AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

Allowable Revenue and Forecast Capital Expenditure 2022-23 to 2024-25

December 2021

Proposal to the Economic Regulation Authority

Important notice

PURPOSE

AEMO has prepared this proposal to the Economic Regulation Authority (ERA) in Western Australia as required by clause 2.22A.2 of the Wholesale Electricity Market Rules (WEM Rules) and rule 108A of the Gas Services Information Rules (GSI Rules). This proposal is part of the process to set the level of revenue that can be recovered from market participants for the Wholesale Electricity Market (WEM) Market Operations and System Operations functions, and the Gas Services Information (GSI) function, for the 2022-23 to 2024-25 review period (commonly known as the AR6 period).

DISCLAIMER

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VERSION CONTROL

Version	Release date	Changes
#	17/12/2021	Submission to ERA

Key points

Wholesale Electricity Market (WEM)

- The Allowable Revenue 6 (AR6) period sees AEMO continue to support the Western Australian Government's Energy Transformation Strategy.
- AEMO will implement the new real-time energy and essential system services (ESS) market, which will enable more efficient dispatch, co-optimised services, and more competition. AEMO will also support integration of Distributed Energy Resources (DER), keeping the power system secure and enabling DER participation in the market.
- The new WEM arrangements are the biggest reforms to the Western Australian energy sector in well over a decade. AEMO is committed to delivering a functioning market within agreed timeframes and acceptable risk – at an efficient cost.
- The scale of reform to deliver and operationalise is a primary driver of the material increase in WEM fee in AR6.
- Forecast allowable revenue for the AR6 period is $156.2 million over the next three financial years.
- Average market fees will increase by $0.679/megawatt hour (MWh) (64%) over the AR6 period. This represents an estimated increase of $6.45 on the annual average residential tariff, moving from $10.11 per year to $16.56[1]
- Nearly half (47%) the AR6 increase is due to recovery of capital expenditure (capex)[2], most of which has been incurred to facilitate the energy transition.
- Operating costs (excluding D&A) will increase by $33.9 million over the period. This is due to the additional labour resources and IT systems required to operate the new, more sophisticated market, and to manage the system security risks posed by inverter-based generation.
- WEM capex proposed for the AR6 period is $69.4 million. This is $13.0 million less than AR5.
- AR6 capex comprises $44.6 million for finalising and implementing the new market arrangements, $9.4 million to deliver the WA Government's DER Roadmap actions, and $15.4 million to deliver IT lifecycle upgrades, cyber security enhancements, and improved operational capabilities.
- The capex forecast excludes projects that are insufficiently specified at this time, particularly the introduction of five-minute settlement (5MS) and implementing DER aggregator participation.
- AEMO has sharpened its focus on efficiency, governance and challenge given the scale of proposed AR6 expenditure and feedback from stakeholders that they support the reform but concerned over its scale and cost.
- The forecast has been subject to internal challenge at management and Board level and represents a level of expenditure commensurate with AEMO's risk tolerances for power system and market operations.
- As a not-for-profit entity, AEMO only recovers costs actually incurred in performing its functions.
- AEMO has leveraged organisation-wide resources to reduce project and support costs. AEMO has applied historical precedent and market testing to determine costs where practicable and submits that its expenditure forecasts satisfy the tests under clause 2.22A.5 of the WEM Rules.

Gas Services Information (GSI)

- AEMO's average annual GSI Fee will increase from $1.5 million during AR5 to $1.8 million during AR6.
- GSI forecast allowable revenue for AR6 is $5.3 million. This is 13% lower than the AR5 determination ($6.1 million). However, it represents a $0.7 million increase compared to AR5 actual GSI revenue.
- Forecast capex for AR6 is not increasing, remaining at $0.4 million.
- No material changes to the provision of GSI services are proposed for the period.

[1] Assumes Synergy passes full costs through to consumers, based on average residential consumption of 13.00 kilowatt hours (kWh)/day.

[2] Capex is recovered via depreciation and amortisation (D&A) costs, which are spread over the life of the assets placed in service.

Executive summary

Over the next allowable revenue period, AEMO's focus will be on managing Western Australia's energy transition, implementing reform, and delivering new market and power system operation functions efficiently at appropriate risk.

What AEMO's work will deliver

What this will cost

Cost drivers

Gas Services Information

Introduction

AEMO is a not-for-profit entity, responsible for the security and day-to-day operation of Western Australia's principal power system and wholesale market, and the provision of information about Western Australia's gas supply and services. AEMO is also obligated under clause 2.1A.2(ll) of the Wholesale Electricity Market Rules (WEM Rules) to facilitate and implement decisions by the Coordinator of Energy and the Minister regarding the evolution and development of the Wholesale Electricity Market and the WEM Rules, and the management of Power System Security and Power System Reliability in the SWIS.

AEMO may recover its costs for performing its functions from market participants via the WEM Fee and GSI Fee. As part of the process, AEMO develops an allowable revenue and forecast capex proposal sufficient to cover the forward looking costs of providing functions, as contemplated under clause 2.22A.5. AEMO's proposed costs *must include 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, while efficiently promoting the Wholesale Market Objectives*.[3]

AEMO's allowable revenue and forecast capital expenditure is reviewed and determined by the Economic Regulation Authority (ERA), and is subject to ongoing scrutiny and feedback from energy sector stakeholders.

This is AEMO's allowable revenue and forecast capital expenditure proposal for the period from 1 July 2022 to 30 June 2025 (commonly referred to as the AR6 period). The information provided in this proposal details the services, projects and programs AEMO will undertake during the AR6 period, and the forecast operating and capital expenditure (opex and capex) associated with delivering them.

Forecast expenditure and fees for AEMO's WEM functions and GSI functions are presented separately.

Supporting Western Australia's energy transition

The past three years have been a period of ongoing transition for Western Australia's energy sector, with significant increases in penetration of renewable inverter-based generation and growing complexity in dispatch, network constraints and market participation.

Since 2018, the amount of large scale renewable capacity connected to the South West interconnected system (SWIS) has more than doubled, with around 600 MW of solar and wind generation coming online in recent years. Rooftop solar photovoltaic (PV) generation connections have increased by 51%, with one in three homes and businesses in the SWIS having solar panels. This brings the total amount of renewable capacity as at June 2021 to 2,784 MW.

While the growing level of variable renewable generation is helping the SWIS transition towards clean, low-cost generation, it can pose operational challenges. As outlined in AEMO's recent Renewable Energy Integration – SWIS Update report[4], the power system is becoming increasingly volatile, featuring load swings of up to 750 MW within a single half-hour interval[5] and a declining minimum system load[6].

To aid and manage this transition, in March 2019 the Western Australian (WA) State Government launched the Energy Transformation Strategy. Led by Energy Policy WA (EPWA) and supported by energy industry participants, the Energy Transformation Strategy is delivering the most profound and far-reaching changes to Western Australia's electricity market and power system in more than 15 years. Work to deliver the Strategy began during the AR5[7] period and marks the start of an ongoing program that touches almost every aspect of the way electricity is generated, transported, stored, consumed and traded in our state.

As the electricity market and power system operator, AEMO has a central role in facilitating the energy transition. Over the course of AR5, AEMO has undertaken an unprecedented level of activity and investment in modernising and

[3] WEM Rules, clause 2.22A5(b).

[4] At https://aemo.com.au/en/energy-systems/electricity/wholesale-electricity-market-wem/system-operations/integrating-utility-scale-renewables-and-distributed-energy-resources-in-the-swis.

[5] On 10 August 2021, AEMO managed a 750 MW swing, and on 18 October 2020 there were three 250 MW swings within half an hour.

[6] A new record minimum system load of 868 MW was reached on 15 November 2021.

[7] 1 July 2019 to 30 June 2022.

developing the IT systems and processes that keep WA's principal power system secure and allow electricity to be traded. Work is ongoing, and AEMO will deliver the WEM Reform program as directed by WA Government during AR6.

AR6 deliverables

Building on the progress over the past three years, AEMO will deliver systems and processes that implement a new real-time market that co-optimises energy and essential system services (ESS)[8]. The WEM will move from a relatively simple wholesale market with unconstrained dispatch, to a more sophisticated market founded on a complex dispatch algorithm able to identify the optimal/least cost option for delivering electricity to where consumers need it to be, in any operating conditions.

AEMO's work during AR6 will also transform ESS. Historically, ESS have mostly been subject to an administered price, with little or no competition.[9] Under the new arrangements being delivered by AEMO, market participants can compete to provide a suite of ESS including frequency regulation, contingency reserve, and inertia. Not only will this open up potential new revenue streams for participants, it will also promote market-driven pricing, which is likely to result in more economically efficient outcomes in the WEM.

AEMO's AR6 work program will facilitate ongoing connection of large-scale renewables, energy storage, and DER, with a view to allowing more low-cost energy providers to enter the market and provide competitively priced energy to consumers. This will be achieved while addressing the system security challenges posed by falling system loads and continuing to value energy and ESS presently provided by thermal generators.

Foundations will also be laid for DER aggregation and participation. AEMO will continue working with EPWA and industry participants to ensure WA's principal power system is ready for batteries, electric vehicles and other emerging technologies, all of which have potential to be taken up by consumers at significant pace.

In delivering these transformational initiatives, AEMO will draw on its organisation-wide resources to develop the most effective solutions for the SWIS. Through sharing resources, IT systems and support services with the broader business, WEM participants will benefit from the additional expertise and economies of scale of a national organisation. Having this whole-of-sector view means low load and DER challenges can be tackled in a coordinated and more efficient manner, leveraging the latest knowledge and experience in all Australian regions.

Importantly, AEMO will provide dedicated support to WEM participants to help them transition to the new market arrangements. AEMO will also uplift its operational forecasting capabilities and resourcing levels to ensure it can continue to operate the power system and new market securely, within accepted risk tolerances.

AR6 promises to be a period of accomplishment, where many of the reforms EPWA, AEMO, Western Power and market participants have been working towards will bear fruit. By 2025 the Western Australian energy transition will be far from over, but the reformed market will be established, the power system secured for at least the short term, and the sector can begin to realise the benefits of long-lasting and meaningful change.

Impact on participants and end consumers

The upfront costs of delivering reform are substantial. Market participants support the reforms but have told AEMO they are concerned about the cost. In developing the opex and capex forecasts in this proposal, AEMO has sought to identify the lowest practicably sustainable cost of delivering reform, and has applied additional rigour in its forecasting and governance process.

Refreshed governance & contingency frameworks

Taking on board feedback from market participants and the ERA, AEMO has applied the following governance activities when developing the AR6 forecasts:

- Reviewed cost estimates, using historical actuals to inform unit rates and/or market testing where practicable.

[8] Formerly known as ancillary service, e.g. load following, spinning reserve.

[9] Load following ancillary services (LFAS) being the exception, which is provided via a market.

- Revised and validated its tier-rate system for estimating project resources.
- Developed a new project contingency framework and calculator that provides a more accurate estimate of risk and reduces contingency amounts compared with AR5.
- Tested key aspects of the WEM Reform and AR6 proposal with market participants.
- Subjected the costs and resourcing forecasts to top-down challenge by Management, the AEMO Executive Leadership Team (ELT), and ultimately the AEMO Board.
- Benchmarked elements of the forecast where possible[10] to test whether estimates are reasonable.
- Committed to ongoing engagement, transparency, and in-period assessment/reporting.

AEMO has an obligation to facilitate the Energy Transformation Strategy and continue to deliver services as outlined in the WEM Rules. AEMO aims to do this at an efficient cost, making sure market participants get a functional new market, balanced with the low risk tolerances associated with continuing power system operations.

On the basis of the governance activities outlined above, and consideration of market operations and system operations risk, AEMO submits that its AR6 allowable revenue and forecast capital expenditure has been developed on a reasonable basis, that its proposed expenditure is prudent, and that the cost estimates reflect the lowest practicably sustainable cost of delivering services.

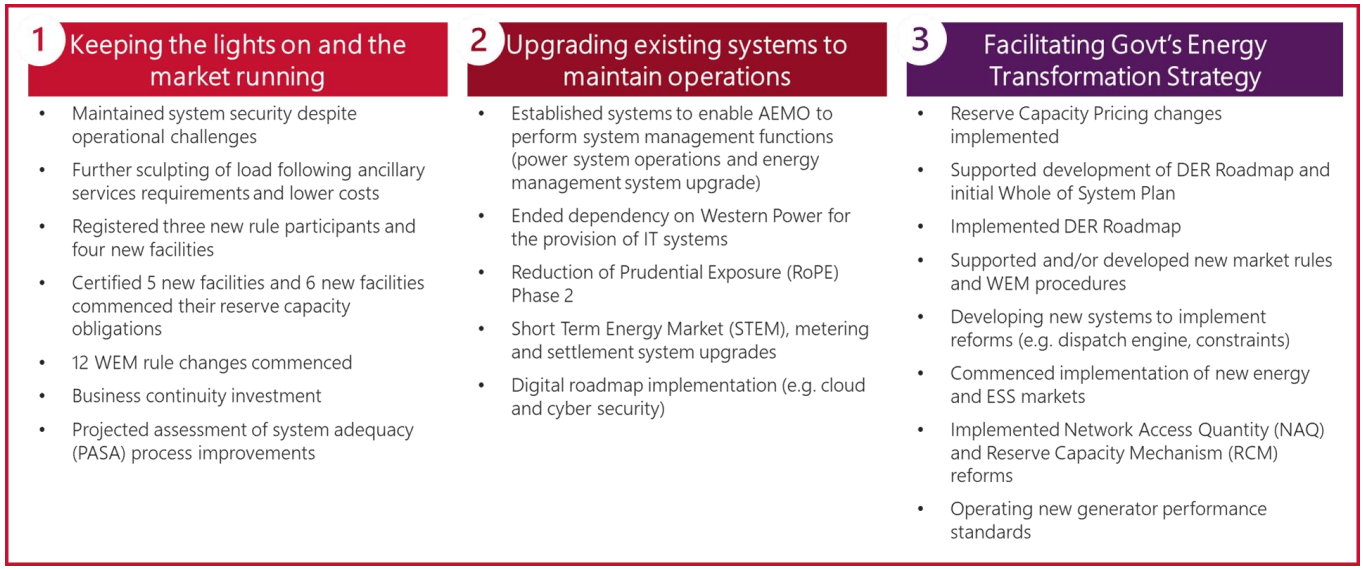
Progress during AR5

The AR6 deliverables are founded on the work conducted over the past three years and will reflect the need to meet many of the same challenges. During the AR5 period (1 July 2019 to 30 June 2022), AEMO has three key focus areas, which align with its functions under the WEM Rules:

- Keeping the lights on and market running – (clause 2.1A.1A).
- Upgrading existing systems to maintain operations – (clauses 2.1A.2(a) and 2.1A.2(b)).
- Facilitating the Western Australian Government's Energy Transformation Strategy – (clause 2.1A.2(ll)).

Figure 1 summarises some of the progress made during AR5.

Figure 1 Focus areas and progress during AR5



[10] This includes an independent assessment of AEMO's corporate costs, which demonstrates its support function costs are lower than many comparable businesses (utilities and financial services business used as proxies).

Highlights during AR5 include completing the transfer of 23 individual system management IT systems from Western Power, delivering key rule changes for reserve capacity and prudentials, and progressing a suite of critical DER Roadmap actions (e.g. Technology Integration and the DER Register).

AEMO has also improved its cyber security risk management and has commenced moving IT systems into a more secure and efficient cloud based environment. This includes aligning AEMO WA's IT capabilities and operations with the rest of the organisation, which will drive future efficiencies and help improve business continuity arrangements.

The progress during AR5 has been made against a backdrop of the ongoing challenges posed by low daytime loads and increasing levels of intermittency in electricity generation, as well as managing the impact of the COVID-19 pandemic. Despite these challenges, AEMO has been able to deliver this for less than what was forecast in the AR5 determination.

Operating costs for the AR5 period are expected to be approximately $6.5 million lower than those approved in the AR5 determination. AEMO has achieved this by managing resourcing levels, reviewing IT service contracts, deferring work where prudent to do so, and delivering projects for less than forecast where practicable. Actual revenue is expected to be around $5.8 million less than forecast and has resulted in market participants paying a lower average WEM Fee than that estimated in the ERA's AR5 determination ($0.884/MWh vs $0.907/MWh estimated).

AR6 forecasts and fees

Ongoing investment in support of the energy transition, coupled with the way in which AEMO's market and power system investments are recovered[11], means market fees will inevitably rise during AR6 and AR7[12]. AEMO has robust governance and regulatory oversight processes in place to challenge and modify its works program as necessary and will endeavour to outperform the AR6 forecasts where possible.

The following sections provide an overview of estimated WEM and GSI costs and fees over the AR6 period.

WEM allowable revenue and operating expenditure

WEM allowable revenue comprises:

- the efficient operating costs to be incurred during the AR6 period to provide WEM services; plus
- expensed depreciation and amortisation (D&A) costs from prior investments; and
- an adjustment for under/over recovery of revenue.[13]

Estimated WEM allowable revenue for the AR6 period is $156.2 million. This comprises total opex of $158.5 million, minus a $2.2 million adjustment from 2021-22 to reflect over recovery during the year.

Opex

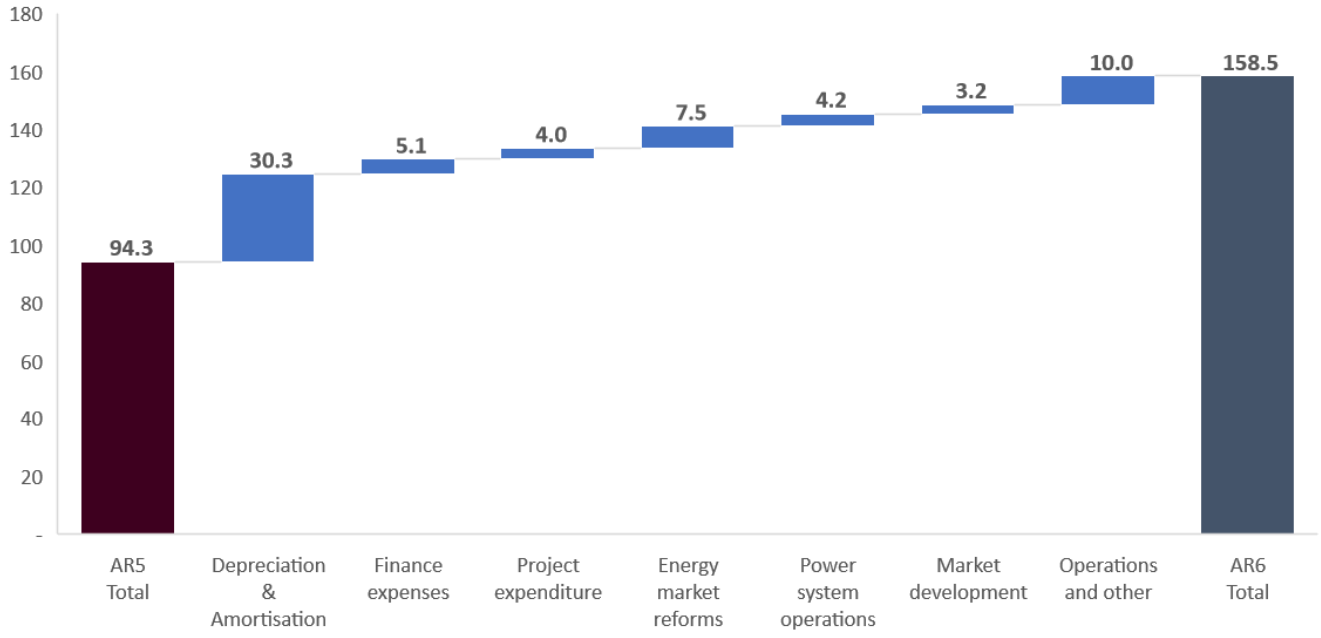
Forecast opex for AR6 is $64.2 million higher than the expected actual opex position at the end of AR5 ($94.3 million). Figure 2 shows forecast changes in opex (operating costs + D&A) between AR5 and AR6.

[11] Capital expenditure is recovered via depreciation and amortisation of the assets, which spreads the cost of the investments over a longer time frame so as to smooth and soften the impact on market fees. As a result, there is a lag between expenditure being incurred and market fees being adjusted to pay for it.

[12] AR7 period: 1 July 2025 to 30 June 2028.

[13] The allowable revenue amount also incorporates an adjustment for under/over recovery of revenue in prior periods, hence the reason why allowable revenue and operating expenditure may not be exactly the same number.

Figure 2 AR5 to AR6 forecast changes in opex ($ million nominal)



D&A and financing

The primary driver of the Opex uplift is D&A, most of which is associated with WEM Reform[14] and DER Roadmap project investments made to date. D&A, along with financing costs, are directly related to the capex program, and combined account for $35.4 million or 55% of the overall opex increase for AR6.

D&A costs are less discretionary and controllable in-period than other opex categories. While some adjustment can be made to asset lives or the timing of when capex projects are finished/assets placed in service, for the most part D&A is a mechanistic outworking of historical investment.

D&A for the AR6 period is $50.9 million and contributes approximately 30% of the 64% WEM Fee increase in AR6.

Labour and IT

Total operating costs excluding D&A and financing costs are estimated at $102.4 million. This is a $28.8 million (45%) increase compared with expected AR5 actuals.

The higher operating costs estimated for the AR6 period are driven by the energy transition. They are a result of the additional labour resources and IT systems required to provide system operation and market operation functions as the new market arrangements commence and the power system becomes more complex, high risk, and data-intensive.

Labour costs[15] are expected to increase by $20.6 million by the end of the AR6 period. IT costs are rising by $6.2 million over the three years. These increases are due to AEMO having a more complex environment in which to operate, requiring more resources and greater reliance on IT systems.

[14] WEM Reform relates to AEMO's WEM Reform Program to prepare for and implement the WA Government's Foundation Regulatory Frameworks (Improving Access to the SWIS And Delivering the Future Power System) - this includes new real time energy and ESS markets; 5-min dispatch, Facility Bidding, SCED and GPS changes.

[15] Employee benefits expense category.

For example, during AR6 a labour cost uplift of approximately $7.5 million is necessary to operate the more sophisticated real time energy and ESS market. The new market will generate a significant increase in the volume of data handling and market operations activities[16], which in turn requires more people and expertise.

Market settlements increase from 100 runs to 208 runs per year

The total labour cost increase covers other obligations arising from Western Australia's energy transformation, such as DER aggregation and Reserve Capacity Mechanism (RCM) changes. AEMO also has an ongoing market development obligation, which will include supporting further energy transformation activities such as 5MS, DER participation and ongoing WEM Rule changes.

Approximately $4.2 million of the total labour cost increase is driven by changing power system requirements resulting from the challenges of low daytime load, network congestion and increasing intermittency in the generation mix. AEMO must conduct more complex power system and congestion modelling to help maintain system security and support SCED. This will be a recurrent requirement. AEMO also requires an increase in control room operators to mitigate resourcing and succession planning risk during the AR6 period.

Labour costs include a resourcing uplift in IT, driven by the need to rationalise the 23 new applications recently transferred from Western Power's System Management and support the new applications being introduced to facilitate the Energy Transformation Strategy. AEMO expects there will be a peak in activities and resourcing effort during go-live of the new real-time energy and ESS market (2023-24), with a subsequent bedding-down period of 12-18 months. AEMO has considered resourcing requirements against its risk tolerances associated with continuity of operations and submits the labour resourcing forecast is necessary to ensure services can be provided without interruption. The resourcing effort will be met using a combination of contractors and permanent employees, with a view to achieving the optimal resourcing mix available in the market at the time of recruitment.

Resourcing peak during go-live, with 12-18 month bedding-in period.

Over the course of the AR6 period, AEMO will seek opportunities to refine processes and find efficiencies in market and system operations and expects these to be realised after the post go-live bedding-down period and beyond.

The IT opex increase is driven by a shift in the IT landscape from physical infrastructure to cloud-based computing. Cloud costs that are currently being capitalised as part of the WEM Reform project will be expensed once the market goes live and systems are placed in service. These new cloud costs will be offset by a reduction in 'on-premises' hosting expenses, lower consulting spend (due to greater insourcing), and lower costs associated with the legacy Western Power Service Agreement.

WEM Fee

$6.45 per year increase on average residential electricity bill

Average market fees will increase by $0.679 MWh over the AR6 period compared with AR5 actuals (excluding Coordinator fees – which only applies from FY22). This is an average annual increase of 64%.

During the AR5 period, the estimated contribution of WEM costs on the average annual residential electricity tariff was $10.11.[17] If the wholesale market fee increase for AR6 was passed through to residential customers, the WEM component would rise to approximately $16.56. This equates to an increase of $6.45 per year[18] on the average annual residential customer bill. The above fee assumption includes both Regulator and Coordinator fees.

Table 1 shows the breakdown of estimated the WEM Fee for AR6.

[16] For example, the frequency of market settlements is moving from 100 settlement runs per year to 208 per year post October 2023.

[17] Assumes average residential of 13 kWh per day (2021 data from Synergy/Dept of Treasury). AR5 average tariff $1.066/MWh / 1000 x (13 kWh per day) x2 because the fee is charged to both generation and load.

[18] Note the estimated consumer impact is an indicative calculation only. AEMO has no control or visibility of how market participants ultimately absorb or pass-through wholesale market and system management costs to end consumers.

Table 1 Estimated market fees during the AR6 period ($/MWh nominal)

WEM Fee ($/MWh)	AR5 average fee	2022-23	2023-24	2024-25	AR6 average fee	Change in average fee (%)
Market Fee	0.374	0.430	0.668	0.765	0.621	66%
System Operation Fee	0.509	0.708	0.967	1.088	0.921	81%
Regulator Fee*	0.183	0.199	0.203	0.207	0.203	11%
Coordinator Fee		0.077	0.078	0.080	0.078	
Total	1.141	1.413	1.916	2.140	1.823	64%

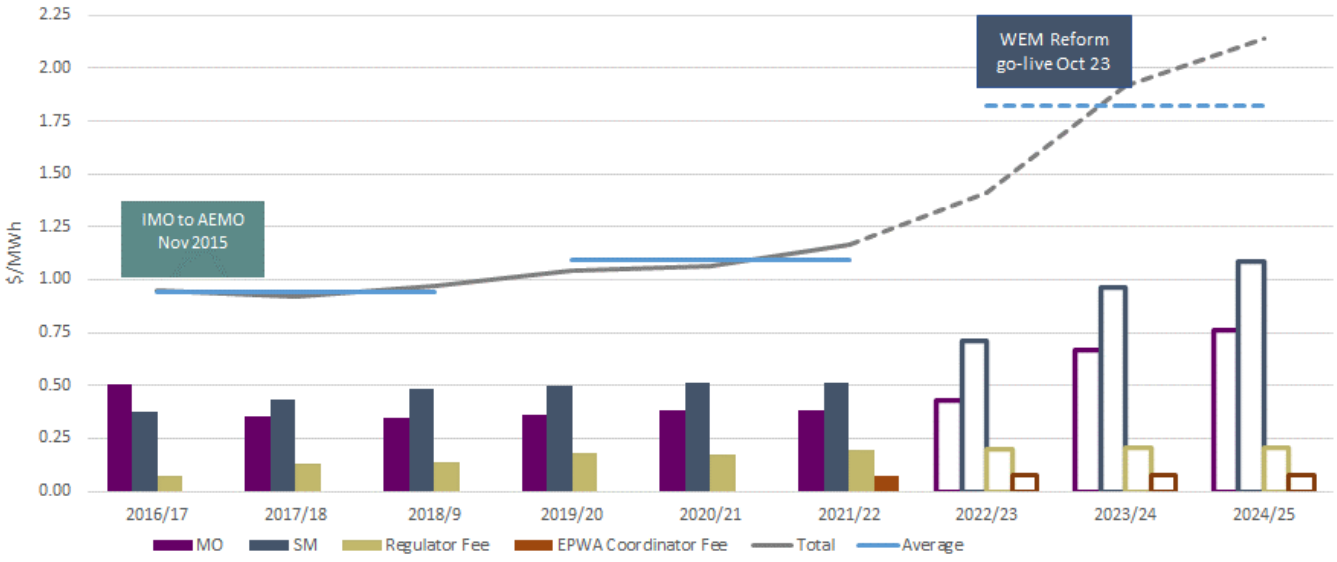
* The Regulator Fee is for the ERA's regulatory and Rule Change Panel support services. Note the Rule Change Panel functions moved to EPWA in July 2021. EPWA's costs for this function is included in the Coordinator Fee from 2021-22 onwards. The Regulator Fee and Coordinator Fee has been estimated by escalating the 2021-22 fees by CPI only. This estimate is subject to change pending the ERA and EPWA's publication of their fees for the AR6 period. The Coordinator Fee has been excluded for the period comparison as it only applies to 2021-22 during AR5.

As discussed previously, the higher overall WEM Fee is driven by inclusion of D&A and financing costs from prior investments. D&A accounts for 30% of the fee uplift ($0.204/MWh), and reflects the capital costs incurred to date of implementing the new markets and associated Energy Transformation Strategy activities (WEM Reform and DER Roadmap assets). These capex costs are being recovered via D&A over 5-10 years[19], and will continue to impact fees throughout AR6 and into AR7.

The WEM Fee increase is also due to the uplift in resources to service the new market and continue to operate the power system securely. Energy consumption is forecast to decline 1% per annum over AR6, which also impacts prices.

Fee increases for AR6 follow a period of relatively stable fees since 2016-17. Figure 3 shows the progression of fees over the AR4, AR5 and AR6 periods.

Figure 3 WEM Fee, AR4 period to end of AR6 ($/MWh nominal)



[19] The depreciation recovery period varies depending on the type of asset being placed in service.

There is a lag between incurring investment and recovering costs. Historically, material uplifts in fees have been driven by changes to the electricity market and/or power system, with the intent of either responding to power system challenges or improving market effectiveness.

Prior to the AR6 period, the most significant fee increases since market start followed the introduction of the Balancing Market in 2012. The Balancing Market was the first major reform in the WEM following its commencement, and was driven by government, the former IMO and market participants.

After the Balancing and Load Following Market commenced, the Market Fee increased significantly as AEMO commenced recovery of D&A on the new IT assets installed to operate the new market. Though the fee increases to recover the cost of these 2012 reforms were steep, the benefits to the market were tangible and ultimately recovered by participants. A 2014 Independent Market Operator report[20] determined a range of $8.9 million to $24.8 million in net benefits for the introduction of the Balancing and Load Following Market and a market benefit of $15.3 million in the first year of its operation.

It is the same scenario for AR6. The majority of capex incurred during AR4 and AR5 will start to impact market fees over the next 5-10 years. Investments during AR6 will similarly flow through to AR7, before declining as assets are amortised.

This pattern of relatively flat costs, followed by periods of investment and subsequent cost increases, is common in power systems all over the world, particularly in recent years as generation technologies and consumer behaviours change. Power systems are getting more complex, consumers are demanding greater choice and control over their energy generation and usage, and markets are getting more sophisticated. Periodic investment is essential to keep pace with change and ensure power systems and markets remain secure, fit-for-purpose, and in line with consumer expectations.

Ultimately, the WA Government's Energy Transformation Strategy and the associated package of reforms are expected to result in significant benefits to the energy sector. The introduction of SCED will result in more economic and equitable dispatch outcomes, while the broader market, power system and DER initiatives will enable the market to extract maximum value from existing generating facilities, while encouraging newer low-cost generation sources to connect.

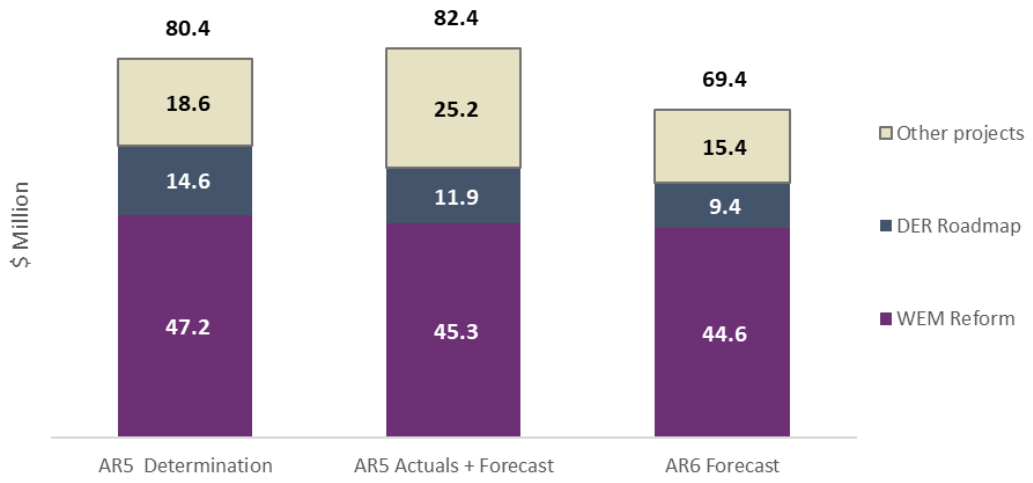
The actual impact on market fees will vary depending on actual expenditure incurred and energy consumption. Fees are revised accordingly via the annual budget adjustment process, with in-period expenditure being subject to a range of internal and external governance controls. Historically, actual market fees have been lower than forecast, as the system and market operator has sought to outperform the regulatory determination.

WEM forecast capital expenditure

Forecast capex for the AR6 period is currently estimated to be lower than incurred during AR5. Total forecast capex for AR6 is $69.4 million, compared with the $82.4 million expected to be invested by the end of AR5 (see Figure 4).

[20] Independent Market Operator, The Balancing and Load Following Market 2013 assessment, produced by Sapere.

Figure 4 AR5 historical and AR6 forecast capex, $ million nominal



The bulk of AR6 forecast capex will be spent on delivering projects in support of the Energy Transformation Strategy, specifically the implementation of the new real-time energy and ESS market by 1 October 2023. Approximately $44.6 million is required to complete the design and delivery of the new markets. This revised forecast to deliver the new markets is higher than that estimated when developing the AR5 forecast in 2019 and brings the total forecast capital cost of the new markets to $91.2 million (incl. contingency), up from the initial $61 million estimate.

Revised WEM Reform forecast based on more complete scope and information

The revised forecast for implementing the new market arrangements is based on more complete information than was available when the reform program was first conceived. The original $61 million estimate was based on a preliminary view of market design only, and as such significantly underestimated the scope and complexity of the program.

Since the original estimates were made, the scope and rules for the new markets have largely been defined. AEMO, EPWA and market participants also have a greater understanding of the complexity and volume of data, system, and processing requirements, as well as the business change activities necessary to ensure the new market can commence with manageable risk. These new assumptions have been built into the revised AR6 forecast and represent the full cost of delivering the new markets by 1 October 2023 based on the information to date.

It is important to highlight that the higher costs for implementing the new market are not driven by the 12-month deferral. Rather, the 12-month deferral is a consequence of the greater understanding of the scope and effort required to deliver the new arrangements, which led AEMO to recommend market start be pushed back to enable the program to be fully delivered and market participants fully prepared.

The AR6 capex forecast includes approximately $9.4 million to deliver actions assigned in the WA Government's DER Roadmap and related activities required to manage increasing penetrations of DER in the WEM and SWIS. The DER Roadmap actions during AR6 include delivering the DER orchestration pilot (Project Symphony), completing work on how best to integrate DER technologies into the SWIS, and making preparations for enabling DER aggregators to participate in the WEM.

Other projects incorporated in the AR6 capex forecast are for technology upgrades, IT infrastructure lifecycle investments, and enterprise-wide costs allocated to WA, such as cyber security. These investments are necessary to allow AEMO to operate securely, implement WEM rule changes and reforms, and ensure the business has fit-for-purpose systems to manage an increasingly complex and variable generation mix.

The WA Government has recently published its initial thinking around the program of work that comprises stage two of the Energy Transformation Strategy. The action and investments required by AEMO to facilitate Energy Transformation Strategy – Stage 2[21] have not yet been defined, and insufficient information is available at the time of

[21] See https://www.wa.gov.au/government/announcements/western-australias-energy-transformation-strategy-moves-its-next-stage.

preparing this AR6 proposal to inform a robust capex forecast. Further, there remains some uncertainty around the scope and technical requirements of the move to five-minute market settlement directed by the Western Australian Government's Energy Transformation Taskforce[22], as well as the timing for full DER participation in the market.

Capex forecast excludes 5MS and Energy Transformation Strategy Stage 2

While broad capex estimates have been made for 5MS and full DER participation, AEMO has not included them in its allowable revenue and forecast capex proposal at this time.[23] AEMO will continue to work with EPWA and market participants during the AR6 period to fully scope and define the Energy Transformation Stage 2, 5MS and DER participation activities, and where practicable will endeavour to deliver them within the approved budgets.

Should the ongoing work program require investment greater than the allowances available, AEMO will develop an in-period forecast capex adjustment proposal for consideration and determination by the ERA.

Gas Services Information

The Gas Bulletin Board (GBB) and Gas Statement of Opportunities (GSOO) continues to meet industry requirements. The five-year review of the GBB zones did not result in any material changes to the GBB service provision.

The 2020 Western Australian (WA) GSOO indicates domestic potential gas supply is expected to exceed demand through to 2028, with options to manage any potential shortfall thereafter. As such, AEMO does not forecast any significant changes to its GSI functions. While there is interest from some market participants to introduce a gas trading hub or gas market, any changes remain at concept level only and are therefore too uncertain to incorporate into this allowable revenue proposal.

Table 2 summarises the key GSI parameters for the AR6 period.

Table 2 Summary of forecast GSI revenue, capex and fees ($ million nominal)

GSI parameter	2022-23	2023-24	2024-25	Total
GSI allowable revenue (opex)	1.595	1.785	1.874	5.254
GSI capex	0.047	0.279	0.051	0.377
GSI Fee	1.59	1.79	1.87	5.25

GSI allowable revenue / opex

GSI forecast allowable revenue for AR6 is $5.3 million. This is 13% lower than the amount approved in the AR5 determination ($6.07 million). The GSI forecast for AR6 reflects the efficient cost of providing GSI services over the next three years, however, opex will be $0.7 million higher than in incurred during AR5.

Actual AR5 revenue is expected to be approximately $1.5 million lower than the AR5 determination ($6.1 million). AEMO has been able to outperform the AR5 Determination by incurring lower consulting and IT costs, however, most of the revenue reduction during AR5 is due to lower D&A costs.

The reduction in consulting costs was a result of AEMO undertaking a more rigorous and competitive procurement process for the 2020 and 2021 WA GSOOs. The transition of forecasting from consultants to in-house during the AR5 period has also contributed to the reduction in AR5 costs.

[22] In December 2019, the Energy Transformation Taskforce decision 5MS would be implemented in the WEM. However, no further clarification of the scope and timing of the move to 5MS is available at time of preparing this proposal.

[23] Current high-level estimates suggest 5MS may cost $21 million to $46 million, while DER Participation may cost $10 million to $14 million. These estimates are based on minimal scope and uncertain timing and technical requirements and should not be used for budgeting or forecasting purposes.

The $0.7 million opex increase for the period is predominately the result of an increase in consulting costs, Labour costs, driven by remuneration adjustments, cyber security allocation, and the mandatory 5-year GSOO review. The labour cost increase is driven by periodic remuneration increases, plus an additional partial resource allocation from corporate services for cyber security support over the three-year period.

5-year GSOO review due in AR6

The higher consulting spend is due to AEMO's requirement to undertake its five-year review of the WA GSOO during the AR6 period. Note forecast consulting spend for AR6 is $0.1 million lower than that approved in the AR5 determination. AEMO will endeavour to outperform the forecast again where practicable.

GSI capex

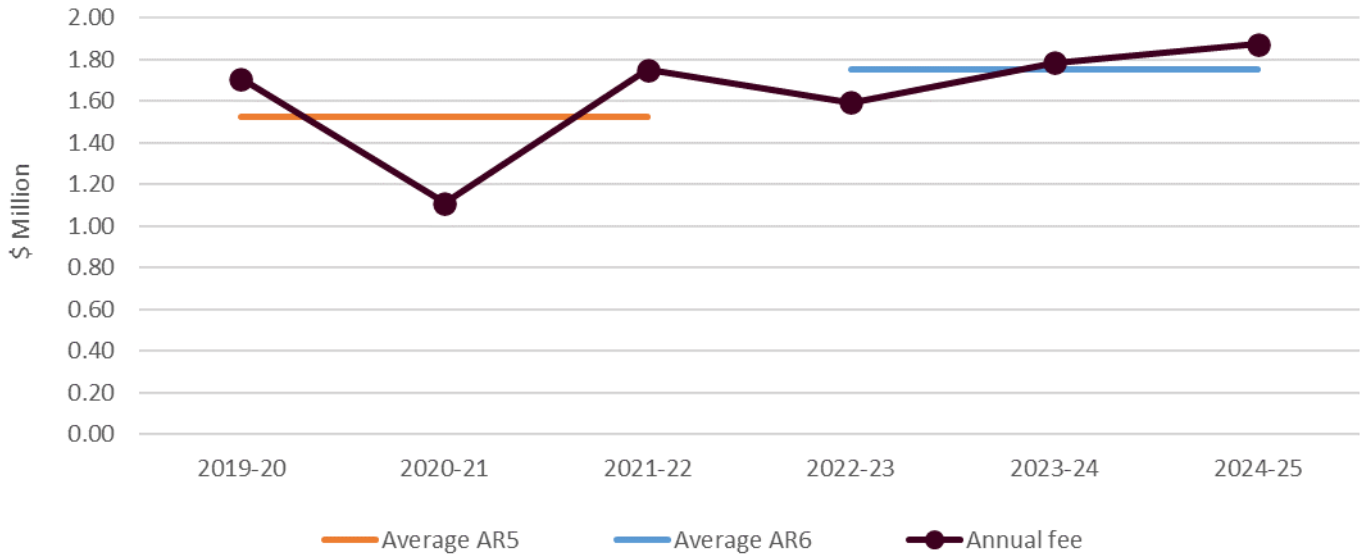
GSI forecast capex is estimated to be $0.4 million in line with AR5 forecast spend. GSI capex during AR6 includes costs to address two minor GSI Rule changes, GBB lifecycle investment, which will transfer the GBB to AEMO's digital platform (cloud), and a 0.6% allocation of an enterprise-wide cyber security project.

GSI Fee

The GSI Fee is collected on a quarterly in arrears basis split evenly between gas shippers and producers. Gas shippers are charged on the actual share of gas deliveries based on the aggregated daily actual flows and each registered production facility operator (gas producer) is charged based on share of gas produced.

AEMO's GSI fee moves over the review period from an average of $1.5 million in AR5 to $1.8 million in AR6.

Figure 5 Estimated Average annual AR6 GSI Fee compared with AR5 average



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1. About this proposal

1.1 Structure of this document

This proposal details AEMO's forecast allowable revenue for WEM services (recovered via market fees) and for GSI services (recovered via GSI fees). Given these different fees are paid by different groups of participants and cover disparate services, WEM and GSI costs are presented separately. As such, the WEM and GSI forecast capital expenditure (forecast capex) is also presented separately.

- Section 1 provides a summary of the allowable revenue process, legislative requirements, and the governance and forecasting activities that have informed this AR6 proposal.
- Section 2 presents the WEM allowable revenue, which is made up of the costs required to provide the functions outlined in clause 2.1A.1A and 2.1A.2 of the WEM Rules.
- Section 3 presents the estimated impact on market fees for the AR6 period and includes an estimate of the impact of the AR6 capex program on baseline market fees in the AR7 period.
- Section 4 presents WEM forecast capex to be undertaken during the AR6 period.
- Section 5 covers forecast opex, capex and fees for GSI services.

1.2 Values used in this proposal

All financial information in this document is presented in nominal dollars unless otherwise stated. Some tables may not sum precisely due to rounding.

Financial information in this proposal is based on AEMO's budgets and forecasts as of 30 September 2021.

1.3 The allowable revenue and forecast capital expenditure determination process

This is AEMO's allowable revenue and forecast capex proposal for the period 1 July 2022 to 30 June 2025 (commonly referred to as the AR6 period). The information provided in this document outlines the services, projects, and programs AEMO will undertake during the AR6 period, and the forecast operating and capital costs associated with delivering them.

The ERA must determine the allowable revenue AEMO can recover for the functions it provides during the AR6 period. In summary, AEMO's functions are:

- Ensuring that the SWIS operates in a secure and reliable manner, as per clause 2.1A.1A of the WEM Rules.
- Providing market operation and administration services, system planning and operation services, and constraint-related and network congestion services, as set out in clauses 2.1A.2(a) to (m) of the WEM Rules.
- Facilitating and implementing decisions by the Coordinator and the Minister regarding the evolution and development of the Wholesale Electricity Market and the WEM Rules, and the management of Power System Security and Power System Reliability in the SWIS, as per clause 2.1A.2(ll) of the WEM Rules.
- Providing the Gas Services Information functions, as set out in rule 8(1) of the GSI Rules, which includes the Gas Bulletin Board and other information services provided by AEMO to gas market participants.

On 31 October 2021, the ERA released a guideline to help inform AEMO's allowable revenue and forecast capex proposal. AEMO's expenditure forecasts, AR6 proposal and work plan was substantively developed prior to the

guideline being available. AEMO has reviewed an updated its proposal to meet the guidelines where practicable, and will provide further information to the ERA where requested during its review process.

1.3.1 Purpose and context of the allowable revenue and forecast capex determination process

Setting the WEM and GSI fees

The primary purpose of the allowable revenue and forecast capex process is to determine an estimate of the market fees payable by market participants for the next three years.

The WEM Fee is a value, expressed in $/MWh, paid by parties who generate and consume electricity in the WEM (market participants). It is a transaction fee paid to AEMO to cover the costs of operating the power system and market, and is an ongoing business cost of trading in the WEM.

The GSI Fee is paid by parties (gas shippers and gas producers) who use the information about gas services provided by AEMO (GSI participants). Unlike the WEM Fee, the GSI Fee is expressed as an annual dollar amount, collected on a quarterly in arrears basis, split evenly between gas shippers and producers and then allocated based on delivered quantities and actual flows. Again, it is an ongoing business cost of producing and shipping gas in WA.

AEMO develops a forecast of the costs it expects to incur in the provision of its WEM and GSI services over the next three-year period. As a not-for-profit company, AEMO's forecast is based on the efficient actual costs of providing services, within the accepted risk tolerances of providing critical market operations and system operations functions.

The ERA must review the prudence and efficiency of these forecast costs (subject to broad criteria in the WEM and GSI Rules) and make a final revenue determination, which is then used to form AEMO's annual budget estimates. AEMO's annual budget estimates are then used to set the WEM and GSI Fees in each year of the allowable revenue e period.

