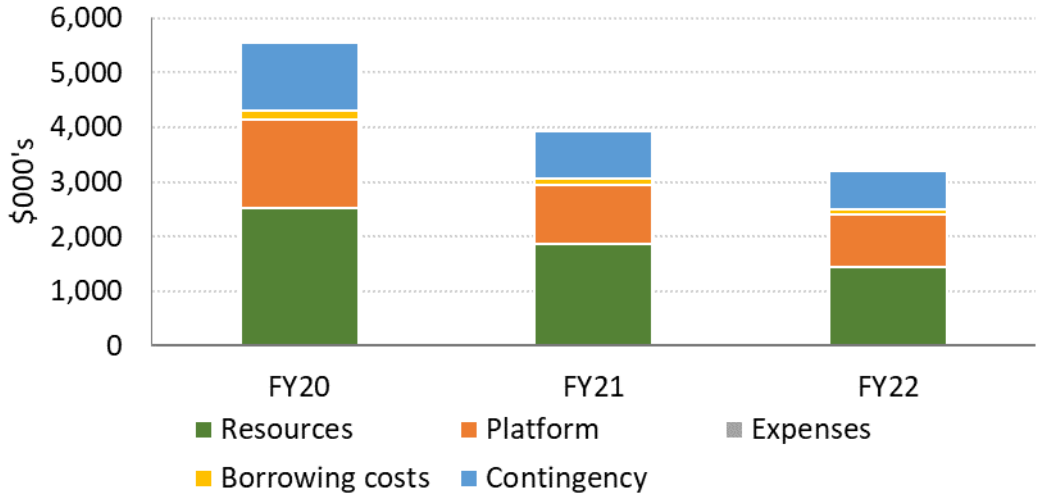
- **Cyber Security**: is to create one secure environment for AEMO's people, processes, technologies and IT infrastructure.
- **Compute**: is the infrastructure platform all AEMO's systems will be built on or transitioned to, including the critical market and system management processes.
- **Data**: is AEMO's strategy for collecting, authenticating, storing and utilising data.
- **Solutions**: covers all other systems that are not directly related to market and system operation but are still required to service the organisation. This includes corporate systems and project delivery initiatives.

The Digital Roadmap capex requirement over the AR5 period relating to the WEM is $12.7 million, with $5.6 million, or 44%, incurred in the first AR5 year[15]. This trend is generally consistent across all four workstreams of Digital Roadmap and is consistent with implementing the Digital Roadmap early so that the WEM reform work can leverage the benefits.

Total costs by component and workstream are shown in Figure 2 and Figure 3 respectively. The resources component is the most significant at $5.8 million, accounting for 62% of the base AR5 Digital Roadmap capex[16] followed by the contingency provision which has been set at 30% or $2.8 million over the AR5 period. The resource component is primarily comprised of labour costs which falls under the resources category[17].

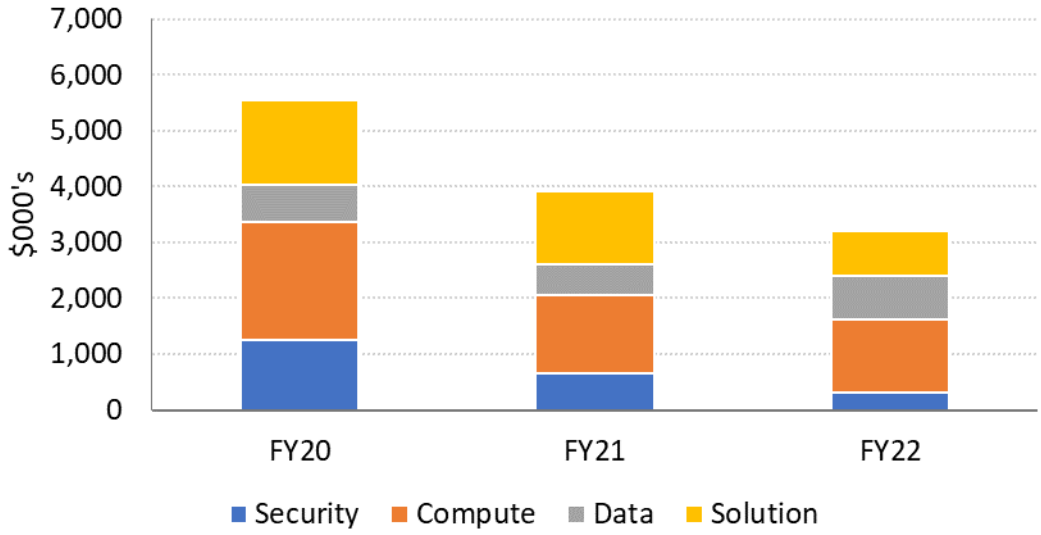
[15] This has been revised to $13.0 million across AR5 and $5.7 million in the first year as part of the AEMO Draft Decision Response.
[16] Excluding contingency and borrowing costs.
[17] From detailed cost breakdown from the AEMO Confidential Submission.

Figure 2 **Digital Roadmap proposed capex by component**



Source: AEMO AR5 Proposal

Figure 3 **Digital Roadmap proposed capex by workstream**



Source: AEMO AR5 Proposal

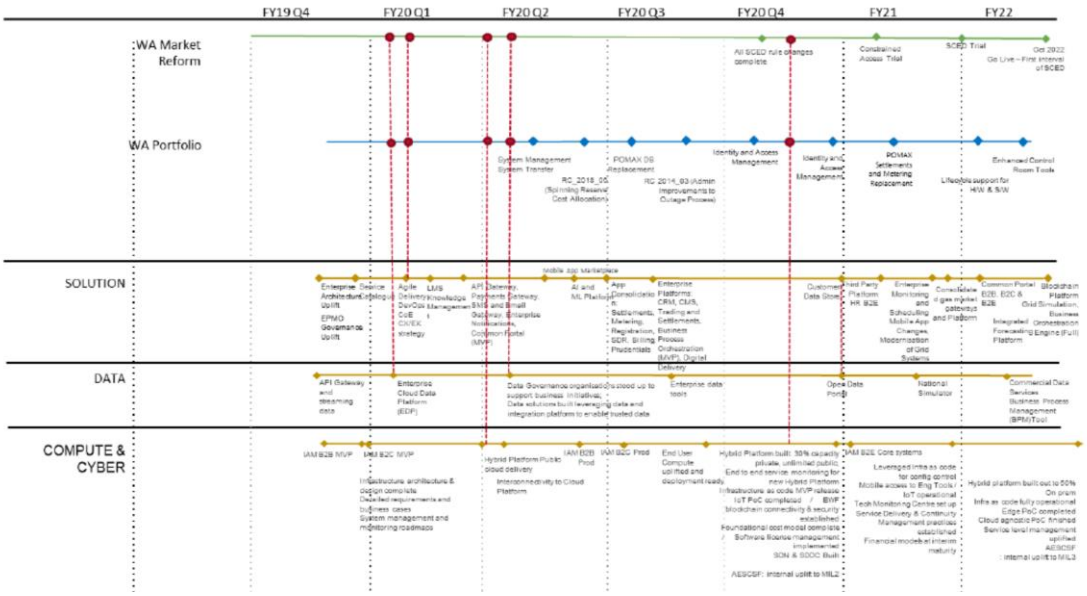
AEMO engaged PWC to identify the potential benefits of having a centralised digital strategy and platform applicable to the National Electricity Market (NEM). PWC identified significant operational cost savings such as an 80% increase in the provisioning of infrastructure and 30% reduction of IT unit costs by 2022. Separate external advice on the potential benefits that may be applicable to the WEM and Gas Services Information (GSI) suggest cost reductions of 15% to 30% in the area of shared service functions such as corporate systems, and that the compute platform could lower operational and capital costs by 15% to 35%. Based on the proposed costs across the entire AR5 period, AEMO has estimated a 15% cost saving across operations

and capex corresponding to $1.5 million and $3.9 million respectively[18]. The capex saving of $3.9 million is equivalent to a 5% reduction in the AR5 capex requirement, or a 30% recovery of the Digital Roadmap capex during the AR5 period. These benefits were previously not provided in the original AEMO AR5 proposal and related information.

3.1 Considerations

AEMO provided a confidential submission for the components of the Digital Roadmap which included significant detail around the background, scope of work, strategic alignment and intended benefit for each of the workstreams and sub-components[19]. AEMO also provided an overview of key project linkages back to the WEM reform program and business as usual capex projects (Figure 4). However, there is still a lack of information guiding how current systems transition onto this longer-term vision in the AEMO AR5 Proposal.

Figure 4 AEMO WA Capital Key Project Linkages – preliminary overview



Source: AEMO AR5 proposal

Assessing the Digital Roadmap and the underlying workstreams against clause 2.22A.11 flagged high-level concerns around the timing and uncertainty of benefits associated with the project in the early years of AR5. AEMO has stated that the Digital Roadmap project is still in the early stages and the capex for Digital Roadmap incurred in AR5 will not flow through to market fees until the commencement of AR6. A key question relates to whether this is the right time to approve the full capex amount accounting for the need to take a long-term view.

IES acknowledges and agrees with AEMO that some form of systems consolidation and transitioning towards a common platform makes sense and we do not dispute the potential benefits that may be achieved with the full implementation. Such a vision requires

[18] AEMO Draft Decision Response, page 35.
[19] AEMO, 2019-22 allowable revenue and forecast capex confidential submission, March 2019.

stakeholders to take a longer-term view given the lead time required for people, processes and culture to evolve. However, critical information around when existing main systems (and relevant sub-systems) will be transitioned to the new Digital Roadmap platform and the corresponding timing of when the benefits are to be realised remains unclear.

