Economic Regulation Authority

Procedure Change Report: Benchmark Reserve Capacity Prices

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Executive summary

In Western Australia's Wholesale Electricity Market (WEM), the Reserve Capacity Mechanism is used to signal opportunities for investment in (or retirement of) capacity to meet system reliability requirements. Benchmark Reserve Capacity Prices (BRCPs) are used, along with the level of excess capacity in the WEM and reserve capacity requirements, to determine reserve capacity prices. The BRCPs are based on cost estimates for building and connecting specified reference technologies to the network, called Benchmark Capacity Providers.

In December 2023, the Coordinator determined that there would be a change in the reference technology from a 160 megawatt (MW), liquid fuelled, open cycle gas turbine to a Battery Energy Storage System (BESS). This BESS was specified as a lithium-ion BESS, with 200-MW injection and 800 MW hour storage capacity, connected at a 330-kilovolt transmission line near Kwinana or Pinjar.[1]

The Coordinator also introduced a new flexible capacity product, requiring the determination of a flexible BRCP. The BESS is the reference technology for both the new flexible BRCP and the existing peak BRCP.

Finally, the Coordinator determined that the BRCPs would be calculated on a gross cost of new entry basis. The gross cost of new entry comprises the expected capital cost of developing the BESS and its fixed operating and maintenance costs.[2]

The Coordinator's determination triggered the ERA's review of the WEM Procedure for determining the BRCPs. Given the extent of the changes, the ERA has re-written the existing WEM Procedure to:

- Reflect the introduction of the new BESS reference technology, which required changes to the way the BRCP should be computed, including changes to capital cost and fixed operating and maintenance cost components.
- Provide detail on the Benchmark Capacity Providers' technical specifications and operating assumptions to give effect to the Coordinator's determination.

The ERA has also introduced a mechanism to address investors' expectations of future decreases in BESS capital costs, due to technological advances and manufacturing economies of scale, to appropriately incentivise investment in capacity. This mechanism, referred to as an "annuity tilt", provides more cashflow upfront when compared to a constant annuity, which it does by applying a tilt factor to the reserve capacity price. In its procedure change proposal, the ERA proposed setting the tilt factor to 1.24.

In preparing this report, the ERA was guided by the principle to "have regard to the need to promote regulatory outcomes that are in the long-term interest of consumers in relation to the price, quality and reliability of goods and services provided in relevant markets."[3,4] The ERA

1 Energy Policy WA, 2023, *Coordinator of Energy Determination: Benchmark Capacity Providers, Peak Capacity Provider and Flexible Capacity Provider,* (online).

2 Gross Cost of New Entry (CONE) differs to net CONE, which is the gross CONE less energy and essential system service revenues.

3 *Economic Regulation Authority Act 2003 (WA)*, clause 26(1)(b). p.15 (online).

4 The ERA must also consider the WEM Objectives, which includes an objective "to minimise the long-term cost of electricity supplied to customers from the South West interconnected system". Wholesale Electricity Market Rules (WA), 8 June 2024, Rule 1.2.1(d), (online).

also took account of consultation feedback and considered several key issues relating to impending reserve capacity pricing outcomes and their effect on consumers.

The introduction of the BESS as the new reference technology, with capital costs calculated on a gross cost of new entry basis, will immediately set the BRCP for the WEM substantially higher than when the reference technology was an open cycle gas turbine. The tilt factor will then potentially add to an already substantially higher BRCP.

Given the potential for immediate and considerable increases in prices for consumers, and having regard to the WEM objectives, the ERA has decided to introduce the tilt factor to address concerns regarding falling capital costs in the future, but to set the current value of the tilt factor to 1.0. This will effectively render the tilt factor neutral at the present time.

The ERA's role is to ensure that the reserve capacity price, through the BRCP, delivers sufficient revenue for the investment required to ensure system reliability. The reserve capacity mechanism needs to provide the correct price signals to encourage capacity investments and maintain system reliability for consumers. The Australian Energy Market Operator is expecting capacity shortfall conditions, which could lead to increases in reserve capacity prices.[5] The ERA does not consider that its decision to set the tilt factor to 1.0 at this time will undermine investment in the market.

The ERA periodically reviews the WEM Procedure for setting the BRCPs. At least once in every five years, or within one year of the Coordinator of Energy determining the Benchmark Capacity Providers, the ERA must review the WEM Procedure documenting the method and the process it must follow to determine the BRCPs.[6] The ERA will monitor the market over the coming years and any implications for the BRCP including the value of the tilt factor.

The new WEM Procedure will commence on 1 August 2024, at which time the ERA will commence the process of determining the new BRCPs using this WEM Procedure. The ERA will determine the BRCPs for the 2027/28 Reserve Capacity Year by 15 January 2025.

5 Australian Energy Market Operator, 18 June 2024, *2024 Wholesale Electricity Market Statement of Opportunities*, p. 3 (online).

6 Wholesale Electricity Market Rules (WA), 8 June 2024, Rule 4.16.9(b), (online).

Amendments to the WEM Procedure

Table 1 summarises the key changes to the WEM Procedure for setting the BRCP following the ERA's procedure change process. The revised WEM Procedure is available on the ERA's website.[7] The WEM Procedure will take effect on 1 August 2024.

Table 1: Summary of key amendments to the WEM procedure

Topic (Report Section)	Summary of Key Amendments
Flexible BRCP and Peak BRCP (4.1)	The ERA will apply the same method to determine both flexible and peak BRCPs.
Benchmark Capacity Provider	The Benchmark Capacity Providers are lithium-ion battery electric storage systems (BESS), as specified by the Coordinator of Energy's determination.[8] This has changed from the 160 MW, diesel fuelled, open cycle gas turbine, used in previous BRCP determinations.
BESS Sub-chemistry (4.2.1)	The Benchmark Capacity Providers will both be lithium-ion iron phosphate (LFP) BESSs.
Design specifications and assumptions (4.2.2)	The BESS must be able to provide 200 MW injection capacity and 800 MWh energy storage on its first day of operation, on 1 October in Year 3 of a Reserve Capacity Cycle.
Estimate of capacity credits	The number of capacity credits will be based on AEMO's assessment criteria in the WEM Rules.[9] This will be based on an assessment for Electric Storage Resources.
BESS capital costs (4.3)	The WEM Procedure states the formula for estimating capital costs and lists the capital cost components that must be estimated.
Supply and installation costs (4.3.1)	The ERA must estimate supply and installation costs of Benchmark Capacity Providers as part of its annual BRCP determinations. This includes the costs of battery containers or enclosures, power conversion systems, electrical and control balance of plant incurred in developing the Benchmark Capacity Providers, civil balance of plant, and installation labour and temporary equipment hire.
Transmission connection costs (4.3.2)	The ERA must estimate costs to connect the Benchmark Capacity Provider to the transmission network and can seek a provider to estimate these transmission costs. The WEM procedure states the process and provides the details for estimating transmission costs based on the most economical solution.
Land costs (4.3.3)	The WEM Procedure requires the ERA to estimate a single, average land cost based on average land prices across both Kwinana and Pinjar regions.
Other capital costs (4.3.4)	The ERA must estimate other costs including legal costs, construction financing, insurance, engineering and design services and environmental approval costs.

7 Economic Regulation Authority, 'WEM Procedures', (online).

8 The Coordinator of Energy determined the Benchmark Capacity Providers on 18 December 2023. See: Energy Policy WA, 2023, *Coordinator of Energy Determination: Benchmark Capacity Providers. Peak Capacity Provider and Flexible Capacity Provider,* (online).

9 Wholesale Electricity Market Rules (WA), 8 June 2024, Rule 4.11.3, (online).

Topic (Report Section)	Summary of Key Amendments
Fixed operation and maintenance costs (4.4)	The ERA must estimate fixed operation and maintenance (O&M) cost components as part of its annual BRCP determinations, including fixed maintenance costs, substation costs, corporate overheads, consulting services and other reasonable costs.
Annuity period (4.5.1)	The Benchmark Capacity Providers' capital costs must be annualised over a 15-year period.
Rate of return (WACC) (4.5.2)	The WEM procedure summarises the purpose and application of the Weighted Average Cost of Capital (WACC), outline the WACC determination method, and explains the computation of the WACC and pre-tax Officer WACC formula. The WEM procedure fixes certain WACC components until ERA's next review of the WEM procedure and identifies which components will be reviewed in the ERA's annual BRCP determinations.
Annuity tilt (4.5.3)	The WEM procedure adopts a tilted annuity, applied as a constant multiple. The multiple of the constant annuity is set at 1.0 at the present time.
Cost estimation and adjustment method (4.6)	The WEM Procedure explains when the ERA must adjust capital costs and fixed O&M costs and requires the ERA estimate capital costs and fixed O&M costs for the Benchmark Capacity Providers as at 1 April in Year 3 of the Reserve Capacity Year.
Procedure administration (4.7)	Appendix 1 of the WEM Procedure includes a timeline of amendments to the WEM Procedure since its inception in 2008. Sections 1 and 2 of the WEM Procedure outline the requirements from the WEM Rules so the WEM Procedure explains all aspects of the BRCP.

1. Introduction

To ensure reliable supply of electricity, generation needs to continuously meet consumer demand. To achieve this in Western Australia, the Reserve Capacity Mechanism (RCM) was implemented to provide investment signals to install capacity in the South West Interconnected System (SWIS).

The Australian Energy Market Operator (AEMO), through the RCM, procures capacity two years in advance of a capacity year.[10] AEMO uses the reliability planning criterion outlined in the Wholesale Electricity Market (WEM) Rules to establish a reserve capacity target for the relevant capacity year, which is the level of capacity required to maintain system reliability.[11]

AEMO invites capacity suppliers to offer their capacity for that capacity year and assigns capacity credits to those suppliers consistent with their estimated contribution to meeting the planning criterion.[12] Capacity suppliers receive payments consistent with the number of capacity credits they hold, and in return, commit to making their capacity available in the capacity year. If a Capacity Credit holder does not make the capacity available that is associated with those credits, they must pay refunds.

The reserve capacity price provides signals for investing in capacity. For example, the reserve capacity price will be higher when there is a low amount of excess capacity or a capacity shortage, which can encourage new investment in additional capacity. In contrast, the capacity price will be lower at times of high excess capacity, signalling to the market that no new investment is needed to meet reliability requirements.

Electricity retailers fund the procurement of capacity and recover their cost from consumers through retail electricity tariffs.[13]

The WEM Rules specify a reserve capacity price curve to calculate the price of capacity credits, expressed in dollars per megawatt, per capacity year ($/MW/Year).[14,15] The price of capacity credits depend on the Benchmark Reserve Capacity Price (BRCP), the level of excess capacity in the WEM, and the reserve capacity targets required to meet the planning criterion.[16]

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10 A capacity year commences on 1 October each year. For example, the 2027/28 Capacity Year commences on 1 October 2027. See: Wholesale Electricity Market Rules (WA), 8 June 2024, Chapter 11, 'Capacity Year', (online).

11 Wholesale Electricity Market Rules (WA), 8 June 2024, Rule 4.5.9, (online).

12 A capacity credit is a notional unit equivalent to 1 MW of either peak capacity or flexible capacity provided by a facility during a capacity year. A Facility can hold peak capacity credits and flexible capacity credits for the same MW of capacity, but it cannot hold more flexible capacity credits than peak capacity credits. For example, a facility with 100 MW nameplate capacity could receive up to 100 MW of peak capacity credits and 100 MW of flexible capacity credits. Each product has separate peak and flexible reserve capacity obligation quantities.

13 The cost of capacity payments is balanced against the benefits of procuring capacity to improve the reliability of the system. Although consumers value a secure and reliable electricity supply, they should not be expected to pay for excess capacity that provides little additional benefit to system security and reliability.

14 Wholesale Electricity Market Rules (WA), 8 June 2024, Rule 4.29.1, (online).

15 Currently, the WEM Rules specify one reserve capacity price curve with a single BRCP as the input. EPWA is currently reviewing the reserve capacity price curve and will introduce separate price curves for determining the peak Reserve Capacity Price and the flexible Reserve Capacity Price. See: Energy Policy WA, 2024, 'Differentiating Peak and Flexible Capacity', *WEM Investment Certainty Review Working Group – Meeting 2024_01_24*, p. 11, (online).

16 The calculation of the BRCP, together with its application in the determination of capacity price, seeks to balance the cost to consumers of procuring capacity credits against the benefits to consumers of improving the reliability of electricity supply. See: Energy Policy WA, 2023, *BRCP Reference Technology Review, Consultation paper*, p. 9, (online).

The BRCP must reflect the lowest annualised capital cost and annual fixed operation and maintenance (O&M) cost of a Benchmark Capacity Provider that can provide capacity to the SWIS for a capacity year that commences two years into the future.[17]

The ERA must annually determine the BRCP using a WEM Procedure that outlines the method the ERA must use and the process it must follow to determine the BRCP.[18] The ERA must also review the WEM Procedure at least once in a five-year period or within one year of the Coordinator of Energy's determination of the Benchmark Capacity Provider, where the Coordinator determines a change in the technology of the Benchmark Capacity Provider.[19,20]

In its review of the WEM Procedure, the ERA must:

- Ensure the WEM Procedure is consistent with the WEM Objectives, WEM Rules, the *Electricity Industry Act 2004* and *Electricity Industry (Wholesale Electricity Market) Regulations 2004*.[21]
- Follow the procedure change process outlined in the WEM Rules.[22,23] These obligations are summarised in section 1.2.

In December 2023, the Coordinator determined that there would be a change in the technology of the Benchmark Capacity Provider (summarised in section 1.2) to be a Battery Energy Storage System (BESS), initiating the ERA's review of the WEM Procedure. Following this, on 5 April 2024, the ERA published a procedure change proposal and sought stakeholder feedback on its draft WEM Procedure by 6 May 2024.[24]

The ERA received seven submissions in response to its procedure change proposal and feedback from the Market Advisory Committee's (MAC) Working Group that was established for the review of the WEM Procedure.[25] This feedback is discussed in Chapter 3.

The ERA has considered the feedback it received to reach this final determination. This document sets out stakeholders' feedback, provides the ERA's responses, and outlines the ERA's amendments to the WEM Procedure:[26]

- Chapter 1 summarises the current WEM Procedure, changes in the WEM design, and the procedure change process.
- Chapter 2 explains the scope of the ERA's review of the WEM Procedure.

17 Wholesale Electricity Market Rules (WA), 8 June 2024, Rules 4.16.1 and 4.16.2, (online).

18 Ibid, Rule 4.16.3.

19 Ibid, Rule 4.16.9(b).

20 The Coordinator of Energy determined the Benchmark Capacity Providers on 18 December 2023. See: Energy Policy WA, 2023, *Coordinator of Energy Determination: Benchmark Capacity Providers. Peak Capacity Provider and Flexible Capacity Provider,* (online).

21 Wholesale Electricity Market Rules (WA), 8 June 2024, Rule 2.9.3(a), (online).

22 Ibid, Rule 2.10.

23 Energy Policy WA, 2021, *WEM Procedure: Procedure Administration,* (online).

24 Economic Regulation Authority, 2024, *Procedure Change Proposal: Benchmark Reserve Capacity Price*, (online), and Economic Regulation Authority, 2024, *Draft WEM Procedure – Benchmark Reserve Capacity Prices* (online).

25 All submissions are available on the ERA's website, (online). The MAC is a committee of industry and consumer representatives that provides advice on the evolution of the WEM Rules.

26 To amend a WEM Procedure, the ERA must follow the procedure change process required by the WEM Rules by publishing a procedure change proposal for public consultation, followed by a procedure change report, which includes the proposed replacement of the WEM Procedure and the reasons for the replacement. The procedure change process is summarised in Section 1.2 of this report. Wholesale Electricity Market Rules (WA), 8 June 2024, Rule 2.10, (online).

- Chapter 3 outlines the ERA's stakeholder consultation process and highlights stakeholder concerns regarding increasing costs. Feedback regarding other topics is presented within the relevant sections in chapter 4.
- Chapter 4 outlines changes to the WEM Procedure and the ERA's reasons for the changes.
- The updated WEM Procedure is provided in Appendix 1.

1.1 Changes to the WEM design and the need for review

Through the Energy Transformation Strategy, the State Government is implementing reforms to improve the WEM.[27] Changes to the WEM now allow BESS to participate in the Real-Time Market and Essential System Services (ESS) market and receive capacity credits.[28] Further reforms are underway.[29]

The reforms introduced a flexible capacity product, which is reserve capacity that can respond at very short notice to manage changes in load during high ramp periods.[30] This complements the existing capacity product, called peak capacity, which is reserve capacity that contributes to meeting system peak demand. As a result, the ERA must determine two BRCPs from its next determination (the 2025 Reserve Capacity Cycle, which applies to the 2027/28 capacity year) – a peak BRCP and a flexible BRCP.[31,32]

The reforms also introduced a new function for the Coordinator of Energy to determine the following BRCP parameters:

- The appropriate reference technology (the benchmark capacity providers) and the underlying technical parameters such as size and capabilities.[33]
- The uncongested network location.

27 Energy Policy WA, 15 November 2023, *Energy Transformation Strategy*, (online) [accessed on 9 July 2024].

28 An explanation of the new market design is available on AEMO's website. See: Australian Energy Market Operator, 2023, *Wholesale Electricity Market Design Summary*, (online).

29 For instance, the Coordinator is reviewing the reserve capacity pricing curve and the effect of the emissions threshold on the allocation of capacity credits. See: Energy Policy WA, 2024, *WIC Review Working Group – Meeting 24 January - Papers*, pp. 4-16, (online).

30 Energy Policy WA, 22 December 2023, 'Stage 2 of the RCM Review – Energy Policy WA', *Reserve Capacity Mechanism Review*, (online).

31 The flexible BRCP reflects the expected annualised capital cost plus the annual fixed O&M cost of the Benchmark Flexible Capacity Provider and is expressed as dollars per MW of flexible capacity credits per year.

32 The peak BRCP reflects the expected annualised capital cost plus the annualised fixed O&M cost of the Benchmark Peak Capacity Provider and is expressed as dollars per MW of peak capacity credits per year.

33 Benchmark Capacity Providers include the Benchmark Peak Capacity Provider and the Benchmark Flexible Capacity Provider. The Benchmark Peak Capacity Provider is a notional new facility of the facility technology type that can provide peak capacity at the lowest annual capital cost and annual fixed operating and maintenance costs, as determined by the Coordinator of Energy. The Benchmark Flexible Capacity Provider is a notional new facility of the facility technology type that can provide flexible capacity at the lowest annual capital cost and annual fixed operating and maintenance costs, as determined by the Coordinator of Energy. Wholesale Electricity Market Rules (WA), 8 June 2024, Rule 4.16.11, (online).

- Whether the BRCP is to be assessed based on a gross or net Cost of New Entry (CONE).[34,35]

In December 2023, the Coordinator determined that both flexible and peak Benchmark Capacity Providers must be a lithium-ion BESS, with 200 MW injection and 800-megawatt hour (MWh) energy storage, that are in or near Kwinana or Pinjar, on an unconstrained 330-kilovolt (kV) transmission line.[36] The Coordinator also determined that the BRCP will be calculated on a gross CONE basis, consistent with the current approach for determining the BRCP.[37,38]

1.1.1 Current WEM Procedure

The current WEM Procedure outlines the method for determining the BRCP based on the expected cost incurred in developing the previous reference facility, which was a 160 MW, distillate-fuelled, Open Cycle Gas Turbine (OCGT). The calculation estimates the following components:

- The total capital cost, comprising engineering, procurement and construction costs, transmission interconnection costs, fixed fuel related costs, land costs, a contingency margin, and the cost of capital.
- Fixed O&M costs for the reference facility and the transmission interconnection, including fixed network access charges and insurance costs.

These cost components are annualised through a 15-year annuity using a discount rate, which is currently set equal to the weighted average cost of capital (WACC). The BRCP is then calculated by dividing the annuity amount by the amount of capacity credits expected to be assigned to the reference facility. This is summarised in the following equation:

$$BRCP = \frac{ANNUAL_{FIXED\ O\&M} + ANNUALISED_{CAPEX}}{CAPACITY\ CREDITS}$$

Following the Coordinator's determination of the Benchmark Capacity Providers and changes to the WEM design, the ERA must update the WEM Procedure used to determine the BRCP. Given the significant number of amendments required to update it in line with the reforms, the ERA has replaced the WEM Procedure entirely, rather than amend specific clauses.

Appendix 1 provides the updated WEM Procedure, which will take effect from 1 August 2024.

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34 Ibid, Rule 4.16.12, (online).

35 Gross CONE represents the total capital investment and fixed costs the marginal new entrant reference facility (Benchmark Capacity Provider) incurs to enter the market. Net CONE represents the capital costs of the new entrant facility, less an estimate of the contribution towards capital costs from the facility's participation in the Real-Time Market.

36 Energy Policy WA, 2023, *Coordinator of Energy Determination: Benchmark Capacity Providers. Peak Capacity Provider and Flexible Capacity Provider,* (online).

37 Ibid.

38 In 2022, the Minister for Energy provided the Coordinator of Energy with a draft statement of policy principles to apply penalties to high-emission technologies in the WEM. The policy intends to incentivise connection of new renewable generation capacity. The WEM Investment Certainty Review is currently developing emission thresholds for existing and new high emission technologies in the WEM. To determine the technology underlying the Benchmark Capacity Providers, the Coordinator noted the technology must have the potential to meet the emission threshold requirements proposed under the WEM Investment Certainty Review. See:

Energy Policy WA, 2022, *Draft Statement of Policy Principles: Penalties for high emission technologies in the Wholesale Electricity Market*, (online).

Energy Policy WA, 2023, *BRCP Reference Technology Review: Consultation Paper*, p. 11, (online).

Energy Policy WA, 2023, *Scope of Work for the WEM Investment Certainty Review*, (online).