It is important to highlight that the allowable revenue determination and resulting market fees are a **forecast only**. The actual fees paid by WEM and GSI participants are subject to ongoing scrutiny and adjustment in-period, and ultimately only reflect the costs that are actually incurred by AEMO.

Historically, the WEM Fee has been on average 5% ($0.047/MWh) **lower than forecast** in AR4 and AR5 periods. Around 40-50% of the WEM Fee is paid by the government-owned electricity generator and retailer Synergy. [24]

Promoting transparency and efficiency of AEMO's expenditure

The allowable revenue and forecast capex determination process is designed to provide assurance to participants that the estimated costs of operating the electricity market and system, and providing GSI services, are efficient and have been arrived at on a reasonable basis. It provides transparency to market participants that market and system operations are prudent, achieving an acceptable balance between cost, risk and service.

AEMO's not-for-profit status means it gains no financial advantage from spending more than is absolutely necessary to provide services. However, it does mean that the organisation carries greater risk when providing services, and is reliant on having sufficient contingency allowance in its forecasts and access to overrun provisions in the WEM Rules to help manage that risk.

The triennial allowable revenue and forecast capex review process provides important oversight and transparency of AEMO's costs, and helps promote efficient behaviour. However, additional check and balances exist in-period that also test that AEMO is providing WEM/GSI functions for the lowest practicably sustainable cost. These include:

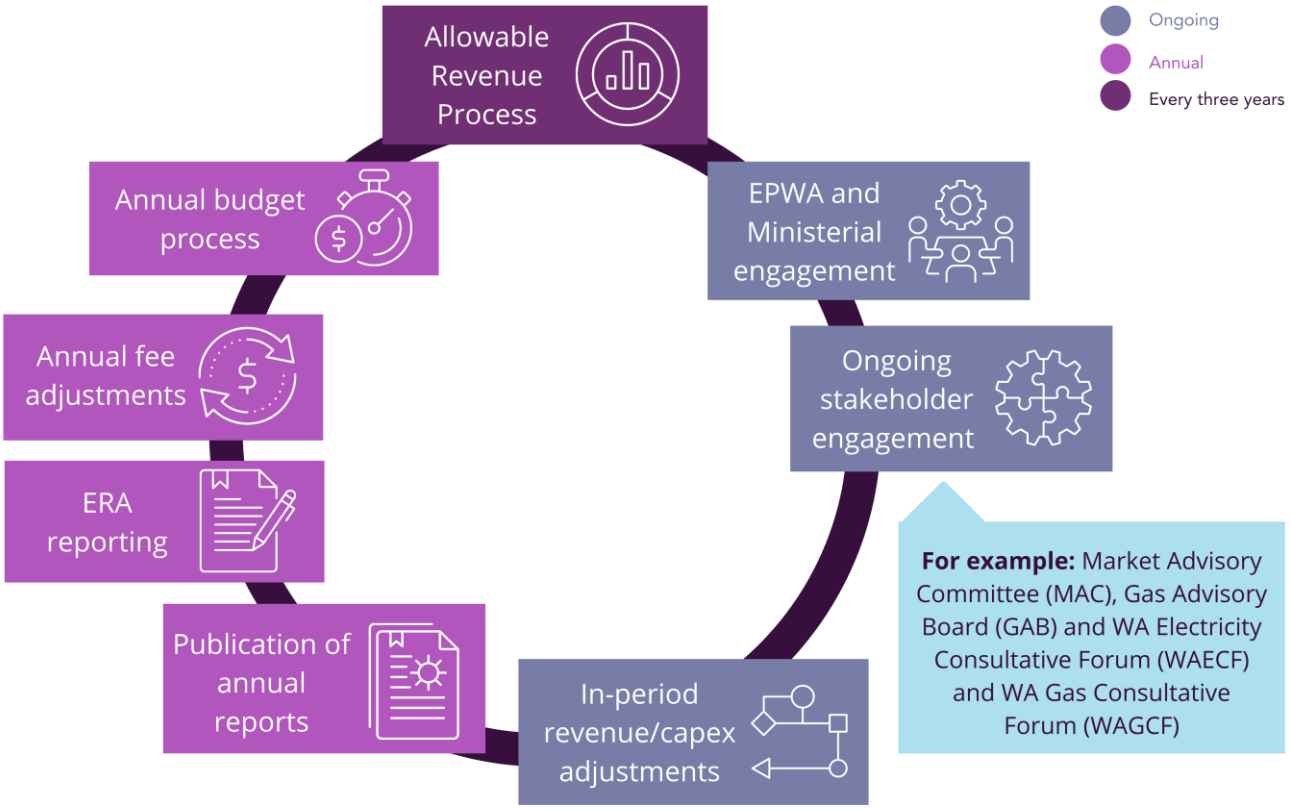
- Annual budget process.
- Annual fee adjustments.
- ERA reporting.

[24] Based on 2020-21 settlement data.

- Publication of annual reports.
- EPWA and Ministerial engagement.
- Ongoing stakeholder engagement (e.g. Market Advisory Committee (MAC), Gas Advisory Board (GAB) and WA Electricity Consultative Forum (WAECF) and WA Gas Consultative Forum (WAGCF)).
- In-period revenue/capex adjustments.

Each of these activities help provide transparency of AEMO's plans and expenditure, and provide important inputs into the way AEMO provides services and manages its investments in-period.

Figure 6 Recurring governance and oversight activities applied to AEMO's expenditure



With regard to oversight and scrutiny of AEMO's expenditure, it is important to distinguish between the allowable revenue and the forecast capex aspects of the determination process.

Allowable revenue

Allowable revenue comprises the efficient operating expenditure to be incurred over the three-year period, plus recovery of capital expenditure through the depreciation and amortisation (D&A) of assets from prior investments. The allowable revenue amount for a regulatory period also incorporates an adjustment for under or over recovery of revenue compared to forecast in prior years.[25] This adjustment or 'true up' between forecasts and actuals is the reason why the forecast allowable revenue and operating expenditure values may not be exactly the same number. However, the drivers for allowable revenue and opex are essentially the same.

[25] These unders and overs are the result of variability in energy consumption/trading, which directly impacts the amount of revenue AEMO recovers.

As stated in clause 2.22A.5(a) of the WEM Rules and rule 109(2) of the GSI Rules, the allowable revenue proposed (and approved) must be sufficient to cover the forward looking costs of providing services. Allowable revenue includes the following operating cost categories:

- Labour
- Accommodation
- IT and telecommunications
- Supplies and services
- Borrowing costs
- Depreciation and amortisation.

AEMO must provide a forecast of all these operating costs, which then informs the market fee estimates. Operating costs are recovered in the year they are incurred, with an annual true-up process to make sure participants only pay for services that were provided.

Excluding D&A, the opex forecast is typically repeatable, with revealed costs for the prior period typically representing efficient ongoing costs. However, there may be periodic step increases resulting from material changes in operating functions, such as the transfer of system operations functions from the network operator, or commencement of new market arrangements.

When developing its opex forecast AEMO's focus is to ensure step changes are required and demonstrate that any increases in costs are prudent and have been developed on a reasonable basis. Excluding D&A, labour and IT service costs are typically the largest allowable revenue components. D&A costs are an outworking of capex incurred in previous periods and asset life assumptions, and are added to the forecast operating costs.

Forecast capital expenditure

Forecast capex differs in that it is not recovered in the year it is incurred. Capex is recovered over the life of the asset via the D&A of the assets. These D&A costs are recovered as opex (via the D&A allowable revenue cost category listed above). Recovery of D&A costs does not commence until the relevant asset is put into service.

This method of cost recovery means any increase in fees resulting from capex investment is smoothed over a longer horizon. This longer recovery horizon affords greater opportunity for participants/consumers to manage or offset those increases against benefits arising from the capex investment. It also means new participants that enter the market as a result of major investments (such as market reform) will pay a share of the costs.

AEMO develops a capex **forecast** only, which the ERA assesses ex-ante. AEMO's capex estimates are developed using the best information available at the time, and represent a forward-looking view of the magnitude and value of investment required over the next three years.

The purpose of the capex forecast is to provide transparency of what investments are planned, and give participants and the ERA the opportunity to test that expenditure forecast. The test applied to the capex forecast is that the proposed investments are prudent (i.e., should be undertaken in line with AEMO's regulatory functions) and that the forecast put forward by AEMO reflects that of a service provider delivering the project for the lowest practicably sustainable cost.

Actual capex incurred **will** vary from the forecast capex determination, both in terms of value and timing. However, an approved forecast does not commit AEMO to incurring that level of capital expenditure or delivering those exact projects. Wherever practicable, AEMO will endeavour to outperform the capex forecast and deliver projects for less.

Any forecast capex amounts that are not spent are adjusted for in the annual true-up process. Where prudent to do so, AEMO may reallocate some forecast capex to projects that may not have been included in the forecast capex determination. This may be to address risks that emerge in-period or in response to energy policy direction. The WEM Rules do not require reallocation of capex in-period to be reviewed or approved by the ERA, provided AEMO remains within budgeted allowances. AEMO provides transparency of changes to allocation of funds through regular

WAECF/WAGCF[26] updates and by providing costs estimates as part of the rule change procedure change process. AEMO only incurs capex on activities necessary to perform its functions.

As a result, actual D&A recovery may differ from that forecast in the AR6 determination. If this is the case, fees are adjusted in the following year to reflect a revised D&A amount. AEMO only recovers capex it spends, and market participants are only charged for actual capex, not the forecast.

AEMO therefore bases its capex forecasts on the project scope available to it at the time, combined with an assumption of expected market conditions (and therefore costs) at the time of project delivery. Contingency is built into the project forecast based on the degree of confidence and risk surrounding the project. AEMO's not-for-profit status means it relies on contingency to accommodate risk, and ensure it can fully fund services to market participants.

Including project contingency reduces the need for adjustments to the forecast in-period and helps avoid the substantial costs associated with making in-period adjustments. AEMO is not bound to spend up to its forecast capex amount in each period.

All these matters mean it is generally more beneficial to market participants and AEMO to slightly overestimate capex than underestimate.

1.3.2 Expenditure overrun provisions

After the allowable revenue and forecast capex is determined by the ERA, AEMO must prepare budgets that are consistent with the ERA's final determination. The actual amount incurred during the period may vary from the ERA's determination. The WEM and GSI Rules each provide for this variation by including overrun provisions for allowable revenue (opex) and capex

Clauses 2.22A.12 and 2.22.A.13 of the WEM Rules and rules 111A(4) and (5) of the GSI Rules allow for revenue recovery/ capital expenditure of up to 10% or $10 million ($0.5 million for GSI) greater than the ERA's determination for the review period (whichever is lower). AEMO considers the purpose of these overrun provisions is to account for the inherent uncertainty in operating an electricity market and power system.

While a certain level of base expenditure is predictable, a range of external factors can directly impact electricity market and power system operations. These include system events, consumer behaviours, market participant behaviours, energy policy changes, environmental factors and meteorological events. While GSI functions are less likely to be subject to such variances as WEM functions, externally driven projects and unforeseen IT issues could result in cost overruns.

The overrun provisions allow AEMO to manage and respond to these factors quickly and unencumbered. This is particularly important as AEMO's not-for-profit status means it does not hold significant funding reserves.

For the AR6 period, AEMO maintains its position in prior review processes that the overrun provisions under the WEM Rules and GSI Rules are designed to accommodate expenditure that was unforeseen or could not be forecast accurately at the time of developing the allowable revenue proposal.

In order to reserve these overrun provisions for unforeseen risks or in-period requirements, AEMO factors an amount of project contingency into individual project estimates. AEMO aims to minimise use of project contingency to the extent practicable, and contingency amounts will only be released subject to senior management approval as per AEMO's project governance framework.

Following feedback from the ERA during the December 2020 adjustment to AR5 forecast capex, AEMO has reviewed and strengthened its contingency calculation process. This is discussed in section 1.6.6 of this proposal.

[26] Western Australia Electricity/Gas Consultative Forum.

1.4 AEMO's WEM functions

As the national energy market operator, AEMO plays an important role supporting the energy industry to deliver an integrated, secure and cost-effective energy supply. AEMO provides independent planning, forecasting and power systems information, security advice, and services to stakeholders.

In WA, AEMO is responsible for both the system and market operations within the SWIS, which enable the effective operation of WA's electricity markets for the benefit of businesses and households in the state.

The WEM Rules place an obligation on AEMO to provide specific market and system operation functions. Clauses 2.1A.1A and 2.1A.2 defines the functions[27] to be provided by AEMO.

2.1A.1A. The function of ensuring that the SWIS operates in a secure and reliable manner for the purposes of the WEM Regulations is conferred on AEMO.

2.1A.2. The WEM Regulations also provide for the WEM Rules to confer additional functions on AEMO. The functions conferred on AEMO are:

(a) to operate the Reserve Capacity Mechanism, the Short Term Energy Market, the LFAS Market, and the Balancing Market;

(b) to settle such transactions as it is required to under these WEM Rules;

(c) to carry out a Long Term PASA study and to publish the Statement of Opportunities Report;

(cA) to procure adequate Ancillary Services where Synergy cannot meet the Ancillary Service Requirements;

(d) to do anything that AEMO determines to be conducive or incidental to the performance of the functions set out in this clause 2.1A.2;

(e) to process applications for participation, and for the registration, de-registration and transfer of facilities;

(f) to release information required to be released by these WEM Rules;

(g) to publish information required to be published by these WEM Rules;

(h) to develop WEM Procedures, and amendments and replacements for them, where required by these WEM Rules;

(i) to make available copies of the WEM Procedures, as are in force at the relevant time;

(iA) to monitor Rule Participants' compliance with WEM Rules relating to dispatch and Power System Security and Power System Reliability;

(j) to support:

i. the Economic Regulation Authority's monitoring of other Rule Participants' compliance with the WEM Rules;

ii. the Economic Regulation Authority's investigation of potential breaches of the WEM Rules (including by reporting potential breaches to the Economic Regulation Authority); and

iii. any enforcement action taken by the Economic Regulation Authority under the Regulations and these WEM Rules;

(k) to support the Economic Regulation Authority in its market surveillance role, including providing any market related information required by the Economic Regulation Authority;

[27] These Rule reference reflect the functions as of 17 December 2021, As the market evolves through the AR6 period as will AEMO's Functions with these clauses being amended/new ones commencing (e.g. to include operation of the new real-time market from the new WEM Commencement Date).

(l) to support the Coordinator and the Economic Regulation Authority in their roles of monitoring market effectiveness, including providing any market related information required by the Coordinator or the Economic Regulation Authority;

(lA) to contribute to the development and improve the effectiveness of the operation and administration of the Wholesale Electricity Market, by:

i. developing Rule Change Proposals;

ii. providing support and assistance to other parties to develop Rule Change Proposals;

iii. providing information to the Coordinator as required to support the Coordinator's functions under these WEM Rules; and

iv. providing information and assistance to the Coordinator and the Economic Regulation Authority as required to support the reviews they carry out under the WEM Rules;

(lB) to develop and maintain a Congestion Information Resource;

(lC) to establish, maintain and update a DER Register in accordance with clause 3.24;

(lD) to participate in the Technical Rules Committee and provide advice on Technical Rules Change Proposals as required by the Economic Regulation Authority under the Access Code, to provide submissions as part of the public consultation process in respect of Technical Rules Change Proposals and to develop and submit Technical Rules Change Proposals relating to System Operation Functions;

(lE) to support each Network Operator in relation to the standard or technical level of performance in respect of a Technical Requirement applicable to Transmission Connected Generating Systems and perform the associated functions set out in Chapter 3A of these WEM Rules;

(lF) to advise and consult with each Network Operator in respect of AEMO's System Operation Functions as contemplated under the Technical Rules applicable to the Network;

(ll) to support the Coordinator's role, and to facilitate and implement decisions by the Coordinator and the Minister regarding the evolution and development of the Wholesale Electricity Market and the WEM Rules, and the management of Power System Security and Power System Reliability in the SWIS; and

(m) to carry out any other functions conferred, and perform any obligations imposed, on it under these WEM Rules.

These functions are essentially AEMO's core operational activities, and represent the suite of services AEMO must provide to market participants to ensure the market continues to operate effectively and the electricity system remains secure.

1.4.1 Legislative framework for determining WEM allowable revenue and forecast capital expenditure

The process for assessing and determining AEMO's allowable revenue and forecast capex is set out in clause 2.22A.5 of the WEM Rules, specifically part (b), which requires AEMO's revenue forecast to be prudent and efficient:

2.22A.5. The Economic Regulation Authority must take the following into account when determining AEMO's Allowable Revenue and determining Forecast Capital Expenditure or an application for reassessment to the Allowable Revenue or Forecast Capital Expenditure:

(a) the Allowable Revenue must be sufficient to cover the forward looking costs of performing AEMO's functions in accordance with the following principles:

i. *recurring expenditure requirements and payments are recovered in the year of the expenditure; and*

ii. *capital expenditure is to be recovered through the depreciation and amortisation of the assets acquired by the capital expenditures in a manner that is consistent with generally accepted accounting principles;*

(b) *the Allowable Revenue and Forecast Capital Expenditure must include 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 delivering AEMO's functions, while effectively promoting the Wholesale Market Objectives;*

(c) *where possible, the Economic Regulation Authority should benchmark the Allowable Revenue and Forecast Capital Expenditure against the costs of providing similar functions and/or projects in other jurisdictions; and*

(d) *where costs incurred by AEMO relate to both the performance of its functions in connection with the WEM Rules, and the performance of AEMO's other functions, the costs must be allocated on a fair and reasonable basis between:*

i. *costs recoverable as part of AEMO's Allowance Revenue and Forecast Capital Expenditure; and*

ii. *other costs not to be recovered under the WEM Rules; and*

(e) *any other matters the Economic Regulation Authority considers relevant to its determination.*

Wholesale Market Objectives

AEMO's expenditure and day-to-day activities are informed by the Wholesale Market Objectives in clause 1.2.1 of the WEM Rules. These are:

(a) *to promote the economically efficient, safe and reliable production and supply of electricity and electricity related services in the SWIS;*

(b) *to encourage competition among generators and retailers in the SWIS, including by facilitating efficient entry of new competitors;*

(c) *to avoid discrimination in that market against particular energy options and technologies, including sustainable energy options and technologies such as those that make use of renewable resources or that reduce overall greenhouse gas emissions;*

(d) *to minimise the long-term cost of electricity supplied to customers from the SWIS; and*

(e) *to encourage the taking of measures to manage the amount of electricity used and when it is used.*

1.5 Gas Services Information

The Gas Bulletin Board WA (GBB) and Gas Statement of Opportunities (GSOO) were established in 2013. The development of these information services was a key recommendation of the Gas Supply and Emergency Management Committee, following two major gas supply disruptions in WA in 2008.

The GBB is a website, the primary purpose of which is to publish information about short and near term natural gas supply, transmission, storage, and demand in WA. It also provides an emergency management facility to assist in the management of gas supply disruptions. The GBB may also include information about other fuels, and later could be developed into a platform to facilitate the introduction of buyers and sellers of gas should that be required by Government policy or rule change.

The GSOO is an annual planning document providing a comprehensive long term outlook of natural gas supply and demand in WA and natural gas transmission and storage capacity in the state.

AEMO is responsible for operating the GBB and developing the GSOO in accordance with the GSI Rules and relevant GSI Procedures. The costs of providing the information services are recovered by AEMO via the GSI fee on a non-profit basis. The GSI fee is shared evenly between gas shippers and gas producers, and then allocated within each group by delivered quantities and actual flows as appropriate. Participation in the GBB is mandatory for most producers, pipeline owners/operators and shippers, and the GSI fee is allocated to all GSI participants.

1.5.1 Legislative framework for determining GSI allowable revenue and forecast capital expenditure

The process for assessing and determining AEMO's allowable revenue and forecast capital expenditure is set out in rule 109(3) of the GSI Rules, which requires AEMO's forecast of revenue and capex includes '*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 delivering AEMO's functions, while effectively promoting the GSI Objectives*'.

GSI allowable revenue is forecast separately from WEM allowable revenue and is recovered via GSI fees payable by gas participants.

GSI Objectives

AEMO's investments in and operation of the GBB, development and publication of the GSOO and associated gas information services are informed by the GSI Objectives. As stated in rule 2(1) of the GSI Rules, these objectives are to promote the long term interests of consumers of natural gas in relation to:

(a) the security, reliability and availability of the supply of natural gas in the State;

(b) the efficient operation and use of natural gas services in the State;

(c) the efficient investment in natural gas services in the State; and

(d) the facilitation of competition in the use of natural gas services in the State.

1.6 Promoting efficient costs

The upfront costs of delivering reform are substantial. The ongoing cost of operating the new, more sophisticated market, along with the increasingly complex power system, will also be greater than historical levels.

Energy sector stakeholders have said they support reform. Consumers want and value renewable energy, and all parties have an interest in making certain WA's energy system remains secure. However, stakeholders are understandably concerned about the cost of achieving all this.

That is why AEMO has sought to apply additional rigour in its forecasting and governance processes. AEMO has taken on board feedback from the ERA and EPWA, coupled with lessons learnt from similar major energy system transformations in the National Electricity Market (NEM) and elsewhere, and applied them when developing the AR6 proposal.

To test AEMO's plans are prudent and to ensure the forecasts only include efficient costs, AEMO has:

- Reviewed cost estimates, using historical actuals to inform unit rates and/or market testing where practicable.
- Provided transparency of estimated costs and planned investment via regular engagements (WAECF/WAGCF, WRIG, MAC and GAB meetings).
- Re-scoped and re-profiled the WEM Reform program to ensure the solutions, costs, and resourcing levels reflect the greater clarity of scope now available.
- Revised and validated its tier-rate system for estimating project resource costs.

- Conducted a detailed bottom-up-build of operational resource requirements.
- Based labour costs on actual remuneration of similar roles.
- Developed a new project contingency framework.
- Tested key aspects of the WEM Reform program and AR6 proposal with market participants.
- Subjected the costs and resourcing forecasts to detailed bottom up build, with top-down challenge by WA Management, the AEMO Executive Leadership Team, and ultimately the AEMO Board.
- Benchmarked costs where possible to test whether estimates are reasonable and consistent with current market conditions.
- Committed to ongoing engagement and in-period assessment/progress reporting on less certain projects.

AEMO has an obligation to facilitate the Energy Transformation Strategy (as directed by the Coordinator of Energy and Minister for Energy), and to continue to deliver functions as outlined in the WEM Rules. AEMO aims to do this at an efficient cost, achieving a balance between price impact, deliverability and risk.

Particular focus has been given to the Opex forecast, with a focus on labour costs. AEMO's functions are typically labour intensive, relying on staff with specialised skillsets to operate the power system and keep the market functional. While the introduction of more technology will bring a degree of automation to complex market processes, the level of analysis and input to enable that automation has not diminished, and in many cases will increase.

Notwithstanding this, AEMO's Executive Leadership Team and Board has challenged the detailed bottom-up labour forecast, and applied a 5% efficiency target to the original bottom up build of labour costs in the final year of the forecast, as well as challenging the allocation of costs between Opex and capital projects.

AEMO submits its AR6 allowable revenue and capital expenditure forecast has been developed on a reasonable basis, its proposed expenditure is prudent, and the cost estimates reflect the lowest practicably sustainable cost of delivering services.

The following sections discuss key governance arrangements that help promote prudence and efficiency at AEMO and in the AR6 forecasts. It also gives an overview of forecasting methods used by AEMO, as well as outlining continuous improvement and benchmarking activities that have helped challenge and shape the AR6 forecast.

1.6.1 Organisational governance arrangements

AEMO is a not-for-profit public company limited by guarantee incorporated under the *Corporations Act 2001 (Cth)*. Ownership is Australian Governments (60%) and industry participant members (40%). AEMO only recovers the actual costs of providing market/power system services in line with its functions.

In WA, AEMO's revenue is subject to annual adjustments to ensure the fees paid by participants are commensurate with the cost of providing services, irrespective of the allowable revenue forecast determination.

AEMO operates under the governance of a Board comprising an independent Chair, a Managing Director (who is also the Chief Executive Officer (CEO)), and eight non-Executive Directors. The Board has representation across AEMO's jurisdictions, and is responsible for providing direction and oversight of AEMO's WA functions, as it does with other functions. Subject to travel restrictions (arising from the COVID-19 pandemic), the AEMO Board meets periodically in all its jurisdictions.

The Board delegates the day-to-day management of AEMO to the Managing Director & CEO, assisted by the Executive Leadership Team (ELT). The ELT has authority over all AEMO jurisdictions and has a permanent and active presence in WA. Key members of the ELT also sit on the AR6 Steering Committee (described below), which has been specifically appointed to ensure sufficient scrutiny and challenge is placed on the allowable revenue and capex forecast. The ELT also provides ongoing financial stewardship and is responsible for ensuring the WA projects and services are delivered at the lowest practicably sustainable cost.

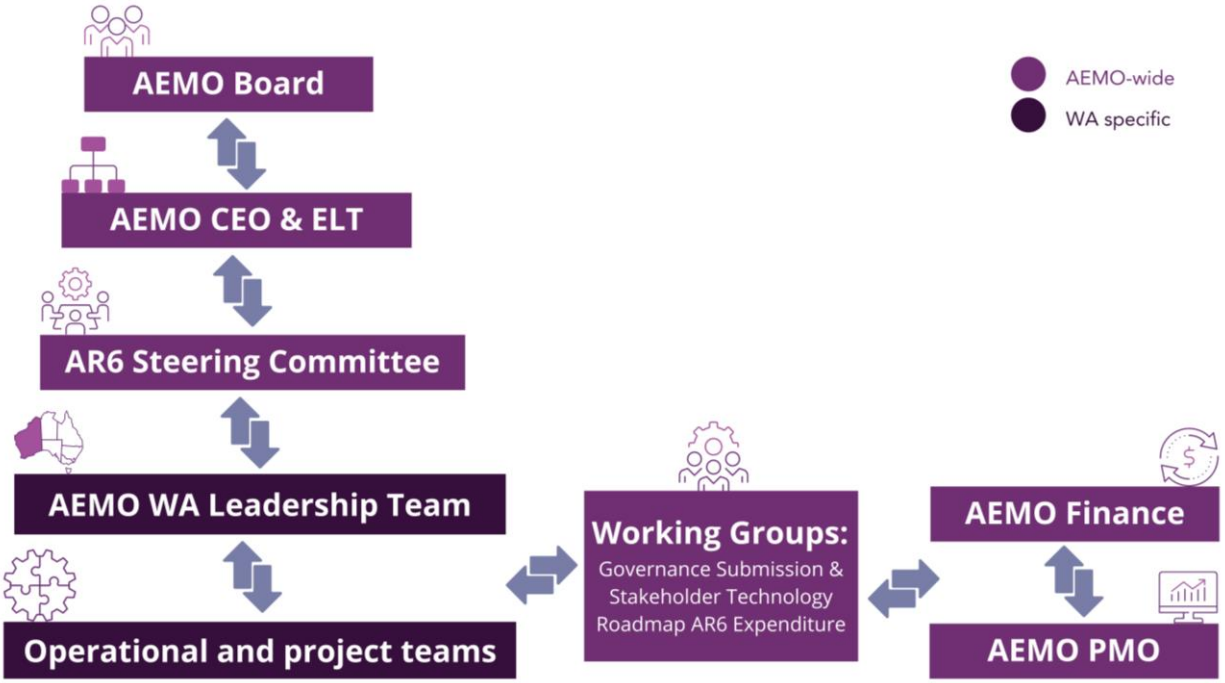
1.6.2 AR6 proposal governance and approach

The Energy Transformation Strategy activities and associated energy transition are critical to the security and efficiency of WA's principal electricity power system and wholesale market.

The expenditure uplift necessary to deliver them over the next three years is material. Therefore, the AR6 proposal is founded on a more exhaustive governance process than prior revenue and capex reviews.

To test the information provided in this proposal is accurate, consistent and developed in line with broader regulatory requirements, AEMO set up a governance structure using a mix of AEMO-wide resources and local (WA) expertise. This mix ensured sufficient oversight and support from AEMO's national organisation was available to input into the AR6 proposal and identify opportunities for alignment between the WEM and NEM. Figure 7 shows an overview of the AR6 proposal governance structure.

Figure 7 AR6 proposal governance structure



Multiple reviews, validations and challenges were provided throughout development of the AR6 proposal. Roles and responsibilities within the framework are provided in Table 3.

Table 3 AR6 proposal governance roles and responsibilities

Group	Role and responsibility
AEMO Board	• Accountable for overall approval of allowable revenue and forecast capital expenditure proposals.
AEMO Managing Director / CEO	• Responsible for approving final AR6 proposal to be provided to the ERA. • Supported by AEMO Executive Leadership Team (ELT).
AR6 Steering Committee	• Chaired by the Executive General Manager (EGM) WA with the following core members: EGM Finance; EGM Digital. • Responsible for providing strategic direction and key parameters of the proposal. • Responsible for reviewing and challenging the allowable revenue and forecast capital expenditure proposals (including scope, timing and scale – and rejecting proposals/projects where they are not sufficiently justified).

Group	Role and responsibility
WA Leadership Team and AR6 Working Groups	• Members are EGM WA; Group Manager (GM) WA Markets; GM System Management; Manager Operations, Governance & Integration; Manager Market Operations; Manager Reserve Capacity; Manager Power System & Market Planning; Manager Power System Operations; Senior Manager WA Reform and Market Development; Manager Distributed Markets WA; Manager WA IT Solutions; Management Accountant, WA Finance Business Partner; Principal Stakeholder Relations (WA). • Responsible for providing management and officer level support, guidance and challenge of allowable revenue and forecast capital expenditure proposals (including regulatory justification). • Responsible for interface with AEMO Portfolio Management Office (PMO) and AEMO Finance and ensuring internal processes and WA regulatory requirements are understood and adhered to. • Four working groups: Governance; Submission & Stakeholder; Technology Roadmap; AR6 Expenditure.
AEMO Finance	• Responsible for setting overall budget guidelines and policies. • Responsible for calculation of allowable revenue and market fee requirements.
AEMO PMO	• Responsible for setting capex initiative information requirements. • Responsible for review and validation of all capital project proposals (across all AEMO functions). • Responsible for providing all capex requirements to AEMO Finance for allowable revenue calculations.
Operational and project teams	• Responsible for scoping, and estimating capex projects (including financial and regulatory justification). • Responsible for project contingency estimation and justification. • Responsible for engaging with stakeholders on proposed projects and capex solutions, where appropriate. • Responsible for assessing current and ongoing resourcing requirements, and advising on the most efficient resourcing mix to ensure AEMO can continue to provide services. • Responsible for estimating any operating cost uplift and providing regulatory justification. • Responsible for reviewing and validating allowable revenue (and opex) forecasts.

Investment requests and regulatory considerations

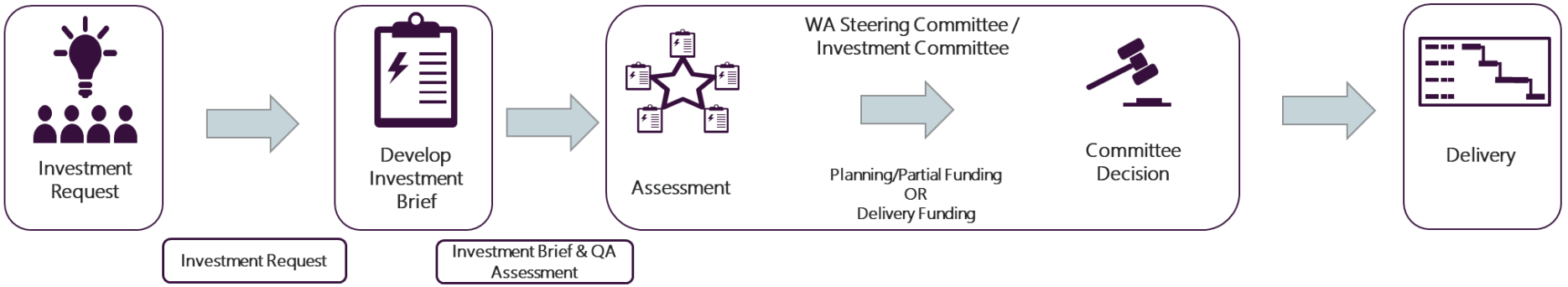
In developing its AR6 capital project justification, AEMO has applied its standard project governance approach to the extent possible. AEMO highlights that some projects are more uncertain/less mature than others and as such will be subject to further refinement as they progress through the project lifecycle and investment governance process. An important feature of AEMO's governance process is the development and approval of investment requests. Managers of capital projects were required to prepare an investment request document[28], which outlines the following considerations:

- Problem/opportunity
- Project objectives
- Value/benefit
- Proposed solution
- Options considered
- Change impacts/interdependencies
- Risks
- Costs.

These investment requests are subject to scrutiny and challenge from the AR6 Steering Committee, ELT and AEMO Board. The review and approval of investment requests – and ultimately project delivery – is governed by AEMO's Project Management Framework (discussed in section 1.6.3 below). Project investment approval is subject to a stage gate process, and ongoing reporting to the Steering Committee/ELT is required for major projects such as WEM Reform. The Board is responsible for approving the overall AR6 expenditure forecast. Figure 8 summarises the investment approval lifecycle.

[28] The level of detail in the investment requests varies depending on how mature the project is at the time of developing this proposal.

Figure 8 AEMO investment approval lifecycle – high level



High level summary of the proposed investment

Investment Types
- Large scale programs
- Small or low risk projects
- Capacity funded streams of work
- BAU initiatives requiring enterprise resources
- Investigation of opportunities

Request Type
- CAPEX, OPEX, resource

Provides detail sufficient for Committee to make a decision

'Right Sized' to the investment and decision requested

Engagement
Process engages critical SME areas to provide relevant input and advice on the proposed investment

Typical Requests
- Planning funding
- Stage funding
- Full delivery funding
- 'Always on' / Capacity funding
- Delegation requests

Submissions
- General Managers and above to present
- All submissions require an Executive sponsor

Committee reviews the Investment Brief with different lenses (and appropriate advice)
- Strategy
- Finance
- Regulatory
- Technology
- Resource Availability
- Commercial
- Legal

Decisions
- Approves or rejects investment request
  - Partial funding
  - Gate funding
  - Full funding
  - Portfolio/Program funding
- Approve delegation of an investment decision to an Executive.
- Committee determines if Board approval is required.

Delivery Approach
- Traditional
- Agile
- Tiger Teams

Governance
- Delivery governance – program/project steering committees.
- Business Sponsor accountability

To help ensure the prudence and efficiency tests prescribed in the WEM and GSI Rules were considered, AEMO applied an additional level of top-down challenge, which required each capex project owner to consider the following tests:

- Is now the right time? – *prudent*
- Is it the right solution? – *prudent*
- Is it the right cost? – *efficient*
- How does it compare with others? – *efficient/benchmarked*
- What other options did you consider? – *prudent/benchmarked*
- What are the benefits of doing it? What is the risk of not doing it? – cost/benefit to participants, consumers, AEMO? – *prudent*
- How much is it going to cost participants? – *efficient*
- What do market participants (and others) think? – *prudent/efficient/engagement*

Each of these questions are designed to bring the project originator back to the fundamental concept of the objectives and tests under clause 2.22A.5(b) of the WEM Rules and rule 109(3) of the GSI Rules. This process enabled AEMO to filter out any proposed initiatives that could not be justified, and ensure the capex program being put forward represents only expenditure that would be incurred by a prudent provider of AEMO's WEM and GSI functions, acting efficiently, to achieve the lowest practicably sustainable cost of delivering the services.

Similarly, when developing revised operating cost forecast, management was required to consider the same tests, as well as AEMO's defined risk tolerances with regard to continuation of operations.

Reflecting on the ERA's October 2021 *Guideline to inform AEMO funding submissions under the WEM Rules and GSI Rules*, AEMO has also reviewed its works program to ensure the scope of its capital projects provide the functions as described in the WEM Rules, and no more.

AR6 forecast governance summary

The AR6 forecast has been subjected to top-down challenge by WA Management, the AEMO ELT, and ultimately by the AEMO Board. This top-down challenge is designed to ensure that the forecast are accurate, tested and approved by AEMO's leadership.

The Managing Director / CEO sits on the AEMO Board, and supported by the AEMO ELT, is accountable for the day-to-day management of the organisation and the development (and approval) of the WA allowable revenue and forecast capex proposal. The AEMO ELT, particularly those members whose departments provide a material role in the delivery of WA functions, has been engaged in the challenge process, as well as the development of the expenditure program and benchmarking material.

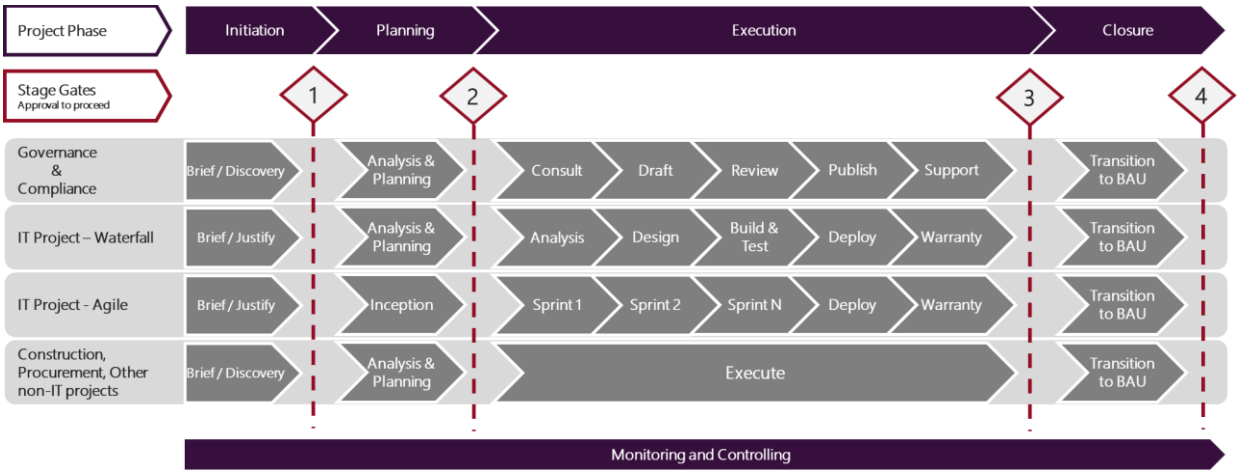
Where possible, benchmarking has been undertaken to test whether estimates are reasonable. This includes an independent assessment of AEMO's corporate costs, which demonstrates its support function costs are lower than many comparable businesses (see section 1.6.4 below). Key aspects of the proposal have been tested with energy sector participants, and stakeholder feedback has informed AEMO's proposal.

The AEMO Board considered the content of this AR6 proposal at its November 2021 Board meeting, providing detailed feedback to management. The proposal was subsequently approved by the Board in December 2021.

1.6.3 Governance of new and ongoing projects

AEMO has a formal project delivery framework. The framework, owned and developed by the AEMO Portfolio Management Office (PMO), provides a stage gate process applied to all projects ranging from rule changes to IT investments. Figure 9 provides an overview of the AEMO project delivery framework.

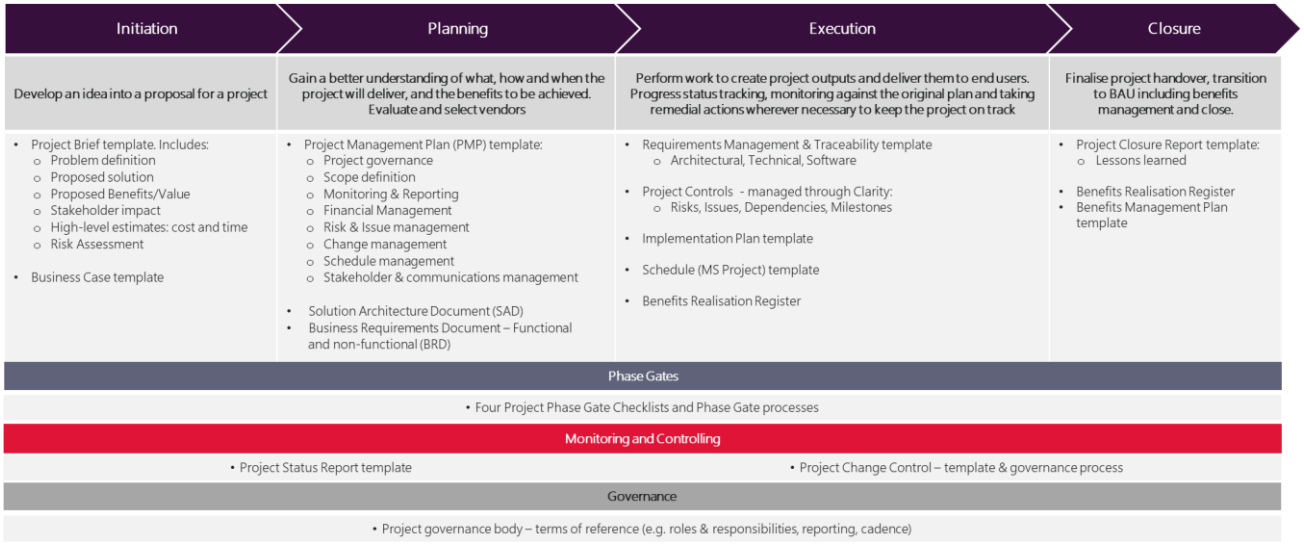
Figure 9 AEMO's project delivery framework



Given the challenging timeframes and scale of the reforms, and noting staged delivery of rules relating to reform, AEMO has used 'agile' project management and delivery methods for in-flight programs and projects (e.g. WEM Reform and WA DER). This has allowed many of the projects to be planned and commenced with imperfect information, with the intent that the solution (and therefore the project) will evolve over time. This method uses a 'least regrets' approach to deliver a minimum viable product, which in turn provides flexibility to allow a level of change within the project.

Stage gates are used to outline the activities required to enter into a project phase and what expectations are required to be met to exit a project phase. The minimum requirements of the stage gate process is represented in Figure 10 below.

Figure 10 AEMO project delivery framework – stage gate process



Investment coordination and oversight during project delivery is provided via AEMO's PMO governance function. The PMO governance function oversees project lifecycle journey. It does this by:

- Coordinating an investment request through to investment brief approval via the investment committee forum.

- Providing updates to the Managing Director & CEO via whole of PMO portfolio status reporting on approved projects, with Board provided regular updates on major projects.
- Coordinating the project closure phase.

The key decision making body with regard to project initiation and delivery is the WA Steering Committee, with Board approval required for projects above the Managing Director & CEO's delegated financial authority.

Major programs such as WEM Reform may be given their own specialised steering committee, which may be given delegated authority from the Board.

WA Steering Committee

The WA Steering Committee is responsible for approving or endorsing investments and ensuring WA projects align with corporate strategy. The WA Steering Committee was set up with particular focus on the WEM Reform and WA DER programs.

The Committee:

- Makes investment decisions.
- Monitors investment benefit realisation.
- Determines which initiatives will be submitted to the Board for further approval.
- Sets the overall investment framework.

Members of the WA Steering Committee is determined by the Managing Director & CEO, who may also sit on the Committee.

The WA Steering Committee is responsible for overseeing project status, assisting issue resolution, endorsing changes to timing or budget above agreed investment tolerances. If a project goes over time or requires use of funds above original total budget (including contingency allowance), the WA Steering Committee has authority to release funds or change scope. For major program or substantial budget/timing variations, the WA Steering Committee may take its contingency/timing advice to the Board for endorsement.

AEMO submits that its approach to project governance and project management follows widely accepted principles and practices, and helps ensure capital projects are initiated prudently and delivered efficiently in line with broader regulatory obligations. As AEMO progresses through the AR6 period, it will ensure each of the proposed capex projects undertaken is subject to strict governance, and is prepared to amend projects where scope changes or where efficient alternatives are identified while the project is in-flight.

1.6.4 Benchmarking and market testing

Benchmarking corporate costs

AEMO's operating costs were recently benchmarked to understand how they compare with peers. This work is particularly relevant for AEMO WA, given corporate support functions are provided centrally, with AEMO WA paying for its share.

In July 2021, AEMO commissioned Boston Consulting Group (BCG) to review AEMO's organisational effort, costs and operating model. BCG undertook a range of diagnostic analyses including:

- Development of an activity breakdown structure for AEMO, looking at core activities, corporate support functions, and reform activities.
- Detailed comparison of effort in corporate functions against similar-sized organisations.
- Benchmarking of core activity costs against international peers, using public reporting.

BCG looked at the effectiveness and efficiency of AEMO's activities. The work looked at two key aspects:

1. The effectiveness of AEMO's overall operating model.

2. Where and how efficiently AEMO's efforts are allocated today.

In summary, BCG found:

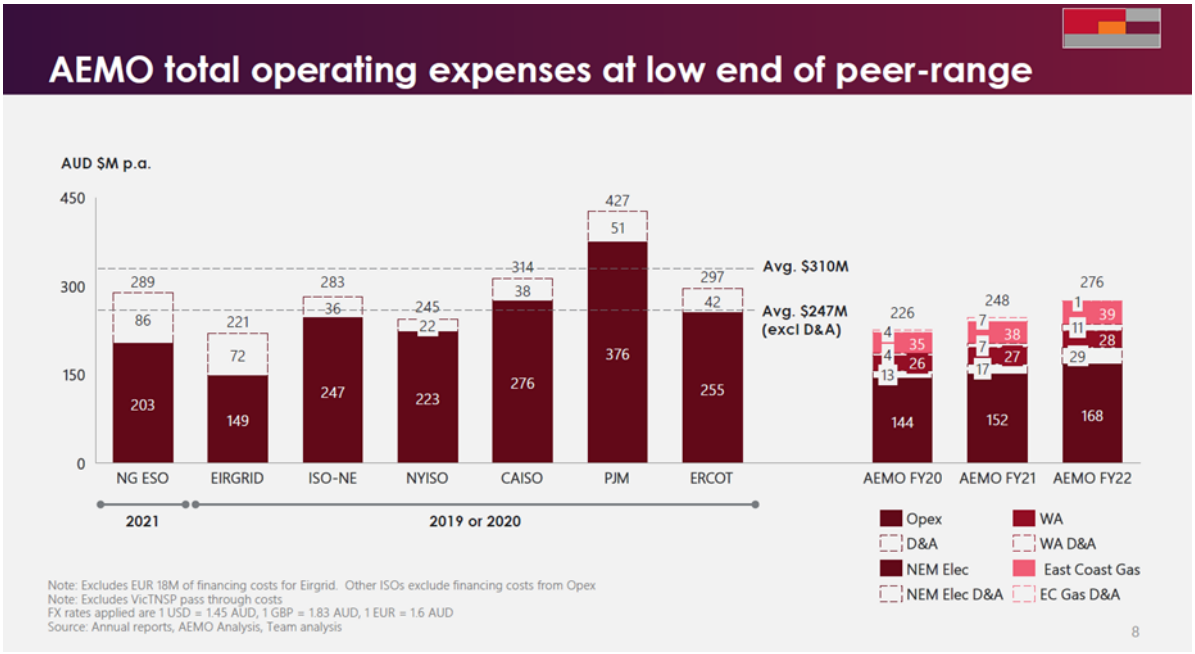
- AEMO's core activities are well directed against its mandated functions and costs are comparable with peers.
- AEMO's corporate support function effort is at the low end of benchmarks.
- AEMO's digital 'run-the-business costs' are well above comparators, due to legacy technical debt.