IES acknowledges that what is required to satisfy the lowest practicably sustainable cost requirement may not be achievable given that the project is only in the early stages, the nature of the project itself and the difficulties in providing alternative cost estimates. Despite AEMO's track record of project governance and cost control, we do not think it would be prudent for ERA to approve the full capex amount without at least some of the following information:

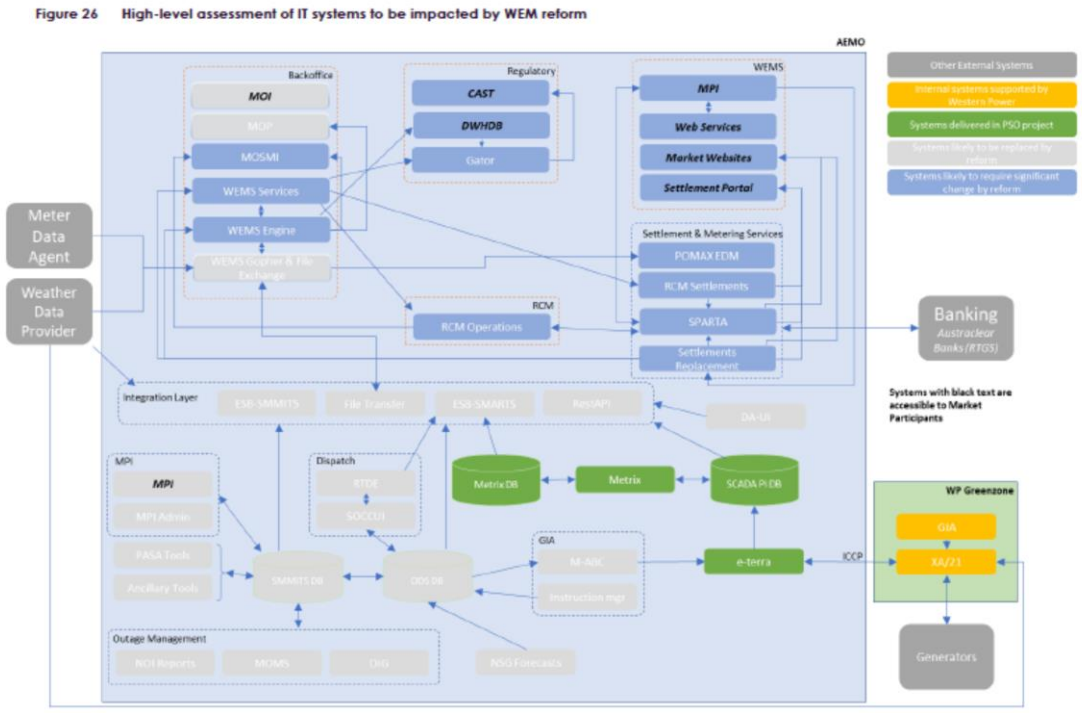
- The high-level architecture of WEM systems is shown in Figure 5 which shows the systems that will be impacted and possibly replaced by the WEM reform work. AEMO has not yet provided details around exact benefits and transition periods of existing systems to the Digital Roadmap platform, or which other non-WEM reform system changes would benefit from the Digital Roadmap implementation. Although the Digital Roadmap is a series of interconnected programs and projects to incrementally replace and uplift existing capabilities, we note that many of the critical systems[20] will require some change but will remain on existing infrastructure following WEM reform changes and the full benefits from the Compute and Data workstreams may not materialise until after these systems are replaced entirely. The WEM reform project would clearly benefit but has been costed on a standalone basis without estimates based on the Digital Roadmap solution.
- There were no labour cost breakdowns which we assume is indicative of the Digital Roadmap being at an early stage. Labour accounts for more than 50% of the Digital Roadmap AR5 capex (excluding contingency and borrowings) and whether the proposed costs were reasonable could not be determined at this time.
- AEMO is of the view that a WA-specific standalone option would cost significantly more, however, that assertion is not supported with estimates around what the costs of maintaining current arrangements throughout AR5 and possibly AR6 might be. Some of the initial submissions responding to ERA's issues paper on this matter raise the question of whether AEMO should specifically look at a WA-specific option.
- The Digital Roadmap is an AEMO-wide initiative covering the NEM, WEM and GSI and we would expect the total capex to be allocated based on the proportionality of the projects and programs relating to shared and market-specific services. The proposed profiling is fixed across the years and would suggest a corporate share allocation rather than a project-by-project assessment. IES understand the market fees will be adjusted to account for actual incurred costs relating to the provision of WEM services.

AEMO has acknowledged that mapping out a transition path in the current environment has its own challenges and that a complete 5-year roadmap and detailed costs and benefits the Digital Roadmap can deliver is not available at this time. Analysis provided to date has been preliminary in nature. AEMO has indicated that, at the very least, it would be best for WA to

[20] Power Systems Operations project, e-terra EMS, POMAX settlements replacement, Reserve Capacity Mechanism.

be considered as part of the Digital Roadmap design and scoping process because it would naturally make sense for WEM systems to eventually be migrated onto the new platform in the future. IES agrees with the principle for ERA and WEM stakeholders to take a longer-term perspective and to recognise the lead time required to properly embed the Digital Roadmap vision. The approach of approving a baseline to ensure WA's consideration for detailed scoping and planning would be beneficial as several Digital Roadmap projects is intended to enhance AEMO's capability in specifically addressing some of these questions.

Figure 5 High-Level Assessment of IT Systems to be Impacted by WEM Reform



Source: AEMO AR5 proposal

As part of an update to the Digital Roadmap project, AEMO has proposed business systems and focus areas that are scheduled in the first AR5 year where detailed information including the costs and benefits is more readily available. The capex relating to this initial stream of work for the WEM has been estimated at $4.5 million and includes various projects under each of the four key work streams of the Digital Roadmap. These are deemed foundational projects to provide additional clarity and to ensure WA's consideration within the Digital Roadmap context. These projects are discussed in the following sections.

3.1.1 Cyber Security

The existing systems, including those that have been newly implemented or recently replaced and the WEM reform project proposal, are based on the existing cyber security platform. Current security measures were assessed against the Australian Energy Sector Cyber Security

Framework[21] and were found to be lower than what is targeted by AEMO. AEMO are regularly updated on the evolving risks of cyber security and have targets agreed with the Australian Cyber Security Centre and Critical Infrastructure Centre. Due to the critical nature of cyber security and potential security breaches impacting grids and markets, the AEMO Board has a zero-tolerance position on this matter.

In assessing the Cyber Security component of the Digital Roadmap, AEMO's proposal does not mention how much it would cost to upgrade the existing cyber security platform instead, if at all feasible. There is also no indication whether the AR5 proposed projects relating to system changes and replacements would experience a sufficient uplift to security, or whether the overall WEM system security level won't experience the full uplift until most or all systems have transitioned to the new Digital Roadmap. If these options are not viable, then would it be imprudent of AEMO to maintain existing security arrangements.

Whilst we do not disagree that a standalone option would likely incur additional costs over and above the enterprise solution, or that it would be impractical for AEMO to maintain disparate cyber security systems, it would not be prudent for ERA to approve the entire cyber security capex amount for cyber security without proper consideration of the points raised here.

In its response to ERA's Draft Decision, AEMO has identified six key cyber security projects under the US National Institute of Standards and Technology (NIST) security framework which is an internationally accepted standard. They have been proposed on the basis that maintaining a separate security arrangement is not a viable option for WA.

- **Identity and access management ($812,000)**: continues from the tranche 1 work proposed separately in Section 5.2.10. The work proposed here extends the foundational design in the corporate systems into WEM and GSI systems. AEMO will have full accountability of all systems with the transition away from Western Power but have stated some of this work will need to be revisited when existing systems are replaced. AEMO has also stated that remaining on existing cyber arrangements is too high a risk for its critical services.

- **Security and awareness, training and culture ($76,000)**: the uplift in security also requires an uplift in culture awareness and training to minimise risks of successful attacks targeting employees and contractors with access to key AEMO systems. AEMO has noted it would be impractical to exclude or provide alternatives for WA AEMO employees.

- **Key controls ($264,000)**: aims to improve the resilience of critical systems and functions from external attacks including denial-of-service protection, better risk traceability and governance and transition from on-premise to cloud-based services for added resilience. AEMO has not provided an alternate costing for this project as it is impractical for WA to have disparate cyber security arrangements.

- **Secure in design, dev and ops ($120,000)**: Provides an uplift to AEMO's security architecture framework affecting all future and transitioned systems, cloud services and

[21] https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Cyber-Security/Framework-resources

technologies. Similar to the other projects, an alternative standalone solution for WA has not been considered due to the impracticality of maintaining disparate solutions.

- **Assurance, testing and exercise and Threat detection and response ($530,000)**: These two projects are to provide continual monitoring and testing for cyber security breaches after the frameworks and systems are in place, and to ensure cyber security arrangements are continually evolving and can adequately respond to any issues identified. AEMO has stated it would be impractical for an alternative standalone system for WA.

The total cost for the cyber security work proposed in the first AR5 year is $1.8 million including contingency, however, additional cost details and the cost allocation methodology from the enterprise level has not been provided.

3.1.2 Compute and Data

AEMO has revised its plans and for the first year of AR5 for the Compute and Data work streams to specifically include four foundational projects at a cost of $2.13 million (including contingency).

- **[Data] Consumption - Enterprise data consumption tool foundation build and Governance framework ($257,000):** There is currently a lack of consistency around how data is stored, analysed and provided to customers. and shared within the organisation. The management of data including the treatment of new data sources also lacks a governance framework leading to fragmented data structures and solutions. These two projects aim to consolidate and define a data governance model for all data housed and processed by AEMO. The approval of this project will ensure WA is considered in the development of the tool.

- **[Compute] Platform infrastructure - Hybrid cloud detailed design ($1.35 million):** relates directly to a hybrid cloud solution that will provide AEMO the ability to easily extend its computing platform. AEMO has identified this as one of the more critical components of work. AEMO has stated that the benefits to the WEM reform program cannot be precisely quantified, however, consolidated WEM systems on this centralised platform could produce significant cost savings compared to the standalone solution.

- **[Compute] Service management - Service management ($528,000):** is designed to improve event performance and capacity, service transition, and asset configuration and IT financial management. Similar to other enterprise initiatives, the project will benefit the overall IT capability of AEMO and is not tied to any market-specific service. This project will also allow for improved cost allocations between shared functions.