In recent annual BRCP determinations, various stakeholders have raised concerns that the calculation method for the BRCP has several shortcomings, which the ERA has included in this review.[39]

1.2 The procedure change process

The ERA must publish a procedure change proposal that includes the proposed amended drafting for the WEM Procedure and the reasons for those amendments.[40] The ERA must seek feedback on its proposal.[41]

The ERA may seek advice from the MAC when conducting this review.[42] The MAC may provide feedback to the ERA through meetings or by delegating its role to a working group of rule participants and other stakeholders.[43]

After considering stakeholder feedback on its proposal, the ERA must publish a procedure change report that outlines:

- The wording of amendments to the WEM Procedure and the reasons for the amendments.
- All submissions received before the due date for submissions, a summary of these submissions, and the response of the ERA to the issues raised in those submissions.
- A summary of the views expressed by the MAC or, if the MAC has delegated its role to consider the procedure change proposal to a working group, a summary of the views expressed by that working group.
- A proposed date and time for the amendments to commence, which must, in the ERA's opinion, allow enough time after the date of publication of the procedure change report for rule participants to implement the changes required.[44]

39 For example, stakeholders have previously noted the reference technology is outdated and the hard-coded WACC parameters in the Procedure are not reflective of inflationary pressures. Previous BRCP determinations can be found on the ERA's website, (online).

40 Wholesale Electricity Market Rules (WA), 8 June 2024, Rules 2.10.5B and 2.10.6, (online).

41 The consultation period must be at least 20 business days. The ERA can extend the consultation period at its discretion by publishing a notice of extension. Wholesale Electricity Market Rules (WA), 8 June 2024, Rules 2.10.7, 2.10.17 and 2.10.18, (online).

42 Wholesale Electricity Market Rules (WA), Rule 2.10.9, (online).

43 Ibid, Rule 2.3.17.

44 Ibid, Rules 2.10.10, 2.10.12B and 2.10.13, (online).

2. Scope of the ERA's review

To scope this review, the ERA considered the purpose of the RCM in providing appropriate price signals for capacity providers to enter the capacity market and thereby ensure there is sufficient capacity in the SWIS.

The ERA considers the objective of its review is to develop a WEM Procedure to annually determine a flexible BRCP and peak BRCP that:

- Reflect the Coordinator of Energy's determination of the Benchmark Capacity Providers, including the technical parameters and location of the technology, and the introduction of flexible capacity.
- Can be used in conjunction with the capacity demand curve used to determine the reserve capacity price.
- Includes:
  - All reasonable and material costs expected to be incurred in the development of the Benchmark Capacity Providers, including capital expenditure and fixed O&M costs incurred in developing and operating the facility in the WEM.
  - A reasonable method to annualise costs that suitably aligns with an investor's practice in raising funds and developing the Benchmark Capacity Providers.
- Allows the ERA to undertake a technical bottom-up cost evaluation of the entry of the Benchmark Capacity Providers into the SWIS for the relevant capacity year.
- Is clear and unambiguous in its interpretation; provides certainty to industry on how the BRCPs will be determined annually; and complements the energy market reforms.
- Is consistent with the WEM Objectives, WEM Rules, the *Electricity Industry Act (2004)* and WEM Regulations.

To fulfil the objective outlined above, the ERA undertook a three-step process.

First, the ERA adopted the perspective of prospective investors intending to invest in a 200 MW / 800 MWh lithium BESS in the SWIS. This analysis identified how the BRCP Procedure can encourage investors to invest in electricity capacity. For instance, the ERA considered how the change in reference technology from an OCGT to a BESS changes investors' expectations of future cashflows, and how that may affect the method to annualise costs in the BRCP calculation. The ERA has sought feedback from the MAC working group, technical consultants with expertise in BESS, and financial institutions that typically finance BESS projects. This is further discussed in section 4.5.

Second, the ERA identified the capital expenditure and fixed O&M cost components of a 200 MW / 800 MWh lithium BESS and developed methods to determine the lowest costs possible. The ERA engaged GHD to provide advice on BESS cost components, drivers, and estimation methods. To demonstrate the application of its recommended cost estimation methods and guide the development of changes to the WEM Procedure, GHD conducted a bottom-up evaluation and produced an indicative BRCP, which is included in its report. GHD's report is available in Appendix 2.

Third, the ERA considered which parameters must be fixed in the WEM Procedure until the ERA's next review of the WEM Procedure, and which parameters may vary between the

ERA's annual BRCP determinations.[45] This exercise balanced the need to provide certainty and clarity to industry on how the BRCP will be determined annually, while keeping the WEM Procedure dynamic, to respond to changing market conditions. For instance, the Coordinator has determined the BESS chemistry as lithium-ion, but there are various lithium sub-chemistries. Prescribing a lithium sub-chemistry in the WEM Procedure provides transparency and certainty for investors. This is discussed further in section 4.2.1.

Chapter 4 outlines the ERA's amendments to the following areas of the WEM Procedure:

1. Flexible BRCP and peak BRCP: The flexible BRCP is a new product and the proposed WEM Procedure must provide guidance on how to determine both BRCPs.

2. BESS technical specifications: The WEM Procedure must outline the BESS design specifications and operating assumptions to give effect to the Coordinator's determination of the Benchmark Capacity Providers.

3. Capital costs: The WEM Procedure must outline material capital cost components of the BESS and reasonable methods to estimate those costs.

4. Fixed O&M costs: The WEM Procedure must outline material fixed O&M cost components of the BESS, including reasonable methods to estimate those costs.

5. Annualisation: As capital costs are fixed costs that are incurred at the start of the project, these costs must be annualised to derive an annualised capital cost for the BRCPs. The WEM Procedure must provide guidance on how to determine an annualised capital cost. This includes guidance on the factors that must be specified in the WEM Procedure to allocate capital and financing costs over the project's life. These factors include the rate of return, annuity period and expected cashflow profiles.

6. Method to estimate future costs: The BRCPs are determined approximately two years in advance of the relevant capacity year and the expected development time to construct the BESS. The WEM Procedure must account for price movements between the date of the BRCP determination and the date the ERA expects the costs to be incurred.

7. Procedure administration: To improve readability of the WEM Procedure and references to the WEM Rules where appropriate.

2.1 Matters outside the ERA's scope

As part of the review of the WEM Procedure, the ERA did not review the parameters of the BRCPs that are within the Coordinator of Energy's determination of Benchmark Capacity Providers, such as the appropriateness of the reference technology, its technical parameters and location.[46]

The ERA has not considered a BESS investor's expected revenue streams from the Real-Time Market or Frequency Co-optimised Essential System Services (FCESS) markets that could offset the BESS's capital costs. This is in line with the Coordinator's determination that

[45] The ERA cannot specify a fixed value in the WEM Procedure for a parameter that is likely to change from year to year. Instead, the ERA must specify principles or procedures for determining that parameter. Wholesale Electricity Market Rules (WA), 8 June 2024, Rule 4.16.4, (online).

[46] Wholesale Electricity Market Rules (WA), 8 June 2024, Rule 4.16.12, (online).

the BRCPs must be calculated on a gross CONE basis and not consider the expected contribution to capital costs from participation in the Real-Time Market.[47]

Given the Coordinator has determined an unconstrained network location for the Benchmark Capacity Providers, the application of network access quantities will not affect the allocation of capacity credits and therefore the method to determine the BRCP.[48]

The Coordinator has indicated that it may review its determination of the Benchmark Capacity Providers more frequently if the reference technology costs materially change before its next triennial determination.[49] A change in the Coordinator's determination of Benchmark Capacity Providers requires the ERA to review the WEM Procedure within one year. The ERA must review the WEM Procedure at least once every five years but can review it more frequently and in doing so, must consult with stakeholders when it reviews the WEM Procedure.

There are many possible aspects of the method that are potentially subject to change that could trigger the ERA undertaking a review sooner than the required five-year timeframe. Examples include (but are not limited to) review of:

- the choice of sub-chemistry, which GHD recommended should occur in three years' time, as BESS technologies continue evolving.
- the appropriateness of a site-specific approach to estimating transmission costs, depending on the progress of SWIS transmission upgrades.

47 Energy Policy WA, 2023, *Coordinator of Energy Determination: Benchmark Capacity Providers, Peak Capacity Provider and Flexible Capacity Provider*, p. 6, (online).

48 The network access quantity is a new element of the RCM that provides a cap on the amount of capacity credits a facility can receive based on the available network capacity at the relevant connection point. AEMO determines each facility's network access quantity. See: Wholesale Electricity Market Rules (WA), 8 June 2024, Rule 4.15, (online).

49 Energy Policy WA, 2023, *Coordinator of Energy Determination: Benchmark Capacity Providers, Peak Capacity Provider and Flexible Capacity Provider*, p. 12, (online).

3. Stakeholder feedback on the ERA's proposal

On 5 April 2024, the ERA published a procedure change proposal for stakeholder feedback.[50]

This chapter summarises the stakeholder consultation process and highlights feedback the ERA received regarding increasing costs in response to its procedure change proposal. Other feedback is presented within the relevant sections in chapter 4.

The ERA's position in this report has not materially changed from its proposal, however the ERA has adjusted the annuity tilt factor. Details on the annuity tilt factor and the reasons for the change from the procedure change proposal are presented in section 4.5.3.

3.1 Industry working group

In November 2023, the MAC established a working group to advise the ERA on this review of the WEM Procedure.[51] The BRCP WEM Procedure Review Working Group provided the ERA with feedback over four meetings and out of session.[52,53]

Meeting 1 of the Working Group was held on 18 December 2023. Consideration was given to the project scope and timeline and seven main topics for review:

- the aim of the BRCP procedure
- implications of the coordinator's determination
- the method to estimate the cost of the Benchmark Capacity Providers
- the cost recovery period
- the discount rate
- transmission costs
- Network Access Quantities.

Meeting 2 was held on 6 February 2024. The ERA provided a progress update and the working group discussed three main topics including battery chemistry, the weighted average cost of capital, and the annuity tilt.

Meeting 3 occurred on 22 February 2024 in which preliminary advice from GHD was presented on BESS technical specifications and cost components, along with a preliminary BRCP. The approach to determining transmission and land costs was also discussed.

The final meeting occurred on 19 April 2024. The ERA summarised its procedure change proposal and Draft WEM Procedure and summarised feedback received out of session from

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50 Economic Regulation Authority, 2024, *Procedure Change Proposal: Benchmark Reserve Capacity Price – EEPC_2024_01*, (online).

51 Market Advisory Committee, 23 November 2023, 'Benchmark Reserve Capacity Price (BRCP) WEM Procedure Review', *MAC Meeting Minutes*, pp. 11 - 12 (online).

52 The ERA Secretariat chairs and provides secretariat support to this working group. All working group papers, including meeting minutes and terms of reference, are published on its website. See: Economic Regulation Authority, 2023, *BRCP WEM Procedure Review Working Group,* (online).

53 The ERA Secretariat – as secretariat to the working group – emphasised that the ERA's Governing Body is the ultimate decision maker on the review of the WEM Procedure, and the working group has an advisory role only. See: BRCP WEM Procedure Review Working Group, 28 December 2023, 'Item 1. Welcome', *Final Minutes – 2023_12_18*, p.1, (online).

the Working Group on the draft WEM Procedure in March 2024. The ERA sought feedback on whether queries were adequately resolved. Members did not provide any further feedback.

At the MAC meeting on 13 June 2024, the Working Group Chair recommended that the MAC disband the Working Group.

The ERA sought feedback from the MAC working group at the workshop held on 19 April 2024, and considered the working group's feedback when developing the procedure change report.

3.2 Public submissions

The ERA sought feedback on its procedure change proposal by 6 May 2024. The ERA received seven stakeholder submissions from:

- Alinta Energy[54]
- AEMO[55]
- Chamber of Minerals and Energy WA (CME)[56]
- The Expert Consumer Panel[57]
- Synergy[58]
- Tesla Holdings[59]
- A confidential submission.[60]

Stakeholder feedback regarding increasing costs is highlighted below and other feedback is discussed in the relevant sections in chapter 4.[61]

3.2.1 Concern regarding general increase in costs

Some stakeholders, including CME, expressed concern about the substantially higher costs that will be borne by electricity consumers following the changes to the BRCP determination method.[62]

Stakeholders raised similar concerns during the MAC working group meetings, including concern about the expected increase in capacity costs, and the resulting cost for consumers,

54 Alinta Energy, 2024, *Submission to the ERA's procedure change proposal EEPC_2024_01*, (online).

55 Australian Energy Market Operator, 2024, *Submission to the ERA's procedure change proposal EEPC_2024_01*, (online).

56 Chamber of Minerals and Energy WA, 2024, *Submission to the ERA's procedure change proposal EEPC_2024_01*, (online).

57 Expert Consumer Panel, 2024, *Submission to the ERA's procedure change proposal EEPC_2024_01*, (online).

58 Synergy, 2024, *Submission to the ERA's procedure change proposal EEPC_2024_01*, (online).

59 Tesla Holdings, 2024, *Submission to the ERA's procedure change proposal EEPC_2024_01*, (online).

60 Name withheld, 2024, *Submission to the ERA's procedure change proposal EEPC_2024_01*, (online).

61 All submissions are published on the ERA's website (online).

62 GHD's draft report, which was published alongside the ERA's procedure change proposal for stakeholder feedback, estimated an indicative BRCP of $383,276. See: GHD, 15 March 2024, *Benchmark lithium BESS costs – BRCP Procedure update, Report for the Economic Regulation Authority,* p. 47, (online).

driven by increases in the reserve capacity price due to the expected capacity shortfalls, and increases due to the changes proposed to the WEM Procedure.[63]

The scope of this review is limited to a review of the WEM Procedure used to determine the BRCP. The WEM Procedure must comply with the Coordinator of Energy's determination, which has changed the Benchmark Capacity Providers from an OCGT to a BESS and requires the ERA to determine the BRCPs on a gross CONE basis. This does not allow for the consideration of revenue from other sources and assumes the BESS investor recovers all fixed costs through capacity credit payments.

Given an already high BRCP, in their submission to the ERA's rule change proposal, the Expert Consumer Panel expressed concerns about the potential for significant extra capacity costs being transferred away from investors to consumers in the early years because of tilting the annuity. The Expert Consumer Panel considered that revenues from the Real Time Market and shortage conditions due to the retirement of coal plant and demand growth would lead to further increases in reserve capacity prices. On this basis they advised the ERA not to apply the tilt factor.

Following stakeholders' feedback, the ERA has changed the originally proposed annuity tilt factor to 1.0, to better achieve the WEM objective of minimising the long-term cost of electricity supplied to customers. This is discussed in section 4.5.3.4.

[63] BRCP WEM Procedure Review Working Group, 19 April 2024, 'Item 3. Summary of the ERA's procedure change proposal and draft WEM Procedure', *2024_04_19 – Meeting 4 minutes,* p. 2, (online).

4. Changes to the WEM Procedure

This chapter outlines the ERA's amendments to the WEM Procedure. The relevant clauses of the updated WEM Procedure (Appendix 1) are described in the yellow boxes.

4.1 Flexible BRCP and Peak BRCP

As explained in section 4.1, the WEM Procedure must provide guidance on determining both the flexible and peak BRCPs. Given the Coordinator's determination that both flexible and peak Benchmark Capacity Providers are the same reference technology, the ERA will apply the same method to determine both BRCPs.[64,65,66]

To avoid repetition, the WEM Procedure is drafted to provide guidance on both the flexible BRCP and the peak BRCP together. A reference to the BRCPs in the WEM Procedure is a reference to both the flexible BRCP and the peak BRCP, unless otherwise stated. Similarly, a reference to capacity credits in the WEM Procedure is a reference to both flexible and peak capacity credits, unless otherwise expressed.

WEM Procedure:

- Clause 1.1.1(a) defines the BRCPs as the Peak BRCP and Flexible BRCP unless otherwise expressed in the Procedure.
- Clause 1.1.1(b) defines the Benchmark Capacity Providers as Flexible and Peak Benchmark Capacity Providers unless otherwise expressed in the Procedure.
- Clause 1.1.1(c) defines Capacity Credits as Peak Capacity Credits and Flexible Capacity Credits unless otherwise expressed in the Procedure.
- Clause 2.1.2 specifies that the BRCPs must include all reasonable costs expected to be incurred in the development of the Benchmark Capacity Providers.
- Clause 2.1.5 summarises the Coordinator's determination of the Benchmark Reserve Capacity Providers.
- Clause 2.1.6 outlines the same design specifications for both Benchmark Capacity Providers.
- Clause 2.2.3 outlines the formula for determining the BRCPs.

64 Facilities receiving flexible capacity credits must meet all the same requirements as for peak capacity credits, and the additional ramping requirements determined by the Coordinator of Energy. These include a requirement for daily generation, a ramp rate of 100 per cent of capacity in 30 minutes, 30 minutes start time and minimum online generation of 25 per cent. A facility can receive both peak and flexible capacity credits. Wholesale Electricity Market Rules (WA), 8 June 2024, Rule 4.20.5A(a) (online).

65 GHD advised that all BESS technologies that comply with the Coordinator's determination can achieve both the peak and flexible service requirements and did not recommend any specific design differences for the flexible service providers. The design specification and assumptions are summarised in section 4.2 of this paper and detailed in GHD's report. GHD's report is provided in Appendix 2. See: GHD, 2024, *Benchmark lithium BESS costs, BRCP procedure update*, Report for the Economic Regulation Authority, p.4.

66 The flexible BRCP and peak BRCP can differ due to differences in flexible capacity credits and peak capacity credits respectively assigned. The flexible Reserve Capacity Price and peak Reserve Capacity Price can differ due to differences in flexible BRCP and peak BRCP, the pricing curve used to determine the flexible and peak capacity prices, as well the supply of flexible and peak capacity products. Wholesale Electricity Market Rules (WA), 8 June 2024, Rule 4.20.5A(a) (online).

4.2 BESS technical specifications

4.2.1 BESS sub-chemistry

The Coordinator determined that the peak and flexible Benchmark Capacity Providers must be a lithium-ion BESS.[67] There are many different lithium-ion BESS battery cell sub-chemistries. The chosen lithium-ion sub-chemistries affect the characteristics of a BESS, including cost, cycle life, operational characteristics, and the investor's expected cashflows.

The ERA considered:

- Which sub-chemistries are cost-effective and commonly implemented across BESS projects, and what is reasonable for the purpose of the BRCP.
- The benefits of specifying the sub-chemistry in the WEM Procedure to provide industry with greater certainty, or whether it is more reasonable to leave the sub-chemistry as a parameter for the ERA's annual BRCP determination.

In the WEM Procedure, the ERA specifies that the Benchmark Capacity Providers are a lithium iron phosphate (LFP) BESS. The ERA considered GHD's advice, the ERA's engineering consultant, that the LFP sub-chemistry is currently investors' technology of choice and has the best technical characteristics, such as cost, life span, safety risk, performance and energy density, when compared to other lithium sub-chemistries.

Given the preferred qualities of the LFP sub-chemistry and that there is a high adoption of LFP in major grid-scale BESS projects across Australia, GHD recommended that LFP is likely to be the investor's preferred technology choice in the medium-term, and that it is reasonable for the purpose of the BRCP determination.

4.2.1.1 Stakeholder feedback

Feedback from submissions was generally supportive of this recommendation. In their submissions, AEMO and Synergy considered that the choice of the LFP sub-chemistry was reasonable.[68] Synergy also considered the ERA's approach to specifying the sub-chemistry in the WEM Procedure was reasonable, as it provides certainty to market participants and enough flexibility to ensure assumptions remain accurate.

AEMO noted the WEM Rules require the ERA to review the WEM Procedure every five years and recommended more frequent reviews to ensure the sub-chemistry remains the most efficient choice as BESS technology advances. Synergy recommended that the ERA review the BESS sub-chemistry every three years.

The ERA notes that the Coordinator must review the Benchmark Capacity Providers if AEMO changes the Electricity Storage Resource Duration Requirement, which is the length of time that storage needs to provide electricity for and is currently set at four hours. This will subsequently trigger the ERA's review of the WEM Procedure.

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67 Energy Policy WA, 2023, *Coordinator of Energy Determination: Benchmark Capacity Providers, Peak Capacity Provider and Flexible Capacity Provider*, p. 5, (online).

68 Australian Energy Market Operator, 2024, *Submission to the ERA's procedure change proposal EEPC_2024_01*, (online), and Synergy, 2024, *Submission to the ERA's procedure change proposal EEPC_2024_01*, (online).

WEM Procedure

Clause 2.1.6(a) specifies that the Benchmark Reserve Capacity Providers use a lithium-ion iron phosphate sub-chemistry.

4.2.2 Design specifications and assumptions

The Coordinator determined that both flexible and peak Benchmark Capacity Providers must provide 200 MW injection capacity and 800 MWh energy storage. Given the Benchmark Capacity Providers are BESS technologies, which are classified as Electric Storage Resources (ESR) in the WEM Rules, they will receive capacity credits based on their ability to operate and output over the four-hour obligation period, at an ambient temperature of 41 degrees Celsius.[69,70]

In its procedure change proposal, the ERA assumed that the BESS must be able to provide 200 MW injection capacity and 800 MWh energy storage on its first day of operation, that is, 1 October in Year 3 of a Reserve Capacity Cycle.[71] The ERA proposed that the WEM Procedure will *not* specify the sizing required to achieve the required energy and power capacity, given the energy and power capacity requirements can vary based on the BESS design and the WEM Rule requirements.

4.2.2.1 Stakeholder feedback

Stakeholder feedback suggested that the minimum requirements for the BESS be stated but that there is no need to specify the amount of oversizing. Oversizing is when an investor installs more capacity than is required to account for degradation expected in battery units prior to the start of operations. This is to ensure that the BESS can meet the minimum operational requirements on the first day of operations.