The competitiveness of AEMO's corporate support costs provides a significant advantage to AEMO WA and ultimately WEM participants. By being part of a larger organisation, AEMO WA benefits from economies of scale and scope, and greater purchasing power than it would as a standalone business.

For example, AEMO WA shares AEMO's central cyber security program and benefits from a heightened level of market and power system cyber security and business continuity arrangements, at a fraction of the cost than if it were to deliver its own cyber security program for WA

As shown in Figure 11, AEMO's total operating expenses are at the low end of the peer range studied.

Figure 11 Extract from BCG July 2021 benchmarking outcomes – total opex



NG ESO = National Grid Electricity System Operator, Great Britain
EIRGIRD = EirGrid, Republic of Ireland
ISO-NE = Independent System Operator, New England, USA
NYISO = New York Independent System Operator, USA
CAISO = California Independent System Operator, USA
PJM = system operator across 13 states and the District of Columbia, USA
ERCOT = Electricity Reliability Council of Texas, USA

BCG's findings are consistent with opex benchmarking conducted by National Grid ESO (Great Britain) in 2019, which found AEMO's direct operating costs per capital served and per km of network are lower than most independent system operators (see Figure 12 and Figure 13).

Figure 12 High level benchmarking of system operator direct opex per capita 2019

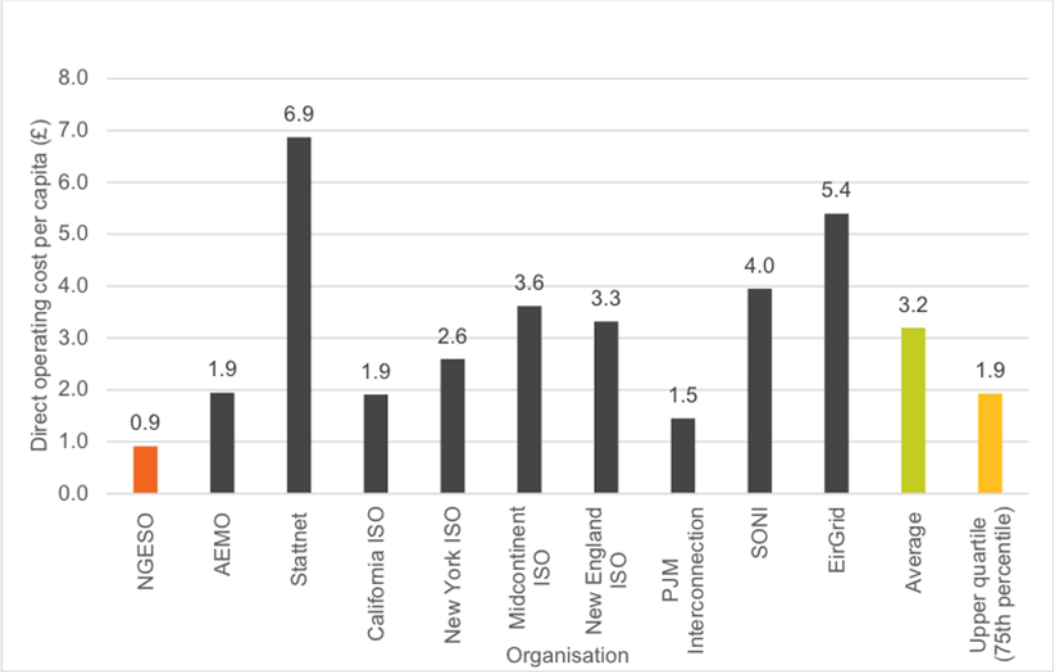


Figure 1- High-level benchmarking: direct operating costs per capita (£, 2018 prices)

Source: National Grid ESO RIIO-2 Business Plan Annex 1, October 2019
Statnett = System operator, Norway
Midcontinent ISO = system operator of 15 states, USA and the province of Manitoba, Canada
SONI = System Operator of Northern Ireland

Figure 13 High level benchmarking of system operator direct opex per km of network 2019

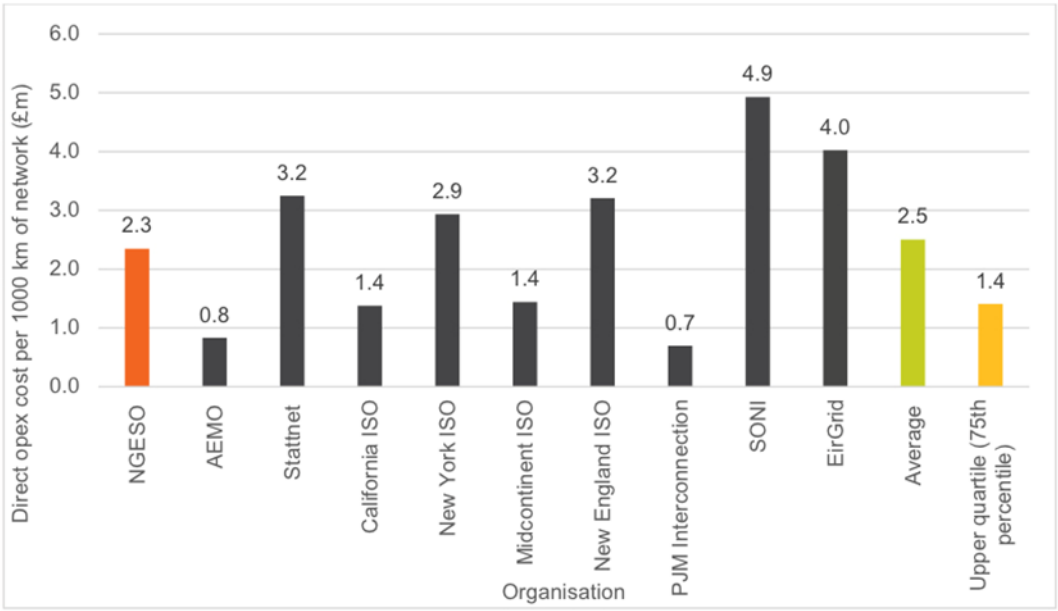


Figure 2 - High-level benchmarking: direct operating costs per 1000 km of network (£m, 2018 prices)

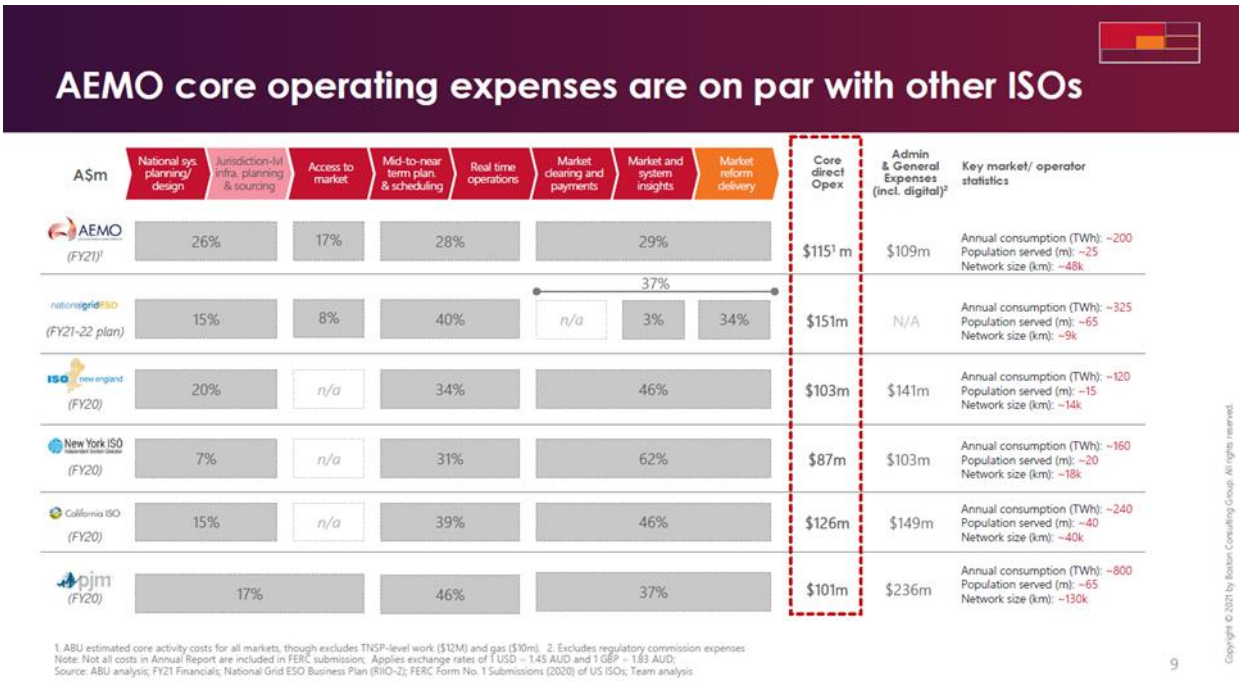
Source: National Grid ESO RIIO-2 Business Plan Annex 1, October 2019

The BCG study looked at AEMO's core activity opex and how each compares with peers. Core activities are identified as:

- System planning/design
- Jurisdictional infrastructure planning and resourcing
- Transmission network work (Victoria only)
- Access to market
- Mid-to-near term planning and scheduling
- Real-time operations
- Market clearing and payments
- Market and system insights.

As shown in Figure 14, AEMO's core operating expenses are comparable with other independent system operators.

Figure 14 Extract from BCG July 2021 benchmarking outcomes – core opex



BCG found that across the chain, AEMO's direct core activity opex is comparable – within the limits of reporting standards – to peer operators. However, the balance of spend appears to differ, with peers reporting a higher share of direct operating expenditure in system and market operation than AEMO, and AEMO spending relatively more on system design and access to market activities. This can be explained to some extent by the high penetration of non-synchronous renewable generation in the Australian power systems, as well as differences in AEMO's obligations/mandate compared with the UK and US system operators.

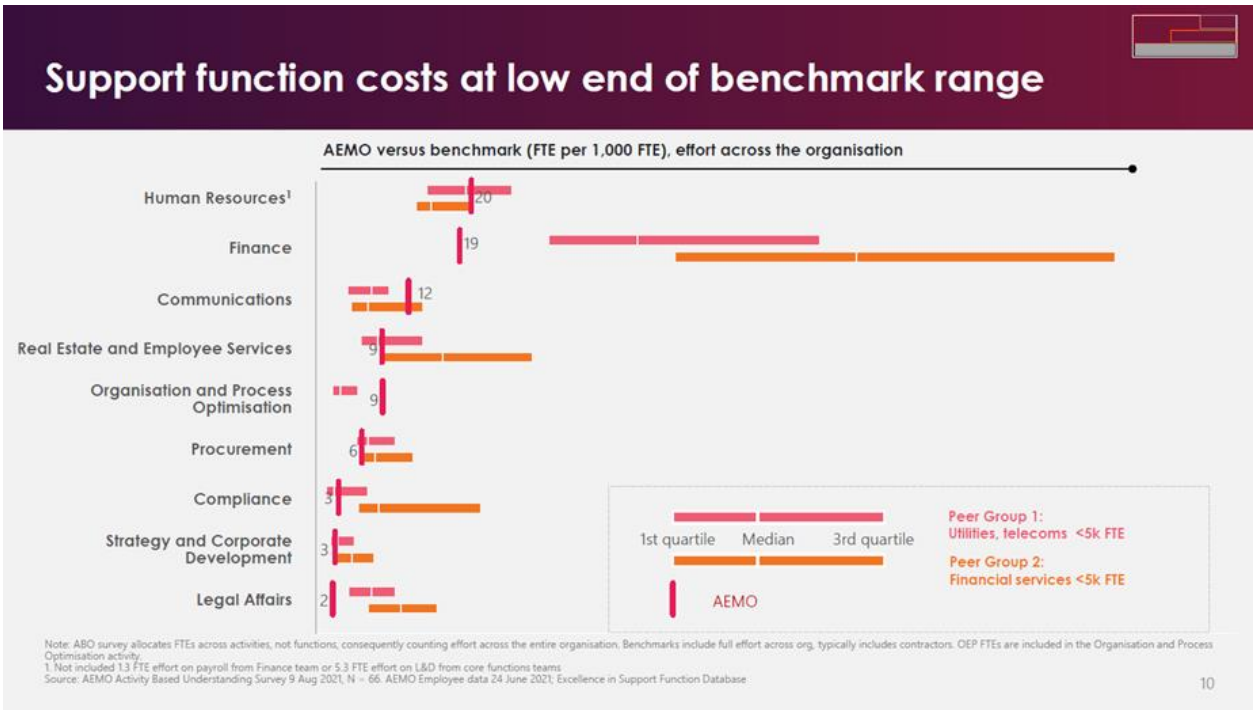
The study also considers AEMO's corporate support services, including Human Resources, Finance, Procurement and IT. AEMO WA shares these corporate support services with the rest of the business.

Due to the unique and varied nature of AEMO's services, BCG looked at two peer types as comparators:

1. Utilities/telecommunications businesses <5,000 FTE
2. Financial services businesses <5,000 FTE

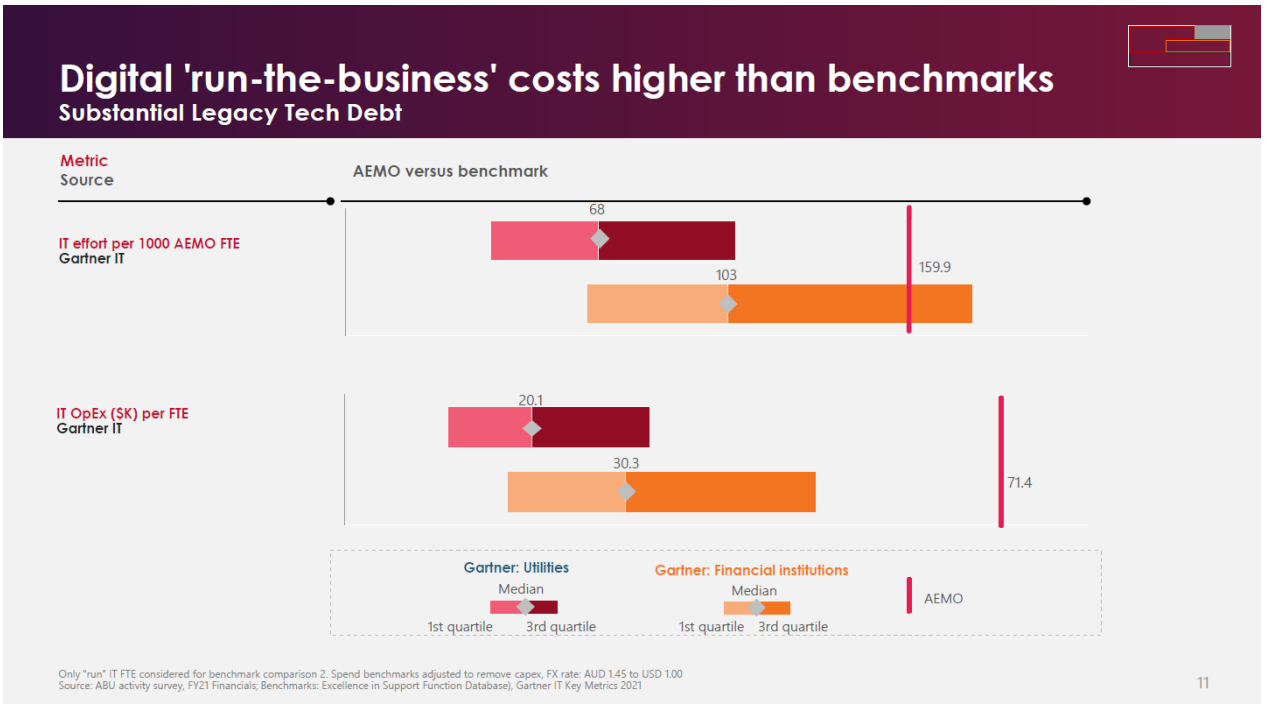
BCG found that AEMO's corporate support services effort is at or below the median (see Figure 15).

Figure 15 Extract from BCG July 2021 benchmarking outcomes – corporate support services



However, AEMO's digital 'run-the-business' costs are significantly above the media of broader industry peer groups (see Figure 16).

Figure 16 Extract from BCG July 2021 benchmarking outcomes – digital/IT costs



This higher level of FTE effort required to support critical IT functions is due to the high number of legacy systems in use at AEMO. The AEMO business as it exists today has been drawn together over many years from the various state-based system and market operators. As a result, AEMO inherited a large number of bespoke and varied systems within limited interconnectivity.

AEMO has been working to address this issue, undertaking a digital transformation program to create standard digital platforms, rationalise applications, and move to cloud-based working. This program is ongoing and will help drive AEMO's IT costs closer to the median benchmark. However, it will take some time for the reduced technical debt to flow through to reductions in IT effort.

The WA business unit is one of the first parts of AEMO to benefit from the digital transformation, with the new WEM Reform applications being among the first to utilise the digital platform and cloud services.

Purchasing and market testing

AEMO purchases a range of goods and services during the course of providing its system and market operation functions. To drive value for stakeholders and to encourage competition among suppliers, AEMO has a structured Purchasing Policy and suite of processes for all purchasing activities.

The Purchasing Policy aims to ensure procurement occurs in an economically effective manner. It establishes a standard approach to purchasing any good services, including but not limited to:

- IT systems including, but not limited to, hardware and software
- Professional Services including, but not limited to consulting
- Corporate Services, including but not limited to travel and accommodation
- Any goods or services involving the transfer of intellectual property
- Real estate (for example, an AEMO office site or carpark)
- Goods by lease or hire-purchase
- Audit services.

All personnel involved in purchasing goods or services must have regard to the following:

- The desired outcome is that of best value gained when considering total cost, risk and quality.
- Total cost will, as appropriate, consider the full anticipated life-cycle costs of the goods or services, including such factors as maintenance, servicing, reliability costs, and costs of ultimate decommissioning and/or disposal where AEMO may be responsible for them.
- Value may and should, where appropriate, be assigned to such factors as sustainability, environmental and social benefits and of improving the competitiveness of the supplier base on which AEMO depends.
- In addition to the total cost of acquisition or ownership, an objective is to reduce where possible the administrative cost of acquiring and owning goods and services. Selection of the most appropriate procedure to obtain an approximation to best value without incurring excessive administrative cost (or without unduly diverting limited resources from other activities and priorities) is therefore vital.

AEMO's Purchasing Policy is central to the purchasing lifecycle, as summarised in Figure 17.

Figure 17 AEMO's purchasing lifecycle

The purchasing lifecycle outlines the circular nature of purchasing and all the steps in the purchasing process. These steps include:

- Procurement Strategy
- Planning
- Sourcing
- Requisition to Pay
- Contract Management.

One of the most important aspects of the purchasing lifecycle is sourcing. Standard practice when sourcing goods and services is to go to market for quotes. The number and frequency of quotes depends on the nature of goods and services being sourced.

Under the Purchasing Policy AEMO must:

- Be able to demonstrate how they used their best efforts to obtain Business Value when Purchasing.
- Before purchasing goods and services, ensure there are adequate controls in place to eliminate or mitigate any environmental and workplace health and safety risks associated with that purchase, including alerting the Workplace Health, Safety and Environment Manager to the proposed acquisition or hire of goods such as office furniture, plant, electrical equipment or chemicals.
- Not renew a contract, or allow a contract to be renewed, without first conducting a benchmarking exercise, consisting of an assessment of the supplier, the need for the goods or services supplied under the current contract, and of the proposed contract, including the price compared to the market.
- Use a preferred supplier when a preferred supplier arrangement is available, which allows for quotes for certain spend categories to come from a select number of chosen suppliers without requiring an exemption for purchase totalling less than $200,000.
- Not establish preferred supplier arrangements without approval from the Group Manager of Business Services.

- Meet the minimum requirements when purchasing as outlined in the table below, unless the purchase is the subject of an exemption.

Table 4 Purchasing minimum requirements

Financial Limit $AUD (excluding GST)	Purchasing activity (minimum requirement)
$500,000 +	A full tender process, irrespective of any preferred supply arrangements, with assessment of at least 3 suppliers via the AEMO online tendering system. A member of the Procurement Team must endorse the sourcing strategy and form part of the evaluation and negotiation team.
$200,000 - $499,999	Distribution and evaluation of at least three written quotes, via the AEMO online tendering system. The Procurement Team must endorse the sourcing strategy.
$75,000 - $199,999	Distribution and evaluation of at least two written quotes, to be stored in AEMO's contract management system.
$5,000 - $74,999	Distribution and evaluation of at least one written quote, to be stored in AEMO's contract management system.
$0 - $4,999	One written quote, no purchase order required.

Where practicable, AEMO uses the market to test the cost of goods and services. Where AEMO has prepared a forecast for a project or piece of work that has not yet been fully scoped, or is towards the end of the AR6 period, cost estimates are typically based on historical costs for projects of a similar nature. The AEMO Purchasing Policy and associated processes will be applied at point of purchase.

1.6.5 Expenditure forecasting methods

AEMO uses a range of well-established methods to develop its expenditure forecasts. The forecasting method used varies based on the nature of the expenditure. For example, if the expenditure is recurring and predictable, a simple roll-forward of historical costs may be appropriate. Where expenditure is a one-off project, a bottom-up build (or zero-base) based on specific needs and timing would be applied.

All Opex and capex forecasts are subject to a top-down challenge by the WA Leadership Team, AR6 Steering Committee, ELT and Board. Subsequent adjustments are then made as part of AEMO's standard governance process.

A general rule of thumb is that capex forecasts tend to be developed via bottom-up build, with Opex tending towards a roll-forward, or 'base-step-trend' method. An overview of the forecasting methods used by AEMO is provided below.

Bottom-up build

For most capital projects and for some aspects of operating expenditure, AEMO uses a 'bottom-up' method to derive the expenditure forecast. AEMO identifies the need and the required timing of the capital project or Opex step change in accordance with a series of expenditure drivers.

AEMO's expenditure drivers are directly related to its strategic priorities as identified in its 2022 Corporate Plan (see Figure 18).

Figure 18 AEMO's strategic priorities at a glance

Table 5 summarises how these strategic priorities drive AEMO WA's expenditure (both opex and capex).

Table 5 AEMO's strategic priorities and expenditure drivers

Strategic priority	How this drives AEMO WA's expenditure	Relevant obligation/clause under the WEM Rules
Operating today's systems and markets	AEMO's first priority is to ensure the power system continues to operate securely and IT systems and markets are functional and operate efficiently. Expenditure under this driver is designed to address ongoing and emerging challenges such as low daytime loads, system safety and emergency management, and cyber security. It also includes ongoing asset replacement and IT lifecycle upgrades to ensure the suite of applications and systems that underpin today's energy markets and systems continue to function.	2.1A.1A 2.1A.2(a)
Navigating the energy future	AEMO has an obligation to evolve the energy markets in the interest of participants and end consumers. This includes implementing policy changes as directed by the Government, and developing new systems to support Western Australia's energy transition. Expenditure under this driver includes implementing new markets and SCED, as well as enabling DER integration and broader DER Roadmap deliverables.	2.1A.2(ll)
Engaging our stakeholders	AEMO operates the energy markets and systems on behalf of industry participants. AEMO's stakeholders and end consumers are the reason it is in business. AEMO is therefore committed to collaboration and transparency across all functions, and seeks to provide high quality services and advice to the energy sector. Expenditure under this driver is designed to improve the way AEMO engages with and/or provides information to stakeholders. This includes information provision training, reporting, and rule and procedure changes.	2.1A.2(k)(l) and (lA to lF)
Evolving the way we work	AEMO has an ongoing commitment to improving work practices and finding new and innovative ways to provide services more efficiently. AEMO's focus is on maintaining good practice and ensuring systems and processes are fit for purpose, offering a valued service to industry participants and end consumers. Expenditure under this driver includes implementing new systems that will improve productivity or security, or making greater use of enterprise-wide solutions and resources to benefit AEMO WA. Examples include the move to cloud-based working and improving mobile capabilities to promote remote working.	2.22A.5(a) and (b)

Once the expenditure driver and timing has been identified, AEMO considers a range of feasible options to address the need, and selects the option that is least cost or is most likely to maximise benefits.

AEMO uses a standardised cost estimation model to forecast project cost elements such as internal and external resources, IT platforms, expenses and contingency. Where third party support is required, this is estimated based on prevailing market conditions and, where practicable, obtaining a range of quotes. Where a range of new quotes are not available (for example where there may only be one service provider, or where the project is at a very early planning stage), AEMO uses historical actuals or comparable projects to inform unit rates.

The precise method for building up the project capex forecast will vary depending on the type of project being delivered, specifically whether the project has recent precedent, is entirely unique or unprecedented, or is already in-flight:

- Recent precedent – where a project is similar to one delivered previously (for example in the NEM), AEMO will base the cost estimate on historical actual costs.
- Unique projects – where a project is entirely new and without precedent, AEMO will adopt a T-shirt sizing approach (i.e. small, medium, large, extra-large) to estimate the effort and resources required to deliver the project. From there, AEMO will estimate each element from a zero base, using prevailing market conditions and unit rates to determine costs where possible.
- In-flight projects – where a project is ongoing across multiple allowable revenue periods, the project will be reassessed and a revised forecast developed based on new or updated inputs and assumptions where available. In this instance, AEMO may focus on justifying the step change (up or down) in capital costs, and/or reprofiling the overall project cost depending on how significantly the project scope has changed.

AEMO's preference is to use historical precedent where possible, and will use a mixture of estimating techniques (for example T-shirt sizing for different elements of projects where appropriate.

All capital projects are subject to top-down challenge at the project management level, with major projects subject to further challenge at management/executive level, and some such as the WEM Reform program at Board level.

Each project forecast includes an amount of estimated contingency. The amount of contingency estimated for each project will vary based on project scale, risk, and how certain/well defined the project scope is at the time of developing the AR6 forecast. AEMO has a standard project contingency calculator, which is applied to all capital projects. An overview of the contingency calculator and estimating approach is provided in section 1.6.6.

Top-down challenge

Where a forecast has been developed via a bottom-up build, it is important to take a top-down view to assess whether the forecast is reasonable. A bottom-up build is inherently conservative and is typically developed in isolation. The purpose of the top-down challenge is to test the cost estimates (opex or capex) and ensure a portfolio-wide or enterprise-wide view is applied to the forecast. This allows synergies or potential overlaps to be identified, typically resulting in a reduction in the initial forecast.[29] It also ensures broader stakeholder considerations are factored into the cost estimates.

The top-down challenge generally involves consideration of the forecasts based on historical expenditure and future drivers, such as changes in market participation and volumes of activity. The top-down challenge also considers the timing of expenditure, impact on market/GSI fees, the recurrent nature of costs, and opportunities to better manage the variable cost components of any expenditure (for example use of temporary vs permanent resources). The challenge may also include a cost-saving target or efficiency factor, designed to promote outperformance of the expenditure forecast where practicable.

[29] Noting that a top-down challenge can result in forecasts increasing as well as decreasing.

All opex and capex forecasts have for the AR6 period been subject to a series of top-down challenges by the WA Leadership Team, AR6 Steering Committee, ELT and Board, with information more granular at the lower management levels.

Base-step-trend

AEMO forecasts its operating expenditure using variants of the base-step-trend method.[30] This involves selecting a starting actual Opex amount, which is then adjusted to accommodate step increases or decreases for the forthcoming period, and escalated for CPI and other factors. This approach considers whether expenditure is recurrent and takes into account inclusion/exclusion of 'one-off' operating expenditure items. Typically, AEMO will use actual operating costs over the prior period (AR5 in this case) as the base, and estimate the efficient forward-looking costs from there.

Where the base-step-trend approach is not suitable, AEMO applies alternative forecasting methods, such as a bottom-up build of costs. Note operating expenditure step changes are subject to the expenditure drivers described in the 'bottom-up build' section above.

Estimating labour costs

To provide the market and system operations function prescribed by clauses 2.1A.1A and 2.1A.2 of the WEM Rules, AEMO must have access to sufficient in-house skills and expertise. AEMO may outsource work or bring in consultants as appropriate for discrete projects or transient activities, however, AEMO's core system operations, market operation, and GSI functions tend to be repeatable, highly specialised, and more suited to permanent employees or fixed-term contractors.

Continued attraction, development and retention of workforce skills and expertise is critical to AEMO's success and has been highlighted its 2022 Corporate Plan. Labour costs are a significant component of AEMO's cost base for operating activities and capital projects.

The method AEMO uses to estimate labour costs depends on whether they are operational roles or capital project resources.

Opex labour estimates

Consistent with the ERA's requirements, AEMO estimates operational roles based on the cost of existing internal resources where possible. The general approach for labour opex is:

- Existing roles are based on current costs, adjusted for expected changes in base salaries, superannuation and on-costs.
- New roles are based on the average actual cost of equivalent role(s). All new roles are within existing teams, which have well defined responsibilities. This means there is generally little to no difference between the scope of the new and existing equivalent roles.

Capex labour estimates

Capital project resourcing requirements are derived from a bottom-up assessment of the project scope. The project manager identifies the number, skill set and types of personnel required, and the number of days for each resource. These are tested with the project sponsor, who is typically a member of the Executive Leadership Team.

Project labour costs are then estimated by applying the appropriate daily rate for each resource. These daily rates are estimated using a tier system.

Following feedback from the ERA during the December 2020 AR5 in-period adjustment process, AEMO has reviewed and improved its approach, and has moved to a more granular 10-tier system.

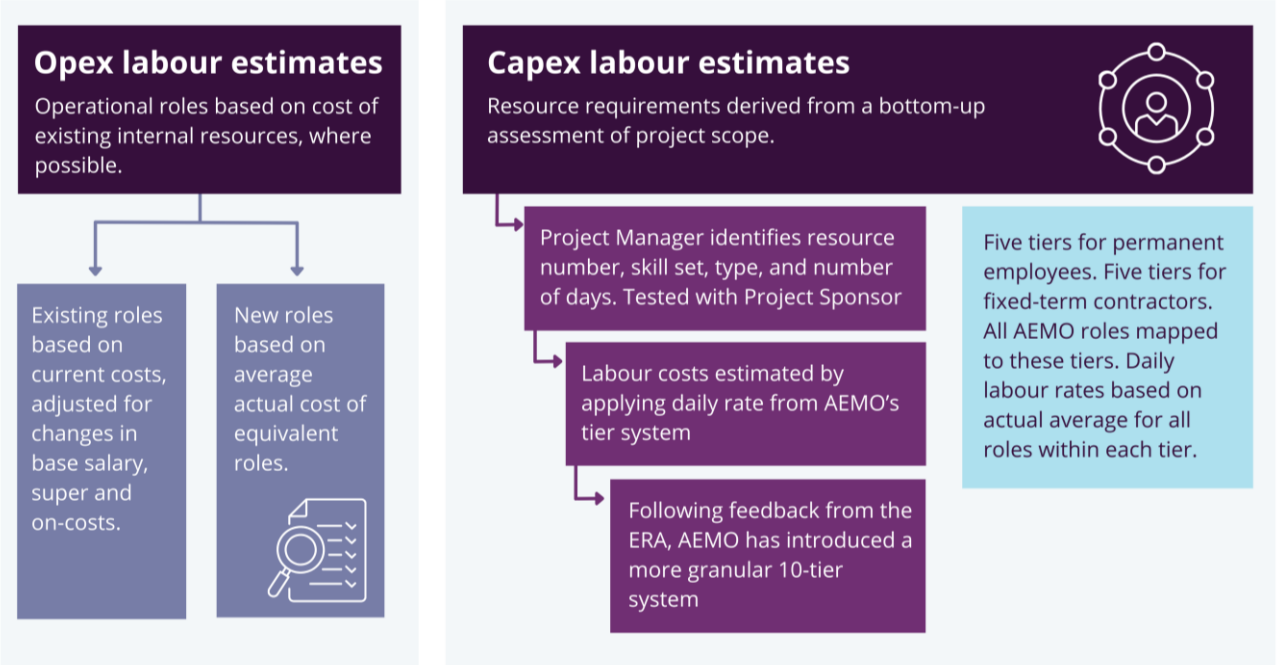
[30] With the exception of D&A, which is essentially a mechanistic outworking of historical capex and asset life assumptions.

There are five tiers for permanent employees and five tiers for fixed-term contractors. All AEMO roles are mapped to one of these tiers accordingly. Daily labour rates are derived from the actual average costs for all roles within each resourcing tier[31].

Using average actual rates across each tier ensures a consistent basis for forecasting internal resource requirements, as it accounts for the variability of actual resource costs within each tier. It also provides a sound basis for estimating resource costs for projects early in the lifecycle, where it may not be possible to identify specific personnel.

AEMO considers the 10 tiers provide sufficient granularity to allow accurate labour cost forecasts.

Figure 19 Overview of opex and capex labour forecasting approach



1.6.6 Estimating contingency

AEMO has included a contingency amount for all capex projects. Project contingency is a reserve of funding in the project cost estimate to cover and alleviate the risk of cost exposure and uncertainty. This approach of building contingency into project forecasts is consistent with the approach accepted by the ERA in previous allowable revenue and forecast capex reviews.

The amount of contingency incorporated in a project forecast reflects the level of confidence in the base cost estimate and an assessment of risks. A project that has a narrow scope and fewer dependencies on third parties and external factors will have a relatively small contingency. A project subject to greater uncertainty, external factors and shifting scope will have a large contingency.

Project contingency framework

With a view to continuous improvement and in response to the ERA's feedback in its December 2020 forecast capex determination for DER projects, AEMO's PMO (with support from a range of Program and Project Management professionals in the business) has revised its contingency approach since the last allowable revenue review process.

[31] Note that project capitalisation and ultimately WEM Fees are based on actual labour costs incurred. Tier rates are used for forecasting only.

The key change is that rather than relying on a standard contingency factor as the base estimate[32], the new approach places more emphasis on quantifying project risk exposure and adjusting (ideally reducing) contingency as the project matures.

Contingency application methods

In line with industry models and standards[33], AEMO's approach for calculating contingency is to take into account the project lifecycle stage, level of detail known about project design and risk profile of the project. This enables contingency quantification to be tailored to project size, risk profile and lifecycle phase.

The two methods are:

- Method 1 – fixed percentages of the base cost estimate based on the project risk profile developed through the level of certainty of key project parameters; and
- Method 2 – analysis to estimate 'most likely' contingency requirement based on probability of occurrence and estimated impact of specific project risks.

The method applied depends on the stage the project is at. A project at the very early 'idea' stage will adopt method 1 in the first instance. However, the expectation is that method 2 is applied once the project enters the planning to execution stage, as project risks are better understood and identified.

Table 6 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.

Tools to aid contingency calculation under each method are provided as part of the framework.

For method 1, AEMO has developed a calculator that can be applied to all projects to estimate a fixed percentage on the base cost of a project to determine contingency. Factors include consideration of project complexity, market participant impact, resource availability, budget, timeframe and scope volatility.

The calculator and associated weightings have been developed based on an assessment of other widely used models and experience from across AEMO. Contingency calculations in the calculator range from 5% to 80% with the upper end reflecting large complex programs spanning multiple years and with wide scale impacts for AEMO and market participants.

For method 2, AEMO has developed an Expected Monetary Value (EMV) tool, which allows project managers to quantify risk exposure and use this to inform a contingency amount. Determining project risk exposure involves the following:

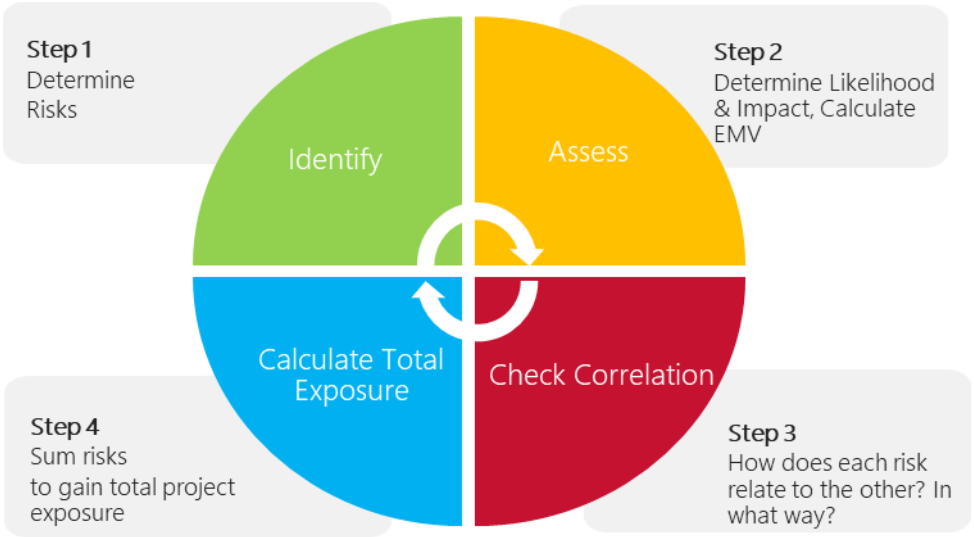
[32] AEMO's former approach was to assume a 30% contingency as the standard starting point and then adjust according to project risk, complexity and timing.

[33] See for example, The Government of UK Green Book - 5.5 Unintended consequences, and Australian Government Department of Finance – Contingency.

- Creation of a risk register[34], using the AEMO Project Risk Matrix to guide determination of risk level; and
- Quantification of risk exposure using the EMV approach.

The EMV tool is used to calculate the probability of risk occurring, multiplied by the cost of the impact. The EMV tool is applied and then reapplied at each stage of the project (planning, execution, etc.), with the intent of identifying whether contingency is likely to be incurred and whether the amount of contingency is sufficient.

Figure 20 EMV tool contingency assessment process



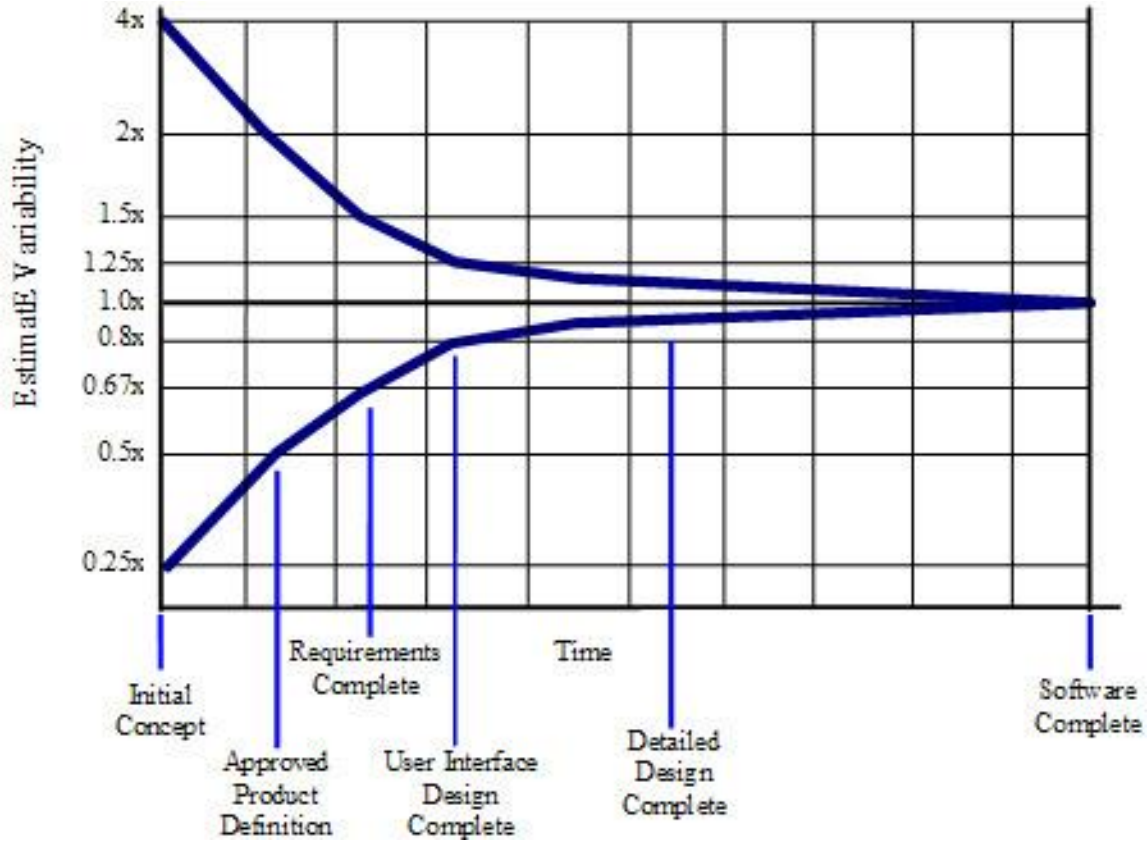
For this AR6 submission all project contingencies are estimated using AEMO's contingency calculator with calculations (at a Program level) ranging from 10% to 33% and an average of 26%. AEMO contends that these are reasonable and efficient calculations when assessed against AEMO past performance and reflecting on internal models[35] and studies of project cost overruns[36]. The 'cone of uncertainty' (see Figure 21) is a well-known software delivery estimating tool that also supports the reasonableness of AEMO's contingency calculations – particularly noting that many of AEMO's projects are at very early stage of conception:

[34] A robust risk register is a required deliverable from the project planning phase, ahead of an Investment Brief.

[35] The UK's HMRC Green Book recommends starting with a 200% 'Optimism Bias' calculation for large scale IT projects and adjusting down based on risk mitigation and confidence factors. See https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/191507/Optimism_bias.pdf.

[36] A 2012 study by McKinsey and Oxford University on 5.400 IT Projects found that software projects had an average 66% overrun and non-software projects an average 43% overrun. See https://www.mckinsey.com/business-functions/mckinsey-digital/our-insights/delivering-large-scale-it-projects-on-time-on-budget-and-on-value..

Figure 21 Cone of uncertainty



Source: https://www.construx.com/books/the-cone-of-uncertainty/

While contingency is applied to all capital projects, AEMO's intent is always to deliver the project within the base budget estimate, only spending contingency where necessary to mitigate risk. A contingency amount is forecast as its own cost line, and each contingency amount is linked to a specific risk or issue. Funding for a contingency event is released when a defined risk/issue is realised.

A project may only draw down on its contingency via approval from the relevant Steering Committee. A change request is required and AEMO's formal change request process followed.

AEMO recognises the importance of developing and managing contingency effectively, as this reflects the actions of a prudent service provider seeking to achieve the lowest practicably sustainable cost of delivery. When developing project estimates, there is an ongoing feedback loop where AEMO will look at what amount of contingency has/has not been incurred on similar projects. This historical performance is factored into the project contingency estimate.

Any forecast capex amount including contingency for a project an upper bound. AEMO is not obligated nor compelled to spend the full capex amount and pass those costs onto participants. AEMO provides transparency of costs through its ongoing reporting, stakeholder engagement, and via the triennial allowable revenue review process.

2. WEM allowable revenue

2.1 Overview of allowable revenue and operating expenditure

This section presents the forecast allowable revenue required by AEMO to provide the functions outlined in clauses 2.1A.1A and 2.1A.2 of the WEM Rules.

Allowable revenue is essentially the operating expenditure (opex) component of AEMO's forecast, with minor adjustments to account for historical under/over recovery of revenue from the previous period. Allowable revenue covers the ongoing cost of providing services, and is recovered each year, adjusted for actuals accordingly.

Opex is separated into the following cost categories:

- **Labour** – salaries, superannuation, leave provisions, payroll tax and work cover.
- **Accommodation** – rent/lease, utilities and associated facilities management costs.
- **IT & Telecommunications** – IT service support, software support contracts, telecommunications, IT leased assets, and cloud costs.
- **Supplies and services** – consulting/contracting costs, audit costs, training & conferences, travel, general office costs, memberships, bank fees, tax and statutory charges, corporate services, insurance, licences and system security charges.
- **Borrowing costs** – borrowing expenses, foreign exchange gains/losses and bank interest.
- **Depreciation and amortisation** – D&A of assets used to provide WEM and GSI services, including software and licences, hardware, furniture and fittings.

The operating costs categories are then split across AEMO's two core WEM functions – market operations and system operations. GSI revenue, costs and fees are discussed separately in section 5 of this proposal.

AEMO estimates the allowable revenue to provide market and system operation services for the AR6 period is $156.6 million. This comprises forecast opex of $158.8 million, minus a $2.3 million adjustment for expected revenue over recovery during 2021-22.

Table 7 presents a breakdown of allowable revenue for the AR5 and AR6 periods by cost category.