Additional cost details including the allocation methodology from the enterprise level has not been provided. The implementation of service management project will allow for accurate cost allocations than current allocation methods, however, WA would still be required to fund its share of the development so as to be included in the overall consideration of developing these foundational tools and capabilities.

3.1.3 Solutions

The Solutions workstream of the Digital Roadmap is comprised of several sub-components which relate to servicing AEMO's broader operations not directly related to market operations or system management and can be roughly classified as:

- **Project Delivery and Application Simplification**: covers the transition towards an agile service delivery, including project management skills, flexible resource allocation, knowledge sharing, tools and workflow processes. This is relevant to improving the delivery requirements in a rapidly changing and uncertain environment and is relevant in the context of distributed energy resources (DER) and WEM reform system changes. Application simplification aims at reducing the duplication of effort and applications across WEM systems.
- **Corporate Systems and Digital Delivery**: this component includes areas such as talent management, finance and HR system, employee applications and compliance tools. These initiatives are not specific to WEM reform, or the delivery of the other WEM service capex projects. Digital Delivery is intended to build a digital hub to service all future customers from registration, legal to data and reporting. Design and scoping of this may be beneficial but may not see material benefits with implementation at such an early stage.

In the revised Digital Roadmap plan for the first AR5 year, AEMO has proposed a total capex of $610,000 to cover the WEM share of the Digital Roadmap roll-out in the Solutions category.

- **Digital delivery, AEMO web enhancement ($165,000):** is aimed at AEMO's corporate website and associated portals due to its fragmented nature and incoherent layout and access points. The proposed solution here is consistent with AEMO's 2016 decision to consolidate the corporate website and portals. Any other standalone option would result in a duplication of effort and maintaining the existing site in our opinion would not be worthwhile over the long-term.
- **Corporate systems, design ($254,000):** This project is to design and review the state of the current corporate systems capabilities. This would be required for AEMO to establish how WA fits in with rest of the AEMO corporate systems and will then determine the scope of subsequent projects to replace, rationalise or upgrade existing systems. Alternatively, AEMO has indicated a standalone review most likely would involve additional costs relating to duplication of licenses, service management and vendor support.
- **Enterprise capabilities, enterprise architecture uplift ($191,000):** will create a central repository mapping all systems and provide guidelines for IT development to enable more efficient systems development. AEMO requires undertaking this work to properly identify how the existing WA systems including WEM reform systems would fit in the Digital Roadmap context. AEMO has identified this as a key project to be able to answer questions pertaining to how the existing WEM systems may also transition onto the new Digital Roadmap platform.

It would be important for ERA to fund the WA portion to allow the WEM be considered in the design and scoping stages. However, additional cost details including the allocation methodology from the enterprise level has not been provided to assess its reasonableness.

3.2 Recommendations

We understand the Digital Roadmap is a long-term vision and many of these changes particularly infrastructure, processes, people and culture will require changes well in advance to successfully implement this vision. Although the revised $13.0 million capex proposed by AEMO for the WEM won't be passed through in the form of market fees until AR6 after the Digital Roadmap platform has been implemented, we acknowledge that the Digital Roadmap project is still at an early stage and emphasise the approval requirements set out in the WEM Rules. There is not enough information for ERA to confidently approve the full capex as meeting the lowest practicably sustainable cost requirement, however, IES supports the notion of including the WEM in AEMO's consideration of the enterprise-wide Digital Roadmap design and planning.

The revised first year costs by AEMO includes projects that are directly related to the initial design work and would allow AEMO to determine firmer requirements at a later stage, however, additional cost details including the allocation methodology from the enterprise level was not provided and IES are unable to assess the reasonableness of the underlying cost estimates.

IES's overall recommendation is that ERA reject the entire AR5 Digital Roadmap capex proposal and hold off approving the revised first year costs until which time AEMO is able to provide detailed cost breakdowns. At some later date, a stronger business case and implementation costs including alternative options, where applicable, can be provided to support AEMO's assertion that the Digital Roadmap is the right solution and lowest practicably sustainable cost for the WEM.

4 WEM Reform

The WEM reform program has been endorsed by the Minister for Energy to ensure improvements to WEM operations are carried out which also supports the government's broader objectives for the energy sector. The set of proposed changes has long been viewed as necessary by the ERA and market participants and is broadly consistent with the previous Electricity Market Review (EMR) design[22]. The actual design of the WEM reform package won't be finalised until mid-2020 and still needs to undergo consultation with market participants before a planned start date of October 2022.

The WEM reform program comprises significant changes and improvements to the operations of the WEM, including a new dispatch engine and implementation of constrained network access, to prepare for projected system challenges such as the changing generation mix and increasing DER. AEMO note that changes would need to be pursued regardless of the WEM reform because of the need to adapt to challenging new conditions. Over the medium term, a failure to enact reform measures will likely pose security and reliability risks and hold back DER integration. Some of the measures as part of the WEM reform include:

- Improved reserve capacity pricing mechanism;
- Constrained network access framework;
- Security constrained economic dispatch;
- Co-optimised energy and ancillary services;
- Shorter gate closures, facility bidding, 5-minute dispatch; and
- Market power mitigation

AEMO's role has been expanded since the EMR, from implementation to also include preparing, planning and designing in conjunction with the Public Utilities Office (PUO) in accordance to clause 1.20.1 of the WEM Rules. The costs associated with this expanded role are to be recovered under the same framework as WEM services and therefore be borne by market participants.

The WEM reform work commenced in AR4 but actual capex ($1.6 million) was lower than what was proposed as a consequence of slower progress on some elements of market design. The total proposed cost of WEM reform work in AR5 is $48.5 million with another $5.7 million estimated for AR6. This is based on AEMO's best understanding of the requirements to date[23]. The WEM reform has been structured as two tranches of work broadly split into what groundwork is required and is more certain, followed by the delivery of security constrained

[22] The core design features are generally consistent, however, the EMR was intended to be implemented under the National Electricity Rules framework. AEMO also has a greater responsibility in delivering the work program under the current arrangement.

[23] This was revised in the AEMO Draft Decision Response.

economic dispatch in tranche 2. The overall contingency provision of 30% has been revised down to 25% in AEMO's response to ERA's draft decision.

The PUO is responsible for assessing the net market benefits and previously commissioned a study on the EMR design which shares the same core design concepts as the WEM reform program. Benefits were estimated to be between $190 million to $375 million in present value terms. The PUO is expected to commission another study later in 2019 specific to the WEM reform implementation.

4.1 Considerations

One of the main concerns is whether ERA should approve the full capex amount over the full AR5 term given the level of uncertainty still present with the market design and systems required. AEMO recognises the need for budget certainty and a limited capability to undertake the necessary work without funding secured in advance, but also the fact that there is still further work to finalise the market design of the WEM reform package.

Additional consultations and work on the WEM reform program will assist to develop clarity but the final design won't be formally approved until mid-2020 (Figure 6). This impacts how the ERA should approach capex approval for this WEM reform work. The uncertainty is embedded in the contingency values for each of the AR5 years in shown in Table 1 below. Tranche 1 is scheduled to be completed by FY2020 and has a much lower contingency (13%) than tranche 2 which starts towards the end of FY2020 and continues through AR5 with a higher contingency of up to 31%. Tranche 1 and tranche 2 costs over the AR5 period were not explicitly provided but can be roughly split into costs for FY2020 and costs over FY2021 and FY2022, respectively. The higher contingency values are due to the higher risk IT design and delivery labour requirements for tranche 2.

Table 1 Proposed AR5 WEM reform capex requirements ($000's)

Component	FY2020	FY2021	FY2022	Total
Resources	6,787	13,065	13,905	33,757
Platform	805	2,069	918	3,791
Expenses	36	36	36	107
Contingency	1,022	3,590	4,642	9,254
Borrowing Costs	285	619	643	1,548
Total	8,935	19,379	20,143	48,458
Contingency (%)	13%	24%	31%	25%

Source: Revised costs from AEMO Draft Decision Response.

AEMO states the proposed WEM reform work must commence in 2019-2020 to meet the October 2022 deadline. This refers to tranche 1 which has more certainty and lays the groundwork for the balance of WEM reform work. As tranche 2 accounts for the majority of the WEM reform capex, has the most uncertainty and doesn't start until late FY2020, it may be prudent to allow for certainty to develop and submitting a revised proposal under a staged approach consistent with the approach adopted for the AR4 review.

A staged approach would require ERA approve tranche 1 costs and baseline costs to ensure AEMO has the resources to cover design and scoping for the WEM reform package across the entire AR5 period. The baseline costs would be directly related to ensuring a core WEM Reform team was available throughout. Updated information on these costs were provided and include 22 staff (on a full-time equivalent basis) across roles in program management, market and rule design, operational subject matter exports, and IT design and management over the entire duration of the AR5 period. This alternative approach was costed by AEMO at $19.9 million but includes a 25% contingency associated with the baseline costs in the second and third AR5 year. IES view a contingency margin of 13.5% to be more appropriate and arrive at an adjusted figure of $18.9 million[24].

Under a staged approach, AEMO has provided additional costs it would be likely to incur. These costs are listed below including the percentage increase to the total AR5 WEM reform cost (excludes contingencies) and represent the higher range of estimates provided. Downward adjustments would need to be applied contingent on what is approved by ERA in the interim if a staged approach were to apply. The certainty associated with capex proposals under the staged approach would need to be weighed against potentially increasing the WEM reform capex requirement by more than 5%[25]. The increase in potential costs are:

- Risk premiums because of efficiency losses associated with less time for resource planning of resources ($2.2 million, 4%);
- Cost of in-period submissions ($170,000);
- Risk of delays and needing fixed costs for longer ($0.75 to $1.25 million, 3%); and
- Delayed market benefits associated with WEM reform delays. No costing for this was provided[26].

