Review of AEMO's Allowable Revenue and Forecast Capital Expenditure 2022-23 to 2024-25

Economic Regulation Authority

DRAFT DETERMINATION REPORT

06 March 2022

IES
Intelligent Energy Systems

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Executive Summary

Intelligent Energy Systems (IES) has been appointed by the Economic Regulation Authority (ERA) to provide independent technical advice on the capital expenditure requested by AEMO in its submission for the Allowable Revenue and Forecast Capital Expenditure 2022-23 to 2024-25, the sixth Allowable Revenue period (AR6). The capex consists of three main programs

- WEM Reform program, $ 44.6 million;
- WA DER program, $9.4 million; and
- WEM Sustaining capex, $15.4 million.

The submission also notes that Five-minute market settlements and DER Participation Implementation are not included in the AR6 proposal due to insufficient information available to make a reliable estimate.

The regulatory framework requires AEMO to include only costs that would be incurred by a prudent provider delivering efficient and sustainable services at the lowest cost. Capex is recovered by means of depreciation and amortisation following generally accepted accounting standards (GAAP).

IES has reviewed information provided by AEMO in its public submission as well as that provided on a commercial in confidence basis. The consultant has also provided comparisons to similar projects that have been or are being implemented in other jurisdictions.

Improvements in governance processes stated in AEMO's AR6 submission have been noted. However, the evidence provided by AEMO does not show the resulting impact on initial estimates and/or consistency of application, such as the case in contingency estimation using the newly introduced contingency estimation tools.

Based on our analysis we made recommendations in each of the capex areas which took account of feedback from participants on ERA's Issues Paper.

WEM Reform

Licence and cloud costs

Based on the considerations relating to licence costs discussed in Section 3.2.3 it is recommended to ask AEMO to provide clarification as to why licence costs are not avoidable and why licence and cloud costs should be capitalised.

ERA can either reject the capex amount of the licence and cloud costs or postpone the decision until further information is received from AEMO and assessed.

Contingency

Based on the considerations relating to contingency discussed in Section 3.2.4 it is recommended that ERA apply these changes to the contingency amount and reject the capex

amount resulting from applying these changes. The two changes are using a weight of zero for the 'N/A' risk category and reducing the weight of the 'Rare' category to one tenth of the weight used in the AEMO calculator.

Based on considerations relating to contingency for unknown risk and the availability to AEMO of an over run of the lesser of 10% (approximately $7 m) or $10 m it is recommended that the contingency amount of carry-over be rejected for individual projects. Since the carry-over is included to deal with the risk from unknown unknowns, this is equivalent to rejecting the contingency amount associated with unknown unknowns.

Given the inconsistencies in some of the provided contingency calculators, it is recommended to request all contingency calculators be checked and verified against the FTS amounts to enable analysis based on up-to-date information.

Leveraging the NEM, reusing existing systems and market benchmarking

It is recommended that AEMO provide additional information and analysis as evidence in support of including the selected option in the submission.

WA DER Program

Project Symphony P1978

Based on the considerations discussed in relation to Project Symphony P1978 it is recommended that the ERA request clarifying information about the project including if there is an opportunity to reduce the capex in light of the grant received from ARENA.

Licence and cloud costs

Based on the considerations in Section 4.1.2 above the same questions and recommendations arise as those in the WEM Reform program.

ERA can either reject the capex amount of the licence and cloud costs or postpone the decision until further information is received from AEMO and assessed.

Contingency calculators

Based on the considerations in Section 4.1.3 it is recommended that ERA request the updated contingency calculators so they can be analysed to decide on what is an appropriate capex contingency amount to approve in AR6.

Market Visibility and DER Data Access and Management

Following on from the submission by participants on the Issues Paper, discussed in Section 4.1.4, in which participants expressed strong sentiment doubting if these projects deliver net benefit, and in view of the absence of objective assessment of cost-benefit analysis and the assumptions it is based upon; it is recommended that AEMO demonstrates the net benefit of these two projects and provide justification for why they should not be postponed. In

particular, this applies to the project 'Market Visibility project' whose timeline is dependent on progress of other projects.

Sustaining Capex

The recommendations made to partially reject the capex across the projects amounts to rejecting $2.2 million, which revises the total across the sustaining capex projects to $13.2 million. This recommendation is subject to the following clarifications:

- Clarification from AEMO relative priorities of the various projects comprising the lifecycle projects (EDP, legacy market systems and integration streams) and more detailed information on the impact to AEMO and its ability to carry out its responsibilities should those projects be deferred.
- Clarification of license and cloud costs relating to (1) lack of detail on why the licenses are required during the project delivery timeframe, (2) a lack of clarity on the underlying license costs, or if additional licenses were required because AEMO didn't have existing licenses the development work could leverage, (3) treatment of license post-project delivery and distinction between capitalising the costs and expensing through opex, and similarly, (4) the reason for capitalising cloud costs.
- Clarification on penetration testing requirements and cost estimates across theindividual Lifecyle projects.

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1 Introduction

Intelligent Energy Systems (IES) has been appointed by the Economic Regulation Authority (ERA) to provide independent technical advice in relation to the efficiency and appropriateness of capital expenditure forecasts proposed by the Australian Energy Market Operator (AEMO). The report reviews AEMO's capital expenditure estimates contained in its submission on 17 Dec 2021 for the Allowable Revenue and Forecast Capital Expenditure 2022-23 to 2024-25, the sixth Allowable Revenue period (AR6). Below is an overview of AEMO's capex estimates for AR6.

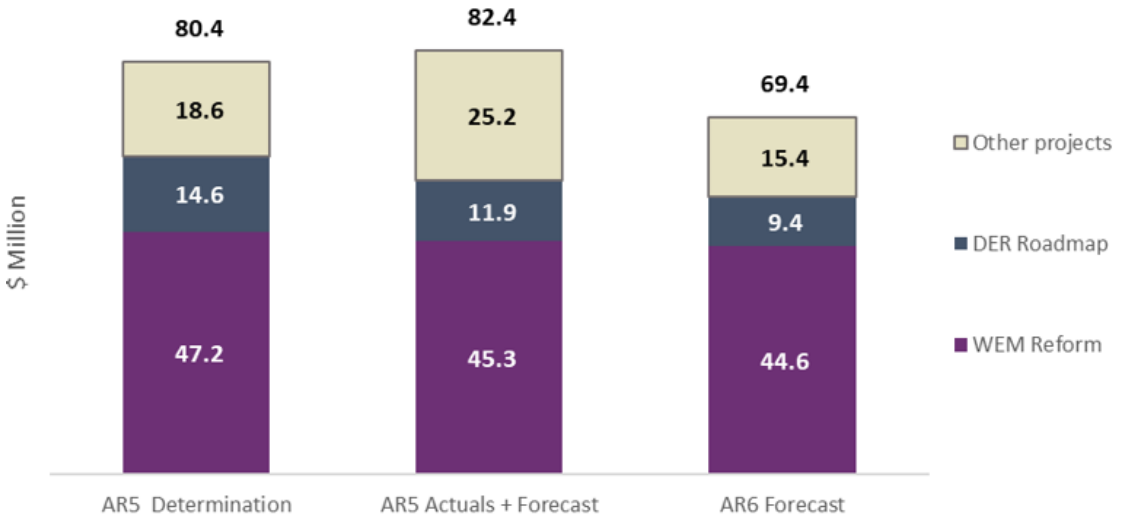
1.1 Overview of the proposed AR6 capital expenditure proposal (Dec 2021)

The AR6 proposed WEM capex to deliver the new markets by 1 October 2023 is a total amount of $69.4 m across three programs that fall into two categories

- Capex to facilitate the Energy Transformation Strategy:
  - WEM Reform program, $44.6 m;
  - WA DER program, $9.4 m;
- WEM sustaining capex:
  - Technology upgrades, control room tools and enterprise allocations, $15.4 m.

Compared to the AR5 determination of $80.4 m, the amount in the AR6 proposal represents a reduction of $11 m or 13.7%. Compared to the forecast at the end of the AR5 of $82.4 m, the amount in the AR6 proposal represents a reduction of $13 m or 15.8%, refer to Figure 1.

Figure 1 AR5 and AR6 forecast capex by program ($ million nominal)



Source: AEMO's AR6 proposal, December 2021 (Figure 4)

Facilitating the Energy Transformation Strategy (ETS) is made up of two programs, WEM Reform and WA DER.