Table 7 Total forecast WEM allowable revenue by cost category ($ million nominal)

Cost category	AR5 determination	AR5 actual (forecast to 30 June 2022)	2022-23	2023-24	2024-25	AR6 Total
Labour	48.7	52.6	21.7	25.3	26.2	73.2
Accommodation	1.6	3.8	1.8	1.7	1.7	5.2
IT & Telecommunications	8.2	4.8	2.4	3.7	4.8	11.0
Supplies and services	17.3	12.4	4.1	4.3	4.6	13.0
Borrowing	-	-	0.4	2.0	2.8	5.2
D&A	23.6	20.7	10.7	18.4	21.8	50.9

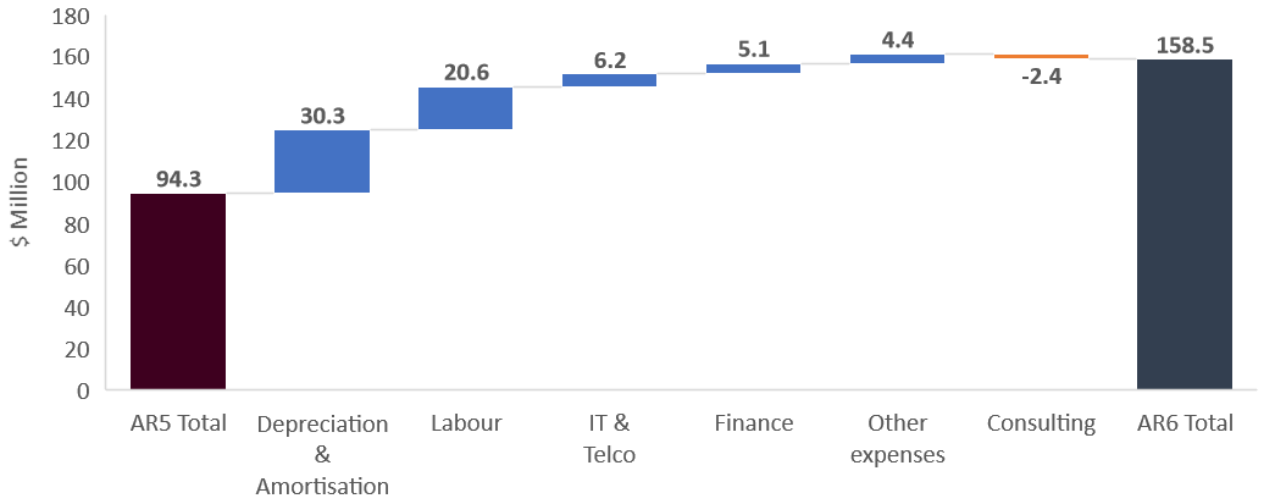
Cost category	AR5 determination	AR5 actual (forecast to 30 June 2022)	2022-23	2023-24	2024-25	AR6 Total
Adjustment for over/under recovery	-	-	-2.3	-	-	-2.3
Total revenue	**99.5**	**94.3**	**38.8**	**55.5**	**62.0**	**156.2**

2.1.1 Operating expenditure

Forecast Opex for the AR6 period is 158.8 million. The single biggest driver of the revenue increase in AR6 compared with AR5 is D&A, which makes up $51.2 million of the total Opex forecast.

Figure 22 shows the change in forecast Opex compared with the AR5 period by cost category.

Figure 22 WEM opex increase by category, AR5 to AR6 ($ million nominal)



Note consulting forms part of the 'Supplies and services' Opex category.

Depreciation & amortisation

D&A accounts for 47% of the overall Opex increase. The majority of forecast D&A costs are associated with recovery of capex on assets installed during the AR4 and AR5 periods.[37] The D&A forecast includes $27.8 million for recovering the capital costs associated with WEM Reform and WA DER activities where the asset has been commissioned.[38]

D&A costs are less discretionary and controllable in-period than other Opex categories. While some adjustment can be made to asset lives or the timing of when capex projects are finished/assets placed in services, for the most part D&A is a mechanistic outworking of historical investment.

D&A contributes approximately 30% of the 64% increase in AR6 allowable revenue.

Refer to section 2.3.6 for a breakdown of D&A costs during AR6.

Operating costs excluding D&A

Annual operating costs ***excluding D&A***, are more discretionary in nature and controllable in-period. These discretionary costs include labour, accommodation, IT & telecommunications, and supplies and services.

[37] A portion of the D&A forecast is for commencement of recovery of costs associated with assets installed during the last two years of the AR6 period.

[38] Where capex has been incurred, but not yet resulted in a commissioned asset, the D&A costs will be recovered in future periods.

Annual operating costs excluding D&A are forecast to increase over the period, rising from $25.8 million in 2021-22 (the end of AR5) to $40.1 million in 2024-25 (the final year of AR6).

Total operating costs excluding D&A for AR6 are estimated at $107.6 million, a $33.9 (53%) million increase compared with AR5 actuals.

The higher operating costs estimated for the AR6 period are driven by the energy transition. They are predominantly a result of the additional labour resources and IT systems required to provide system operations and market operations functions as the new market arrangement commence and the power system becomes more complex, high risk, and data intensive.

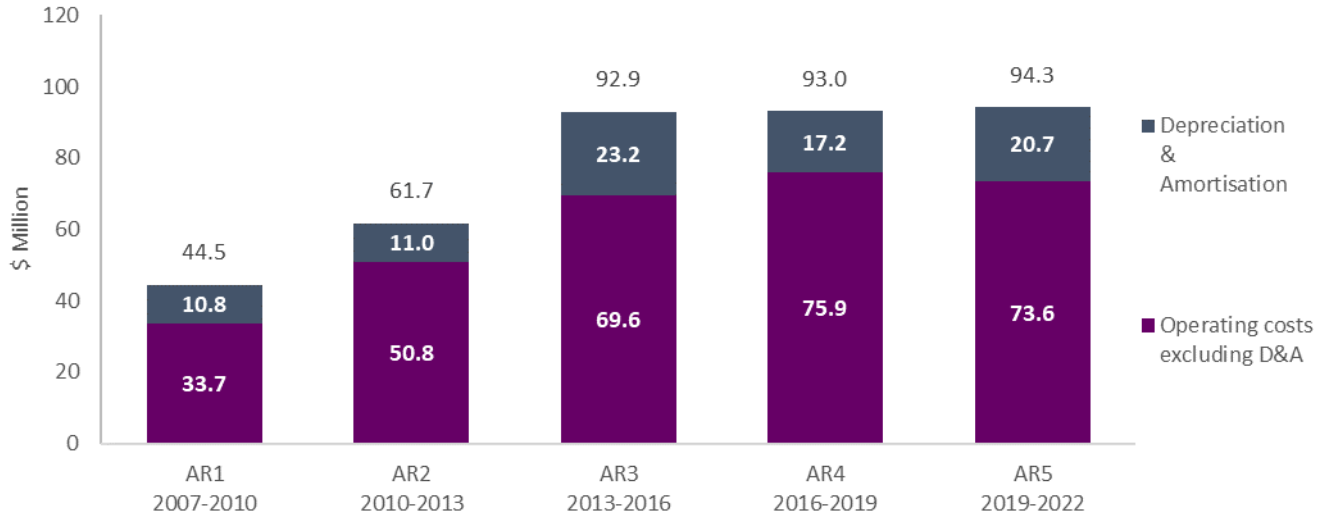
Labour costs[39] are expected to grow by $20.6 million by the end of the AR6 period. IT costs are rising by $6.2 million over the three years. These increases are due to the fact AEMO will have a more complex environment in which to operate, requiring more resources and greater reliance on IT systems.

Further information on the Opex cost categories is provided in section 2.3.

2.1.2 Comparison with history

Figure 23 shows the historical increases in allowable revenue since the AR1 period (2006-2009).

Figure 23 Allowable revenue in each period since AR1 ($ nominal)



While allowable revenue has risen since market start, revenue increases have been relatively modest since AR3 (2013-2015). AEMO has been able to manage its operating costs prudently, keeping them relatively stable over time.

History shows that step increases in allowable revenue tend to be driven by recovery of costs to deliver key market and power system initiatives. Examples include the introduction of the Balancing Market and Load Following Ancillary Service market in 2012 and the merger of Western Power's System Management (SM) and the Independent Market Operator (IMO) in 2015-16.

The Balancing Market and the SM/IMO merger were government-led energy sector reforms. AEMO therefore engaged with government, energy sector stakeholders and participants, and invested accordingly in its systems to deliver the Balancing Market and SM/IMO merger. These investments drove subsequent increases in revenue requirements as D&A costs were recovered following completion of these projects.

[39] Employee benefits expense category.

It is the same case for the AR6 period. AEMO has a formal obligation under clause 2.1A.2(ll) of the WEM Rules to support and facilitate market and power system evolution. The increase in AEMO's allowable revenue requirement for AR6 is directly linked to delivery and operation of government-led reforms.

History also shows the difficulty in accurately estimating resource increases. In the AR2 period (2009/10 to 2012/13) actual opex was around $6 million higher than forecast. The majority of this overspend was on labour resources and costs associated with the Balancing Market, which were under forecast in the AR2 proposal.

2.1.3 Comparison with other market bodies

AEMO's operating costs are increasing over the AR6 period. As discussed, this is driven by the changing energy landscape and power system complexity. AEMO has looked at how this energy transition has affected other market bodies in Australia. While the NEM is somewhat further advanced than the WEM on its transformational journey, the cost of change in the NEM provides a useful comparator.

Since 2016:

- Costs incurred by both the Australian Energy Market Commission (AEMC) and the Australian Energy Regulator (AER) have increased significantly:
  - The AEMC's funding from Governments has increased from $20.3 million in 2015-16 to $30.8 million for 2019-20. The AEMC proposes to flatten this across the next three years with forecast Government revenue being $31.7 million in 2022-23.
- The AER has seen an increase in direct expenditure across the same years (figures exclude the contribution to corporate overheads and administration costs shared with the Australian Competition and Consumer Commission (ACCC)):
  - In 2018–19 direct expenditure was $46.02 million (21.9% higher than the previous year).
  - In 2017-18 direct expenditure was $37.75 million (16% increase on previous year).
  - In 2016-17 direct expenditure was $31 million (29% increase on the previous year).

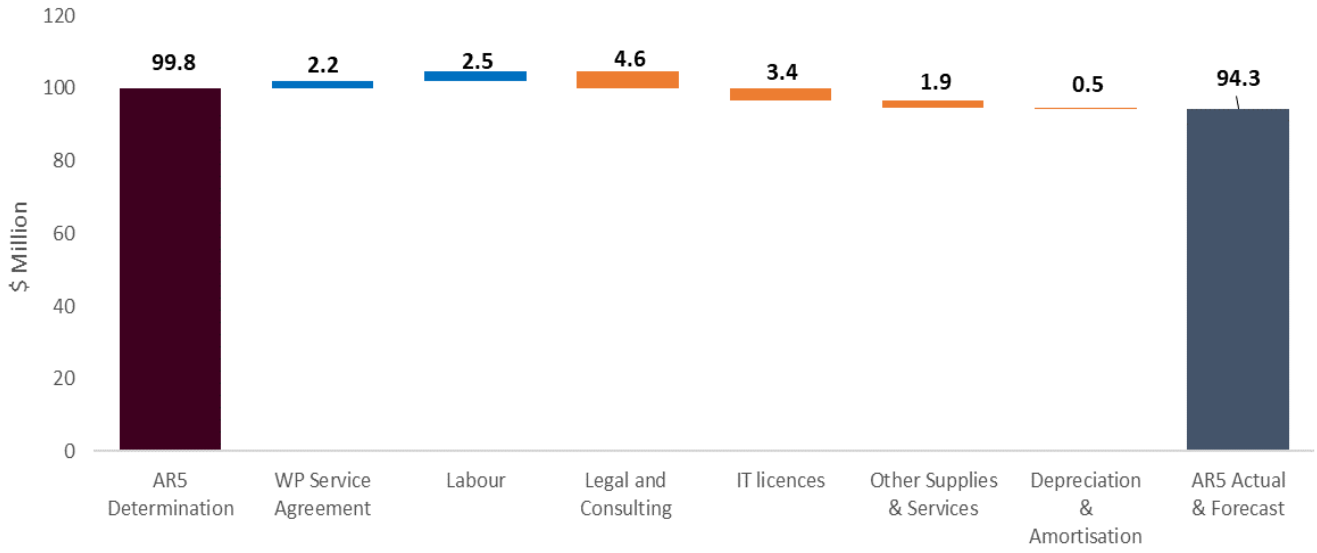
In comparison, AEMO WA's recurring operating costs (excluding D&A) are increasing by 46% over AR6, after having increased by around 6% over the previous nine years.

Benchmarking shows AEMO costs compare favourably with international system and market operators. Refer to section 1.6.4 for an overview of benchmarking information.

2.2 Performance during the AR5 period

During the AR5 period AEMO has sought to provide services for the lowest practicably sustainable cost, and expects to spend less opex than approved in the AR5 determination (see Figure 24).

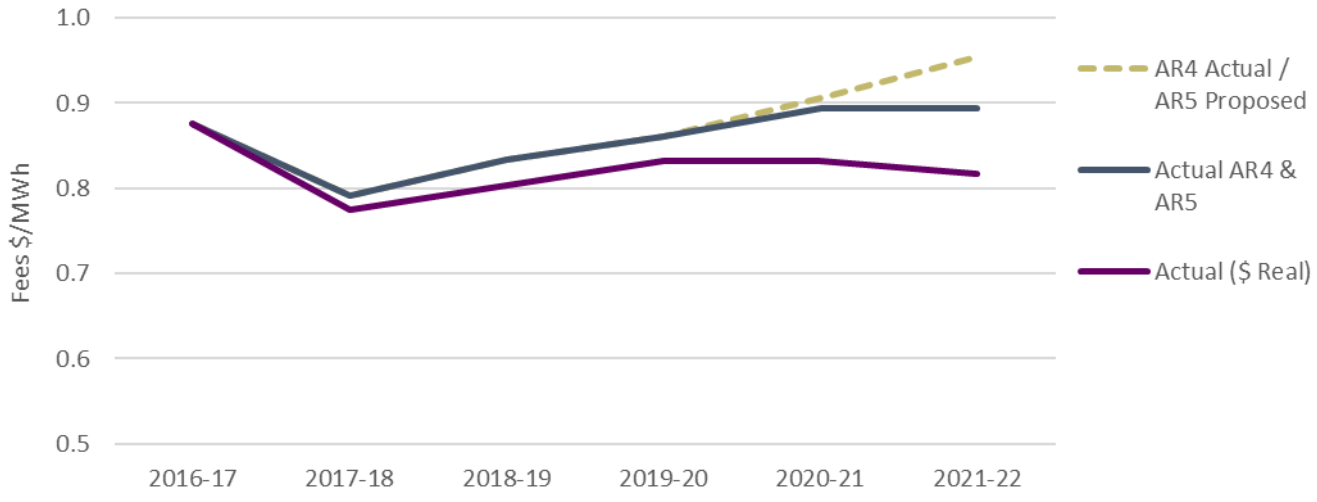
Figure 24 AR5 operating expenditure compared with AR5 determination



Operating costs for the AR5 period are expected to be approximately $5.8 million lower than those approved in the AR5 determination. This underspend is due to some activities being deferred or scaled back due to third party delays and the impact of the COVID-19 pandemic.

By achieving lower than forecast operating expenses during AR5, actual revenue for the period is expected to be around $5.8 million lower than the AR5 determination. This has resulted in market participants paying a lower average fee than that approved by the ERA (see Figure 25).

Figure 25 Actual WEM Fees[40] compared to forecast, AR4 and AR5 ($/MWh)



The AR5 determination estimated WEM fees would increase by 1.7% per year on average over the period. However, AEMO has been able to limit WEM fees to a nominal increase of 0.4%, which is a 1.4% reduction in real terms (see Table 8).

[40] This includes the System Management and Market Operator Fee components only – it does not include the Regulator or Coordinator Fee components

Table 8 Actual WEM fees compared to ERA determination, AR4 and AR5 ($/MWh)

WEM Fee	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	Average change
AR5 determination	0.888	0.877	1.013	0.856	0.883	0.915	1.7%
AR4 & AR5 actual/estimate	0.876	0.791	0.834	0.861	0.894	0.894	0.4%
AR5 determination ($ real)	0.876	0.775	0.804	0.861	0.861	0.844	-0.1%
AR4 & AR5 actual/estimate ($ real)	0.876	0.775	0.804	0.833	0.833	0.816	-1.4%

2.3 Operating expenditure forecast by category

In a change from previous allowable revenue proposals, opex costs in this section are presented as a total across both the WA Market Operations and System Management functions, rather than showing them separately. Presenting the costs in this way better reflects the integrated nature of AEMO's WA functions, as the WA departments share facilities and resources, and coordinate closely with each other during the course of operating the power system and market.

Consistent with the ERA's guidelines[41], the workbooks provided to the ERA in support of this proposal groups data by AEMO's functions as separately classified in the WEM Rules.

Table 9 presents the WEM opex forecast for the AR6 period.

Table 9 WEM opex AR6 forecast ($ million nominal)

Cost category	AR5 total	2022-23	2023-24	2024-25	AR6 Total	Change ($)
Labour	52.6	21.7	25.3	26.2	73.2	20.6
Accommodation	3.8	1.8	1.7	1.7	5.2	1.3
IT & telecommunications	4.8	2.4	3.7	4.8	11.0	6.2
Supplies and services	12.4	4.1	4.3	4.6	13.0	0.6
Borrowing	0.0	0.4	2.0	2.8	5.2	5.1
D&A	20.7	10.7	18.4	21.8	50.9	30.3
Total opex	**94.3**	**41.1**	**55.5**	**62.0**	**158.5**	**64.2**

The values in Table 9 include costs for three opex projects forecast for AR6. These projects are discussed in section 2.4. The following sections provide further detail on the AR6 opex forecast by category.

2.3.1 Labour

WEM forecast labour costs for the AR6 period are $73.2 million. This is a $20.6 million increase compared to the expected actuals at the end of AR5 ($52.6 million). These labour cost increases are largely a result of WA's energy transition and the greater number of employees/contractors required to manage it.

[41] At https://www.erawa.com.au/cproot/22231/2/-AR.6---Funding-Proposal-Guideline-for-publication-rev-3-2-.pdf.

The WA energy sector is becoming more complex; the generation mix more diverse; the network more constrained; and the market more competitive. As a result, the rules, regulations and procedures that govern the sector are too becoming more complex and exhaustive.

This energy transition drives a need for more detailed modelling, data management, analysis and human effort to ensure WA's market and power system can continue to operate efficiently, compliantly and within acceptable risk tolerances.

AEMO WA labour resource requirements fall into two broad types:

- WA departments – WA Markets and System Management.
- WA support functions – IT (WA Solutions) and various corporate services such as External Affairs, Finance and Governance.

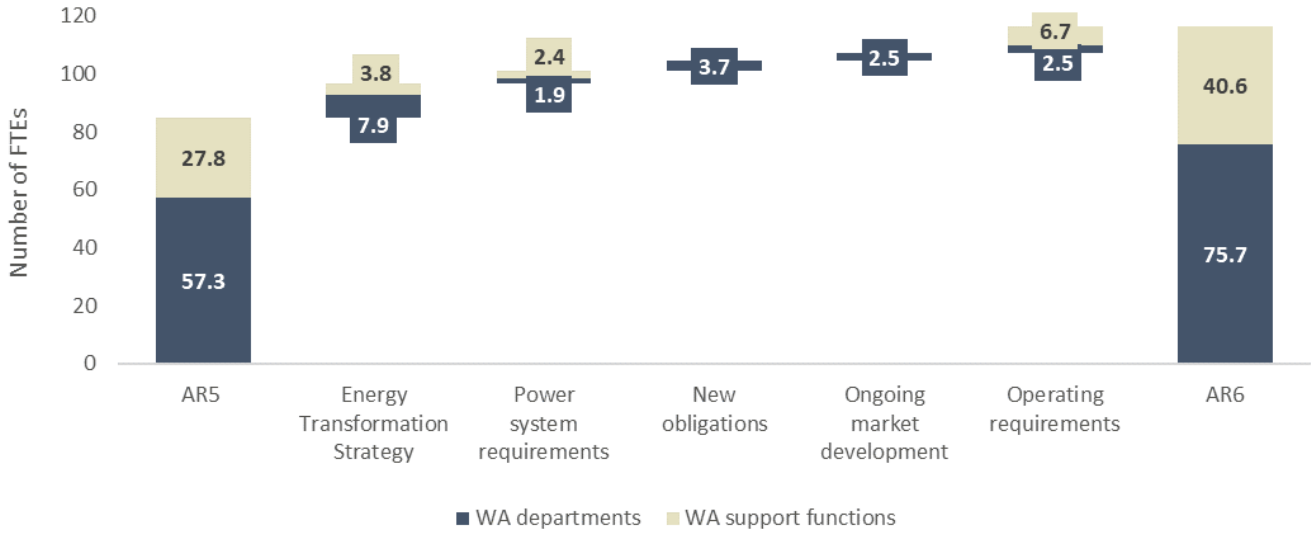
Table 10 shows actual and forecast labour costs for the two resource types over AR5 and AR6

Table 10 AR6 forecast labour costs compared with AR5 ($ million nominal)

WEM Labour	AR5 total	2022-23	2023-24	2024-25	AR6 total	Change ($)
WA departments	39.5	15.5	18.1	18.9	52.5	13.0
WA support functions	13.1	6.1	7.2	7.3	20.7	7.6
Total labour ($M)	**52.6**	**21.7**	**25.3**	**26.2**	**73.2**	**20.6**

The increase in labour costs is driven by the changing FTE resource requirements over the AR6 period (see Figure 26).

Figure 26 Change in FTE resource requirements AR5 to AR6 (WEM only, excludes GSI)



Forecasting labour costs

The resourcing effort is calculated by estimating full-time equivalent (FTE) resources required during the period. FTEs can comprise a mix of both permanent employees and full-time contractors. Where roles already exist, actual remuneration is used to develop the labour opex forecast. Where new or additional roles are required, actual costs of similar roles are used as a proxy. Actual remuneration is subject to market testing at the point of recruitment.

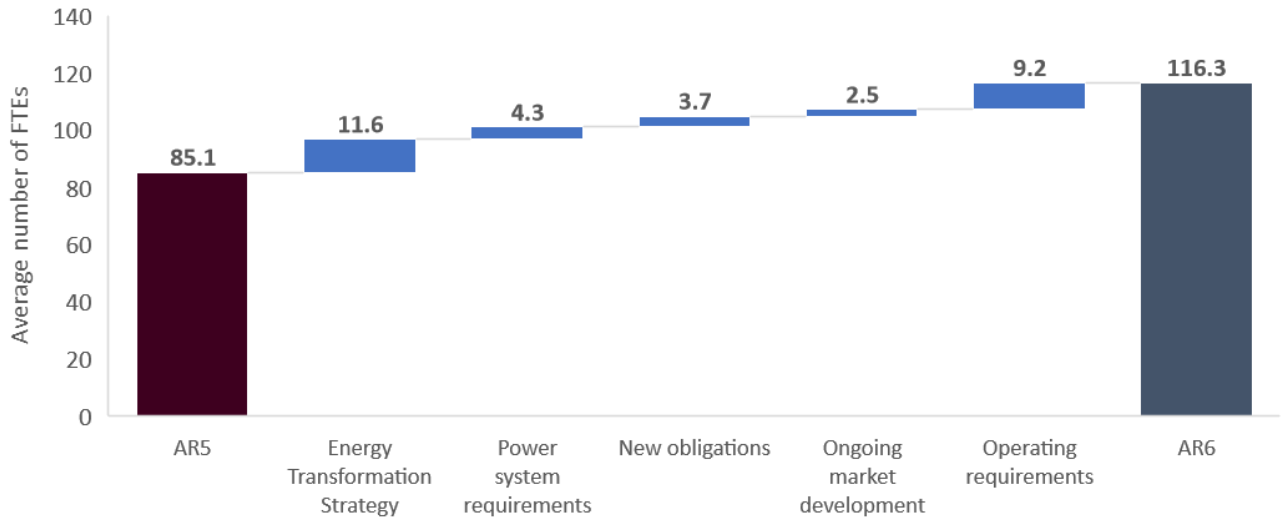
Changes in AEMO's FTE resourcing requirements are driven by changes in obligations, work practices and increases in system and market operations and GSI activities. For the AR6 period, the following factors will drive resourcing requirements:

- **Energy Transformation Strategy outcomes** – increased volume and complexity of activities resulting from new market arrangements from October 2023 and DER Roadmap actions.
- **New obligations** – AEMO has new obligations commencing immediately relating to network access quantity (NAQ) and reserve capacity cycle changes, and new obligations regarding generator performance standards (GPS) and network constraint modelling.
- **Power system requirements** – new processes and increased power system modelling required to address low load and changing generation mix issues. AEMO must also uplift its operational forecasting capabilities to keep pace with changing energy system characteristics and consumer trends. AEMO requires an increase in control room operators to mitigate succession planning risks.
- **Ongoing market development** – AEMO has an ongoing obligation to implement market development activities, including WEM/GSI Rule changes and supporting further government policy initiatives.
- **Operational requirements** – increase in support function costs associated with growth in systems, process and data management over the period. For example, the increase in the number of IT applications utilised by AEMO WA requires an uplift in IT resources to support the systems.

Labour costs are also subject to annual review and uplift in line with inflation, remuneration reviews and terms of the enterprise bargaining agreement (EBA).

Figure 27 shows the how the drivers listed above impact the average FTE uplift from AR5 to AR6.

Figure 27 Drivers of average FTE increase AR5 to AR6



Over the AR6 period the average FTE resourcing level increases from 85.1 FTEs in AR5 to 116.3 FTEs in AR6. Activities being delivered in response to the Energy Transformation Strategy are driving an increase in the resourcing effort over the period, however, more than half of the increase is not directly associated with the new market.

For example, the resourcing effort associated with changing power system requirements is growing organically as a result of the complexity of the power system and volume of system operations activities necessary to keep the system secure. This system operations resourcing uplift would be required irrespective of whether a new market was being introduced in the period.

Similarly, the growth in operating requirements is primarily a consequence of AEMO's changing IT landscape and an uplift in the resourcing effort to support the WA functions.

These forecast resourcing levels are required to ensure AEMO can continue to provide its functions in clauses 2.1A.1 and 2.1A.2 of the WEM Rules, without increased levels of risk.

Forecasting method

To forecast the FTE effort required to efficiently resource the transition to and commencement of the new market arrangements, AEMO undertook an exhaustive estimation process.

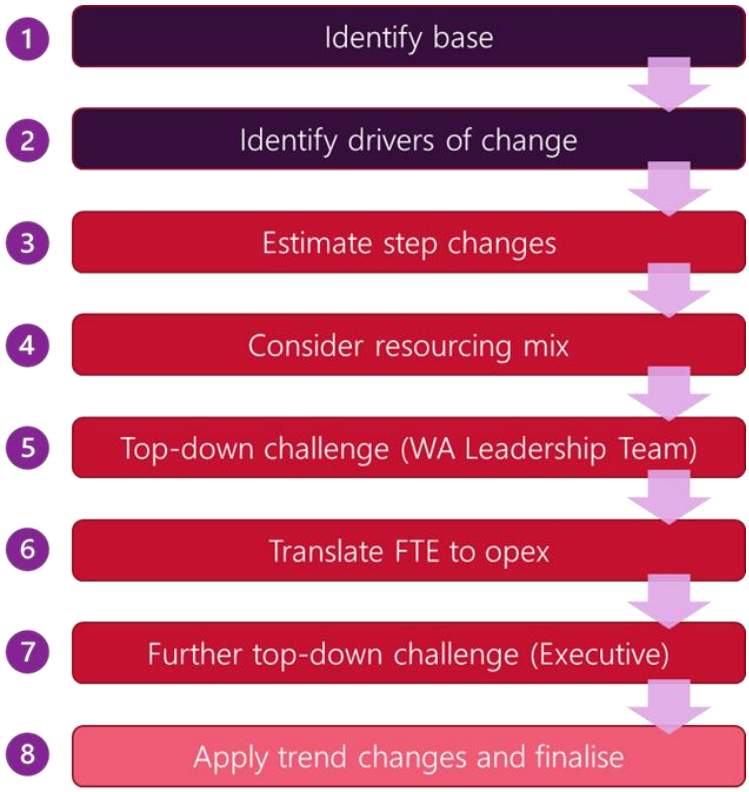
For each WA department, AEMO identified the base level of FTE effort required to deliver current market and system operations activities. AEMO then developed a detailed bottom-up-built of activities at the department level. Managers in each department identified what activities are changing, what are falling away, and what are new, and estimated the FTE effort necessary to deliver the new activities. This resulted in a bottom-up-build of the FTE effort required for:

- the period up to new market go-live (noting that not all resourcing uplifts are a direct result of the new market);
- new market go-live and the transition period thereafter, and
- post go-live transition.

The raw bottom-up-build of FTE effort was then used to inform a series of challenge sessions, which looked at the validity and certainty of the estimates, and considered how the estimate of FTE effort should translate into budgeted headcount.

Figure 28 provides an overview of the FTE forecasting method.

Figure 28 FTE forecasting method



The above steps were undertaken over an exhaustive six-week challenge period and applied to all WA departments and functions supporting WA markets and systems.

An important consideration was the timing of the new reformed markets. The sharpest increase in resourcing effort occurs during the second year of the AR6 period, following commencement of the new market arrangements in October 2023.

While the resource requirements for the first year of the AR6 period are relatively certain, the actual amount of effort required to resource the new market in years two and three are subject to additional uncertainty and may be greater than anticipated. Experience from the commencement of the Balancing and LFAS markets in AR2, which resulted in labour requirements being significantly underestimated, demonstrates this.

During the top-down challenge process with the ELT – step seven in the diagram above – AEMO considered the timing and uncertainty of resource requirements. The ELT accepted that while a peak in resourcing requirements is likely to occur during go-live and the remainder of 2023-24, it is reasonable to assume there may be some opportunity to refine and reduce the resourcing effort during the third year of the period.

The AEMO ELT therefore set an efficiency target for resourcing the third year of AR6, reducing the labour opex forecast by 5%. The ELT considered a 5% efficiency target represented a balance between uncertainty and risk tolerances associated with market and power system operations.

The top-down challenge also resulted in AEMO applying an additional 1% reduction to the overall labour cost forecast to accommodate a 'vacancy allowance'. This reduction accounts for periods during the AR6 period whereby roles may be vacant (and therefore are not being paid for).

These reductions were applied to the FTE forecast before being translated into the labour opex forecast.

A more detailed description of the FTE forecasting method, including the individual WA department estimates of FTE effort by activity, has been provided to the ERA with this proposal document.

Type of FTEs and market testing costs

FTEs can comprise a mix of both permanent employees and employees on a fixed-term contract. AEMO's general rule of thumb is to appoint permanent employees where there is a clear and ongoing recurring need for the resource, and to use fixed-term employees where the project or activity is over a specified period and is not recurrent in nature.

Where a new role is the same as one already engaged by AEMO (for example a Market Analyst), actual fixed remuneration (base salary + superannuation) is used to develop the labour forecast. Where additional resources are required in new roles, fixed remuneration of similar roles recently recruited is used as a proxy. Actual remuneration incurred is subject to market testing at the time of recruitment.

The appointing managers are tasked with identifying the required skill set, seniority of the role, and timing, and building this into the expenditure forecast and recruiting process.

AEMO will seek to fill any new operational roles with experienced employees who have worked within the business, for example on the WEM Reform capital program, to ensure continuity of knowledge across the new market and to minimise the costs and time associated with training and upskilling. Where this is not possible, AEMO will seek to appoint new employees externally.

AEMO's resourcing strategy for fixed-term employees is influenced by:

- The nature of the project
- Project complexity
- Specialised capability requirements
- Availability of internal team
- The length of the requirement.

AEMO's preference is to utilise internal capability where practicable. Where internal capability is not available, fixed-term employees, and in some cases external contractors, are engaged either through direct recruitment or through AEMO's preferred suppliers.

For all new hires (i.e., roles not filled by existing AEMO NEM or WEM resources) a job description is put together based on role requirements (technical skills, years of experience, qualifications etc). This is agreed between the hiring manager and the HR team to establish the job level. The job levels used by AEMO enables consistency of benchmarking of roles across the organisation and is underpinned by Korn Ferry's job sizing methodology.

A remuneration review is then undertaken based on the role against internal relativities, external market, performance and affordability. Based on the job level, AEMO is then able to use Korn Ferry salary survey data to benchmark the fixed salary against the external market.

These details are used for recruitment, which covers both internal and external markets, allowing AEMO to review all suitable candidates and appoint the best fit for the position. Stringent approvals and delegations are in place to ensure salaries are both internally and externally matched and consistently applied.

By adopting this process as standard, AEMO can ensure employees and external contractors are remunerated according to market rates.

2.3.2 Accommodation

Table 11 WEM accommodation (occupancy) AR6 forecast ($ million nominal)

WEM accommodation	AR5 total	2022-23	2023-24	2024-25	AR6 total	Change ($)
Accommodation	3.8	1.8	1.7	1.7	5.2	1.3

Accommodation or occupancy costs are estimated using a base-step-trend method. The AR6 forecast is based on historical costs, escalated for CPI and any known changes in leasing/rental agreements or working practices.

Overall WEM accommodation (or occupancy) costs for the AR6 period are expected to remain at AR5 levels. WEM occupancy costs for the AR6 period are forecast at $5.2 million. While this is $1.3 million higher than opex incurred during the AR5 period ($3.8 million), this is simply due to a change in accounting treatment compared with AR5.

Approximately $1.3 million of occupancy costs were capitalised/assumed to be capitalised as part of projects during 2019-20, 2020-21 & 2021-22 bringing total WEM occupancy spend during AR5 to $5.1 million. As a result, overall occupancy costs are not materially changing.

Following a review of how Australian Accounting Standard AASB116 is applied at AEMO, from 1 July 2021 all occupancy costs are recognised as an operating expense as incurred. Historically, occupancy costs associated with project teams were charged to the capital project and recovered in the future via D&A. This practice has now ceased and all occupancy costs are expensed and recovered immediately via market fees in the year incurred.

As a result of this policy change, accommodation costs that were previously captured under forecast capex will now be incorporated into opex and therefore the allowable revenue forecast. While this change in capitalisation of costs will drive a step change in accommodation opex for AR6 compared with AR5, there will be a commensurate decrease in forecast capex.

It is important to note that despite the forecast increase in FTEs for the AR6 period, AEMO WA does not propose to increase its accommodation footprint for the AR6 period. In response to the COVID-19 pandemic, AEMO like many other businesses transitioned to more flexible working arrangements, placing an emphasis on working from home where practicable. Experience during the pandemic demonstrated some activities can be conducted remotely without a material decrease in productivity, and that it is not essential to have all employees and contractors on site during working hours.

During the post-pandemic environment AEMO expects to increase employee contact time spent in its offices, particularly as Energy Transformation Strategy and new market activities ramp up. However, AEMO will maintain the flexible working practices put in place during the pandemic, and continue to use its current accommodation arrangements efficiently despite the anticipated resourcing increase. AEMO will monitor the need to maintain its current accommodation footprint post WEM-reform, and seek to minimise occupancy costs where safe and efficient to do so.

2.3.3 IT & telecommunications

Table 12 WEM IT & telecommunications AR6 forecast ($ million nominal)

WEM IT & telecommunications	AR5 total	2022-23	2023-24	2024-25	AR6 total	Change ($)
IT & telecommunications	4.8	2.4	3.7	4.8	11.0	6.2

IT services include IT support, software support contracts, telecommunications, IT leased assets, and cloud costs. IT costs are forecast using the base-step-trend method.

The AR6 forecast uses historical actuals from AR5 as the starting point for estimating IT operating costs, adjusting for any known changes in IT practices, volume of activities or the expected working environment over the next three years.

Forecast IT & telecommunications costs for the AR6 period are $11.0 million. This is a $6.2 million increase compared to the expected position at the end of AR5.

The higher IT opex costs for the AR6 period are primarily the result of greater software support and cloud costs. Increases in software support and cloud use are a direct result of the greater reliance on hosted applications AEMO has to manage in the AR6 IT landscape, many of which are driven by WEM reform and the broader energy transition.

Completion of the SMST project in 2020 added 23 new applications to AEMO's IT environment, all of which require ongoing software support. The WEM Reform program will add more complex applications, which again will require whole of lifecycle support. Refer to *IT Roadmap 2023-2025* for detail on the IT projects planned to support AEMO WA in the rapidly changing energy sector.

Cloud costs represent the biggest IT Opex step increase, rising from $0.1 million during the first year of the AR6 period, to $1.9 million by the end of 2024-25. This is due to the commencement of the new real-time energy and ESS market in October 2023. Upon market start the suite of new systems will go-live, and the cloud costs for hosting these systems will start to be expensed.

AEMO commenced moving towards a predominantly cloud-based IT environment during the AR5 period, and has established an organisation-wide cloud strategy. In 2019, AEMO recognised that the organisation's technology landscape had become antiquated, complex and unsuitable for further development. A digital roadmap was developed to facilitate a more efficient, scalable, and secure digital environment in which to build and enhance IT systems now and in the future. Since then, AEMO has introduced new cyber security tools and standards, provisioned public cloud services, and introduced new, modern tools and processes to enable agile IT project delivery using DevSecOps and continuous deployment practices.

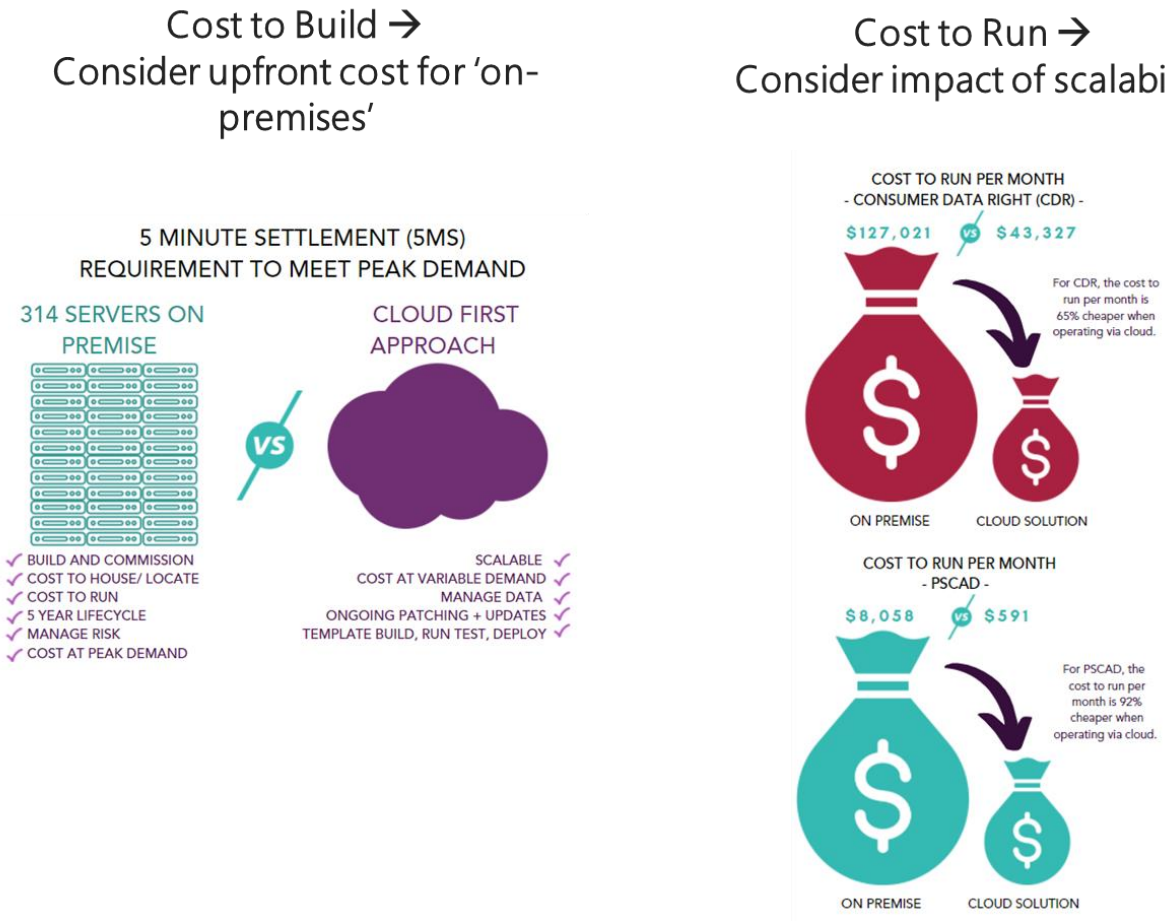
WEM Reform is one of the first programs to take advantage of AEMO's new digital platform (along with 5MS in the NEM), with the new GPS application moving into production in July 2021 on AEMO's public cloud. The solution design process for reform has been completed and many of the applications will also be deployed into this new digital platform. This includes some to be hosted on AEMO's new private cloud environment.

The drivers for moving to cloud-based work were speed to market, scalability, quality, security and cost. AEMO's cloud service provider is Microsoft Azure. As a heavy IT user and a longstanding client of Microsoft, AEMO was able to negotiate a ~20% discount when establishing its cloud agreement.

An advantage of cloud pricing is that all the running costs that would be incurred if servers are managed on-premises are built into the price. This includes power, air conditioning, operational support to upgrade/patch services etc. It also enables AEMO to eliminate ongoing asset upgrade and server/infrastructure replacement costs.

A post build analysis of the 5MS project in the NEM looked at the costs to build the solution on-premises (see Figure 29). It showed it was significantly cheaper to build those same solutions in Microsoft Azure to support peak (elastic) workloads. It would also have taken far longer to procure, set up and put hundreds of servers into operation. The risks of not having this infrastructure available in a timely manner would have cause significant delays to market-driven dates for 5MS. The cloud enabled AEMO and NEM participants to benefit from the project being completed in a timely and more cost-effective manner than an on-premises solution.

Figure 29 Post build analysis of 5MS project, on-premises vs cloud



By utilising the AEMO cloud for WEM Reform and other key initiatives/applications, AEMO WA benefits from having access to a larger IT platform and pool of expertise. The cloud environment provides a more secure, sophisticated and scalable suite of IT solutions, and reduces AEMO WA's on-premises server and infrastructure costs.

2.3.4 Supplies and services

Table 13 WEM supplies and services AR6 forecast ($ million nominal)

WEM supplies and services	AR5 total	2022-23	2023-24	2024-25	AR6 total	Change ($)
Supplies and services	12.4	4.1	4.3	4.6	13.0	0.6

Supplies and services include recurring operating costs such as licences, training, travel, printing & stationery, corporate services and consulting. These costs are typically estimated using a base-step-trend method.

Over the AR5 period, AEMO has made a conscious effort to reduce operating costs where possible, particularly in light of the COVID-19 pandemic and the ongoing energy transition. Forecast supplies and services costs for the AR6 period are $13.0 million. While this is approximately $0.6 million higher than the expected position at the end of AR5 ($12.4 million).

Where possible, AEMO will attempt to maintain the cost reductions achieved during AR5 into AR6. AEMO expects printing & stationery, and consulting costs will be maintained at a lower level than what was originally estimated for the AR5 period. While there will be an uplift in travel and accommodation costs in AR6 compared to the exceptionally low levels during the pandemic, AEMO will continue to utilise remote working practices where appropriate, with a view to keeping these costs at or below historical levels.

The estimated $0.6 million increase in other supplies and services costs compared to AR5 actuals reflects a normalisation of costs in the post-pandemic environment. Training and education costs over the AR6 period are expected to return to historical levels ($1.6 million), driven by the need for development and roll out of training and education packages for participants in the new market arrangements.

The other supplies and services category also includes control room maintenance costs, data purchase for forecasting/constraint modelling, and approximately $0.4 million of costs associated with the DER Network Services Marketplace Trial and Design project.[42]

Increases in some categories of supplies and services opex are offset by a decrease in consulting costs due to cessation of the Western Power Services Agreement, which was approximately $3 million per year.[43]

The consulting budget for the AR6 period includes approximately $0.5 million for work AEMO is expected to be required to undertake on the next edition of the Whole of System Plan (WOSP). AEMO has an obligation under clause 4.5A.11 of the WEM Rules to provide support to the Coordinator of Energy. While the Coordinator of Energy has not yet defined the scope of the next WOSP, AEMO contributed technical input into to the first version of the WOSP and anticipates being asked to provide power system modelling expertise (e.g. approach to constraints and ESS) for the next edition.

2.3.5 Borrowing

Table 14 WEM borrowing costs AR6 forecast ($ million nominal)

WEM borrowing	AR5 total	2022-23	2023-24	2024-25	AR6 total	Change ($)
Borrowing (Financing)	0.0	0.4	2.0	2.8	5.2	5.1

[42] The DER Network Services Marketplace Trial and Design is a research and development project, and therefore cannot be capitalised under Australian accounting standards. Refer to Section 2.4.1 for information on the DER Network Services Trial project.

[43] The Western Power Service Agreement was an ongoing contract for provision of IT system support for the 23 legacy System Management systems it owned, which were being used by AEMO to manage the power system. These systems have now been transitioned fully to AEMO, meaning the Western Power Service Agreement is no longer necessary.

As a not-for-profit entity with no ability to accumulate reserves, AEMO utilises borrowing (financing) facilities to fund its investment in non-current assets. As costs are incurred on a capital project, funds are drawn down from borrowing facilities and borrowing costs are capitalised.

For efficiency purposes, AEMO has a combined bank funding facility which service capital investment funding requirements across the organisation. The average cost of finance from these facilities has been applied to investments in WA assets.

Interest on borrowing costs is recovered in two ways, depending on whether the project is in-flight or complete and the asset is in service. In summary:

- Interest on borrowings while a capital project is in-flight is capitalised (i.e. added to the capital cost of the project/asset) and subsequently recovered as D&A costs. D&A is ultimately recovered via market fees and used to repay debt over the life of the asset.
- Once the project is complete and the asset is in service, interest on outstanding borrowings is expensed as a borrowing cost and recovered as Opex through allowable revenue.

Forecast WEM borrowing costs for the AR6 period are $5.2 million, resulting from the significant amount of WEM Reform, DER Roadmap and other major capital investments made during the AR6 period.

AEMO WA incurred immaterial borrowing costs during the in the AR5 period, reflecting its policy to capitalise finance costs on assets under construction, and low allocation of finance costs on past investments to WA. With the implementation of a new finance system in AEMO will adjust its approach to allocating financing costs across the business from FY23. This ensures AEMO WA's borrowing cost allocation for the AR6 period reflects the full cost of funds required to support WA activities.