In terms of the entire proposed capex, AEMO's implementation approach is based on an in-house delivery to leverage skills and the NEMDE solution for the WEM. Although external providers can be competitive relative to an in-house approach, AEMO provides sufficient reasoning for why procuring off-the-shelf systems may not be cost-effective in its current state when design and scope have not been finalised. AEMO state vendor quotes can vary widely with no assurance of being able to deliver the solution optimally when requirements are of a non-firm nature. IES agree with this general notion, however, note the difficulty in verifying what has been proposed is the lowest practicably sustainable cost[27]. There may be

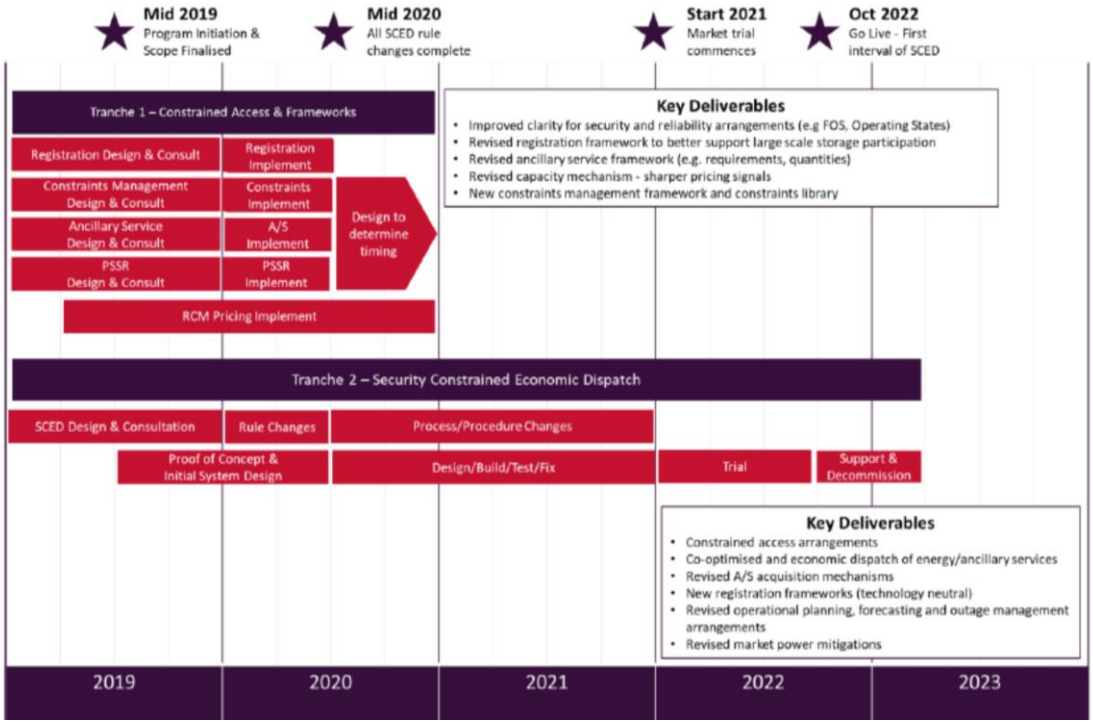
[24] The 13.5% contingency is based on the revised first year costs for WEM reform work in the AEMO Draft Decision Response.
[25] IES is of the opinion AEMO could manage costs more effectively than what is suggested here.
[26] This could be significant given what was indicated in the EMR, however, Clause 1.20.3(a) of the WEM Rules state capex approvals need to be based on the WEM reform package implemented before October 2022.
[27] The normal process would require AEMO to (1) scope the systems functionality, (2) internally estimate the cost of developing and maintaining it (3) obtain quotations from products from major equipment vendors, and (4) justify decision to proceed with an in-house implementation against the information collected from vendors.

opportunities to explore external vendor solutions for comparison when the design is finalised although the timing would most likely rule out this option.

In comparing the total capex of WEM reforms to other comparable implementations either by AEMO or in other jurisdictions, IES note there is very limited direct comparisons available for various reasons. Based on our experience working on ICT projects and applying high-level adjustments to labour cost differentials between south-east Asia and Australia, we can conclude the $55.8 million proposed for the WEM reform program[28] is high but not unreasonable.

AEMO also highlight material benefits from leveraging the Digital Roadmap platform[29]. This would suggest the $48.5 million capex proposal over the AR5 period is conservative as the proposed WEM reform cost is calculated on a standalone basis. AEMO has since provided a capex cost saving guidance of $3.9 million although this would include benefits associated with a Digital Roadmap implementation for all AR5 projects.

Figure 6 WEM reform program timing



Source: AEMO AR5 proposal

4.2 Recommendations

IES view that there is not enough certainty for ERA to approve the full capex. The increase in costs associated with a staged approach is not significant enough to move away from this approach, however, we note that implementing tranche 1 within the first year of AR5 and

[28] Includes AR4 and AR6 capex amounts.
[29] AEMO Confidential Submission.

approving baseline costs for the remaining term is key to delivering the entire WEM reform on time by October 2022. We propose ERA approve the first-year capex figures as most of it is related to tranche 1 and the WEM reform core team costs for the remainder of FY2021 and FY2022. The capex amount corresponding to this recommendation is $18.9 million after an adjustment for contingency for the second and third AR5 years.

Towards the end of FY2020 additional clarity should have developed allowing AEMO to re-submit the proposal for the balance of tranche 2 work. This would entail additional resources and effort from AEMO and the ERA but provided there is sufficient time to allow for the in-period submission, we view this staged approach as the balanced option. The ERA would need to consider the timing risks and whether this is possible within the regulatory framework. We would also encourage AEMO provide capex figures specifically with and without the Digital Roadmap platform[30].

[30] This may be possible after FY2020 if WEM costs are approved for the relevant foundational Digital Roadmap projects.

5 WEM Services

WEM services pertains to AEMO's provision of system planning and management services and market operation and administration services in accordance with clause 2.22A.1 of the WEM Rules. The updated capex requirement for WEM services over the entire AR5 period is forecast to be $24.6 million[31]. Approximately half of this relates to the Digital Roadmap and the remaining half can be classified as either 1) end of life replacements or upgrades to existing systems, 2) completing the transition of system management operations from Western Power to AEMO, or 3) required system changes due to rule changes.

This section summarises our assessment of each individual capex project dealing with the provision of WEM services. A brief overview of the proposed capex projects is provided below. Digital Roadmap which is also a WEM service is discussed separately in Section 3.

5.1 Overview of WEM services capex projects

IES recommends that ERA approve $9.1 million of the $11.6 million proposed under WEM services[32]. IES regarded many of these projects to be critical but recommend some projects be pushed back based on insufficient information around the exact requirements and costing. Detailed cost breakdowns were provided detailing labour resource (internal and external), software and hardware requirements and any other relevant information[33]. IES did not find anything unreasonable or inconsistent with the specified requirements.

Table 2 provides a high-level snapshot of the WEM services (excluding Digital Roadmap) review recommendations. These findings should be read in conjunction with the detailed considerations in the following sub-sections.

Table 2 WEM services review summary ($000's)

Category	Project	Original Proposed Capex	AEMO Revised Capex*	Recommended Capex	Reason
Systems transition	Power systems operations project	473	516	473	Retain original contingency submission
Systems transition	System management system transition	2,209	2,215	1,805	Removed contingency for remediation activities and hardware and licenses

[31] AEMO Draft Decision Response.
[32] The original capex amount for WEM services (excluding Digital Roadmap) was $13.2 million. The revised $11.6 figure excludes the Rule Change Allowance and Accommodation components.
[33] Some projects were based on AEMO's standard estimation model.

Category	Project	Original Proposed Capex	AEMO Revised Capex*	Recommended Capex	Reason
Systems transition	e-Terra 3.2 upgrade	687	0	0	Decision to directly install e-terra version 3.2 as part of PSO project
Systems transition	Business continuity capability	498	229	229	
Systems transition	System management application remediation	406	402	179	Approval for SOCCUI only
Upgrades or new systems	POMAX EDM application and database upgrade	1,036	997	997	
Upgrades or new systems	Enhanced control room tools	304	314	0	Not enough information to support lowest sustainable cost
Upgrades or new systems	Demand and renewable energy forecasting	90	89	0	Not enough information to support lowest sustainable cost
Upgrades or new systems	Market operator interface	420	363	363	
Upgrades or new systems	PASA process improvement	216	209	0	No costs are incurred until the second year and can be deferred until requirements are known towards end of first AR5 year
Upgrades or new systems	STEM Fortran Replacement	469	448	0	No evidence of lowest cost
Upgrades or new systems	Identity and Access Management	1045	112	112	
Upgrades or new systems	Hardware and software lifecycle support	904	864	817	Adjustment to contingency percentage
Upgrades or new systems	POMAX Settlements Replacement	1,597	1,521	1,521	

Category	Project	Original Proposed Capex	AEMO Revised Capex*	Recommended Capex	Reason
Upgrades or new systems	Reduction of Prudential Exposure - Phase 2	2,324	2,478	2,478	
Rule change	Spinning reserve cost allocation (RC 2018_06)	176	129	129	
Rule change	Admin improvements to outage process (RC 2014_03)	408	759	0	No risk to delaying capex approval for more accurate costing
Total		**13,262**	**11,646**	**9,103**	

** Based on AEMO Draft Decision Response*

5.2 Upgrades to end-of-life or new systems

5.2.1 Reduction of Prudential Exposure - Phase 2

The Reduction of Prudential Exposure (RoPE) - Phase 2 project relates to the RC 2017_06 rule change approved by the Rule Change Panel in May 2018. Rule change RC 2017_06 seeks to minimise prudential risk arising from market customer Individual Reserve Capacity Requirement obligations by adjusting the capacity credit allocation process because of concerns around capacity payment shortfalls in the event of a default. The rule change is expected to commence in June 2019.

Phase 1, which covers the requirements of this rule change, is due to be completed by May 2019 with an estimated actual cost of $1.6 million against a forecast of $2.7 million[34]. Phase 2 is intended improve the calculation accuracy by moving to a calculation that is based on real-time outcomes and has the benefit of reducing credit support requirements and minimising the risk of participant default. The current calculation methodology is based on data inputs that can be up to 70 days out of date. The total capex of $2.32 million is proposed to be incurred in the first year of AR5.