1.1.1 WEM Reform program

The WEM Reform program spans three allowable revenue periods; AR4, AR5 and AR6. The total estimate for this program, including the AR6 capex, is higher than the initial forecast produced as part of delivering AR5. The proposed capex (including $11.4 m of contingency) in AR6 of $44.6 m for WEM Reform brings the total program forecast capex to $91.2 m. This is significantly (50%) higher than the initial forecast of $61 m generated in 2019 as part of developing the AR5 forecast. In AEMO's submission this increase is attributed to the availability of more complete information and greater clarity on the scope and rules of the new market arrangements.

1.1.2 WA DER program

The Minister of Energy launched the Distributed Energy Resources (DER) roadmap in 2019 to facilitate integration of DER resources into the power system. AEMO applied for and the ERA approved an in-period submission during AR5.

AR6 includes $9.4 m for the DER program. This includes the completion of three projects started in the AR5 period and four projects to commence in AR6.

1.1.3 WEM Sustaining capex

The WEM sustaining capex category relates to capital expenditures required to maintain or replace systems and platforms, hardware replacements and broader enterprise systems, and expenditures relating to capability uplift associated with the increasing complexities of managing the power system. Continued investment in these areas underpins the operations of the WEM and is critical in ensuring the power system is managed efficiently. The AR6 capex proposal includes $15.4 m for capex projects necessary to enable AEMO to continue to perform its functions under the WEM Rules.

1.1.4 Exclusions from the AR6 capex

The AR6 capex submission does not include potential projects related to the ETS – stage 2. The initial thinking of the WA government on this stage was published recently. At the time of submission there was insufficient information available to allow a reliable estimate to be developed. The potential transformational programs excluded from the AR6 capex but that are likely to be delivered in the near future are:

- Five-minute market settlement (5MS)
- DER Participation Implementation
- Other reforms arising from EPWA's RCM Review and Cost Allocation Review.

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.

1.2 Conventions

All monetary amounts in this report have been rounded with units indicated and are quoted in Australian dollars presented on a nominal basis. All references to years are specified on calendar basis unless otherwise stated.

2 Methodology and Approach

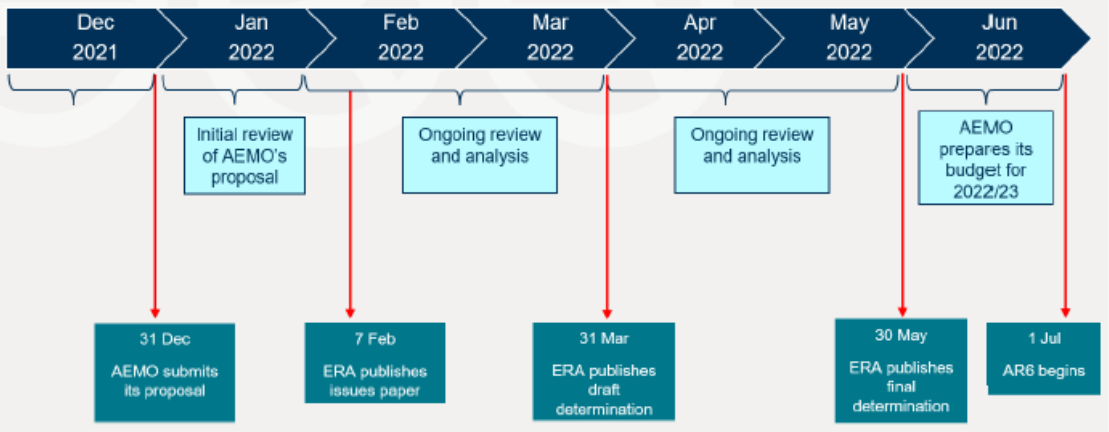
2.1 Regulatory framework

New rules gazetted in December 2021

The Wholesale Electricity Market Rules (WEM Rules), clauses 2.1A.1A and 2.1A.2, specify the services AEMO is obligated to provide to the South West Interconnected System (SWIS). Clause 2.22A.5(b) requires AEMO to include in its capex estimates "…only costs which would be incurred by a prudent provider of the services provided by AEMO in performing its functions, acting efficiently, to achieve the lowest practicably sustainable cost of performing AEMO's functions." These costs are to be recovered through depreciation and amortisation in a manner consistent with generally accepted accounting principles (GAAP).

The revised timeline for the AR6 review process is shown in Figure 2 taken form the ERA Issues Paper.[1]

Figure 2 Revised Timeline for the AR6 Review



Source: Issues Paper (Figure 3)

2.2 Approach to assessing AEMO's AR6 submission

The approach adopted was consistent with previous other engagements whereby IES has been concerned with reviewing capex including the AR5 review. The approach is to assess and review provided information, engage in meetings arranged through the ERA with process owners, and review any additional information or insights in light of responses. Our opinion and recommendations are based on the above in a manner consistent with the governing legislation.

The information provided by AEMO included the following sources:

[1] Australian Energy Market Operator's allowable revenue and forecast capital expenditure proposal for the period 1 July 2022 to 30 June 2025 Issues paper, 7 February 2022.

- AEMO's public submission and related documents,
- Additional supplementary reports from AEMO which are confidential in nature,
- AEMO's internal policy documents and models such as the Project Contingency Framework and various Project Contingency Estimation Toolset,
- Additional information provided by AEMO during meetings attended by the ERA; and
- Additional information provided by AEMO in response to information requests raised by ERA or IES. IES' requests were directed and received through the ERA.

2.2.1 Information reviewed

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

- ELECTRICITY INDUSTRY ACT 2004. ELECTRICITY INDUSTRY (WHOLESALE ELECTRICITY MARKET) REGULATIONS 2004. WHOLESALE ELECTRICITY MARKET RULES (18 December 2021) (WEM Rules);
- AEMO's Proposal to the Economic Regulation Authority, for the Allowable Revenue and Forecast Capital Expenditure for 2022-23 to 2024-25, December 2021 (AEMO AR6 proposal);[2]
- All confidential Financial Tracking Spreadsheets (FTS) provided by AEMO;
- Confidential estimates of project contingency and the Project Contingency Framework. Project Contingency Estimation Toolset files for individual projects are listed in the Appendix;
- Accounting Paper – AR6 Forecast Capital Expenditure, AR6 Proposal. December 2021;
- Project capex figures are based on the December AEMO AR6 proposal unless otherwise stated; and
- Other confidential submissions from AEMO supporting its AR6 proposal.

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;

[2] AEMO, December 2021, Proposal to the Economic Regulation Authority, Allowable Revenue and Forecast Capital Expenditure 2022-23 to 2024-25. Available at https://www.erawa.com.au/cproot/22361/2/AEMO-proposal.PDF.

- 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 AR6 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[3].

The electricity market in Ontario, Canada is undergoing a major redesign expected to come into service in March 2023. Ontario's electricity market has 5.3 million distribution customers, 231 generators and 70 retailers.[4] In 2016 the Independent Electricity System Operator (IESO) of Ontario launched a Market Renewal Program (MRP) to deliver a more efficient electricity market than the competitive market introduced in 2002. In Oct 2019, with MRP well underway and the high-level design completed, IESO published the report Market Renewal Program, Energy Stream Business Case[5] which assessed the operational, reliability and financial benefits and costs. Detailed-level design documents[6] show that the MRP's new systems cover the major functional areas of:

- Market Registration (Participant registration, Facility registration, Prudential and Metering),
- Market Inputs (offers, bids and data inputs),
- Scheduling and Optimisation (Day-ahead calculation engine, Pre-dispatch calculation engine, Real-time calculation engine, market power mitigation, Grid and market operations integration), and
- Market Settlement and Outputs.

[3] 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.
[4] ENERGY AT A GLANCE 2020 – 2021 available at https://www.oeb.ca/sites/default/files/2022-03/Energy-at-a-Glance-2020-2021-en.pdf
[5] Available on IESO's website https://www.ieso.ca/en/Market-Renewal
[6] IESO, Market Renewal Program: Energy, Overview. Detailed Design, Issue 2.0, 28 January 2021

The MRP business case report estimated implementation cost, in nominal terms, at Canadian dollars (CAD) 170 million (including CAD16 million contingency) with a range of CAD 151 million to CAD 194 million. An additional CAD 6 million is estimated to be needed in the first five years post implementation. Capex represents CAD 11 million actual costs, a forecast of CAD 120 million and a contingency amount of CAD 16 million. Refer to Figure 3 for a cost summary and to Figure 4 for a breakdown by major cost category.