2.3.6 Depreciation and amortisation

Table 15 WEM D&A AR6 forecast ($ million nominal)

WEM D&A	AR5 total	2022-23	2023-24	2024-25	AR6 total	Change ($)
Depreciation and amortisation	20.7	10.7	18.4	21.8	50.9	30.3

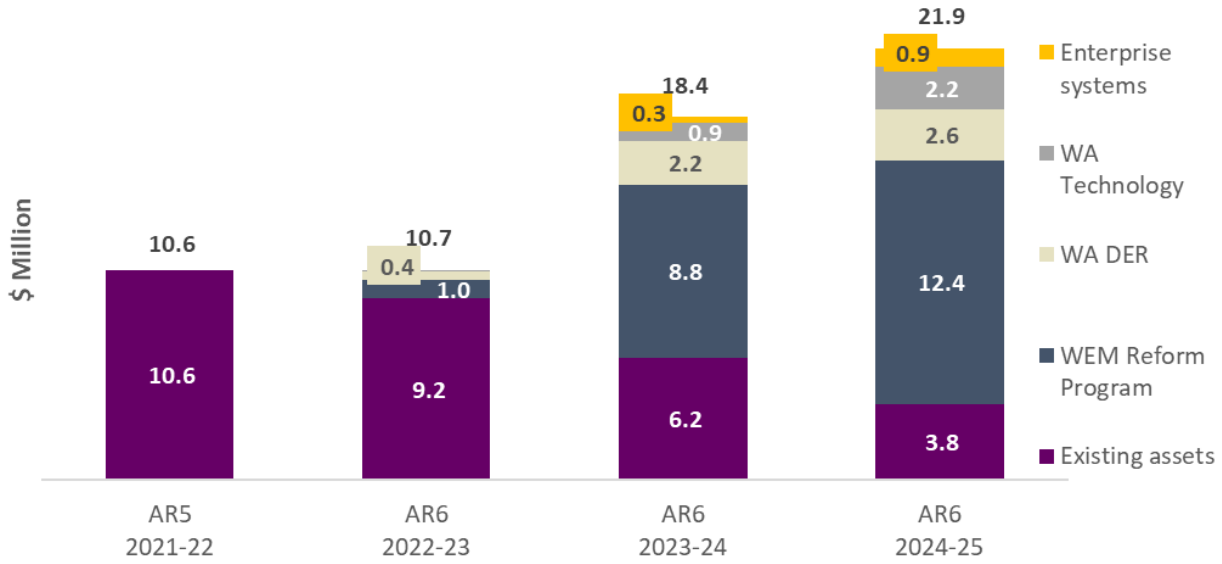
D&A is a mechanical outworking of the value of capex incurred in prior periods and the economic lives assumed for the assets. The AR6 D&A forecast is therefore relatively certain and less controllable than other aspects of the allowable revenue forecast.

D&A costs are determined by the expected written down value of assets at 30 June 2022, together with forecast depreciation that flows from assets purchased during the AR6 period. Consistent with clause 2.22A.5(a)(ii) of the WEM Rules, costs of the resulting assets will be recovered via D&A expenses, commencing in the year after the asset is placed in service/the capital project is completed.

Forecast WEM D&A costs for the AR6 period are $51.2 million. This is a $30.6 million increase compared with AR5, and accounts for 47% of the overall revenue increase in AR6.

The significant increase in D&A reflects the unprecedented level of investment AEMO has undertaken during the AR5 period to facilitate the Energy Transformation Strategy, which will continue into AR6. Figure 30 shows the components that make up the depreciation forecast for AR6, with a comparison to actual depreciation costs for the final year of the AR5 period.

Figure 30 Forecast D&A cost components AR6, $ million nominal



WEM Reform, specifically implementation of the new real-time energy and ESS markets, comprises the biggest D&A component ($22.2 million), with the bulk of D&A impacting allowable revenue in the final year of AR6 following the new market go-live in October 2023. D&A recovery will continue through AR7 and beyond.

This recovery approach for capex is consistent with historical practice and current Australian Accounting Standards, and helps smooth the impact of major capital investments on market fees.

Recovery of costs associated with existing assets is the second largest D&A driver ($19.2 million). It includes recovery of the capital costs associated tangible and intangible assets acquired by AEMO during AR4 and AR5 and from the merger of Western Power System Management with the IMO.

Forecast D&A costs during AR6 includes commencing recovery of capex that will be incurred during the first two years of the AR6 period (2022-23 and 2023-24).

2.4 Opex projects

The opex forecast also includes costs for three projects to be delivered during the AR6 period:

- WA DER Network Services Marketplace Trial and Design
- WA 5MS Planning
- WEM Reform Decommissioning.

These projects are generally research, planning or operational activities and will not result in the creation of separately Identifiable assets. AEMO therefore considers costs associated with these projects should not be capitalised under current Australian Accounting Standard 138 (Intangible Assets).

2.4.1 Network Services Marketplace Trial and Design

Table 16 WA DER Network Services Marketplace Trial and Design AR6 forecast ($ million nominal)

WA DER Network Services Marketplace Trial and Design	2022-23	2023-24	2024-25	AR6 total
Labour	-	0.2	1.2	1.4
IT & telecommunications	-	-	0.5	0.5
Supplies and services	-	-	-	-
Total	-	0.2	1.7	2.0

In 2019 the WA Government released its DER Roadmap.[44] The Roadmap contains a series of actions to be delivered by energy sector participants to facilitate ongoing connection of DER while, maintain power system security, and enable DER aggregators to participate in the WEM.

The Network Services Marketplace Trial and Design project is driven by DER Roadmap actions 31 and 32:

- Action 31

  By July 2023, develop the initial design of the framework for a distribution services market with fit for purpose arrangements for dispatch and settlement. Include an assessment of the cost and benefits of market creation

- Action 32

  By July 2024, commence the development of trials for a distribution services market for network support

AEMO is obligated under clause 2.1A.2(ll) of the WEM Rules to support EPWA in delivering these actions.

The project will see AEMO work closely with EPWA to test and demonstrate the technical and regulatory capability for AEMO to trial the facilitation of a marketplace for network services provided by DER aggregators, alongside WEM services.

Project objectives include:

- Providing inputs to a cost-benefit analysis (managed by EPWA).
- Designing solutions that enable dynamic, integrated and consistent DER management, increasing competition for both wholesale and network services via a common market access point managed by AEMO.
- Undertaking a trial for a distribution services marketplace with a focus on standardisation of network services and potentially contracts being offered and transacted.
- Gaining a sound understanding of the system and regulatory changes required to operate a network services market in the SWIS.
- Informing regulatory changes required to implement a network services market in the WEM/SWIS.

As this project is essentially a research and development project, all costs will be expensed as opex in the year they are incurred.

To help achieve the lowest practicably sustainable cost of delivering this project, AEMO will make use of learnings and investments already made in a similar component of the NEM's Project Edge demonstration. That trial is establishing a 'Local Services Exchange' component within AEMO's platform, which has potential to provide functionality for this project. Utilising this functionality instead of building a new platform is expected to provide significant savings for this project.

[44] At https://www.brighterenergyfuture.wa.gov.au/wp-content/uploads/2020/10/DER-Roadmap_April2020.pdf.

AEMO will require specialist resources for this project and will use people that have already been engaged in delivery of Project Symphony and other DER Roadmap actions to avoid training costs for new resources. This project is new for AEMO WA and will not overlap with any existing functions. It may lead to new functions in the future should the trial demonstrate value in doing so. However, being a trial, this project will not build to support any new functions. Rather, the intention is to run the project and systems in a non-production environment to minimise impacts on WEM and/or NEM operational systems.

This project is dependent on the successful delivery of Project Symphony, DER Participation, progress being made in DER Participation Implementation, and insights gathered from demonstration of the Local Services Exchange in Project Edge in the NEM.

2.4.2 WA 5MS Planning

Table 17 WA 5MS Planning AR6 forecast ($ million nominal)

WA 5MS Planning	2022-23	2023-24	2024-25	AR6 total
Labour	0.9	-	-	0.9
IT & Telecommunications	-	-	-	-
Supplies and services	-	-	-	-
Total	0.9	-	-	0.9

As discussed in section 4.1.1 of this proposal, the move to 5MS was directed by the WA Government's Energy Transformation Taskforce in December 2019. The timeframes for commencing 5MS have not been confirmed and remain subject to some uncertainty given the new market go-live has been deferred from October 2022 to October 2023. At the time or submission there also remains minimal detail on the market and regulatory design for 5MS in the WEM.

Given this uncertainty, AEMO has not included the cost of implementing 5MS in its AR6 capex forecast. AEMO understands EPWA remains committed to implementing 5MS and is also mindful that AEMO's meter data handling capabilities require an uplift to support both 5MS and the roll out of advanced metering infrastructure (AMI) by Western Power. As such, AEMO believes it will be required to commence planning for 5MS during the AR6 period.

AEMO has therefore included costs for a six-month planning stage for 5MS in the AR6 opex forecast. The purpose of this planning stage will be to develop the proposed solution and scope for implementing 5MS in the WEM, working closely with EPWA to define timing and deliverables. A key component of the planning work will be to support EPWA in market and regulatory design, which will ultimately inform the 5MS solution.

AEMO's approach to the planning stage for 5MS will be aligned to the PMO governance methodology, with key activities including (but not limited to):

- Subject matter expertise input into rule changes and EPWA designs.
- Business assessment of required procedure, and process changes necessary to deliver 5MS.
- Technology assessment of the system changes necessary to deliver 5MS.
- Cost and schedule estimates for procedure, system and process changes.

The main objective of the planning stage is to inform an in-period submission to provide AEMO with confidence it can move through into program execution. As such, the planning stage has been scoped to minimise up front effort while providing appropriate level of detail to secure a revenue allowance. [45]

[45] Common practice is for planning to be 10% of the total project forecast, however AEMO has constrained the 5MS planning forecast for this proposal to $1 million.

AEMO's forecast assumes final detailed planning and design will take place in the execution phase. AEMO proposes to undertake initial market testing to inform AEMO of potential costs, with final commercial activity (if deemed most efficient approach) taking place after the AR6 determination has been made.

The planning activity will build on the initial scoping and estimation work undertaken to inform the current high-level capex estimates discussed in section 4.1.1. AEMO will continue to draw on the knowledge, experience and expertise of NEM colleagues to minimise efforts, guide planning and identify key risks and mitigations.

AEMO estimates the project planning stage will require the following dedicated resources with the majority being recruited on a fixed term contract basis:

- Senior Project Manager
- Principal Analysts (providing business SME input into market design and business requirements)
- Senior Developers
- Senior Test Analysts
- Senior Business Analyst
- Solution Architect
- Change Manager.

2.4.3 WEM Reform Decommissioning

Table 18 WEM Reform Decommissioning AR6 forecast ($ million nominal)

WEM Reform Decommissioning	2022-23	2023-24	2024-25	AR6 total
Labour	-	1.0	-	1.0
IT & Telecommunications	-	-	-	-
Supplies and services	-	-	-	-
Total	-	1.0	-	1.0

When the new real-time energy and ESS market goes live, and number of systems and applications will become redundant. The cost of decommissioning these systems and applications, as well as storing historical data is an operating expense and will not be capitalised as part of the WEM Reform capex project.

These decommissioning costs comprise principally of labour costs including both technical (architecture, development and test) and business (subject matter expert analyst and business analysis) resources. These labour resources will work to assess system and data needs following implementation of the new market arrangements and develop a decommissioning plan that takes into consideration contingency planning (e.g. what systems may AEMO need to fall back on in the case of significant operational issue post go-live).

As planning for system transition, cut over and post go-live operations is yet to commence in earnest, the detailed scope and scale of decommissioning activity will not be developed until during the AR6 period. AEMO has assessed decommissioning requirements relative to other projects, however, the bespoke nature and scale of WEM Reform has made it difficult to find suitable comparators. Resource requirements and costs are simply based on a high level estimate of six months decommissioning effort post go-live.

3. WEM fees

The revenue required to fund AEMO's market and system operations functions is recovered via fees charged to WEM participants. The overall WEM Fee has three components:

- Market Fee – this covers the cost of market operation services, system planning services and market administration services.
- System Operation Fee – this covers the cost of operating the power system
- Regulator Fee – this covers the cost of the ERA's monitoring, compliance, enforcement and regulation services
- Coordinator Fee – this covers the Coordinator of Energy and the Rule Change Panel's market administration services.

Fees are charged based on the volume of energy generated or consumed by market participants and are subject to an annual adjustment for any under/over recovery and differences between forecast and actual costs and energy. This true-up ensures market participants only pay for expenditure actually incurred.

3.1 Estimated WEM fees in the AR6 period

At time of developing this AR6 submission, the ERA and Rule Change Panel (now part of EPWA) had not advised their forecast fees for the AR6 period. AEMO has therefore assumed the Regulator Fee will increase by CPI only until otherwise advised, using the 2021-22 Regulator Fee ($0.195/MWh) as a base rate.

Table 19 shows the breakdown of the estimated WEM Fee for AR6.

Table 19 Estimated market fees during the AR6 period ($/MWh nominal)

WEM Fee ($/MWh)	AR5 average fee	2022-23	2023-24	2024-25	AR6 average fee	Change in average fee (%)
Market Fee	0.374	0.430	0.668	0.765	0.621	66%
System Operation Fee	0.509	0.708	0.967	1.088	0.921	81%
Regulator Fee*	0.183	0.199	0.203	0.207	0.203	11%
Coordinator Fee		0.077	0.078	0.080	0.081	
Total	**1.066**	**1.413**	**1.916**	**2.140**	**1.826**	**64%**

* The Regulator Fee is for the ERA's regulatory and Rule Change Panel support services. Note the Rule Change Panel functions moved to EPWA in July 2021 and are now captured under the Coordinator Fee. - It only applies from FY22 onwards therefore not included for comparison purposes.

Average market fees will increase by $0.679/MWh over the AR6 period compared with AR5 actuals. This is an average increase of 64%. (excluding coordinator fee)

During the AR5 period, the estimated contribution of AEMO's WEM costs on the average annual residential electricity tariff was $10.11.[46] AEMO has no influence or visibility of how and whether market participants pass through wholesale market cost increases to consumers. However, if WEM fee increases were to be passed through to

[46] Assumes average residential of 13 kWh per day (2021 data from Synergy/Dept of Treasury). AR5 average tariff $1.066/MWh / 1000 x (13 kWh per day) x2 because the fee is charged to both generation and load.

residential retail tariffs, AEMO's WEM Fee component of the residential charge would rise to approximately $16.56. This equates to an increase of $6.45 per year[47] on the average annual residential customer bill.

AEMO highlights that this is a rough estimation, included for indicative purposes only. The calculation assumes an average residential consumption of 13.00 kWh/day, based on 2021 date from the WA Department of Treasury.

As discussed previously, the higher overall WEM fee is driven by inclusion of D&A costs from prior investments. D&A accounts for 30% of the uplift ($0.203/MWh), and reflects the capital costs incurred to date of implementing the new markets and associated Energy Transformation Strategy activities (WEM Reform and DER Roadmap assets).

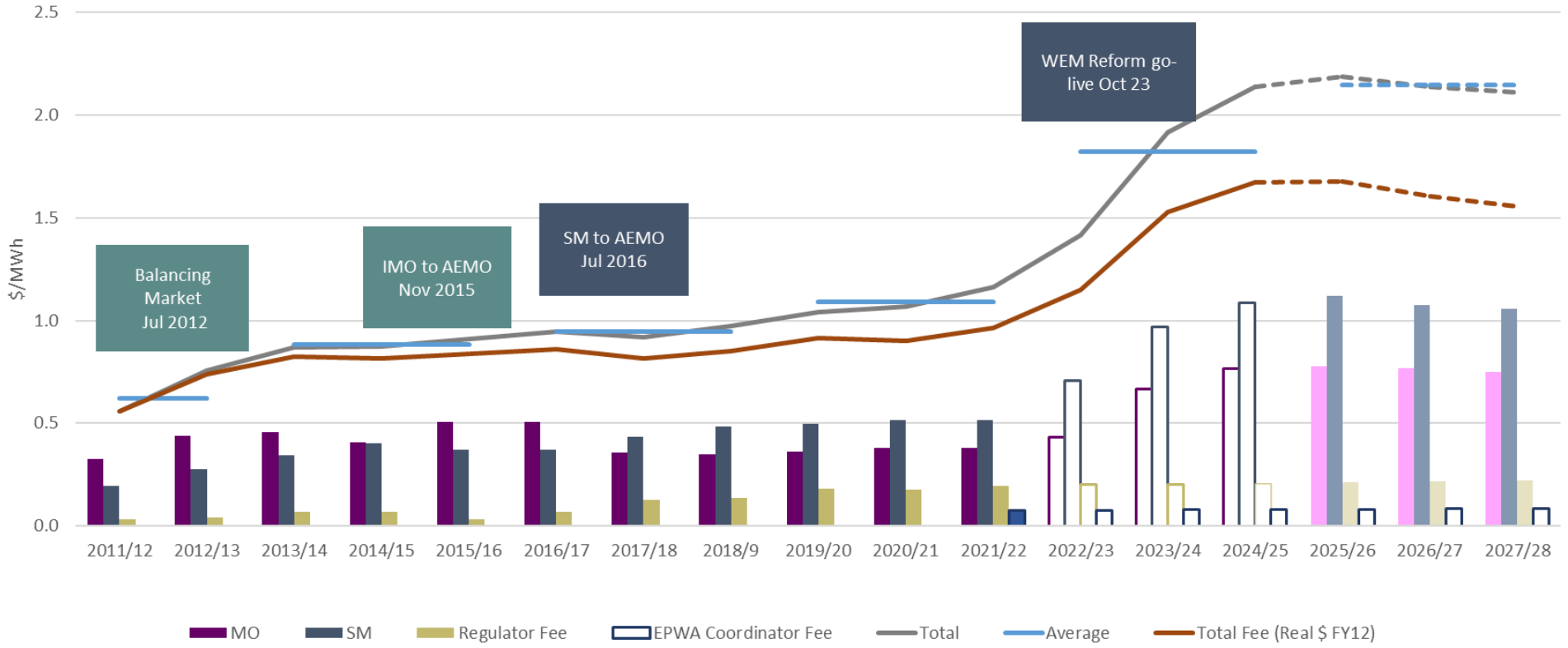
The WEM Fee increase is also due to the uplift in resources to service the new market and continue to operate the power system securely. Energy consumption is forecast to decline 1% per annum over AR6, which also impacts prices.

[47] Note the estimated consumer impact is an indicative calculation only. AEMO has no control or visibility of how market participants ultimately absorb or pass-through wholesale market and system management costs to end consumers.

3.2 Analysis of WEM Fee movement

Fee increases for AR6 follow a period of relatively stable fees since 2013-14. Figure 31 shows the progression of fees since the last major market reform (the Balancing Market) was introduced in 2012, and includes a projection of fee increases into the AR7 period.

Figure 31 WEM Fee, market start to end of AR7 ($/MWh nominal)



There is a lag between incurring investment and recovering costs. Historically, material uplifts in fees have driven by changes to the electricity market and/or power system, with the intent of either responding to power system challenges or improving market effectiveness.

Prior to the AR6 period, the most significant fee increases since market start followed the introduction of the Balancing and Load Following Market in 2012. The Balancing Market was the first major reform in the WEM following its commencement, and was driven by Government, the former IMO and market participants.

After the Balancing and Load Following Market commenced, the Market Fee increased significantly as AEMO commenced recovery of D&A on the new IT assets installed to operate the new market. Though the fee increases to recover the cost of these 2012 reforms were steep, the benefits to the market were tangible and ultimately recovered by participants. An IMO report[48] determined a range of $8.9-$24.8 million in net benefit for the introduction of the Balancing and Load Following Market and a market benefit of $15.3 million in the first year of its operation.

AEMO expects a similar pattern to emerge following the implementation of the real-time energy and ESS market. While there will be an initial cost impact, D&A costs from the initial capital outlay will fall away.

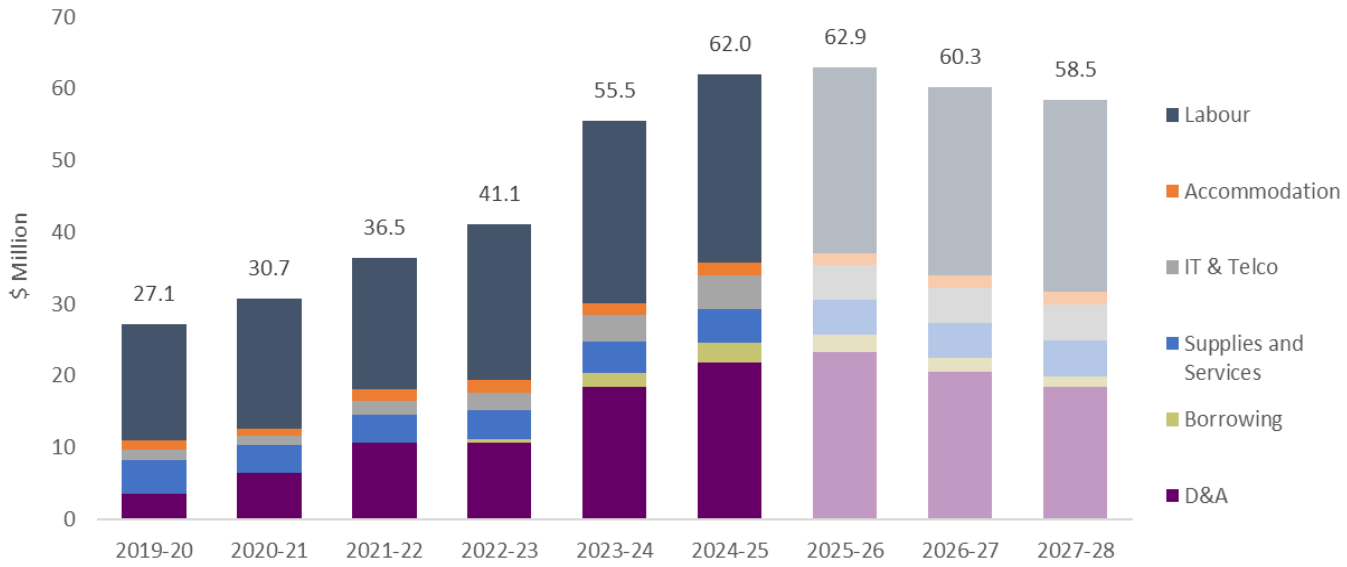
Ultimately, the WA Government's Energy Transformation Strategy and the associated package of reforms are expected to result in significant benefits to the energy sector. The introduction of SCED will result in more economic and equitable dispatch outcomes, while the broader market, power system and DER initiatives will enable the market to extract maximum value from existing generating facilities, while encouraging newer low-cost generation sources to connect.

3.3 Estimated WEM fee impact in the AR7 period

Assets associated with the new market arrangements and DER Roadmap activities will be depreciated over 5-10 years. Depreciation commences after the assets are placed in service/project is complete. This means a significant portion of the capital asset value and associated financing costs will be recovered over the AR7 period.

AEMO has conducted some high-level modelling to help identify the potential impact of expected D&A on the AR7 WEM Fee. Figure 32 shows how forecast Opex will change during the AR7 period based on current AR6 assumptions.

Figure 32 WEM operating expenditure, AR5 to AR7, ($ million nominal)



[48] Independent Market Operator, The Balancing and Load Following Market 2013 assessment, produced by Sapere.

Note the above figure is indicative only, and is based on the following assumptions:

- Expenditure categories that inform the AR7 WEM Fee have been extrapolated based on AR6.
- AR7 capex assumed to be business as usual lifecycle driven only, represented by the AR6 non-reform WA Technology capex of ~$3.7 million per annum, plus continued enterprise investment in cyber at the AR6 average, and another EMS upgrade in FY28. Total AR7 capex $14.6 million.
- Zero reform related capex.
- D&A recovery assuming the 2024-25 interest rates and average asset lives from AR6.

Based on these assumptions, Table 20 shows the estimated impact on market fees during AR7.

Table 20 Estimated impact on baseline market fees during the AR7 period ($/MWh nominal)

WEM fee ($/MWh)	AR6 average fee	2025-26	2026-27	2027-28	AR7 average fee	% change in average fee
Market Fee	0.621	0.778	0.766	0.750	0.765	23%
System Operation Fee	0.921	1.119	1.074	1.057	1.083	18%
Regulator Fee*	0.203	0.211	0.215	0.220	0.215	6%
Coordinator Fee*	0.081	0.081	0.083	0.084	0.083	2%
Total	**1.826**	**2.189**	**2.138**	**2.111**	**2.146**	**18%**

*Regulator and Coordinator fees assumed to increase by CPI only for modelling purposes.

AEMO estimates the ongoing impact of the AR6 proposal, based on current assumptions, will result in approximately 18% indicative increase in the average annual WEM Fee during the AR6 period.

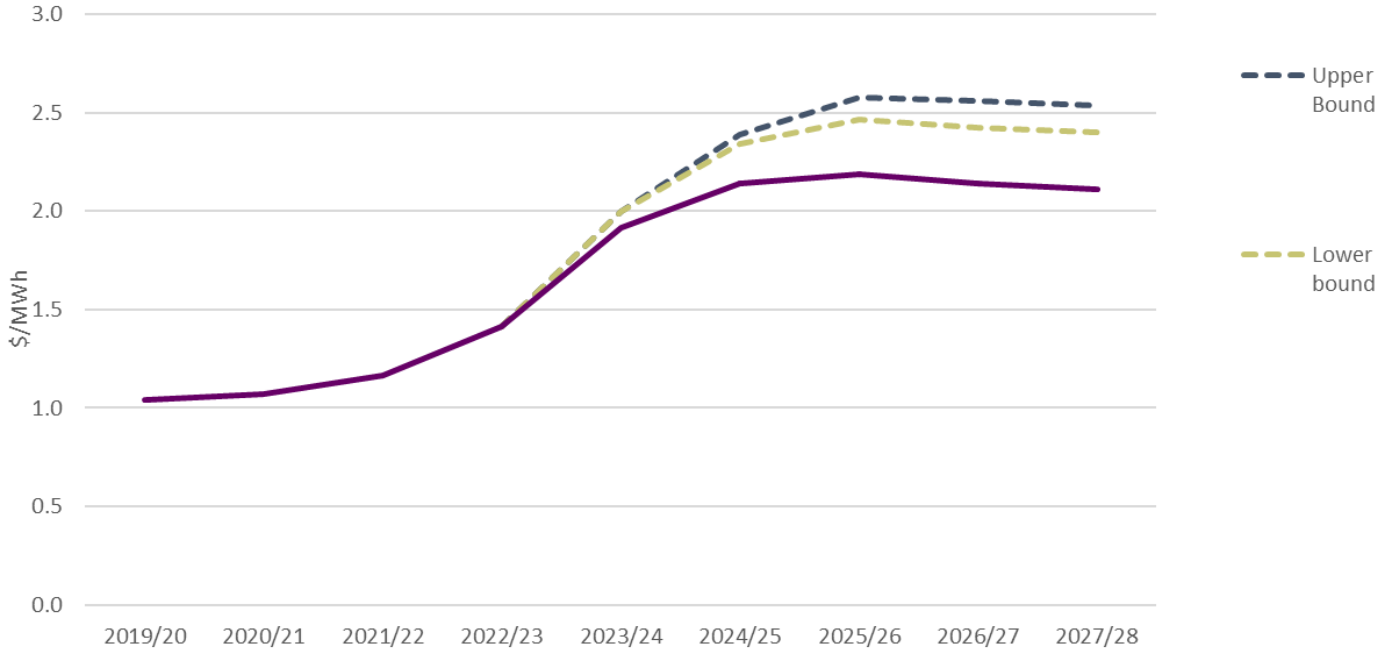
Actual impact on market fees will vary depending on actual capex incurred, depreciation schedules and changes to operating costs resulting from the reformed market and ongoing energy transition. Fees will be adjusted accordingly via the annual budget adjustment process.

3.3.1 Sensitivity analysis – impact of potential projects not currently included in the AR6 forecast

A number of capex projects have potential to arise during the AR6 period, but are not currently included in the AR6 expenditure forecast due to uncertainty around their timing and scope. These projects are discussed in section 4.1.1.

The potential additional expenditure associated with these projects during the AR6 period ranges from $32 million to $64 million. AEMO has therefore modelled the impact of incurring this additional expenditure on the WEM Fee in AR6 and AR7 (see Figure 33).

Figure 33 Estimated impact on AR6 and AR7 WEM Fee of uncertain projects if included in the AR6 forecast ($/MWh nominal)



In summary, if the potential projects are required to be delivered during the AR6 period, the average WEM Fee would increase to between $2.403/MWh and $2.536/MWh by the end of the AR7 period.

4. WEM forecast capital expenditure

4.1 Overview of WEM forecast capital expenditure

This section provides discussion and justification of the forecast capex AEMO requires to perform system and market operations in line with its functions under clauses 2.1A.1A and 2.1A.2 of the WEM Rules. Note forecast capex on GSI activities is presented separately in section 5 of this proposal.

Capex for the AR6 period can be separated into two broad categories:

- Capex to facilitate the Energy Transformation Strategy
- WEM sustaining capex

> 2.1A.2 The functions conferred on AEMO are:
> ...
> (ll) to support the Coordinator's role, and to facilitate and implement decisions by the Coordinator and the Minister regarding the evolution and development of the Wholesale Electricity Market and the WEM Rules, and the management of Power System Security and Power System Reliability in the SWIS.

Capex to facilitate the Energy Transformation Strategy includes expenditure on implementing the new market arrangements and delivering DER Roadmap activities. These two major reform programs are driven by the WA Government and are a continuation of the work commenced during the AR5 period. AEMO has limited discretion on these activities and is obligated to deliver the Energy Transformation Strategy activities under clause 2.1A.2(ll) of the WEM Rules.

WEM sustaining capex includes expenditure on AEMO WA's IT lifecycle replacement and upgrades, rule changes, and control room tools and equipment. It also includes AEMO WA's share of investment to maintain critical enterprise-wide systems the WEM relies on to operate securely. This includes cyber security and the energy management system.

Both these categories of capital expenditure are essential to enable AEMO WA to continue to perform market and system operations functions. The new market arrangements and DER integration/participation will ultimately become 'business as usual' functions provided by AEMO, with market participants using and benefitting from these services.

All forecast capex is related to delivering one or more of its functions under the WEM Rules. How each of the capex projects proposed for the AR6 period maps to AEMO's functions is included in the expenditure model provided to the ERA.

Forecast capex for the AR6 period is $69.4 million. This is a 13% decrease from the $82.4 million forecast position at the end of the AR5 period.

Table 21 presents a summary of the AR6 forecast capex by category.

Table 21 Total AR6 forecast WEM forecast capex by cost category ($ million nominal)

Cost category	2022-23	2023-24	2024-25	AR6 Total
Facilitating the Energy Transformation Strategy				
WEM Reform program	31.5	13.1	0.0	44.6
WA DER program	6.8	2.6	0.0	9.4
Total Facilitating the Energy Transformation Strategy	38.3	15.7	0.0	54.0
WEM sustaining capex				
WA technology				
Capability uplift	0.2	0.2	0.9	1.3
Lifecycle	2.0	2.1	2.9	7.1
WEM Rule changes	0.3	0.0	0.9	1.2
Total WA technology	2.6	2.4	4.8	9.7
Enterprise systems				
Energy management system	1.1	0.3	0.0	1.4
Cyber	0.9	1.0	1.0	3.0
Operational forecasting	0.0	1.1	0.0	1.1
Infrastructure	0.1	0.1	0.0	0.2
Total enterprise systems	2.1	2.5	1.1	5.8
Total WEM sustaining capex	4.7	4.9	5.8	15.4
Total capex	**43.0**	**20.6**	**5.8**	**69.4**

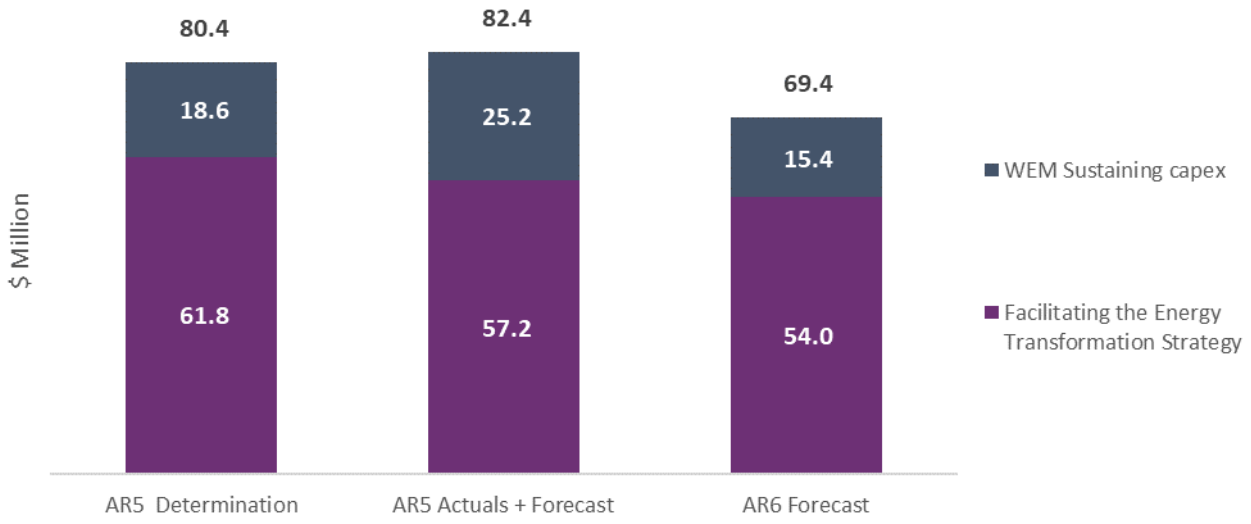
Table 22 shows how the AR6 forecast compares with the AR5 determination and the expected actuals at the end of the AR5 period, and Figure 34 shows the split by capex category.

Table 22 AR6 forecast capex v AR5 actuals + forecast by category ($ million nominal)

Cost category	AR5 approved	AR5 actuals + forecast	2022-23	2023-24	2024-25	AR6 Total	Variance AR6 to AR5 a+f
Facilitating the Energy Transformation Strategy							
WEM Reform program	47.8	45.3	31.5	13.1	0.0	44.6	-1.7%
WA DER program	14.6	11.9	6.8	2.6	0.0	9.4	-20.7%
WEM sustaining capex							

Cost category	AR5 approved	AR5 actuals + forecast	2022-23	2023-24	2024-25	AR6 Total	Variance AR6 to AR5 a+f
Technology upgrades, control room tools and enterprise allocations	18.0	25.6	4.7	4.9	5.8	15.4	-39.7%
Total capex	**80.4**	**82.8**	**43.0**	**20.6**	**5.8**	**69.4**	**-16.1%**

Figure 34 AR5 and AR6 forecast capex by category ($ million nominal)



Facilitating the Energy Transformation Strategy

The majority of capex during the AR5 period was incurred on delivering projects to facilitate the Energy Transformation Strategy, specifically the implementation of the new real-time energy and ESS market and the DER Roadmap activities. This trend continues during the AR6 period as AEMO works towards implementing the new market arrangements by 1 October 2023 and continuing DER Roadmap activities.[49]

Approximately $44.6 million is required to complete delivery of the new market arrangements. This revised forecast to deliver the new markets is higher than that estimated when developing the AR5 forecast in 2019,and brings the total forecast capital cost of the new markets to $91.2 million (incl. contingency), up from the initial $61 million estimate.

Revised WEM Reform forecast based on more complete scope and information

The revised forecast for implementing the new market arrangements is based on more complete information than was available when the WA Government's reform program was first conceived. Since the original estimates were made, the scope and rules for the new markets have largely been defined. AEMO, EPWA and market participants also have a greater understanding of the complexity and volume of data, system and processing requirements, as well as the business change activities necessary to ensure the new market can commence with a reasonable and manageable level of risk. These new assumptions have been built into the revised AR6 forecast, and represent the full cost of delivering the new markets by 1 October 2023 based on the information to date.

[49] Note AEMO has not included any capex for implementing deliverables that emerge from Stage 2 of the Energy Transformation Strategy, as scope and deliverables were not available at the time of preparing this proposal.

The AR6 capex forecast also includes approximately $9.4 million to deliver actions assigned by the Government's DER Roadmap. The DER Roadmap actions during AR6 include completing the DER orchestration pilot (Project Symphony), and work on how DER technologies can be integrated into the SWIS and designing to enable DER aggregators to access the WEM.

WEM sustaining capex

Capital expenditure associated with running the business over the AR6 period is estimated at $15.4 million. This is a 39% decrease on similar capital costs during AR5. Capex projects in this category are for critical upgrades and system lifecycle replacement of the multitude of IT systems used by AEMO to operate the WA power system and markets. Sustaining capex includes development of control room tools and provision for potential WEM Rule changes during the AR6 period that may require minor system enhancements.

Sustaining capex also comprises AEMO WA's allocation of upgrades and lifecycle costs for enterprise systems it uses to run the WA business. These include expenditure on cyber security and operational forecasting systems. Enterprise system capex for the AR6 period is forecast at $5.9 million, a 28% decrease in enterprise system costs compared with AR5 ($8.1 million). Enterprise system costs are allocated on a causer or beneficiary pays basis.

4.1.1 Potential projects not included in the AR6 forecast

Capex forecast excludes 5MS and Energy Transformation Strategy Stage 2

While expenditure on facilitating the Energy Transformation Strategy is currently forecast to be less than that incurred during the AR5 period, the AR6 forecast does not include amounts that may be incurred to facilitate further government-driven reforms.

The WA Government has recently published its initial thinking around the program of work that comprises stage two of the Energy Transformation Strategy. The action and investments required by AEMO to facilitate Energy Transformation Strategy – Stage 2[50] have not yet been defined, and insufficient information is available at the time of preparing this AR6 proposal to inform a robust capex forecast.

Transformational programs 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.

5MS

The move to five minute market settlement was directed by the WA Government's Energy Transformation Taskforce in December 2019. The December 2019 policy decision originally intended to introduce 5MS from October 2025. This is three months into the AR7 period.

The October 2025 start date for 5MS was based on the assumption amendments to the WEM Rules to effect five minute settlement will be drafted and consulted on following commencement of the new market arrangements, and that design, development and implementation of the systems required for 5MS will take approximately three years to deliver.

However, this assumption was based the original new market start date of 1 October 2022. Market start has since been deferred to 1 October 2023.

Complementary to 5MS, Western Power is currently rolling out advanced metering infrastructure (AMI) across its network. AMI is necessary to enable metering data to be captured and sent to AEMO in real time so that the market can be settled every five minutes. AEMO's existing meter data handling systems do not have the capacity to handle real time metering data in the volumes that will result from a mass AMI roll out.

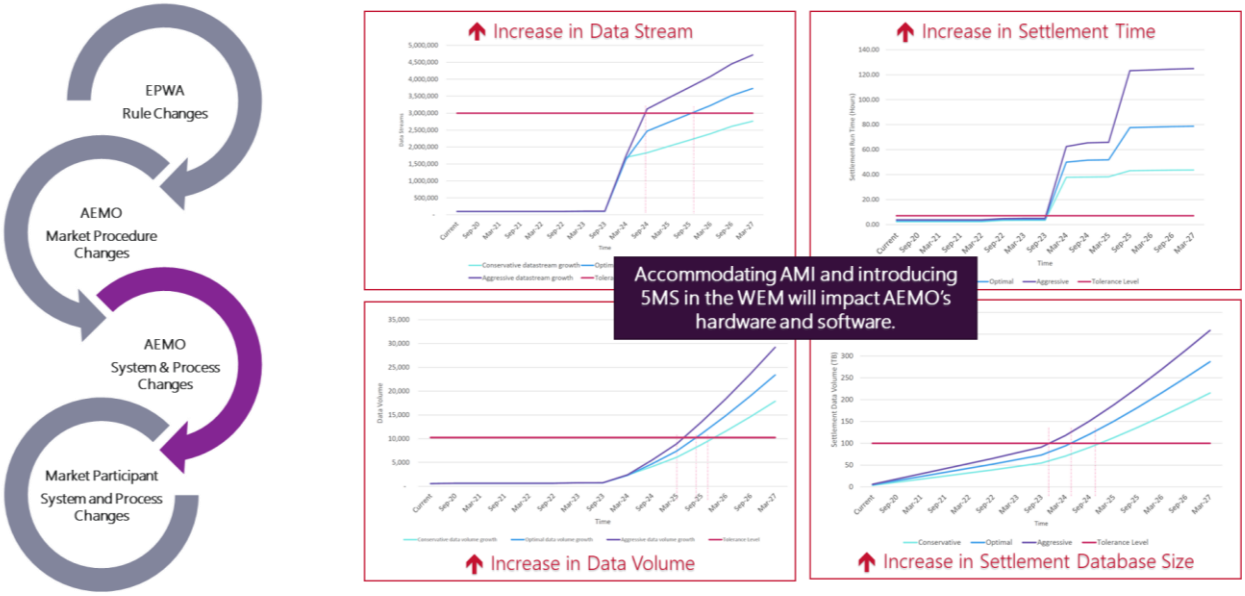
[50] See https://www.wa.gov.au/government/announcements/western-australias-energy-transformation-strategy-moves-its-next-stage.

Early investigations by AEMO and EPWA have identified that designing and implementing 5MS will require changes to ~300 clauses in the WEM Rules. It will also require changes to between 25 and 40 WEM Procedures and associated documents. More significantly, 5MS and AMI will exponentially increase the amount of metering data AEMO's systems are required to process and store. AEMO estimates at least nine existing systems will require significant upgrade or replacement to be able to support the increase in data volumes and processing frequency (noting settlement is currently done on a 30-minute basis).

5MS requires changes estimated to ~300 WEM Rules clauses + transitional rules + cross-references

5MS requires changes to 25-40 WEM Procedures + other documents

Figure 35 5MS and AMI will significantly increase data volumes (charts represent high level estimates only



AEMO has not yet fully assessed the potential system requirements for market participants, however, participants will need to update their processes and systems relating to:

- Meter data management
- Settlement reconciliation
- Customer billing and reconciliation.

Preliminary estimates suggest the cost for AEMO to implement 5MS will be between $21.2 million to $45.4 million.[51] This does not include the cost of market participants upgrading their systems. Ongoing opex to support 5MS is estimated at $4.6 million per year.

Note the 5MS estimate is based on minimal scope and uncertain timing and technical requirements, and should not be used for budgeting or forecasting purposes.

The 12-month deferral to market start, coupled with further investigation into the potential costs and scope of 5MS and AMI have generated significant uncertainty around when 5MS will go ahead and what the solution will look like. AEMO will continue to engage with EPWA, Western Power, and market participants on 5MS and AMI. However, AEMO has not included 5MS costs in its capex forecast at this time.

[51] A proportion of this cost is likely to be OPEX reflecting he need to utilise Cloud computing systems as the most efficient way to manage increasing data volumes

As discussed in Section 2.4.2, AEMO has included an allowance in its AR6 opex forecast to work with industry and undertake detailed planning that will enable an implementation scope, cost and timeframe to be defined.

As the 5MS and AMI project requirements are progressed further by EPWA, Western Power and participants, AEMO will review its work program and budget estimates to understand what implementation work can reasonably be delivered during the AR6 period. AEMO will propose an in-period adjustment to accommodate any costs above approved budget amounts, where necessary.

DER Participation Implementation

The WA Government's DER Roadmap outlined a suite of actions to be undertaken by Western Power, Synergy, EPWA and AEMO to address power system security issues resulting from the significant increase in and penetration of DER, and to facilitate ongoing connection of DER in the SWIS. One of the key objectives of the DER Roadmap is to allow DER to be aggregated and for those aggregated resources (sometimes referred to a virtual power plants or VPPs) to participate in the wholesale and ESS markets. This is action 30 in the DER Roadmap.

Costs to implement DER Participation were not included in AEMO's AR5 in-period DER proposal. This is because scope and requirements to estimate these implementation costs were not available at the time. The DER Participation Implementation project will build on the DER Orchestration Pilot (Project Symphony, undertaken as DER Roadmap actions 22 & 23), and the DER Participation Project design program (DER Roadmap actions 24 to 29). The original intent was for full DER implementation costs to be included in the AR6 proposal, with a proposed July 2023 start date for participation.

Both the DER Participation Project and DER Orchestration Pilot are under way and are now scheduled to be completed during the AR6 period. However, the detail of key policy decisions and WEM Rules necessary for implementing DER Participation have not yet been defined and are not expected to be sufficiently developed before the AR6 determination is made. As a result AEMO cannot include full costs implementing DER in the AR6 proposal.

In a similar vein to 5MS, the decision to defer commencement of the new market arrangements until October 2023 casts uncertainty over the timing of when rules will be in place to support fully formed market arrangements for DER aggregators to participate in the WEM market. The original July 2023 assumption is no longer feasible, as the new market arrangements will not be in place.

AEMO does not consider it prudent to fully implement DER Participation in the existing market, only to require considerable re-work when the new market goes live, or to expect market participants to change business processes to meet changed market arrangements from October 2023. Further, at the time of submitting EPWA has not provided additional clarity on when fully formed arrangements for DER Participation should commence.

Given this uncertainty, AEMO has not included the full costs of implementing DER Participation in the AR6 capex forecast. Instead, AEMO has only included approximately $2 million to be incurred during AR6 to support planning and initial implementation activities. Further information on the $2 million of planning and implementation costs is provided in section 4.3.1.

AEMO's current estimate of the full cost of DER Participation implementation is approximately $10 to $14 million (including the $2 million planning and initial implementation costs). This, however, is based on high level assumptions due to AEMO's limited visibility of the WEM Rules and technical specifications that will determine the solution.

Following further clarity on rules and requirements AEMO will utilise the $2 million planning allowance to commence the project and develop an in-period forecast capex adjustment for the balance of the DER Participation Implementation project costs. The timing of the in-period proposal to be developed by AEMO will depend heavily on further policy positions and rules from EPWA, developed with input from energy industry stakeholders. Delays or inflexible determination dates are likely to have a significant impact on AEMO's ability to deliver this project quickly or efficiently. AEMO's resource forecast assumes in-period approval to commence DER Participation Implementation will be secured by 2023-24. However, if this timing changes, it may lead to less efficient resource allocation within the DER program.

Other potential reforms

In addition to the transformational programs above, EPWA has recently initiated the RCM Review[52] and the Cost Allocation Review[53]. Both reviews will draw on input from AEMO and industry stakeholders via dedicated MAC Working Groups and are targeting rule change proposals in 2023. AEMO notes these reviews are at a very early stage and it is not yet able to determine what the capex (or opex) impacts may be. As these reviews progress, AEMO will aim to assess impacts and provide contingent cost estimates to support cost benefit analysis and stakeholder planning.

With initiation of the RCM Review, EPWA has placed a number of related rule change proposals on hold. One of these is RC_2019_03 (Relevant Level Methodology (RLM) used for the assignment of Certified Reserve Capacity to Intermittent Generators)[54]. AEMO's cost estimate for this RLM project (based on current draft rules) is c $1.2 million (incl. $0.2m contingency). However, this has not been incorporated in the AR6 capex proposal.

4.2 Performance during the AR5 period

The AR5 period saw completion of critical sustaining capex projects, as well as commencement of the WEM Reform and DER Roadmap programs. More than 75 individual projects either have been delivered or will have been commenced by the end of the AR5 period (with WEM Reform accounting for around 25 of them).