Considerations

- The original $2.32 million capex was revised upwards in May 2019 to $2.48 million. The contingency increased from $452,000 to $606,000 relating to the potential for added

[34] Rule Change Panel, Final Rule Change Report: Reduction of the prudential exposure in the Reserve Capacity Mechanism (RC_2017_06), May 2018, page 31.

complexity associated with settlement calculations and the integration with existing WEM systems[35].

- The change itself is aligned to broader Wholesale Electricity Market Objectives of producing efficient outcomes and lowering end-user costs. AEMO estimates potential savings of $1.3 million a year, in aggregate market terms, based on AEMO's calculation of overstated credit support requirements of up to $25 million.
- AEMO note participants have been engaged on the Phase 1 and 2 work and responses from the various forums have generally been supportive. Specific capex costs relating to RoPE - Phase 2 were presented in the WA ECF on 11 December 2018. The costing was based on a competitive tender to assess implementation strategies. The proposed cost reflects the lowest cost conforming vendor that best met the requirements[36].
- RoPE - Phase 2 is based on a dynamic full outstanding amount calculation that utilises all available and estimated data to determine the exact STEM exposure, whereas the alternative was based on available data only. Both options had very similar resourcing requirements and were put forward to market participants in October 2017. The approach based on a full set of data inputs was chosen in favour of the alternative approach.
- There is no intention to replace this capex project considering AEMO's Digital Roadmap vision. AEMO has also confirmed the project life of RoPE - Phase 2 is expected to span five years.
- The work delivered here will be extended to support the POMAX settlements replacement project and will drive cost efficiencies for that project (see Section 5.2.1).
- Detailed cost breakdowns were provided detailing labour resource (internal and external) and hardware requirements and were not found to be unreasonable based on our understanding of the scope required. The hardware requirements are based on the need for faster processing requirements and larger volumes of data.
- Contingency on this project has been set to 32% which is higher than what was approved for Phase 1 reflecting the complexity of the calculations and implementation.

Recommendation

Delivering RoPE - Phase 2 is consistent with the Wholesale Electricity Market Objectives and that there are clear benefits associated with the project. The solution itself does meet the requirement that it is the lowest practicably sustainable cost given it went out to a competitive tender process, and AEMO has confirmed that this capex project will not be replaced with the potential introduction of the Digital Roadmap i.e. is expected to serve the full intended 5-year project life. There is also the consideration that this project will provide the groundwork for

[35] AEMO Draft Decision Response. There is a component of work from Phase 1 that is scheduled in the first year of AR5 and included in the Phase 2 contingency - this should be included in the base cost as it is a 100% known requirement. This would reduce the contingency to $386,000 or 13% of the total base cost.
[36] AEMO, Project Overview Reduction of Prudential Exposure, 11 December 2018, slide 6.

the critical POMAX settlement replacement project. As such, IES recommend ERA approve the full capex amount.

5.2.2 POMAX Settlements Replacement

The current POMAX settlements system is supplied by Brady PLC and is outdated, difficult to change and relies on vendor support for any issues. AEMO note several key risks associated with maintaining the settlement system as AEMO is the only remaining user of this product and support is provided out of Scotland by two developers leading to key person risks. The proposed solution is to extend the settlements system under Reduction of Prudential Exposure - Phase 2.

The total capex has been proposed at $1.52 million most of which will be incurred in the first AR5 year[37].

Considerations

- Although Brady PLC have offered to extend support, the key risks remain and is not a viable solution moving forward. AEMO estimate the costs of maintaining the system will be more than $400k[38] over the AR5 period. There would also be additional costs over and above what would be required of the proposed solution for any related project/system changes that is required to interface with the existing POMAX settlements system due to external vendor reliance.
- Key risks listed in 2018 WEM Audit Report highlight the reserve capacity mechanism settlement system has added complexity to the current settlement process (largely related to data interfacing) and that AEMO should consider, ideally, merging all settlement processes into a single settlement run.
- The proposed replacement option is based on AEMO's in-house solution which will remove any external dependencies when considering changes or extension to the system. The proposed solution and proposed capex will leverage off the work rolled out under RoPE - Phase 2 to minimise costs. The RoPE project was identified by the 2018 WEM Audit Report as an opportunity to replace the POMAX settlements system.
- Off-the-shelf solutions were considered but rejected due to concerns of costs and reliance on external support for a key WEM function. A NEM-based solution was not appropriate for the WEM and waiting to consolidate the settlements system onto the Digital Roadmap platform would not be available for at least three to five years. AEMO's stance is to immediately replace the current system.
- Detailed cost breakdowns were provided detailing labour resource (internal and external) and hardware requirements. The hardware requirements are smaller than that

[37] Revised capex figure from AEMO Draft Decision Response and includes minor changes to the base cost and contingency values.
[38] Historical support costs provided by AEMO supports this figure.

provisioned for the RoPE - Phase 2 project due to a difference in processing requirements. These costs were not unreasonable or inconsistent with the specified requirements.

- The project includes an overall 37% contingency factor mainly for external labour as formal design has not been completed and reflects the uncertainty and complexity involved with the replacement of a critical system.
- The design will be finalised in February 2020. Implementation is not due to start until after RoPE - Phase 2 in January 2020 because of the dependency and is expected to be completed before Sep 2020.

Recommendation

IES agree that the key risks identified warrant consideration for the replacement in the AR5 period and the proposed in-house solution is in line with recommendations from the 2018 WEM Audit Report. The in-house solution leverages work already underway in RoPE and will remove one of the core risks associated with external solutions and reliance on vendors to make changes.

With regards to the potential for 'regret spend' and the Digital Roadmap vision, AEMO intends to utilise this capex item for as long as practicable until which time it is prudent to transition onto the new platform. The proposed solution will require changes but will not be replaced with the introduction of the WEM reform program.

We do not perceive any material benefit in delaying the POMAX settlements replacement until the design is finalised (for a lower contingency) when weighed against the estimated annual support costs and risks for keeping the existing system. The high contingency reflects the complex nature of a critical system replacement and only actual incurred capex is passed through to market participants. IES recommend the ERA approve the full capex amount of $1.52 million.

5.2.3 POMAX EDM application and database upgrade

The POMAX EDM metering product is provided by Brady PLC and requires upgrades to the underlying Oracle database and Windows operating system it currently sits on. This upgrade will mitigate risks associated with running critical systems on unsupported software. Oracle version 11c and Windows Server 2008 R2 will reach end of life, i.e. will not be supported by Oracle and Microsoft by December 2020 and January 2020, respectively. The POMAX EDM software would also require a version upgrade in conjunction with the Oracle database upgrade. The $997,000 proposed capex is planned for the first AR5 year[39].

Considerations

- AEMO note critical risks associated with running critical systems that are unsupported and the potential to impact the security and stability of the power system.

[39] Revised down from $1.036 million to $997,000 in the AEMO Draft Decision Response and includes minor changes to both base cost and contingency values.

- AEMO considered an alternative rebuild option but the proposed upgrade solution was more cost-efficient given external consultancy fees ($3.5 million) associated with the rebuild option would be far greater than the proposed upgrade approach. The NEM is currently exploring a new metering solution for its 5-minute settlement rule change and would not be available for the WEM to adopt at this point in time.
- The POMAX EDM metering product is still used by a larger customer base and therefore key dependency risks are not as critical as that affecting the POMAX settlements system. The upgrade of the EDM metering product will be carried out by Brady.
- Although the Oracle upgrade will be supported up until 2025, AEMO are proposing to depreciate the capex over the lower range of project life guidelines in its Fixed Asset and Intangibles Policy. AEMO recognise there may be a requirement to upgrade this metering solution sooner than 5 years.
- Resources mostly relate to labour costs particularly testing requirements. The contingency of 8% was set on the basis of a standard database and operating system upgrade.

Recommendations

There is a clear requirement to upgrade the systems relating to its POMAX EDM to remove any key support risks associated with the existing Oracle and Windows platforms. AEMO has also considered other options and what has been proposed is in our opinion consistent with the lowest practicably sustainable cost requirement. IES recommend ERA approve the full capex amount of $997,000.

5.2.4 Demand and renewable energy forecasting

The demand and renewable energy forecasting capex project is intended to improve DER and renewable energy forecasting which will lead to more efficient dispatch outcomes in the WEM. The South-West Interconnected System (SWIS) has a high penetration of DER and a desired increase in forecasting accuracy supports the benefit aspect of this proposal.

AEMO's Operational Forecasting team is currently performing a pilot study across the NEM and WEM looking into various data sources which may be used to improve forecasting outcomes. The data will then be integrated into SWIS forecasting tools and the proposed capex specifically relates to the integration of data. Total proposed capex for this project is $89,000 incurred in the first year of the AR5 period[40].

Considerations

- The DER data will be integrated into the PSO (demand forecasting system) and this work would be retained with the WEM reform changes. It is unclear whether this would include changes to the underlying forecast methodology to leverage benefits of the expanded input pipeline.

[40] Minor cost revision from the AEMO Draft Decision Response.

- AEMO confirmed there is no business case to demonstrate the benefits of an improved forecast accuracy, or improved forecast accuracy in general. However, it is highly probable integrating additional data sources will materially improve forecasting outcomes.
- The contingency value is set at 29% with a project life of 3 years. The 29% contingency is based on the potential need for some external resources for developing and testing, and the potential for added scope. IES has concerns around the correct application of the contingency calculation for the added scope component[41].
- The resourcing costs and FTE requirements do not seem unreasonable. The costing was based on AEMO's standard cost estimation model but we note alternative solutions and associated costs, such as from external vendors, for improving demand and renewable forecasting accuracy have not been provided.

Recommendations

IES do not dispute the benefits of integrating additional data sources to improve forecasting accuracy, or the benefits it would provide in the form of more efficient dispatch outcomes. However, there is no clear indication what has been suggested is the lowest cost or the best solution to achieving similar outcomes. IES recommend ERA reject the capex proposal on this basis, or at the very least until AEMO are able to provide additional details around the accuracy improvements and benefits, and high-level cost estimates for alternative options. We also recommend AEMO review the contingency calculation to ensure its calculation has been applied correctly.