Synergy stated that it was reasonable for market participants to determine their own degree of oversizing and that the WEM Procedure should not specify the degree of oversizing. AEMO suggested that the WEM Procedure should state the facility's nameplate capacity (that is, 200 MW) and specify that the facility be able to achieve a four-hour duration for each day during the first year of operation, rather than on its first day of operation only.

The ERA's changes to the WEM Procedure are based on the Coordinator's determination requiring the BESS to have a "200 MW injection capability".[72] The WEM Procedure is consistent with that determination. The ERA and GHD considered stakeholder feedback and the ERA has maintained its recommendation to *not* specify the degree of oversizing. This would enable the ERA to determine the extent of oversizing required to meet the WEM Rule requirements in its annual BRCP determination, based on the most up to date information. GHD has estimated that a 10 per cent capacity uplift is enough to maintain injection levels

69 Wholesale Electricity Market Rules (WA), 8 June 2024, Rules 4.10.1(fA)(ii), 4.11.3 and 4.11.3A, (online).

70 Australian Energy Market Operator, 2021, *Electric Storage Resource Obligation Intervals for 2023-24 Capacity Year,* (online).

71 Economic Regulation Authority, 2024, *Procedure Change Proposal: Benchmark Reserve Capacity Price*, p. 15, (online).

72 Energy Policy WA, 2023, *Coordinator of Energy Determination: Benchmark Capacity Providers, Peak Capacity Provider and Flexible Capacity Provider*, p. 5, (online).

above 200 MW for two years, based on the expected degradation rates outlined in their report (assuming no other factors apply).[73]

Alinta Energy stated that the reserve capacity price would under-compensate new storage facilities if the ESR duration requirement increases. This is because the timing of the BRCP determination and the determination of the ESR duration requirement are not aligned. The BRCP determination is completed before AEMO determines the ESR duration for the associated capacity year.[74] The review of the Benchmark Capacity Providers and BRCP procedure can take up to 18 months to complete following the change in the ESR duration requirement. While the issue may be best addressed through changes to the WEM Rules, Alinta Energy asked the ERA to consider alternative solutions (for example, not specifying the capacity of the BESS).

The ERA concludes that regardless of whether the WEM Procedure specifies the capacity of the BESS, the WEM Procedure must follow the Coordinator's determination.

WEM Procedure

- Clauses 2.1.6(b), 2.1.6(c) and 2.1.6(d) require the Benchmark Capacity Providers to:
  - have an installed capacity that enables 200 MW injection on 1 October Year 3 of the Reserve Capacity Cycle.
  - have enough energy storage capacity to enable 800 MWh charge and discharge on 1 October of Year 3 of the Reserve Capacity Cycle.
  - Include the minimum level of equipment or systems required by the WEM Rules.
- Clause 2.1.7 specifies that the ERA may engage a suitably qualified consultant to identify the factors affecting power and energy capacity requirements as per Clauses 2.1.6(b), 2.1.6(c) and 2.1.6(d), including temperature derating for operation at 41 degrees Celsius, voltage stability required under the WEM Rules, reactive power compensation for required levels, and capacity loss from battery degradation.

4.3 Capital costs

The ERA sought advice from GHD on the capital cost components of a BESS.[75] GHD advised that capital costs account for approximately 95 per cent of the estimated BRCP and includes:

- BESS supply and installation costs.

[73] GHD's report is provided in Appendix 2. See: GHD, 2024, *Benchmark lithium BESS costs, BRCP procedure update*, Report for the Economic Regulation Authority, pp. 19 - 20.

[74] The ERA must provide AEMO with the BRCPs by 15 January of Year 1 of a Reserve Capacity Cycle - Wholesale Electricity Market Rules (WA), 8 June 2024, Rule 4.1.4, (online) – and AEMO must determine the ESR Duration Requirement by10 June of Year 1 of a Reserve Capacity Cyle - Wholesale Electricity Market Rules (WA), 8 June 2024, Rules 4.1.8, 4.5.11 and 4.5.12, (online).

[75] GHD's report is provided in Appendix 2. See: GHD, 2024, *Benchmark lithium BESS costs, BRCP procedure update*, Report for the Economic Regulation Authority, p. 22.

- Land costs.
- Transmission connection costs.
- Other costs, such as connection agreement, market registration and licencing costs; regulatory approval costs; design and project management costs; and legal, financing and insurance costs.

Each of these cost components are summarised in the following sections.

WEM Procedure

- Clause 3.1.1 outlines the formula for estimating capital costs.
- Clause 3.2.1 lists the capital cost components that the ERA must estimate. Subsequent clauses provide further detail on these cost components.

4.3.1 Supply and installation costs

The BESS supply and installation cost is the largest component of capital costs and is comprised of:

- Battery containers or enclosures that typically include racks of battery modules, thermal management systems such as air conditioning or liquid cooling, control equipment, and a fire suppression system.
- Power conversion systems that typically include multiple inverters placed near the battery containers.
- Electrical and control balance of plant that are infrastructure costs incurred in developing the BESS and typically include all enabling electrical infrastructure, cables, conduits, transformers, switchgear, protection and control equipment for the BESS and its substation.
- Civil balance of plant that are infrastructure costs incurred in developing the Benchmark Capacity Providers that typically include the foundations, transformer bunds, and equipment pads for the BESS and its substation.
- Installation labour and temporary equipment hire that typically include local construction labour to develop the site and install the BESS, as well as the hiring of temporary equipment during the BESS construction phase.

The ERA proposed that the WEM Procedure specify that the ERA must estimate these supply and installation cost components as part of its annual BRCP determination.

As the costs of lithium-ion battery modules are susceptible to changes in lithium prices, which can vary significantly over the course of a year, the ERA may engage a consultant to provide advice on these cost components in its annual BRCP determinations.

4.3.1.1 Stakeholder feedback

There is no change to the ERA's position on the BESS supply and installation costs based on stakeholder feedback. None of the submissions specifically commented on the BESS supply and installation costs. Comments about the BESS degradation are addressed in sections 4.3 and 4.4, which is a separate issue related to supply and installation costs.

WEM Procedure

- Clause 3.3.1 requires the ERA to estimate the following supply and installation costs of the Benchmark Capacity Providers:
  - battery containers or enclosures,
  - power conversion systems,
  - electrical and control balance of plant incurred in developing the Benchmark Capacity Providers,
  - civil balance of plant incurred in developing the Benchmark Capacity Providers, and
  - and installation labour and temporary equipment hire.

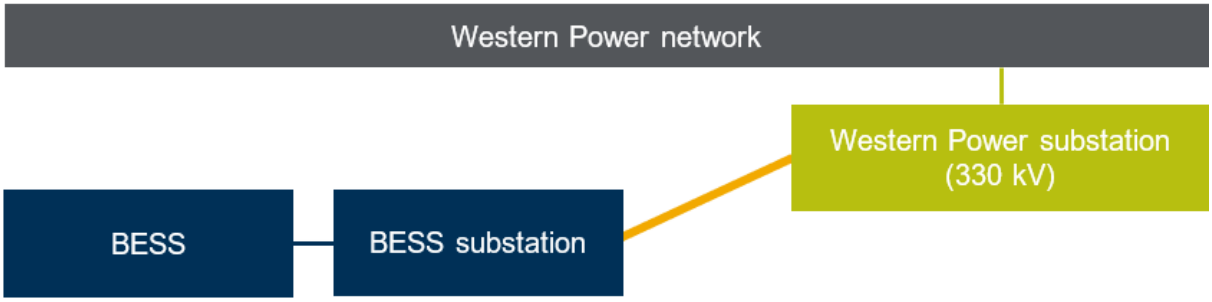
4.3.2 Transmission connection cost

The capital cost of a Benchmark Capacity Provider must include transmission costs, which generally include the costs incurred to connect the facility to Western Power's transmission network and all associated infrastructure, such as:

- A 330 kV transmission substation that can serve as the dedicated 330 kV connection point for the BESS and can connect to Western Power's transmission network.
- A BESS substation that can step up the system voltage of the BESS (33 kV) to Western Power's network voltage (330 kV).
- The connecting transmission lines.

This is illustrated in Figure 1.

Figure 1: Stylised illustration of the transmission connection arrangement



Source: ERA

Two main factors affect the estimate of transmission connection costs:

- Access to existing shared transmission infrastructure, such as 330 kV transmission lines and a 330 kV substation, will lower a BESS developer's cost to connect the Benchmark Capacity Provider to Western Power's network, as the developer will use existing infrastructure and reduce costs associated with building the required infrastructure.

- The availability and cost of acquiring land within the regions specified by the Coordinator, Kwinana and Pinjar, that is in proximity to existing shared transmission infrastructure.[76]

These factors vary across both regions and over time as the shared transmission network is augmented or project developers locate their facilities close to existing Western Power terminals.

The ERA considered two approaches to estimate the Benchmark Capacity Providers' transmission costs.

Given an investor's approach to minimise costs, the ERA first considered that an investor would develop the facility as close as possible to existing 330 kV lines and Western Power's substations to minimise the need for 330 kV substation infrastructure and transmission lines between the facility and the connection point.

The ERA considered the merits of identifying a specific site adjacent to existing 330 kV substations in each of the Kwinana and Pinjar regions, estimating the cost of purchasing these specific sites and connecting it to the nearby transmission lines. This approach is not appropriate for the BRCP determination method for three reasons:

1. This approach creates uncertainty about the estimated cost reflecting actual connection costs, as the access to existing infrastructure and availability of land varies over time.[77]

2. This approach may be considered too specific and not a benchmark that is reflective of typical costs incurred by a Benchmark Capacity Provider seeking to construct a BESS. In practice, producing a least cost estimate may be subject to a detailed evaluation of sites, existing infrastructure, and various connection designs. This depth of analysis for an annual BRCP determination is impractical and inconsistent with the purpose of the BRCP. While this approach may reflect the lowest cost of transmission connection costs, the estimate would inevitably be uncertain and require realisation of all assumptions, such as design configurations and access to existing infrastructure.

3. This approach would require Western Power and Landgate (or alternative providers of transmission costs and land costs respectively) to evaluate four site options, resulting in a significant increase in the resources and time required for analysis, and the resulting cost to industry, without a corresponding significant impact on the estimated overall BRCP.[78,79]

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76 As noted in section 1.1, the Coordinator determined that the Benchmark Capacity Providers must be located near Kwinana or Pinjar on an unconstrained 330 kV line. The approach to estimate land costs is further discussed in section 4.3.3.

77 For example, there is a 330kV line and existing 330 kV terminal in Kwinana but there is limited land adjacent to the terminal. An investor may consider developing the BESS further away from the terminal, but this may increase costs as the Kwinana area is generally built up, and the land costs in Kwinana are already generally higher than the Pinjar region. The Pinjar terminal is serviced by a 132 kV; however, this is expected to be upgraded to a 330kV line in 2027 as part of the SWIS Demand Adequacy (SWISDA) upgrades. The nearest 330 kV line in the Pinjar region is in Neerabup; however, it is expected to be congested until 2027 until the SWISDA upgrades are completed. An investor may consider the risk that the upgrades of the 330 kV lines in Pinjar are not completed on time, as the 2025 BRCP determination will apply for the 2027/28 capacity year. See: Market Advisory Committee, *8 February 2024,* 'Item 6 – Western Power: Update on Transmission Network Infrastructure'*, Meeting Agenda*, p. 39 (online).

78 The four options include:

- A specific site costing in each of the Kwinana and Pinjar regions (which would require identifying specific sites located adjacent to the existing shared infrastructure); and
- Generic costings in each of the Kwinana and Pinjar regions based on average land prices in the regions.

79 Transmission and land costs comprise approximately 10 per cent of the total BRCP.

To estimate transmission connection costs, the ERA:

- Noted the flexibility of the BESS's technical specifications, which allow it to connect anywhere along the transmission network.
- Considered the availability of existing Western Power 330 kV substations and 330 KV transmission lines within the Kwinana and Pinjar regions.

In its proposal, the ERA's approach to estimate transmission costs included:

- Costs to develop a 330 kV substation that will be dedicated to the Benchmark Capacity Provider and owned by Western Power.[80] The ERA considered GHD's advice that this approach is consistent with recent trends in generation developments. This cost assumes the substation will cut-in to an existing 330 kV line.
- Costs for transmission lines between the BESS site and the 330 kV substation. This approach assumes the BESS is located as close as possible to the existing transmission network to minimise the need for transmission lines between the facility and the connection point.[81] The ERA sought advice from Western Power on specifications such as the length of line and type of land required. The connection configuration and costs assume the 330 kV substation is located adjacent to the existing network and provides for the BESS substation and BESS to be located near the same location.
- Indirect costs associated with project development and procurement.

4.3.2.1 Stakeholder feedback

AEMO and Synergy agreed with the ERA's approach to estimate transmission costs. Other submissions did not comment on transmission costs.

80 Where the connection asset will be dedicated to a single user, the asset can be constructed by either the user or by Western Power, and the user has the option to own the asset or to allow Western Power to own the asset. Under either scenario, the user pays for access to the connection assets as per Western Power's Policy Statement – Transmission Connection Price. See: Economic Regulation Authority, 31 March 2023, *Appendix 2 Tariff Structure Statement, Access Arrangement*, (online).

81 The assumption underlying the connection configuration and costs is that the 330 kV substation is located adjacent to the existing network and provides for the BESS substation and BESS to be located near the same location.

WEM Procedure

- Clause 3.4.1 requires the ERA to estimate the costs to connect the Benchmark Capacity Providers to the transmission network.
- Clauses 3.4.2 to 3.4.5 explains how the ERA may seek a transmission costs estimate provider (like Western Power or a reasonable alternative).
- Clause 3.4.6 outlines the process for estimating the cost to connect the Benchmark Capacity Providers from the high voltage bus bar to the shared transmission network. The process includes estimating costs of a 330 kV substation, the shallow connection easement, and connection of the substation into the existing transmission line based on the most economical solution.
- Clause 3.4.7 notes that the estimate provider can use historical data to estimate transmission costs if they consider it appropriate.
- Clauses 3.4.8 and 3.4.9 outline the estimate provider's assurance and reporting requirements.

4.3.3 Land costs

The capital cost of a Benchmark Capacity Provider must include land costs, which generally includes the cost of land that is sufficient to accommodate the BESS, the BESS's substation, and transmission network connection assets, such as a Western Power substation and buffer zones.

GHD advised that 6.5 hectares of land is sufficient to accommodate the Benchmark Capacity Provider and its required assets.[82] GHD recommended that the land size of 6.5 hectares be specified in the WEM Procedure as it is not expected to vary materially from year to year.[83]

As noted earlier, the Coordinator determined that the Benchmark Capacity Providers must be located near Kwinana or Pinjar on a 330kV transmission line.[84] The ERA considered various methods to determine land cost that fulfils the Coordinator's determination and complement the ERA's approach to estimate transmission costs.[85,86]

The ERA proposed that the WEM Procedure specify that the ERA must estimate a single, average land cost based on average land prices across the Kwinana and Pinjar regions. As

82 In forming its recommendation, GHD considered two standard BESS layouts and allowed for an uplift of balance of plant; buffer zones to suitably account for noise, fencing and clearances; the size of the BESS containers; the size of the BESS substation and Western Power's substation; and sufficient land to account for the area between the two substations, including allowances for access roads and additional buffer around the perimeter of the fence. GHD's report is provided in Appendix 2. See: GHD, 2024, *Benchmark lithium BESS costs, BRCP procedure update*, Report for the Economic Regulation Authority, p. 18.

83 Ibid.

84 Energy Policy WA, 2023, *Coordinator of Energy Determination: Benchmark Capacity Providers, Peak Capacity Provider and Flexible Capacity Provider,* p. 5, (online).

85 For instance, the ERA considered the benefits of identifying and costing specific 6.5-hectare sites, including sites located near existing substations, in each of the Kwinana and Pinjar regions, and using the lower of the cost options as an input into the BRCP determination. In comparison, the ERA's proposed approach is simpler and relies on a single average price based on generic prices across both regions and is a more reasonable benchmark for the purpose of the BRCP determination.

86 While land costs in the Pinjar region are expected to be lower in comparison to the Kwinana region, a potential facility's access to the transmission infrastructure in the Pinjar region is expected to be constrained until the SWISDA upgrades are completed.

explained in section 4.3.2, the ERA considered the availability of existing transmission infrastructure as well as the availability of land in both regions.[87,88]

The ERA considered its proposed approach to estimate a generic land cost, rather than a site-specific cost, provides a balanced cost estimate of land between the more expensive concentrated industrial areas in Kwinana and the less expensive rural areas in Pinjar. This approach complements the generic cost estimation approach to estimate transmission costs, as outlined in section 4.3.2, and is also consistent with the method to estimate the land cost input in the current BRCP determination method.

4.3.3.1 Land size to future-proof for BESS degradation

In its proposal, the ERA sought feedback on how the WEM Procedure can address a BESS investor's treatment of expected BESS degradation.[89] For instance, it sought feedback on whether the WEM Procedure should specify a greater land size to accommodate the installation of more battery modules in the future that can supplement existing capacity so that the BESS will have the opportunity to receive its full capacity credit allocation and associated revenues.

4.3.3.2 Stakeholder feedback

AEMO and Synergy considered the ERA's approach to estimating land costs was reasonable. Synergy added that the site assumptions need to remain reasonable and should be reviewed over time to consider network constraints and land availability.

AEMO submitted that specifying a greater land size is not an appropriate response to account for battery degradation. AEMO recommended that the ERA compare the option of including additional land to other alternatives, including a "do nothing" option.

Tesla considered that if the Procedure assumes the lifespan of the BESS is 15 years, then the Procedure should allow for land size that is sufficient to replace the capacity expected to degrade over 15 years.[90]

The ERA considers that the BRCP mechanism must allow investors the opportunity to address degradation, which may otherwise result in a negative net present value outcome. While BESS degradation costs are recoverable through the Real-Time Market, the investor is likely to receive lower capacity revenues resulting from degraded capacity.

GHD advised that the land size of 6.5 hectares includes a buffer, which provides investors an opportunity to add further battery modules to address battery degradation. Further, investors may choose to address battery degradation by swapping aging battery modules rather than by installing additional battery modules. How investors address battery degradation is typically both site and BESS specific, and the industry approach is evolving. As degradation due to calendar fade and operations cannot be easily separated, degradation costs are a variable

87 See section 4.3.2 for a discussion on the availability of 330 kV lines.

88 The ERA also considered the practical application of its proposed method, including the resources required – and the resulting cost to industry – to estimate land costs through a third-party provider like Landgate.

89 While degradation costs associated with cycling the BESS can be included in a facility's submissions into the Real-Time Market, an investor is likely to consider the effects of degradation on decreasing its expected revenue from capacity credits in the future. An investor will consider how to restore the BESS and when to incur costs to do so. This can be achieved by adding more battery modules to increase capacity to maintain capacity revenues.

90 The ERA proposed that the BRCP be determined by annualising costs over a 15-year period.

cost.[91] To ensure that only fixed costs are covered by the BRCP, the WEM Procedure provides for the option to address battery degradation through adding additional battery modules or oversizing but does not specify this as a requirement.

Tesla sought confirmation of whether sizing of the land accounts for noise considerations and if not, whether the BESS construction costs incorporate the costs of the required noise walls. GHD advised that requirements for noise intervention depend on the BESS's location and its proximity to any sensitive areas. In their report, GHD assumed that the BESS is in a suitably zoned area within Kwinana and Pinjar, eliminating any need for noise mitigation. Further, GHD advised that their recommendation for the BRCP procedure is based on the higher land requirements for each component, meaning noise emitting equipment will be a moderate distance from site boundaries. In any case, unless all BESS sites include noise walls, their cost should not be included in the costing for the reference technology to avoid over-costing.

WEM Procedure

- Clauses 3.5.1 and 3.5.7 require the ERA to estimate land costs to accommodate the Benchmark Capacity Providers based on the average land cost of the Pinjar and Kwinana regions.
- Clause 3.5.2 requires the ERA to engage Landgate or a suitable alternative provider to provide land valuations.
- Clauses 3.5.4 and 3.5.5 require the land valuer to assess the Pinjar and Kwinana regions and estimate land costs of a 6.5-hectare area within these regions.

4.3.4 Other costs

GHD advised that there are other capital cost components of the Benchmark Capacity Providers.[92] These include direct and upfront costs involved in:

- Connecting and registering a BESS to the SWIS so it can operate in the WEM. These include:
  - Network connection agreements with Western Power.[93]
  - Market registration and certification of reserve capacity with AEMO.[94]

91 Calendar fade occurs where a battery incurs time-based degradation, which is degradation that results irrespective of whether or how the battery is operated. This is further explained in GHD's report (Appendix 2).

92 GHD's report is provided in Appendix 2. See: GHD, 2024, *Benchmark lithium BESS costs, BRCP procedure update*, Report for the Economic Regulation Authority, p. 25.

93 The BESS proponent must negotiate a network connection agreement with Western Power – and AEMO, which reviews certain aspects of the agreement – by developing a high-level concept design with a breakdown of shared assets and connection assets. BESS procurement and construction can generally begin after the network connection agreement is formed. GHD's report is provided in Appendix 2. See: GHD, 2024, *Benchmark lithium BESS costs, BRCP procedure update*, Report for the Economic Regulation Authority, pp. 25-26.

94 To provide peak and flexible reserve capacity services, the BESS must register as an electric storage resource in the energy market and be certified for reserve capacity. Market registration and reserve capacity participation costs can vary widely between projects depending on the maturity of the proponent and their existing systems. GHD's report is provided in Appendix 2. See: GHD, 2024, *Benchmark lithium BESS costs, BRCP procedure update*, Report for the Economic Regulation Authority, p. 27.