Key projects completed or commenced during AR5 were:

- Markets and Settlements work program (STEM, POMAX and RoPE) – critical upgrades and enhancements to the STEM Systems (that urgently required modernisation ahead of Reform) as well as market meter data and settlement systems.
- System Management Systems Transition (SMST) - transfer of 23 IT systems from Western Power to AEMO.
- Power System Operations project – implementation of a new energy management system (e-terra), removing reliance on Western Power's XA/21 system and transferring real-time forecasting to AEMO's MetrixIDR system.
- Business Continuity Capability – establishing an emergency back up facility/control room for the power system.
- Reserve Capacity Mechanism – amending systems and processes to improve the responsiveness of the capacity price formula to the level of excess capacity in the market.
- Digital transformation projects – cyber security uplift, design and build of public cloud, and uplifts in data governance capabilities.
- WEM Reform program (ongoing) – design and commence delivery of new market arrangements and associated digital platform and system upgrades.
- DER Roadmap program (ongoing) – delivery of DER Roadmap activities including establishing the DER Register, DER orchestration, design work for DER Participation and commencing technology integration.

Actual capex incurred by the end of the AR5 period is expected to be $82.8 million. This is $2.4 million higher than the amount approved in the AR5 determination ($80.4 million).

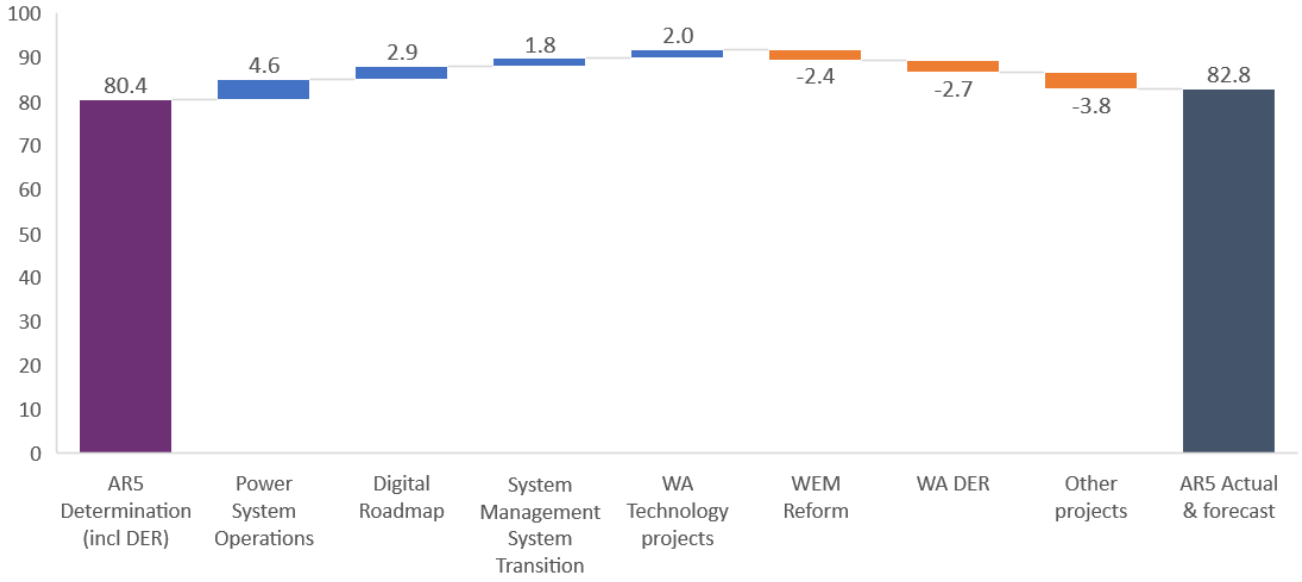
Figure 36 summarises the variance between the AR5 determination and forecast.

[52] MAC-02-11-2021-Combined-meeting-papers.pdf (www.wa.gov.au) (Agenda Item 8)

[53] MAC-2021_12_14-Combined-meeting-papers.pdf (www.wa.gov.au) (Agenda Item 8)

[54] https://www.wa.gov.au/government/document-collections/rule-change-rc201903

Figure 36 AR5 forecast capex determination compared with AR5 actuals + forecast ($million nominal)



A summary of the variance in some of the key programs for AR5 is provided below.

PSO (e-terra EMS implementation)

The largest variance to the AR5 capex forecast occurred in the PSO project. Expenditure was $4.6 million higher than that expected to be incurred during the AR5 period ($0.5 million).

This overspend is a result of system implementation being more complex than the original project scope suggested. The original project estimate of $6.18 million to implement a new energy management system (EMS) did not factor in a number of unique operating characteristics of the WEM, and as such was understated. The final total cost of the PSO project (across AR4 and AR5) was $9.4 million, a total project variance of $3.22 million.

A more detailed explanation of the PSO AR5 variance is provided below.

AR5 variance

PSO was a project to implement an EMS and forecasting system at AEMO WA. Its purpose was to remove AEMO WA's reliance on Western Power's outdated XA/21 system and MetrixIDR real-time forecasting system to support system operations. The project commenced in 2016, driven by the then WA Government's Electricity Market Review, which directed the transfer of Western Australia's power system and wholesale market operations from Western Power and the IMO, to AEMO.

AEMO uses GE's e-terra EMS in the NEM. Therefore, the logical decision was made at the time to also implement e-terra in the WEM. This would enable AEMO WA to leverage the benefits of shared platform and support costs.

When the PSO project commenced in 2016, AEMO used e-terra version 2.5 in the NEM, but was scheduled to upgrade to version 3.2 during early 2019. The original plan was to implement e-terra version 2.5 in the WEM, and then upgrade to version 3.2 at a relatively low cost once the NEM upgrade was complete. This would allow AEMO WA to cease reliance on Western Power's XA/21 system (as well as eliminate service costs payable to Western Power) and have its own EMS and demand forecasting capability more quickly.

Most of the original design work and preparation to implement e-terra 2.5 was incurred during the AR4 period. At the time of the AR5 proposal (March 2019), the total project cost of implementing e-terra 2.5 was estimated at $5.49 million, with $0.47 million of this to be incurred during the first year of the AR5 period. The subsequent upgrade to

version 3.2 was estimated at $0.69 million, bringing the original total capex forecast for the PSO project to $6.18 million.

As discussed in AEMO's May 2019 response to the ERA's AR5 determination, delays to the NEM upgrade project prompted AEMO to revisit this original plan. AEMO changed approach, deciding not to implement e-terra version 2.5 in the WEM and instead jump straight to version 3.2 after the NEM upgrade was completed. This would avoid approximately $0.69 million of potential costs associated with the version 2.5 to 3.2 upgrade. The ERA agreed with this decision to implement e-terra version 3.2 directly. [55]

The final implementation costs expected to be incurred during the AR5 period were revised marginally to $0.51 million (from the original $0.47 million). The ERA approved this forecast in its AR5 determination.

E-terra implementation cost estimates were developed by the NEM e-terra support team (with input from WEM subject matter experts) and was based on an assumption that the work/knowledge conducted in the NEM for the 2.5 to 3.2 upgrade would be transferrable and therefore implementing the system in the WEM would be a relatively straightforward exercise.

The NEM e-terra upgrade was completed in September 2019, meaning focus could turn to the WEM implementation. However, it soon became apparent that fundamental differences between the NEM and the WEM power system and market arrangements meant that implementing any version of e-terra (or any other new EMS) in the WEM would be significantly more complex than originally anticipated.

In hindsight, the original cost estimate was overly optimistic. AEMO significantly underestimated the effort required to implement unique WEM functionality such as Synergy dispatch, automatic balancing control, and the volume and detail included in displays[56]. Transferring data from Western Power's XA/21 system to e-terra was particularly problematic, requiring multiple iterations to transfer data accurately. Other WEM nuances resulted in significantly more effort to get the same e-terra modules working in the WEM compared with the NEM. Automatic generation control and state estimation were especially challenging.

The complexity of the solution also caused resourcing challenges. Grid system engineers and modellers are very specialist resources, and not readily available in the market. AEMO's engineers and modellers were engaged on the e-terra implementation in the NEM, with subsequent NEM power system operations being the priority once e-terra had been implemented (to make certain it was working correctly). This meant resources were not immediately freed to help solve the WEM implementation complexities. Remote working arrangements in response to the COVID-19 pandemic also made problem solving more difficult.

These challenges led to the project requiring considerably more analysis, testing, and build time and resources than originally forecast.

The WEM e-terra implementation was completed in August 2021. The total project cost was $9.4 million, of which $5.1 million was incurred during the AR5 period.

SMST

The SMST project saw the transition of 23 legacy IT system operation systems from Western Power to AEMO. The project commenced during the AR4 period and at the time was estimated to cost a total of $5.4 million. As discussed in AEMO's AR5 proposal, the project straddled the AR4 and AR5 periods, with $2.2 million expected to be incurred during AR5. The project was forecast to be completed in November 2019.

SMST was linked to the PSO project (described above), and had a number of dependent components. The original plan was for SMST to be delivered after e-terra had been implemented, as it was considered desirable to reduce AEMO's reliance on Western Power's XA/21 EMS as a priority from a system security perspective.

[55] ERA, *Australian Energy Market Operator Allowable Revenue and Forecast Capital Expenditure 2019/20 to 2021/2022 – Draft decision*, page 26.

[56] Being a smaller system operational zone, WEM coverage goes further into the distribution system than in the NEM, which adds more detail and complexity to the information that needs to be displayed.

However, the PSO project was delayed, which caused the SMST project to be deferred until foundational elements of the PSO project had been delivered. Ongoing issues with the e-terra implementation meant that the SMST was at risk of being delayed further. AEMO therefore decided (in early 2020) to bring forward delivery of SMST ahead of PSO, as the SMST was nearer completion than PSO and would enable a larger portion of the monthly service costs payable to Western Power to be eliminated.

The SMST project was completed in November 2020, at a total cost of $6.2 million. This is $0.8 million higher than originally forecast during AR4, due predominantly to the delays caused by the interdependencies with the PSO project and the need to change the design so didn't rely on the full PSO scope to be delivered first. The above-forecast spend in the AR5 period is due to the shift in project timing, with more of the overall costs being incurred during AR5 than originally anticipated.

WEM Reform

The AR5 determination included $47.8 million of capex to enable AEMO to provide regulatory and market design support and undertake the majority of implementation activities ahead of the original planned Go Live of October 2022 ($46.2 million). It also included a forecast of ~$1.5 million to deliver the settlement enhancements reforms, which were subsequently brought under the operational scope of the WEM Reform Program. Each of these projects was established to provide a solid foundation for implementation of the new market early in the period.

The forecast for AR5 was based on extremely high-level information on the scope and requirements for the new market arrangements. During AR5 AEMO commenced development and implementation works prior to the full scope and requirements of the new market arrangement being available in December 2020. Some components of the reform program such as introduction of GPS have been delivered. However, other aspects relating to SCED and the new real-time energy and ESS market have been delayed.

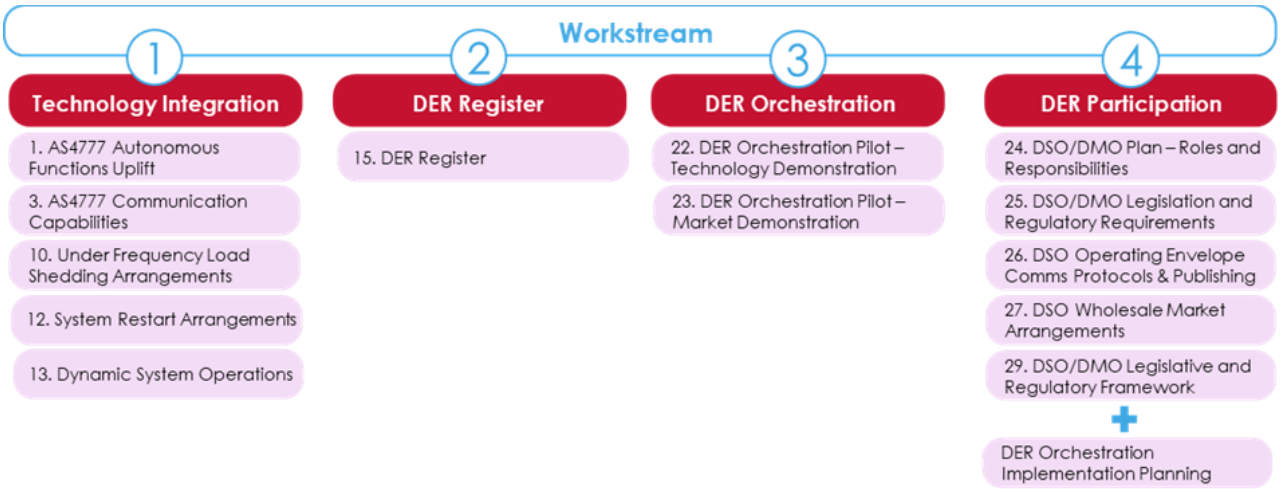
During the AR5 period, AEMO has worked in an agile way, focusing on developing the minimum viable product for each WEM Reform component while technical scope and business requirements were still being refined. AEMO has deferred costs where possible, while progressing efforts to avoid/minimise delays and has developed a revised program forecast since the initial AR5 proposal.

An overview of the difference in the AR5 and AR6 WEM Reform program forecast and discussion on each of the projects is provided in section 4.3.1.

WA DER

The WA DER program has been one of AEMO's successes in the AR5 period. The program has seen AEMO delivering against more than 14 DER Roadmap actions embedded in four projects/workstreams in response to the WA Government's DER Roadmap (see Figure 37).

Figure 37 DER Roadmap Actions requiring input from AEMO during the AR5 period



A capex estimate for delivering the WA DER program was provided as an in-period adjustment to AR5 forecast capex. In December 2020, the ERA approved a forecast of $14.6 million to deliver the program. This included proposed project and program management costs.

The ERA disallowed the specific project contingency AEMO estimated for the WA DER program. This is because in its draft decision the ERA considered the proposed contingencies *…can be accommodated within the 10% above forecast expenditure, that AEMO is able to spend before it needs to apply to the ERA for a budget uplift.*[57] The ERA maintained this position in its Final Decision.

Assuming the 10% overrun provision is available for WA DER program, this results in a total AR5 allowance of $16.1 million.

In addition to the allowances in the AR5 determination and overrun provisions in the WEM Rules, AEMO, as part of the Project Symphony consortia, has since been awarded grant funding from the Australian Renewable Energy Agency (ARENA) of up to $2.5 million.[58]

This ARENA grant has provided the additional funding necessary to enable AEMO to plan, manage and deliver its DER projects, without having to use the overrun provisions to date. With the ARENA grant AEMO was able to reduce the forecast capital expenditure required from participant fees, while ensuring the DER projects are able to be delivered within acceptable risk tolerances.

Following the approval of the in-period adjustment AEMO has rolled contingency allowances, and program support costs into each project budget. This is set out in Table 23 below.

AEMO notes however, that recent schedule changes for Project Symphony have led to a revised forecast being undertaken at the time of writing this proposal. This updated forecast was presented to stakeholders during December[59] (including the ERA), however due to the lateness of its confirmation AEMO has been unable to include it in the data for this submission. An updated forecast will be provided to the ERA ahead of the ERA's draft determination. The revised forecast currently shows AEMO is highly likely to draw down on contingency to complete Project Symphony.

[57] Page 18, ERA, Australian Energy Market Operator in-period funding submission for implementation of the Distributed Energy Resources Roadmap – Draft findings report, November 2020.

[58] AEMO notes however, that this funding comes with additional scope expectations to support the consortia and conduct knowledge sharing activities.

[59] See AEMO stakeholder forum presentation from 1 December 2021 (https://aemo.com.au/-/media/files/stakeholder_consultation/working_groups/der-program/wa-der-market-participation-forum/pack-1-dec-2021.pdf?la=en).

In addition to the Symphony forecast changes, the DER Participation project scope has also adjusted as a result of dependencies and changed priorities. Planning for this revised scope is underway and will also provide adjustments to the ERA in February 2022.

AEMO's anticipates the cost to complete the WA DER Program's completed and existing projects will be $14.1 million.

Table 23 provides a summary of AR5 performance in each WA DER project, noting the key points above.

Table 23 WA DER progress to date ($ million nominal)

Workstream	Status	Progress to date	Budget*	Actual / forecast completion cost
DER Register	Complete	DER Register delivered in full and completed on time and within budget ($989,000). The contingency allocation was not used.	1.3	1.0
Technology Integration	In-flight	Planned deliverables underway, with need to divert resources at times to ensure priority system security challenges are addressed. Some activities and tasks have been delayed by resource availability and dependencies on partners, and will be delivered within 2022-23. As a result, some spend will be incurred during AR6. The project is tracking under budget.	3.7	3.2
DER Orchestration (Project Symphony)	In-flight	Project Symphony fully scoped, developed use cases, requirements, ran procurement, implemented partnership contracts and secured ARENA contract with partners, developed AEMO platform scope of works and build commenced, test and learn strategy, partner integration designs. However, delays with partners have impacted delivery against original schedule. *Project budget excludes ARENA contribution.	8.9	7.3
DER Participation	In-flight	AEMO has provided detailed advice to EPWA to consider market integration opportunities and issues, and engaged on an ongoing basis with regards to market participation arrangements. EPWA has not held to DER Roadmap schedule creating high uncertainty. Resources and attention has diverted to design and deliver distributed PV management solution during the year.	2.2	2.7
Total			16.1	14.1

* Note the budget is based on the AR5 in-period determination + the 10% overrun provision in the WEM Rules. Program support costs are included in workstream budgets.

4.3 Forecast capital expenditure for the AR6 period

4.3.1 Capex to facilitate the Energy Transformation Strategy

As per the AR5 period, the majority (78%) of AEMO's forecast capex for the AR6 period is required to facilitate the WA Government's Energy Transformation strategy. As shown in Table 24, this expenditure comprises two key programs:

- WEM Reform
- WA DER.

Table 24 Facilitating the Energy Transformation Strategy AR6 forecast capex ($ million nominal)[60]

Program	Actual + forecast	2022-23	2023-24	2024-25	AR6 Total	Total AR5 + AR6
WEM Reform program	45.1	31.5	13.1	0.0	44.6	89.7*
WA DER program	11.9	6.8	2.6	0.0	9.4	21.3
Total	57.0	38.3	15.7	0.0	54.0	111.2

* Plus $1.5 million incurred during AR4, bringing the program total to $91.2 million.

WEM Reform program

WEM Reform is a program of work that will deliver a new real-time energy and ESS market. The WEM will move from a relatively simple wholesale market with unconstrained dispatch, to a more sophisticated market founded on a complex dispatch engine able to identify the optimal/least cost option for delivering electricity to where consumers need it to be, in any operating conditions.

The introduction of these new arrangements (which also have profound impact on the RCM) reflect the greatest change to the WEM since its commencement in 2006. The market reforms impact almost all areas of AEMO's processes, systems and procedures – with similar impacts for industry stakeholders and the interfaces and interactions between them and AEMO.

The WEM Reform program commenced late in the AR4 period and accelerated significantly through the AR5 period with the AR5 capex forecast was approved in full by the ERA. Since the original forecast was developed in early 2019, the scope has crystallised and AEMO now has a much greater understanding of the scale of changes to WEM Rules, and therefore the technical requirements of the new systems. This in turn informs what WEM Procedures and other key documentation needs to be developed, and the business and process change necessary to give effect to the reforms.

This has led AEMO, in consultation with EPWA and industry participants, to revise and recommend the commencement date of new market arrangements be deferred 12 months to 1 October 2023. The revised 1 October 2023 start date was confirmed by EPWA in September 2021. In addition to a revised WEM commencement date, AEMO has revised its cost estimate for delivering the program.

The WEM Reform Program comprises 25 individual projects in total which has supported the design of a new market and redevelopment of the WEM Rules and will update/deliver over 30 IT systems and more than 50 WEM Procedures. Twenty-one of the WEM Reform projects are being delivered during AR6. Significant progress has been made across the portfolio of work, and AEMO is confident the revised October 2023 start date is deliverable.

The forecast capital cost to complete implementation of the new market arrangements during the AR6 period is $44.6 million. Total expenditure to date is in line with the AR5 forecast, however, the expected costs to finalise the program have been revised upwards, bringing the total WEM Reform program capex (across AR4, AR5 and AR6) to $91.2 million.

The following sections discuss how the WEM Reform capex forecast has evolved since March 2019, and provides an overview of the key WEM Reform packages of work to be delivered during the AR6 period.

Evolution of the WEM Reform forecast

AEMO's AR5 allowable revenue and forecast capex proposal was submitted to the ERA in March 2019, around the same time the WA Government launched the Energy Transformation Strategy. The most critical and highest profile part of the Energy Transformation Strategy is the commencement of the new market arrangements, founded on the

[60] Capex forecasts for these Programs are based on formal 'end-of-month' data for September 2021 and generated in October 2021 to enable all relevant review and governance ahead of the initial planned submission date of 30 November 2021. As these are 'live' programs forecasts will be regularly reviewed and updated and AEMO will provide the ERA with revised data in February 2021 to inform its AR6 draft determination.

principles of constrained access and security constrained economic dispatch (SCED). Referred to as 'WEM Reform', the wholesale market requires a complete redesign, with new dispatch algorithms, methods for allocating reserve capacity, rules, procedures and a suite of IT systems all needing to be built/modified and implemented.

Given the cost of similar market reforms elsewhere ranged in cost from $70 million (New Zealand) to $200 million (IESO), it was clear WEM Reform would be the biggest cost component of the Energy Transformation Strategy. The target date for the new market start was 1 October 2022, which meant the vast majority of market design, development and implementation costs would be incurred during the AR5 period.

At the time of developing the AR5 forecast, the new market arrangements were not fully designed or scoped. The core WEM Rules that would subsequently underpin the new market had not yet been developed, and were not planned to be developed for at least 12 months. Therefore, the WEM Reform forecasts put forward in the AR5 proposal were informed by a high-level understanding of the following key policy parameters:

- Introduction of network constraints
- SCED
- 5-minute dispatch
- Real-time gate closure
- Co-optimised ESS

AEMO built out its AR5 forecast using its understanding of potential market design requirements at the time. Costs and provisional specifications were informed by market reform work undertaken to date in the NEM. A desktop view of market reform precedent elsewhere also helped inform the forecast, along with AEMO's own view of the technical requirements and limitations of its existing market and system operations systems.

As explained in AEMO's AR5 proposal:

Top-down estimation has been used to build the implementation costs given current program timing and lack of new rules and therefore detailed business requirements. Modelling is based on high-level policy design with reference to previous cost estimation carried out for the EMR, other relevant AEMO IT projects, and the experience of AEMO's Program Management team.[61]

The initial capex forecast put forward for the WEM Reform program during the AR5 period was $51.2 million. This was subsequently revised to $48.5 million in response to the ERA's AR5 draft decision, following concerns raised by the ERA on project contingency amounts. The ERA's final AR5 determination was to approve the full proposed forecast capex of $48.5 million.[62] This comprised a $39.2 million base estimate plus $9.3 million contingency.

The original AR5 forecast also included an assessment of the total cost of delivering the new market, estimated at $61 million (including $13 million contingency).

AEMO's Board approved the March 2019 AR5 proposal and with it the initial total WEM Reform forecast of $61 million. Key assumptions as of March 2019 were:

- Registration, constraint management, ancillary service and power system security and reliability (PSSR) Rules gazetted end-2019.[63]
- The new market and regulatory design completed by end Q2 2020.
- New systems to be delivered on AEMO's known WEM technology stack and delivery model (pre-digital transformation, on-premises infrastructure).

[61] Page 83, AR5 proposal, AEMO, March 2019.

[62] Page 40, Final AR5 determination, ERA, June 2019.

[63] Page 110, AR5 proposal, AEMO, March 2019.

Based on these assumptions and a decision to proceed form its Board, AEMO commenced supporting EPWA[64] with market development while building out its core team and preparing for implementation. AEMO also continued regular engagement with energy sector and market participants via the Transformation Design and Operations Working Group (TDOWG)[65] and various other forums.

Some aspects of the program such as generator performance standards (GPS) and constraints management changes progressed well. However, progress on the RCM, core SCED, settlement and registration components of new market design proved more challenging.

As part of its ongoing project governance process, in June 2020 AEMO's WEM Reform program team provided an update on the WEM Reform project to its Technical and Regulatory Committee (TARC). At this stage the Program Team noted the risks to delivery timeframes and cost estimates given growing knowledge of the scale of new market arrangements and challenges to completing the market design.

The new market design and associated WEM Rules for SCED, ESS and settlements were gazetted in December 2020. This milestone gave AEMO a first detailed scope and view of market implementation requirements.

With a market design established and the key foundational Rules in place, AEMO was able to update its assumptions and develop a revised baseline of the WEM Reform capex forecast. This baselining exercise was conducted in February and March 2021, and established an estimate of c.$80 million.

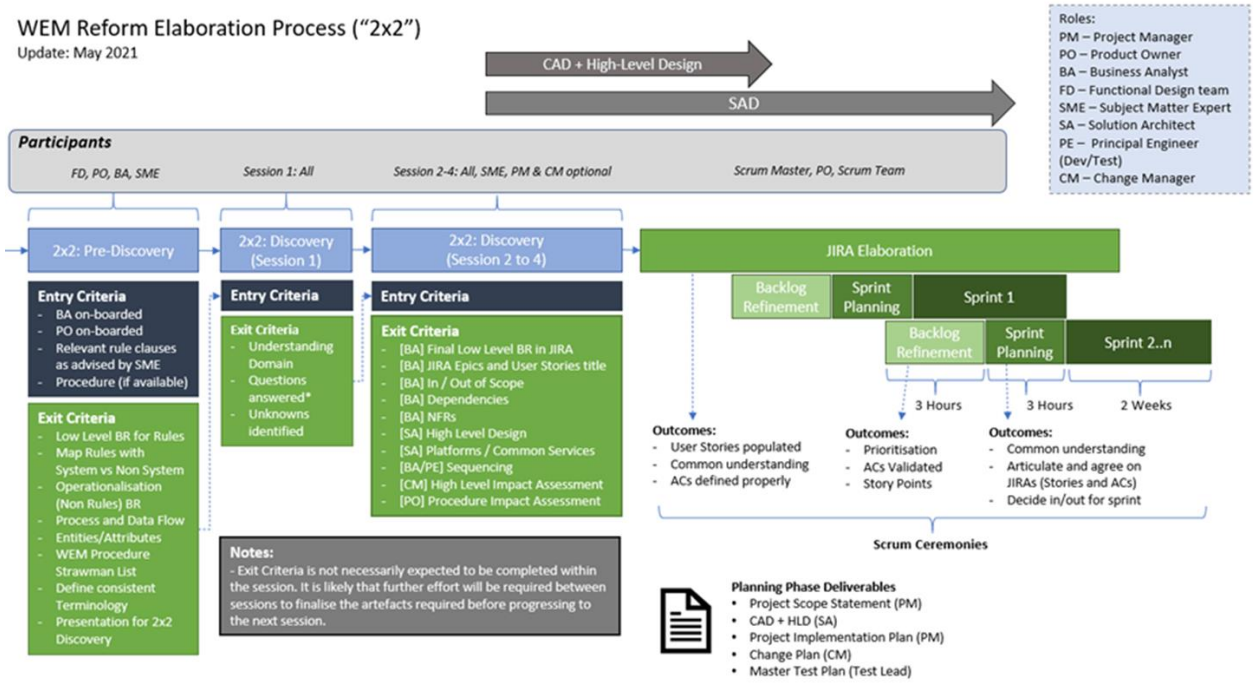
In June 2021, a further tranche of rule changes was released (Tranche 4A), which corrected errors and filled a number of gaps in the December 2020 rules. In light of this new information, along with visibility of the forthcoming Tranche 4B suite of rules, AEMO undertook a detailed rescoping and reforecasting exercise of the whole WEM Reform program.

The reforecasting exercise (summarised in Figure 38 below), took place over a 12-week period (May-July 2021) in preparation for challenge and endorsement by the AEMO Board in August 2021.

[64] The Public Utilities Office became Energy Policy WA (EPWA) with the ETS initially delivered by the Energy Transformation Taskforce and Energy Transformation implementation Unit (ETIU).

[65] Initial stakeholder engagement was via the Power Systems and Operation Working Group (PSOWG) managed by AEMO and the Market Design and Operation Working Group (MDOWG) managed by the PUO. In early 2020 ETIU and AEMO initiated the WEM Reform Implementation Group (WRIG).

Figure 38 WEM Reform program rescoping and reforecasting exercise



AC: Acceptance Criteria
CAD: Conceptual Architecture Design
HLD: High Level Design
BR: Business Requirements
SAD: Solution Architecture Design

The reforecasting process covered 14 work packages, all individually scoped and based on the new WEM Rules. Over 50 workshops were held, involving more than 70 people including business subject matter experts, project and change management experts, IT architects and principal development and test engineers. The estimates were based on an elaboration process that enabled the product vision, strawman architecture, and delivery task breakdown to be developed.

This detailed bottom-up build resulted in a revised estimate of ~$85 million, comprised of a base estimate of $72 million plus $13 million contingency. However, as per AEMO's forecasting and governance processes, it was then subjected to top-down challenge by a range of internal and external experts, and the AEMO Board.

The top-down challenge commenced with a senior manager/consultant peer review of the workplan and budget. This included a stress test exercise to ensure appropriate confidence around financial estimates and delivery risks.

The internal top-down challenge drew heavily on lessons learnt from the recent 5MS implementation in the NEM. This management challenge identified that a number of system integration and broader resource management risks had been underestimated (e.g. the need to manage departure risk of FTC resources as go-live approaches and staff look to secure their next position). Senior management advised the forecast be revised upwards from the ~$85 million base estimate and include additional contingency to ensure the program would be fully funded and deliverable by the 1 October 2023 go-live date.

The revised capex forecast submitted to (and subsequently approved by) the AEMO Board was $94.6 million.

Following changes to accounting treatment of property costs the adjusted approved total capex budget is $91.2 million. This is comprised of a $75.5 million base estimate plus $15.7 million contingency).

Table 25 provides an overview of the WEM Reform forecast evolution.

Table 25 WEM Reform forecast evolution timeline

	AR5 submission - March 2019	TARC update - June 2020	Baselining - March 2021	Timeline-Budget Revision - Aug 2021
Available scope	• Key policy parameters announced by WA Govt (e.g. SCED, 5-min dispatch) but no formal market design	• Policies in place. High level market design being developed (approx. 75% complete). WEM Rules informing the technical solution still to be gazetted.	• Market design in place and key Rules (Tranche 0-3) gazetted Dec 2020 • First full view of constraints, SCED, ESS, RCM, settlements requirements.	• Additional rules available (Tranche 4A and 4B). More detailed scope available to inform a detailed cost estimate and delivery timeframe to be developed.
Delivery status	• Program Management, Market Design and Technical Leads in place • No delivery projects initiated	• Program Leadership and Core Team in place (e.g. Architects and Development and Test Leads) • Systems - Options Assessment and Recommendations (OAR) approved • WEMDE Prototype development underway	• GPS, Constraints Management, Settlement Enhancements, RCM and RTMS in Execution with WEMDE and System Planning projects in planning • Change Management Strategy in place and WEM Reform Implementation Group initiated	• GPS and Settlements Enhancement Complete • WEMDE in execution following appointment of vendor to support technical design and build
Estimation approach	• Top-down 'IT module' approach • Relativity assessment to IMO, AEMO and international market reforms	• Work package breakdown based on early view of high level market design. • T-shirt sizing based on experience of similar WEM projects (incl. Balancing Market, Rope, PSO)	• Bottom-up-build of costs based on revised scope and first full view of business and technical requirements	• Bottom-up-build of costs based on technical and business requirements • Lessons learnt from 5MS in NEM • Detailed risk assessment • Top-down challenge on contingency
Key assumptions	• Market and rule design complete by Q2 2020	• Market and rule design delivered by revised Sep 2020 milestone • Lightweight conceptual architecture	• Final rule changes by end 2021 • Prototype and strawman solution for WEMDE	• Final rule change by end 2021 • Strawman solution design on all projects
Base estimate	$48 million	$54 million	$69 million	$75.5 million
Contingency	$13 million	$7 million[66]	$11 million	$15.7 million
Total program forecast	$61 million	$61 million	$80 million	$91.2 million[67]

[66] Significant delays to rules and implementation were not included in contingency with estimate that 6 months = $5-10m.

[67] An additional c. $2m is forecast in OPEX for Decommissioning and internal training – c. $0.5 million is included in the Total Program Forecasts for training in the earlier forecasts

Table 26 shows when the various WEM Rules changes relating to WEM Reform were (or are scheduled to be) gazetted.

Table 26 Summary of WEM Rules changes relevant to WEM Reform

Rule change tranche	Relevant WEM Reform content/topic	Gazettal
Tranche 0	Constraints management	July 2020
Tranche 1	Generator Performance Standards (GSP), Contingency Events framework, Frequency Operating Standard framework	September 2020
Tranche 2 & 3	SCED, ESS, settlements, RCM, STEM, Monitoring and Compliance framework in the WEM, Operational Planning and PASA, Outage Management and Commissioning Tests	December 2020
Tranche 4A	Amendments to Tranche 2 & 3, Registration taxonomy and Glossary items to facilitate RCM and technology participation	June 2021
Tranche 4B	Amendments to Tranche 2 & 3 Change management processes for PSSR standards, UFLS and System Restart, GPS pertaining to amendment of Droop definition, amendment to the definition of Credible Contingency Event, RCM changes pertaining to sub metering, treatment at the component level, publication obligations, treatment of net offer shortfall, additional information requirement for facility class determination, treatment of Facility Technology Types, Real Time Market Submissions refunds	September 2021
Tranche 5	Registration framework (including intermittent loads), NCESS, Market Information, Settlement amendments, RCM amendments	December 2021
Tranche 6	To be confirmed - Demand Side Program Outage/refunds and Dispatch treatment, Standing Data, STEM submissions, amendments to facilitate DER Roadmap deliverables, addressing minor amendments such as typographical errors	TBC in 2022

AEMO has continued working through the market design process, and engaging with EPWA to help develop an efficient market design solution. AEMO has provided informal options analysis and cost expertise to EPWA, which in turn has guided several design decisions towards the overall lowest implementation cost. This revised forecast reflects these design decisions to date.

It is important to highlight that the higher-than-forecast costs for implementing the new market are not specifically driven by the 12-month deferral. Rather, the 12-month deferral is a consequence of the greater understanding of the scope and effort required to deliver the new arrangements.

While AEMO will incur some additional project management costs as a result of the 12-month deferral, the time extension is not a material contributor to the revised forecast. The original $61 million estimate would have been revised upwards even if the 1 October 2022 start date had been retained.

Contingency assumptions

The original scope and complexity of the program was underestimated. The original $61 million forecast did not appropriately reflect the cost of uncertainty and risk. In the AR5 forecast AEMO noted it had not included any 'management reserve' in its contingency estimates[68] and on reflection believes this led to an overly optimistic total forecast for WEM Reform given the limited detail on policy and implementation requirements at the time.

AEMO has learnt from this experience and has placed greater focus on ensuring the contingency amounts in the revised forecast more accurately reflect project risk.

The forecast capex for the WEM Reform program in AR6 is $33.2 million + $11.4 million contingency (34%).

[68] AEMO Response to ERA AR5 Draft Determination, page 7.

This contingency amount has been estimated using AEMO's revised contingency calculation method described in section 1.6.6. The WEM Reform projects that are in-flight use the 'mixed' method to estimating contingency and projects yet to start use the 'fixed' method.[69]

The contingency amount is required to accommodate following key delivery risks:

- Resourcing risks reflected in contingency as increased labour rates above base estimates (e.g. competitive market, retention risk particularly as the program draws close to go-live and contractors look for their next jobs).
- Scope risks related to outstanding market design and rules (and risks that issues will be found through implementation) - reflected as additional resourcing costs
- Business and market readiness activities for both AEMO and industry participants, including both interdependencies (e.g. transition of Synergy fleet operations) and uncontrollable activities (e.g. individual commercial decisions and system changes for independent power producers).
- Technical complexity and challenges associated with bespoke IT systems (e.g. SCED engine and Network Access Quantity model) - reflected as additional resourcing costs.

The contingency assumptions draw on experience from recent transformational projects such as PSO and SMST, and most significantly, implementing 5MS in the NEM. Implementation of 5MS in the NEM delivered system changes of a comparable scale to the WEM Reform project, and relied heavily on detailed design inputs from third parties and development of bespoke IT systems. Many of the risks outlined in the above bullet points arose in the 5MS project.

While AEMO is applying many of the lessons learnt from 5MS in order to try to avoid these risks occurring, AEMO considers it prudent to include sufficient contingency in the forecast to accommodate a similar degree of risk. This will help ensure AEMO can deliver the new market in the agreed timeframes and to a quality desired by participants.

AEMO's intent is to not spend project contingency where possible. Ongoing reporting is provided to senior management on WEM Reform progress, and the program must seek Steering Committee approval for any draw down of contingency amounts.

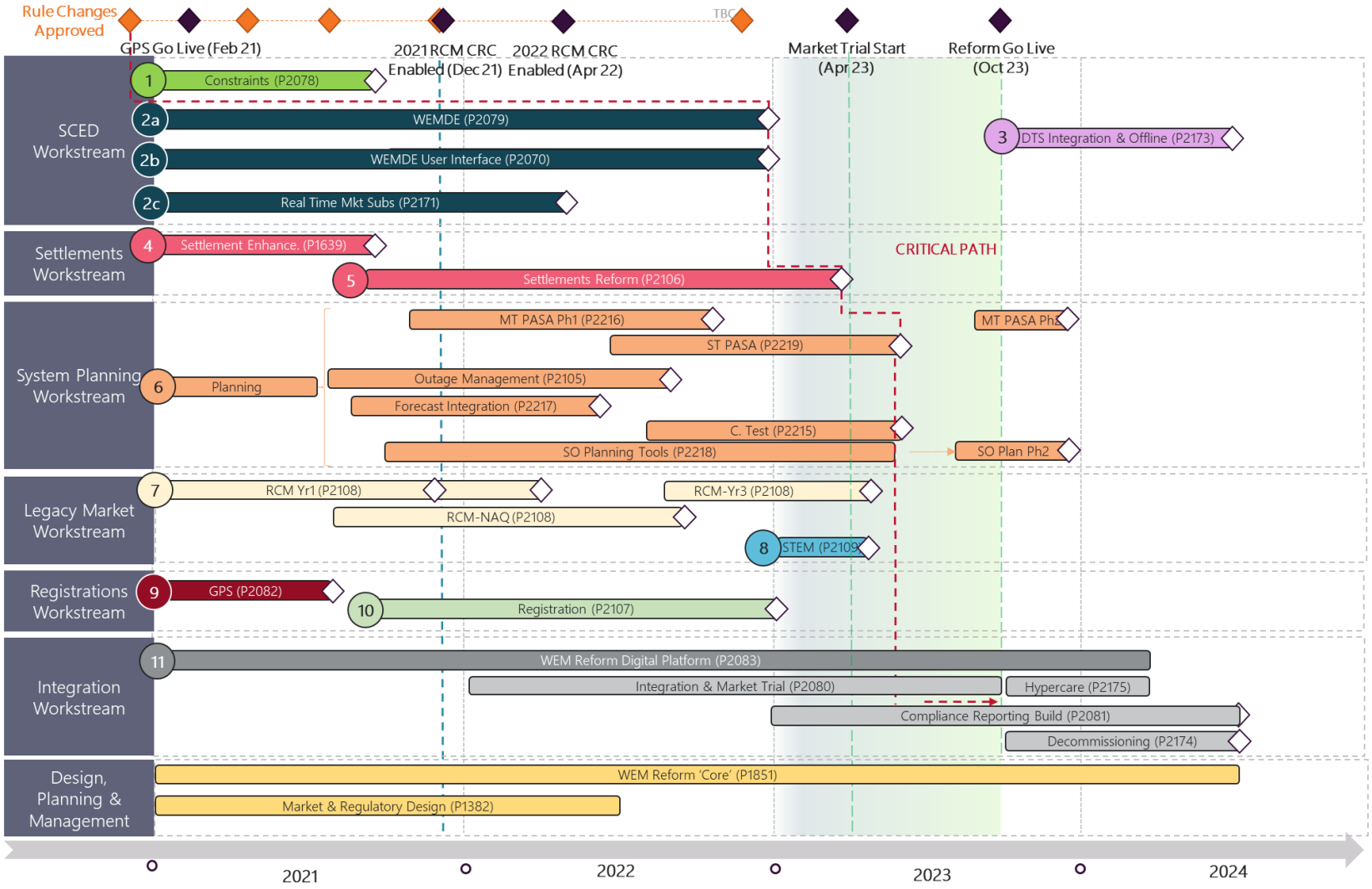
As a further control, the CEO & Managing Director will withhold c. 30% of the proposed contingency, meaning this amount cannot be released without detailed justification, consideration of options to avoid contingency, and express permission from him.

WEM Reform program forecasts by workstream

The WEM Reform program for the AR6 period will deliver 25 projects across seven workstreams. These workstreams are presented in Figure 39.

[69] The STEM Project contingency reflects current uncertainty over Rule requirements with core estimate based on a less complex implementation. This would require further Rule Changes however and the contingency reflects additional cost of full implementation to current Rule requirements.

Figure 39 WEM Reform program workstreams and high level timeline



AEMO estimates it will cost $44.6 million to complete the WEM Reform program during the AR6 period. This includes some costs post the 1 October 2023 go-live to ensure full system integration.

WEM Reform capex is primarily made up of labour resources (both employees and contractors) required to:

- Develop, test and manage IT systems
- Development of modified/new WEM Procedures
- Plan and implement changes to business processes, including education and training (both within AEMO and across the industry) and internal procedures and documentation
- Plan and implement robust Market Trial of end-to-end processes.

Table 27 presents the WEM Reform forecast capex by workstream and enabling project.

Table 27 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

More information on what each workstream will deliver is provided in the following sections.

SCED

AEMO is required to develop new market and dispatch systems and processes to introduce security constrained economic dispatch of generation in the SWIS. These requirements are primarily delivered through the SCED workstream which consists of five projects that to enable:

- Market Participants to submit new real time submissions for energy and ESS.
- AEMO to manage and disseminate information on network constraints.
- AEMO to dispatch energy and ESS on a five-minute basis.
- AEMO controllers to visualise and interact with key operational systems in real-time.
- AEMO to train staff and undertake simulation and what-if analysis.

AEMO has worked with Western Power to develop thermal and non-thermal constraint equations, which aim to portray the security constraints or physical limitations in the Western Power Network. This library of constraint equations is used as inputs into the dispatch algorithm to enable the security constrained aspect of the new market arrangements.

The current dispatch algorithm is not capable of accounting for network constraints. While some generators have been connected under constrained access contracts, these facilities have been constrained outside the market

arrangements. The new market design requires a dispatch engine capable of accounting for network constraints in its solution of the least-cost dispatch solution.

The new market arrangements will also require the dispatch algorithm to co-optimise energy and ESS. This will determine the overall least cost solution to meet demand for electricity while maintaining system security through ESS. To implement a security constrained, co-optimised market design, AEMO is adapting the dispatch algorithm and some of the core logic used in the NEM (as well as lessons learnt) for use in the WEM.

This project also includes development and testing of interfaces between the new dispatch algorithm and other systems including for example the energy management system (e-terra), the outage management system and settlement system, as well as the creation of user interfaces and development of new data publication capabilities.

Training and education in the operation of the new systems and processes is fundamental to the success of the implementation of SCED. This project will not only introduce these new ways of working in real-time systems, but will also include parallel changes to the dispatch training simulator, and the development of an off-line version of WEMDE to provide analysis capability and to support industry in investment planning (in particular for Western Power and EPWA).

During the current period, AEMO has completed the works required to develop the constraint library. AEMO has commenced work on the dispatch algorithm and associated interfaces with completion of these critical path systems forming a large part of the work to be undertaken in the next three years.

Over the AR6 period, AEMO forecasts it will spend $6.6 million (including contingency) to deliver a new security constrained, optimised energy and ESS market as shown in Table 28.

Table 28 WEM Reform – SCED workstream projects AR6 forecast capex ($ million nominal)

SCED	2022-23	2023-24	2024-25	AR6 total
AEMO - P2078 - Constraint Management	0.0	0.0	-	0.0
AEMO - P2079 - WEM Dispatch Engine	1.8	0.0	-	1.8
AEMO - P2170 - WEMDE User Interface	2.6	0.0	-	2.6
AEMO - P2171 - Real Time Market Submissions (RTMS)	0.0	0.0	-	0.0
AEMO - P2173 - DTS Integration & SCED Offline Tools	0.4	1.7	-	2.1
SCED total	4.8	1.8	-	6.6

This forecast has been developed as a specific set of project estimates based on known requirements at July 2021, and built out through the elaboration processes. The forecast for RTMS and WEMDE has also been market tested as AEMO undertook competitive market tender processes to select the delivery partners for these projects.

Table 29 summarises the status of the SCED projects and how AEMO will aim to achieve the lowest practicably sustainable cost of delivering the work.

Table 29 Summary of SCED workstream project status

Project	Status	Solution approach	Resourcing approach	Other options considered	How AEMO will achieve the lowest practicably sustainable cost	Risk/interdependencies
P2078 - Constraint Management	Complete	Build	AEMO	Adopt NEM approach	• In house build supports operational knowledge and reduces handover effort and support risks. • NEM approach was discounted as technology and tools no longer on strategic roadmap (note that WEM system may potentially be adapted for future NEM purposes).	• The constraints management tool is a critical dependency for the WEM Dispatch Engine and therefore SCED operations – secure operation of the power system. • The Congestion Information Resource is an important tool both for AMEO's operational purposes and for industry participants supporting operational and investment planning – which drives efficient operation of the market.
P2079 - WEM Dispatch Engine	Execution	Build & partial re-purpose of NEM systems	AEMO & Vendor	Buy vendor product – RFP undertaken in Q2 2021	• The WEMDE is built following the development of a prototype engine than proved the core elements of the market design. • While not a full re-purpose of NEM systems the WEMDE utilises the same linear solver engine and shares many elements of the NEMDE architecture (and lessons learned through 20+ years of its operation). • AEMO ran a Request for Proposal in Q2 2021 and assessed options to augment AEMO team and build a new solution as well as buying and customising a vendor product. AEMO proceeded with a build option and chose an experienced vendor with international dispatch engine experience based on a total cost of ownership and risk assessment.	• The WEMDE replaces the current Real Time Dispatch Engine and is the integral solution to enabling the new real time market and co-optimisation of ESS. • There are multiple input dependencies and projects for WEMDE including Constraints, Registration, RCM, RTMS and Outages. As well as integration with AEMOs existing Energy Management System (GE e-terra) for SCADA and dispatch and security functionality. • WEMDE is also a key dependent system for other projects including WEMDE UI, ST & MT PASA, STEM and Settlements.
P2170 - WEMDE User Interface	Planning	Build & re-use	AEMO & Vendor (TBC)	Re-purpose NEM systems	• WEMDE-UI will be built based on the AEMO Digital Portal platform and will be the primary visualisation and control mechanism for WEMDE. • NEM Systems were discounted due to amount of customisation necessary to support the WEM,	• WEMDE-UI is a critical project enabling Power system Controllers to continue their 24/7 real time operation of the Power System. • It provides both visualisation and control of the dispatch engine, monitoring of dispatch compliance and B2B interfaces to Market Participants.