5.2.5 Enhanced control room tools

This capex proposal is to allow for additional tools to be deployed to provide a more accurate understanding of real-time operations and is intended to help with growing DER penetration in the SWIS. The tools are expected to be prototyped then developed by AEMO or sourced from third-party vendors. The total proposed capex is $314,000 spread across the AR5 period[42]. The proposed tool suite will include MIAMI which is a logging tool that is currently used in the NEM. The MIAMI tool accounts for $54,000 of the total capex.

Considerations

- The cost of the MIAMI logging tool ($54,000) is expected to be implemented in FY2021 and reflects the requirements from a previous implementation within AEMO.
- There already exists a logging tool based in Excel. The information logged is not uploaded to a database, nor is there the ability to efficiently perform search and comparisons. Although the intention is to have a standardised tool, it is not clear if there are lower cost alternatives such as implementing data mining capabilities into existing processes.
- The other tools will allow AEMO to properly monitor and respond to various systems states relating to inertia, ($76,000), voltage/var ($75,000) and system strength. ($83,000). These

[41] A potential 25% increase in effort has been applied as 125%.
[42] AEMO Draft Decision Response.

tools will be prototyped in-house and deployed once validated. The WEM reform program does not include situational awareness tools. AEMO has investigated off-the-shelf options which generally would require additional customisation, however, the associated costs compared to the proposed capex has not been provided.

- A contingency of 34% was applied, with a project life of 3 years. The contingency includes the potential for an increased scope and effort during the integration phase which has been estimated to add an additional 25% on top of the base cost. The calculation of this component was applied incorrectly as a potential 125% uplift was included.
- The risk of delaying this process is that information provided to individual WEM controllers may not reflect an accurate snapshot of system conditions resulting in inefficient market outcomes or in the worst-case scenario a breach of system security limits. However, the rating and cost of this risk relative to the proposed capex is unclear.

Recommendation

IES recommend ERA reject the capex proposal until AEMO is able to provide evidence off-the-shelf (plus support costs) are indeed more costly than what has been proposed here, and whether it would be worthwhile to build in data mining capabilities into the existing MIAMI tool. We also recommend AEMO review the contingency calculation to ensure it has been applied correctly.

5.2.6 PASA process improvement

AEMO is required under the WEM rules to provide the Projected Assessment of System Adequacy forecasts on a regular basis across three different horizons. The 2018 WEM Audit Report identified several shortcomings and non-compliance risks in the PASA process. This capex item is focused on providing an alternate application to replace the existing Excel-based tool. The solution is yet to be finalised and total capex proposed is $209,000 incurred in the second AR5 year[43].

Considerations

- The current Excel tool is not capable of being modified to comply with the WEM PASA requirements. Areas of non-compliance include 1) the current PASA process does not consider transmission constraints and 2) the ST PASA is not revised when there are material changes[44]. Benefits with the replacement also include minimising the risk associated with the manual process[45]. These instances of non-compliance were assigned a low risk rating corresponding to a minor impact on operations and outcomes if not addressed.

[43] Revised in AEMO Draft Decision Response.
[44] 2018 WEM Audit Report, Ref: 17WEM2.16 and 17WEM2.17.
[45] Ibid, Ref: 17WEM2.08.

- The shortcomings to the PASA process and reporting limit its usefulness for market participants and overall efficiency of market dispatch. Market participants have been engaged on the matter and responses support an improved PASA process.
- A contingency of 26% was applied, with a project life of 3 years. The contingency includes the potential for 25% in additional effort because of scope change, however, the calculation assumes an incorrect 125% uplift.
- The tool will be developed after the system management system transition project is complete. The current capex proposal shows no costs incurred in the first year of AR5 as the actual requirements and detailed costing will not be finalised until June 2020 and would still require market participant feedback.
- The nature of the solution will be built with implications of the Digital Roadmap in mind.

Recommendation

Although AEMO is required to rectify non-compliance issues, there is still design work before the full requirements are finalised towards the end of the first AR5 year. As such, IES recommend ERA reject the capex until which time AEMO is able to provide a more certain solution design and cost breakdown. We also recommend AEMO review the contingency calculation to ensure it has been applied correctly.

5.2.7 Market operator interface

The current Market Operator Interface (MOI) is a legacy system that needs to be replaced citing security concerns and is supported by broader recommendations from the 2018 WEM Audit Report. The MOI was built off Java applet technology which is no longer supported by the major browsers due to security concerns and AEMO are planning to re-write the MOI to remove the current security risks. The version of Java the MOI is based on will also be unsupported in the near future. The MOI is important as it provides WEMS event management, updates of global key parameters, participant activity monitoring and outage monitoring.

Total proposed capex is $363,000 incurred in the first AR5 year[46].

Considerations

- AEMO considered three options and costings before deciding on the proposed approach:
    1. Heavyweight MOI replacement: entails a full rebuild and loading all events management components of the MOI from the WEMS. This would be based on AEMO's endorsed technology stack and delivered via a web interface. This proposed solution is estimated to cost over $1 million but would have an expected project life between 7-10 years.
    2. Light weight MOI replacement: the data would be extracted from the WEMS and placed in a separate system that specifically serves the MOI interface and would be

[46] Revised for incorrect contingency amount in AEMO AR5 Proposal.

web-based. The lifespan of the solution would be 5-7 years with costs estimated at $600,000.

3. Extend existing WEB applications: by adding additional screens and would require no backend changes as existing data sources would be retained. This AEMO's preferred approach as it is the most cost-effective and easiest way to remove the applets and reduce cyber security issues. This has a proposed cost of $363,000 to be incurred in the first year of AR5.

- The contingency is set at 12% reflecting the potential for work to be outsourced and unforeseen additional scope and related resources to deliver the project. The project will be amortised over a 3-year project life which is at the lower end of the solution lifespan but reflects the replacement likelihood as part of the WEM reform work.
- If the MOI is left unmodified, AEMO will end up relying on an old version of Java that will be unsupported by Oracle. AEMO has advised of substantial market impacts in the unlikely event that issues arise requiring support from Oracle. The alternative would then be to re-write the MOI based on the newer Java version which is not a viable solution.
- The 2018 WEM Audit Report in general recommended legacy systems be retired or remediated to bring it up to standards required by AEMO. Broader risks associated with legacy systems were rated as medium, and AEMO has in the past experienced manual errors impacting dispatch because of the legacy MOI. There were at least 2 instances of out of merit order dispatch in 2018. We view these instances of non-compliance as material and generally propose remediation in a timely manner based on our systems audit experience.
- Any work carried out on any systems would need to be considered in the context of the WEM reform program, and the potential that it will be entirely replaced.

Recommendations

AEMO has stated the risk of the 'do nothing' approach would not be considered low. IES support the rectification of compliance and support risks associated with maintaining the current MOI even though this is likely be replaced under WEM reform program and therefore selecting the least-cost option makes sense. IES recommend ERA approve the MOI project.

5.2.8 STEM Fortran replacement

The Short-Term Energy Market (STEM) applications are currently based on Fortran which is an old programming language and requires specialist knowledge. This skillset is still present within AEMO but is recognised as not widely available and has seen limited industry use. The STEM Fortran replacement project intends to update the entire STEM application suite based on an updated technology stack which will allow AEMO to rectify issues in a timelier manner reducing operational risks for AEMO in the interim, and allow for easier interfacing with new systems.

Total proposed capex is $448,000 incurred in the first AR5 year[47].

Considerations

- The current risk is related to support and whether AEMO can respond to errors resulting from the underlying STEM applications in a timely manner so as to avoid a market suspension event. A suspended STEM event would have flow on effects for market participants, exposures to the balancing market, and generally less efficient outcomes. Broader 2018 WEM Audit Report findings recommend the replacement of legacy systems which would apply to the current STEM application suite.
- We understand the STEM experienced a number of issues relating to the underlying Fortran code back in 2011/12 causing a delay but there have not been any other issues since that time.
- The proposed capex cost of $448,000 is based on AEMO's internal cost estimate and includes a 24% contingency, to allow for a higher mix of external resources and the potential for added effort and scope. The project has a project life of 3 years. A detailed cost estimate which mainly includes internal staffing costs is consistent with the scope of work required but the solution is still in the early development stages.
- The STEM design will be unaffected by the WEM reform program and therefore won't will not require replacement. However, STEM applications will require changes regardless of situation to ensure they are capable of interfacing with the new WEM systems.
- As part of this proposal, the STEM applications will be redeveloped in accordance to Digital Roadmap standards to easily interface with other systems as necessary and allow for easier extension or changes of the applications. Additional costs would will be required to interface with WEM reform system changes if the current STEM applications were maintained, however these costs have not been provided.

Recommendations

IES agree with the broader recommendations made by the 2018 WEM Audit Report to replace legacy systems. The replacement option suggested here would also be unaffected by WEM reform changes and have lower integration costs with newer systems. However, that there is no evidence what has been proposed is the lowest practicably sustainable cost. We also note there are no dependencies on this project. IES recommend ERA hold off on approving the project until AEMO can justify the proposed solution is the least cost option.

5.2.9 Hardware and software lifecycle support

Current Western Australian systems require additional uplift from time to time to serve growing requirements of storage, compute and/or network across WEM and GSI systems. This

[47] The contingency was revised down in the AEMO Draft Decision Response. Total capex in the AEMO AR5 Proposal was $469,000.

capex item of $864,000 presents the cost of upgrading existing services for the WEM and is spread throughout the AR5 period[48].

Considerations

- Costs are based on forecast requirements, and a review of its asset register and end of life upgrade or replacement timings. Costs are matched against supplier details which are tested via AEMO's regular testing of market through competitive tender processes. The AR4 data centres involved in this uplift would still be relevant in the context of the Digital Roadmap.
- An alternative to an in-place upgrade would be to migrate systems over to a new platform however, this is not at all feasible since requirements are incremental, and the vision of AEMO is for all infrastructure to be transition onto the Digital Roadmap.
- The contingency for this project is 22% and represents the unknown future requirements for all current AEMO WEM systems. IES note AEMO's AR4 July 2018 submission included the migration of its Malaga data centre to AEMO's private cloud platform which we deem more complex than what is proposed here. The contingency associated with the Malaga data centre migration project was 11% and was not required to be drawn.
- The split of the total WA cost ($919,000) covering the WEM ($864,000) and GSI ($55,000) is based on a corporate allocation split. An 94% allocation was made to the WEM on this basis and is consistent with how other enterprise-level capex projects have been allocated between the two markets. AEMO will assess this allocation at a later stage but do not expect a material deviation from what has been suggested.
- IES assume the uplift here excludes ongoing capex projects that have a specific hardware component such as that for RoPE - Phase 2.