  - Obtaining a generation licence from the ERA.[95]
- Obtaining environmental, development and building approvals associated with the BESS's development and construction.[96]
- Obtaining project management and owner's engineering services, which include costs incurred by the BESS developer on feasibility studies, construction management and project management.
- Legal, financing and insurance costs incurred in the development and construction of the BESS.[97]

GHD advised that the costs of these components are relatively small in comparison to the BESS supply and installation costs.

The WEM Procedure specifies that the ERA must determine these capital cost components. The ERA may engage a technical consultant to provide advice on these costs as part of its annual BRCP determinations.

WEM Procedure

The ERA is required to estimate the costs as per the following clauses:

- Clause 3.6.1 – Costs of owner's engineer and design services and project management services. The clause lists typical costs under each cost category.
- Clause 3.7.1 – Legal costs associated with the development and construction of the Benchmark Capacity Provider. The clause lists some typical legal costs.
- Clause 3.7.2 – Financing costs associated with financial advisory and transaction costs associated with raising capital and setting up the project vehicle for financing during the construction.
- Clause 3.7.3 – Costs to insure the Benchmark Capacity Providers for loss due to irreparable damage.
- Clause 3.8.1 – Environmental and development approval costs associated with the development and construction of the BESS.
- Clause 3.9.1 – Costs involved in connecting and registering the Benchmark Capacity Providers to the SWIS. The clause lists the typical costs.

95 Electricity generators with capacity less than 100 MW must obtain a generation licence from the ERA as part of the construction process. GHD's report is provided in Appendix 2. See: GHD, 2024, *Benchmark lithium BESS costs, BRCP procedure update*, Report for the Economic Regulation Authority, p. 27.

96 For instance, this may include costs associated with obtaining environmental approvals under the *Environmental Protection and Biodiversity Conservation Act*, native vegetation clearing permits under the *Environmental Protection Act 1986*, development approval under the *Planning and Development Act 2005*, building permits under the *Building Act 2011*, and a dangerous goods storage licence under the *Dangerous Goods Safety (Storage and Handling of Non-explosives) Regulations 2007*. GHD's report is provided in Appendix 2. See: GHD, 2024, *Benchmark lithium BESS costs, BRCP procedure update*, Report for the Economic Regulation Authority, pp. 28-31.

97 These cost items can vary significantly. For instance, legal costs can vary depending on the complexity of the contract arrangements and the level of legal support required. Similarly, the construction insurance cost is dependent on the capital already committed to the project. Financing costs include financial advisory and transaction costs associated with raising capital and can vary depending on the debt proportion of the capital raised. Given the volatility in costs, the ERA proposes to estimate legal, financing and insurance costs as a percentage of the total capital costs as part of the annual determinations. GHD's report is provided in Appendix 2. See: GHD, 2024, *Benchmark lithium BESS costs, BRCP procedure update*, Report for the Economic Regulation Authority, pp. 33-35.

- Clause 3.2.1(c) – Any other reasonable costs.

4.4 Fixed O&M costs

The ERA sought advice from GHD on the fixed O&M cost components of the BESS.[98] GHD advised that fixed O&M costs account for approximately 5 per cent of the estimated BRCP and typically include the following components:

- Service, inspection and preventative maintenance of the BESS, which typically includes the costs of electrical testing, inspections and preventative maintenance on the primary and secondary electrical equipment, structures, footing, buildings and civil items, as well as costs of section, inspection and preventative maintenance of inverter stations, battery modules, racks, the energy management system, earthing and protection.
- Fixed costs for corporate overheads and various consulting services, which typically include superannuation contributions, work cover contributions, technical engineering support, ongoing legal and regulatory costs.
- Local government rates for a 6.5-hectare site.
- Site security services for monitoring and oversight of the BESS.
- Fixed O&M costs of transmission connection assets, which include overheads, hire equipment and labour costs for routine maintenance of the connection switchboard and transmission line.
- Transmission storage service charges for use of the Western Power network.[99]

The WEM Procedure specifies that the ERA must estimate these fixed O&M cost components as part of its annual BRCP determinations. The ERA may engage a consultant to provide advice on these cost components.

4.4.1 Stakeholder feedback

Tesla noted that some degradation occurs regardless of the BESS's operation and therefore should be considered as a fixed cost that can be recovered through the BRCP. Tesla recommended that the ERA reconsider the approach of recovering all costs associated with replacing degraded capacity as a variable cost through a facility's submissions into the Real-Time Market.[100]

GHD advised that:

- Calendar fade has been factored into the pre-commissioning state of the BESS procurement.

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98 GHD's report is provided in Appendix 2. See: GHD, 2024, *Benchmark lithium BESS costs, BRCP procedure update*, Report for the Economic Regulation Authority, pp. 37-41.

99 A BESS must pay to access and use the Western Power network. The Western Power 2023-24 Price List sets out the charges for users connected to its network. The Western Power price list sets out the price of their transmission services charges.

100 The ERA's Offer Construction Guideline (OCG) notes that degradation costs associated with BESS cycling can be included in Real-Time Market submissions. The Guideline is silent on the treatment of degradation inherent in BESS irrespective of the facility's operation. See: Economic Regulation Authority, 11 September 2023, *Offer Construction Guideline*, p. 44, (online).

- Post-commissioning degradation of the battery modules is primarily driven by cycling which is a variable cost, not a fixed cost.
- The BESS's degradation cannot be split between degradation due to calendar fade and degradation due to cycling.

WEM Procedure

Clause 5.1.1 requires the ERA to estimate the following annual fixed O&M costs: fixed maintenance costs, substation costs, corporate overheads, consulting services and other reasonable costs. The clause lists some typical costs under each category of fixed O&M costs.

4.5 Annualisation

The BRCP's annualisation approach allows an annual payment to be determined over the project to ensure the return of capital (depreciation) and return on capital (financing costs). The annualisation calculation requires the determination of the following four factors to allocate capital and financing costs over the project's life:

- capital costs (previously discussed in section 4.3)
- annualisation period (section 4.5.1)
- rate of return (section 4.5.2)
- annuity tilt (section 4.5.3).

4.5.1 Annuity period

The BRCP is based on the annualised capital cost of the Benchmark Capacity Providers, which requires an estimate of the period to annualise costs over (the annuity period). The annualisation period represents the period over which capital charges are recovered. The greater the annuity period, the lower the annual payment will be and the longer it will take for an investor to recover the return of capital (depreciation) and a return on capital (financing costs).

The ERA considers the annuity period must be specified in the WEM Procedure as this provides certainty for the industry on the period that they can recover their costs over and helps to provide appropriate price signals for future investment in generation capacity. [101]

In determining a reasonable annuity period to specify in the WEM Procedure, the ERA considered the factors affecting an investor's expected cost recovery period, such as the technical and economic life of the Benchmark Capacity Providers as advised by GHD, and information from the industry and financial institutions that typically finance BESS projects. Based on this information, the ERA proposed that the WEM Procedure specify that the Benchmark Capacity Providers' capital costs must be annualised over 15 years. The reasons underlying the ERA's proposal are summarised below.

[101] This is consistent with the approach in the previous WEM Procedure, that determined the BRCP based on an OCGT, and specified an annualisation period of 15 years.

The annuity period is based on a BESS's battery module warranty. The ERA considered advice from GHD on BESS warranties, the drivers underlying the technical life of different BESS components, and the typical degradation profile of the BESS's power and energy capacity. GHD advised that BESS systems are relatively new and there is currently a degree of uncertainty regarding the technical life.[102]

Given the variability of the actual technical life of BESS elements, investors generally look at the manufacturer's warranties for the critical elements. For a BESS, this element is the battery modules, and the warranty can vary depending on the type of degradation warrantied.[103] The warranties for components are typically shorter than the technical life of the whole asset, with the BESS's batteries expected to last at least 15 years.

The ERA also considered common contracted periods and the terms of finance available for grid-scale BESS projects in Australia to evaluate typical investor expectations for the recovery of capital. The ERA sought feedback from financial institutions and industry involved with BESS projects on the practicality of financing BESS projects and the terms of finance typically offered.[104] The feedback indicated that BESS projects typically enter long term contractual arrangements upwards of 15 years and financial arrangements align with this contractual term.

The ERA also reviewed industry feedback provided during the Coordinator's determination of Benchmark Capacity Providers, which assumed an annuity period of 25 years based on the Coordinator's estimate of the economic life of the technology.[105,106] In response to the Coordinator's consultation paper, Synergy and the Clean Energy Council considered a 25-year life to be too optimistic and stated that the BRCP determination method should align with market participants' expectation of the economic life of electricity storage resources.[107]

While the ERA acknowledges that the Coordinator's assumption of a 25-year period was adopted for the purpose of comparing technologies, the ERA's advice is that a 25-year period does not align with investors' expectations of BESS capital returns and therefore is not the appropriate period for the BRCP determination process.

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102 Batteries are generally considered to be at their end of life when the state of health is below a certain threshold (typically 70-80 per cent) or when the state of health is observed to be rapidly degrading. Depending on duty cycles, batteries may last between 15 to 20 years. The typical lives of inverters, which are another key component of a BESS, are up to 20 years but this varies.

103 For instance, there are two main types of warranties on BESS modules. Firstly, a warranty based on the amount of energy stored and delivered by the battery at any time (energy throughput). This warranty will give a guaranteed MWh throughput for the batteries, regardless of duty cycle or charge rate. Assuming one cycle per day to align with the maximum operational requirement under the WEM Rules, this corresponds to a battery life cycle of 8.2 to 11 years. The second type of warranty is based on the intended duty cycle of a BESS, which considers the operating profile of the battery and is adjusted over time based on the actual usage of the battery. This warranty is becoming increasingly common for grid-scale BESS. Original Equipment Manufacturers (OEMs) warrant these batteries for a lifetime of between 15 to 20 years.

104 Given the sensitivities of BESS project financing costs, the feedback from the financial institutions is not published. The feedback from industry was provided by the MAC working group. BRCP WEM Procedure Review Working Group, 6 February 2024, '3.3 Annuity tilt', *Meeting minutes*, p. 4, (online).

105 Energy Policy WA, 2023, *Coordinator of Energy Determination: Benchmark Capacity Providers, Peak Capacity Provider and Flexible Capacity Provider*, pp. 10-11, (online)

106 The Coordinator noted the assumptions in its determination were included for the purpose of comparing reference technologies only and that it is up to the ERA's review of the WEM Procedure to determine the appropriate annualisation period. Energy Policy WA, 2023, *Coordinator of Energy Determination: Benchmark Capacity Providers, Peak Capacity Provider and Flexible Capacity Provider*, pp. 10-11, (online)

107 Ibid.

The ERA's proposed 15-year annuity period considers a BESS's components' warranty periods, the BESS's likely technical life, and investors' expectations. The ERA acknowledges that the 15-year period may expose investors to greater risk if the warranty life is shorter, which can occur depending on the type of warranty and the operation of the battery.

However, the 15-year period does not unduly extend capital recovery well into the future to some uncertain technical life, given that the BESS is a new technology, which may act as a disincentive to investment. The 15-year annuity period is a balance of these factors and aligns with investors' expectations and project financing periods, while also remaining consistent with the annuity period in the previous WEM Procedure (which was based on an open cycle gas turbine as the reference technology).[108]

4.5.1.1 Stakeholder feedback

AEMO considered the ERA's 15-year capital annuity period was reasonable. AEMO viewed the capital annuity period as an important component to provide certainty for investors and appropriate price signals for future capacity investment.

Synergy noted that a 15-year asset life for a BESS aligns with assumptions of the BESS undertaking one-cycle a day. For a BESS facility that is solely undertaking load-shifting, this may be a reasonable assumption.

However, Synergy viewed that this assumption may not apply to all BESS facilities and considered that BESS facilities that provide frequency co-optimised essential system services (FCESS) and/or flexible capacity are likely to cycle more often which reduces the asset's life. Synergy indicated that the asset life and annuity period for flexible capacity assumptions may need further consideration to ensure that they align with market expectations and requirements.

Synergy suggested that the annuity period and asset life for BESS facilities should be monitored and reviewed as part of the ERA's triennial review process.

GHD reviewed the degradation of BESS facilities providing peak and flexible capacity. GHD agreed that cycling more than once a day may result in the BESS degrading at a faster rate than the rate shown in indicative profiles (based on one full cycle a day).[109]

The ERA considers there is a level of uncertainty in how often (intraday and over the year) those BESS's that qualify for flexible capacity will be cycled beyond the base of one full cycle a day. The design assumptions for both peak and flexible capacity are based on one cycle a day, which is based on the minimum operational requirement of the WEM Rules.

The ERA will annualise capital costs over a 15-year period for both the flexible and peak BRCPs. This period is consistent with investors' expectations and provides the most certainty for investors.

WEM Procedure

- Clauses 2.2.3 notes the capital cost must be annualised over a 15-year period.

[108] Setting an annuity period less than the technical life is not inconsistent with the approach for the previous gas plant reference technology. The BRCP annualisation period for the previous reference technology – an OCGT – was 15 years, compared to a longer technology life of 50 years.

[109] GHD's report is provided in Appendix 2. See: GHD, 2024, *Benchmark lithium BESS costs, BRCP procedure update*, Report for the Economic Regulation Authority, p. 20.

4.5.2 Rate of return (WACC)

The BRCPs are estimates of the annualised fixed costs of the Benchmark Capacity Providers. The costs included in the BRCP calculation include capital expenditure, a return on the capital expenditure, and fixed O&M costs.

Annualising capital costs requires an estimate of a long-term required rate of return over the reasonable cost recovery period.

The WACC has been historically used for this estimate.[110] The WACC is a transparent approach to estimating the rate of return that divides the cost of finance into debt and equity. The WACC remains a commonly used approach by regulators and investors.

Investors expect to receive the return of (depreciation) and return on (rate of return) capital invested in a project over its life. Calculating annual annuity payments, which covers the recovery of depreciation and a rate of return, requires estimation of the following factors:

- the capital cost of new capacity
- the life of the new capacity
- the return of capital required by investors.

The rate of return provides for the funding costs required by investors to provide investment capital for the project and compensates investors for the risk of committing funds. The rate of return is usually determined based on calculating debt and equity costs on a benchmark basis and weighting those costs to form a WACC.

The previous WEM Procedure calculated a WACC to:

- Convert the power station's capital costs into an annualised cost that can be recovered over the assumed life of the project. In this annuity approach, the WACC represents a long-term required rate of return over the life of the project.[111]
- Estimate initial financing costs, which are added into the reference power station's capital expenditures. This accounts for financing costs before the commissioning of the power station and the realisation of revenues from participation in the WEM.

For the purpose of the BRCP determination, the WACC:

- Represents a long-term required rate of return.
- Is used in an annuity calculation to calculate an annual compensation amount to the investor for capital costs over the life of the asset.
- Is updated annually to reflect efficient financing costs at a point in time.

The WEM Rules require the ERA to *not* specify in the WEM Procedure a fixed value of a parameter that the ERA reasonably expects to vary from year to year.[112] As part of this review, the ERA has considered which WACC parameters must be updated through annual BRCP

110 The previous WEM Procedure is provided in Appendix 3 of the procedure change proposal. See *Market Procedure: Benchmark Reserve Capacity Price*, Version 7, Clause 2.9, (online).

111 Ibid.

112 Wholesale Electricity Market Rules (WA), 8 June 2024, Rule 4.16.4, (online).

determinations, and which WACC parameters can be specified in the WEM Procedure until the ERA's next review of the WEM Procedure.

The ERA has examined the individual WACC parameters from the existing WEM Procedure to identify if they must be updated to reflect the change in the reference technology from an OCGT to a BESS. This included reviewing publicly available information on BESS projects in Australia and overseas.

Additionally, the ERA cross-checked its analysis of the WACC parameters by seeking feedback from industry and financial institutions that typically finance grid-scale BESS projects. The ERA also reviewed its WACC parameters with investor surveys.[113,114] The ERA's analysis of the above is presented in Appendix 4, which indicates that investors expect a higher return on a BESS project relative to an OCGT project, and therefore the WACC parameters must be updated.

For the rate of return for the BRCP in the WEM Procedure, the ERA determined that the WEM Procedure:

- Retain a nominal pre-tax WACC, consistent with the current WEM Procedure.
- Retain the following set of components from the current WEM Procedure:
    - Annual components, which require review each year and comprise the risk free rate, debt risk premium and corporate tax rate.
    - Fixed components, which are fixed in the WEM Procedure until the ERA's next review of the WEM Procedure. These components include the market risk premium, equity beta, debt issuance costs, franking credit value and gearing ratio.
- Update the value of the equity beta parameter from 0.83 to 1.2, based on the best available information on BESS projects.
- Update the value of the market risk premium from 5.9 to 5.7, to current market conditions.
- Update the value of the debt issuance cost parameter from 0.100 per cent to 0.165 per cent.

4.5.2.1 Stakeholder feedback

The ERA notes that AEMO supported the approach to determine the WACC and considered the updated WACC parameters as reasonable.

Synergy submitted that while it was reasonable to retain the use of a nominal pre-tax WACC for BESS facilities, it was not appropriate for the BRCP WACC to use the gas rate of return instrument.

[113] Oxford Economics, 2023, *Cost of capital survey 2023, A report produced for the Australian Energy Market Operator*, (online).

[114] Synergies Economic Consulting, 2022, *Updating the ISP Discount Rate, A report produced for the Australian Energy Market Operator*, Report prepared for Australian Energy Market Operator, (online).

The ERA notes that it has reviewed and updated the BESS-specific WACC parameters (for example, equity beta) to reflect the change in the reference technology from an OCGT to a BESS. In addition, the ERA considers the use of the gas instrument to inform the BRCP WACC process as reasonable, as it must also determine other market wide WACC parameters in the same way as other WACC determinations.

Detailed analysis underlying the ERA's determination related to the WACC parameters are presented in Appendix 4.

WEM Procedure

- Clauses 4.2.1 and 4.2.2 summarise the purpose and application of the WACC.
- Clauses 4.2.3 and 4.2.4 outline the method to determine the WACC.
- Clauses 4.2.5 and 4.2.6 explain the computation of the WACC and the pre-tax Officer WACC formula.
- Clause 4.2.7 lists the components that are fixed until the ERA's next review of the WEM procedure and which components will be reviewed in the ERA's annual BRCP determination.

4.5.3 Annuity tilt

4.5.3.1 Background – Why is a tilt required?

The current BRCP Procedure uses a constant annuity for the recovery of capital costs via an annualisation process. The payment consists of a return of (depreciation) and a return on (financing costs) capital. A constant annuity provides the same annual payment for the life of the annuity.

A constant annuity is suitable when capital costs are expected to be stable, such as with mature technologies like an OCGT. However, constant capital costs are not expected to be appropriate for newer technologies like BESS due to technological advances, manufacturing economies of scale and other changes that are expected to reduce capital costs over time. Over the last 10 years, battery prices have experienced a compound annual decline of approximately 16 per cent.[115]

The BRCP is determined each year to reflect the capital cost of the day. In an environment of expected reducing capital costs, continued battery cost reductions benefit the market through declining BRCPs each year. However, it disadvantages investors that need to commit capital on the basis of the BRCP. This is potentially exacerbated through the usage of a constant annuity approach.

The constant annuity provides investors with a cashflow profile that defers the recovery of invested capital towards the end of annuity period. A constant annuity cannot consider the effect or expectations of competition and new technology costs on the expected prices in the future. This will be applicable for new technologies like grid-scale BESS.

When input prices are falling, potential investors expect that new entrants in the future will have a lower cost base. In an environment of continued expected cost reductions, investors may no longer expect to recover their invested capital (both depreciation and financing costs)

[115] Bloomberg New Energy Finance, 26 November 2023, *Lithium-Ion Battery Pack Prices Hit Record Low of $139/kWh*, (online) [accessed 9 July 2024].

as the annual BRCP determinations would be reset lower and set to recover decreasing costs compared to when the investor first invested.

This would reduce investment incentives provided through the BRCP, which could result in potential under-investment and be against the objective of the RCM.

For the initial procedure change proposal, the ERA considered that a tilted annuity could address these issues by providing more cashflow upfront when compared to the constant annuity in a net present value neutral manner. This earlier provision of cashflows improves the opportunity for investors to recover their capital and earn a return on their investment. This may be necessary as potential investors are more likely to invest today if they can expect to recover more of their cashflows in the early periods, as they expect to face a lower cost entrant in the future and lower reset prices.

It is important to note that a tilt factor does not remove all risk from future cost reductions for investors. If BESS capital costs fall faster than expectations, investors will not be able to recover their invested capital from the BRCP.

Based on the information available at the time of the initial procedure change proposal, the ERA proposed that the WEM Procedure specified a fixed annuity tilt factor of 1.24, to be reviewed during periodic reviews of the WEM Procedure.

4.5.3.2 Summary of stakeholder feedback

There was majority support for the proposed annuity tilt from stakeholders. AEMO and Synergy considered that the ERA's approach was reasonable. Telsa stated that the overall proposal was consistent with the WEM Objectives and the WEM Rules.

The Expert Consumer Panel strongly objected to the tilted annuity approach for the following reasons:

- BESS facilities are likely to have additional revenue and other mechanisms to provide certainty over capital cost recovery.
- Transitioning to a flat annuity when costs stabilise would allow for over-recovery for early investors, especially if capital costs increase.
- Using the mean of forecasted BESS capital costs is inappropriate, given the range of individual forecasts.
- The overall BESS capital costs may not decline as assumed, where both BESS and non-BESS components may instead increase. Applying a tilt to increasing costs will result in over-compensation.

4.5.3.3 Amendments to the WEM Procedure

The ERA has considered stakeholder submissions and reviewed the application of an annuity tilt.

The application of an annuity tilt is a well-established tool in regulatory economics.[116] A tilt is commonly applied by economic regulators in markets experiencing rapid technological

[116] Crew, M and Kleindorfer, P., 1992, 'Economic Depreciation and the Regulated Firm under Competition and Technological Change', *Journal of Regulatory Economics,* vol. 4, pp. 51-61.

changes and costs such as telecommunications.[117,118,119] From an economic perspective, where capital cost declines are expected under a framework of annually resetting prices, investors would not expect to recover their investment in the capacity market.