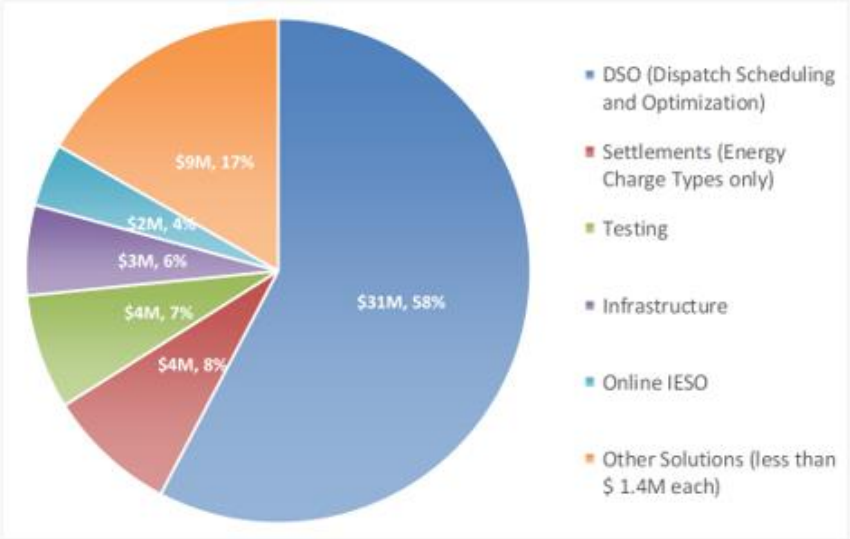
Figure 3 Market Renewal Program – Capex and Opex Summary

Source: Market Renewal Program, Energy Stream Business Case (Figure 4-4)

This comprises the major cost categories of:

- IESO Labour – Represents the largest cost category comprising CAD 58 million of actual and forecast cost. Includes both full time IESO staff and temporary contractors.
- Professional and Consulting (P&C) Costs – Includes CAD 34 million of costs to augment IESO's internal resources through hiring specialist consulting firms (CAD 12 million), outsourced and insourced contractors (CAD 17 million) and legal costs (CAD 6 million).
- IT (Hardware/Software) Costs – IT costs for both hardware and software comprise CAD 53 million of the program costs for a total of 18 systems. The largest single cost component is the Dispatch Scheduling and Optimization (DSO) solution, representing 58% of the total IT costs. Refer Figure 4.
- Contingency – CAD 16 million with the lion share going to IT costs at 23% of estimated costs with lower percentages assessed for the remaining categories, refer Figure 5.
- Other (representing interest and rent) – is estimated at CAD 7 million with no contingency.

Figure 4 Market Renewal Program – IT Costs breakdown



Source: Market Renewal Program, Energy Stream Business Case (Figure 4-9)

Figure 5 Market Renewal Program – Contingency

Cost Category	Estimated Costs (Without Contingency)	Contingency	Estimated Contingency Amount
IESO Labour	$42M	5%	$2M
IT (Hardware and Software)	$53M	23%	$12M
Other (Funding Interest, Rent)	$7M	0%	$0M
Professional and Consulting (P&C)	$25M	8%	$2M
Total	**$127M**	**13%**	**$16M**

Source: Market Renewal Program, Energy Stream Business Case (Table 4-1)

NPV over the 10 years is expected to be CAD 375 million with a range of CAD 290 million – CAD 450 million. The benefits over the 10-year study horizon include CAD 450 million of constrained off payments to generators that would be avoided in the new market design. A further benefit of CAD 525 million is attributed to market efficiencies.

The costs included in the MRP business case show a different mix of external IT (Hardware and Software) versus in-house development than adopted by AEMO in its AR6 submission. However, there is no evidence included in the study that this has resulted in a significant difference to overall costs. Contingency, as a percentage of costs is lower, than estimated by AEMO but IT costs still represent the largest contingency percentage. A major contrast with AEMO's submission is that the IESO Labour and Professional and Consulting cost categories

have much lower percentages than the average contingency percentages assessed in AEMO's AR6 submission.

2.3 Labour costs

Labour costs represent the overwhelming portion of capex. Labour costs in AEMO's AR6 proposal were calculated by AEMO by applying a tiered labour rate multiplied by the number of days estimated for each resource for the project. Five tiers for permanent employees and five for contractors were used. The tier rates are based on average actual rates across the tier even when an individual member of staff has been identified. AEMO's rationale is that this accounts for variability within the tier and accommodates changes in project personnel over the lifetime of the project. Capitalisation and cost recovery is based on actual costs incurred. The use of average rates by tier represents a reasonable approach to budgeting for projects.

In its AR6 submission AEMO states that it prefers to use internal capability where practicable. For new hires the hiring manager develops a job description that is then agreed with the HR function to achieve consistency across the organisation and ensure remuneration is consistent with the prevailing market rates. The job level is said to be based on Korn Ferry's job sizing methodology and remuneration on Korn Ferry's salary survey data. We have requested information from AEMO relating to Korn Ferry's reports to analyse and assess the application of this approach. At the time of writing this information was not available.

2.4 Contingency

Project contingency was calculated by AEMO using its AEMO-wide project contingency framework which takes account of project lifecycle stage, level of detail known about project design and risk profile of the project. The methods employed in this framework are summarised in Table 1 below.

Table 1 Contingency calculation methods

Method	Applied when?	Tools
1 - Fixed Fixed percentages of the base cost estimate	IDEA Upfront and may be revisited at each lifecycle stage	A calculator based on a pre-defined list of questions that calculate a contingency risk percentage
2 – Risk Based Analysis to estimate 'most likely' contingency requirement based on probability of occurrence	PLANNING to EXECUTION Created up front and updated throughout each lifecycle based on risk	A workbook that is able to list all risks, defining the probability and cost for each
Combination	Projects can opt to carry-over Method 1 when developing Method 2 to ensure unknown unknowns can be catered for.	Both tools in methods 1 and 2.

Source: AEMO's AR6 proposal, December 2021 (Table 6)

Contingency estimates for AR6 were supported, for nearly all projects, by contingency calculator files. The framework represents an improvement on the method used during AR5. However, the framework has been only recently implemented in AEMO and no historical data is available to gauge its performance. Analysis of the files provided by AEMO as supporting evidence on a confidential basis has raised questions which that have been communicated to AEMO.

AEMO's AR6 proposal describes the EMV tool that is used in method 2. The EMV tool estimates the risk by multiplying the probability of risk occurring by the cost of the impact. The probability weight used for some risks categories are higher than can be justified for those categories. AEMO's response is that it will review this internally and assess the need for change. AEMO also expressed the view that the change, if applied to AR6, will not result in a material change to the proposed capex contingency.

2.5 AEMO's Governance process

AEMO's AR6 proposal states that it has responded to feedback from participants and applied additional rigour in developing the AR6 estimates.

- AEMO revised its tier-rate system to increase granularity and improve estimation accuracy,
- A new project contingency framework was developed by AEMO's PMO function and revised following internal challenge,
- Forecasts were built up from the bottom up and subjected to top-down challenge by AEMO's Executive Leadership Team and the Board, and
- Reviewed cost estimates against historical costs and benchmarked where possible.

Improvements stated in AEMO's AR6 submission have been noted. However, the evidence is not provided with sufficient transparency to show how these processes impacted initial estimates. In some areas, such as contingency, the evidence suggests that version control and/or consistency of application can be improved.

2.6 General findings

Where relevant, IES provides general comments on the AEMO AR6 proposal and/or process which ERA may consider for future AEMO allowable revenue and forecast capital expenditure assessments.

3 WEM Reform

3.1 Background

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 WEM Reform program spans three allowable revenue periods; AR4, AR5 and AR6. The total estimate for this program, including the AR6 capex, is higher than the initial forecast produced as part of delivering AR5. The proposed capex (including $11.4 m of contingency) in AR6 of $44.6 m for WEM Reform brings the total program forecast capex to $91.2 m. This is significantly (50%) higher than the initial forecast of $61 m generated in 2019 as part of developing the AR5 forecast. In AEMO's submission this increase is attributed to the availability of more complete information and greater clarity on the scope and rules of the new market arrangements.

The WEM Reform AR6 proposed capex amount of $44.6 m is summarised by workstream in Table 2.