Project	Status	Solution approach	Resourcing approach	Other options considered	How AEMO will achieve the lowest practicably sustainable cost	Risk/interdependencies
					coupled with the fact that the technology and tools are no longer on strategic roadmap. • Where possible AEMO is also utilising and revising existing systems (e.g. newly implemented e-terra EMS and AEMO's public Market Pulse website).	• It is both closely linked to and dependent on the WEMDE Project.
P2171 - Real Time Market Submissions (RTMS)	Execution	Build	AEMO & Vendor	Nil – bespoke system requirements based on new market design	• AEMO ran an RFP in Q1 2021 and chose a technical delivery partner based on value for money criteria • Augmented team with both AEMO and vendor resources also enables efficient operational knowledge and reduces handover effort and support risks.	• Submissions received by the RTMS from Market Participants are an integral input into the WEMDE. • The RTMS project is also a key tool for Market Participants, Coordinator and ERA as it will provide validation and notification of submissions as well as providing access to historical information (e.g. for compliance purposes). • There primary input dependency for RTMS is the Registration project.
P2173 - Dispatcher Training Simulator (DTS) Integration & SCED Offline Tools	Initiation	Build	AEMO (TBC)	Re-purpose NEM Systems	• Extensions of WEMDE, WEMDE-UI and supporting interfaces into the simulation environment to support ongoing Power System Controller training and accreditation.	• This project is dependent on all of the other supporting systems being delivered (e.g. WEMDE, WEMDE-UI) such that they can be deployed into the simulation environment and interfaced with the Dispatcher Training Simulator (DTS) component of the GE EMS (e-terra).

Settlements reform

During the current period, AEMO replaced its two existing settlement systems (POMAX Settlements and RCM Settlements) with a single in-house prudential and settlement system by adapting the existing prudential calculation engine. The driver for this project is the end of maintenance support for the POMAX Settlements system, which was due to occur at the end of 2020[70].

Only the STEM and RCM market components will be retained under the new market arrangements. This drives the need for the settlement system (including prudentials) to be updated to reflect the new calculations and timelines for all settlement processes. In particular this project will provide for changes to reporting requirements, increased frequency of settlements and invoice aggregation required under the new market arrangements.

As part of this project, AEMO will also make updates to the invoicing application to allow for the use of settlement data under both the current and new market arrangements until 1 October 2024 to account for up to 12 months of settlement adjustments. As the settlement system is being modified AEMO will look to introduce an archival strategy for historical settlement data and modernise the metering verification tools to improve settlement data integrity.

This project includes costs associated with the independent certification of the calculation formulation documentation and all calculations within the new prudential and settlement system.

Over the AR6 period, AEMO forecasts it will spend $2.7 million (including contingency) to deliver a new prudential and settlement system as shown in Table 30.

Table 30 WEM Reform – Settlements workstream projects AR6 forecast capex ($ million nominal)

Settlements	2022-23	2023-24	2024-25	AR6 total
AEMO - P1639 - Settlements Enhancements	-	-	-	-
AEMO - P2106 - Settlements Reform	2.7	0.0	-	2.7
Settlements total	2.7	0.0	-	2.7

Forecasting for Settlements Reform has benefitted from the ability to compare and contrast with the scale and complexity of the recently completed Reduction of Prudential Exposure (RoPE) and Settlement Enhancement projects. While it is not direct like-for-like development, AEMO has been able to draw on the knowledge of the technical, business and consultant SMEs involved in those projects to build confidence in estimates – and will equally draw on these resources for implementation.

Table 31 summarises the status of the Settlements workstream projects and how AEMO will aim to achieve the lowest practicably sustainable cost of delivering the work.

[70] A limited support contract extension has bene struck with Brady to support POMAX through to mid-2022 to provide contingent support for the conclusion of the 12-month settlement cycle.

Table 31 Summary of Settlements workstream project status

Project	Status	Solution approach	Resourcing approach	Other options considered	How AEMO will achieve the lowest practicably sustainable cost	Risk/interdependencies
P1639 - Settlements Enhancements	Complete	Re-purpose	AEMO & Vendor	Buy (note this project was submitted and approved as a standalone AR5 project)	• AEMO's solution minimised risk and cost by building on the core systems developed in the Reduction of Prudential Exposure projects providing AEMO with a single suite of Prudential and Settlements Systems (PaSS). • AEMO was able to utilise skills and knowledge built up over that project for development while minimising changes for operational teams (e.g. known technical and functional capabilities). • AEMO ran an RFP in Qct 2020 and chose a technical delivery partner based on value for money criteria.	• As noted, this project was conducted as vendor support was being withdrawn for the previous settlement product. • This project is a key precursor project for the Settlements Reform.
P2106 - Settlements Reform	Planning	Re-use	AEMO & Vendor	Nil	• As above Settlements Enhancements was undertaken with explicit view that the PaSS would be used for Reform – as such, AEMO continues to be able to leverage knowledge, skills and recent experience to scope and deliver project • This approach also provides a longer economic life for the underlying solution and initial assessment of WEM 5MS includes an option for the continued use of the PaSS (with modifications).	• Settlements is a critical regulatory and business operation, and the PaSS is an integral downstream solution that receives data (and is therefore dependent on) many other WEM Reform projects including WEMDE, RCM and Outage Management.

System planning

The underlying methodology and principles for forecasting risks to power system security and reliability in a security constrained network are fundamentally different to those in an unconstrained network. Accordingly, AEMO will need to develop fit-for-purpose planning tools.

Planning across pre-dispatch, the short term and the medium term will need to be amended to ensure power system security and reliability can be maintained. AEMO will need to replace the existing PASA toolset with a new power system model to leverage the new dispatch algorithm to analyse different potential dispatch outcomes over a variety of horizons up to three years. It will provide scenario analysis based on the most up to date market offers and different inputs (forecasts, outages, etc), with processing capability to identify risks to power system security and reliability.

This project also includes changes to forecasting and planning tools used for system planning functions to accommodate the new market arrangements, and new tools designed to improve planning capabilities (such as allowing the transfer of dispatch outcomes to offline security packages, and the collection and use of high-speed monitoring data).

Legacy systems for commissioning and testing, and outage management functions were transferred from Western Power to AEMO largely untouched with a view to their replacement through WEM Reform. This project will see the development of two new systems to suit the new more dynamic SCED environment, integrate new planning tools and processes, and improve transparency of planning information.

Over the AR6 period, AEMO forecasts it will spend $5.1 million (including contingency) to develop new planning and forecasting tools required to ensure system adequacy under the new market arrangements as shown in Table 32.

Table 32 WEM Reform – System planning workstream projects AR6 forecast capex ($ million nominal)

System planning	2022-23	2023-24	2024-25	AR6 total
AEMO - P2105 - Outage Management Reform	0.1	0.0	-	0.1
AEMO - P2215 - Commissioning Tests Reform	1.5	0.0	-	1.5
AEMO - P2216 - MT PASA Reform	1.0	0.0	-	1.0
AEMO - P2217 - Forecast Integration	0.1	0.0	-	0.1
AEMO - P2218 - System Operation Planning Tools Reform	0.7	0.2	-	0.9
AEMO - P2219 - ST PASA	1.5	0.0	-	1.5
System planning total	4.9	0.2	-	5.1

These forecasts have been developed as a specific project estimates based on known requirements at July 2021, and built out through elaboration processes. Where relevant (e.g. MT PASA) the forecast for these projects have also been tested against similar projects undertaken in the NEM.

Table 33 summarises the status of the System Planning workstream projects and how AEMO will aim to achieve the lowest practicably sustainable cost of delivering the work.

Table 33 Summary of System Planning workstream project status

Project	Status	Solution approach	Resourcing approach	Other options considered	How AEMO will achieve the lowest practicably sustainable cost	Risk/interdependencies
P2105 - Outage Management Reform	Execution	Build	AEMO	Re-purpose WEM Systems	• Outage Management will be built based on the AEMO Digital Portal platform and will be the primary entry point, visualisation and process flow mechanism for both Market Participant and Network Operator Outages. • Existing WEM Systems were discounted due to amount of customisation necessary to support the new market design, coupled with the fact that the technology and tools are no longer on strategic roadmap.	• Input dependencies for this project are Registration, RCM and Constraints. • Outage Management is also a key dependent system for other projects including WEMDE, WEMDE UI, ST & MT PASA, RCM, STEM and Settlements.
P2215 - Commissioning Tests Reform	Initiation	Build (using existing AEMO systems)	TBC	Re-purpose WEM Systems	• Commissioning Test Plan will be built based on the AEMO Digital Portal platform and will be the primary entry point, visualisation and process flow mechanism for Market Participant Commissioning Test Plans. • Existing WEM Systems were discounted due to the fact that the technology and tools are no longer on strategic roadmap and therefore result in higher on-going costs.	• Input dependencies for this project are Registration and Outages. • Commissioning Test Management is also a key dependent system for other projects including WEMDE-UI, ST & MT PASA, RCM, STEM and Settlements.
P2216 - MT PASA Reform	Planning	Build & Buy	AEMO (Integration) & Vendor (SaaS)	Re-purpose WEM Systems	• AEMO intends to progress with a PLEXOS model utilising NEM knowledge and leveraging the licensing model already in place with our external vendor. • AEMO will build the interfaces necessary to feed the PLEXOS model and process the output data. Where possible AEMO will utilise the native PLEXOS user interface, however some user interface development will be required to manage the inputs and visualise the processed data. • Existing WEM Systems were discounted due to the fact that they were fundamentally incapable of being extended to support new market requirements, and in addition the technology and tools are no longer on strategic roadmap.	• There are multiple input dependencies and projects for MT PASA including Constraints, Registration, Forecast Integration, and Outages.

Project	Status	Solution approach	Resourcing approach	Other options considered	How AEMO will achieve the lowest practicably sustainable cost	Risk/interdependencies
P2217 - Forecast Integration	Planning	Re-purpose WEM Systems	TBC	Nil	• AEMO will utilise existing forecast systems and build new interfaces to new market systems for provision of forecast data. • This project will also incorporate a software upgrade to the latest supported version of the forecasting software to ensure ongoing supportability and leverage new API capability for interface build.	• Forecast Integration is also a key dependent system for other projects including WEMDE, WEMDE UI and ST & MT PASA.
P2218 - System Operation Planning Tools Reform	Initiation	Build	TBC	Nil	• This project is primarily focussed on delivering WEM Procedures and supporting processes required to support new obligations in under the reformed market (e.g. new System Restart obligations). • It will also develop minor tools to extract data from new market systems (as such a Build option was only viable approach) in a format capable of being imported into existing power system security assessment tools such as the EMS (e-terra) and DiGSILENT modelling tools.	• This project is dependent on WEMDE, WEMDE UI and the ST & MT PASA systems being developed in order to leverage the data produced.
P2219 - ST PASA	Initiation	Build	TBC	Re-purpose WEM Systems	• AEMO will leverage the systems delivered as part of the WEMDE and WEMDE-UI projects, and extend these to cover ST PASA analysis. • Existing WEM Systems were discounted due to the fact that they were fundamentally incapable of being extended to support new market requirements, and in addition the technology and tools are no longer on strategic roadmap.	• This project is dependent on the WEMDE and WEMDE UI projects and also several input dependencies including Constraints, Registration, Forecast Integration, and Outages.

Legacy markets

While the underlying RCM and STEM mechanisms are not being replaced under the new market arrangements, the system and processes will need to be amended to align with initiatives in other areas of the WEM – primarily to account for SCED. For RCM this requires substantial change particularly as the WEM moves from an unconstrained to constrained network access model.

The legacy markets project will modify:

- RCM systems and processes to account for the new registration framework (i.e. new facility classes and technology types – in particular improving arrangements for storage facilities).
- RCM systems and processes to allow AEMO to consider the impact of network constraints through the certification process (the Network Access Quantities - NAQ). The reforms to the RCM allow for this assessment to occur in a constrained network context (NAQ assessment).
- STEM systems and processes to account for the new market arrangements in relation to the calculation of participants' contractual positions ahead of the trading interval, and for settlement calculations.
- STEM systems to remove its reliance upon a legacy scheduling application.

Over the AR6 period, AEMO forecasts it will spend $4.1 million (including contingency) to make changes and build the new congestion model to support the new market arrangements as shown in Table 34.

Table 34 WEM Reform – Legacy markets workstream projects AR6 forecast capex ($ million nominal)

Legacy markets	2022-23	2023-24	2024-25	AR6 total
AEMO - P2108 - RCM Reform	3.4	0.0	-	3.4
AEMO - P2109 - STEM Reform	0.6	0.6	-	1.2
Legacy markets total	4.1	0.6	-	4.6

These forecasts have been developed as a specific project estimates based on known requirements at July 2021, and built out through elaboration processes.

Table 35 summarises the status of the Legacy markets workstream projects and how AEMO will aim to achieve the lowest practicably sustainable cost of delivering the work.

Table 35 Summary of Legacy markets workstream project status

Project	Status	Solution Approach	Resourcing Approach	Other options considered	How AEMO will achieve the lowest practicably sustainable cost	Risk/interdependencies
P2108 - RCM Reform	Phase 1 Execution Phase 2 Planning Phase 3 Initiation	Re-use and Build	AEMO & Vendor	Buy (for Phase 2 NAQ model)	• The RCM is a bespoke market mechanism and AEMO (previously IMO) have continued to invest in internal systems to meet requirements (including the RCM Pricing Project which concluded in Sep 21) – this prolongs life and ensures maximum value from previous system modifications. • For RCM Phase 1 (supporting registration and Relevant Level changes for the 2021 Cycle) AEMO ran an RFP in Jan 2021 and chose a technical delivery partner based on value for money criteria. • For RCM Phase 2 (changes for the 2022 Cycle) AEMO intends to build the Network Access Quantity (NAQ) model as the design is bespoke to the WEM – AEMO plans to use an augmented team with specialist internal and external development resources. • Initial NAQ model release to enable current 2022 Cycle timelines to be maintained will include some manual operations which will be automated following initial successful operation to reduce operational risk and labour in subsequent Reserve Capacity Cycles. For RCM Phase 3 (Year 3 changes to Reserve Capacity Testing and Reserve Capacity Obligation Quantities) AEMO intends to modify existing systems.	• The RCM is a critical component of the WEM design and integral to ensuring the reliability of the SWIS. • AEMO has obligations which commence in 2021 and 2022 (as per published timeframes[71]) and must commence implementation as early as possible to enable operation of the 2021 and 2022 Reserve Capacity Cycles and provide requisite investment (and operational planning) certainty. • There are interdependencies between RCM solutions and a number of other critical systems/projects including WEMDE, STEM, Settlements and Outage Management. • A key input dependency for this project is Registration, Settlement, Outage Management, Commissioning Test and Constraint Management.
P2109 - STEM Reform	Initiation	Re-use	TBC	Nil	• AEMO's STEM auction system was upgraded to a modern code base in the AR5 period and was an 'approved' WEM Reform precursor project in the AR5 determination. • The STEM is a bespoke market mechanism in the WEM and with only consequential changes (as opposed to reforms) for this element of the market amendments to the existing minimise total cost (e.g. known technical and functional elements for ongoing operations). • AEMO has worked with EPWA to reduce the implementation risk to STEM and other projects by reducing complexity and interdependency through revision to the proposed rules.	• The STEM is a critical component of the WEM design and integral to managing commercial risk and supporting market efficiency. • There are interdependencies between the STEM solution and the Settlement system. • Key input dependencies for this project are Registration, RCM, WEMDE and Outages.

[71] At https://aemo.com.au/-/media/files/electricity/wem/reserve_capacity_mechanism/timetable/2021-and-2022-reserve-capacity-timetables.pdf.

Registrations

The WEM registration system caters for the current participant and facility classes. Through the WEM Reform program, a new registration taxonomy is being implemented. This project will make the necessary changes to the registration system to support the new taxonomy, including but not limited to modifications to the registration portal, registration form management functionality and processes, standing data, and reporting functionality.

Over the AR6 period, AEMO forecasts it will spend $1.3 million (including contingency) to make minor changes to the registration systems to support the new facility and participant classes as shown in Table 36.

Table 36 WEM Reform – Registrations workstream projects AR6 forecast capex ($ million nominal)

Registrations	2022-23	2023-24	2024-25	AR6 total
AEMO - P2082 - Generator Performance Standards (GPS)	-	-	-	-
AEMO - P2107 - Registrations Reform	1.3	0.0	-	1.3
Registrations total	1.3	0.0	-	1.3

This forecast has been developed as a specific project estimate based on known requirements at July 2021, and built out through elaboration processes.

Table 37 summarises the status of the Registrations workstream projects and how AEMO will aim to achieve the lowest practicably sustainable cost of delivering the work.

Table 37 Summary of Registrations workstream project status

Project	Status	Solution approach	Resourcing approach	Other options considered	How AEMO will achieve the lowest practicably sustainable cost	Risk/interdependencies
P2082 - Generator Performance Standards (GPS)	Complete	Build	AEMO	Adopt NEM approach	• In house build supports operational knowledge and reduces handover effort and support risks. • NEM approach was discounted as technology and tools no longer on strategic roadmap and design driven by specific WEM Rule obligations and WA functionality (note that WEM system may potentially be adapted for future NEM purposes) • 'Standard' SharePoint functionality used where appropriate (e.g. submission of Generator Modification Plans) to minimise scope/cost • While manual operations were enacted from 'early Go Live of obligation in Feb 2021 this was only possible and efficient while initial submission numbers and data volumes were very low – systems required for efficient operations (e.g. reducing need for additional operational labour) on enduring basis and went live in July 2021.	• The GPS solution is essentially 'standalone' however key driver for project were early obligations.
P2107 - Registrations Reform	Planning	Re-purpose WEM Systems	TBC	Build	• In-house build was discounted in favour of repurposing existing WEM Registration system as the implementation and timeline risk is decreased by using operational knowledge and support for the existing system. • By using a façade to integrate with other projects, the foundation of the WEM Registration can be updated to newer technologies in the future to reduce operational support risks.	• Registration is the key dependent system for other projects including WEMDE, RTMS, ST & MT PASA, RCM, GPS, Commissioning Test, Outages, STEM and Settlements to obtain information about Participants and Facilities.

Integration

This workstream incorporates five discrete projects that together enable the implementation of the WEM Reform program overall:

- Integration and Market Trial – This project included costs associated with market trial activities and the final solution integration activities. The market trial component includes change management, stakeholder engagement, training and issues resolution.
- Compliance Reporting – This project delivers capability to gather and report on monitoring operational compliance from AEMO and participants with particular focus on meeting the market effectiveness and market monitoring requirements of EPWA And the ERA respectively.
- Decommissioning – This project involves decommissioning all redundant systems and applications, and the storage and management of historical data.
- Hypercare and Support – This project is the support of operational teams in the 6-month period post Go Live and includes the costs associated with identifying, triaging and remediating post-go live defects; costs for updating operating and WEM Procedures as necessary; and costs for supporting EPWA in any immediate rule modification.
- Digital Platform – This project will see the implementation of standard system environments and methods (including for example for deployment, data storage and management, integration and data visualisation). It also includes software, infrastructure, testing and cloud costs directly attributable to enabling WEM Reform projects.

Over the AR6 period, AEMO forecasts it will spend $16.1 million (including contingency) to enable the delivery and integration of the WEM reform program as shown in Table 38.

Table 38 WEM Reform – Integration workstream projects AR6 forecast capex ($million nominal)

Integration	2022-23	2023-24	2024-25	AR6 total
AEMO - P2080 - Integration and Market Trial	3.0	2.1	-	5.1
AEMO - P2081 - Compliance Reporting	0.8	1.8	-	2.6
AEMO- P2174 - Decommissioning	-	-	-	-
AEMO - P2175 - Hypercare and Support	0.0	2.0	-	2.0
AEMO - P2083 - Digital Platform	4.6	1.8	-	6.4
Integration total	8.5	7.7	-	16.1

These Digital Platform forecasts have been developed as a specific project estimate based on known requirements at July 2021, and built out through elaboration processes. While revised estimates for the remaining projects were also developed in preparation for August Board approval, requirements and approach were/are still in early stages of consideration and as such these projects were estimated top down based on relative assumptions of effort and timeframes.

Table 39 summarises the status of the Integration workstream projects and how AEMO will aim to achieve the lowest practicably sustainable cost of delivering the work.

Table 39 Summary of Integration workstream project status

Project	Status	Solution approach	Resourcing approach	Other options considered	How AEMO will achieve the lowest practicably sustainable cost	Risk/interdependencies
P2080 – Integration & Market Trial	Initiation	Build	AEMO & Vendor(s)	Nil	• Leveraging industry standard integration tools. Leverage existing tools for participants market trial purpose to run test cases, data, environment access and issue, query and collaboration tools (PractiTest/SharePoint/JIRA). • Build continuous SIT in projects for those that have commenced prior to this project, then handle any integrations with a dedicated focussed team within this project.	• Availability of resources (integration architecture, data architecture, technical development) as well as live data for trial purposes. • Completion of SIT in preceding projects.
P2081 – Compliance Reporting	Initiation	Build (TBC)	AEMO (TBC)	Re-purpose	• Major data from WEM applications will be collected at Enterprise Data Platform (EDP) which will facilitate compliance monitoring and notifications via reporting capability using data science tools.	• Dependency is on individual projects and EDP to collaborate the data and make available.
P2083 – Digital Platform	Execution	Re-purpose, Build & Buy	AEMO & Vendor(s)	Nil	• Overall, WEM Reform architectural approach has been developed in line with AEMO's company-wide technology roadmap and amended where relevant for WEM specific requirements and/or time requirements – this enables AEMO WA to leverage NEM resources and expertise and benefit from longer term operating and support efficiencies • Where WEM Reform has had to uplift current application designs (e.g. RabbitMQ , ELK) AEMO has conducted RFPs to choose a technical delivery partner based on value for money criteria • AEMO has developed a panel of external providers to augment internal resources (e.g. DevOps, Cloud Design) and to meet peak resource demands (e.g. as opposed to Permanent or FTC recruitment) • WEM Reform initiated an AEMO-wide procurement process to establish a cyber panel that has delivered significant cost efficiencies for specialist resources and PEN Testing services • Reviewed and revised current cloud infrastructure implementation to promote better cost control by exploring and implementing shared infrastructure options (e.g. Elastic SQL Pools, Shared AKS Clusters)	• All of the WEM Reform implementation projects are dependent on the Digital Platform project to provide development patterns; technical support; environment and release management; on—premise infrastructure design and delivery. • This is the digital enablement arm for WEM Reform where common services are developed and consumed. • This project has dependencies on AEMO's corporate digital uplift program including introduction of strategic EDP, AEMO Portal, IDAM, APIM, Boomi
P2175 – Hypercare & Support	Initiation	N/A	AEMO	N/A	• AEMO will utilise existing team members, tools and process within the markets and operations teams to log, triage and support participants support calls to appropriate service levels.	• This support activity is critical to ensuring the safe and secure transition of the power system and market operations from the existing arrangements. AEMO must be resourced to quickly respond to system and/or process issues that arise post Go Live.

Design, planning and management

The WEM Reform Program is underpinned by a design, planning and management workstream. The design planning and management workstream comprises three projects; WEM Reform core; Market and regulatory design; and Technical and process design. The latter two projects are substantively complete, and will only incur minor costs during the AR6 period. The WEM Reform core project continues for the duration of the project, and is the key enabler of the whole program.

The design planning and management projects are summarised as follows:

- WEM Reform Core – this is the core program management and assurance function, providing leadership, direction and oversight across all other workstreams. Resources in this project cover program management and controls (e.g. Senior Program Manager and Program Management Office), program leadership (e.g. Business Leads, Architecture Lead), and cross-program resources including the principal developer and tester, a market readiness advisor and training advisor.

  The WEM Reform core program also captures costs such as external program assurance, recruitment placement fees, development of the WEM Rules obligation map, training development costs and travel expenses.

- Market and Regulatory Design – this project captures AEMO resources and subject matter experts that have been (and will be) required to support EPWA in market and regulatory design activities.

  Activities include undertaking and/or supporting the development of technical analysis, Energy Transformation Taskforce information papers, drafting instructions, and legal drafting. It also includes supporting stakeholder consultation and engagement on the WEM Reform solutions (e.g. via TDOWG).

- Technical and Process Design – this project was initiated to establish key IT and planning artefacts. This included the Options Assessment and Recommendations position (e.g. high-level build, buy, re-use, and re-purpose assessment for IT systems approved in March 2020), the initial program implementation plan (June 2020) and initial program architecture (November 2020).

  Key resources in this team included a Technical Design Lead, Technical Program Lead, and Solution Architect Lead. Technical and process and design work under this project is complete, with c. $36,000 expected to be incurred in this project during AR6 related to ongoing finance costs.

Over the AR6 period, AEMO forecasts it will spend $8.2 million (including contingency) on program management (plus associated costs as outlined above) and market and regulatory design as shown in Table 40.

Table 40 WEM Reform – Design planning and management workstream projects AR6 forecast capex ($million nominal)

Design, planning and management	2022-23	2023-24	2024-25	AR6 total
AEMO - P1851- WEM Reform Core	5.2	2.8	-	-
AEMO - P1382 - Market & Regulatory Design	0.1	0.0	-	-
AEMO - P1863 - Technical & Process Design	0.0	0.0	-	-
Design, planning and management total	5.3	2.9	-	8.2

This forecast has been developed as a specific project estimate based on known requirements at July 2021

Table 41 summarises the status of the Design, planning and management workstream and how AEMO will aim to achieve the lowest practicably sustainable cost of delivering the work.

Table 41 Summary of Design, planning and management workstream project status

Project	Status	Solution Approach	Resourcing approach	Other options considered	How AEMO will achieve the lowest practicably sustainable cost	Risk/interdependencies
P1382 – Market & Regulatory Design	Execution	N/A	AEMO & Vendors	N/A	• AEMO has worked closely with EPWA (and previously PUO and ETIU) to understand the market regulatory design scope and provide AEMO support and expertise where most beneficial – this has been flexible based on the topic with greater level of resource provided on areas such as ESS and Power System Security and Reliability frameworks. • AEMO has actively drawn on the knowledge and expertise of NEM colleagues to supplement the WEM experts and help apply lessons learned (e.g. Constraints, GPS and Registration and Participation). • Where relevant (e.g. development of the Market Design Summary), AEMO has conducted RFPs to choose a delivery partner based on value for money criteria.	• The Market and Regulatory Design of the WEM Reform provides the foundation for implementation including the minimum set of business and functional requirements. • AEMO's close collaboration with EPWA on the market design has (and will continue to) provide benefits to the overall Program by ensuring prioritisation of efforts; early technical input; and continuity of knowledge – which flows through into requirements setting, system design and development of WEM Procedures.
P1851 – Core	Execution	N/A	AEMO & Vendors	N/A	• AEMO's Program Management Function and Structure have been regularly reviewed and updated to reflect the status and needs of the Program (e.g. only adding implementation focussed roles when sufficient market design was complete). • Where relevant (e.g. Obligation Map), AEMO has conducted RFPs to choose a delivery partner based on value for money criteria. • Overall, Program Management and Controls costs fall within assumed average ranges[72]	• Given the scale and complexity of the WEM Reform Program (including parallel delivery of multiple projects) a suitably resourced Program Management and Assurance function is critical to managing delivery risk and improve confidence of successful and efficient delivery (e.g. cross-program resource management).
P1863 – Technical & Process Design	Completed	N/A	AEMO & Vendor	N/A	• AEMO conducted an RFP to choose a technical delivery partner based on value for money criteria to help develop the initial Options Assessment and Recommendations.	• While this activity is now complete it provided the foundation technical and implementation approach/plans for the whole of the WEM Reform Program.

[72] https://www.projectmanagement.com/contentPages/article.cfm?ID=269591&thisPageURL=/articles/269591/Project-Management-on-a-Budget#_=_ and https://www.pmi.org/learning/library/project-management-much-enough-appropriate-5072

WA DER program

The WA DER program has been shaped to deliver the actions defined by the WA Government's April 2020 DER Roadmap. It also includes related activities that flow on from the DER Roadmap activities in order to address the risks associated with DER penetration and enable DER to participate in the WEM.

Delivery of the WA DER program commenced in 2020, with AEMO undertaking activities across more than 14 DER Roadmap actions under four projects or workstreams. The program is progressing well, and AEMO expects to complete the AR5 program of work within forecast budgets set out in Table 23.

Forecast capex for the WA DER program in the AR6 period is $9.4 million. The AR6 WA DER program forecast does not include the full costs of implementing DER Participation in the WEM. If DER Participation Implementation proceeds during the AR6 period, AEMO plans to seek an in-period adjustment to the WA DER capex forecast to complete this project.

The $9.4 million forecast for AR6 includes $3.2 million carried over from the AR5 period to complete the DER Orchestration (Project Symphony), Technology Integration and DER Participation projects. The addition of $2.5 million of ARENA funding in 2021 means each project can deliver its expected scope with market participants exposed to funding no more than the ERA's in-period forecast capital expenditure determination.

The AR6 WA DER capex forecast comprises four new projects for the period:

- DER Participation Implementation (DER Roadmap action 30)
- EVs in the DER Register (DER Roadmap action 16)
- Market Visibility (driven by market needs)
- DER Data Access & Management (driven by system needs).

A further project, the Network Services Marketplace Trial and Design (required under DER Roadmap actions 31 & 32) is scheduled for the AR6 period. However, this is essentially a research and development project, and therefore will not be capitalised under Australian Accounting Standards. The Network Services Marketplace Trial and Design will be expensed as opex (see section 2.4.1).

Table 42 summarises the AR6 WA DER projects and maps them to the relevant DER Roadmap actions.

Table 42 Summary of AR6 WA DER projects and related DER Roadmap actions

WA DER Project	Status	Related DER Roadmap actions	Scope	Expenditure type
Project Symphony	In-flight	22 & 23	Deliver a VPP pilot to test and demonstrate technical capability of aggregated DER and its potential to participate in the market, and provide network support services to Western Power.	Capex
Technology Integration	In-flight	1, 3, 10, 12 & 13	Uplift system security parameters such as Under Frequency Load Shedding, System Restart, and promote the evolution of standards based on an uplift of AEMO's system modelling and prediction tools.	Capex
DER Participation	In-flight	24, 25, 26, 27 & 29	Develop market design, roles and responsibilities, initial rules, implement visibility arrangements to enable DER to participate in the WEM, in line with an incremental approach towards implementation.	Capex
DER Participation Implementation	New for AR6	30	Build the interfaces with WEM systems to enable DER aggregators to participate in the WEM and facilitate changes to existing systems.	Capex

WA DER Project	Status	Related DER Roadmap actions	Scope	Expenditure type
Market Visibility	New for AR6	Driven by market need	Provide improved visibility of market conditions and outcomes, and participation requirements aiming to reduce barriers to entry for DER aggregators.	Capex
DER Data & Access Management	New for AR6	Driven by system need	Increase visibility of the distribution network through access to additional DER and distribution network data while integrating this with existing tools to enable informed operational decisions.	Capex
EVs in the DER Register	New for AR6	15 & 16	Include electric vehicle data in the DER Register. This project will provide opportunity to draw on the DER Register systems to commence the data capture for EVs during their early growth phase in WA.	Capex
Network Services Marketplace Trial and Design	New for AR6	31 & 32	Support the delivery and management of a trial to demonstrate the feasibility of a Network Service Marketplace trial, with the intention to support EPWA in defining future regulatory changes to implement a network services marketplace.	Opex

Forecasting method

For the projects already in-flight, AEMO has reassessed each project based on progress to date, experience from the last 12 months, and any changes to timing and other assumptions. Following feedback from the ERA on AEMO's resource estimating process during the AR5 in-period adjustment process, AEMO has reviewed the mix of permanent vs contracted resources delivering each project and revised its labour cost estimates accordingly.

The timing for completion of the three in-flight projects has changed. However, at this time AEMO's forecast capital expenditure has not required revisions to the total capex forecast from that developed for AR5 (including contingency). At the time of writing, AEMO expects to deliver the in-flight DER Roadmap projects within the budget amounts. Forthcoming updates to the Project Symphony schedule are expected to require some draw down on project contingency during AR6 to complete that project.

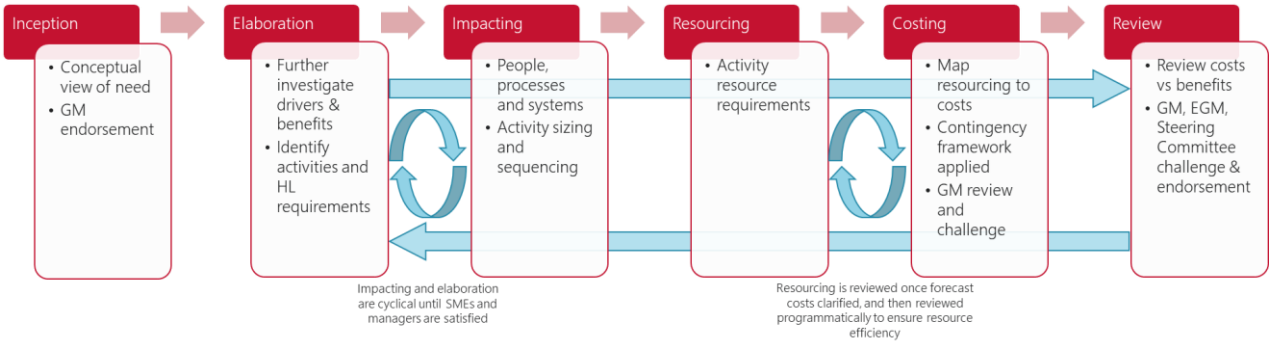
For the new DER Roadmap projects, AEMO developed the forecasts using a bottom-up build (zero base). This commenced with a qualitative view of the expenditure drivers, and the need and potential benefits of each. For each project, AEMO built up a profile of the activities needed to deliver the outcomes and the resource requirements.

Wherever possible, AEMO has drawn on practical experience and precedent in the NEM, and recent WEM experience. For example, costs for the Network Services Marketplace Trial and Design project are based on the actual costs incurred during the NEM's DER Orchestration Pilot (Project Edge), which features a network services marketplace component and trial. AEMO has used the unit costs from the vendor used to deliver the trial in the NEM as an input and scaled them for the WEM forecast. For the Electric Vehicles (EVs) in the DER Register project, AEMO has used the actual costs incurred for the WEM and NEM DER Register projects to inform its forecast.

AEMO has used internal subject matter experts where possible to develop the project forecasts and identify the resourcing level required for each component of work. Resources have then been assigned to each work component accordingly.

Figure 40 summarises the forecasting process for the DER Roadmap projects.

Figure 40 DER program forecasting process



AEMO mapped current DER resources against the new project resource requirements. This informed project sequencing and allowed AEMO to optimise delivery and ensure existing resources are fully utilised before looking at recruiting new staff/contractors.

For example, the current resources deployed on the in-flight Project Symphony and DER Participation projects will be redeployed to deliver the DER Participation Implementation project during the last two years of the AR6 period. This approach leads to a more efficient outcome, as knowledge is retained, and fewer new resources are required – although it should be noted some new resource will still be necessary.

Standard resource rates as per AEMO's cost estimation model have been applied in the DER Roadmap project forecast.

Table 43 presents the AR6 capex forecast by project. The Network Services Marketplace Trial and Design opex projects is discussed in section 2.4.1.

Table 43 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**

The following sections provide an overview of each of the WA DER capex projects.

Project Symphony

Project Symphony is a continuation of the DER Orchestration Pilot, which commenced development in June 2020. Project Symphony was included in AEMO's AR5 in-period forecast capex adjustment, and subsequently reviewed and approved by the ERA.

The scope and budget of this project is unchanged. However, the timing of the project has been shifted due to delays with project partners, with a revised completion date in the second half of 2023 (from December 2022).

The scope of work for the AR6 period includes:

- Finalising deployment of test scenarios.
- Commencing test scenarios in parallel across at least six months of testing.
- Undertaking analysis of the ongoing results and providing ongoing input into further testing.
- Developing proposed performance specifications for aggregated DER, and analysing technical understanding.
- Analytics, reporting and knowledge sharing.

AEMO has reviewed the original project budget estimates and is not requesting additional funding in AR6 above that already approved by the ERA in the AR5 period. This is as a direct result of AEMO's receipt of $2.5 million of ARENA grant funding, and confirmation from AEMO's governance committee that drawing on contingency is acceptable to manage anticipated schedule overruns (specifically the 2023-24 forecast capex).

Technology Integration

The Technology Integration project covers the critical actions required to ensure system security as more and more DER connects to the grid and these devices become more active and controllable. The original project was included in AEMO's AR5 in-period forecast capex adjustment, and subsequently reviewed and approved by the ERA.

The scope and budget of this project is unchanged. However, system security needs have required some elements to be expedited. The timing of the projects has been shifted due to resource availability and dependencies on Western Power (which has also had to adjust priorities at times), with a revised completion date of December 2022, changed from June 2022.

The scope of work for the AR6 period includes:

- Continuing model development.
- Continuing analysis of the performance of DER during disturbances, and assessment of the adequacy of revised standards.
- Technical analysis of DER behaviour within restart processes.
- Development of communications and interoperability standards for DER.

DER Participation

In the AR5 submission, the DER Participation workstream encompassed the activities necessary to plan for implementation of DER orchestration in the WEM/SWIS. As described in AEMO's AR5 in-period forecast capex adjustment submission, the DER Participation project covers the planning and legislative work ahead of implementing a full DER Participation model in the WEM. However, EPWA's preferred approach for enabling DER to participate in the WEM now requires incremental steps to be taken, alongside early development of a more complete market design and rules establishment. As a result, the scope for this project now differs slightly from that originally proposed. Note the DER Participation project is distinct from the DER Participation *Implementation* project (described below).

Along with the revised incremental approach, the timing of the project has also shifted slightly due to delays in key policy decisions by EPWA, with some activities extended to December 2022.

The scope of work for the AR6 period includes:

- Continuing support for EPWA's development of market arrangements for DER aggregators, leveraging learnings from Project Symphony.
- Consideration and enabling visibility of DER aggregations within AEMO's systems, where they are providing services outside of the WEM.
- Considering early arrangements to provide services to solve challenges caused by DER and DER aggregations, and potentially enacting these through mechanisms such as Non Co-optimised Essential System Service (NCESS) arrangements.

AEMO has reviewed the original project budget estimates and at this time recommends no changes to current total forecast capex, although the schedule changes mean some of this will now occur in the AR6 period. However, given the lateness of this scope change AEMO will be refining its forecasts during January 2022 for this project, with updated data to be provided to the ERA for inclusion in its AR6 draft determination.

DER Participation Implementation

The DER Participation Implementation project is driven by DER Roadmap action 30 to:

…enable DSO and DMO go live in the SWIS, with DER able to respond to meet network needs as well as be dispatched into the WEM and be compensated appropriately.

The DER Participation Implementation project is the next step in enabling aggregated DER to provide energy and ESS into the market. This project will leverage investments made in Project Symphony, along with the market development and planning activities from DER Participation project, to implement a model for DER aggregator participation in the WEM.

Although the primary driver for this project is the delivery of WA Government policy, AEMO is aware of the need to encourage DER aggregators to participate, and the need to put arrangements in place that will ensure the DER is encouraged to behave in a way that supports the power system. The primary objective in this project is to implement a solution that provides visibility and control of DER using a method that is acceptable and beneficial to participants and stakeholders, and results in the maximum benefits to the market, system and ultimately end consumers.

At a high level, activities in this project include:

- Enabling market entry in priority service(s), developing the DER aggregator market segment, and expanding towards full market participation over time.
- Establishing compliance and accreditation arrangements for DER aggregators as appropriate to enable their participation in the WEM, and engaging with emerging DER aggregators to understand capability and to support market entry.
- Implementing systems that enable the exchange of data between the Distribution System Operator (Western Power) and AEMO, and deployment of DER aggregations to meet network service needs (alongside market services via the NCESS arrangements or similar).
- Implementing systems that interface the requirements for DER aggregators with AEMO's operational systems efficiently, with the aim of avoiding making significant change to those systems.
- Implementing systems that enable DER aggregators to register customer level equipment with AEMO.
- Establishing appropriate compliance arrangements for aggregated DER facilities to provide services to the WEM.
- Drawing on the technical demonstrations from Project Symphony to design and implement appropriate systems to enable DER aggregators to participate in the WEM.

Using platform and market design investments from AR5, this project will build the interfaces with WEM systems to enable DER aggregators to participate in the market. It will also facilitate changes to existing systems where required to perform new functions. To support the definition of these functions, this project will also require AEMO to continue to support EPWA rule change development and implement procedure changes as required to support DER aggregator market entry.

DER Participation Implementation will encourage DER aggregators to provide orchestration services to customers, the benefits of which include:

- Improved visibility of DER to support system management understanding of the majority of power flows on the network and delivering more representative pricing outcomes.
- Integration of DER with AEMO's dispatch systems (via DER aggregators), enabling control in response to market-based incentives.

- New capability and requirements for DER (including batteries, EVs, rooftop solar PV and controllable loads) to perform in accordance with system security requirements / obligations (such as relevant generator performance requirements), preparing for low and/or reducing synchronous generation.
- Increased competition in the WEM by providing market access to a new segment, aligning to WEM objectives for competition and efficient market entry which benefits all end consumers through more efficient and effective market operation.
- Fairer allocation AEMO's fees across a broader base by inclusion of aggregators as market participants.

DER market participation is expected to start with one or two services, moving to full participation over a one to two-year period, consistent with EPWA's view of incremental implementation. However, AEMO will have to establish systems to enable the end state, so will require further clarity prior to implementing.

Delivery of DER Participation Implementation depends on progress and findings in Project Symphony and the DER Participation project. The timelines for these two projects have shifted. In order to be efficient and avoid rework, DER Participation Implementation also depends on the new market arrangements being in place, which is now scheduled for October 2023. The policy decisions and WEM Rules changes required to implement DER Participation in the new market have not yet been made.

As a result, AEMO has not included the full costs of DER Participation Implementation in the AR6 capex forecast. Rather AEMO has only included costs to enable regulatory planning and initial implementation activities, with a view to enabling an efficiently and prudently planned capital expenditure forecast to be prepared for consideration by the ERA during the AR6 period.

AEMO's request in this proposal is therefore for approval of 'regulatory planning' and initial implementation activities of up to $2.0 million, which will enable AEMO to:

- Move quickly from Project Symphony and DER Participation to enable implementation while retaining key resources. This will avoid inefficiencies and delay caused by having to reduce resourcing, wait for the ERA's determination, and then re-hire and train new resources following this.
- Develop WEM procedures and undertake related stakeholder engagement.
- Commence early implementation activities such as system and architecture designs, and undertake detailed implementation planning in parallel to the ERA's consideration of the in-period forecast capital adjustment.
- Develop comprehensive plans and gain confidence in implementation costs with sufficient accuracy as expected under the ERA's guidelines.[73]
- Prepare and negotiate an appropriately detailed in-period submission for ERA consideration and approval as an adjustment to the approved AR6 forecast capital expenditure.

Commencement of this work will occur following further advice and rule development by EPWA, after which time AEMO will have sufficient clarity to move forward with this regulatory planning and initial implementation activity phase.

Market Visibility

As the market operator, AEMO currently provides a suite of data dashboards and visualisations to industry, which can be used to help inform participants' operational and investment decisions. Through the Market Visibility project, AEMO proposes to expand the current suite of data to include specific information DER aggregators can use, and that will promote and support their participation in the market.

The aim of this project is to:

- Provide relevant information on technical and participation requirements for emerging DER aggregators (reducing load and inquires on operational staff to respond to queries).

[73] See https://www.erawa.com.au/electricity/wholesale-electricity-market/annual-price-setting/allowable-revenue-and-forecast-capital-expenditure-determinations.

- Provide market information on an ongoing and dynamic basis in a form that is publicly available, structured and technically easy to access that meets the needs of DER aggregators (for example, including dynamic operating envelopes in this data).
- Establish data sources and insights that can support an increased knowledge base across the community around how devices and VPPs support grid security and operation, anticipating an increasing role for 'behind the meter' devices in the WEM and SWIS.
- Increase competition for WEM services by reducing barriers to entry for DER aggregators.

Providing aggregators greater visibility of market arrangements will enable them to identify opportunities to participate, which in turn will bring greater diversity and competition to the market. It will also create additional data, new dispatch patterns, and help identification of locational value (in light of the SCED arrangements) that can be analysed and shared with stakeholders to further enable participation.

To help achieve the lowest practicably sustainable cost of delivering this project, the solution will draw upon AEMO's proven capacity (in the WEM and NEM) to provide support, data visualisation, training material and outreach. Where possible, existing systems and expertise will be used to deliver this project.

Over the long term the WEM is expected to become increasingly reliant on services provided from DER via aggregators. This project's core benefit is to provide greater access to the market and reinforce the benefits of participation by DER aggregators, enabling earlier realisation of the benefits of visibility and control of DER across the WEM.

The DER Roadmap did not explicitly include information to enable market access and develop aggregator sophistication and readiness. While this project is indirectly related to DER Participation, AEMO is pursuing this project as a value-add to its suite of existing market visibility and support arrangements.

This project is dependent on progress of Project Symphony and enabling visibility and early incremental of market participation in the DER Participation project.

DER Data Access and Management

Frequent low load conditions and more volatile demand create the need for greater visibility of all DER across the SWIS. The DER Register was completed and launched in 2020 and provides some visibility. However, the DER Register is simply a central source of static data, which is accessed via manual processes.

AEMO has identified an opportunity to make better use of additional data to enable more accurate analysis of DER behaviour, which can be used in forecasting and operational activities. For example, standing and dynamic DER data can be coupled with local generation, load and solar irradiance data (already captured in other systems) to create a more accurate data stream into AEMO's forecasting and operational tools. This could be used to create a real-time assessment of the risks of DPV tripping due to faults at any given time.

The DER Data Access and Management project will look beyond the DER Register and source improved distribution network level data to represent passive DER generation and consumption (through the network operator, or other procured data sources). This additional data will be used to gain better visibility of passive DER and load, reducing the impacts of estimation errors when procuring essential system services.