Recommendations

IES recommend ERA approve the capex based on a smaller contingency. We believe this is a standard process and that AEMO has the information to accurately assess the growth requirement and corresponding resources required to maintain current systems infrastructure over the AR5 period. Our opinion is AEMO would be capable of managing this project with a lower contingency of 15% bringing it closer to what was approved for the Malaga data centre migration. This would bring the total capex down from $864,000 to $817,000.

5.2.10 Identity and access management

Identity and access management is related to the Cyber Security component of Digital Roadmap. The broader requirement relates to a required uplift in access security across all of AEMO's internally and externally facing systems and forms the first tranche of the broader Cyber Security work. This work to determine the scope, design and implementation plan is in

[48] Contingency and base cost revised in the AEMO Draft Decision Response.

progress and commenced in the final year of AR4. The proposed capex in the original AEMO AR5 proposal for the WEM is $1.05 million but has been revised down to $112,000.

Considerations

- The original proposed capex has been revised down to $112,000 and is based on an updated apportioning of costs across the AR4 and AR5 periods and faster than expected progress. The contingency for this project was set at 30% but has since been revised down to zero following the update in work progress.
- The split of total Western Australian costs ($168,000) over the AR5 period for the WEM and GSI was based on reviewing requirements across 18 AEMO systems of which 3 related specifically to Western Australia. Two of these systems were related to the WEM which resulted in 67% of costs allocated to the WEM and the remaining 33% to the GSI. IES do not find this methodology unreasonable and understand the allocations will be reviewed in accordance with the actual effort required over time.

Recommendations

IES recommend ERA approve the work to completion on the basis that this stream of work is near completion and that the remaining capex proposed incorporates certainty to deliver the remaining work with zero contingency.

5.3 Completion of systems transition

5.3.1 Power systems operations project and e-terra 3.2 upgrade

The power systems operations project relates to the transition of system management functions and implementation of the energy management system. The implementation of e-terra 2.5 as part of the power systems operations project will remove the need for AEMO to rely on Western Power's XA/21 system via an existing service level agreement and was originally scheduled to be completed by June 2019. Delays in upgrading e-terra for the NEM has pushed back the schedule for the WEM into the first year of AR5. The $473,000 proposed here is consistent with what was forecast in AR4 but has since been revised to $516,000.

The upgrade of e-terra version 2.5 to 3.2 was intended to be rolled out for the WEM in a separate project and is a vendor-driven requirement[49]. This separate project has a proposed capex of $687,000, however, AEMO has since decided to install version 3.2 directly saving the full cost of moving from version 2.5 to 3.2. The new e-terra system is expected to be live by Dec 2019.

Considerations

- Based on the previous capex proposal, the cost of upgrading Western Power's system was quoted in the range of $6-8 million in comparison to the $3.7 million cost over the span of AR4 and AR5 for e-terra version 2.5. The cost of the e-terra implementation was

[49] Still supported but is on legacy support arrangements where future support is dependent on the client base.

considered reasonable by ERA in its review of AEMO's last AR4 submission back in December 2018.

- The total proposed capex has increased from $473,000 to $516,000 due to a revision of the contingency required. AEMO cited the potential for additional specialist resourcing required over and above what was initially proposed.
- The original contingency of 13% was based on AEMO's experience with the system in the NEM. The e-terra system is currently used for the NEM with the corresponding version 3.2 upgrade to go live by June 2019. This has now been revised upwards to 23%.
- The useful life of e-terra will be amortised over a shorter timeframe of five years in accordance to AEMO's Fixed Asset and Intangibles Policy. This is a shorter period relative to the actual life of an energy management system of around ten or more years.

Recommendations

The delay in spend from the AR4 to AR5 period requires approval from the ERA. As this is not a new capex project, and the base cost and requirements have remained the same, IES recommend approving the costs (including contingency) based on the original proposal of $473,000. It is unclear why the contingency has been revised upwards given AEMO's experience with e-terra in the NEM with no change in circumstances since the original AEMO AR5 Proposal. Should additional resources be required, AEMO can utilise the 10% capex buffer in accordance to Clause 2.22A.9[50].

5.3.2 System management system transition

The system management system transition along with the Power System Operations project will remove AEMO's reliance on Western Power's systems. It incorporates dispatch, outage management, planning and forecasting and the data functions. AEMO had previously decided to extend the service agreement with Western Power under the context of replacing these systems with the introduction of the EMR. However, delays in the EMR along with the WEM reform timeline would require AEMO continue the existing arrangement with Western Power up until October 2022. As part of the July 2018 capex submission, AEMO stated whilst the previous short-term extension of the agreement with Western Power was manageable, retaining it until October 2022 would be imprudent.

The capex required for developing AEMO's in-house system over the AR5 period is $2.2 million based on a copy-and-paste implementation and is consistent with AEMO's July 2018 capex adjustment proposal[51]. AEMO has noted these systems will need to be replaced with the introduction of WEM reform changes.

Considerations

[50] The buffer is based on the entire capex budget and not at the project level, however, would still provide some level of contingency over and above what is approved by the ERA.
[51] Some of the capex planned for AR4 was delayed into the current AR5 period.

- In the previous July 2018 AEMO AR4 submission, AEMO highlighted numerous options that were considered including outsourcing to a third-party vendor, off-the-shelf vendors, or for AEMO to rebuild the system entirely. None of these were determined to be feasible given cost and time considerations. The only available options are the two discussed here.
- Western Power note that these IT systems are end of life and would require significant investment to extend the service. The service agreement would also need to be re-negotiated.
- AEMO has noted these systems will need to be replaced with the introduction of the WEM reform. However, this proposed solution of bringing the systems in-house has been estimated to be the least-cost option and at least be cost-neutral.
- The contingency applied to this project is 30% based on the number of bespoke and higher risk systems comprising the copy-and-paste effort and is consistent with what was recommended in AR4[52].The total contingency of $512,000 comprises $225,000 of costs associated with remediation work which should be included in the System Management Application Remediation project (Section 5.3.3). There is also a provision in the contingency of $182,500 for additional hardware and license requirements corresponding to a cost impact of $730,000 at 25% likelihood – the assumptions underpinning this component is unclear.
- The project will be depreciated over 3 years which is in line with the WEM reform October 2022 deadline.

Recommendations

Although this solution will be short-lived assuming the WEM reform is not delayed, AEMO has taken the necessary steps to show the copy-and-paste option is the most prudent course of action. We note that this proposed function also provides a hedge against delays as AEMO will have the option to enhance and extend the system as required. IES recommend ERA approve $1.81 million which corresponds to the full capex amount minus contingency components associated with remediation activities and the additional hardware and licensing requirements.

5.3.3 System management application remediation

The system management application remediation project relates to work required after the system management system transition to AEMO to remediate many of the underlying systems. The 2018 WEM Audit report found many of Western Power's systems, which will be copy and pasted across, to be outdated and relying on manual processes, or could be simplified to reduce operational risks that have the potential to impact the underlying market. The current capex estimate is $402,000 spread over the AR5 period[53].

[52] Technical advice in relation to the efficiency and appropriateness of proposed forecast capital expenditure requested by the Australia Energy Market Operator for the AR4 Period 2016-19, Stantons International, December 2018, page 18.
[53] Revised in AEMO Draft Decision Response.

Considerations

- This is a separate work program to the system management system transition project and intended to be performed after the transition is completed by November 2019. It is noted that many of these systems that will be transitioned over to AEMO from Western Power only have a short project life with the introduction of the WEM reform program as many of these systems will be replaced altogether.
- The system management system transition has progressed to a stage where AEMO has now identified key areas of remediation, 1) automation of manual processes ($52,000), 2) remediation of security concerns ($109,000), 3) systems operations control centre user interface ($179,000), and 4) other critical works currently not identified ($62,000).
- The systems operations control centre user interface is a critical service used to perform various tasks such as adding constraints, change demand forecasts which impacts dispatch, and generating pre-dispatch plans. AEMO has advised the systems operations control centre user interface regularly fails and requires frequent updates and is hard to implement changes.
- Other work components do not have enough information to establish whether the cost proposed would result in higher cost savings in the interim.
- Contingency for this is 29% across all of the four key areas with a project life of 3 years. The 3 years is consistent with the timing of the WEM reform program. The contingency associated with the different key areas include a reasonable uplift for potentially outsourcing the development and testing work, and an additional 30% increase in scope and effort required.

Recommendations

There are significant risks associated with the systems operations control centre user interface particularly around the regular failures of the system and its potential impact on market outcomes. However, it is unclear whether the proposed cost for the other components meets the approval requirements without additional information around the costs or existing risks associated with maintaining existing processes in place. IES recommend ERA approve only the $179,000 for remediation work relating to the systems operations control centre user interface.

5.3.4 Business continuity capability

AEMO under the current arrangement depend on Western Power for its backup facilities in the event there is the need to evacuate the Perth office if impacted by incident or crisis. This current arrangement with Western Power extends through to January 2020 and Western Power has advised it will no longer be able to extend the contract past this date. The capex proposal is for AEMO to seek an alternative site for its business continuity requirements.

The total proposed capex has been updated to $229,000 and falls within the first AR5 year.

Considerations

- AEMO put forward four options and related costings for consideration:

    1. Leverage existing control rooms and controllers servicing the NEM: Involves operating the WEM out of the NEM control rooms. The different rules and operations of the WEM would require training staff to be able to operate the WEM to cover all shifts in the event of emergency. The cost estimated for this solution was $3 million with 18-24 months of lead time for training.