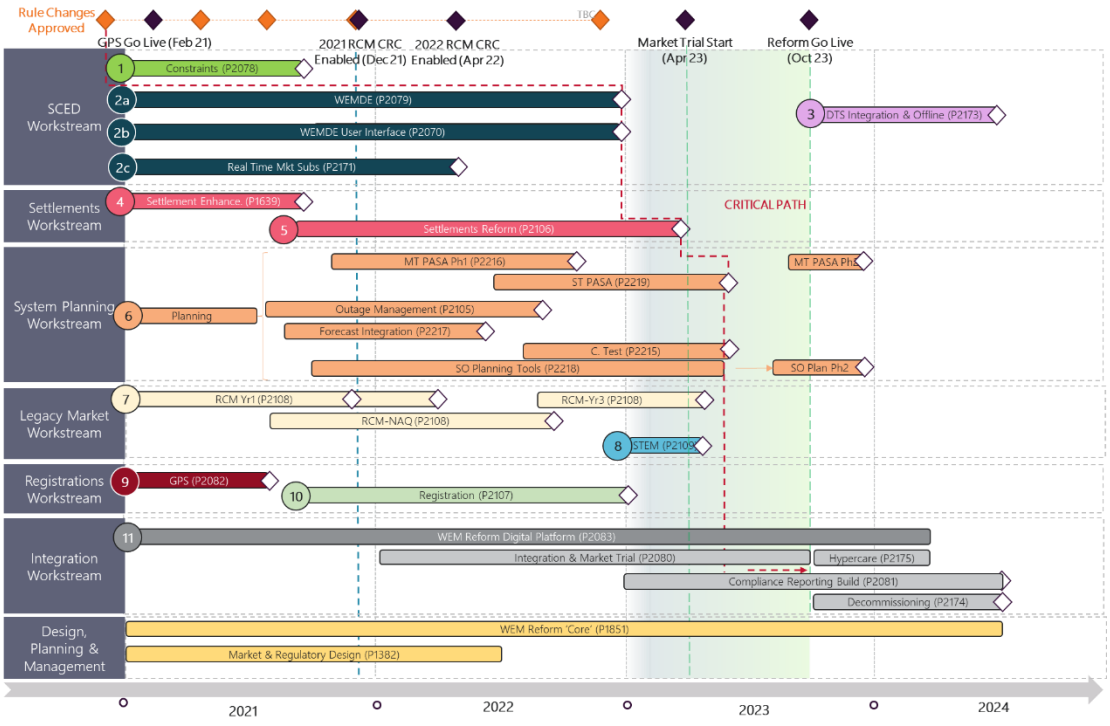
Table 2 WEM Reform AR6 forecast capex by workstream and enabling project ($ million nominal)

Workstream/enabling project	2022-23	2023-24	2024-25	AR6 total
SCED	4.8	1.8	-	6.6
Settlements	2.7	-	-	2.7
System planning	4.9	0.2	-	5.1
Legacy markets	4.1	0.6	-	4.6
Registrations	1.3	0.0	-	1.3
Integration	8.5	7.7	-	16.1
Design, planning & management	5.3	2.9	-	8.2
WEM Reform total	**31.5**	**13.1**	-	**44.6**

Source: AEMO's AR6 proposal, December 2021 (Table 27)

The timeline for delivering the program is shown in Figure 6.

Figure 6 WEM Reform program workstreams and high-level timeline



Source: AEMO's AR6 proposal, December 2021 (Figure 39)

3.2 Considerations

3.2.1 FTS and AR6 proposal

The financial tracking spreadsheets (FTS) were analysed and the amount for each project compared to the capex amount in the AEMO's AR6 proposal. Both the base estimate (excluding contingency) and the contingency amounts for AR6 were checked. The amounts were reconciled for the WEM Reform projects.

3.2.2 FTS and contingency calculators

The FTS information was also checked against the contingency amounts in AEMO's contingency calculators. There were differences across many projects and AEMO was provided with examples of differences for specific projects and asked to review all contingency calculators. AEMO reviewed the files and found that it had previously provided old versions of the calculator files and provided 18 contingency calculator files, 14 of which were marked "new". AEMO noted a small difference between the FTS and "new" calculator for Project P1851. The "new" calculators were analysed and found to still have differences, large in some cases, from the contingency amounts shown in the FTS. For example, project P2080 - Integration and Market Trial shows a contingency amount in the "new" calculator which is only 5% of the amount shown in the FTS as a WOL contingency amount. This difference is likely due

to some inputs being left out from the contingency calculator. However, absent the correct version of the contingency calculator we cannot form robust recommendations based on analysis of the information.

3.2.3 Licence and cloud costs

AEMO's AR6 submission includes amounts for licences used during the development of the WEM Reform projects. Some of the items are described as development tools while others refer to more general software licences that could be reasonably expected to be available for use in the program without incurring additional cost. If additional costs are justified a second question arises in relation to the capitalisation of these costs. Costs that are capitalised should pertain to the portion of the licence relating to the period of development activity. Costs related to the period whilst in operation should be part of the opex. Finally, there is a question about whether the recent revision of the accounting standard allows cloud services to be capitalised. Details of the software licences were provided to ERA in the Excel workbook 'Software Costs AR6 programs 20220302' which contains three sheets each pertaining to one of the three capex programs. In summary:

P2083 - Digital Platform within the integration workstream. Licence and cloud costs comprise more than half of the amount requested in AR6. 72% of that amount is in the AR6 period and the balance is in prior allowable revenue periods.

P1851- WEM Reform Core within the Design, planning & management workstream. Has a small amount of costs indicated as licence and cloud costs wholly in periods prior to AR6 with no detail available in the FTS relating to the licence costs. This is outside the AR6 period, the scope of this report, but is noted for information.

3.2.4 Contingency

AEMO's AR6 proposal describes the EMV tool that is used in method 2. The EMV tool estimates the risk by multiplying the probability of risk occurring by the cost of the impact. The probability weight used for some risks categories are higher than can be justified for those categories. In response to a request for clarification and further information AEMO will review this issue internally and assess whether it should be corrected. It also expressed the view that these changes, if applied to AR6 will not result in a material change to the proposed capex contingency amount.

The two areas in contingency are the reduction of the 'N/A' category weight to zero and of the 'Rare' category to one tenth of the value AEMO uses in the calculator.

Method 3 is a mixed method which uses both method 1 (Fixed) and method 2 (EMV). A project can opt to carry over an amount from method 1 to account for unknowns. In its AR6 proposal AEMO indicated that all WEM Reform projects that are in-flight used the mixed method. While this may be justified for some projects that AEMO undertakes this may not be the case for WEM projects. The legislation allows AEMO an over-run of the lesser of 10% or $10 m dollars

and this over-run should be taken into account when assessing how to budget for unknown risks.

It is also recommended to request all contingency calculators be checked and verified against the FTS amounts to enable analysis based on up-to-date information.

3.2.5 Participants' submissions on the Issues Paper

We have reviewed submissions by participants on the Issues Paper and provide the following additional comments.

3.2.5.1 Leveraging the NEM, reusing existing systems and market benchmarking

AEMO refers in several places in its submission that it has leveraged experience from similar projects in the NEM and attempted to utilise existing systems where possible. It also refers to using benchmarking where practicable. While the submission includes statements and references in tables to projects in which AEMO has implemented these approaches, there is insufficient detail to provide the reader with confidence that the best option was indeed selected and included in the submission.

In the AR6 submission AEMO states that it has reviewed cost estimates against historical actuals and/or market testing where practicable. In the tables in Section 4.3 of the submission AEMO states if other options were considered and the reason for selecting the option included in the submission. So as to avoid duplicating the entries of the submission tables a few examples are provided below.

P2079 - WEM Dispatch Engine (WEMDE) - AEMO states that it has considered buying a vendor product in an RFP in Q2 2021. AEMO assessed options to augment AEMO team and build a new solution versus buying and customising a vendor product. The outcome of the assessment based on a total cost of ownership and risk assessment was to proceed with the build option. AEMO states it intends to use internal and vendor resources using an experienced vendor with international dispatch engine experience. Requested capex including contingency = $1.8 million.

P2170 - WEMDE User Interface – AEMO states in the submission that it considered repurposing NEM systems but assessed that it was not feasible due to the amount of customisation needed to support the WEM requirements. The solution however, where possible uses and revises existing systems such as the newly implemented e-terra EMS and AEMO's public Market Pulse website. AEMO states it intends to use internal and vendor resources. Requested capex including contingency = $2.6 million.