Since the procedure change proposal, the ERA has refined the assumptions regarding the annuity tilt by:

- Including additional forecasts regarding BESS capital costs from the International Energy Agency and the CSIRO.[120, 121]
- Considering approaches to combine the updated set of forecasts using the mean, median and trimmed mean.
- Calculating the battery cell proportion of BESS capital costs as a dynamic input instead of a fixed assumption of 55 per cent.

Given the uncertainty present when forecasting future BESS capital costs and the imprecision of the estimation process, the ERA will round the tilt factor to nearest first decimal place.

The ERA's refined methodology and approach to calculating the annuity tilt is presented in Appendix 5.

4.5.3.4 Changes to the tilt from the procedure change proposal

The procedure change proposal had an estimated tilt factor of 1.24 (rounded to 1.2 using the above approach). However, after considering stakeholder feedback, the ERA has given the tilt further consideration. The introduction of the BESS as the new reference technology, with capital costs calculated on a gross cost of new entry basis, will immediately set the BRCP for the WEM substantially higher than when the reference technology was an open cycle gas turbine. The tilt factor will then add significantly to the already substantially higher BRCP in the early years of investment.

Given the potential for an immediate and considerable increase in prices for consumers, and having regard to the WEM objectives, the ERA has decided to introduce the tilt factor to address concerns regarding falling capital costs in the future, but to neutralise it at the present time by setting the value to 1.0.

The ERA does not consider that its decision to set the tilt factor to 1.0 at this time will undermine investment in the market. The reserve capacity mechanism needs to provide the correct price signals to encourage capacity investments and maintain system reliability for consumers. In relation to this, the ERA notes that AEMO is expecting capacity shortfall conditions, which could lead to increases in reserve capacity prices.[122]

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117 ACCC, April 2009, *Assessment of Telstra's Unconditioned Local Loop Service Band 2 monthly charge undertaking.*, pp. 269-271.

118 ACCC, December 2007, *Unconditioned Local Loop Service Access Dispute Between Telstra Corporation Limited (access provider) and Primus Telecommunications Pty Ltd (access seeker) (monthly charges), Statement of Reasons for Final Determination*, p. 85.

119 New Zealand Commerce Commission, December 2021, *Chorus' price-quality path from 1 January 2022 – Final decision Reasons paper*, pp. 191-199.

120 International Energy Agency, 2024, *Batteries and Secure Energy Transitions*, p.11, (online).

121 CSIRO, May 2024, *GenCost 2023-23 Final Report*, p. 86, (online).

122 AEMO, June 2024, *2024 Wholesale Electricity Market Statement of Opportunities*, p. 3 (online).

The ERA will monitor the market over the coming years and reevaluate the value of the tilt factor if necessary.

WEM Procedure

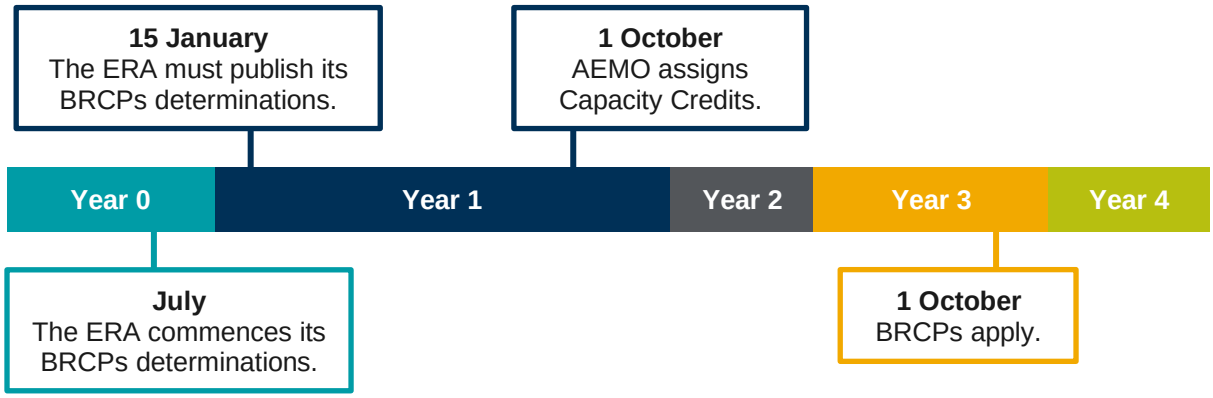
- Section 4.1 explains the application of a tilted annuity through a multiple of the constant annuity as per the following table:

Step	Required calculation
$\boldsymbol{A}$: Constant Annuity Amount	Using a constant annuity formula based on the capital costs, the WACC and the annuity period
$\boldsymbol{B}$: Multiple of Constant Annuity Amount	Applying an annuity tilt adjustment through a multiple equal to 1.0 of the constant annuity amount, which is fixed in this Procedure until the ERA's next review.
$CAPITAL\ COST_{Annualised}$	$\boldsymbol{A} \times \boldsymbol{B}$

4.6 Cost estimation and adjustment method

As explained earlier, the BRCP is based on the annualised cost estimate of the Benchmark Capacity Providers that are constructed to provide capacity to the SWIS for a capacity year commencing approximately two years into the future. For a reserve capacity cycle, the ERA must determine the BRCPs by 15 January of Year 1, while the BRCP applies from 1 October in Year 3 (Figure 2).[123]

Figure 2: Simplified timeline of a reserve capacity cycle



Source: ERA interpretation of WEM Rules.

To receive revenue from capacity credits, a facility must be available from 1 October of a reserve capacity year. However, an investor is likely to schedule completion of the construction of a new facility a few months in advance of 1 October, to account for any construction overruns and to allow for facility commissioning.[124] For computational simplicity, the ERA proposed that the WEM Procedure assume that capital works are completed by 1 April of Year 3 of a reserve capacity cycle (that is, six months in advance of the date that the BRCP applies). This is consistent with the assumption in the current WEM Procedure.

123 Wholesale Electricity Market Rules (WA), 8 June 2024, Chapter 4, (online).

124 Wholesale Electricity Market Rules (WA), 8 June 2024, rule 3.21A, (online).

The BRCP determination must account for cost changes between the date of the BRCP determination and when the BRCPs apply. This analysis will depend on the nature of the cost estimation approach and whether the costs are reasonably expected to change over time.[125] For instance, construction labour costs are expected to vary year on year due to changes in wages and inflation.[126]

The ERA proposed that the WEM Procedure specifies that the ERA must adjust:

- Capital costs using an appropriate adjustment method where the costs are reasonably expected to change over time between the date of the ERA's determination and 1 April of Year 3 of the reserve capacity cycle. The determination of capital costs as at 1 April assumes that capital outflows are largely incurred in advance of the Benchmark Capacity Providers commencing operation and receiving revenue from capacity credits on 1 October of Year 3 of the reserve capacity cycle.
- Fixed O&M costs using an appropriate adjustment method where the costs are reasonably expected to change over time between the date of the ERA's determination and 1 October of Year 3 of the reserve capacity cycle. The determination of fixed O&M costs as at 1 October assumes that these costs will be incurred after the Benchmark Capacity Providers commence operation and start receiving revenue from capacity credits on 1 October.

Additionally, the WEM Procedure will allow the ERA to engage a consultant to advise on appropriate cost adjustment methods and sources.

Similarly, the BRCP determination must account for the cost of capital in the period between when capital is raised and when the revenue from capacity credits is expected to be realised. The ERA proposed that the WEM Procedure specify that the WACC be used for this purpose, based on the assumption that the capital costs of the Benchmark Capacity Providers are incurred as at 1 April of Year 3 of the Reserve Capacity Cycle.

WEM Procedure

- Section 3.10 outlines the ERA's approach to adjust capital costs to account for future price movements.
  - Clause 3.10.1 requires the ERA to estimate capital costs for the Benchmark Capacity Providers as at 1 April in Year 3 of the Reserve Capacity Year.
  - Clause 3.10.2 explains when the ERA must adjust capital cost components. If the ERA adjusted the costs, it must outline the method it used to adjust costs in its BRCP determination.
- Section 5.2 outlines the ERA's approach to adjust fixed O&M costs to account for future price movements.
  - Clause 5.2.1 explains that the ERA must estimate fixed O&M costs for the Benchmark Capacity Providers as at 1 October in Year 3 of the Reserve Capacity Year.

125 Ibid, rule 4.16.4, (online).

126 GHD suggested various cost drivers and suggested data sources for cost escalation. GHD's draft report is provided in Appendix 2. See: GHD, 2024, *Benchmark lithium BESS costs, BRCP procedure update*, Report for the Economic Regulation Authority, pp. 42-47.

- Clause 5.2.2 explains when the ERA must adjust fixed O&M cost components. If the ERA adjusted the costs, it must outline the method it used to adjust costs in its BRCP determination.

4.6.1 Stakeholder feedback

Synergy commented that further consideration is needed as investors are likely to be subject to debt margins during the period between capital raising and receiving capacity credit revenue.

The ERA's proposal and determination reflects investors' needs over that intervening six-month period as it appears to be a reasonable time between a likely BESS project being completed and the start of the capacity year for which it will receive capacity payments. The six-month period is a balance between the likely completion time for building a new BESS facility, covering investors' debt margins over this period, and ensuring that the period is not unreasonably long which would increase the BRCPs, adding costs to consumers. Consequently, the ERA's final WEM Procedure has not changed from the proposal on this point.

4.7 Procedure administration and guidance on future reviews

The ERA has proposed the following amendments to improve the readability of the WEM Procedure and provide further guidance to industry on the application of the WEM Procedure:

- Appendix 1 of the WEM Procedure includes a timeline of amendments to the WEM Procedure since its inception in 2008.
- Sections 1 and 2 of the WEM Procedure outline the requirements from the WEM Rules so that the WEM Procedure explains all aspects of the BRCP.

Appendix 1 Updated WEM Procedure

The updated *WEM Procedure: BRCP* (version 8) is available on the ERA's website (online).

The *WEM Procedure: BRCP* will take effect on 1 August 2024.

Appendix 2 GHD's report

The ERA engaged GHD to provide advice on the cost components, estimation method and drivers of BESS technologies for the purpose of reviewing and updating the WEM Procedure. GHD's draft report was published on the ERA's website as part of the ERA's procedure change proposal (online).

After considering stakeholder feedback on the ERA's procedure change proposal, GHD refined its report to provide further clarity on degradation costs, maintaining that the land size will allow for more battery modules to be installed, and that sound abatement is site specific.

GHD's final report is available on the ERA's website (online).

Appendix 3 Summary of stakeholder submissions

Stakeholder feedback	The ERA's response
AEMO	
AEMO noted that it agreed with most aspects of the proposed WEM Procedure and considered that it aligns with the WEM Objectives and WEM Rules. However, AEMO raised the following points: • Regarding the BESS sub-chemistry: - AEMO supported the ERA's view that specifying sub-chemistry in the Procedure will provide transparency to investors. However, AEMO recommended a frequent review of the Procedure to ensure the sub-chemistry remains the most appropriate choice. - AEMO suggested determining the sub-chemistry in annual BRCP determinations instead of specifying in the Procedure. This will result in the Procedure adapting to changing technology but reduces certainty for investors. • The BRCP procedure should clearly state the nameplate capacity capable of delivering 200 MW sent-out for 4 hours (800MWh). It may be more representative to align the BESS with the certification of Electric Storage Resources (ESR) and size the BESS so that it can always achieve a 4-hour duration within the first capacity year (rather than from day 1). • A strong case has not yet been made for including battery degradation within the BRCP. Even if battery degradation is included, the ERA should not increase land size to accommodate additional batteries because cost of degradation can be recovered in the Real-Time Market and as a material component of the BRCP land costs should be supported by a comparison analysis (including a 'do nothing' option). • It does not foresee significant changes or time requirements to implement the new WEM procedure.	The ERA has specified the sub-chemistry to provide transparency to investors and notes that this is subject to review in future ERA BRCP WEM Procedure reviews. The technical requirements for the BESS are discussed in section 4.2.2. Consistent with GHD's advice, the ERA has treated battery degradation as a variable cost that will be covered under OEM warranty.
Alinta Energy	
Alinta Energy observed that the Reserve Capacity Price (RCP) would under-compensate new storage facilities if the ESR duration requirement increases. This is because the timing of the BRCP determination and the determination of the ESR duration requirement are not aligned. Review of the Benchmark Capacity Providers and BRCP procedure can take up to 18 months to complete following the change in the ESR duration requirement. While the issue may be best	The ERA acknowledges the timing issue between the ERA's BRCP determination and AEMO determining the ESR duration requirement. Changes to the WEM Rules may be required. The ERA will inform Energy Policy WA as it is beyond the scope of this WEM Procedure review. Issues relating to the Offer Construction Guideline are outside the scope of this project.

Stakeholder feedback	The ERA's response
addressed through changes to the WEM Rules, Alinta Energy asks the ERA to consider alternative solutions (e.g. not specifying the capacity of the BESS). Alinta Energy suggests including examples in the Offer Construction Guideline outlining how costs of ameliorating degradation should be recovered in the Real-Time Market.	Sections 6.5 and 6.6 of the OCG provide guidance to explain how the ERA currently proposes to interpret the WEM Rules in relation to the construction of offers.
Chamber of Minerals and Energy of Western Australia (CMEWA)	
The CMEWA is concerned about the current trajectory of electricity costs in the WEM and wants the ERA to consider that low emission, reliable and cost-competitive electricity is critical to enabling future WA green industries when developing the revised BRCP procedure.	The ERA notes this concern.
Expert Consumer Panel	
While the Expert Consumer Panel supports most elements of the procedure change proposal, they strongly oppose the annuity tilt and argue that it is not consistent with the WEM objectives for the following reasons: • The overall BESS capital costs may not decline as assumed, where both BESS and non-BESS components may instead increase. Applying a tilt to increasing costs will result in over-compensation. • In practice, BESS facilities will have additional sources of revenue in the near term that will generate revenue to pay for BESS capital costs, which obviates the need for a tilt. • Other mechanisms exist to provide certainty over capital cost recovery such as the State Government's ongoing WEM Investment Certainty Review and the Federal Government's Capacity Investment Scheme. • Transitioning to a flat annuity when costs stabilise would allow for over-recovery for early investors, especially if capital costs increase. • Tilting the annuity shifts risk on to consumers and will increase costs of all technology types, including more mature technologies with stable costs. • Using the mean of forecasted BESS capital costs is inappropriate given the dispersion and outliers present in individual forecasts. • The expected higher reserve capacity price will reduce the likelihood of investors not recovering their capital costs.	See the 'Stakeholder consultation' section in Appendix 5 which addresses these points.

Stakeholder feedback	The ERA's response
Name withheld	
The name withheld submission stated: • AEMO has increased the reserve capacity margin from 300 MW to 600 MW. • The BRCP has increased from around $160,000/MW/year to, recently, $235,000/MW/year. • The new change from open cycle turbines to batteries will have an estimated cost of $383,000/MW/year, as indicated by GHD's report, and this estimate has a +/- 50 per cent level of accuracy meaning that the cost could be as high as $575,000/MW/year. • This, combined with around a $160 million increase in the costs of ESS and AEMO seeking an increase in market fees will lead to substantially high costs for electricity consumers. • At what point does the pursuit of new market reform at all costs lead to an energy cost that is unsustainable? What is the total cost of all of these changes expected to be on the cost to deliver energy in the WEM?	The overall cost of energy in the WEM is an issue that is outside the scope of this project, but an important consideration for future WEM reforms. Section 4.5.3.4 includes the ERA's acknowledgement of the costs for consumers and the adjustment to the annuity tilt factor. Further concerns on the general increase in electricity costs is discussed in section 3.2.1. The expected capital cost trajectory for BESS is downward over time but in the short-term, it is likely that the change in the Benchmark Capacity Providers will lead to higher BRCPs than previously determined. The BRCP is an input into the Reserve Capacity Price, which is the ultimate price that will be passed onto consumers, depending on the forecast WEM demand requirements, and the level of forecast excess capacity.
Synergy	
Synergy considers most aspects of the proposed WEM Procedure are reasonable, but makes the following comments: • It is not reasonable for the WACC to be based on a gas rate of return instrument given the change in the reference technology to a BESS. • The Offer Construction Guidelines do not clearly highlight whether degradation costs can be included in a market participant's offers nor provide guidance on constructing compliant offers. • The ERA needs to further consider asset life and annuity period for Flexible Capacity because such a facility may operate cycle more than once per day and therefore will not have a 15-year asset life. • Annuity period and asset life need to be monitored and revised during the ERA's triennial review. • Accounting for the cost of capital in the period between the investor raising the capital and received revenue from capacity credits needs further consideration because investors are likely to be subject to a debt margin during this time.	The ERA has the following responses to Synergy's comments: • Section 4.5.2.1 addresses the issue on why using the gas rate of return is still appropriate. • Issues relating to the Offer Construction Guideline are outside the scope of this project and may be considered in future Offer Construction Guideline reviews. • The issue relating to asset life and annuity period for flexible capacity is addressed in section 4.5.1.1. • When the ERA reviews the BRCP WEM Procedure, at least once every five years, the annuity period and asset life are considerations that will depend on the Benchmark Capacity Providers required by the Coordinator of Energy's determination. • The period between needing to raise capital and the revenue to be received from capacity credits is discussed in section 4.6.

Stakeholder feedback	The ERA's response
• Synergy does not expect significant implications for the organisation or any implementation requirements.	
Tesla Holdings	
Tesla Holdings considers that the procedure change proposal will have no implications on the organisation and is consistent with the market objectives and the Wholesale Electricity Market Rules but makes the following comments: • Costs of replacing the degraded capacity should be considered as fixed O&M costs, as degradation will occur regardless of battery cycling. • At full power, noise emission from batteries may exceed nearby boundary requirements, so the land boundaries and sensitive receptors need to be a sufficient distance away from the source to comply. Additionally, the land size should be sufficient to accommodate replacement of degraded capacity over the 15-year life span of the BESS.	The comments about degradation depend on how the BESS is operated, and degradation between calendar fade and cycling cannot be easily separated. This is discussed in section 4.4.1. The issues around noise emissions are site specific and are discussed in section 4.3.3.2. The issue of land size being sufficient to accommodate degradation of capacity is discussed in sections 4.3.3.1 and 4.3.3.2.

Appendix 4 Rate of return (WACC)

This appendix provides further detail on the ERA's analysis of the rate of return components of the BRCP.

Cost of capital

The BRCP estimates include the annualised fixed costs of the Benchmark Capacity Providers. The costs included in the BRCP calculation include a return of capital expenditure, a return on the capital expenditure, and fixed operating and maintenance costs.

Investors expect to receive a return of capital (depreciation) and a return on capital (rate of return) that is invested in a project over its life.

To calculate the annual annuity payments, which cover the recovery of depreciation and a rate of return, the following is required:

- The capital cost of a new Benchmark Capacity Provider.
- The life of the new Benchmark Capacity Provider.
- The return of capital required by investors.

The rate of return provides for the funding costs required by investors to offer investment capital for the project and compensates investors for the risk of committing funds. The rate of return is usually determined based on calculating debt and equity costs on a benchmark basis and weighting those costs to form a weighted average cost of capital (WACC).

Section 2.9 of the previous WEM Procedure calculates a WACC to:

- Convert the power station's capital costs into an annualised cost that can be recovered over the assumed life of the power station. Under this approach, the WACC represents a long-term required rate of return over the life of the project.
- Estimate initial financing costs, which are added into the Benchmark Capacity Provider's capital expenditures. This accounts for project financing costs before the power station is in operation and the realisation of revenues from participation in the WEM.

For the purpose of the determination of the BRCPs, the WACC:

- Represents a long-term required rate of return.
- Is used in an annuity calculation to calculate an annual compensation amount to investors for capital costs over the life of the asset.
- Is updated annually to reflect efficient financing costs at a point in time.
- This appendix details the required rate of return for the BRCPs and any changes required for the change in the BRCP reference technology from an OCGT to a BESS.

Calculation of the WACC

Section 4.2 of the proposed WEM Procedure states how the ERA is to calculate the WACC for determining the BRCPs:

4.2.5 The ERA must compute the WACC on the following basis:

(a) The WACC must use the Capital Asset Pricing Model (CAPM) as the basis for calculating the return to equity.

(b) The WACC must be computed on a Pre-Tax basis.

(c) The WACC must use the standard Officer WACC method as the basis of calculation.

4.2.6 The pre-tax Officer WACC shall be calculated using the following formulae:

$$WACC_{nominal} = \frac{1}{(1 - t(1 - \gamma))} R_e \frac{E}{V} + R_d \frac{D}{V}$$

Where:

$WACC_{nominal}$	is the nominal WACC
t	is the corporate tax rate
γ	is the value of franking credits
Re	is the nominal return on equity
R_d	is the nominal return on debt
$\frac{E}{V}$	is the market value of equity as a proportion of the market value of total assets
$\frac{D}{V}$	is the market value of debt as a proportion of the market value of total assets

The ERA must estimate the WACC annually, following the WEM procedure.

The WEM Rules require the consideration of which of these separate parameters need to be updated annually and which can be fixed until the next BRCP Procedure review. The ERA's annual review involves two sets of components listed in clause 4.2.7 of the proposed WEM Procedure, these are:

- Annual components, which require review each year and comprise the risk free rate, debt risk premium and corporate tax rate.
- Fixed components, which are fixed in the WEM procedure and remain constant between the ERA's BRCP WEM Procedure reviews. These fixed components include the market risk premium, equity beta, debt issuance costs, franking credit value and gearing ratio.

For the BRCP:

- A long-term rate of return is used as the BRCP requires the estimation of annual capital costs through an annuity over the life of a new Benchmark Capacity Provider project.