Rather than being a standalone initiative this project will draw heavily on the systems already in place and under development for the WEM and NEM. Key project elements identified include:

- Developing enhanced methods of data management and validation for the DER Register data set (for example verification with the Clean Energy Regulator data).
- Integrating DER Register data and data insights with AEMO's operational tools and platforms.
- Drawing on key information to inform AEMO's operations of the risks associated with DER tripping, weather-driven events (such as volatility) or other behaviour.

- Leveraging new data measurement systems and sources across the SWIS, including for example power flow measurements from the network operator, or solar irradiance measurements at strategic locations across the SWIS (providing critical localised inputs into updated operations forecasting systems).
- Drawing on AEMO's experiences and capabilities for data collection, in particular from South Australia and Queensland where there is high DER penetration.

Delivering the above will:

- Build new data sources to enable greater visibility of active DER, loads and power flows in the distribution network, which can be used to inform efficient system planning and development.
- Enhance existing operational tools, increasing the utility to AEMO's market and system operations, and limit the costs of developing new tools.
- Generally, enhance AEMO's capacity to operate the WEM and maintain system security through access and use of more granular data on the makeup and operation of the system.

To help achieve the lowest practicable cost, AEMO will draw on its WEM and NEM resources as required to share capability and knowledge considered in this project. Further, the requirements for this project would also be developed in collaboration with the Operational Forecasting project, to ensure the efficient and prudent delivery of enhanced forecasting capability.

EVs in the DER Register

The EVs in the DER Register project is driven by DER Roadmap actions 15 and 16:

- Action 15:

  By July 2020, deliver a register of static DER data for the SWIS, with processes to support data collection and future DSO functionality.

  By July 2020, establish the required regulatory arrangements for the DER register for the SWIS and the functions and obligations for AEMO, Western Power and DER providers with respect to the register.

- Action 16:

  By June 2020, commence work on planning to integrate electric vehicles in the grid, including for the deployment of charging points (household and fast charge) and trials to better understand the capabilities of vehicle to grid technology.

Under action 16 the WA Government released its WA EV Action Plan[74] in August 2021 to prepare the state for an expected rapid uptake of fully electric and hybrid plug-in vehicles. The plan sets out a range of 'no-regrets' actions to help manage the future integration of EV's in WA.

Visibility of EVs by AEMO is one of 11 elements of the EV Action Plan, setting out actions to expand the DER Register to incorporate EV charging equipment information. The EV Action Plan recognises that EV charging behaviours are likely to have significant impact on the power system. AEMO understands that controlled charging may become a part of retailer offerings, or service provision to the network operator.

The DER Register currently captures EV information from a generation perspective, where the EV battery is able to export to the grid. The EVs in the DER Register project would build mechanisms to capture data in relation to EV charging equipment, where EV batteries are not exporting to the grid.

The solution will include:

- Implementing related procedure changes as required.
- Engaging with the WA Government and other stakeholders (as required) to design and implement information collection systems (including agreed data) for EVs.

[74] See https://www.wa.gov.au/sites/default/files/2021-08/EPWA-EVActionPlan_18Aug2021e.pdf.

- Defining and confirming EV data to be collected in the WEM.
- Establishing the API and data exchange interfaces to provide EV data to AEMO's existing DER Register database on an ongoing basis.
- Implementing a technology solution that expands the DER Register to hold relevant EV data, validate data as appropriate and provide this data to AEMO's enterprise data systems.
- Supporting use of EV data with AEMO's WA operational functions as required (including public data dashboards).

AEMO will deliver this project at the lowest practicably sustainable cost by expanding existing DER Register systems and build on work already undertaken in the NEM to define data requirements[75]. Capturing EV data in the register will deliver the following benefits:

- Promoting better operational decisions – EV data will enhance planning through increased visibility of charging equipment characteristics, reducing the assumptions that need to be made, and resulting in less conservative power system operational and planning decisions.
- Improving operation of the power system – enhanced visibility of EV charging equipment will lead to improvements in the quality of AEMO's load forecasting and modelling.
- Establishing a single source of truth for all DER assets in the WEM and SWIS – AEMO's DER Register will become a key resource for DER data with the inclusion of EVs, further enabling this resource to support diverse equipment types that may be deployed by DER aggregators.

4.3.2 WEM sustaining capex

The remainder of the AR6 capex forecast (22%) is on capital projects necessary to sustain the business, enabling it to continue to provide its functions under the WEM Rules.

As shown in Table 44, AR6 sustaining capex comprises two categories:

- WA technology.
- Enterprise systems.

Table 44 WEM sustaining AR6 forecast capex ($ million nominal)

WEM sustaining capex	2022-23	2023-24	2024-25	AR6 Total
WA technology				
Capability uplift	0.2	0.2	0.9	1.3
Lifecycle	2.0	2.1	2.9	7.1
WEM rule changes	0.3	-	0.9	1.2
Total WA Technology	2.6	2.4	4.8	9.7
Enterprise systems				
Energy management system	1.1	0.3	-	1.4
Cyber	0.9	1.0	1.0	3.0
Operational forecasting	0.0	1.1	-	1.1
Infrastructure (Norwest data centre)	0.1	0.1	-	0.2

[75] See https://aemo.com.au/-/media/files/stakeholder_consultation/working_groups/der-program/deip-ev/2021/deip-ev-data-availability-taskforce-report.pdf?la=en.

WEM sustaining capex	2022-23	2023-24	2024-25	AR6 Total
Total enterprise systems	2.1	2.5	1.1	5.8
Total WEM sustaining capex	**4.7**	**4.9**	**5.8**	**15.4**

WA technology

WA technology comprises upgrades and lifecycle replacement to WEM-specific IT systems. It also includes investment in power system control room tools, and an amount of capex to manage WEM and GSI rule changes[76] that may arise during the AR6 period.

The WA technology capex subcategories are described in the following sections.

Capability uplift

The increasing complexity of the power system, coupled with increasing PV penetration, means system security issues are becoming more frequent and more difficult to predict. This category of expenditure comprises three key projects designed to uplift AEMO's ability to monitor, predict and management power system issues:

- Wide area monitoring systems (WAMS)
- Transient stability tool
- Operations simulator.

WAMS and the transient stability tool are power system control room projects, designed to enable more accurate monitoring and situations awareness. The operations simulator is designed to improve AEMO's ability to predict and analyse wind and solar generated energy inputs into the grid.

Table 45 presents forecast capex for each project.

Table 45 Capability uplift AR6 forecast capex ($ million nominal)

WEM sustaining capex – capability uplift	2022-23	2023-24	2024-25	AR6 Total
WAMS	0.2	-	-	0.2
Transient stability tool	-	0.2	-	0.2
Operations simulator	-	-	0.9	0.9
Total technology upgrades	**0.2**	**0.2**	**0.9**	**1.3**

The forecasts for these projects have been developed based on the costs associated with implementing similar projects in the NEM.

To help ensure these projects can be delivered for the lowest practicably sustainable cost, AEMO will utilise systems already established in the NEM, either modifying them to make them suitable for WEM use, or using them as the basis for developing a WEM equivalent. Where practicable, AEMO will draw on its organisational-wide expertise to deliver these projects.

A standalone WA solution was considered for each project. However, these options were dismissed due to the significant additional costs associated with both project implementation and ongoing operational support. By leveraging similar solutions already developed in the NEM, WEM participants will benefit from AEMO WA having

[76] Note any capex costs that arise from GSI rule changes will be charged to the GSI costs centre when they are incurred and recovered from GSI participants via the GSI Fee.

better data to drive power system operations decisions, and will pay less for these new systems than if AEMO WA were a standalone business.

The capability uplift projects are discussed below, and in the IT Roadmap.

WAMS

Low system strength and reduced inertia due to an exponential increase in inverter-based generation has been shown through simulations and observations to cause threats to power system security. Minimum daytime load is falling. There are operational limits at which load is too low to enable the power system to function securely. The more accurately these operational limits can be determined and monitored, the more efficiently actions can be taken to manage them and keep the power system operational.

AEMO currently has no real-time visibility of the impact on inverter-based generation on the power system. This makes it difficult to assess and predict operational limits. Currently, operational limits are based on estimated inverter-based generation quantities and historical experience of system stresses. The estimated limits are likely more conservative than actual limits.

Western Power is currently undertaking a trial to instal phasor measurement units (PMUs) in its network. PMUs enable power system characteristics such as inertia and system strength to be measured more accurately. It therefore makes sense for AEMO to leverage this and have the appropriate control room tools to be able to analyse data provided by the PMUs.

PMUs and the wide area monitoring systems (WAMS) necessary to monitor PMU output (as well as other technologies) are commonplace in other power systems, and have already been implemented in the NEM. AEMO therefore proposes to implement this same WAMS technology in the WEM. This approach enables AEMO WA to benefit from experiences and expertise with these type of systems in the NEM, and ensure the WAMS solution for WA is fit for purpose.

The scope of this project is to

- Implement GE's Wide Area Monitoring System software.
- Integrate into AEMO Energy Management System (EMS).
- Develop Control Room procedures for use of the system.
- Transition users to the new WAMS.

AEMO will leverage the investments already made in the NEM, meaning that the technology costs will be lower than if AEMO WA were to build new standalone solutions from scratch. AEMO WA will also benefit from shared ongoing support costs and more efficient procedure development.

This project is expected to be completed in 2022-23.

Transient stability tool

Transient stability is becoming a major issue as synchronous generation is replaced by wind and solar farms, as well as changes in the way thermal plant is being operated. There is currently no process for AEMO to monitor N-1 rotor angle or oscillatory stability in the WEM in real-time. This lack of visibility could lead to insecure power system operation.

Introducing a real-time transient stability tool will provide enhanced situational awareness to the control room. This will enable better-informed system operation decisions to be made, and mitigate the risk of system security issues.

To deliver this solution for the lowest practicably sustainable cost, AEMO proposes to leverage the NEM's existing tool – Dynamic Security Analysis (DSA). Implementing DSA in the WEM will give AEMO WA greater visibility of transient stability issues under all operating conditions. It will also provide better feedback to Western Power on limit equations by benchmarking against the real time limits calculated by this application.

This project is expected to be completed in 2023-24.

Operations simulator

The operations simulator is a tool that will allow AEMO to predict the impact of asynchronous generation (wind and solar) on the power system. By being able to model and understand how new large and small scale inverter-based generation capacity will affect system security, AEMO can make operational decisions to manage the impact. AEMO can also use the simulator to provide advice to Western Power and existing and potential market participants on how best to manage WA's ongoing energy transition.

AEMO has already implemented the Australian Operations Simulator in the NEM. The proposed solution for the WEM is to make the necessary updates and modifications to enable the WA market and power system to be included in the simulator.

AEMO submits this is the most efficient solution for WEM participants, as it will leverage the experience and conclusions of over five years of intensive analysis, operational management of power systems issues, industry consultation and engineering development in the NEM. For the WEM, it is an opportunity to access technical and process expertise, as well as design and hardware, to manage the emerging security issues associated with inverter-based generation.

A solution for the WEM requires licenses, dedicated hardware and resources to on-board the WEM power models to the Australian Operations Simulation.

The project is expected to be completed in 2024-25.

Lifecycle

AEMO is an IT-intensive organisation, relying on more than 470 IT systems to enable it to provide system and market operations, with 97 of these being WEM-specific. AEMO has a planned hardware and software upgrade and remediation program that ensures all systems are supported, fit-for-purpose, reliable and cost effective to run.

The lifecycle program upgrades to hardware and software that will come out of vendor support during the AR6 period. AEMO has zero tolerance for risks relating to the availability of critical systems supporting power and gas operations. Failure to mitigate or remediate these legacy systems prior to their support ending is considered technical debt, and places significant risk to the confidentiality, availability and integrity of AEMO's systems and data.

Table 46 presents forecast capex for each project.

Table 46 Lifecycle AR6 forecast capex ($ million nominal)

WEM sustaining capex – lifecycle	2022-23	2023-24	2024-25	AR6 Total
Lifecycle enterprise data platform (EDP)	-	1.0	0.7	1.6
Lifecycle legacy market systems	-	0.5	1.4	1.9
Lifecycle integration	-	0.7	0.5	1.1
Lifecycle Perth computer room	2.0	-	-	2.0
ITRON upgrade	-	-	0.4	0.4
Certificate authority	0.3	-	-	0.3
Total lifecycle	**2.3**	**2.1**	**2.9**	**7.4**

The lifecycle program will see 20 software applications upgraded or remediated over the course of the AR6 period as well as a refresh of the hardware hosted in the Perth Data Centre. The program has been staged to ensure deliverability and to make certain all software and hardware will be upgraded in line with vendor recommendations.

To help ensure the program is delivered for the lowest practicably sustainable cost, AEMO WA will draw on internal NEM/WEM resources undertake the work and avoid external costs where practicable.

The suite of systems being upgraded as part of the lifecycle program, are detailed in AEMO's IT Roadmap.

WEM rule changes

In line with its obligation in clause 2.1A.2(IA) of the WEM Rules, AEMO is required to make the necessary system and tool/application changes to give effect to any changes to the WEM Rules.

On 1 July 2021, responsibility for the administration of the WEM Rules was transferred from the former Rule Change Panel to the Coordinator of Energy. All rule changes to be implemented by AEMO are in response to directives from the Coordinator of Energy.

The exact scope of rule changes that may be required during an allowable revenue period is often unknown. Therefore, common practice is for AEMO to include an amount of capex in its forecast to enable it to fund any unforeseen or unscoped rule changes that arise.

Table 47 presents the rule change forecast capex for the AR6 period.

Table 47 WEM changes AR6 forecast capex ($ million nominal)

WEM sustaining capex – WEM rule changes	2022-23	2023-24	2024-25	AR6 Total
WEM rule changes	0.1	-	0.9	1.0

AEMO proposes an amount be included in the AR6 capex forecast to accommodate WEM rule changes. This is consistent with advice during the AR5 review processes, where stakeholders expressed the view that AEMO should have a minimum provision in its allowable revenue and/or forecast capital expenditure for the development and implementation of business-as-usual rule changes.[77]

The ERA ultimately disallowed costs for business-as-usual rule changes in its AR5 final determination. However, AEMO submits that including an amount in the forecast is a prudent course of action, as it will ensure AEMO can fund rule changes, and minimises the requirements for in-period adjustments to the AR6 capex determination.

AEMO will only incur the efficient costs associated with any rule changes that arise, and market participants will only be charged for rule change costs (via the WEM Fee) if and when they occur.

Given unknown scope of AR6 rule changes, AEMO has used a T-shirt sizing method to estimate potential costs (see Table 48).

Table 48 WEM T-shirt sizing estimates

Small • Little impact, complexity or risk. • Primarily involves one-two divisions. • Cost typically <$50,000	**Medium** • Some impact, complexity or risk. • May involve three or more divisions. • Cost typically $50,000 to $200,000.
Large • May have impact on market(s) / participants, and or on AEMO's reputation.	**X-Large** • Executive leadership-driven projects. • Significant direct impact on the market(s) / participants.

[77] Page v, ERA AR5 draft determination: https://www.erawa.com.au/cproot/20404/2/AR5%20Draft%20determination%20paper.pdf, noting that the ERA reversed its position in its final decision.

- Involves multiple stakeholder groups.
- Material complexity (e.g. technology, resourcing, stakeholders etc.).
- Contains significant risks (e.g. financial, technology, AEMO reputation, or impact to participants).
- Cost typically $200,000 to $500,000

- Significant impact on AEMO's reputation.
- Significant complexity (e.g. across technology, resourcing, stakeholders etc.).
- Contains significant or critical residual risks (e.g. financial, resourcing, technology, AEMO reputation, or impact to participants).
- Cost typically >$500,000

AEMO has assumed one of each size rule change will occur during the AR6 period.

Enterprise systems

As a national organisation, AEMO has a number of central systems and services that are shared across all its jurisdictions. Examples include AEMO's energy management system (e-terra) and various accounting and HR systems. AEMO's preference is to utilise shared systems and IT platforms wherever practicable, as this helps reduce software, hardware, support and lifecycle costs and eliminates duplication of effort. Most importantly, it allows the various state-based parts of the organisation to access critical IT systems and expertise at a typically lower cost than if they were standalone businesses.

AEMO WA benefits from a number of shared systems, with costs for using those systems allocated to the WEM costs centres, and recovered via WEM and GSI Fees accordingly. The allocation method for each system varies slightly, and is based on the following principles:

- The allocation of benefits between functions
- Use of systems
- Level of customisation required.

The allocation method for the four enterprise projects identified for the AR6 period is summarised in Table 49 below.

Table 49 WEM enterprise project allocation AR6 forecast capex ($million nominal)

WEM enterprise project allocation	2022-23	2023-24	2024-25	AR6 Total	% allocation and basis
Energy management system	1.10	0.29	0.00	1.39	18% - use of system calculated as the database point usage.
Cyber	0.95	0.99	1.04	2.97	11.8% - proportional average use across three parameters
Operational forecasting	0.00	1.15	0.00	1.15	WEM system onboarding costs
Infrastructure (Norwest data centre)	0.10	0.10	0.04	0.24	11.7% - based on WA's use of data centre servers
Total	**2.14**	**2.53**	**1.08**	**5.75**	**n/a**

Energy Management System

The AEMO energy management system (EMS) is used to monitor, control and optimise the flow of energy in the power system. It is fundamental to AEMO WA's system operation functions.

AEMO WA shares the e-terra EMS with the rest of AEMO. The current e-terra version 3.2 is coming out of support in July 2024 and requires upgrade to version 3.4. The application will be upgraded nationally, with costs apportioned between the WEM and NEM entities. Some customisation will be required for the WEM.

Cost estimates for this project have been provided by the vendor. e-terra remains AEMO's EMS of choice, and it is important that the software is up to date and the system fit for purpose. Given AEMO WA has only recently switched to using e-terra (from Western Power's XA/21) system, it was not considered prudent to investigate AEMO WA moving away from e-terra or seeking a standalone option.

By using e-terra, AEMO WA will benefit by having access to the latest tools, a better user interface, functional improvements in the power system applications, security improvements, design improvements, and have a standardised foundation for future improvements. By maintaining alignment of EMS versions, AEMO national and WA will benefit from cost efficiencies associated with maintaining one uniform code base. Undertaking regular, small upgrades rather than less frequent large upgrades exposes AEMO to less business risk.

Costs are allocated between the NEM and the WEM based on the use of system, calculated as the database point usage. This results in 82% of the costs allocated to the NEM, and 18% to the WEM.

Cyber security

Cyber security is one of the most critical issues for AEMO. As an IT-intensive organisation that manages critical energy infrastructure, it is imperative AEMO's systems remain protected from cyber security incidents (whether malicious or user error).

AEMO has a central cyber security program, established in 2019, which covers all aspects of cyber security for the entire organisation. The following enterprise initiatives have been delivered to date:

- Established identity & access management by delivering a comprehensive 'business to employee' identity lifecycle governance service, including the closure of long-standing audit items relating to identity management.
- Delivered a new privileged access management platform to ensure very strong controls are applied to the use of highly privileged access to technology services.
- Further strengthened foundational key controls to ensure AEMO can effectively protect from attacks against email and web services through implementation of DDoS protection and email fraud controls.
- Established a baseline for cloud security controls and new security architecture standards to support major initiatives such as consumer data rights platform and 5 minute settlements.
- Launched a new platform-based approach to foster security awareness across AEMO.
- Established a security operations centre through threat detection and response imitative.

AEMO plays an important role in energy sector cyber security, and is currently working with the Commonwealth Department of Industry, Science, Energy and Resources (DISER) and the Australian Cyber Security Centre to define roles and responsibilities on the issue. AEMO is likely to be responsible for maintaining the 'Australian Energy Sector Cyber Incident Response Plan', therefore it is imperative that its own resilience to cyber attack is high.

In 2022, the Australian Federal Government is expected to pass legally binding regulations on cyber security for the energy sector based on the Australia Energy Sector Cyber Security Framework (AESCSF). AEMO will almost certainly be nominated as Critical Infrastructure and Systems of National Significance (CI/SONS), and therefore will be subject to enhanced security obligations.

Compliance with *SOCI Act* requires an assessment of the current state, development of a plan for uplifting from the current state to the required compliance level, and implementation of the plan to achieve AESCSF Security Profile 3 (SP-3) level compliance by 2025. While the detail of the *SOCI Act* is not yet available, AEMO proposes to commence its cyber security uplift during the AR6 period. The AR6 cyber security project covers four workstreams:

- Ransomware resilience
- Threat detection and response

- Threat and vulnerability management
- Identity and access management.

Seven cyber security projects will be delivered across these four workstreams during the AR6 period. The individual projects are discussed in AEMO's IT Roadmap. The cyber security program is designed to develop organisational capability and maturity to:

- Manage cyber security risk to systems, people, assets and data.
- Implement appropriate safeguards and protective controls to ensure delivery of critical services.
- Rapidly identify the occurrence of a cyber security event and initiate response in a timely manner.
- Take effective action regarding a detected cyber security incident and contain impact and minimise harm.
- Restore and sustain such services that were impaired due to a cyber security incident in a timely manner.

AEMO WA shares AEMO's central cyber security program and benefits from a heightened level of market and power system cyber security and business continuity arrangements, at a fraction of the cost than if it were to deliver its own cyber security program as a standalone business.

Costs for the cyber security project is allocated between the NEM and WEM based on a weighted average of three parameters assigned to each workstream. The parameters are:

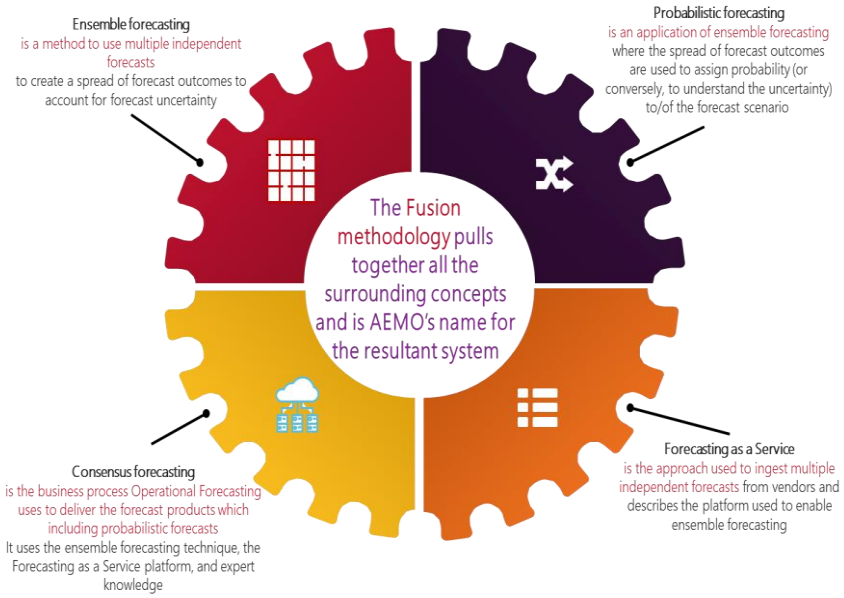
- FTEs.
- Assets (plus an WA specific costs.
- IT support and cloud costs.

Operations forecasting

Operations forecasting is an AEMO-wide program of work to uplift its forecasting capabilities. The growing volumes of variable renewable energy connected to the power system, coupled with increasing frequency of extreme weather events, means the ability to forecast electricity supply and demand has never been more vital.

AEMO has therefore reviewed its current, fragmented operational forecasting capabilities and is investing in its various IT systems and processes to create a more accurate consolidated forecasting function that will be used by the entire businesses. AEMO is developing the 'Fusion Methodology', which draws together elements of forecasting best practice to allow it to produce robust energy supply and demand forecasts (see Figure 41).

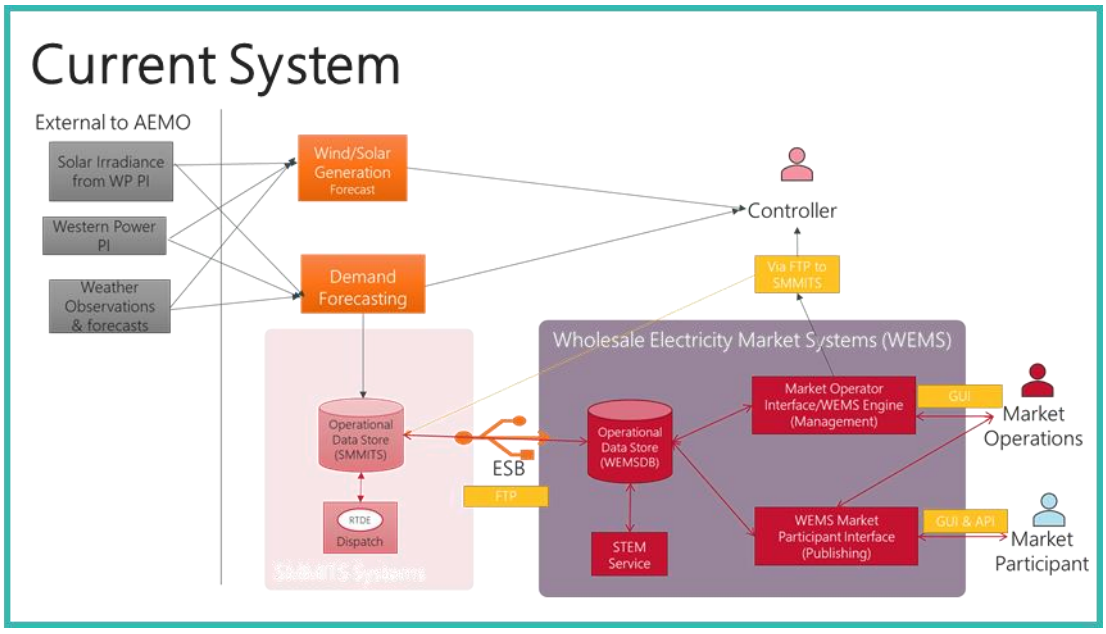
Figure 41 AEMO's Fusion Methodology operational forecasting system

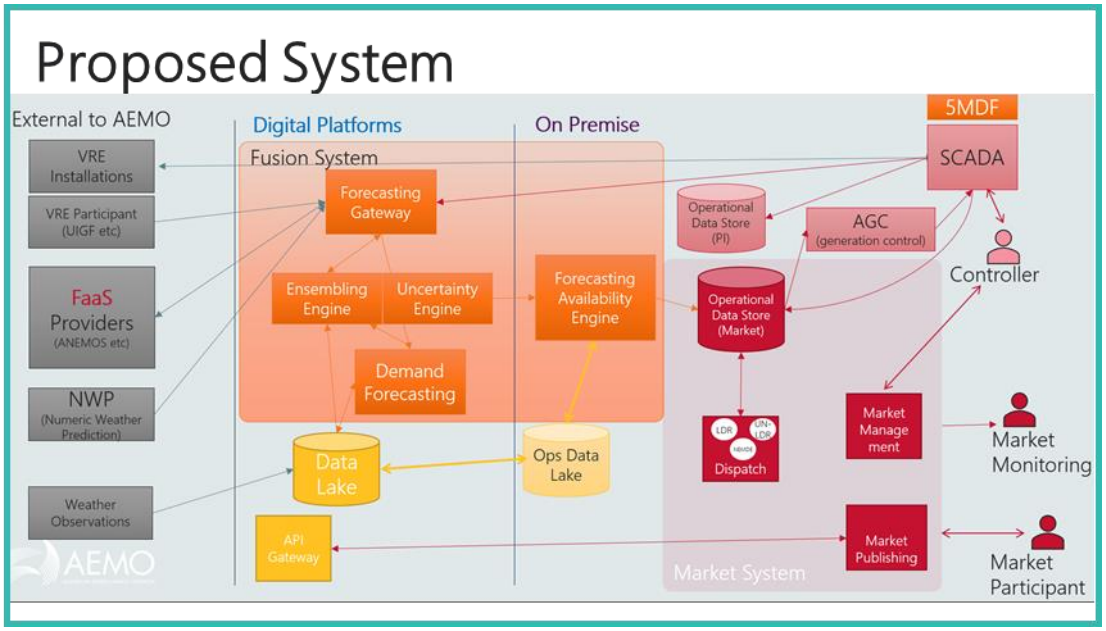


The Fusion Methodology forecasts can be provided to system operation and market operations staff to enable better informed and more effective decisions on how to manage the power system and market in real-time. This will be particularly important for AEMO WA as it moves to real-time wholesale market and ESS market operations. The forecasts will also improve medium and long-term planning, and can be shared with market participants.

By centralising and uplifting AEMO's forecasting capabilities, AEMO can reduce reliance on third parties and consultants to produce bespoke forecasts, as well as establishing a single source of the truth for energy supply/demand estimates. Figure 42 provides an overview of the current and proposed forecasting methods and IT systems.

Figure 42 Proposed changes to AEMO's forecasting methods





Key changes are:

- AEMO will source data from specialist 'forecasting as a service' (FaaS) providers rather than relying on network operators (Western Power) for critical inputs.
- Moving most of the forecasting system components to AEMO's digital platform (cloud), helping improve security and reducing on-premise costs.
- The ANEMOS Forecasting System, which currently sits within AEMO's systems framework will move outside the framework.
- Simplified data feeds, reducing costs and multiplicity of sourcing.

The operational forecast project is being delivered nationally, and will be established in the NEM in the first instance. Rather than being allocated a share of the original project costs, AEMO WA's costs for this project will be incurred directly. Once the operational forecasting solution has been built in the NEM, a WEM capability will be built using the NEM platform as a base line. Essentially, the WEM will be 'onboarded' on to the new system and the cost charged to AEMO WA budgets.

This onboarding approach means AEMO WA will get access to a leading forecasting tool at a lower cost than if it were to build a standalone WEM solution from scratch. It will also ensure WEM participants only pay for the portion of the capex build than benefits them.

Once the project is complete, AEMO WA and WEM participants will benefit from improved forecasting capabilities, with significant cost reductions expected. At the most basic level, the Fusion Methodology will reduce the cost and complexity of data feeds, which currently cost up to $175,000 per feed.

More significantly, improved forecasting will reduce the cost of frequency regulation. The LFAS market in WA costs around $70 million to 80 million per year[78]. Being able to more accurately identify LFAS requirements will ensure this service provision more accurately reflects the system need and should promote more efficient market outcomes.

The improved operational forecasting capability will also support key WEM projects and functions, including:

- DER aggregation and participation
- Short term PASA
- Whole of system planning
- ESOO and GSOO production.

Infrastructure

AEMO owns and operates its own Data Centre in its Norwest facility. Many WEM applications and services are hosted there including production, development, and test environments. As this data centre also hosts a significant number of NEM services, WA receives the benefits of an enterprise-scale data centre capability at relatively low cost.

AEMO has a planned hardware upgrade program, which includes a replacement timeframe for all data centre hardware. During the AR6 period the Norwest facility requires a number of critical upgrades, including replacement/upgrade of the following equipment:

- Uninterruptible power supply (UPS) units A and B including batteries
- Computer Room Air Conditioning (CRAC) units 2 and 3
- Static network switches A and B
- Power Factor Correction (PFC) Unit A.

Making these upgrades is essential to ensure the security and integrity of the data centre and mitigates the risk of business disruption due to failing hardware components. AEMO has a low risk tolerance for activities relating to availability of critical systems supporting market operations and a zero tolerance for activities relating to availability of

[78] $73.17 million in 2020.

critical systems supporting power and gas operations. The impact of running on legacy infrastructure/ technology/ power supplies would introduce a critical risk which is unacceptable to AEMO.

The option to continuing to use the aging hardware was considered and dismissed as due to the significant risk this adds to the availability of critical applications and services. AEMO also considered migrating the Norwest services to AEMO's digital platform, however the WEM services currently hosted at Norwest are all required for the WEM Reform program. While there may be potential to migrate all services to the cloud in the future, conducting this migration in parallel with the WEM reforms would require changes to the underlying system architecture and would add significant risk to delivery of the reform program.

AEMO's procurement policies ensure that all new hardware is purchased at lowest possible cost and is some cases AEMO WA receives preferential prices by being part of large, national organisation.

The upgrade has been forecast centrally based on historical actual costs of this work and allocated between the NEM and the WEM based on the number of WA servers relative to the total. AEMO has 1860 operational servers in the Norwest data centre, 218 of them are WA servers, resulting in a split of 11.7% to WA.

5. Gas Services Information

This section provides an overview of GSI revenue, capex and fees for the AR6 period. GSI revenue is forecast separately from WEM allowable revenue and is recovered via GSI fees payable by gas market participants. AEMO's GSI services are defined in rule 107 of the GSI Rules:

As required by rule 109(3), AEMO's forecast of GSI revenue and capex includes *only costs which would be incurred by a prudent provider of the relevant AEMO GSI Services, acting efficiently, seeking to achieve the lowest practicably sustainable cost of delivering those services in accordance with the Rules, while effectively promoting the GSI Objectives.*

5.1 GSI allowable revenue and operating expenditure

Forecast GSI allowable revenue during the AR6 period is $5.3 million. This is $0.7 million (15%) higher than the forecast position at the end of the AR5 period.

GSI forecast Opex for AR6 is 13% lower than the amount approved in the AR5 determination ($6.1 million).

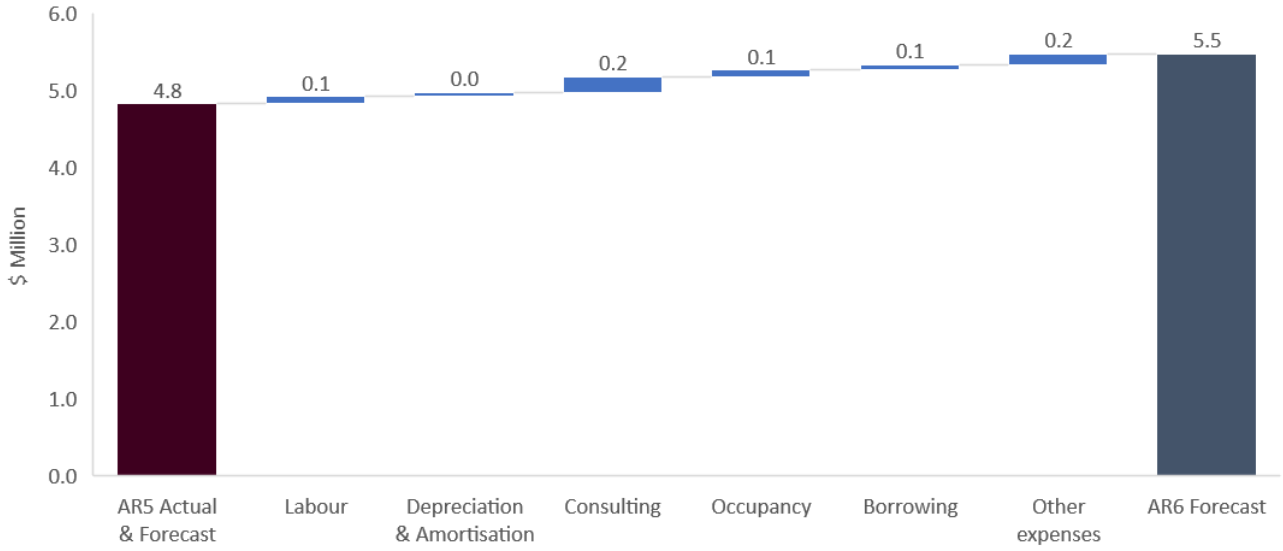
GSI allowable revenue comprises forecast Opex for the AR6 period, plus/minus an adjustment for under/over recovery of revenue from the prior period. Table 50 presents the GSI allowable revenue forecast by Opex cost category.

Table 50 Total forecast GSI allowable revenue by cost category ($ million nominal)

Cost category	AR5 determination	AR5 actual (forecast to 30 June 2022)	2022-23	2023-24	2024-25	AR6 Total
Labour	3.0	3.0	1.0	1.1	1.0	3.1
Accommodation	0.1	0.2	0.1	0.1	0.1	0.3
IT & telecommunications	0.4	0.2	0.1	0.1	0.1	0.2
Supplies and services	1.4	0.9	0.5	0.4	0.4	1.3
Borrowing	0.0	0.0	0.0	0.0	0.0	0.1
D&A	1.0	0.5	0.1	0.2	0.2	0.6
Adjustment for over/under recovery	0.0	0.0	-0.2	0.0	0.0	-0.2
Total revenue	**6.1**	**4.8**	**1.6**	**1.8**	**1.9**	**5.3**

Figure 43 shows the change in GSI opex between AR5 and AR6.

Figure 43 Forecast AR6 GSI opex compared with AR5



The Gas Bulletin Board (GBB) and Gas Statement of Opportunities (GSOO) continues to meet industry requirements. The five-yearly review of the GBB zones did not result in any material changes to the GBB service provision. As per the 2020 Western Australian (WA) GSOO, domestic potential gas supply is expected to exceed demand through to 2028, with options to manage any potential shortfall thereafter. As such, AEMO does not forecast any significant changes to its GSI functions.

The opex increase for the period is predominately the result of an increase in labour costs and consulting costs, driven by remuneration adjustments, cyber security allocation, and the mandatory 5-year GSOO review.

Opex changes per regulatory category are discussed in the following sections.

Labour

Forecast labour costs for GSI during the AR6 period are $3.18 million. This is a 3% increase compared to the forecast position at the end of AR5.

The labour cost increase is driven by periodic remuneration increases included as part of the Enterprise Bargain Agreement, an increase in leave provisions, and an additional partial resource allocation from enterprise-wide corporate services for cyber security support over the AR6 period.

Note that none of the FTE uplift proposed for the WEM functions is allocated to GSI. AEMO anticipates no uplift in GSI resourcing requirements during the AR6 period other than for cyber security.

Accommodation

Forecast accommodation costs for GSI during the AR6 period are $0.30 million. This is a 36% increase compared to the forecast position at the end of AR6.

This increase is due to a change in accounting treatment, which means accommodation costs are no longer charged to capex projects, and are instead expensed as opex in the year they occur.

No increase in accommodation footprint for GSI is forecast for the AR6 period.

IT & telecommunications

Forecast IT and telecommunication costs for GSI during the AR6 period are $0.19 million. This is a 4% ($7,650) increase compared to the forecast position at the end of AR6.

No material changes to IT costs or the GBB are anticipated for the AR6 period.

Supplies and services

Forecast supplies and services costs for GSI during the AR6 period are $1.26 million. This is a 38% increase compared to the forecast position at the end of AR5.

This increase is largely driven by a $0.20 million increase in consulting costs to the need for specialist services to support the mandatory five-yearly review of the GSOO in 2023. The remainder of the increase in this cost category is due to expected increases in the amount of travel, training and other office expenses incurred in a post-pandemic environment. Note the supplies and services forecast for the AR6 period is $0.10 million lower than the approved AR5 determination.

Borrowing

Forecast borrowing costs for the GSI during the AR6 period are $0.06 million. AEMO did not recover any expensed interest on borrowing costs during the AR5 period as they were directly attributed to capital projects and therefore capitalised and recovered as part of the depreciation schedule for those assets.

As discussed in section 2.3.5, AEMO has adjusted its capitalisation policy to standardise its financing arrangements across the organisation. As a result, a small amount of borrowing costs relating to GSI investments will be expensed and recovered from GSI Fees during the AR6 period.

Depreciation and amortisation

Forecast D&A costs for GSI during the AR6 period are $0.56 million. This is a 9% increase compared to the forecast position at the end of AR5.

The D&A costs for the AR6 period are an outworking of depreciation schedule for assets installed during AR4 and AR5.

5.2 GSI Fee

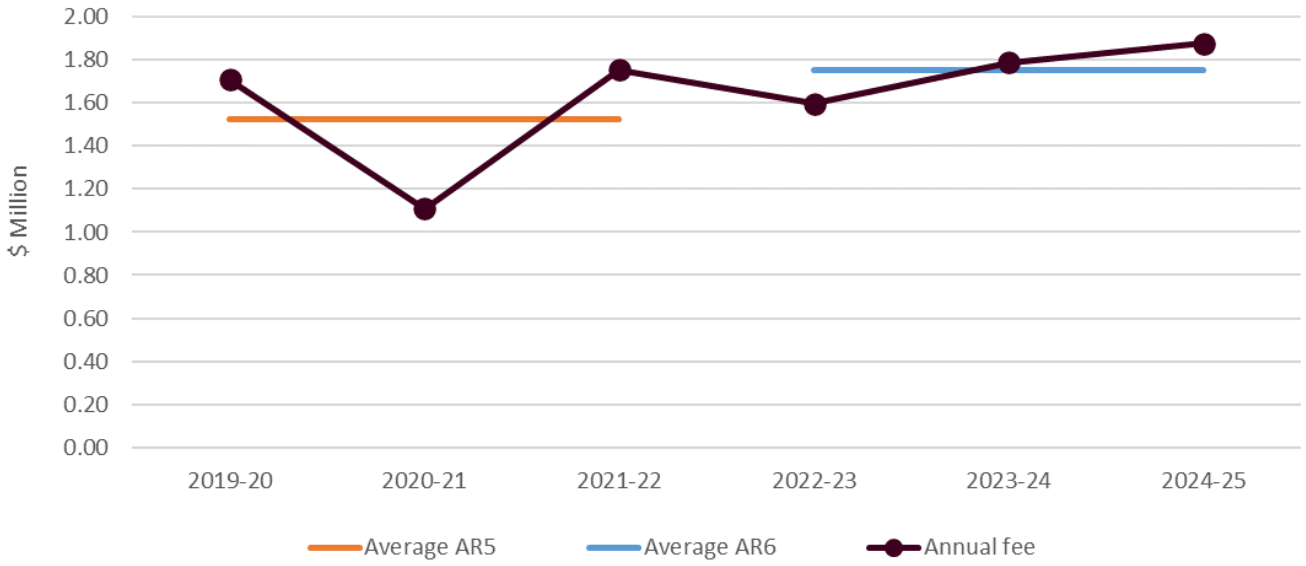
The GSI Fee is collected on a quarterly in arrears basis split evenly between gas shippers and producers. Gas shippers are charged on the actual share of gas deliveries based on the aggregated daily actual flows and each registered production facility operator (gas producer) is charged based on share of gas produced.

Table 51 and Figure 44 show the forecast GSI fees for the AR6 period.

Table 51 Estimated average annual GSI Fee during the AR6 period ($ million nominal)

	AR5 average	2022-23	2023-24	2024-25	AR6 average	Change in average (%)
GSI Fee	1.52	1.59	1.78	1.93	1.77	16%

Figure 44 Estimated average annual AR6 GSI Fee compared with AR5 average



AEMO's GSI fee moves over the review period from an average of $1.5 million in AR5 to $1.8 million in AR6.

5.3 GSI forecast capex

Forecast capex on GSI projects for the AR6 period is $0.38 million. This is consistent with the $0.40 million invested during the AR5 period.

Table 52 Estimated GSI capex during the AR6 period ($million nominal)

GSI capex project	2022-23	2023-24	2024-25	Total AR6
GBB lifecycle investment		0.23	-	0.23
Enterprise-wide cyber security	0.05	0.05	0.05	0.15
GSI capex	**0.05**	**0.28**	**0.05**	**0.38**

AEMO expects to deliver two key projects[79] in the AR6 period that will impact GSI:

- GBB lifecycle investment.
- Enterprise-wide cyber-security project.

GBB lifecycle investment

The Gas Bulleting Board is currently hosted on-premises in the Norwest data centre. The application is based on obsolete Java code, and requires updating.

This project entails re-writing the GBB code (moving from Java to .NET), and moving the application to be hosted on AEMO's digital platform (cloud). The $0.2 million estimate for this project is comprised mostly of labour costs

[79] AEMO is also looking to progress a Rule Change to include LNG Trucking within the GBB but at the time of finalising its CAPEX forecast for this proposal was unclear on whether this would be progressed in the AR5 or AR6 period. Implementation costs are assumed to be < $50k and AEMO will provide an update to the ERA in advance of its Draft Determination as to whether this will be progressed in AR5 or to be included as part of the aR6 proposal.

associated with the specialist resources required to re-write and test the GBB. This project is part of the lifecycle program described in AEMO's IT Roadmap.

The forecast is informed by the recent STEM Fortran replacement project during the AR5 period, which saw the STEM re-written from Fortran to .NET. The STEM Fortran project was delivered for $0.4 million.

AEMO considered leaving the GBB hosted on-premises in Java, however, this option was dismissed as the Java platform currently in use is already unsupported. Moving the GBB is consistent with AEMO's broader digital strategy and will eliminate hardware upgrade costs in the future.

Enterprise-wide cyber security

This is the GSI allocation (0.6%) of the enterprise-wide cyber security project described in section 4.3.2.

Glossary

Term	Definition
5MS	5 Minute Settlement
AEMO	Australian Energy Market Operator
AR4	The fourth allowable revenue period – 1 July 2016 to 30 June 2019
AR5	The fifth allowable revenue period – 1 July 2019 to 30 June 2022
AR6	The sixth allowable revenue period – 1 July 2022 to 30 June 2025
AR7	The seventh allowable revenue period – 1 July 2025 to 30 June 2028
Capex	Capital expenditure
CPI	Consumer Price Index
D&A	Depreciation and amortisation (costs)
DER	Distributed Energy Resources
ELT	Executive Leadership Team
EMS	Energy Management System
EMV	Expected Monetary Value
ERA	Economic Regulation Authority
ESOO	Electricity Statement of Opportunities
FTE	Full Time Equivalent
GSI	Gas Services Information
GSOO	Gas Statement of Opportunities
IAM	Identity and Access Management
IMO	Independent Market Operator
IT	Information Technology
LFAS	Load following ancillary service
MAC	Market Advisory Committee
MOI	Market Operator Interface
MWh	Megawatt hours
NEM	National Electricity Market
NEMDE	National Electricity Market Dispatch Engine
OGI	Organisational Governance & Integration

Term	Definition
Opex	Operational expenditure
OT	Operating technology
PASA	Projected Assessment of System Adequacy
PSMP	Power System & Market Planning
PSO	Power System Operations
PUO	Public Utilities Office
PV	Photovoltaic
RCM	Reserve Capacity Mechanism
RCP	Rule Change Panel
RoPE	Reduction of Prudential Exposure
SCADA	Supervisory control and data acquisition
SCED	Security Constrained Economic Dispatch
SMST	System Management Systems Transition
STEM	Short Term Energy Market
SWIS	South West Interconnected System
WA	Western Australia
WAECF	Western Australia Electricity Consultative Forum
WAGCF	Western Australia Gas Consultative Forum
WEM	Wholesale Electricity Market
WEMS	Wholesale Electricity Market System