P2106 - Settlements Reform – No other options were considered by AEMO as the related project, P1639 - Settlements Enhancements, approved in AR5, was undertaken with the view to use the existing system "PaSS" for WEM Reform. AEMO states it intends to use internal and vendor resources. Requested capex including contingency = $2.7 million.

P2216 - MT PASA Reform – AEMO states that it has considered repurposing existing WEM systems but they were judged as “fundamentally incapable of being extended to support new market requirements”. The solution adopted was to use a PLEXOS model. AEMO states it intends to use internal resources for integration and vendor resources (SaaS). Requested capex including contingency = $1.0 million.

The submission does not provide detailed assessments and comparison of options which weakens the rationale for the option included in the submission. Also absent is any cost-benefit analysis for each project, work stream or program.

When it comes to contingency; the rationale for generally high contingency amounts, as a percentage of the base capex, or explanation for extremely high percentage contingency amounts, such as with P2106 in the above examples, is not provided in adequate detail. While AEMO provided a level of response on a confidential basis to the ERA and consultants, this is not available to participants and creates a confidence gap.

3.2.5.2 Depreciation lifetime

Participants’ submissions referred to depreciation lifetime as a means of smoothing out market fee increases. AEMO was requested to provide details of the depreciation charges included in the submission. We will assess AEMO’s response to this request before commenting on the reasonableness of the depreciation life. The WEM Rules require depreciation and amortisation to be done in accordance with generally accepted accounting standards (GAAP).

3.3 Recommendations

3.3.1 Licence and cloud costs

Based on the considerations relating to licence costs discussed in Section 3.2.3 it is recommended to ask AEMO to provide clarification to the following questions:

Q1 - Are these licence costs avoidable by using licences under current AEMO arrangements?

Q2 - If they are not avoidable, can you review the cost allocation to ensure that only the portion used during development is capitalised and all costs incurred during the "in-operation" period are accounted for under operating costs (not capex).

Q3 - There is a general question about whether cloud services can be capitalised. Can you review this and treat in accordance with the accounting standard?

ERA can either reject the capex amount of the licence and cloud costs or postpone the decision until further information is received from AEMO and assessed.

3.3.2 Contingency

Based on the considerations relating to contingency discussed in Section 3.2.4 it is recommended that ERA apply these changes to the contingency amount and reject the capex

amount resulting from applying these changes. The two changes are using a weight of zero for the 'N/A' risk category and reducing the weight of the 'Rare' category to one tenth of the weight used in the AEMO calculator.

Based on considerations relating to contingency for unknown risk and the availability to AEMO of an over run of the lesser of 10% (approximately $7 m) or $10 m it is recommended that the contingency amount of carry-over be rejected for individual projects. Since the carry-over is included to deal with the risk from unknown unknowns, this is equivalent to rejecting the contingency amount associated with unknown unknowns.

Given the inconsistencies in some of the provided contingency calculators, it is recommended to request all contingency calculators be checked and verified against the FTS amounts to enable analysis based on up-to-date information.

3.3.3 Leveraging the NEM, reusing existing systems and market benchmarking

It is recommended that AEMO provide additional information and analysis as evidence in support of including the selected option in the submission.

4 WA DER Program

The Minister of Energy launched the Distributed Energy Resources (DER) roadmap in 2019 to facilitate integration of DER resources into the power system. AEMO applied for and the ERA approved an in-period submission during AR5. AR6 includes $9.4 m for the DER program. Table 3 summarises this information with the first three projects being projects that were started during AR5 and due to be completed during AR6 while the remaining four projects are new projects commencing in AR6.

Table 3 WA DER program AR6 forecast capex by project ($million nominal)

WA DER capex project	2022-23	2023-24	2024-25	AR6 total
Project Symphony (DER Marketplace Orchestration)	1.1	-	-	1.1
Technology Integration	1.2	-	-	1.2
DER Participation	0.9	-	-	0.9
DER Participation Implementation	2.0	-	-	2.0
Market Visibility	0.4	1.1	-	1.5
DER Data Access & Management	0.9	1.2	-	2.1
EVs in DER Register	0.3	0.3	-	0.6
Total WA DER	**6.8**	**2.6**	**-**	**9.4**

Source: AEMO's AR6 proposal, December 2021 (Table 43)

4.1 Considerations

4.1.1 FTS and AR6 proposal

The financial tracking spreadsheets (FTS) were analysed and the amount for each project compared to the capex amount in the AEMO's AR6 proposal. Both the base estimate (excluding contingency) and the contingency amounts for AR6 were checked. The amounts were reconciled except for P1978 DER Marketplace Orchestration (Project Symphony). AEMO has been asked to provide further detail in relation to this project and its response will be incorporated in the final report. The amount in the submission proposed for this project is $1.1 million which is lower than the amount included in the FTS for that project. In its proposal AEMO states that the project has received a $2.5m grant from ARENA and that it has decided to not request funds beyond what has been already approved during AR5.

4.1.2 Licence and cloud costs

The same considerations and questions discussed in the WEM Reform section arise in relation to two projects of the WA DER program

- Project Symphony (DER Marketplace Orchestration) P1978. A significant amount of the capex requested for AR6 is in licence and cloud fees of which more than half is within the AR6 period and the balance in prior periods.
- Market Visibility for a total amount of less than 10% of the AR6 capex amount .

A third project, Technology Integration P2093, has licencing fees of incurred wholly in periods prior to AR6. This is outside the AR6 period, the scope of this report, but is noted for information.

4.1.3 FTS and contingency calculators

The FTS information was also checked against the contingency amounts in AEMO's contingency calculators. There were differences across many projects and AEMO was provided with examples of differences for specific projects and asked to review all contingency calculators. The calculators for inflight projects for DER Program submitted reflected a superseded version of the calculator. This resulted in a higher amount carried over into contingency to account for unknown risks, a category used in AEMO's contingency calculations. The carry-over component of the contingency is based on a percentage of the base cost (excluding contingency). AEMO provided the revised lower percentages for reference but has not submitted revised calculator files for these projects.

4.1.4 Participants' submissions on the Issues Paper

We have reviewed submissions by participants on the Issues Paper and provide the following additional comments.

4.1.4.1 Market Visibility and DER Data Access and Management

WEM reform projects and WA DER projects mostly continued from the AR5 period. Investment request documents were only produced and provided for the few projects that started in AR6, such as these two projects. The investment request documents for these two projects refer to the market becoming reliant on DER over the long term. The reference to the long term suggests the potential to defer the project. While AEMO expects benefits to accrue to market participants it is reasonable to require AEMO to explain benefits to participants and seek feedback. In the submissions on the Issues Paper participants expressed a strong sentiment doubting if these projects deliver net benefit. While AEMO's AR6 submission acknowledges participant's concern over increasing fees there is probably a divergence between AEMO and the participants in their assessment of cost vs benefit. The absence of cost-benefit analysis in the submission on a project, work stream or program level opens the door to subjective judgement instead of objective assessment of the results of the cost-benefit analysis and the assumptions it is based upon.

AEMO's AR6 submission, page 180, states that the Market Visibility project "is dependent on progress of Project Symphony and enabling visibility and early incremental of market participation in the DER Participation project". This provides an additional reason for why

AEMO should explain why the project should not be postponed until this uncertainty is removed.

4.2 Recommendations

4.2.1 Project Symphony P1978

Based on the considerations discussed in relation to Project Symphony P1978 it is recommended that the ERA request clarifying information about the project including if there is an opportunity to reduce the capex in light of the grant received from ARENA.

4.2.2 Licence and cloud costs

Based on the considerations in Section 4.1.2 above the same questions and recommendations arise as those in the WEM Reform program.

ERA can either reject the capex amount of the licence and cloud costs or postpone the decision until further information is received from AEMO and assessed.

4.2.3 Contingency calculators

Based on the considerations in Section 4.1.3 it is recommended that ERA request the updated contingency calculators so they can be analysed to decide on what is an appropriate capex contingency amount to approve in AR6.

4.2.4 Market Visibility and DER Data Access and Management

Following on from the submission by participants on the Issues Paper, discussed in Section 4.1.4, in which participants expressed strong sentiment doubting if these projects deliver net benefit, and in view of the absence of objective assessment of cost-benefit analysis and the assumptions it is based upon; it is recommended that AEMO demonstrates the net benefit of these two projects and provide justification for why they should not be postponed. In particular, this applies to the project 'Market Visibility project' whose timeline is dependent on progress of other projects.