- A nominal basis is used as investors require compensation for the effect of inflation. A prudent and efficient Benchmark Capacity Provider investor would issue nominal debt and would be contractually required to make nominal interest payments (this includes a component for expected inflation). Similarly, an efficient equity investor would seek to be compensated for expected inflation.
- The pre-tax basis is used as there are many different corporate structures that can impact the actual tax paid by the Benchmark Capacity Provider associated business. The development of tax accounts is complex and can be affected by different corporate structures.

Separate WACC parameters are discussed in more detail below.

Gearing

The gearing ratio is the proportion of a business's assets financed by debt. Gearing is defined as the ratio of the value of debt to total capital (that is, including debt and equity) and is used to weight the costs of debt and equity when the regulated WACC is determined.

Clause 4.2.7 of the proposed WEM procedure details a gearing ratio (debt to total assets ratio) of 40 per cent, which is to be reevaluated when the ERA conducts a review of the BRCP WEM Procedure.

In reviewing gearing, the ERA has considered available benchmark data from a sample of Australian and international businesses with operational or proposed battery storage projects across Australia.

There are five sampled firms available. The ERA's gearing analysis is presented in Table 2.

Table 2: ERA gearing analysis as at June 2024*

Firm	Gearing 5-year average	Gearing 10-year average
Neoen #	0.41	n/a
Naturgy	0.41	0.45
Iberdrola	0.44	0.45
Engie	0.54	0.42
Genex ##	0.64	n/a

**Source: Annual reports, Bloomberg and ERA analysis. Gearing is calculated as debt to total capital (that is, including debt and the market value of equity)*

 # data is available for Neoen for 2018 to 2022.

data is available for Genex Power Limited for 2016 to 2023.

The analysis has produced a gearing range between 0.41 and 0.64, which indicates that gearing of 40 per cent is consistent with current data.

The ERA also sought feedback from financial institutions and industry participants involved with BESS projects on typical gearing levels. These discussions confirmed that BESS project gearing levels will vary with the degree of project contracting where the more merchant exposure a BESS has, the lower its level of gearing. This discussion confirmed that a 40 per cent gearing level was reasonable for the BRCP.[127]

The BRCP uses a gearing ratio of 40 per cent to reflect the financing structure of an efficient BESS project under the BRCP. This compares to a higher gearing ratio of 55 per cent in the gas rate of return guidelines for regulated gas pipelines. The lower gearing for a BESS reflects that these businesses are exposed to more risk than a regulated gas pipeline, with regulated revenues being provided to pipelines.

For the BRCP, the ERA continues to support the gearing ratio of 40 per cent in the WEM Procedure.

As gearing is relatively stable, the ERA fixes the gearing ratio of 40 per cent in the WEM Procedure until the ERA's next review of the WEM Procedure.

Return on Debt

The return on debt is the return that debtholders require to compensate them for the risk they take in providing debt financing.

The WEM Procedure details how the return on debt is to be calculated. Clause 4.2.6(b) of the WEM Procedure specifies the nominal return on debt, Rd, for the relevant capacity year as:

$$R_d = R_f + DM$$

where Rf is the nominal risk free rate at the time of the BRCP determination, and DM is the debt margin, which is calculated as the sum of the debt risk premium, DRP, and debt issuance cost, d.

The ERA estimates the return on debt based on a risk premium over and above the risk free rate, combined with an additional margin of administrative costs.

Return on debt = risk free rate + debt risk premium + administrative costs

Risk free rate

The risk free rate is the return an investor would expect when investing in an asset with no risk.

The risk free rate is the rate of return an investor receives from holding an asset with a guaranteed payment stream (that is, where there is no risk of default). Since there is no likelihood of default, the return on risk free assets compensates investors for the time value of money.

Clause 4.2.6(g) of the WEM Procedure specifies that the nominal risk free rate, R_f at the time of the BRCP determination, is based on a moving average basis from the annualised yield on Commonwealth Government bonds with a maturity of 10 years:

[127] Given the commercial sensitivities of BESS project financing costs, the feedback from the financial institutions is not published.

- Using the indicative mid rates published by the Reserve Bank of Australia.
- Averaged over a 20-trading day period.
- Clause 4.2.6(i) of the WEM Procedure specifies that if there are no Commonwealth Government bonds with a maturity of 10 years on any day in the period referred to in Clause 4.2.6(g) of the WEM Procedure, the ERA must determine the nominal risk free rate by interpolating on a straight line basis from the two bonds closest to the 10-year term, which also straddle the 10-year expiry rate.
- If the methods used in clause 4.2.6(i) of the proposed WEM Procedure cannot be applied due to suitable bond terms being unavailable, the ERA may determine the nominal risk free rate by means of an appropriate approximation.

The BRCP WEM procedure uses Commonwealth Government bonds as the proxy for risk free assets in Australia. The ERA uses observed yields from Commonwealth Government bonds as the best proxy for risk free assets in Australia to estimate the risk free rate of return.

The WEM Procedure does not treat the risk free rate for debt and equity differently. Clause 4.2.7 of the WEM Procedure states that the risk free rate is to be reviewed annually.

For the updated WEM procedure, the ERA continues to require the use of the risk free rate approach of the previous WEM Procedure. The use of a 10-year term for the risk free rate is consistent with that intended for the WACC for the purpose of BRCP calculations, which is to reflect a long-term rate of return for the annuitisation of capital costs over the life of the BRCP reference technology.

The risk free rate varies with financial conditions and an annual update is appropriate.

To calculate the risk free rate, the ERA uses indicative mid-rates published by the Reserve Bank of Australia. Where there are no Commonwealth Government bonds with a maturity of exactly 10 years the ERA interpolates the risk free rate on a straight line basis.

Debt risk premium

Clause 4.2.6(h) of the WEM procedure details the debt risk premium, DRP, which is a margin above the risk free rate reflecting the risk in provision of debt finance.

For the updated WEM procedure, the ERA continues to require using the risk premium approach of the previous WEM procedure.

The ERA will estimate this margin as the difference between the observed annualised yields of Australian corporate bonds, which have a BBB (or equivalent) credit rating from Standard and Poor's, and the nominal risk free rate. The ERA must determine the method for estimating the DRP which, in the opinion of the ERA, is consistent with current accepted Australian regulatory practice.

Credit rating

The debt risk premium is closely aligned with the risk of the business. When issuing debt in the form of bonds, a credit rating can be assigned that reflects the probability of default of the issuer, and therefore the risk present in the bond. A credit rating is the forward-looking opinion provided by a ratings agency of an entity's credit risk.

Clause 4.2.6(h) of the WEM procedure details that when estimating the debt risk premium Australian corporate bonds with a BBB (or equivalent) credit rating from Standard and Poor's must be used.

The ERA has reviewed available credit ratings for a sample of firms which have operational or proposed battery storage projects across Australia. The ERA found that credit ratings of these businesses varied between BBB- and BBB+, which is not inconsistent with the BBB rating as an investment-grade rating (see Table 3).

Table 3: ERA credit rating analysis as at June 2024

Firm	Credit rating
ElectraNet	BBB
Engie and Eku Energy	BBB+
Iberdrola	BBB+
Naturgy	BBB
Vena Energy	BBB-

Source: Annual reports, Bloomberg and ERA analysis

The ERA also sought feedback from financial institutions and industry participants involved with BESS projects on typical debt premiums for BESS projects. These discussions confirmed that BESS project debt premiums generally align with a credit rating of BBB and that this is reasonable for the BRCP. [128]

The ERA considers the credit rating to be relatively stable over time, and this supports the use of a benchmark credit rating of BBB. To provide certainty to investors, the ERA applies a BBB rating to be fixed until the next BRCP method review.

Debt risk premium estimation

The ERA uses the "revised bond yield approach" across its regulatory functions to determine the debt risk premium at a point in time for a given credit rating. Estimating the debt risk premium involves the following process:[129,130, 131]

- Step 1: Determining the benchmark sample – Identifying a sample of relevant domestic and international corporate bonds that reflect the credit rating of the benchmark efficient entity.
- Step 2: Collecting data and converting yields to Australian dollar equivalents.
- Step 3: Averaging yields over the averaging period – Calculating an average Australian dollar equivalent bond yield for each bond across the averaging period.

128 Given the commercial sensitivities of BESS project financing costs, the feedback from the financial institutions is not published.

129 Economic Regulation Authority, 2023, *2022 Gas Rate of Return Instrument (amended)*, pp. 11-14, (online).

130 Economic Regulation Authority, 2023, *Final Determination – 2023 Weighted Average Cost of Capital For the Freight and Urban Networks, and the Pilbara Railways*, pp. 32-33, (online).

131 The tools and process documents are available on the ERA's website. Economic Regulation Authority, 2023, *2022 Gas Rate of Return Instrument (amended)*, (online).

- Step 4: Estimating curves - Estimating yield curves on the bond data by applying the Gaussian Kernel, Nelson-Siegel and Nelson-Siegel-Svensson techniques.
- Step 5: Estimating the return on debt – Calculating the simple average of the three yield curves' 10-year costs of debt to arrive at a market estimate of the 10-year cost of debt.
- Step 6: Calculating the debt risk premium by subtracting the 10-year risk free rate from the 10-year cost of debt.

The ERA revises the return on debt each year to incorporate an annual update of the estimate of the debt risk premium.

Debt raising costs

Debt-raising costs are the administrative costs and other charges incurred by businesses when obtaining finance. Debt-raising costs should include direct costs only, which will be compensated in proportion to the average annual debt issuance.

The previous WEM procedure set debt issuance costs at 0.1 per cent of the amount of debt.

The ERA updated debt-raising costs to 0.165 per cent per annum to best estimate the cost in the market environment.

The ERA determined that the debt issuance costs be fixed until the next BRCP review.

Return on Equity

The return on equity is the return that shareholders require from a firm to compensate them for the risk they take by offering their capital. Since there are no readily observable proxies for the expected return on equity, a model is required to estimate this parameter.

The model most used by Australian regulators for quantifying the return on equity has been the Sharpe-Linter Capital Asset Pricing Model (CAPM):

$$R_i = R_f + \beta_i(R_m - R_f)$$

where:

R_i	is the required rate of return on equity for the asset, firm or industry in question.
R_f	is the risk free rate.
β_i	is the equity beta that describes how a particular portfolio i will follow the market which is defined as $\beta_i = cov(R_i, R_m)/var\ (R_m)$.
R_m	is the return on the market portfolio.
$(R_m - R_f)$	is the market risk premium.

For the BRCP, the ERA is continuing to require using the CAPM to estimate the return on equity.

Risk free rate

The risk free rate is the return an investor would expect when investing in an asset with no risk.

The approach to the risk free rate is consistent with the current market procedure and has been detailed earlier in this Appendix.

Market risk premium

The market risk premium is a parameter of the Sharpe-Lintner CAPM and is the expected rate of return over and above the risk free rate that investors require to invest in a fully diversified portfolio. Prior to investing capital (ex ante), investors always require a rate of return above the risk free rate to invest and so the expected market risk premium is always positive. After capital has been invested (ex post), the realised return to the market portfolio may be negative; that is the nature of risk. To establish the cost of capital, it is the ex ante market premium that is relevant.

The market risk premium compensates an investor for the systematic risk of investing in a fully diversified portfolio. Systematic risk is risk that cannot be diversified away by investors because it affects all firms in the market. Therefore, the market risk premium represents an investor's required return, over and above the risk free rate of return, on a fully diversified portfolio of assets. This is a forward-looking concept.

The market risk premium is a market parameter that is unaffected by a specific project or business considerations. Therefore, the same market risk premium applies to all market participants in an economy.

The market risk premium is calculated as follows:

$$MRP = R_m - R_f \qquad \text{(equation 1)}$$

where:

R_m is the expected market return on equity observed in the Australian stock market.

R_f is the risk free rate of return.

While estimates of the cost of debt can be obtained by observing debt instruments, financial markets do not provide a directly observable proxy for the cost of equity for either individual firms or the market as a whole. The market risk premium cannot be directly observed because it depends on investors' expectations, which are unobservable. To set the return on equity, the market risk premium needs to be estimated for a future time period.

For the BRCP, the ERA's forward-looking market risk premium is estimated for a 10-year period, consistent with the long lives of electricity assets that can provide capacity and the regulatory framework.

The ERA continues the approach applied for the 2020 BRCP review but, consistent with its recent regulatory determinations, has simplified and refined the approach to calculating the market risk premium. Further detail on the ERA's market risk premium approach can be found in the explanatory statement to the 2022 Final Gas Rate of Return Instrument.[132]

[132] Economic Regulation Authority, 2022, *Explanatory statement for the 2022 final gas rate of return instrument*, pp. 129-145, (online).

For the BRCP, the ERA has updated the market risk premium based on current market information.

The following details how the ERA determined the expected market risk premium for the BRCP.

Historic market risk premium

The ERA estimates the historic market risk premium by using current data. The historic market risk premium can be directly measured. The Ibbotson approach is a well-accepted method for calculating the market risk premium using historic data.

As the ERA is using a 10-year term for equity, the risk free rate for the market risk premium will also be determined using a 10-year term.

The ERA will estimate the market risk premium using the Ibbotson method, which requires the selection of a time period over which to analyse historical data.

The length of the estimation window involves a trade-off between relevance of the data and statistical robustness:

- Longer periods can include behaviour in the data that is no longer relevant due to changing economic and market conditions.
- However, shorter periods may produce estimates that are less statistically robust.

For the estimation of the historic market risk premium for the BRCP, the ERA uses the following four overlapping periods:

- 1958 to current
- 1980 to current
- 1988 to current
- 2000 to current.

The ERA maintains the use of multiple sub-periods. The ERA considers that the periods chosen represent structural changes in the economy and financial markets that cannot be pooled together into a single period.

The ERA relies on a reference dataset (the BHM dataset) to estimate the historic market risk premium.[133]

When applying the historic market risk premium, an averaging method must be selected to apply to historical returns. There are two averaging methods which can be used to derive an annualised return — the arithmetic mean and geometric mean.[134]

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[133] Brailsford, T., Handley, J. and Maheswaran, K., 2008, *Re-examination of the historical equity risk premium in Australia*, Accounting and Finance, Vol. 48, pp. 78-79.

[134] The arithmetic mean is also called the simple average, which is the sum of all numbers in the series divided by the count of all numbers. The arithmetic mean formula is:

$$Arithmetic\ Mean = \frac{\sum_{i=1}^{n} x}{n} = \frac{x_1 + x_2 + \cdots + x_n}{n}$$

The geometric mean is the average of a set of products. The geometric mean formula is:

A thorough consideration of arithmetic and geometric means is in the explanatory statement to the 2022 Final Gas Rate of Return Instrument.[135]

For the BRCP, the ERA considers that an unbiased estimate of the historic market risk premium is likely to be somewhere between the arithmetic mean and the geometric mean. The ERA uses both the arithmetic and geometric means, with different weightings to estimate the historic market risk premium.

The ERA considers that it is appropriate to give greater weight to the arithmetic mean. This approach recognises that:

- To the extent that arithmetic or geometric means are biased, a combined approach is more likely to result in a robust estimate.
- An unbiased estimate of the historic market risk premium is likely to be somewhere between the geometric mean and the arithmetic mean.
- Given the volatility of returns over time, an investor may consider different investment horizons.
- Investor practice may favour and place more weight on the arithmetic mean.

After considering the above information, the ERA considers that an unbiased estimate of the historic market risk premium is likely to be closer to the arithmetic mean than the geometric mean. The ERA calculates the historic market risk premium estimate as the weighted average of the arithmetic mean (60 per cent) and geometric mean (40 per cent).

The ERA will incorporate all the data periods to calculate an arithmetic mean and a geometric mean. The ERA then weights the resulting arithmetic and geometric means.

- The estimates of the historic market risk premium are detailed in Table 4.

Table 4: Historic market risk premium (%)

Time period	Arithmetic mean	Geometric mean
1958-2023	6.65	4.51
1980-2023	6.65	4.68
1988-2023	6.35	4.97
2000-2023	6.51	5.08
Mean	6.54	4.81
Weights	60	40
Historic market risk premium estimate	**5.8**	

$$Geometric\ Mean = \left(\prod_{i=1}^{n} x\right)^{\frac{1}{n}} = \sqrt[n]{x_1 \cdot x_2 \cdots x_n}$$

When a geometric mean is used with percentage returns, the formula is altered to reflect the compounding effect, as below:

$$Geometric\ Mean\ for\ \%\ return = \sqrt[n]{(1+x_1\%) \cdot (1+x_2\%) \cdots (1+x_n\%)} - 1$$

[135] Economic Regulation Authority, 2022, *Explanatory statement for the 2022 final gas rate of return instrument*, pp. 133-145, (online).

Source: ERA analysis.

For the updated WEM procedure, the ERA has estimated a historic market risk premium of 5.8 per cent.

Dividend Growth Models

The ERA's approach to estimating the market risk premium also incorporates information from the dividend growth model (DGM).

The DGM uses an assumed forecast dividend growth rate and current share prices to estimate an implied market risk premium. This forward-looking discount rate is the implied market return on equity.

The DGM is based on the following formula to calculate a stock or market index price as presented below:

$$Market\ price\ = \frac{Current\ value\ of\ the\ dividend\ \times (1 + dividend\ growth\ rate)}{Market\ rate\ of\ return - Assumed\ dividend\ growth\ rate}$$

(equation 2)

Through rearranging the above formula, an implied market rate of return (r) can be calculated from market price (p), current dividend (D_0) and an assumed dividend growth rate (g). The market risk premium can then be calculated by using that market rate of return and subtracting the risk free rate.

The ERA uses a two-stage DGM. This DGM specification assumes that dividends grow at the long-term growth rate following the dividend forecast period. The ERA's dividend growth model estimate uses a growth rate of 4.6 per cent.[136]

While the DGM has the benefit of taking the current economic outlook into account, it is unreliable on its own. The DGM suffers from some weaknesses, including the form of the model, its input assumptions, its sensitivity to assumptions and its upward bias. The ERA has concerns with the usage of the DGM and does not place a large reliance on the model's market risk premium estimate.

However, the BRCP continues to use the DGM to inform the market risk premium estimate.

The ERA supports the use of a simple two-stage approach to the estimation of the implied market risk premium from the DGM.

Previous analysis by the ERA has revealed that DGM estimates can vary substantially month to month.

Accordingly, to reduce sensitivity, the ERA estimates the DGM monthly in the six months prior to the relevant determination. The DGM estimates of the market risk premium are detailed in Table 5. The average of these estimates will be the DGM estimate.

[136] Economic Regulation Authority, 2022, *Explanatory statement for the 2022 final gas rate of return instrument*, pp. 151-152, (online).

Table 5: Dividend growth model estimates of the market risk premium (%)

	Jan 2023	Feb 2024	Mar 2024	Apr 2024	May 2024	Jun 2024	Mean
DGM implied return	9.18	9.35	9.46	9.61	9.49	9.54	9.44
Risk Free Rate	4.15	4.14	4.05	4.27	4.33	4.24	4.19
DGM market risk premium	5.04	5.21	5.42	5.34	5.16	5.30	5.24
DGM estimate							**5.2**

Source: ERA analysis.

To inform the updated WEM procedure, the ERA calculated a DGM market risk premium estimate of 5.2 per cent.

Determination of the point estimate

For the BRCP the ERA maintains its preference for the historic market risk premium approach, as it accords with a plausible model of investor behaviour, where investor expectations are shaped by past information (realised returns) and current practices (adopted methods). The historic market risk premium estimate can be considered as an unconditional estimate that informs the determination of the expected market risk premium.

Australian regulators commonly use historical returns when estimating the expected market risk premium. This appears to be a consistent investor, market and academic practice.

The DGM receives less weight due to the ongoing concerns that the ERA has about the proper implementation of the dividend growth model given the issues surrounding input assumptions, forecasts and variability of outputs. Until these matters are resolved, the ERA will continue to put more weight on the historic market return estimates. The dividend growth model estimate can be considered to be a conditional estimate that helps inform the determination of the expected market risk premium.

The historical market risk premium estimate (5.8 per cent) and the dividend growth model estimate (5.2 per cent) provide the basis from which the ERA uses its regulatory discretion to decide on an appropriate estimate.

For the updated WEM Procedure, the ERA adopts a market risk premium of 5.7 per cent.

The expected market risk premium will remain fixed until the next BRCP review as this figure is unlikely to change from year-to-year.

Equity beta

Equity beta is the 'slope' parameter β_i in the Sharpe-Lintner CAPM. The slope parameter β_i correlates the return on the specific asset, in excess of the risk free rate of return, to the return on the market portfolio.

$$R_i = R_f + \beta_i(R_m - R_f) \quad \text{(equation 3)}$$

where:

R_i	is the required rate of return on equity for the asset, firm or industry in question.
R_f	is the risk free rate.
β_i	is the equity beta that describes how a particular portfolio *i* will follow the market which is defined as $\beta_i = cov(R_i, R_m)/var\ (R_m)$
R_m	is the return on the market portfolio.
$(R_m - R_f)$	is the market risk premium.

The risk of an asset is typically thought of as the variance in asset returns. This variance is a measure of the total risk of an asset. Total risk consists of systematic and non-systematic risk. Systematic risk is that part of the total risk in a firm's returns that stems from the economy and markets more broadly. Systematic risk cannot be easily eliminated through diversification.

Non-systematic risk is the risk stemming from unique attributes of the firm, which may be eliminated by an investor through diversification. For this reason, only systematic risk is compensated in the return on equity.

The equity beta is a parameter that measures the systematic risk of a security or a portfolio in comparison to the market as a whole.

Two risk factors are generally considered to affect the value of equity beta for a particular firm:

- The type of business, and associated capital assets, that the firm operates, measured by asset or 'un-levered' beta.
- The amount of financial leverage (gearing) employed by the firm, which levers or 'amplifies' the asset beta to arrive at equity beta.