    2. Leverage existing NEM control rooms but with WEM controllers: Alternatively, WEM controllers could be flown to the NEM control rooms but this also presents a logistics issue given the flight distance from Perth to the east coast. The estimated cost for this was $200,000 per month when required (includes flights, accommodation and rostering costs).

    3. Leasing a commercial facility in WA: Staff could be mobilised quickly with a separate commercial facility with the required facilities and server connections already in place. The cost of this was originally estimated at $498,000 for setup and $72,000 per annum for operating costs. AEMO has selected its preferred leasing option and has revised this option to $229,000 (including contingency).

    4. Purchase a facility: Similar to the above except AEMO makes an outright purchase of a facility. This was not considered viable because of the long-term nature of a property purchase. Property prices remain high and this facility would only be needed on an emergency basis for up to six WEM controllers.

    5. Portable remote access: Using a laptop or computer to securely connect into the WEM systems would be the cheapest option, however, would not suit extended periods of use with risks associated with connectivity and setup which would be far limited than what would be available in a physical backup control room.

- Detailed costs breakdowns for hardware and resources seem reasonable. Although the setup can allow for WEM controllers to operate the NEM, no cost allocation has been made to the NEM for the same reason it wasn't viable for NEM controllers to operate the WEM.

- A 15% contingency has been applied with a project life of 5 years in accordance with AEMO's Fixed Asset and Intangibles policy. The contingency reflects the selection of the facility location and some uncertainty attributed to a higher mix of external resources and setup costs at the facility.

Recommendations

We note the absolute requirement for this capex item in the timeframe proposed by AEMO to ensure there is an adequate business continuity plan post-2020 expiry of the existing arrangement with Western Power. This project would also need to be implemented before the completion of system management system transition by the end of 2019. AEMO has provided high-level options analysis to support a leasing solution to be the lowest cost and sustainable. IES recommend approving the revised capex in full.

5.4 Related to rule changes

5.4.1 Spinning reserve cost allocation (RC 2018_06)

The RC 2018_06 rule change seeks to replace the current runway approach for allocating spinning reserve costs to a full runway approach. The current modified runway approach involves allocating costs based on capacity block sizes, however, this methodology has been noted to distort generation outcomes around the ends of the capacity block ranges to minimise spinning reserve cost allocations[54]. The full runway approach will allow for a more granular cost allocation and is consistent with the Wholesale Market Objectives of improving efficiency and cost reflectivity.

The draft rule change report was released in 27 February 2019 and is currently in the second submission period before a final rule change report is due in mid-June 2019. The total proposed solution is $176,000 and will be incurred in the first AR5 year coinciding with a planned commencement date of 1 September 2019.

Considerations

- AEMO submitted two implementation options:
  - Option 1: was to make changes to the current POMAX settlement system with an estimated cost of $176,000 which is lower than initial estimates of $240,000. This cost has been further revised down to $129,000 due to bringing forward some of the work into the AR4 period[55].
  - Option 2: was to include the new rule change requirements as part of the POMAX settlements replacement project which would have incurred no incremental cost.
  - Although option 1 has a cost associated with it, the interest in addressing the issue lead to the Rule Change Panel concluding that this cost was justified.
- Contingency for this capex project is set at 15% with a project life of 2 years. The 2-year life is consistent with the timing of the POMAX settlements replacement program. The contingency was revised down 13% due to participant support and increased confidence of the rule change as the draft rule change report had no material changes from the first consultation period.
- A detailed cost breakdown of the work involved between internal AEMO staff, Brady PLC and Robinson Paul Bowmaker was provided. Costs were not unreasonable based on our understanding of the scope of development work[56].

Recommendations

[54] Draft Rule Change Report: Full Runway Allocation of Spinning Reserve Costs (RC_2018_06), Rule change Panel, 27 February 2019

[55] Revised in AEMO Draft Decision Response.

[56] AEMO incorrectly allocated $55,000 platform costs which should be classified as resources.

IES recommend ERA approve the $129,000 capex to ensure the rule change can be implemented by the planned rule change start date. The details provided suggest the proposed solution has been consulted via the rules change process, and options analysis was provided.

5.4.2 Admin improvements to outage process (RC 2014_03)

Rule change RC 2014_03 was proposed back in 2014 with the objective of improving the efficiency of outage logging, outage reporting and the associated administration processes. The rule change was previously placed on hold due to the Electricity Market Review. Under the renewed rule change interest, the scope has been expanded to possibly include improvements to the calculated outage information to improve information efficiency and is currently under consideration.

Since the original rule change proposal, the calculation of outage information was transferred from system management systems to the WEMS. The decision was made to modify the WEMS systems as opposed to any of the system management systems as it is currently being transitioned over to AEMO.

The cost of this project is estimated at $759,000 and incurred within the first AR5 year[57].

Considerations

- The proposed cost of $759,000 is significantly higher than the original rule change proposal. Any comparisons across the two are difficult due to the expanded and non-firm scope and associated contingency buffer. The scope is yet to be finalised. The draft rule change report was extended and is not due until the end of 2019 and the final report won't be released until February 2020[58].
- This project is dependent on the timing of the System Management System Transition project as adjustments to it would need to be applied post-implementation. This is expected to be delivered by November 2019 and any delays to that project would delay the delivery of this rule change implementation.
- A 25% contingency has been proposed with a project life of 3 years. The contingency is based on a 50% chance that the baseline scope may increase by up to 50%, but also has an equal chance of reducing by a similar amount. The net expected value of this is zero and the correct application would be to lower the base capex cost and only factor in a positive increase in cost impact from the expanded scope.
- AEMO acknowledge more accurate cost forecasts could be delivered with certainty of the full scope of rule change to be implemented.
- There were no risks noted by AEMO for delaying this project as the rule change itself has been delayed since 2014. AEMO would be able to provide an indication of costs and

[57] Revised in AEMO Draft Decision Response from $408,000 indicated in the original AEMO AR5 proposal.
[58] https://www.erawa.com.au/rule-change-panel/market-rule-changes/rule-change-rc_2014_03

benefits with a firmer scope following the release of the draft rule change report planned towards the end of 2019.

Recommendations

IES recommend ERA reject the capex proposal in the interim, favouring a revised submission when there is more clarity on the scope of work which is expected by the end of this year. There are also dependencies on the timing of the System Management System Transition project which may possibly push this project back. There are no material risks associated with the existing process and provides comfort that a more prudent outcome can be achieved with a deferral of this capex item until more certainty can be achieved. IES also recommend AEMO revisit the structuring of base and contingency costs.

6 Summary of Findings

IES reviewed the AEMO AR5 proposal to determine whether each individual project met the WEM Rules requirements considering the approach, base cost and alternative cost estimates, risk and dependencies, and any other project-specific information deemed relevant.

All of the individual capex projects had a clear purpose that was in line with the Wholesale Electricity Market Objectives and assessments of the detailed cost breakdowns, where provided, were generally found to be reasonable. Uncertainty was a significant factor in driving the recommendations by IES and raised the key question of whether it was prudent to approve costs likely to be incurred but is currently uncertain. The trade-off considered whether AEMO necessarily needed the funding certainty across the entire AR5 period to carry out its responsibilities, or whether the risks were manageable and approving a baseline or reverting to a staged approach for now, until which time certainty can be developed was the better option. IES view the latter approach being more prudent and appropriate, particularly for the Digital Roadmap and WEM reform program work.

A high-level summary of the recommendations is provided below:

- IES recommends the ERA approve $9.1 million of the $11.6 million proposed for WEM services. The $11.6 million here covers the completion of systems transition from Western Power to AEMO, implementation of approved rule changes and upgrades or replacements to end-of-life systems. IES regarded many of these projects to be critical but recommended some projects be pushed back based on insufficient information around costing.
- IES recommends the ERA reject, at this point in time, the Digital Roadmap capex of $13.0 million on the basis that there is insufficient information on the timing and benefits from transitioning and developing new WEM systems to the common platform. IES would recommend ERA hold off approving the revised first year Digital Roadmap projects until AEMO can provide more detailed cost breakdowns to assess its reasonableness. IES ultimately agrees with AEMO's recommendation that the WEM should be included in the Digital Roadmap consideration alongside the NEM.
- IES recommend ERA approach the WEM reform on a staged approach basis initially approving the first year of work and baseline or WEM reform core team costs for tranche 2 – this has been estimated at $18.9 million. Tranche 2 implementation costs could then be approved as certainty develops towards the middle of 2020. The ERA would need to consider the timing risks and whether this is possible within the regulatory framework.

6.1 General Comments

The following comments relate to some findings or observations that are not within scope of the engagement but would still be relevant in the context of future allowable revenue and forecast capital expenditure assessments.

- The provision of the contingency calculator provides additional detail and helps the assessment of the proposed costs in a more transparent manner. This was an important

area identified for improvement as contingencies form a significant portion (20%), or $14.5 million, of the total AR5 capex requirement[59]. ERA has previously raised this as an issue in its Final Determination of AEMO's 2018/19 Forecast Capital Expenditure Adjustment. The application of contingency was incorrect across some projects but IES nonetheless appreciates the detailed breakdowns comprising the contingency values.

- The WEM Rules suggest, where possible, the allowable revenue and forecast capital expenditure and costs of providing a similar service be benchmarked. This is inherently difficult because of the differing nature of projects, labour costs, and market designs across jurisdictions. Although the framework focuses on delivering projects based on the lowest sustainable cost, it would also be beneficial for AEMO to advise market participants of the estimated operational cost savings for larger capex projects. We view this as additional accountability to market participants. Under the current framework AEMO is not required to provide this information.
- There are projects and circumstances, examples highlighted in this report, where it would have been difficult for AEMO to have produced the requisite details such as cost breakdowns, baseline costs and options analysis and supporting documents to satisfy the approval requirements because of the level of uncertainty involved. It would be easier for the project capex to be broken down into phases to facilitate a staged capex or baseline cost approach to support the initial planning and design work for projects that do not have enough certainty at the time of the determination. Shorter-term projects or projects with certainty in place would not require this breakdown.

[59] Revised figures from AEMO Draft Decision Response.