5 Sustaining capex

5.1 Overview

The WEM sustaining capex category relates to capital expenditures required to maintain or replace systems and platforms, hardware replacements and broader enterprise systems, and expenditures relating to capability uplift associated with the increasing complexities of managing the power system. Continued investment in these areas is necessary and underpins the operations of the WEM and is critical in ensuring the power system is managed efficiently. AEMO is responsible to deliver planning and management services and market operation and administration services in accordance with Clause 2.1A.1A and Clause 2.1A.2 of the WEM Rules.

The proposed capex under the sustaining capex category is $15.4 million over the AR6 period with a gradual increase in expenditure from $4.7 million in FY2023 to $5.8 million in FY2025. Of the $15.4 million proposed over AR6, this is further broken down into WA technology ($9.7 million) and enterprise systems ($5.8 million). Many of these initiatives are a continuation or were previously proposed in AR5 and is consistent with the added responsibility and complexities AEMO faces in the context of the fast-changing energy landscape.

WA technology relates to capability uplift, IT lifecycle replacement and upgrades, and a provision for unknown rule changes. These initiatives relate directly to the provision of WEM-related services. The WA technology project streams at a high-level includes the following initiatives:

- **Capability uplift**: AEMO are investing in tools to improve its capability in managing more varied power system conditions and to ensure it can properly monitor, forecast and manage increasing instances of system security events with higher PV penetration.
- **Lifecycle upgrades**: the increasing complexities of the power system are also compelling AEMO to increase investment in its IT systems and platforms to ensure it can efficiently deliver on its responsibilities. This sub-category includes not only planned hardware and software upgrades but also remediation programs to ensure all its systems are compliant with AEMO policies such as ensuring ongoing support, removing security risks, reliability and remains cost effective. We acknowledge AEMO has a zero tolerance for risks associated with legacy systems, hardware, and software, that no longer meets its requirements. Under-investment in this area poses significant risks to the integrity and efficient operations of the WEM.
- **Enterprise systems**: relates to systems that are common and shared across the organisation, i.e., systems that also support the NEM and/or the GSI. These include data centres, its energy management system, and cyber security platform.

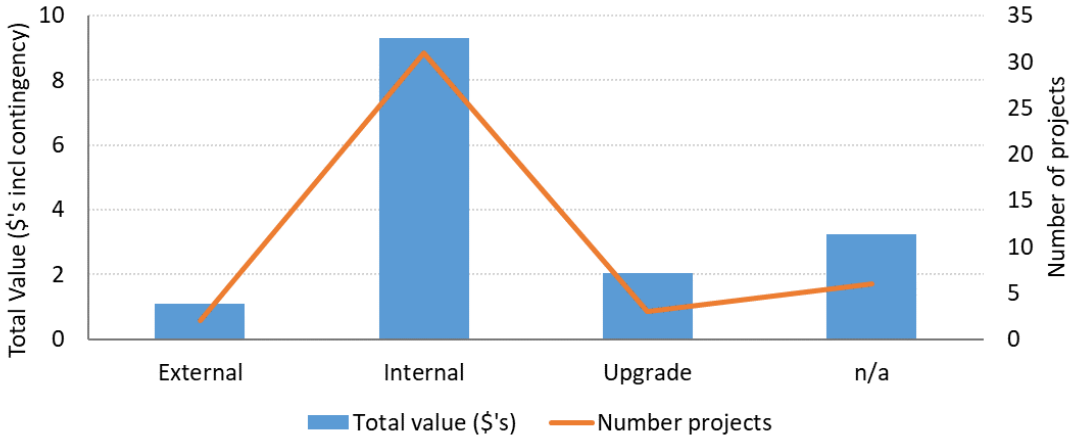
5.2 Key findings

The review process is still underway with questions yet to be clarified by AEMO; however, we have provided our initial high-level findings and more detailed findings at the project level in the following sub-sections. The following are some of IES' broader observations regarding some important aspects of AEMO's AR6 submission:

- **Cost validation**: AEMO has provided details of its purchasing and market testing processes to ensure procurement considers cost and value to AEMO, and that the market is appropriately tested to validate cost assumptions. However, AEMO has not provided any alternative cost estimates or quotes for any of these projects. Although the reasoning behind each of the selected options are generally reasonable, there is little to no support to substantiate the claims.
- **Operational efficiency**: It is important to note that the projects under sustaining capex, as indicated by AEMO, will not result in any meaningful operational efficiencies, i.e., reduced FTE count. The benefits relate to market efficiency gains but are generally hard to quantify. AEMO is not obligated to provide this information, but this information would help to address broader stakeholder concerns focused on operational efficiencies and reduced FTE count from this area of capital expenditure.
- **Critical risks**: AEMO considers the lifecycle projects (EDP, legacy market systems and integration streams) as important due to a range of factors such as end-of-life support and security risks. We note the importance of ensuring critical risks and technical debt are remediated as early as possible, however, note similar arguments for various projects were also put forward in AR5. A subset of those projects was approved by ERA but subsequently not carried out by AEMO over that period – this suggests some flexibility in the delivery of the projects. We note the requirements for many of the lifecycle projects are not finalised and there would be merit in requiring AEMO to provide priorities of the various projects and more detailed information on the impact to AEMO and its ability to carry out its responsibilities should those projects be deferred. AEMO also state some of the projects relating to legacy market systems may not be required subject to more certainty on the 5-min settlements project, however, the capex has been requested in the interim.[7] The following recommendations relating to the lifecycle projects are subject to AEMO's provision of this information.

[7] Page 49, AEMO WA IT Roadmap 2022-2025.

Figure 7 Sustaining capex by development type



Source: IES analysis

- **Development approach**: Most of the projects are to be internally developed. AEMO's sustaining capex developments categorised by external and internal development is plotted in Figure 7. Upgrades relate to existing external vendor systems and the n/a category includes rule change requests, the Perth control room and Norwest data centre. There are 31 projects of the sustaining capex proposed pipeline that are internally developed, representing 59% of the total proposed capex. The significant number of internally developed systems relate to many bespoke systems within the lifecycle project streams, cyber security and operational forecasting systems. The reason cited by AEMO is lower ongoing costs and removal of external vendor support reliance consistent with AEMO's previous AR5 proposal. Although there is a risk of competing internal resources resulting in AEMO having to leverage external contractors to deliver the work, the contingency associated with this risk comprises a much smaller percentage of the total base cost.

  Where possible, AEMO has already procured existing off-the-shelf systems relating to the energy management system (e-Terra) and load forecasting (Itron) - $2 million relates to ongoing upgrade costs to ensure ongoing support. AEMO's proposed project replacements are bespoke to AEMO's systems and are unlikely to have off-the-shelf alternatives. There are many smaller projects comprising the combined internal project cost of $9.3 million. Project specifics relating to the various options considered are included in Section 5.3.

Table 4 Overview of capex recommendation ($ millions, includes contingency)

Sustaining Capex	Program	Project	AR6 Total (WEM)	IES_DRAFT	IES_DIFF
WA technology	Capability uplift	Operations Simulator	0.9	0.5	0.4
WA technology	Capability uplift	Control Room WAMS	0.2	0.1	0.1
WA technology	Capability uplift	Transient Stability tool	0.2	0.2	0.0
WA technology	Capability uplift	Total	1.3	0.8	0.5
WA technology	Lifecycle	Enterprise Data Platform	1.6	1.4	0.2
WA technology	Lifecycle	Legacy Market Systems	1.9	1.8	0.1
WA technology	Lifecycle	Integration	1.1	1.0	0.1
WA technology	Lifecycle	Perth Control Room	2.0	2.0	0.0
WA technology	Lifecycle	Itron Upgrade	0.4	0.3	0.1
WA technology	Lifecycle	Certificate Authority	0.3	0.2	0.1
WA technology	Lifecycle	Total	7.4	6.7	0.6
WA technology		WEM Rule Changes	1.0	0.4	0.6
WA technology		Total	1.0	0.4	0.6
Enterprise systems		Energy management system	1.4	1.4	0.0
Enterprise systems		Cyber security	3.0	2.5	0.5
Enterprise systems		Operational forecasting	1.1	1.1	0.0
Enterprise systems		Infrastructure (Norwest data centre)	0.2	0.2	0.0
Enterprise systems		Total	5.8	5.3	0.5
Total			15.4	13.2	2.2

Note: AR6 total is based on AEMO's AR6 proposal (December 2021)