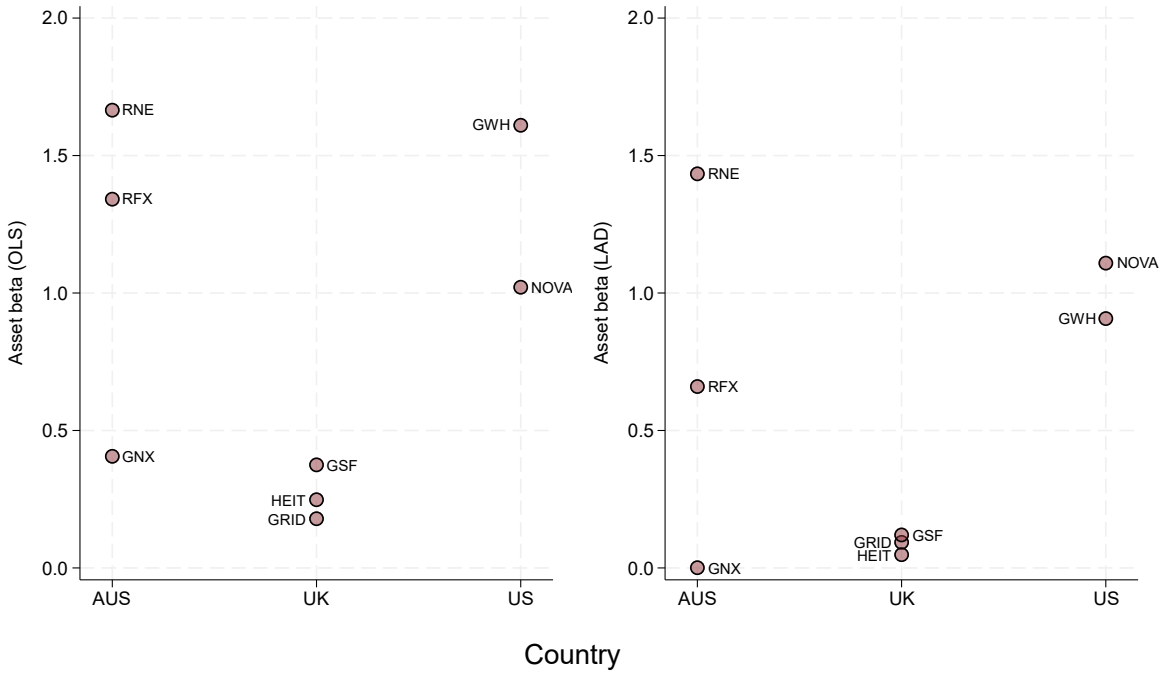
The ERA estimates that the asset beta is 0.7 and the equity beta is 1.2. The equity betas are to remain fixed until the next BRCP review.

These estimates are based on the ERA's analysis of benchmark firms that are likely to have a similar level of risk to a BESS project under the BRCP. In undertaking its analysis, the ERA identified a small sample of comparable listed firms, which displayed a large range of beta estimates.

The resulting asset beta estimates presented in Figure 3.[137]

[137] The beta estimates are conducted according to the procedures as described in the ERA's 2022 Gas Instrument Explanatory Statement, (online).

Figure 3: Asset beta estimates

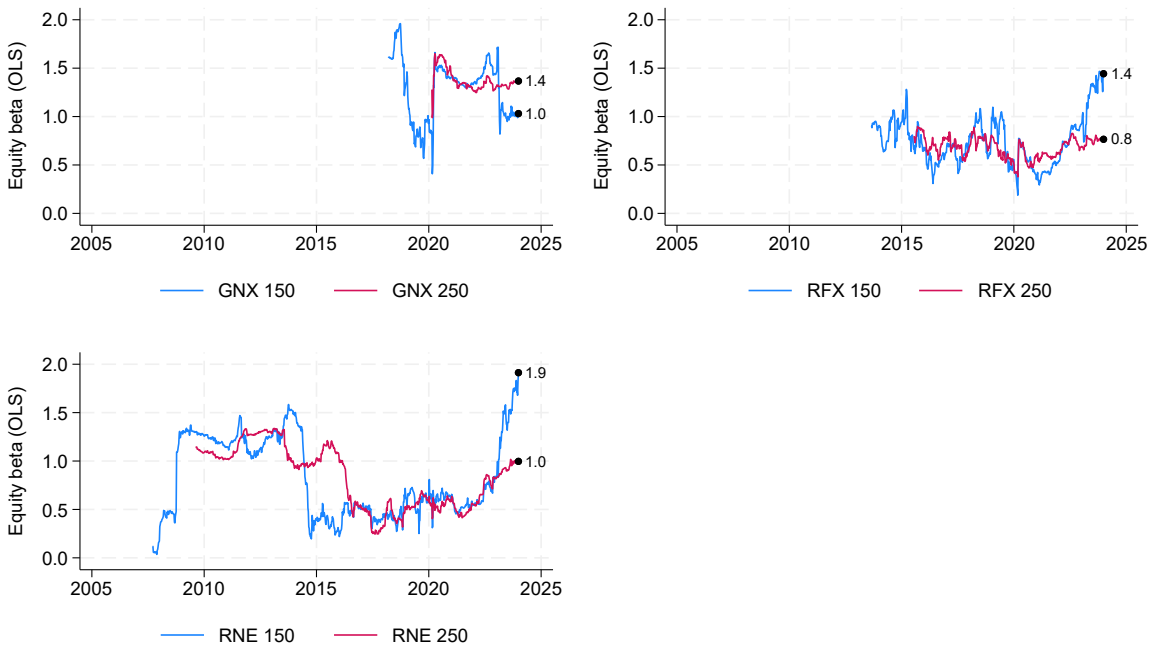


Source: ERA analysis from Bloomberg data.

Note: OLS and LAD asset beta estimates are presented in panels A and B of Figure 3 for comparator firms. Bloomberg tickers are used in the figure for the following firms: GNX: Genex Power; RFX: Redflow; RNE: ReNu Energy; HEIT: Harmony Energy; GSF: Gore Street Energy Storage Fund; GRID: Gresham House Energy Storage; GWH: ESS Tech; NOVA: Sunnova Energy.

The results display a high degree of dispersion, with estimates ranging from 0.2 to 1.6. Further analysis on the Australian comparators also indicates that beta estimates are volatile over time as illustrated by Figure 4.

Figure 4: Rolling equity beta estimate for Australian comparators using 150- and 250-week estimation windows



Source: ERA analysis using Bloomberg data.

Note: Rolling OLS equity beta presented, with 150 and 250 week estimate windows as noted after ticker name. Bloomberg tickers are used in the figure for the following firms: GNX: Genex Power; RFX: Redflow; RNE: ReNu Energy.

In considering the underlying sample of firms, the ERA notes that the firms may well operate under different regulatory arrangements and have varying exposures to merchant risk. Where firms operate under regulatory or commercial arrangements that provide more revenue certainty, or lower merchant risk, they are likely to have lower beta estimates. This is due to their revenues being more stable, predictable, and less correlated to the economic cycle and market conditions, which would lower the covariance with the market portfolio.

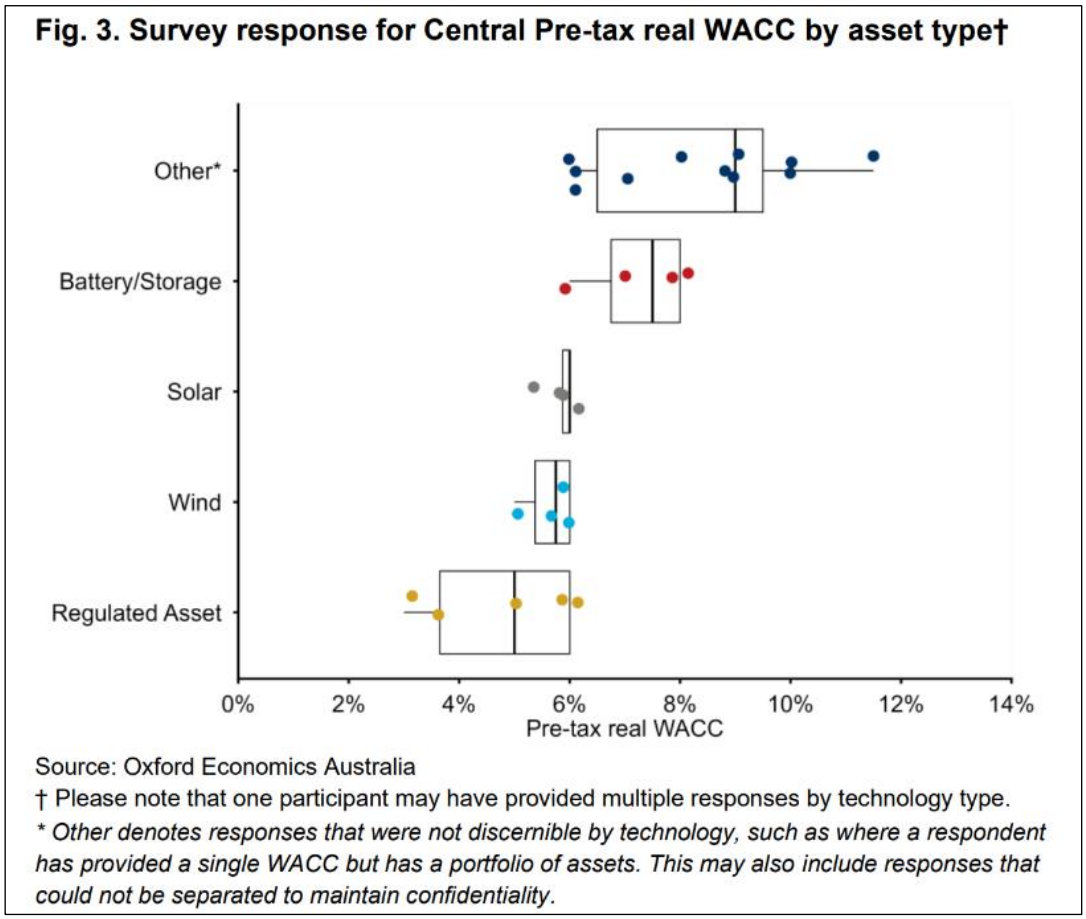
The ERA considers that an asset beta estimate of 0.7 is appropriate as:

- It is likely that the BESS BRCP would have at least as much as risk as the previous reference technology that had an asset (equity) beta of 0.5 (0.83).
- The empirical estimate of betas, while noisy, provide support for an estimate of asset beta no greater than 1.0.
- The distribution of empirical betas appears on the upper end and provides support for an estimate of asset beta close to 1.0.
- The BRCP does not guarantee revenues, which is equivalent to BESS projects that have lower levels of contracting, which would result in a higher beta.

Under the Brealey-Myers approach to leveraging, the asset beta corresponds to an equity beta of 1.2.

Given the range of beta estimates, the ERA has considered other reference points to inform its estimate of beta through examining other regulatory arrangements of similar risk. Oxford Economics conducted an investor survey for AEMO on discount rates in 2023, with the results presented in Figure 5.[138]

Figure 5: Oxford Economics 2023 survey of discount rates by technology type

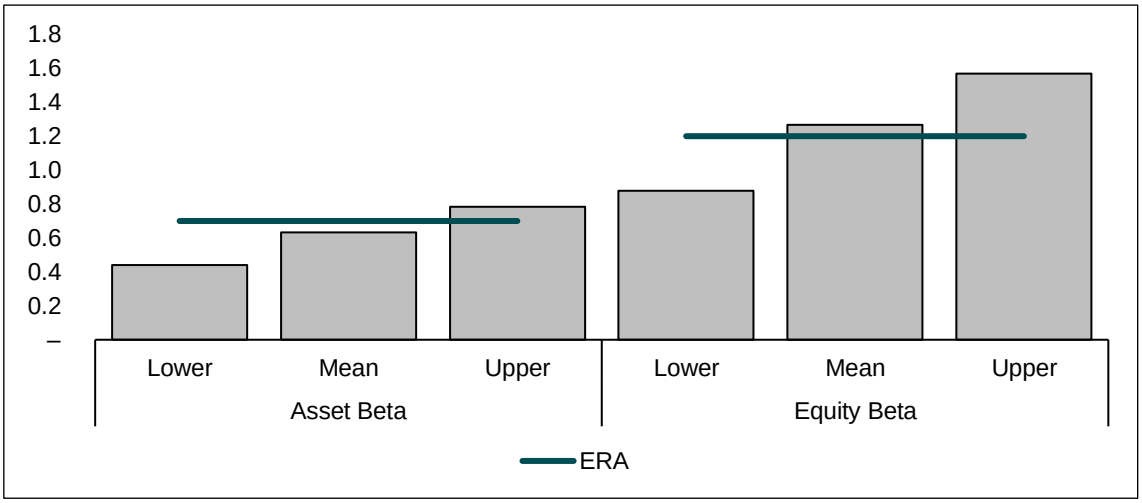


Source: Oxford Economics, 2023, Cost of capital survey 2023 – Report prepared for the Australian Energy Market Operator, p. 6, (online).

This survey indicates that the pre-tax real WACC required for battery and storage projects ranges from 6 to 8 per cent. Investors required higher levels of returns for battery storage projects relative to other generation and energy assets. The ERA has converted these battery storage values to estimate the implied asset and equity beta that is consistent with these estimates in Figure 6.

[138] Oxford Economics, 2023, *Cost of capital survey 2023,* Report prepared for the Australian Energy Market Operator, p. 6, (online).

Figure 6: Oxford Economics 2023 implied asset and equity beta estimates for battery storage assets.



Source: Oxford Economics (2023), ERA analysis.

Note: Oxford Economics survey responses of pre-tax real WACC estimates converted into implied asset and equity betas using the following assumptions and methods. Expected inflation was 2.5 per cent; gearing was 50 per cent; gamma was 0.585; corporate tax rate was 30 per cent; equity risk free rate was 4.0 per cent and the market risk premium was 6.0 per cent. Conversions utilised the pre-tax nominal WACC definition to derive the implied beta estimates for the lower, mean and upper estimates as presented in Figure 5: Oxford Economics 2023 survey of discount rates by technology type. Figure 5. Beta estimates are implied from the lowest, average and highest pre-tax real WACC estimates from surveyed participants for battery storage projects only.

This comparison indicates that the beta estimates applied by the ERA are consistent with the investor survey results as conducted by Oxford Economics. Given the limited amount of publicly available information to estimate the likely systematic risk of a BESS project, the ERA places some weight on investor surveys in the absence of superior information.

The ERA also sought feedback from financial institutions and industry involved with BESS projects on typical return requirements for BESS projects. These discussions confirmed that the level of required returns is affected by the level at which the project is contracted and its exposure to merchant risk. These discussions confirmed that BESS total returns generally aligned with an equity beta above 1.0. This discussion confirmed that an equity beta of 1.2 was reasonable for the BRCP.[139]

The ERA considers that its estimates of asset and equity beta are within the range of values implied from other available information and reasonably reflects the likely risk of a BESS project.

The ERA fixes the equity beta until the next BRCP review for similar reasons to the market risk premium. It is likely that investor expectations regarding systematic risk will be relatively stable in the medium term. Additionally, fixing the value will also provide certainty and stability for investors when considering the calculation of the return on equity.

[139] Given the commercial sensitivities of BESS project financing costs, the feedback from the financial institutions is not published.

Value of imputation credits (gamma)

The imputation tax system prevents corporate profits from being taxed twice. Under the Australian imputation tax system, franking credits are distributed to investors at the time that dividends are paid and provide an offset to those investors' taxation liabilities.

The gamma parameter accounts for the reduction in the effective corporate taxation that arises from the distribution of franking credits to investors. Generally, investors who can use franking credits will accept a lower required rate of return, before personal tax, on an investment that has franking credits, compared with an investment that has similar risk and no franking credits.

Clause 2.9.8 of the previous WEM Procedure applied a 0.5 value for gamma.

The ERA estimates gamma as the product of the distribution rate and the utilisation rate, which leads to a gamma of 0.5.[140,141]

- The distribution rate represents the proportion of imputation credits generated by a benchmark efficient entity that is expected to be distributed to investors. The ERA considers that the distribution rate is a firm-specific rather than a market-wide parameter. The ERA uses a distribution rate of 0.9 informed by the distribution rate from financial reports of the 50 largest Australian Securities Exchange-listed firms.
- The utilisation rate is the weighted average over the utilisation rates of individual investors, with investors able to fully use the credit having a rate of 1, and those unable to use them having a rate of zero. The ERA uses a utilisation rate of 0.6 based on the equity ownership approach to determine the percentage of domestic investors in the Australian equity market.

For the BRCP, the ERA continues to use a gamma of 0.5 in the WEM procedure and fixes the gamma value until the next BRCP review.

Illustrative rate of return for the BRCP

This section illustrates the effect that the ERA's changes will have on the BRCP rate of return. This analysis is for illustrative purposes only and is not the ERA's BRCP determination.

Table 6 details the updated rate of return for the BRCP's BESS project estimates for market data as at 30 June 2024. For comparison, Table 6 also provides the last BRCP published for the open cycle gas turbine, which was based on market data as at 31 October 2023.

140 Economic Regulation Authority, 2022, *Explanatory statement for the 2022 final gas rate of return instrument*,, pp. 219-224, (online).

141 Economic Regulation Authority, 2023, *Final Determination – 2023 Weighted Average Cost of Capital for the Freight and Urban Networks and Pilbara Railways,* pp. 69-70, (online).

Table 6: Illustrative rate of return for BESS BRCP

Parameter	2024 BRCP value	Updated BRCP for BESS
Cost of equity parameters		
Nominal risk free rate (%)	4.69	4.30
Equity beta	0.83	1.20
Market risk premium (%)	5.90	5.70
Pre-tax return on equity (%)	11.28	11.14
Cost of debt parameters		
Nominal risk free rate (%)	4.69	4.30
Debt risk premium (%)	2.153	1.778
Debt issuance costs (%)	0.100	0.165
Pre-tax return on debt (%)	6.94	6.24
Other parameters		
Debt proportion (gearing) (%)	40	40
Franking credits (gamma) (%)	50	50
Corporate tax rate (%)	30	30
Weighted average cost of capital		
Nominal pre-tax WACC (%)	9.54	10.36

Source: ERA analysis; 2024 BRCP for 2026/27 capacity year – final determination (online).

The ERA estimates that the pre-tax nominal WACC for the BESS BRCP is 10.36 per cent, as illustrated in Table 6.

The ERA has considered other Australian regulatory arrangements which would have a similar level of risk to the BESS BRCP.

AEMO applies a pre-tax real discount rate as part of its forecasting and planning studies, such as the Integrated System Plan. AEMO's estimates for its 2023 discount rates are presented in Figure 7.

Figure 7: AEMO 2023 Inputs, Assumptions and Scenarios Report pre-tax real discount rates

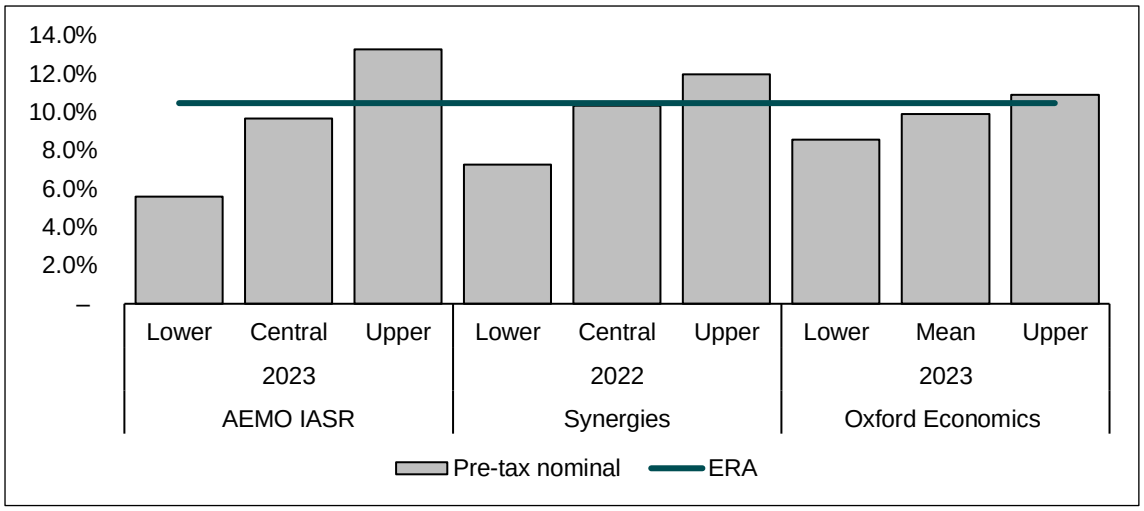
Table 31 Pre-tax real discount rates

	Lower bound	Central estimate	Upper bound
2022 ISP	2.0%	5.5%	7.5%
Draft 2023 IASR	4.0%	7.0%	9.0%
2023 IASR	3.0%	7.0%	10.5%

Source: AEMO 2023 IASR Report.[142]

Converting AEMO's pre-tax real discount rates to pre-tax nominal WACCs allows for more suitable comparisons with the ERA's estimate. The ERA has also made conversions of estimates from AEMO's consultants (Synergies and Oxford Economics) and presents the comparisons in Figure 8.

Figure 8: Pre-tax nominal WACC reference points from AEMO, Synergies and Oxford Economics



Source: ERA analysis of estimates from AEMO, Synergies and Oxford Economics.[143,144,145]

The ERA will not use reference points in a deterministic manner but will consider them as additional information that can inform its judgement. Figure 8 indicates that there is a broad range of overall WACC estimates for similar projects. The estimates from AEMO and Synergies apply to both generation and transmission projects, where it is likely that BESS projects would have a level of risk in the upper end (13.3 and 12.0 per cent, respectively). The estimates from Oxford Economics are for battery and storage specific projects, which have a range of WACCs from 8.5 to 10.9 per cent.