Table 4 summarises our recommended capex approval for the various projects.[8] The recommendations made to partially reject the capex across the projects amounts to rejecting $2.2 million, which revises the total across the sustaining capex projects to $13.2 million. The main drivers are discussed below:

- **Contingency**: All the projects under sustaining capex are projects in the idea phase. i.e., they use the fixed contingency calculator as described in AEMO's AR6 proposal.[9] Most of the project-level contingencies were in the range of 10-22%.[10] In accordance with Section 3.2.4, contingency categories as part of the calculator that were not applicable to the project were reduced to a 0% contingency factor. This has a slight impact across most of the projects listed above – in aggregate it amounts to less than $150,000.
- **Licensing and cloud costs**: There were five (5) projects identified that had license costs that were, at the time of writing this report, unsubstantiated.[11] There is (1) a lack of detail on why the licenses are required during the project delivery timeframe, (2) a lack of clarity on the underlying license costs, or if additional licenses were required because AEMO didn't have existing licenses the development work could leverage, (3) treatment of license post-project delivery and distinction between capitalising the costs and expensing through opex, and similarly, (4) the reason for capitalising cloud costs.[12] We have removed these associated costs ($764,000) from the recommended capex totals until these questions have been addressed.
- **Rule change request**: The proposal includes an allowance for AEMO to address rule changes over the AR6 period using its t-shirt size approach, i.e., provisions for a small, medium, large and X-large rule change over AR6. This differs from the previous AR5 which included potential rule changes over the horizon. Whilst we acknowledge it would be more efficient for AEMO to include an allowance for unforeseen rule changes which may arise, we felt it would better governance for AEMO to request for additional funding through an in-period submission for any potential X-large rule change instead. This reduces the WEM rule change capex to approximately $400,000.
- **Penetration testing costs**: each of the lifecycle projects has an allocated penetration testing cost. This is in accordance with AEMO's requirement to validate that no vulnerabilities are introduced through the remediation work. However, the cost that has been allocated is a generic 'per app' allowance that has been consistently applied to all the underlying projects irrespective of project size. As such, penetration testing costs comprise up to 40% of some base costs. We have also questioned whether an allowance for a penetration testing cost was reasonable for many of the applications that currently does not and will not interface with applications external to AEMO systems. We have removed penetration testing costs for many of the projects until such time AEMO can provide better guidance.

[8] The lifecycle projects have been aggregated here.
[9] See Table 6 of AEMO's AR6 proposal.
[10] Excludes the erroneous 33% contingency for the AR216 WASM ESB project.
[11] Control room WAMS, cyber security, Itron upgrade, WAMS market pulse, and operations simulator.
[12] See Sections 3.2.3 and 4.1.2 for corresponding license and cloud cost considerations.

Enterprise costs have been allocated based on various metrics depending on what would be the most appropriate and include database usage, FTE, IT support and cloud costs. IES did not receive the underlying metrics, or relative sensitivities in the cost ratios for different weightings across these metrics, however, the cost allocations do not look unreasonable relative to what was used in AR5 or general WEM and NEM consumption figures for FY2021.[13]

5.3 Project specific details

The following tables provides key points relating to the rationale and cost options explored for each of the individual projects and the reasons for IES' recommended capex adjustments.[14] IES had access to additional confidential and lower-level cost information relating to AEMO's AR6 submission, however, only the aggregate cost numbers are reported here, i.e., project-level details, particularly cost estimates, not included in AEMO's public submissions have been omitted from the tables.

Specific adjustments are included in the tables below, however, a broader adjustment to the underlying contingency amounts reflect adjustments for the n/a risk classification and is the main reason for slight reductions in total project costs. Projects with a slightly different recommended capex but with no reason for adjustment reflects this change.

Some of the lifecycle projects relating to legacy market systems and integration have slightly higher contingencies due to non-firm scope requirements, however, the base costs and contingencies were low enough for IES to recommend ERA still approving the capex amount given the importance to rectify the identified issues.[15] All of the lifecycle projects depend on the completion of the WEM reform program before commencement during AR6.

[13] The WEM consumption and peak demand share as a percentage of the NEM in FY2021 was roughly in the range of 9-10%.

[14] Costs are reported in millions of dollars. There are some minor adjustments that may not show up due to rounding.

[15] Also subject to AEMO providing further details on the priorities and impacts of the various underlying projects.

Table 5 Capability uplift project summary ($ millions, includes contingency)

PROJECT	RATIONALE	OPTIONS TO RETAIN, UPGRADE, OR NEW	AR6 PROPOSED CAPEX ($ million)	IES RECOMMENDATION ($ million)	REASON FOR ADJUSTMENT
Operations Simulator	This is a tool to predict the impact of asynchronous wind and solar generation on system security. Provides better support for WEM operations which will have flow on effects to more optimal market outcomes.	There is no existing tool for this capability. Standalone new solutions would be more expensive than leveraging the NEM implementation and its 5-yr experience.	0.9	0.5	License category costs have been removed until further information provided
Wide Area Monitoring Systems	Tool that monitors system strength and inertia. Also requires installation of PMUs which has been done in the NEM.	There is no existing tool for this capability. AEMO would have to rely on existing data which does not provide full visibility and may lead to sub-optimal dispatch outcomes.	0.2	0.1	License category costs have been removed until further information provided
Transient Stability Tool	There is currently no way to monitor N-1 rotor angle or oscillatory stability in real-time. This could lead to AEMO operating the system in an insecure state.	There is no existing tool at present for the WEM. There is the risk of AEMO potentially operating the system in insecure state, or not optimally. A separate new tool was explored but was significantly higher in cost to implement and maintain.	0.2	0.2	

Table 6 WEM rule change project summary ($ millions)

PROJECT	RATIONALE	OPTIONS TO RETAIN, UPGRADE, OR NEW	AR6 PROPOSED CAPEX ($ million)	IES RECOMMENDATION ($ million)	REASON FOR ADJUSTMENT
Rule Change – all sizes	Generic budget for potential rule changes	n/a	1.0	0.4	If there is a significantly large rule change, it is best for AEMO to seek an in-period

PROJECT	RATIONALE	OPTIONS TO RETAIN, UPGRADE, OR NEW	AR6 PROPOSED CAPEX ($ million)	IES RECOMMENDATION ($ million)	REASON FOR ADJUSTMENT
					submission with cost estimates based on expected scope requirements.

Table 7 Lifecycle upgrades project summary ($ millions, includes contingency)

PROJECT	RATIONALE	OPTIONS TO RETAIN, UPGRADE, OR NEW	AR6 PROPOSED CAPEX ($ million)	IES RECOMMENDATION ($ million)	REASON FOR ADJUSTMENT
Perth control room	Replacement of end-of-life hardware	There is a need to upgrade hardware as per AEMO's policy on hardware lifecycle to minimise associated hardware risks. The hardware option as opposed to the cloud has been chosen based on specific workloads of the platforms and systems supported.	2.0	2.0	
Itron upgrade	There is already an upgrade in FY2022 included in the WEM reform program, this is the 2nd scheduled upgrade.	There is a need to upgrade the software otherwise the load forecasting capability will be unsupported. Load forecasting is critical to the efficient operations of the WEM. Other options were not considered, and the cloud option for the NEM was not feasible	0.4	0.3	Removal of costs subject to clarification of license costs, and distinction between opex and capex treatment of the licenses
Certificate authority	This relates to Public Key Infrastructure which govern access to AEMO systems. The existing PKI security is outdated, is expiring, and needs to be updated.	Retaining existing infrastructure has vulnerabilities, and a new solution was considered but had higher associated costs (implementation and support)	0.3	0.2	Contingency category related to higher risk of unavailable internal labour resources reduced to Low as the Base cost is predominantly based on external costs already

PROJECT	RATIONALE	OPTIONS TO RETAIN, UPGRADE, OR NEW	AR6 PROPOSED CAPEX ($ million)	IES RECOMMENDATION ($ million)	REASON FOR ADJUSTMENT
Enterprise data platform (comprised of 10 projects)	There is an identified need to replace the various legacy applications supporting data governance, storage, automation, support and maintenance.	Options to upgrade or implementing a standalone (like-for-like) solution would be more expensive than integrating into an enterprise solution.	1.9	1.4	Cloud/license and penetration testing costs removed
Legacy market systems (comprised of 10 projects)	There is an identified need to replace legacy market systems. Failure to replace the systems can lead to significant adverse market impacts.	Options to upgrade or implementing standalone solution would be more expensive than integrating into existing enterprise platform. There are also no bespoke options. This work stream will be impacted by the 5MS program.	1.9	1.8	Minor contingency adjustment leading to larger rounding difference
Integration (comprised of 9 projects)	The WEM Reform will deliver a new digital integration platform which will be able to replace the 9 legacy applications identified.	Options to upgrade or implementing standalone solution would be more expensive than integrating into the enterprise platform delivered with the WEM Reform work.	1.2	1.0	Some of the penetration costs removed. The contingency provided incorrectly included some contingency which has been corrected here. Minor adjustment for a shared service with GBB.

Table 8 Enterprise systems project summary ($ millions, includes contingency)

PROJECT	RATIONALE	OPTIONS TO RETAIN, UPGRADE, OR NEW	National CAPEX ($ million)	AR6 Requested Capex ($ million)	IES RECOMMENDATION for AR6 ($ million)	REASON FOR ADJUSTMENT
EMS Upgrade	eTerra version is coming out of support and AEMO would need to upgrade to 3.4 (or newer version at the time of the project)	There is a clear need to upgrade the EMS as support is critical for EMS (related to system operations). The WEM only recently move to e-	7.7	1.4 (based on 18% WEM share of enterprise capex)	1.4	

PROJECT	RATIONALE	OPTIONS TO RETAIN, UPGRADE, OR NEW	National CAPEX ($ million)	AR6 Requested Capex ($ million)	IES RECOMMENDATION for AR6 ($ million)	REASON FOR ADJUSTMENT
		terra and therefore investigating other options would not be sensible. The benefits for using eTerra (used in the NEM) still hold.				
Cyber Security	Security uplift across the enterprise. AEMO has zero tolerance for security risks given the importance of the efficient and stable running of the WEM.	Existing systems are out of specification as per AR5 submission. Since the previous review period, there has been in increase in security breaches of key infrastructure in other countries.	25.3	2.97 (based on 11.8% WEM share of enterprise capex)	2.5	Removal of cyber security software costs until further information can be provided
Operational Forecasting	The future state of the WEM needs forecasting techniques that can inform AEMO of the bounds of uncertainty. This project will introduce the Fusion method to forecasting (ensemble, probabilistic, consensus, forecasting as a service)	New system to provide a range of forecasting techniques that already exists for the NEM. The cost attributed to the WEM relates only to its specific onboarding cost. AEMO have stated this cost would be lower than alternative standalone options.	Proposed costs are specific to the WEM	1.1	1.1	
Infrastructure (Norwest Data Centre)	The Norwest data centre needs to undergo critical upgrades (hardware). Many WEM applications and services are run out of this data centre.	Delaying the upgrade poses hardware risks. Considerations were made to migrate to cloud, however, critical WEM services hosted at the Norwest Data Centre relating to WEM Reform and would add to WEM	2.1	0.2 (based on 11.6% WEM share of enterprise capex)	0.2	

PROJECT	RATIONALE	OPTIONS TO RETAIN, UPGRADE, OR NEW	National CAPEX ($ million)	AR6 Requested Capex ($ million)	IES RECOMMENDATION for AR6 ($ million)	REASON FOR ADJUSTMENT
		reform delivery risk. The assets would be fully utilised before migrating services to the cloud in the future.				

6 Summary of findings

IES reviewed the AEMO AR6 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.

Subject to the exceptions noted below, 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 broadly found to be reasonable but a number of recommendations relating to potential adjustments are made. The information provided by AEMO shows high input dependency and key dependency among projects. The availability of a cost over-run provision in the rules was taken into account when making recommendations about adjusting contingency capex amounts.

6.1 WEM Reform

6.1.1 Licence and cloud costs

Based on the considerations relating to licence costs discussed in Section 3.2.3 it is recommended to ask AEMO to provide clarification to the following questions:

Q1 - Are these licence costs avoidable by using licences under current AEMO arrangements?

Q2 - If they are not avoidable, can you review the cost allocation to ensure that only the portion used during development is capitalised and all costs incurred during the "in-operation" period are accounted for under operating costs (not capex).

Q3 - There is a general question about whether cloud services can be capitalised. Can you review this and treat in accordance with the accounting standard?

ERA can either reduce the capex by the amount of the licence cost or postpone the decision until further information received from AEMO and assessed.

6.1.2 Contingency

Based on the considerations relating to contingency discussed in Section 3.2.4 it is recommended that ERA apply these changes to the contingency amount and reduce the capex by the amount resulting from applying this change. The two changes are using a weight of zero for the ‘N/A’ risk category and reducing the weight of the ‘Rare’ category to one tenth of the weight used in the AEMO calculator.

Based on considerations relating to contingency for unknown risk and the availability to AEMO of an over run of the lesser of 10% (approximately $7 m) or $10 m it is recommended that the contingency for individual projects be reduced by the amount of carry-over, where that amount has been a component of the contingency amount. This is equivalent to eliminating the contingency amount associated with unknown unknowns.

Given the inconsistencies in some of the provided contingency calculators, it is recommended to request all contingency calculators be checked and verified against the FTS amounts to enable analysis based on up-to-date information.

6.1.3 Leveraging the NEM, reusing existing systems and market benchmarking

It is recommended that AEMO provide additional information and analysis to provide evidence in support of including the selected option in the submission.

6.2 WA DER Program

6.2.1 Project Symphony P1978

Based on the considerations discussed in relation to Project Symphony P1978 it is recommended that the ERA request clarifying information about the project including if there is an opportunity to reduce the capex in light of the grant received from ARENA.

6.2.2 Licence and cloud costs

Based on the considerations in Section 4.1.2 above the same questions and recommendations arise as those in the WEM Reform program.

ERA can either reduce the capex by the amount of the licence cost or postpone the decision until further information received from AEMO and assessed.

6.2.3 Contingency calculators

Based on the considerations in Section 4.1.3 it is recommended that ERA request the updated contingency calculators so they can be analysed so as to decide on what is an appropriate capex contingency amount to approve in AR6.

6.2.4 Market Visibility and DER Data Access and Management

Following on from the submission by participants on the Issues Paper, discussed in Section 4.1.4, in which participants expressed strong sentiment doubting if these projects deliver net benefit, and in view of the absence of objective assessment of cost-benefit analysis and the assumptions it is based upon; it is recommended that AEMO demonstrates the net benefit of these two projects and provide justification for why they should not be postponed. In particular, this applies to the project 'Market Visibility project' whose timeline is dependent on progress of other projects.

6.3 Sustaining Capex

The recommendations made to partially reject the capex across the projects amounts to rejecting $2.2 million, which revises the total across the sustaining capex projects to $13.2 million.. This recommendation is subject to the following clarifications:

- Clarification from AEMO relative priorities of the various projects comprising the lifecycle projects (EDP, legacy market systems and integration streams) and more detailed information on the impact to AEMO and its ability to carry out its responsibilities should those projects be deferred.
- Clarification of license and cloud costs relating to (1) lack of detail on why the licenses are required during the project delivery timeframe, (2) a lack of clarity on the underlying license costs, or if additional licenses were required because AEMO didn't have existing licenses the development work could leverage, (3) treatment of license post-project delivery and distinction between capitalising the costs and expensing through opex, and similarly, (4) the reason for capitalising cloud costs.
- Clarification on penetration testing requirements and cost estimates across the individual Lifecyle projects.

Appendix 1 – List of contingency calculators updated by AEMO

AEMO provided updates to the following contingency estimates:

WEM Reform Program

P1851 - Project Contingency Estimation Toolset - new

P2079 WEMDE - Project Contingency Estimation Toolset - new

P2080 Integration and Market Trail - Project Contingency Estimation Toolset – new [typo in filename as provided]

P2083 WEM Reform Digital Platform - Project Contingency Estimation Toolset - new

P2105 Outage Management - Project Contingency Estimation New

P2108 RCM Reform - Project Contingency Estimation Toolset - new

P2173 DTS Integration and Offline Tools - Project Contingency Estimation Toolset - new

P2175 Hypercare - Project Contingency Estimation Toolset - new

P2215 Commission Test - Project Contingency Estimation New

P2216 MT PASA - Project Contingency Estimation New

P2217 Forecast Integration - Project Contingency Estimation New

P2218 SO Planning - Project Contingency Estimation New

P2219 ST PASA - Project Contingency Estimation New

AEMO also provided P2174 Decommissioning - Project Contingency Estimation Toolset – new. However, this is an opex project and was not evaluated in this report which deals with capex projects only.