The ERA considers that its estimate of 10.36 per cent is within the range of reasonable values from these reference points.

142 Australian Energy Market Operator, 2023, *2023 Inputs, Assumptions and Scenarios Report – Final Report*, p. 123, (online).

143 Australian Energy Market Operator, 2023, *2023 Inputs, Assumptions and Scenarios Report – Final Report*, (online).

144 Synergies Economic Consulting, 2022, *Updating the 2022 ISP Discount Rate*, Report prepared for the Australian Energy Market Operator, (online).

145 Oxford Economics, 2023, *Cost of capital survey,* Report prepared for the Australian Energy Market Operator, (online).

Comparators for asset and equity beta estimation

Ticker	Company Description
GNX AU Equity	Genex Power Limited operates as a power generation development company. The Company focuses on generation and storage of renewable energy. Genex Power serves customers in Australia.
RFX AU Equity	Redflow Ltd. manufactures batteries. The Company produces zinc bromine batteries, which are used to manage network peak loads, storage and release of electricity generated by solar panels, and co-installation with diesel generators to reduce diesel consumption.
RNE AU Equity	ReNu Energy Limited generates electricity through renewable energy projects. The Company operates biogas energy generation project, as well as offers solar photovoltaics, battery storage, and hybrid energy solutions.
HEIT LN Equity	Harmony Energy Income Trust PLC is an investment company. The Company invests in commercial scale energy storage and renewable energy generation projects, with an initial focus on a diversified portfolio of battery energy storage systems located in Great Britain.
GSF LN Equity	Gore Street Energy Storage Fund PLC is a closed-end fund incorporated in United Kingdom. The Fund will invest in a diversified portfolio of utility scale energy storage projects primarily located in the UK. It targets a sustainable and attractive dividend over the long term. The Fund also seeks to provide investors with an element of capital growth.
GRID LN Equity	Gresham House Energy Storage Fund PLC is a closed end fund. The Fund invests in a portfolio of utility scale energy storage systems ("ESS Projects"). Gresham House Energy Storage Fund invests in ESS Projects located in locations across Great Britain that utilize batteries and generators.
GWH US Equity	ESS Tech, Inc. provides energy storage systems. The Company designs, builds, and deploys iron flow batteries for long-duration commercial and utility-scale energy storage applications requiring from 4 to 12 hours of flexible energy capacity. ESS Tech serves customers worldwide.
NOVA US Equity	Sunnova Energy International Inc. provides renewable energy solutions. The Company offers solar battery storage units, as well as maintenance, monitoring, and management services. Sunnova Energy International serves customers in the United States and Northern Mariana Islands.

Appendix 5 Annuity tilt

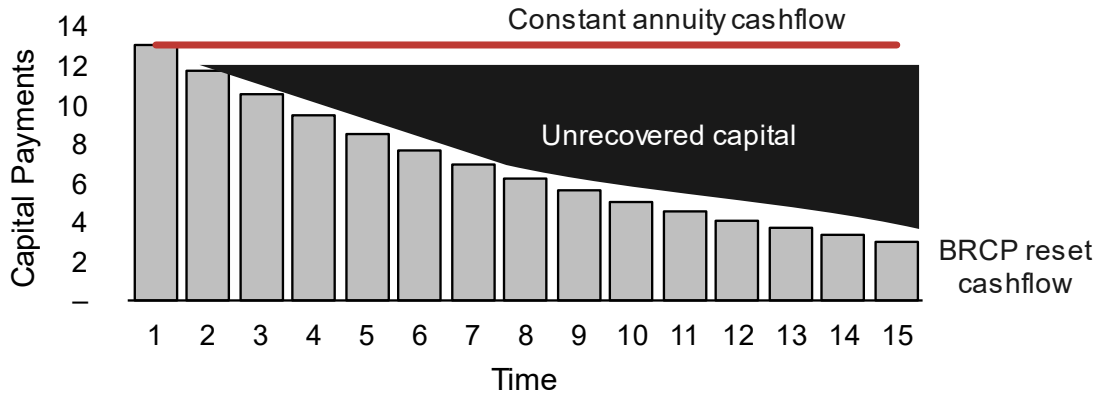
This appendix provides further detail on the ERA's analysis of the annuity tilt component of the BRCP, as summarised in Section 4.5 of this report.

Effect of reducing capital costs

As the BRCP is not a contracting mechanism, it does not guarantee capacity revenues.

The move to a BESS as the BRCP reference technology has a more pronounced cashflow recovery issue than with the previous BRCP reference technology (an OCGT). Since a BESS is not yet a mature technology with its costs expected to decrease over time, the current constant annuity approach under the annual BRCP resets will distort the intertemporal cashflow profile (see Figure 9).

Figure 9: Illustrative constant annuity cashflows versus cashflows under a resetting BRCP with ongoing cost reduction.



Source: ERA analysis.

As illustrated in Figure 9, using a constant annuity approach that is updated annually to reflect current (expected lower) costs means that investors do not recover their required return of (depreciation) and return on (rate of return) capital over the life of the project. A constant annuity calculation, assumes investors will receive a constant annuity payment over future periods, as illustrated by the red line in the figure above. However, in line with the expected decline in BESS capital costs due to technological advances, future year cash flows will decline, and investors will not be able to recover part of their capital payments. This gap in capital recovery is shown by the black shaded area.

Without confidence in the recovery of capital (both depreciation and financing costs) investors would be more reluctant to invest, which undermines the point of the BRCP.

Stakeholder consultation

There was majority support for the proposed annuity tilt from stakeholders. There was no objection to specifying the tilt in the WEM Procedure until the ERA's next review of the WEM Procedure. AEMO and Synergy considered that the ERA's approach was reasonable. Telsa stated that the overall proposal was consistent with the WEM Objectives and the WEM Rules.

The Expert Consumer Panel (ECP) strongly objected to the tilted annuity approach for the reasons outlined below:

1. In practice, BESS facilities will have additional sources of revenue in the near term that will generate revenue to pay for BESS capital costs, which obviates the need for a tilt.

    a. The ERA acknowledges that there will likely be additional revenue sources available to BESS providers, particularly through the Real-Time Market. However, the Coordinator for Energy determined that the BRCP must be determined on a gross CONE basis, which does not allow for the consideration of revenue from other sources and assumes the BESS investor recovers all fixed costs through the BRCP mechanism. The ERA considers that this matter is beyond the scope of the ERA's review and can be addressed by the Coordinator for Energy in future determinations of the Benchmark Reserve Capacity Providers. Furthermore, the ERA notes that it is profit from other revenue streams that is the relevant factor, and it is not clear that combined profits are enough to offset the combined unrecovered capital (both depreciation and financing costs) from the BRCPs.

2. Other mechanisms exist to provide certainty over capital cost recovery, such as the State Government's ongoing WEM Investment Certainty Review and the Federal Government's Capacity Investment Scheme (CIS).[146]

    a. The ERA disagrees that these mechanisms can be considered for the BRCP for various reasons. As noted earlier, the gross CONE approach does not allow for consideration of non-BRCP revenue streams and incentives. Additionally, these schemes are still in their early stages, under consultation, and are difficult to incorporate into a benchmark approach. For example, the CIS, if implemented in Western Australia, will only operate for three years and will only contract with a limited quantity of battery capacity. In addition, the CIS will be awarded to successful tenders, where the floor and cap prices are not currently known.

3. The overall BESS capital costs may not decline as assumed, where both BESS and non-BESS components may instead increase. Applying a tilt to increasing costs will result in over-compensation.

    a. The ERA agrees that applying a tilt (greater than one) in an environment of increasing costs is not appropriate. The consensus view of most agencies that forecast BESS costs indicate that BESS capital costs will continue to decrease for the foreseeable future. For example, recent analysis from the International Energy Agency (IEA) expects a 40 per cent reduction in BESS capital costs by 2030.[147] This is supported by analysis from the ERA's technical advisor GHD that indicates that the non-BESS components such as inverters are a mature technology, and its costs are unlikely to change materially over time.

    b. The ERA has considered the feedback from stakeholders regarding the distribution between BESS and non-BESS capital costs. The ERA has refined its assumption that the battery cell proportion of BESS capital costs are fixed at 55 per cent of total capital costs. This is because the proportion of total capital costs attributable to the battery cells is not static and will decrease over time as BESS capital costs decrease.

[146] The Federal Government is proposing to expand the Capacity Investment Scheme to WA. Its consultation on its proposed design and implementation in WA, which closed in May 2024, proposes to encourage new investment in renewable and clean dispatchable capacity to deliver an additional 32 GW of capacity by 2030.

[147] International Energy Agency, 2024, *Batteries and Secure Energy Transitions*, p.11, (online).

4. Using the mean of forecasted BESS capital costs is inappropriate given the dispersion present in individual forecasts.

    a. The ERA notes that there is no universally agreed upon method to combine forecasts from multiple sources. The ERA has considered a range of forecast values from reputable sources (such as the CSIRO, IEA, Rocky Mountain Institute and Bloomberg New Energy Finance), and various methods to combine the forecasts (such as a simple mean, trimmed mean, or median).

    b. The ERA selected a simple average based on its research on ensemble forecasting methods, which suggested that it is difficult to outperform the simple average when compared to other more complicated approaches.[148] The ERA considers this approach remains reasonable. However, for robustness the ERA has applied the trimmed mean and median approaches as well.

5. Transitioning to a flat annuity when costs stabilise would allow for over-recovery for early investors, especially if capital costs increase.

    a. The ERA acknowledges that investors face uncertainty of over or under recovery of their costs due to variation in battery storage development costs. Over or under recovery of costs is possible due to forecast errors in the determination of the tilt factor. However, not transitioning to a constant annuity when there is evidence that costs stabilise would result in over-recovery.

    b. The ERA notes that a tilt factor does not remove all risk from future cost reductions for investors. If BESS capital costs fall faster than expectations, investors will not be able to recover their invested capital from the BRCP.

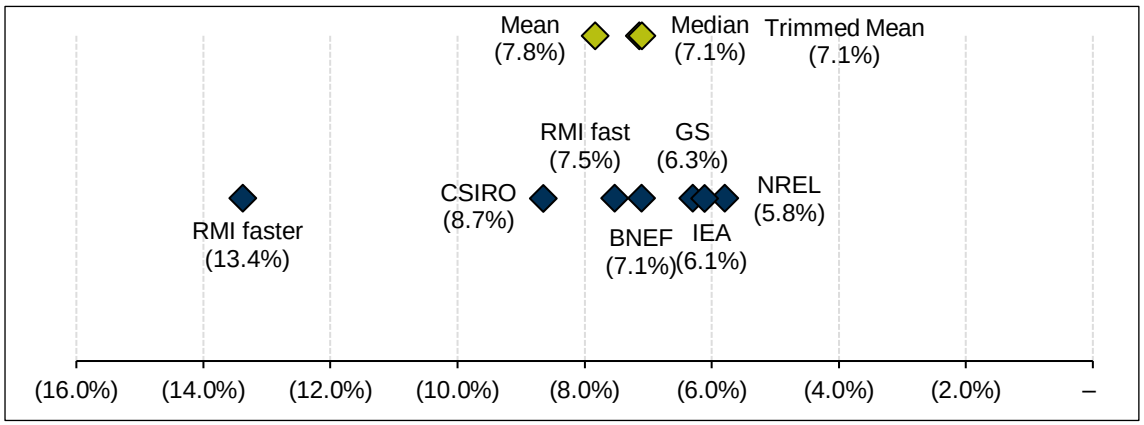
Further details regarding the ERA's methodology and refinements are discussed in the following sections.

Estimation of expected cost declines

To understand the implications of BESS cost declines and adjust BRCP payments, the ERA first needs to estimate expected future capital cost declines. The ERA will use the best available information regarding expected cost changes for battery storage prices to inform its expectations of BESS cost declines, presented in Figure 10.

[148] The seminal reference is Bates, J. M., & Granger, C. W. J., 1969, 'The combination of forecasts', *Operational Research Quarterly*, vol. 20, no. 4, pp. 451–468. A recent literature survey is provided by Wang et al, 2023, 'Forecast Combinations: An over 50-year review', *International Journal of Forecasting*, vol. 39, issue 4, pp. 1518-1547.

Figure 10: Distribution of forecasts for battery cell changes per annum



Source: Rocky Mountain Institute (2023),[149] NREL (2023),[150] IEA(2024),[151] CSIRO(2024),[152] ERA analysis.

Note: ERA analysis of the forecast price changes from 2022 to 2030, converted into a compounded annual growth rate. RMI: Rocky Mountain Institute; BNEF: Bloomberg New Energy Finance; GS: Goldman Sachs; NREL: National Renewable Energy Lab; IEA: International Energy Agency; CSIRO: Commonwealth Science and Industrial Research Organisation.

There is a large degree of dispersion of forecasts, however the consensus from the data sample is for battery costs to decrease over time. The ERA uses the arithmetic mean of the estimates (7.8 per cent) to form its expectation of capital cost changes until the next BRCP WEM Procedure review reassesses this estimate. For robustness and considering stakeholder concerns, the ERA has also considered using the median (7.1 per cent) and the trimmed mean (7.1 per cent) as a combination forecast method.

GHD's analysis suggests that the capital cost component exposed to this cost change is likely to be approximately 55 per cent of total capital costs of the first year, such that the overall cost decline is approximately 4.3 per cent (7.8 per cent x 55 per cent). However, as battery cells become a smaller proportion of total costs over time, this 55 per cent figure will decline.

As an additional refinement, the ERA has changed the methodology to more directly calculate the battery cell cost proportion that arises from the BESS component. This is achieved by applying the cost reduction estimate to only the BESS component for each year, assuming that non-BESS costs are stable for the annuity period. This has the effect of moderating cost reductions compared to the simple static approach, but nonetheless cost reductions are still expected.

This requires these cost declines to be factored into the BRCP to reduce investor reluctance to build capacity sooner.

Estimation of the tilt and multiple representation

The ERA applies annuity tilting to provide a neutral net present value outcome for investors due to expected reductions in capital costs for BESS investments and the annual BRCP resets.

149 Rocky Mountain Institute, December 2023, *X-Change: Batteries – The Battery Domino Effect*, p.p. 19-20.

150 National Renewable Energy Lab, June 2023, *Cost Projections for Utility-Scale Battery Storage: 2023 Update*.

151 International Energy Agency, 2024, *Batteries and Secure Energy Transitions*, p.11, (online).

152 CSIRO, May 2024, *GenCost 2023-23 Final Report*, p. 86, (online).

The tilting formula is as follows:[153]

$$\textbf{Tilt Applied}_t = \mathbf{A}_t = \begin{cases} \frac{g(1-g)^{t-1}}{1-(1-g)^T}, & \text{if } g \neq 0. \\ \frac{1}{T} & \text{if } g = 0. \end{cases}$$

Where:

t indexes the time period.

g is the tilt rate.

T is the economic life of the asset.

To illustrate how this would operate, the following worked example is provided using the assumptions in Table 7. The values chosen are illustrative only to demonstrate the dynamics of the annuity tilt.

Table 7: Annuity tilting assumptions

Assumption	Notation	Value
Capital cost	V_0	100
Annuity period	T	15
WACC	r	10.5%
Capital cost decline	d	(4.4%)
Tilt rate (initial)	g	5.0%
Adjustments to tilt	delta	(5.7%) (solved)
Adjusted tilt	g*	(0.7%) (solved)

A numerical worked example is provided in the following section. The assumptions provided in the table above are used to find the solution for g*, where g is adjusted by delta until net present value neutrality is achieved. This method is also equivalent to setting the adjustment directly to the constant annuity payment for each period. As equivalence is established, the refinements of the model can be computed using the direct method as an equivalent approximation.

[153] Australia Gas Networks, July 2022, *Attachment 6.4 Incenta Expert Report – Assessment of compliance with the requirements for regulatory depreciation,* p. 38.

Profile of cashflows: constant capital costs and no resets

To calculate the profile of payments of the return on and of capital, A_t is calculated for each year of the asset's economic life. The amount of capital returned each year is calculated by $V_0 \times A_t$. An initial tilt rate is chosen but will be solved to create the adjusted tilt that provides net present value (NPV) neutrality. For simplicity, the values provided in this example are such that the following tables are in their solved state.

	Totals	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A_t	100.0%		6.3%	6.4%	6.4%	6.5%	6.5%	6.6%	6.6%	6.7%	6.7%	6.8%	6.8%	6.9%	6.9%	7.0%	7.0%
Capital Returned	100		6	6	6	6	7	7	7	7	7	7	7	7	7	7	7

An asset register is created by calculating the opening and closing balances for each year given the capital returned. This is required as the capital charges will be calculated as the opening balance multiplied by the WACC.

	Totals	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Opening Balance			100	94	87	81	74	68	61	55	48	41	35	28	21	14	7
Capital Returned	(100)		(6)	(6)	(6)	(6)	(7)	(7)	(7)	(7)	(7)	(7)	(7)	(7)	(7)	(7)	(7)
Closing Balance		100	94	87	81	74	68	61	55	48	41	35	28	21	14	7	0

The total capital payments are the sum of the capital charges and capital returned.

	Totals	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Capital Charges	85		11	10	9	8	8	7	6	6	5	4	4	3	2	1	1
Capital Returned	100		6	6	6	6	7	7	7	7	7	7	7	7	7	7	7
Non-resetting Price Path	185		17	16	16	15	14	14	13	12	12	11	10	10	9	8	8
NPV	100																

It can be seen that the profile of payments has a present value equal to $V0$ and is hence NPV neutral.

Profile of cashflows: Declining capital costs and resets

The above examples are calculated on the basis of no changes to capital costs and the resulting non-resetting price path. The dynamics of capital cost declines and BRCP resets are now introduced in the following sections.

Given the assumptions listed previously, the required investment will decline by d = 4.4 per cent per annum, which results in a new schedule of investment costs of V_t . Given annual resets, the capital returned will be the $A_t = A_1$ multiplied by the new investment costs V_t . The capital charges will now be the opening balance of the new investment cost multiplied by the WACC. This can be simplified into Total capital charges for a reset year$t = V_t \times (A_1 + \text{r})$.

	Totals	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Opening balance			100	96	91	87	83	80	76	73	70	67	64	61	58	56	53
Capital Charges	117		11	10	10	9	9	8	8	8	7	7	7	6	6	6	6
Capital Returned	70		6	6	6	6	5	5	5	5	4	4	4	4	4	4	3
Resetting Price Path	188		17	16	15	15	14	13	13	12	12	11	11	10	10	9	9
NPV	100																

As BRCP prices are reset to recover lower and lower investment costs, this might result in a negative NPV outcome for investors. This outcome can be adjusted such that it is NPV neutral, which alters the resetting price path to one that more closely resembles the non-resetting price path. The adjustment to the tilt (delta) can be solved via numerical methods, which results in an adjusted tilt g* of -0.7% for this example. This is equivalent to $\text{g*} = \underset{g}{\text{argmin}}(\sum \text{PV}(\text{Resetting Price Path}) - \text{Investment})$ where PV is the present value operator.

For ease of interpretation, the adjusted tilt can be represented as a multiple of the constant annuity payment. In this example, the constant annuity payment is approximately 13.5, while the first-year value of the adjusted tilted annuity is approximately 16.8. This results in a required multiple of 1.24x the constant annuity to maintain an expected NPV neutrality.

Constant Annuity Payment	13.5
First year of adjusted tilted annuity	16.8
Multiple of constant annuity	1.24x

This multiple representation also provides a method that is independent of investment costs as it can be treated as a scalar constant and can also be expressed algebraically as:

$$\textbf{Multiple of constant annuity} = \frac{(r + A_1)(1 - (1 + r)^{-T})}{r}$$

Direct approach in Excel

This solution can also be presented directly now that it has been derived from the workings above. Given the same assumptions as the above example, the same multiple can be applied to the constant annuity formula for each year (in Excel this would be 1.24 × PMT_t). The table below illustrates that this approach provides the same answer as to the one above (subject to rounding).

	Operation	Totals	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Constant annuity payment with expected declines	PMT	151	14	13	12	12	11	11	10	10	9	9	9	8	8	8	7
Apply multiple of constant annuity	1.24 x PMT	188	17	16	15	15	14	13	13	12	12	11	11	10	10	9	9
NPV	100																

For the table above, each PMT calculation is done at the respective investment cost for the relevant year, assuming that it will be held for the same annuity period and WACC. Applying the multiple to each of those PMT amounts results in a profile that is NPV neutral.

Given the equivalency of these two approaches, the ERA's refinements can be implemented through the direct approach. These include using an updated set of forecasts to include the latest estimates from the IEA and CSIRO, along with modelling the battery cell cost proportion directly instead of relying upon the 55 per cent assumption.

This results in the following capital cost profile:

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
BESS		55.0	50.7	46.7	43.0	39.7	36.6	33.7	31.1	28.6	26.4	24.3	22.4	20.6	19.0	17.5
Rest		45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
Total		100.0	95.7	91.7	88.0	84.7	81.6	78.7	76.1	73.6	71.4	69.3	67.4	65.6	64.0	62.5

Applying this to the above results in an annuity tilt that is lower due to the combined effects of the refinements.

	Operation	Totals	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Constant annuity payment with expected declines	PMT	158	14	13	12	12	11	11	11	10	10	10	9	9	9	9	8
Apply multiple of constant annuity	1.21 x PMT	191	16	16	15	14	14	13	13	12	12	12	11	11	11	10	10
NPV	100																

Applying different forecast combination methods results in a multiple that ranges from 1.19-1.21.

Appendix 6 Workbook underlying indicative BRCP

An Excel workbook explaining the BRCP components, including the application of the annuity tilt, is available on the ERA's website (online).

Appendix 7 List of Tables

Appendix 8 List of Figures